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ARCH19
June 12–13, 2019 – Trondheim, Norway

Proceedings from the 4th Conference on Architecture Research Care & Health

SINTEF Proceedings

Editors:
Johan van der Zwart, Siri Merethe Bakken, Geir Karsten Hansen, Eli Støa and Solvår Wågø

ARCH19
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Proceedings from the 4th Conference on Architecture Research Care & Health

SINTEF Academic Press

SINTEF Proceedings 8
Editors: Johan van der Zwart[1], Siri Merethe Bakken[1], Geir Karsten Hansen[1], Eli Støa[1] and Solvår Wågø[2]
[1] Norwegian university of science and technology, www.ntnu.no
[2] SINTEF, www.sintef.no

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Care & Health

Keywords:
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Cover illustration: The outdoor care retreat (Friluftssykehuset OUS)
Architects: Snøhetta. Photo: Ivar Kvaal, Friluftssykehuset OUS

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SINTEF Academic Press
Address: Børrestuveien 3
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Tel: +47 40 00 51 00

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Preface

Building for Better Health: Proceedings of the 4th Architecture Research Care and Health Conference 2019 (ARCH19)

In the early summer of 2019, the Norwegian University of Science and Technology (NTNU) hosted the 4th Architecture Research Care and Health Conference (ARCH19) in the knowledge centre at St. Olav's University Hospital in Trondheim. The conference was organized by the Department of Architecture and Planning at NTNU's Faculty of Architecture and Design and was made possible by financial funding from the NTNU Health Strategic Research Area, *Sykehusbygg HF* and practical support from SINTEF HF. The conference brought together 120 researchers, architects, urban planners and healthcare managers from across Europe, Asia and the United States, with the aim of discussing the current state of knowledge on architecture research and innovative design processes in the care and health sectors.

ARCH19 was the fourth in a series of conferences that was inaugurated in 2012 at Chalmers University in Sweden (ARCH12). It has since been organized at Aalto University in Finland (ARCH14) and at Aalborg University in Denmark (ARCH17). The driving forces behind these conferences have been the European Research Network for Healthcare Architecture and the Nordic Network for Architectural Research in Universal Design. The next ARCH conference will take place in the Netherlands at the Erasmus MC Education Centre in Rotterdam, from the 22nd to the 24th of August 2022.

The objective of the ARCH conferences is to generate, share, develop and apply knowledge, methods and tools that link new research developments in architecture and urban design in care and health contexts to stakeholders such as municipalities, healthcare organizations and design firms, as well as user, patient and voluntary organizations. Research into the complex interaction between the architecture of the built environment, health promotion and healthcare delivery is inherently inter-disciplinary, drawing knowledge from fields such as industrial design, architecture and urban design, as well as medicine, nursing and gerontology, and the social sciences such as anthropology, environmental psychology and sociology. The ARCH conferences thus have a strong scientific focus, offering insights into recently-acquired knowledge and research projects that focus on issues related to care, health, architecture and urban design, and which aim not only to improve the quality of urban environments and buildings, but also their socio-cultural effects in relation to care and health.

The proceedings presented herein contain papers presented at the conference and subsequently approved by reviewers and the organizing committee. Conference papers underwent a double-blind review process involving two members of the scientific committee, as well as an additional double-blind peer-review by one of the other authors who submitted a paper to the conference. Only papers accepted by the scientific committee were presented at the conference and subsequently included in these proceedings. A selection of six papers, together with a guest editorial, have been published previously in a Health Environment Research and Design (HERD) Journal's special publication on the ARCH19 Conference[1].

The collection of thirty-five papers presented in these proceedings demonstrate the current progress in applied research into healthcare facilities and the planning and design of healthcare buildings and environments that promote health and well-being. The papers encompass a wide diversity of research methods related to healthcare architecture research and education, hospital design strategies, and user involvement in co-design. They also highlight hospital design practices such as the activation of public spaces, the architecture of hospital wards, and the importance of personal space in psychiatry. Other topics covered by the papers address health promotion and current research into issues such as daylight

[1] Van der Zwart, J. (2021) "Building for Better Health: Reflections on Architecture Research for Care and Health. *HERD: Health Environments Research & Design Journal 14.1* 12-18. https://doi.org/10.1177/1937586720971396.

design, walkability in public spaces, inclusive neighbourhoods, and housing for people with special needs.

The papers, together with the seven keynote presentations given at the conference, triggered many discussions on how to balance our current research findings in evidence-based design with other kinds of knowledge, such as best practice developed through successful design, tacit knowledge transferred to trainees as they learn from experienced practitioners, and knowledge based on intuition that finds its origin in an individual's previous experience. These discussions have highlighted the fact that healthcare architecture deals in complexity and, like complex treatments in medicine, requires a holistic approach combining evidence, professional experience, and close attention to situational conditions. A holistic approach in healthcare design should thus combine evidence, experience, and detailed attention to the context of each specific project. Such an approach makes the assessment of the relevance of evidence within specific situational contexts, organizations, cultures and user groups the main focus for further research and design.

28 articles presented at the ARCH 19 forms the contents of the proceedings. We have additionally included the abstract of 6 articles published in the HERD (Health Environments Researchs and design 2021/14.1) to show the wider range of perspectives discussed at the conference.

The organising committee wishes to express its thanks to all the authors who have submitted scientific contributions, and to all those who have assisted in reviewing the manuscripts and promoting the conference. We also wish to thank the NTNU Health Strategic Research Area and *Sykehusbygg HF* for their financial support, and both the HelsA Gemini Centre and SINTEF HF for their practical support in finalising publication of these proceedings.

Johan van der Zwart
Ph.D., M.Sc. Arch., M.Sc. Healthcare Management

Geir Karsten Hansen
Prof. Real Estate and Facility Management, M.Sc. Arch.

Eli Støa
Prof. Housing, Ph.D., M.Sc. Arch.

Siri Merethe Bakken
Professor of Architecture and Process Design

Solvår Wågø
Senior Researcher, M.Sc. Arch.

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- Johan van der Zwart
- Pernille Schanche Feragen

  Department of Architecture and Planning, NTNU Faculty of Architecture and Design
  https://www.ntnu.edu/iap

Organising Committee, ARCH19

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  NTNU, Faculty of Architecture and Design

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  Sykehusbygg HF

- Unni Dahl
  Hospital Planner
  Sykehusbygg HF

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  www.sintef.no/projectweb/geminisenteret-helsa/

- SINTEF HF
  www.sintef.no/

- The *Metamorfose* Centre for Real Estate and Facility Management
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INTRODUCTION

Solvår Wågø [(1)*], **Siri M. Bakken** [(2)*]
[(1)] Architecture, Materials and Structures, SINTEF Community, Norway
[(2)] Department of Architecture and Planning, Faculty of Architecture and Design, NTNU, Norway

* Operations Managers at the Gemini Centre HelsA:
solvar.wago@sintef.no | siri.m.bakken@ntnu.no

Why our physical environment is key to our health and well-being

Think of something that gives you joy on your way to work. Something that makes your day a little bit brighter. It is more than likely that you are thinking about your physical environment. People need beautiful places in which to thrive and feel valued, whether they are travelling, staying in the city or in their neighbourhoods, or when socialising with others. Investment in carefully designed, high quality physical environments, with people in mind, is a strategic tool in community development. Our environment matters, and health and well-being are strongly linked[1].

We all know that the physical environment affects public health, but there seems to be a gap in terms of how we can apply our knowledge actively in community planning. We also need to know more about how this kind of knowledge is implemented in practice and how the built environment can be utilised. In this introduction we will elaborate briefly on some of these issues and offer examples that illustrate the potential of architecture and urban design as key to the promotion of public health. We will also take the opportunity to present a joint initiative (Gemini Centre[2]), recently established by research groups based in Trondheim, that is aiming to advance research-based knowledge in the field of health-promoting architecture.

Architecture stimulates activity. From the Kastrup Sea Baths in Denmark, by White Architekter AB. Photo: Åke Eson Lindman

Work to promote public health is often referred to as society's general efforts to influence what promotes and maintains health within the population. The World Health Organisation (WHO) defines health not just in terms of absence of disease, but as well-being and quality of life. Public health is all about how human populations or groups within these populations are doing. Good health is thus created in our everyday lives, in our meetings with other people, by our

[1] https://www.eea.europa.eu/no
[2] A Gemini Centre is a strategic platform for interdisciplinary collaboration between various research departments at NTNU and SINTEF.

physical mobility and our sensual experiences. Our quality of life is influenced by many factors other than those generated in the health sector. Our physical surroundings thus make an important contribution to the great 'public health calculation', although the quantifiable health effect of the architecture around us has received little serious attention.

Architectural quality is about building societies where people can thrive and feel valued

Architecture and our physical environment are crucial to our health, well-being and quality of life. Architecture is about promoting quality of life using buildings, our physical surroundings and a well-functioning infrastructure. High quality architecture takes care of the totality. Architecture is all about how buildings function, fit in and enrich our environment, and how people use them in the context of their surroundings.

Architecture can be both attractive and promote safety. Torggata in Oslo. By landscape architects Sweco. Photo: Amund Johne/Sweco.

Architecturally well-designed public transport hubs promote a well-functioning transport infrastructure, which in turn encourage more people to travel by public transport. The flower arrangements along Oslo's Carl Johan promenade are not only a key part of the city's preventive measures against terrorism, but are also colourful and attractive features at human scale along a broad city street surrounded by tall buildings.

Safe cycle paths and pedestrian areas offer opportunities for exercise, fresh air, daylight and contact with the elements, all of which increase our ability to concentrate during the stressful working day. Cycling boosts our energy, helps to reduce sick leave and, last but not least, reduces the need for new road development.

It is well documented that physical activity is positive for both our mental and physical health. A study published by the Norwegian University of Life Sciences (NMBU) has shown that daily walking, in contrast to organized workouts, is not linked to socio-economic status[3]. This means that while nearly everyone walks, far from everyone actually exercises. The study highlights the importance of health promotion in urban planning, and argues for the development of attractive and walking-friendly urban environments. It also acknowledges the importance of promoting a broader understanding of outdoor recreation in urban settings, where walking around our neighbourhoods, both for recreation and commuting, should be regarded as an activity in the context of urban recreation.

[3] H. Nordh et.al: Walking as urban outdoor recreation: public health for everyone. Journal of Outdoor Recreation and Tourism 2017. doi.org/10.1016/j.jort.2017.09.005. https://www.nmbu.no/fakultet/landsam/aktuelt/node/33564

Social and economic differences in Norwegian society are widening. We believe that living conditions for the disadvantaged, such as drug addicts, the mentally ill and other vulnerable groups, can be designed in such a way as to provide both security and support in coping with everyday life. In this way, architecture and the environment can make an active contribution to reinforcing what is commonly referred to as human dignity and to creating opportunities for social engagement by marginalized groups. Caring design can provide real support to inclusion, security, tolerance and the ability to cope. Empowerment is everything when it comes to social inclusion. Our physical surroundings are very significant in themselves, but cannot be isolated from the processes that influence our environment and our sense of belonging.

We need attractive places where we can socialise, and others where we can enjoy physical activity. People need other people, and a city needs to be lively, attractive and safe for its inhabitants. The creation of attractive neighbourhoods with pedestrian and cycle paths, easy walking distances to the shops, access to parks and nature, and safe and attractive shortcuts, encourages more people to get their feet wet rather than use the car. But in order for people to choose to walk or cycle, distances must be reasonable, and the experience positive and enjoyable.

A physically active population prevents crime, including violent crime[4]. There is a demand for a focus on planning physical environments that promote trust between people. Research suggests that trust may arise at the interface between the environment and its users, but we appear to have a knowledge gap in terms of finding out how to target this issue.

Can architecture heal?

The manipulation of space by architecture may act as a catalyst in the creation of environments that promote positive therapeutic physical and psychological outcomes among medical patients. Safe inter-personal contacts and elemental experiences in a natural environment have been shown to have a positive impact on patients' ability to cope with their illnesses, build resilient immune systems, and their eventual recovery [5].

Key aspects of healing environments integrated into hospital design are highly relevant in this respect. The term 'Healing Architecture'[6] has been adopted to invoke the sense of a continuous process involving the creation of an environment that is both physically healthy and psychologically appropriate. In the design of hospitals, the relationship between architecture and nature is key to the recovery process. Natural vegetation stimulates the body's senses and represents an important resource for hospital patients and their relatives, employees and local residents. Key to the design of hospital facilities is the concept of the integration of hospital buildings into park-like spaces, surrounded by a green infrastructure and surrounding natural landscapes.

In the west, much research has been completed into the therapeutic effects of nature.[7] Both therapeutic gardens and pet therapy, which promote contact with nature and optimise healing environments for Alzheimer's patients[8], are well-established both in nursing homes and in schools and kindergartens for children with special needs.[9]

Inspiring examples of such approaches were presented at the ARCH19 conference. These included the 'Open Air Hospital' (*Friluftssykehuset*) in Oslo, located close to Oslo University Hospital, which is an outdoor care retreat built in the form of a timber cabin in the middle of a natural woodland. A similar facility has been constructed at Kristiansand Hospital in southern Norway. These 'natural' retreats, located close to hospitals, offer patients and their families an opportunity for peace and quiet away from the hospital wards, but still close enough for easy access to emergency help. The cabins are available to all patients regardless of their disease. The concept was developed by Håvard Hernes in 2015, in collaboration with the Department of Psychosomatics and CL-Child Psychiatry at Oslo University Hospital, the Norwegian Outdoor Hospital Foundation and the architecture firm *Snøhetta*.

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[4] https://www.ojp.gov/ncjrs/virtual-library/abstracts/designing-out-crime-crime-prevention-through-environmental-design
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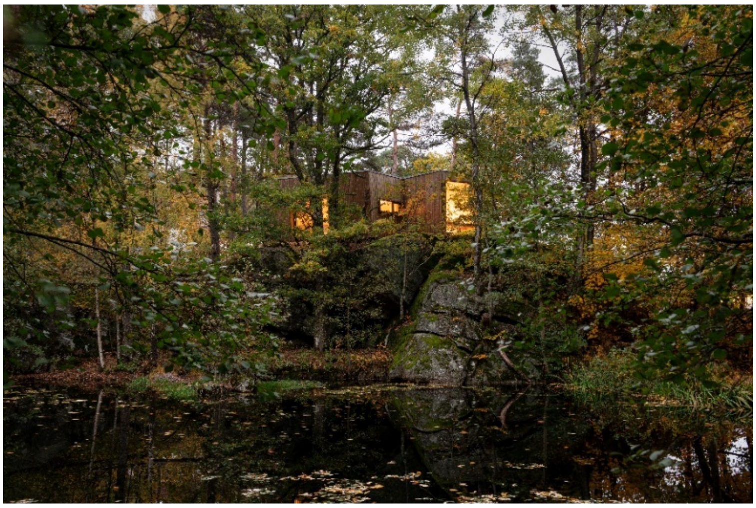



The outdoor care retreat (*Friluftssykehuset* OUS). Architects: Snøhetta. Photo: Ivar Kvaal, *Friluftssykehuset*.

St. Olav's University Hospital in Trondheim also offers innovative architectural solutions and urban design with the aim of promoting health and care. St. Olav's is often referred to both as a hospital within a city and a city within a hospital. It has developed into its own neighbourhood within the city – a kind of medical suburb – emphasising patient focus and humanitarian care. St. Olav's is also known as a 'green hospital', offering easy access to green infrastructure in its precincts and along the Nidelva river. The totality of life in and around the hospital, together with the university and its research activities, combine to offer a calm and therapeutic experience for patients and their relatives during difficult times.

People experiencing emotionally challenging situations are particularly sensitive to their physical surroundings. Nurse Mads Bøhler at St. Olav's Hospital recognised the need for the hospital to offer a space where patients' families and visitors could retreat and be alone with their thoughts[10].

Another example of a project presented at ARCH19, with vulnerable patients in mind, is the so-called '*FRIrom'*. This is a small timber structure installed on the roof of the maternity centre at St. Olav's Hospital, offering patients' relatives a retreat to which they can withdraw in the event of emotional episodes that may arise in difficult situations. The *FRIrom* was designed in 2011 by architecture students Sunniva Vold Huus and Maren Storihle Ødegård as part of their joint master's thesis at the Norwegian University of Science and Technology. Both the *Friluftssykehuset* and *FRIrom* provide excellent examples of how a focus on the promotion of good health, combined with elemental experiences, can boost well-being among hospital patients.


The so-called '*FRIrom'* installed on the roof of the maternity centre at St. Olav's Hospital in Trondheim. Architects: Sunniva Vold Huus and Maren Storihle Ødegård. Photo: Pasi Aalto, NTNU.

[10] http://www.architecturenorway.no/projects/working/frirom-2013/

Health-promoting architecture and the physical environment

The ARCH conferences aim to offer insight into recent research findings and to act as a showcase for research projects that focus on issues related to care, health, architecture and urban design. In May 2019, a centre (the HelsA Gemini Centre) was established in Trondheim to facilitate research into topics such as health-promoting architecture and the physical environment. The centre promotes collaborative research in the fields of architecture, health and social research. HelsA's vision is to develop an international centre of excellence at which knowledge, education and research will combine to promote focus on the physical environment and public health as a natural part of developing a better society[11].

Many of the ideas derived from the ARCH19 conference have been implemented as part of the work carried out at HelsA, combined with input from some of the research communities involved with the conference.

The HelsA centre is joint project involving SINTEF Community, health researchers at SINTEF Digital, and the Faculty of Architecture and Design and Department of Social Research at NTNU. The centre bases its work on an understanding of architecture as fundamental to a community's health and well-being. An acknowledgement of this assertion is hardly controversial, but it continues to be overlooked in our discussions surrounding public health strategies. We often take our physical environment for granted. It can affect us deeply, but we are very little able to manipulate it and utilise it actively to promote our health and well-being. At HelsA we view architecture as a phenomenon subject to continuous change, being shaped and reshaped in ways that may or may not promote our well-being.

HelsA's aim is to act as a hub, offering Norwegian municipalities and other stakeholders an arena where collaborative projects can be initiated. Our existing knowledge is limited and fragmentary and lacks interdisciplinary integration. We want to carry out interdisciplinary research projects that discuss and document the health implications of planning strategies, architectural solutions and technologies. We are also looking to develop pilot projects where innovative solutions can be tested. It will be crucial to be able to develop theoretical and methodological foundations that contribute towards consolidating knowledge-based arguments for human-centred approaches to research in health-promoting environments.

We are hoping to encourage a public debate in which the socio-economic benefits of ideally designed architecture and physical surroundings are taken fully into account. We want to see our common knowledge about the importance of the environment used actively in building and urban designs that promote better public health. There is a great need for research into the impact that our physical surroundings have on human health and well-being. We also hope that the HelsA centre, together with the ARCH arena, will help to encourage greater focus, reflection and collaboration on topics addressing the potential that our physical surroundings have to offer in terms of added value, health, care and well-being in our communities.

[11] https://www.sintef.no/projectweb/geminisenteret-helsa/

Literature review

THE PHYSICAL ENVIRONMENT AND ITS EFFECT ON HEALTH OUTCOMES – A SYSTEMATIC REVIEW

Elizabeth Marcheschi [(1, 3)*], **Ásgeir Sigurjónsson** [(1, 3)], **Roger S. Ulrich** [(1, 3)], **Marie Elf** [(1, 2, 3)]

[(1)] Division of Building Design, Architecture and Civil Engineering, Chalmers University of Technology, Sweden

[(2)] School of Education, Health and Social Studies, Dalarna University

[(3)] Centre for Healthcare Architecture, Chalmers University of Technology

* Corresponding author e-mail: elizabeth.marcheschi@chalmers.se

Abstract

Objective: The study aims to identify and review the latest existing knowledge about evidence- based design (EBD) for healthcare architecture and determine the extent to which such findings pertain to the overarching goals proposed by the Institute of Medicine (IOM).

Background: There is increasing knowledge regarding influences of healthcare physical environments on health and well-being outcomes. The demand for more evidence has steadily grown, and systematic literature reviews have gained increased importance in the healthcare design field.

Research question: A systematic literature review was performed according to the guidelines proposed by The Swedish Agency for Health Technology Assessment and Social Services Assessment. Specific aims included evaluating the current status of research relating to evidence-based healthcare architecture and determining the extent to which such evidence corresponds to the key goals established by the IOM.

Methods: A systematic literature review with a Boolean search strategy was performed using the following databases: CINAHL, Medline, SCOPUS, Cochrane library, and Web of Science. The time period covered was 2010-2018. The reference lists of articles obtained from keyword searches were then examined to identify additional relevant studies. The articles retrieved have been screened for eligibility for inclusion, and the final retained articles have been evaluated with descriptive statistics to identify which IOM quality categories are addressed, what type of healthcare settings, physical environment intervention and target groups are investigated, and what types of research design and methodology have been implemented. Furthermore, two researchers are independently assessing the quality of the material retained. This data is part of an ongoing project therefore, preliminary results are reported.

Results: A total of 4546 articles were retrieved and screened for eligibility for inclusion, resulting in 688 retained articles published since 2010. Of these 92 has been analyzed until now with descriptive statistics and results suggest that the most frequently cited IOM goals are related to health (84%) and safety (46%), person-centred approach (29%) and effectiveness of care (28%). Moreover, research has been performed across acute care and overall hospital settings (22 and 21%).

Conclusion: The systematic literature review indicates that the body of knowledge relating to EBD is clearly growing, and the main focus is on design interventions to improve the health and safety of patients across acute care units. Lack of evidence are instead found in regard to other IOM aspects such as, equality of care and patients' participation.

Keywords: *Evidence based design, healthcare architecture, healthcare users, health outcomes, physical environment*

Introduction

Evidence-based design (EBD) has been defined as a process for using of the best available evidence from research and practice to inform the design of healthcare environments with the deliberate goal of improving outcomes (1). The purpose of applying EBD for the planning of healthcare environments is that of providing possibilities to develop supportive environments for patients' health, improve clinical results, facilitate effective work and reduce nurses' stress, account for waste of resources and sustainability issues (2, 3). Similar to evidence based medicine (EBM) that is used to support decision and intervention in the medical field, EBD for healthcare architecture becomes more and more important to enhance design decisions for a planned environment. EBD should support decision making across all phases of the process to develop new health care environments from planning, to designing and construction (4). Systematic reviews are required to contribute to evidence in all areas, including healthcare architecture (5).

Healthcare settings are complex and dynamic buildings in which technologies, organizational systems and various users such as patients, significant others and staff are constantly interacting with one another. Such interaction is dynamic in the sense that care and technologies, as well as patients' needs, are not stable over time but subject to changes, which set a great pressure on the way the physical environment is designed. Brambilla and colleagues (6) suggests that healthcare facilities should be resilient to the continued evolution of the healthcare system and in this sense, EBD is considered to be essential i.e., the possibility of constantly adding new knowledge about the impact of certain design solutions on health and organizational outcomes.

The role that the physical environment has in affecting health related outcomes has been recognized since the second half of the nineteen century, when the environmental theory proposed by Nightingale was developed (7). Nightingale observed that specific design elements such as good ventilation, cleanliness, light and noise were crucial for health outcomes. Nightingale also emphasized the importance to always consider the individual in the interaction with the environment in order to design environments that support the best possible conditions for healing to occur (7). This view corresponds with today's person-centred approaches for healthcare service (8).

It is an increased awareness that the physical environment is of crucial importance to the quality of care and can affect several important health results. This has created an exponential growth of research studies from several research areas (6).

The latest review conducted on EBD is from 2008 and the results predominantly stress evidence related to hospital design that reduced the frequency of acquired infections (9). For example, implementation of single-bed rooms, effective air quality control, placement of alcohol-based hand-run dispensers, cleanness of surfaces and floors and proper water system design to minimize water stagnation.

The present work seeks to undertake a new review and build upon Ulrich's work from 2008. The framework for the present review is Institute of Medicine's (IOM's) dimensions of quality (10, 11). The challenge of ensuring quality of healthcare remains high on the public and political agenda internationally (10, 12). We also based the review on important concepts such as person-centred and shared-decision making, as the quality perceived by the patient is significant today. Patient expectations and experiences of care has been an important outcome of care (15 13, 14). Recipients of health care services are more likely to expect quality from many perspectives, driven by their changing needs. For example, an acutely unwell patient may rate the dimension of effectiveness highly, but during rehabilitation they may rate person- centredness as the most important dimension of health care quality (15). The IOMs overall quality goals are summarized in the concept of good care in which the environment is seen as an important part to achieve it (11). However, little is still known about what aspects of the environment can contribute to good care outcomes.

This work aims to reduce such knowledge gap, and it is part of a larger research project, in which an update of the latest EBD reports and a detailed description of the current finding of EBD and its contribution to the field of healthcare architecture is developed. The focus of this paper is however, exclusively on the overview of the material found and a descriptive evaluation of it expressed in terms of; healthcare areas investigated, target groups involved, types of research design and methodology, physical environment interventions and IOM goals addressed.

Aim

This systematic literature review seeks to identify the existing knowledge about EBD for healthcare architecture and to develop a descriptive framework of them, which pursue to be informative for the goals of good care proposed by the Institute of Medicine (IOM).

Specific research questions can be summarized as follows:

1. Identify the state of art of EBD for healthcare architecture.
2. Description of the evidence found expressed in terms of; healthcare areas, target groups assessed, design and methodology implemented, physical environment interventions, and IOM goals.

Methods

Review design and search method

A systematic literature review about evidence based design for healthcare architecture was performed according to the method proposed by, The Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU) (16), and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (17).

The search was performed in the following data bases; Medline, Cochrane Library, Cinahl, Web of science and Scopus for the material published between the years 2010-2018. A Boolean search strategy, developed with the support of the university library at Chalmers University, was adopted (table 1).

The electronic search was performed by two authors (EM and AS) between May 2018 and June 2018. Furthermore, a free search was performed based upon the references found and the expertise of the researchers involved during the same timeframe.

Table 1. Boolean search terms by main topics

	AND	
Architecture	Patient(s)	Healthcare setting(s)
OR	OR	OR
Architectural design	Client(s)	Healthcare facility(ies)
Building design	Consumer(s)	Healthcare space(s)
Environment Design	Family	Healthcare building(s)
Physical environment	Relatives	Health facility(ies)
Built environment	Visitor(s)	Hospital(s)
Health Facility Environment	Caregiver(s)	Healthcare service(s)
Evidence-Based Facility Design	Health Personnel	E-health
Evidence-based Design	Staff	Telemedicine
Environmental design	Nurse(s)	Telehealth
Hospital construction	Physician(s)	Medical home(s)
Hospital Design and Construction		Patient-centered medical home
Facility design		Ambulatory Care Facility(ies)
Universal design		Ward(s)
Interior design		Emergency department(s)
Garden(s)		Emergency Service, Hospital
		Intensive care
		Critical Care
		Acute care environment(s)
		Care unit(s)
		Outpatient
		Inpatient
		Waiting room
		Accident and emergency
		NICU
		Rehabilitation room
		PICU
		Operating room

Search outcomes and data screening

All articles that studied the influence of the physical environment of healthcare settings on their users (i.e., patients, staff and visitors) written in English and published in peer-reviewed scientific journals between 2010 and 2018, were eligible for inclusion.

The screening process complied the following steps;

a) Selection for inclusion was performed based upon title and abstract and performed by two authors (EM and AS), all duplicated were eliminated at this stage.

b) Abstracts were screened to determine relevance of the topic by all four authors (EM, AS, ME and RU) and a three-grade system was adopted in which each author independently evaluate the eligibility of the material by either retained, excluded, or uncertain. Uncertain material was solved by means of discussion among the authors (i.e. cross-checking technique per each uncertain abstract).

c) Full texts of relevant papers were retrieved

d) Each full-text was independently evaluated by three authors (EM, AS and ME).

The literature search ended in June 2018 and generated 7062 hits of which 2516 were duplicated and therefore eliminated.

After the first screening of relevance of the topic for the object of this investigation (N = 3483) papers were further eliminated since not addressing hospital setting but other types of residential care settings such as, nursing home and supported housing facilities. The remaining 1062 were independently evaluate by each author and screened in terms of abstract relevance, uncertain material (N = 279) (6%) was also discussed among the authors, following an agreement of 88%.

After this screening (N= 490) paper were eliminated resulting into (N =572) papers. Also, an additional of (N = 96) papers, identified via free search were included, resulting into a total of (N = 688) papers, which full-text is at present scrutinized to determine eligibility of inclusion. The final amount of papers deemed for inclusion will be defined after the full-text evaluation is completed. Also, since this work is part of a larger and ongoing research project, the quality appraisal of the included papers is yet uncompleted and will be reported in the next step of the research. However, the guidelines followed in order to estimate the quality of the material included are those of the "GRADE" system, provided by SBU, which focuses on person-centred perspectives (i.e. patients' benefits and risks) (16).

A flow chart, summarizing the above mention search outcomes, and the ongoing process of this systematic review work is provided in Figure 1.

Qualitative appraisal ongoing process

Two researchers (EM and ME) are independently assessing the quality of the material retained by means of the guidelines suggested by the SBU (2). Different protocols to assess the quality of the paper retained developed from the "GRADE" system used in medical science were therefore used, which implies different grid of evaluations depending on the study design (e.g. randomized control trial, qualitative studies and systematic review). The degree of evidence was based on the reliability, consistency, transferability of the data collected. In the case of disagreement, the researchers discuss their assessments and pursue further evaluation until an agreement is achieved. The quality appraisal phase is still ongoing and for this reason such results are not reported.

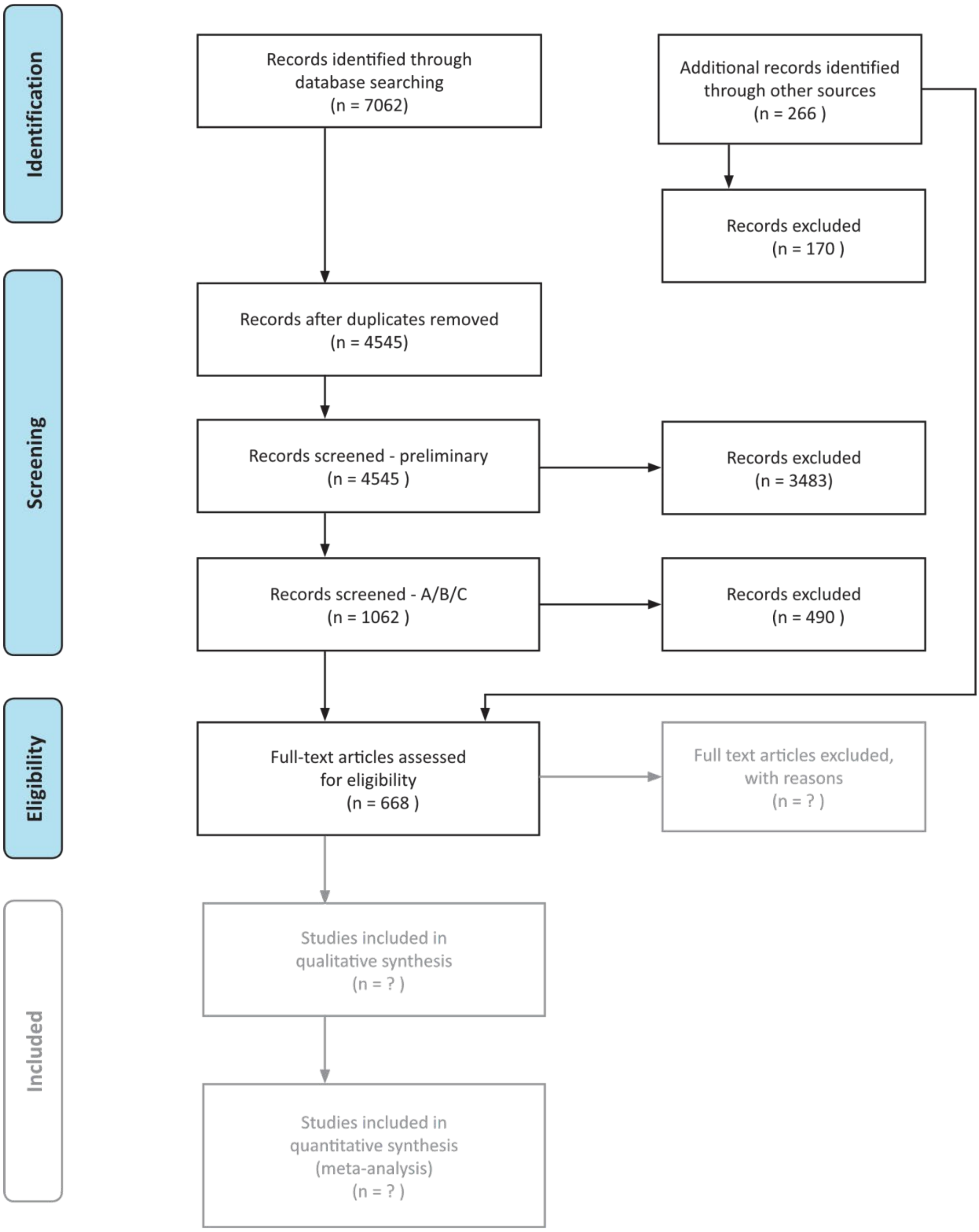
Data extraction and synthesis

Descriptive statistics was used to identify the frequency of appearance of the different healthcare goals, in order to establish which domains were explored and which were overlooked upon. Furthermore, the data synthesis lifts what target groups were investigated what aspects of the physical environment and in which hospital area, as well as, what type of research design and methodology was used.

For this data extraction and synthesis analysis an overarching matrix was used, where three of the co-authors reported the information per each of the full paper included in this study.

A summary of the material included in the present review is reported in Appendix 1. Information includes, authors' name, year, title, journal type, target group, healthcare area of investigation, research design and methodology, physical environment interventions and IOM goals.

Figure 1. PRISMA chart – ongoing process



Results

Preliminary results of the ongoing evaluation of EBD for healthcare architecture

On the whole, the present work confirms the extensive growth of publications addressing evidence based design research studies with a total of 688 eligible for inclusion. The present project is ongoing, and the results refer to the material assessed so far (N = 92). These latter articles suggest that the main areas object of investigation were that of, acute care units (22%) and overall hospital setting (21%), followed by, neonatal units (12%) and psychiatry departments (9%).

Majority of the evidences were derived from the Journal of Health Environments Research and Design (HERD) (20%) tailed by, nursing and medical journals respectively, 17% and 16% of the material evaluated. Such evidences are largely derived by studies conducted in Northern America (N = 45) (49%) and Europe (N = 30) (33%).

Mainly the studies presented a non-experimental research design (72%) (i.e., cross-sectional, cross-over and longitudinal studies) and adopted a mix-method approach of investigation (36%), implying the use of different methodology for the collection of data such as, questionnaires, interviews and observations. Only 6% of the study adopted an experimental research design (i.e., randomized control trial) and 14% were review of the literature on EBD (i.e. systematic reviews and scoping reviews).

The theoretical background was mentioned exclusively in 24% of the study evaluated, and of these, 21% referred to the stress reduction theory proposed by Ulrich and colleagues (1991) (14). Furthermore, the primary target of the investigations on EBD for healthcare architecture seems to be that of patients (60%) followed by that of staff (40%) and visitors (8%).

The physical environment of healthcare settings was found to be investigated primary with regard to its overall layout and configuration (67%), what Harris and colleagues (2002) would define in terms of, *architecture features* (e.g. single vs multiple rooms, centralized vs decentralized nursing stations) whereas, little information about *ambient features* (i.e. light and noise conditions) (22%) and *interior design elements* (i.e. furniture, greenery and other types of positive distractors) (17%) was found.

Across the study evaluated, users' experience of place and care (i.e., perceived quality of place, satisfaction, atmosphere perception) is the principle outcome investigated (60%) followed by safety, stress reduction and infection reduction (between 9-13 % of studies).

The greater majority of the evidence found accounted for the IOM goals of; health (84%) and safety (46%) whereas, a paucity of investigations was found with regard to the IOM goals that are related to a more active engagement of patients into the process of care such as, patients participation, equality and self-care support (4-3% of the investigations).

An overview of the above mentioned results is reported in table 2.

Table 2. Descriptive statistic of the ongoing systematic review (results are not mutually exclusive)

EBD Healthcare area	Theoretical framework	Research design and methodology	Target group	Physical environment intervention	Study outcomes	IOM outcomes
Acute care units (N = 20) (22%) Hospital in general (N = 19) (21%) Neonatal units (N = 11) (12%) Psychiatry dep. (N = 8) (9%) Others (i.e., stroke and geriatric units, waiting areas, cancer units) (N = 34) (37%)	Stress Reduction theory (N = 19) (21%) Other theories (N = 5) (5%) Missing (N = 70) (76%)	Non-experimental (N = 66) (72%) Systematic review (N = 13) (14%) Experimental (N = 5) (6%) Mix-method (N = 33) (36%)	Patients (N= 55) (60%) Staff (N= 37) (40%) Visitors (N= 7) (8%)	Architectural features (N = 62) (67%) Interior design (N = 20) (22%) Ambient features (N= 16) (17%)	Users perception (i.e., experience and satisfaction with place and care) (N = 55) (60%) Safety (N = 12) (13%) Stress reduction (N =10) (11%) Infections (N = 8) (9%) Infant related (N = 6) (6%) Activities (N = 5) (5%)	Health (N = 77) (84%) Safety (N =42) (46%) Person-centred (N = 27) (29%) Effectiveness (N =26) (28%) Shared decision (N = 8) (9%) Patients participation (N = 8) (9%) Timely (N =6) (6%) Self-care support (N = 4) (4%) Equality (N =3) (4%)

Discussion

On the whole the present work confirms the growing body of investigation of EBD for healthcare architecture. Based upon the material investigated up until now, it seems relative clear that certain IOM goals are more studied than others. For example, greater evidence appears to be available for what concern the topic of health and safety as resulting respectively from, users' perception of environmental quality and specific layout and interior design solutions (i.e., single rooms and placement of sanitizers). On the other hand, the IOM goals that account for a more active view of the person receiving care such as that of, participation and self-support seem to have been overlooked.

Also, a lack of theoretical anchor was found, and the little theoretical framework that is reported seems to relay exclusively on the Stress reduction theory proposed by Ulrich (18). Nevertheless, the great focus of the work evaluated addressed other outcomes than just stress, highlighting the need for future integration of other useful theoretical framework such as affordance (19), supportive design and perceived control (20). The integration of further theoretical knowledge can influence what environmental attributes are studied, and what relationships between these attributes and human responses are explored (21-23). Furthermore, theories can help to frame research questions, choose research methods, and help interpretation of results (24). It can also facilitate a better understanding and a more fruitful discussion on how to translate research findings into EBD for hospital's planners and to support their decision making (25).

This is of particular relevance with consideration of the fact that the large majority of the investigation found, lack an experimental design solution, which is known to be the best available research design in order to draw reliable conclusions about the physical environmental influence on health outcomes. However, the results from this work stress the need to be more open towards other types of research design investigations, which appear to be more common when accounting for the complex scenario of human-environment interaction and health outcomes occurring in healthcare settings.

The issue of quality and reliability of the results is then related to how well the methodology of investigation was developed and the data collected, analysed and interpreted. This is also suggested by the guidelines proposed by the SBU (2), which aims at evaluating the quality of each individual research design without implying that one is better than another. This approach and related guidelines were applied for this study and the evaluation of quality per each included paper is ongoing and performed by three of the researchers involved in this work.

The majority of the EBD outcomes seem to stress the importance of integrating users' experience of the environment into the evaluation of healthcare environment quality. Thus, rather than report medical and physiological responses such as, heart rate, blood pressure and infections, the focus appear to be more commonly to report the psychosocial experience of place (i.e., overall impression, beliefs, attitudes, perceived quality of care and social support). This emphasizes the importance of using methods to be able to better understand the influence of patients' subjective experience on health related outcomes. The patients are no longer passive receptors of medical treatment, for which also a sterile and institutionalized hospital environment might function well but should be rather recognizes as active participants in their own care systems, who are sensitive to both physical and social stimulus (26, 27).

From these preliminary descriptive results, we can see how the evidence are indeed dealing mainly with how improvements in the physical environment can promote users' perception of physical environment quality and overall safety. On the other hand, knowledge about how the design might promote the implementation of person-centred care is still missing. As a matter of fact, the preliminary findings of this work have highlighted how those IOM goals that foster a more active view and role of hospital's patients (i.e., shared decision and participations goals) are still overlooked upon by the literature on EBD.

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Appendix 1

Descriptive material of the papers included in this systematic literature review

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Aburas	2017	The Influence of Nature Stimulus in Enhancing the Birth Experience	Health Environments Research and Design Journal	Birthing clinic	Expose to nature	Person centered, Safety, Timely, Effectiveness, Health	Patient's perspective on quality of care. Labor duration, vital signs, pain relief
Adams	2010	Kids in the atrium: Comparing architectural intentions and children's experiences in a pediatric hospital lobby	Social Science and Medicine	Pediatric hospital	A large atrium	Person centered	Children's views
Agrest	2018	Day hospital treatment for people with severe mental illness according to users' perspectives: what helps and what hinders recovery?	J Ment Health	Psychiatry day hospital		Health	Patient perspectives
Ajiboye	2015	Effects of revised consultation room design on patient-physician communication	HERD	Outpatient setting	Concultation room design	Person centered, Patient participation	Patient satisfaction
Alexiou	2016	The impact of facility relocation on patients' perceptions of ward atmosphere and quality of received forensic psychiatric care	J Forensic Leg Med	Forensic ward	New design of the built environment	Person centered, Shared decision making, Patient p., Safety	Patients' perceptions of ward atmosphere and quality of care
Alfonsi	2014	Evidence Based Design and healthcare: an unconven-tional approach to hospital design	Annali di igiene: medicina preventiva e di comunità	Hospital	Homelikeness and comfortable atmoshpere, as well as colours of the wall facility	Health	Case studies concerning: - reduction of infections - reduction of stress on medical staff - improved patient healing.
Alvaro	2016	Evaluating Intention and Effect: The Impact of Healthcare Facility Design on Patient and Staff Well-Being	HERD	Rehabilitation clinic	New design of the built environment	Shared decision making, Self-care support, Patient p., Health	Patients and staff perceptions of improvement in mental health, selfefficacy in mobility, satisfaction, and inter-professional interactions
Anaker	2018	The physical environment and patients' activities and care: A comparative case study at three newly built stroke units	Adv Nurs.	Stroke units	Physical environment	Health	Activity level and interactions
Anaker	2017	A comparative study of patients' activities and interactions in a stroke unit before and after recon-struction. The significance of the built environment	PLoS ONE	Stroke unit	Stroke unit from multiple to single room	Safety, Health	Recovery, activities and social interaction
Andersen	2010	Critical incidents related to cardiac arrests reported to the Danish Patient Safety Database	Resuscitation	Hospital	Room design and locks on doors	Shared decision making, Safety, Effectiveness, Health	Number of critical incidents reported relating to the physical environment
Andrade	2017	Do the hospital rooms make a difference for patients' stress? A multilevel analysis of the role of perceived control, positive distraction, and social support	Journal of Environmental Psychology	Orthopedic	"Favorable design features"	Person centered, Health	Patients stress and perceptions
Annemans	2016	Being Wheeled or Walking: A Qualitative Study of Patients' Spatial Experience in Two Distinct Day Surgery Centers	HERD	Day surgery centers	Physical environment	Person centered	Patients' spatial experience
Apple	2014	A comparative evaluation of Swedish intensive care patient rooms	Health Environments Research and Design Journal	ICU	Daylight and single room, all positive aspects for patients and family. However, not the same experience for the staff	Safety, Timely, Effectiveness, Health	Multifaceted. Impact on patients, families, and staff, (observed and experienced).

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Applebaum	2010	The Impact of Environmental Factors on Nursing Stress, Job Satisfaction, and Turnover Intention	Journal of Nursing Administration	Medical surgical units	Odor, noise, light and color	Health	Personells perceived stress
Baillie	2012	Caring for older people with dementia in hospital Part one: Challenges	Nursing Older People	Hospital NHS (eldelry care)	Floor safety, homelikeness and more environmental friendly settings for dementia users	Safety, Health	Adult nursing students' experiences of caring for older people with dementia in hospital
Bakker	2011	Effects of hospital-wide interventions to improve care for frail older inpatients: a systematic review	BMJ Qual Saf	Hospital	Hospital-wide interventions	Safety, effective-ness, health	For elderly: patientrelated outcomes, quality of care, patient safety, resource use or costs
Banerji	2016	An attempt to explore components of empathic architecture in hospitals – a study of Indian hospitals	Journal of Architecture and Urbanism	Hospital	Overall physical environment configuration	Person centered, Patient participation, Safety, Health	Psychological comfort, stress
Bayramzadeh	2018	Understanding Design Vulnerabilities in the Physical Environment Relating to Patient Fall Patterns in a Psychiatric Hospital: Seven Years of Sentinel Events	J Am Psychiatr Nurses Assoc	Psychiatric hospital	Physical environment	Safety	Falls
Bayramzadeh	2014	Centralized vs. Decentralized nursing stations: An evaluation of the implications of Communication techno-logies in healthcare	Health Environment s Research and Design Journal	Nursing station	Centralized and one decentralize nursing stations (picture on page 67) 4 units in total	Timely, Effectiveness	Differences in the use of communication technologies
Bazley	2016	Interior effects on comfort in healthcare waiting areas	Work	Waiting areas (office of hospital settings)	Feng shui elements	Health	Patients' selfreported comfort levels.
Bazuin	2015	If I were a band-aid, where would I be? Researching the use and location of supplies on two patient units	Health Environment s Research and Design Journal	NICU	Supplies location	Timely, effectiveness	Mapping of supply system location requirements
Beckstrand	2012	Emergency Nurses' Perception of Department Design as an Obstacle to Providing Endof-Life Care	Journal of Emergency Nursing	Emergency	None		Emergency nurses perception on the impact of ED design on EOL care.
Bevan	2016	Dignified care for older people: Mixed methods evaluation of the impact of the hospital environment - single rooms or multi-bedded wards	Healthy Aging Research	Hospital wards NHS (for elderly people)	Single room vs multiple rooms types of wards	Safety, Health	Patients’ perspectives on dignified care and level of satisfaction
Blazejewski	2015	Efficiency of hydrogen peroxide in improving disinfection of ICU rooms	Crit Care	ICU	Disinfection techniques	Safety, Health	Environmental bacterial load
Blennerhassett	2018	Behavioral Mapping of Patient Activity to Explore the Built Environment During Rehabilitation	HERD	Rehabilitation center - rehabilitation unit	Physical environment	Person centered, health	Physical activity, location, and social interaction
Bonuel	2013	Review of the literature: Acuityadaptable patient room	Critical care nursing quarterly	Patient room	acuity adaptable room	Safety, Effectiveness, Health	Literature review (discusses length of stay, infection control, patientsafety, nurse activities, noise levels, and patient and staff satisfaction)
Boog	2013	Assessing the optimal location for alcoholbased hand rub dispensers in a patient room in an intensive care unit	BMC Infect Dis	ICU Single patients room	Different arrangements of alcholbased hand rub dispensers in single room (N =4)	Safety, Health	Usage of alcoholbased hand rub dispensers

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Borckardt	2011	Systematic investigation of initiatives to reduce seclusion and restraint in a state psychiatric hospital	Psychiatr Serv	Psychiatric inpatient	Multiple	Self-care support, Patient p., Equality, Effectiveness, Health	Rate of seclusion and restraint
Borhani	2016	Facilitators and threats to the patient dignity in hospitalized patients with heart diseases: A qualitative study	International J of Community Based Nursing and Midwifery	ICU for coronary diseases	Clean environment, Comfort equipment, Green hospital and Silence in the intensive care unit	Person centered, Health	Patient dignity
Bosch	2012	Staff perceptions before and after adding singlefamily rooms in the NICU	Health Environment s Research and Design Journal	NICU	Added singlefamily NICU rooms / unit renovation.	Person centered, Safety, Health	Staff perceptions: Lower levels of stress.
Brereton	2012	The hospital environment for end of life care of older adults and their families: An integrative review	Journal of Advanced Nursing	Hospital in general	Layout configuration and noise	Safety, Health	Literature review. Various outcomes studied. Patients and families: Satisfaction and experiences.
Broadbent	2014	Implications of the emergency department triage environment on triage practice for clients with a mental illness at triage in an Australian context	Australasian Emergency Nursing Journal	ED	Triage environment (physical and otherwise)	Effectiveness	Quality of triage assessment
Browall	2013	Patients' experience of important factors in the healthcare environment in oncology care	International J of Qualitative Studies on Health and Well-being	Oncology	Design for privacy	Health	Patients' perceptions of the environment
Brown	2013	Access to mainstream health services: A case study of the difficulties faced by a child with learning disabilities	British Journal of Learning Disabilities	Healthcare general	Physical environment	Person centered, Equality, Effectiveness, Health	Case study. No outcome is measured.
Bukh	2015	Impact of healthcare design on patients' perception of a rheumatology outpatient infusion room: an interventional pilot study	Clin Rheumatol	Outpatient rooms	Room modification in terms of; colours, artificial plants and a water bubble wall were added to the room	Health	Patients' perceptions
Burton	2010	Gaining efficiency and satisfaction in the handoff process	Journal of Hospital Medicine	Hospital	Smaller room, noise reduction, closed door, as well as non PE interventions.	Timely, effectiveness	Staff perceptions on handoff efficiency
Chahal	2012	Service Quality and Performance in the Public Health-Care Sector	Health Marketing Quarterly	Hospital (i.e., medicine, surgery, pediatrics, orthopedics, gynecology)		Timely, Effectiveness, Health	Waiting time, patient satisfaction, patient loyalty.
Chang	2017	The Influences of Landscape Features on Visitation of Hospital Green Spaces-A Choice Experiment Approach	International J of Environmental Research and Public Health	Hospital	Landscape features (on photographs)	Person centered, Health	Preferred landscape features

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Chekol	2016	Dimensions of patient satisfaction with comprehensive abortion care in Addis Ababa, Ethiopia	Reproductive Health	Abortion care	The physical environment consisted of five items describing physical environment as general pleasantness, comfort, attractiveness, and conform-ableness with the procedure and waiting room, including cleanness of facilities and equipment.	Person centered, Health	Patient satisfaction
Choi	2011	Developing a multi-systemic fall prevention model, incorporating the physical environment, the care process and technology: A systematic review	Journal of Advanced Nursing	Hospital	Design of room and floor	Safety, Health	Systematic review. Falls.
Chrysikou	2013	Accessibility for mental healthcare	Facilities	Mental healthcare facilities	Universal design aids	Person centered, Equality, health	Mapping of hindrances of movement
Cloutier	2016	Experimental identification of potential falls in older adult hospital patients	Journal of Biomechanics	Hospital (i.e., clinical room and bathroom)	Mock-up of hospital room	Safety, Health	Potential falls motion capture.
Combariza	2018	Costeffectiveness analysis of interventions for prevention of invasive aspergillosis among leukemia patients during hospital construction activities	Eur J Haematol	Hospital (i.e., trauma center)	Isolation room	Safety, Health	Number of incidences of Invasive Aspergillosis.
Cone	2010	From "Baby Barn" to the "single family room designed NICU": A report of staff perceptions one year post occupancy	Newborn and Infant Nursing Reviews	NICU	Single-family rooms	Person centered, Safety, Effective-ness, Health	Staff perception
Copeland	2017	Effects of Unit Design on Acute Care Nurses' Walking Distances, Energy Expenditure, and Job Satisfaction: A Pre-Post Relocation Study	HERD	Nursing stations (centralized vs decentralized)	Nursing stations	Safety, Health	Acute care nurses' walking distances, energy expenditure, and job satisfaction
Corsano	2015	The waiting room as a relational space: Young patients and their families' experience in a day hospital	Child: Care,Health and Development	Day hospital, paediatric wards, waiting room	Waiting room	Health	Patient and family experience
Cummings	2010	Caring with comfort rooms. Reducing seclusion and restraint use in psychiatric facilities	J Psychosoc Nurs Ment Health Serv	Acute adult inpatient unit	Comfort room	Safety, Effective-ness, Health	Patients' perceived reduction of stress
Cure	2015	Effect of hand sanitizer location on hand hygiene compliance	Am J Infect Control	Hospital	Localization of sanitizer (12 rooms were evaluated with similar design but different location of sanitizer)	Safety, Health	Hand hygiene compliance
Curtis	2017	The impact of single and shared rooms on family-centred care in children's hospitals	Journal of Clinical Nursing	Children's hospitals	Single or shared rooms	Person centered, Shared d. m., Self-cares., Effectiveness	Patients', family members' and staffs' experience.
Davis	2011	Rooftop hospital gardens for physical therapy: A postoccupancy evaluation	Health Environment s Research and Design Journal	Hospital (i.e., roof top)	Roof top with greenery	Health	Patient and personnel reported perspectives, accessibility and satisfaction
de Korne	2012	Safety by design: effects of operating room floor marking on the position of surgical devices to promote clean air flow compliance and minimise infection risks	BMJ Qual Saf	Operating room	Floor markings for surgical devices	Safety	Proper placement of equipment
Dendaas	2011	Environmental congruence and work-related stress in acute care hospital medical/surgical units: a descriptive, correlational study	HERD	Acute care hospital	Configuration and environmental crowding	Health	Reported levels of work related stress and nurses attitudes towards environ-mental congruence.

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Deshpande	2017	Are hospital floors an underappreciated reservoir for transmission of health careassociated pathogens?	Am J Infect Control	Hospital		Safety, Health	Floor contamination
Devlin	2016	Qualities of Inpatient Hospital Rooms: Patients' Perspectives	HERD	Hospital rooms	Design features of hospital rooms	Person centered, Health	Patient experience
Digby	2014	People with dementia and the hospital environment: The view of patients and family carers	International Journal of Older People Nursing	Geriatric hospital		Health	Patients' and family carer's perspectives on environment/-design features.
Ding	2017	Factors influencing patients' sleep in the intensive care unit: Perceptions of patients and clinical staff	American Journal of Critical Care	ICU	Environmental and non-environmental factors in the medical intensive care unit that affect patients' sleep.	Health	Perceptions of patients and clinical staff
Dobrohotoff	2011	Psychogeriatric inpatient unit design: A literature review	International Psycho-geriatrics	Psychogeriatric inpatient unit	Unit design	Person centered, Patient p., Safety, Effectiveness, Health	Literature review
Doig	2010	The hazards of using floor mats as a fall protection device at the bedside		Hospital (i.e., bed)	Check the impact of floor mat besides bed	Safety, Health	Falls, near falls and balance (video recorded)
Domanico	2011	Documenting the NICU design dilemma: Comparative patient progress in open-ward and single family room units	J Patient Saf	NICU	Single rooms of NICU	Health	Infants rate of apneic events, nosocomial sepsis and mortality. Time untill transition to enteral nutrition. Number of mothers sustaining stage III lactation, and number of infants discharged breastfeeding.
Donald	2015	Consumer perspectives on the therapeutic value of a psychiatric environment	Journal of Mental Health	Psychiatric	Psychiatric environment	Person c., Shared d. m., Self-cares., Patient p. Safety, E., H.	Patients' experience
Drahota	2012	Sensory environment on health-related outcomes of hospital patients	Cochrane Database of Systematic Reviews	Hospital	Interventions explored were: 'positive distracters', to include aromas (two studies), audiovisual distractions (five studies), decoration (one study), and music (85 studies); interventions to reduce environmental stressors through physical changes, to include air quality (three studies), bedroom type (one study), flooring (two studies), furniture and furnishings (one study), lighting (one study), and temperature (one study); and multifaceted interventions (two studies).	Health	Systematic review. Mostly patient reported outcomes (example: anxiety)
DuBose	2018	Exploring the Concept of Healing Spaces	Health Environments Research and Design Journal	Healing spaces	Built environment	Health	Literature review
Eggert	2014	Personenvironment interaction in a new secure forensic state psychiatric hospital	Behavioral Sciences and the Law	Forensic psychiatric hospital	comparison of two building design	Safety, Health	Ward climate, safety, job satisfaction, and treatment outcomes

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Ellison	2014	Hospital ward design and prevention of hospital-acquired infections: A prospective clinical trial	Canadian J of Infectious Diseases and Medical Microbiology	Hospital (i.e., Medical ward)	comparison between four-bedrooms with shared bathrooms and a newly renovated 'new design' ward (predominantly single rooms with private bathrooms).	Safety, Health	Event rates of hospital-acquired infection and colonization
Fay	2018	Emergency Nurses' Perceptions of Efficiency and Design: Examining ED Structure, Process, and Outcomes	J Emerg Nurs	Emergency department	Units configuration, lighting, layout of patients room, technology, visibility and storage	Effectiveness, Health	Emergency nurses' perceptions of efficiency and satisfaction
Fenko	2014	The influence of ambient scent and music on patients' anxiety in a waiting room of a plastic surgeon	Health Environment s Research and Design Journal	Plastic surgery (waiting room)	Music and scent	Health	Patients' measured anxiety
Ferri	2015	Evidence-based design in an intensive care unit: End-user perceptions	BMC Anesthesiology	ICU	New constructed ICU with EBD approach	Health	Healthcare providers, support staff, and patient family members impressions and experiences.
Flacking	2014	Creating a positive place and space in NICUs	The practising midwife	NICU		Health	Perceived quality of NICU and breastfeeding
Flaherty	2011	Matching the environment to patients with delirium: Lessons learned from the delirium room, a restraint-free environment for older hospitalized adults with delirium	Journal of the American Geriatrics Society	Acute care for elders unit	Delirium room	Safety, Effectiveness, Health	Lenght of stay, number of deaths and more.
Gaboury	2017	Effect of the Postpartum Hospital Environment on the Attainment of Mothers' and Fathers' Goals	Obstet Gynecol Neonatal Nurs	Neonatal/ Postpartum	Privacy and space for the father	Person centered, Health	Perception of quality especially in regard to privacy and space for the other partner
Gharaveis	2018	The Impact of Environmental Design on Teamwork and Communication in Healthcare Facilities: A Systematic Literature Review	Health Environments Research and Design Journal	Healthcare facilities	Environmental design	Effectiveness	Literature review
Shannon	2018	Can the physical environment itself influence neurological patient activity?	Disabil Rehabil	Neurologic al stroke rehabilitation	Comparison between an old environment and a new built	Patient cetered	Mapping of patient physical and social activity, and location of that activity.
Shen	2011	Hospital environment, nurse-physician relationships and quality of care: Questionnaire survey	Journal of Advanced Nursing	Inpatient care	non	Effectiveness	Self-reported relationship between nurse /phys
Siddiqui	2015	Changes in patient satisfaction related to hospital renovation: Experience with a new clinical building	Journal of Hospital Medicine	General both medical and surgery	Total new building - 100% single room and higher-amenity	Patient centered	Visitor-related satisfaction.
Singh	2015	Outcome of inpatient falls in hospitals with 100% single rooms and multibedded wards	Age and Ageing	General medicine ward	SB/MB	Safety, Health	Falls
Smith	2016	Occupancy and patient care quality benefits of private room relative to multibed patient room designs for five different children's hospital intensive and intermediate care units	Work	Childrens hospital	Design fr MBR to PR		-
Soremekun	2014	The effect of an emergency department dedicated midtrack area on patient flow	Acad Emerg Med	ED	Dedicated area in ED		Time from triage to treatment
Stevens	2010	Neonatal intensive care nursery staff perceive enhanced workplace quality with the single-family room design	Journal of Perinatology	NICU	Design of the ward SR or open bay	Safety	Self-reported from personel the quality of safety and security
Stiffler	2015	Hallway Patients Reduce Overall Emergency Department Satisfaction	J Emerg Med	ED	HW vs TR		Patient satisfaction

Author	Year	Title	Journal	Setting	Physical environment	IOM	Outcome
Walsh	2010	Satisfaction with the emergency department environment decreases with length of stay	Emergency Medicine Journal	ED			Number of incidents of pneumonia and deaths caused by pneumonia.
Wang	2018	Private Rooms, Semi-Open Areas, or Open Areas for Chemotherapy Care: Perspectives of Cancer Patients, Families, and Nursing Staff	HERD	Cancer center			Patient satisfaction
Watkins	2011	Same-handed and mirrored unit configurations: Is there a difference in patient and nurse outcomes?	Journal of Nursing Administration	Surgery medical wards	Different layout design	Safety, Health	Needs and preferences of cancer outpatients, their families, and nursing staff
Watson	2015	Impact of noise on nurses in pediatric intensive care units	American Journal of Critical Care	ICU pediatric	A comparison between 3 different ICU	Health	Patients and nurses experiences
Weiland	2017	Managing Acute Behavioural Disturbances in the Emergency Department Using the Environment, Policies and Practices: A Systematic Review	The western journal of Emergency medicine	ED	Non	Safety, Effective-ness, Health	Nurses heart rate and stress ratings
Williams	2011	Optimizing seating in the intensive care unit for patients with impaired mobility	American Journal of Critical Care	ICU	Test seating surfaces- 3 conditions	Safety	Incidence, duration, or severity of ABDs, incidence of injuries, staff absenteeism, frequency or duration of restraint use, and staff or client perceptions
Wingler	2015	Demonstrating the effect of the built environment on staff healthrelated quality of life in ambulatory care environments	Health Environments Research and Design Journal	Health center	Describe staff HRQL and their view of the environment air quality, (2) thermal comfort, (3) spatial layout, (4) lighting, (5) acoustics, (6) office furnishings, and (7) cleanliness.	Health	Number of cells recording exessive preassure for different chair surfaces.
Vokurka	2014	The availability of HEPA-filtered rooms and the incidence of pneumonia in patients after haematopoietic stem cell transplantation (HSCT): results from a prospective, multicentre, eastern European study	Journal of clinical nursing	Hematology and transpl center	HEPA filter	Safety, Health	Staff satisfaction and perceived productivity
Währborg	2014	Nature-assisted rehabilitation for reactions to severe stress and/or depression in a rehabilitation garden: Longterm follow-up including comparisons with a matched populationbased reference cohort	Journal of Rehabilitation Medicine	Rehab garden for sick leave persons due to stress symptom	Nature ass. terapi	Health	Sick-leave status and healthcare consumption
Yelden	2015	A rehabilitation unit at night: Environmental characteristics of patient rooms	Disability and Rehabilitation	Neurological rehabilitation	Non	Health	Noise level, light, temperature and humidity.
Zaal	2013	Intensive care unit environment may affect the course of delirium	Intensive Care Med	ICU	Exposure to light levels and light quality but also multiple vs single room	Safety, health	Delirium incidences
Zhou	2016	Three modes of power operation: Understanding doctor-patient conflicts in China's hospital therapeutic landscapes	Health and Place	Primary care	Non	Person centered, Shared decision making, Patient participation	The physician patient relationship
Zisberg	2016	Factors related to the mobility of hospitalized older adults: A prospective cohort study	Geriatric Nursing	Acute care		Safety, Health	Mobility levels

Abstracts of the papers published in HERD

The following six papers that were presented at ARCH19 were previously published in a special issue of the Health Environment Research and Design (HERD) Journal 14.1 (2021). The abstracts give an overview of topics discussed during the conference; the full papers can be found on https://journals.sagepub.com/toc/hera/14/1.

FROM RESEARCH TO PRACTICE: IS RETHINKING ARCHITECTURAL EDUCATION THE REMEDY?

Tenna Doktor Olsen Tvedebrink [(1)*], **Andrea Jelić** [(1)]
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[(1)] Department of Architecture, Design and Media Technology, Aalborg University, Denmark

* Corresponding author e-mail: tdol@create.aau.dk

Abstract

The full paper has been published in the ARCH19 special issue of HERD Journal 14.1 (2021):

Tvedebrink, Tenna Doktor Olsen, and Andrea Jelić (2021) "From research to practice: Is rethinking architectural education the remedy?." HERD: Health Environments Research & Design Journal 14.1: 71-86. https://doi.org/10.1177/1937586720953529

Objectives – Our aim is to investigate how a new master studies course "Architecture, Health, and Well-being" (AHW) supports development of students' skills in understanding and assessing health-related research as well as applying research-based knowledge through unfolding of user perspectives in their design projects.

Background – With the growing focus on health-related research in Danish design practice, knowing how to translate research findings into research-informed design strategies becomes a preferable, if not (yet) a critical, skill. This calls for architecture educations to reconsider their graduate profiles and teaching curricula, thereby addressing research-to-practice gap.

Method – Based on design project hand-ins, we evaluate whether students participating in the AHW course demonstrate greater sensibility toward user experiences and research-based design (RBD) in their master thesis projects, compared to students attending a more traditional architectural tectonic track. Evaluation relates to the use of scientific literature and theoretical frameworks on topics like "healing architecture" and applied user-oriented methods (interviews, personas, demographics).

Results – Our explorative analysis indicates that students have the skills to make a detailed user analysis when it comes to well-defined user groups in a highly specialized building (e.g., hospice patients and staff). The extent to which health-related research and user perspectives are applied in the design process seems to be primarily driven by thematic focus of the project (welfare buildings in contrast to housing).

Conclusion – Despite the challenges in teaching students to assess and apply academic literature, a RBD paradigm in architectural education can help bridge emerging research knowledge with design skills and professional competencies.

Keywords: *Research to design practice | architectural education | integrated design process | research-informed design | neuroscience for architecture | cognitive science applied to architecture | user perspective*

A CONSCIOUSLY APPLIED, DESIGN-DRIVEN DIALOGUE CAN IMPROVE HEALING ARCHITECTUREOM

Stefan Lundin*

White arkitekter, Sweden

* Corresponding author e-mail: stefan.lundin@white.se

Abstract

The full paper has been published in the ARCH19 special issue of HERD Journal 14.1 (2021): Lundin, Stefan (2021) "A consciously applied, design-driven dialogue can improve healing architecture." HERD: Health Environments Research & Design Journal 14.1: 61-70. https://doi.org/10.1177/1937586720954931

Objective – This paper states that a consciously applied design-driven dialogue can improve healing architecture. It is a critical view on today's often-unilateral focus on evidence, as there are also other kind of knowledge that supports building design, some of which are partly hidden from our conscious. By using a design-driven dialogue, where end-users participate in an open dialogue through design-artefacts, this tacit knowledge might transform to a conscious and explicit one. This will support a more innovative building design as it informs the architect in a richer way.

Another objective for this paper is to present a tentative theory, on a design-driven dialogue, that can support discussions among architects, clients, project managers, users and others regarding the design-process in hospital planning.

Background – That building design, like medical treatment, should rely on evidence seems both natural and hard to question. Inspired by the great success of Evidence-based medicine (EBM), a new field of research has evolved, connecting physical interventions to medical and economical outcomes today known as Evidence-based design, EBD. These findings have been presented in research reviews and they all predicted a fast and growing amount of evidence and a future healthcare design highly influenced by evidence. However, at the same time the scientific quality of these studies has been questioned, and the amount of evidence is limited.

Among EBD-proponents there has been a strive for rigor to avoid arbitrary decisions. As a part of this, personal, subjective and sometimes even esthetical decision had been looked upon with great skepticism. Architects, and others, with an artistic training have traditionally claimed that they have important subjective knowledge that highly influence the final design. This paper suggests a way to diminish this contradiction.

Research question – How can stakeholders' and the architects' knowledge and design skills be better recognized within the design process, to improve design for healthcare buildings?

Methods – This discussion-paper is based on introspection and literature studies. The personal experience is mainly based on three design projects for psychiatric care facilities for the construction client Västfastigheter.

Results – This paper present a tentative design theory, that can be used as a basis for an educational discussion on design processes and architectural skills.

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Keywords: *Practical knowledge | Tacit knowledge | Best practice | Design theory*

CAN HEALING ARCHITECTURE INCREASE SAFETY IN THE DESIGN OF PSYCHIATRIC WARDS?

Lundin, Stefan *

White arkitekter, Sweden

* Corresponding author e-mail: Stefan.lundin@white.se

Abstract

The full paper has been published in the ARCH19 special issue of HERD Journal 14.1 (2021):

Lundin, Stefan (2021) "Can healing architecture increase safety in the design of psychiatric wards?." HERD: Health Environments Research & Design Journal 14.1: 106-117. https://doi.org/10.1177/1937586720971814

Objective – To help architects, planners and staff to deal with partly contradictory features as safety, security and healing environments in making informed decisions in design of psychiatric wards.

Background – Today's psychiatric care sets the patient at the forefront, in line with the model of patient-centered care. As a part of this ambition, the discussion on the patients' physical environment has also advanced. We often use Healing architecture as a general term for this ambition. Healing architecture should in this context be understood as physical interventions that improve patient treatment outcomes.

At the same time, we are all aware of the fact that staff are exposed to threats and violence in their every-day work, which can lead to severe personal psychological suffering as well as physical injuries. And it seems to be an increasing problem within health care in general. As an example, on average 62% of nurses in different countries indicate they have experienced physical violence over the course of a year. The design of the physical environment can reduce aggression among patients and affect staff turnover and sick leave. The Swedish Work Environment Authority reports a general increase in the amount of sick leave due to violence to 40% between 2010 and 2014, and the increase seems to continue. The most vulnerable are the employees in the psychiatric inpatient care and in special forms of housing for people with disabilities.

This means that the final building design must achieve an environment that is both healing, safe and secure at the same time. But can these general design considerations always work together, or are they sometimes contradictive? If they are, which should be put first? Traditionally, staff and patient safety have been at the fore, but increasingly, a healing environment is prioritized. This is ultimately an ethical issue. The standpoint taken has a great impact on the final design.

This paper is part of a tentative framework for an ongoing study Östra - tio år senare … A post occupancy evaluation of a psychiatric facility at Sahlgrenska University Hospital, Östra after more than ten years in operation.

Research question – How do you deal with safe, secure and healing environment when designing psychiatric wards?

Methods – Topics in this paper mainly derive from a handful of personal experiences from planned and completed projects during a period of almost two decades, and studies of peer-reviewed articles that highlight relevant phenomenon.

Results – A paper that could help leaders in psychiatric care and architects to take informed decisions on achieving safe, secure and healing environments when designing psychiatric wards.

Conclusion – In a world of incomplete knowledge, where evidence can only partly guide us, we must constantly try to orient ourselves and respond to claims made. We cannot just leave these unnoticed. Instead, we must penetrate the issues to the best of our ability.

Keywords: *Healing architecture | Safety | Security | Design | Psychiatric wards*

BUILDING FOR CHANGE: COMPARATIVE CASE STUDY OF HOSPITAL ARCHITECTURE

Nirit Putievsky Pilosof [(1)*]

[(1)] Technion - Israel Institute of Technology, Faculty of Architecture and Town Planning

* Corresponding author e-mail: niritpp@technion.ac.il

Abstract

The full paper has been published in the ARCH19 special issue of HERD Journal 14.1 (2021):

Pilosof, Nirit Putievsky (2021) "Building for change: Comparative case study of hospital architecture." HERD: Health Environments Research & Design Journal 14.1: 47-60. https://doi.org/10.1177/1937586720927026

Objective – This study assesses how architectural design strategies impact the flexibility of hospitals to change over time.

Background – Most hospitals are designed for highly specialized medical functions, which is often in conflict with the need to design the hospital facility to accommodate evolvement and change of functions over time. Architectural design strategies provide different approaches to the need to design for a specific medical program while planning for its future change.

Methods – The study compares two hospital buildings with a very similar configuration and medical program but with significantly different architectural design strategies: One was designed for an unknown future medical function, and the second was designed for a specific medical function. The study analyses the two hospital buildings by their design strategy, planning, design process, and construction by phases and compares their change in practice over the last twelve years.

Results – The design strategy to fit a specific function limited the hospital affordance to make changes during the design process, construction, and occupancy phases. Systematic design of system separation for an unknown function, in contradiction to a "tailor-made" approach in the design for a specific function, was found to support a variety of changing medical programs.

Conclusions – Architectural design strategies developed in an early stage of the design process has a major impact on the future evolution of the hospital facility. The different results between the two projects also demonstrate the greater influence of healthcare policies, hospital organization culture, and infrastructure funding models on the architecture and flexibility of hospitals.

Keywords: *hospital design, design strategies, function, flexibility, future change, medical program*

REACTIVATING HOSPITAL, ACTIVE PATIENTS THROUGH SPECIAL DESIGN

Femke Feenstra*
Gortemaker Algra Feenstra architects b.v., Netherlands

* Corresponding author e-mail: info@gaf.eu

Abstract

The full paper has been published in the ARCH19 special issue of HERD Journal 14.1 (2021):

Feenstra, Femke (2021) "Reactivating Hospital, Active Patients Through Special Design." *HERD: Health Environments Research & Design Journal* 14.1: 87-105. https://doi.org/10.1177/1937586720966757

Objective

With the Reactivating Hospital Concept it is our goal to provide a more active stay in a hospital for patients by diverting the focus away from 'lying in bed'. We want to achieve this by changing the spatial environment of the nursing ward. These new spatial interventions are aimed towards helping the patients to be healthier during and after their admission to the hospital.

Background – When it comes to hospitals, we tend to have a mind-set that is basically focused on disease, not on health. The whole hospital is geared towards illness, waiting, lying in bed: a passive attitude of the patient in this medical stronghold. Staying in a hospital has a negative influence on the body, especially for vulnerable patients. However, when patients remain active during their hospital stay, fewer negative effects occur. The risk of complications reduces, and patients recover better and faster. Research shows that only 15% of patients actually need to stay in bed.

In order to enable hospitals and their patients to benefit from these insights, Gortemaker Algra Feenstra architects introduces the Reactivating Hospital Concept: a set of scientifically based practical interventions, intended for a change in organisation and spatial design of hospitals.

Design hypothesis – How can spatial interventions to a geriatric department contribute positively to activating elderly patients during their stay in hospital? Research Question: What impact does providing areas for activation away from a patient's bed have on the quality of the patient's experience?

Methods – The Reactivating Hospital Concept no longer revolves around 'lying in bed', but around the notion of 'making patients stronger'. We are introducing a new rhythm of 8 hours of activation, 8 hours of relaxation and 8 hours of sleep. This requires a different mind-set of patients and personnel and involves a totally different interpretation of space.

To tackle the problem at its roots, the bed will be solely reserved for sleeping and all other activities will take place elsewhere in the nursing ward. To encourage patients to remain active, we soften the transition from bed to room, from room to corridor, from corridor to department and from department to the rest of the hospital. These subtle transitions invite patients to move around, thus remaining active.

To test these methods, we use qualitative and quantitative research methods like observation, conversations with focus groups and questionnaires during the research.

Results – Reactivating Hospital Concept is a concept and a design research in progress in collaboration with the existing Diakonessenhuis hospital and TNO. In this setting there are different scales of innovation. In the first phase we have been working on a completely new bed department with a new typology. In the second phase we are currently testing significant changes on a room, corridor and department level, within the context of the existing department and we are measuring and monitoring the results.

The first research results show a positive effect on the state of mind of patients as well as the nurses. At this moment we are researching the positive effect on the exercise and health of patients and we are expecting the first concrete results to come in at the end of the year.

Conclusion – The initial feedback we have received from the Diakonessenhuis Hospital has been positive. Furthermore, we have noticed that the Reactivating Hospital Concept is receiving more and more support. Lying in bed has a negative effect on patients and a lot of hospitals are aware of this and are therefore looking for alternatives.

Keywords: *Reactivating* | *Hospital* | *Active* | *Patients* | *Health*

DESIGN MODELS FOR SINGLE PATIENT ROOMS TESTED FOR PATIENT PREFERENCES

Clarine van Oel [(1)], **Meloek Mlihi** [(1)], **Arno Freeke** [(1)]

[(1)] Department of Architecture and the Built Environment, Delft University of Technology, The Netherlands

* Corresponding author e-mail: c.j.vanoel@tudelft.nl

Abstract

The full paper has been published in the ARCH19 special issue of HERD Journal 14.1 (2021): van Oel, Clarine J., Meloek Mlihi, and Arno Freeke (2021) "Design models for single patient rooms tested for patient preferences." HERD: Health Environments Research & Design Journal 14.1: 31-46. https://doi.org/10.1177/1937586720937995

Objective – Increasing specialization and technological developments add to the increasing complexity of design processes. Using 3D design models, this study aims to better involve patients by investigating what physical environmental characteristics in hospital patient rooms and consultation/examination rooms are valued by patients.

Background – To some extent, patients are nowadays involved in the design of hospitals, but given the results of studies by Elf [1] and their plea for shared-decision making and collaborative design processes with representatives from healthcare, construction sector and architecture based on evidence and end-users' perspectives, it is clear that such is not yet common practice. Existing research is hampered by poor conceptualization of environmental design factors, as these are differently operationalized between medical and technological sciences. Architects communicate through visuals, whereas the medical professionals and researchers tend to communicate in words. By using 3D modelling in research into the relationship between health and well-being on the one hand and the affordances the built environment offers, this knowledge gap can be better addressed.

Research question – Therefore, using 3D modelling, the research questions were:

- What are the physical environmental characteristics preferences of a patient & a consult/examination room, in the eyes of patients?
- In the eyes of medical professionals, what are the patients' preferences for the physical environmental characteristics of a patient & consult/examination room?

Methods – In total, 204 respondents, 60% patients and 40% medical professionals, engaged in discrete choice experiments visualizing a patient and an examination/consultation room.

Results – A main finding is that patients and medical professionals consistently choose for both hospital rooms and examination/consultation rooms with the highest amount of daylight access. What this study adds, is that the orientation of the windows matters as well. Horizontal windows, allowing for a panoramic view, were twice as much chosen than were vertical windows.

Furthermore, this study found evidence that patients in single patient rooms prefer to stay in contact with medical staff. Patients expressed a significant preference for an open door, whether the door was transparent, or not. Patients did not mind them being visible from the entrance. In contrast, medical professionals felt that patients emphasize safety over privacy.

Conclusion – This study is important as it shows, empirically, that patients may make different choices if the rooms are better conceptualized and thus visualized, and if multiple attributes are assessed in an ensemble rather than using a sequential, one attribute after another, approach.

Keywords: *Hospital design | Patient preferences | Discrete Choice Experiments | Single patient rooms | consultation / examination rooms*

Health promoting design for the urban public domain

ACTIVATING PATIENTS IN HEALTHCARE BUILDINGS: LESSONS LEARNED FROM THE URBAN SCALE

Margo Annemans [(1)*], **Delfien Van Dyck** [(2)], **Ann Heylighen** [(1)]

[(1)] KU Leuven, Dept. of Architecture, Research[x]Design, Belgium

[(2)] Ghent University, Dept. of Movement and Sport Sciences, Belgium

* Corresponding author e-mail: margo.annemans@kuleuven.be

Abstract

Objective – In this paper we aim to learn from research on an urban scale how the built environment can impact on people's physical activity and sedentary behaviour in order to translate this to designing healthcare buildings.

Background – Research shows that physical inactivity (i.e., lack of physical activity or movement) and sedentary behaviour (i.e., sitting or lying behaviour excluding sleeping) are modifiable risk factors in the rising level of chronic diseases like obesity, cardiovascular diseases, type 2 diabetes, and some types of cancer. The design of the built environment on an urban scale, like the provision of sidewalks, parks, and community facilities, has proven to be of significant importance in motivating people to be physically active and reduce sedentary behaviour, and thus to hold the potential of playing a preventive role in keeping people healthy. On the scale of buildings, the relation between the design and physical activity and/or sedentary behaviour is under-researched. Especially in healthcare buildings, patients are often confined to their bed or room, with little support nor motivation to increase their activity level.

Research question – The research questions addressed are both methodological and substantive. We investigate (1) how studies on an urban scale combine qualitative experience-oriented research techniques and quantitative tracking techniques, and what potential the adopted approaches hold for researching the built environment's impact on physical activity and sedentary behaviour on a building scale; and (2) which spaces/spatial characteristics motivate people to be physically active and reduce sedentary behaviour.

Methods – We conducted a scoping review based on journal articles combining a systematised initial search strategy with two more open selection criteria: (1) applying a combination of methods and/or (2) explicitly mentioning spatial characteristics. Grey literature was not included.

Results – By analysing articles about the built environment's impact on physical activity and/or sedentary behaviour on an urban scale, we gained insight into the methodological perspective, keeping an eye on the tools and methods used, and the substantive – spatial – perspective, listing spatial characteristics put forward as relevant to participants' physical activity and/or sedentary behaviour. This combination provides us with a broad view on population, approaches, outcomes, and constraints of research at the hinge of (urban) built environment and physical activity and/or sedentary behaviour.

Conclusion – Studying the impact of urban built environment on physical activity and/or sedentary behaviour allows to learn important lessons to further develop research about the impact of healthcare environments on patients' physical activity and/or sedentary behaviour.

Background

Physical inactivity (i.e., lack of physical activity or movement) and sedentary behaviour (i.e., sitting or lying behaviour excluding sleeping) are modifiable risk factors in the rising level of chronic diseases like obesity, cardiovascular diseases, type 2 diabetes, and some types of cancer [11]. While physical inactivity and high levels of sedentary behaviour are major challenges in society at large, they are particularly problematic in healthcare settings. Healthcare organisations face the challenge of avoiding physical decline amongst patients, especially older ones [7, 40]. When focussing on treating acute illness, staff is not always allowed to spend time with patients walking or performing other forms of exercise. Yet, keeping patients, with diverse physical and cognitive capacities, active – from early mobilisation after severe surgery [36], even in the intensive care unit [39], to long-term rehabilitation [38] – has proven to be crucial in preventing physical decline.

In most of these studies the role of the environment on a building scale is not or only marginally addressed. Only recently, studies in a rehabilitation context focus specifically on building design in relation to physical activity and sedentary behaviour. Whereas some make a comparison between wards/centres [3, 9], others consider only one ward or facility [6, 18, 37]. Depending on the adopted methodology, the studies bring forward which spatial characteristics affect participants' physical activity and sedentary behaviour and why or collect and statistically analyse (mainly self-reported) data in order to find actual correlations between built environment characteristics and patients' behaviour.

So far no studies have been found that objectively measure physical activity, yet related literature suggests the value of expanding the current methods in this direction [38]. The characteristics that are brought to the fore are mostly related to what happens inside the building, physically or socially, like the presence of obstacles in the corridor or lack of social support. When spatial organisation is addressed, the negative impact of single rooms on patients' isolation and sedentary behaviour is mentioned [3]. Healthcare facilities do not seem to be studied in their entirety as a combination of spaces with different functions, either united in one building or scattered across a campus. Connections between healthcare facilities and their larger surroundings are not addressed.

In the context of wayfinding, hospitals can be viewed as small cities, accommodating all activities of community life: sleeping, dining, business, commerce, education, maintenance, industrial processes, warehousing, and health care [2]. Therefore, urban planning and design principles should also be relevant and applicable to their design. Following the same reasoning, we aim to learn from research on an urban scale how the built environment can impact on people's physical activity/sedentary behaviour, thus improving their health and well-being, in order to translate this to healthcare building design. The research questions addressed are both methodological and substantive. We investigate: (1) how studies on an urban scale combine qualitative experience-oriented research techniques with quantitative tracking techniques, and what potential the adopted approaches hold for researching the built environment's impact on physical activity/sedentary behaviour on a building scale, and (2) which spaces/spatial characteristics motivate people to be physically active and reduce sedentary behaviour.

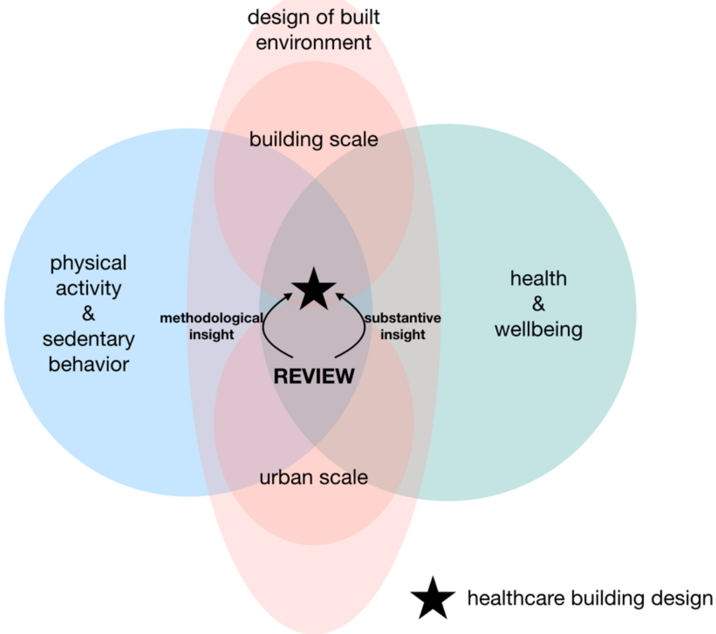

Figure 1. Research aim diagram

Review Approach

This review aims to identify relevant literature about the urban built environment's impact on people's physical activity/sedentary behaviour in order to learn from it both methodologically and substantively for future research on healthcare building design. Therefore, we conducted a scoping review, which is considered as most appropriate to identify relevant literature regardless of study design in order to gain an overview of its coverage or breadth [4]. Because of the large number of articles that seemed eligible within the review's purpose, the initial search strategy was systematised. In the final selection of the articles, however, the open lens of a scoping review was preserved.

Search Strategy

All databases available in the KU Leuven's search engine were searched: Directory of Open Access Journals; Medline (Proquest & Pubmed); OneFile (Gale); ProQuest Central; ProQuest Health & Medical Complete, ProQuest Research Library; Pubmed Central; ScienceDirect Journals (Elsevier); Scopus (Elsevier); Science Citation Index Expanded (Web of Science); and Social Sciences Citation Index (Web of Science).

In line with the review's purpose, three main groups of search terms were combined to screen titles and keywords: physical activity ("physical activity" OR "physical inactivity" OR "sedentary behaviour" OR "sedentary behavior"), urban built environment ("built environment" OR "physical environment" OR "space" OR "spatial" OR "building") and ("urban" OR "city" OR "town" OR "neighbourhood" OR "neighborhood") and design ("design" OR "planning"). Based on the envisaged application in a healthcare context we added a focus on health and well-being with according search terms ("health" OR "wellbeing" OR "well-being" OR "well being"). We limited the search to articles from the past 5 years, written in English, which resulted in 202 articles. Grey literature was not included.

Final selection

The first author screened the 202 articles based on their titles. Titles needed to express a focus on the built environment's impact on physical activity and/or sedentary behaviour. This excluded articles where physical activity was only a means to an end in order to lose body weight, reduce stress, or increase happiness. Also excluded were articles that were purely policy-oriented or aimed to study economic outcomes. We did not exclude articles based on the study setting. This resulted in a broad interpretation of 'urban environments', from comparisons between multiple countries, to single settings like urban parks or malls.

Of the 89 selected titles, the abstracts were screened by the first author in discussion with the last author. Here the selection criteria concerned: (1) applying a combination of methods and/or (2) explicitly mentioning spatial characteristics. This resulted in 37 articles.

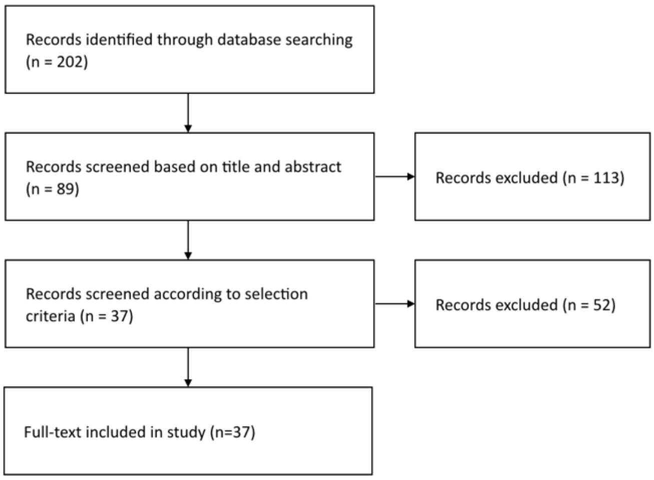

Figure 2. Study flow

Results

The 37 included articles are diverse in nature. They include quantitative [1, 8, 13–17, 20–22, 24, 27, 29, 32, 34, 42–45, 48, 49, 52], qualitative [25, 26, 31, 33], and mixed methods [30, 41, 47, 50] research reports, reviews [12, 23, 28, 35, 46, 51], a protocol [10], and an article on theoretical, methodological, and ethical questions [17]. This combination provides us with a broad view on population (children, adolescents, adults, older people with or without impairment), approaches, outcomes, and constraints of research at the hinge of (urban) built environment and physical activity/sedentary behaviour. We analysed the articles' content from a methodological perspective, considering the tools and methods used, and from a substantive – spatial – angle listing spatial characteristics put forward as relevant to participants' physical activity/sedentary behaviour.

Methodological insights

Studying the relationship between the (urban) built environment and physical activity/sedentary behaviour requires collecting data about each of them, in a way that allows making meaningful connections. The data collected about the environment concern locations and spatial characteristics. Cartographic data stored in Geographical Information Systems (GIS) [1, 10, 13–16, 21, 29, 30, 34, 41, 42, 44, 45, 49, 50], for example by an administration or as part of another research project, can be used as a basis to analyse certain features of the built environment at a certain location, e.g., the number of intersections, street lengths, or number of shops in a neighbourhood. The latter is defined according to administrative boundaries (e.g., postcodes or a perimeter around an address). Besides geographical information, insight into the built environment can be gained from questionnaires or interviews [10, 20, 22, 24–27, 31–34, 47–50]. What information will come out strongly depends on how questions are posed. Closed questions in surveys based on a pre-formulated hypothesis allow for a statistical analysis. Open-ended questions allow to discover new features at play in a particular context or to bring information to the fore about the perceived rather than measured environment. When the study focuses not on the particular context, but on the impact of predefined features, photo-elicitation – with actual [48] or manipulated [47] photos – enables participants to reflect especially on micro-characteristics of concrete built environments (e.g., presence of benches or adequate light) [47].

Given the focus on being active, studies cannot be limited to one place but require methods that allow to map where, how, and why participants move. Most of this information is closely related to the person(s) under study: apart from demographics, valuable to document are participants' personal conditions (e.g., use of assistive technology), activity (levels) and body measures (like BMI). Global Positioning Systems (GPS) are used most frequently to track where one moves at which moment [10, 13, 15, 28, 42, 43, 46, 49, 50]. Demographic data are mostly collected through survey questions. Physical activity/sedentary behaviour can be captured either through technological devices like accelerometers [8, 10, 15, 16, 28, 32–34, 42, 45], providing insight into physical activities' duration and intensity, or through less technical, more ethnographically inspired, methods that document people's routes and physical activity. These can be field observations by researchers [25], surveys [14, 16, 20, 22, 24, 26–30, 32, 41, 43, 44, 49, 52], group [10, 26] and individual [8, 10, 13, 31, 33, 34, 50] interviews, travel diaries [8, 15, 28, 49], photovoice (asking participants to document the followed routes by taking photos) [31, 34, 47, 48], or walk-along interviews [33, 50].

As to data analysis, more than half of the studies (21) conducted only a statistical analysis, seeking correlations between spatial characteristics and physical activity/sedentary behaviour [1, 8, 13–17, 20–22, 24, 27, 29, 32, 34, 42–45, 48, 49, 52]. These studies provide clear insight into which characteristics (of those advanced in the hypothesis) are relevant in relation to physical activity, sedentary behaviour, walking or cycling (in a particular context in space and time and for a specific group of participants); yet, they do not unveil why participants do what they do, or how they perceive the environment while doing so. Both regarding spatial characteristics and regarding physical activity/sedentary behaviour, a remarkable difference is found between the measured and the perceived [8, 15, 23]. Qualitative studies provide insight into why, and how (often micro-) features of the built environment play a role in physical activity [31, 33]. Matching timeframes from GPS and accelerometers can align locations with activity, but also the data retrieved through other methods could be connected. Both measured and perceived information about the built environment and about participants' physical activity can be stored in relation to geographical locations in GIS or by connecting it to locations on a map. Only one study explicitly mentioned such an approach as part of the analysis [31]. A downside of most GIS programs is that they only use 2D maps, not always doing justice to information in a 3D reality [1].

Substantive insights

The studies' outcomes addressed spatial characteristics on a macro- and micro-level. The former relates to general urban planning, the latter concerns smaller elements or interventions, more easily adapted on an ad-hoc basis. Whereas some studies make this distinction explicitly, many others mix up both.

Macro-level features, often aggregated under the umbrella term "walkability", which are frequently mentioned as relevant include density, street connectivity, mixed land-use, proximity of destinations (parks, recreational facilities, shops, restaurants, …), aesthetics (presence of nature, green or blue), and safety (from traffic and crime). In a healthcare context this could be translated to campus or building organisation with specific attention for wayfinding and positioning different functions along the way. In the quantitative studies that explicitly start from a hypothesis, these macro-level features are often the characteristics whose correlation with physical activity is to be tested [13, 14, 16, 21, 29, 32, 34, 41–45, 52]. Qualitative studies tend to focus on one characteristic or feature and dig deeper into its affordances and meanings.

Micro-level features are addressed more often, but not solely, in qualitative studies. Most frequently mentioned are benches [19, 24, 31, 33, 35, 50], availability and evenness of sidewalks [21, 26, 31, 46], clear entrance [24, 35], and light [25, 46]. Benches allow, especially older people [24, 31, 33, 50], to take a rest, but also provide a location for informal social interactions. Ottoni and colleagues [33] draw a parallel between benches, an urban feature, and porches, a building element. The availability of sidewalks is related to the macro-level feature of safety from traffic, evenness helps preventing falls and facilitates wheeled movements, important for older people and parents with children. Both issues are relevant in healthcare contexts as well. Most micro-level characteristics can rather easily be adapted at a fairly low cost [50]. Defining a hierarchy between spatial characteristics requires insight into why certain considerations are made. Van Cauwenberg and colleagues [47] illustrate this with a street where older people, unlike what was expected, seemed to dislike the presence of green. Apparently, they feared the leaves would cause slip hazard in autumn, which would limit their ability to be physically active.

Some studies' aim explicitly mentions the juxtaposition of the social and the built environment [10, 20, 24, 33, 46]. In others the social aspect is not explicated but interwoven with spatial characteristics, like exposure to the neighbourhood [16], facilitating group play and games [25], or designated social space as a destination [32, 33]. Social interactions can clearly play an important role in motivating people to be or become more physically active. Although obviously not all social relations can be brought back to spatial characteristics, the studies show that social aspects are closely related to spatial ones, either supporting or opposing them.

Discussion

This review aimed to learn from research on an urban scale how the built environment can impact on people's physical activity/sedentary behaviour in order to translate this to healthcare building design. Rather than giving a comprehensive overview of the role of the urban built environment in people's physical activity/ sedentary behaviour, the selected articles provide a broad spectrum of ideas on how this can be studied and what outcomes can be expected in relation to the methods applied. The discussion section of many of the articles also sheds a light on strengths and weaknesses of the approaches.

Lesson 1: Develop a shared vocabulary

If the translation from one scale to another is to be successful, the phenomena studied should show sufficient similarity. Identifying search terms that allow addressing similar topics was not straightforward. In a general healthcare context articles often focus on patients' physical functioning, part of which is being physically active, next to staying in control of daily activities (taking medication, doing household chores). In high-care environments like intensive care units, "patient mobilisation" is commonly used to refer to getting people to sit up, sometimes even when still intubated, or at the most to walk along the corridor. In an urban context, "mobilisation" in relation to the built environment yielded a completely different type of studies, focussing on political movements and activism. An important distinction is made between "physical activity" and "sedentary behaviour": whereas the former refers to different activities, mainly walking and cycling, with low to vigorous intensity, the latter is used in studies about sitting versus standing or low-intensity movement. What is considered low-intensity movement in a healthcare context differs between studies (e.g. [5, 38]).

This diversity of terms and associated meanings teaches a first lesson: when physical activity, in the broad sense, is studied and reported on in relation to (healthcare) building design, it will be crucial to define a clear vocabulary that allows different parties – healthcare professionals, architects, and researchers – to talk about the same.

Lesson 2: Connect measured aspects to experienced space and time

Many of the opportunities and limitations of the applied methods we discussed are also relevant at the building scale. It is important to distinguish between what is defined as physical activity spaces in GIS, based on administrative or predefined boundaries, and what is perceived as activity space by participants [8, 14, 21, 41]. A similar concern holds for physical activity: what is measured can differ significantly from what people perceive and self-report [49]. Whereas for studies on a large scale these measures are fairly accurate, on a small scale (e.g., around the home) they risk to misjudge physical activity [34]. Using GPS to document where people actually go, and using these data as prompts for later interviews [13], can bypass the need for delineated spaces to be studied and at the same time provide insight into how these spaces and the activity that takes place therein is perceived. Indoors, however, GPS is not very accurate. Future research should therefore investigate reliable alternatives. Often qualitative studies also allow a more nuanced view on some statistically positively evaluated features, like the presence of trees (and according danger of fallen leaves) [47], or video surveillance providing a feeling of safety (or of being controlled) [35].

Combining methods can reveal different meanings attached to one feature. Mostly quantitative findings are explained by adding qualitative insights [50]. Studies combining quantitative and qualitative data collection and analysis stress how objective and subjective techniques capture different characteristics of the same environment [42, 50]. Although so far, mostly qualitative research serves the quantitative [50], their combination allows deepening insights into the mechanisms at work between urban design and physical activity/sedentary behaviour and increases the reliability of the analysis [41].

We thus learn that the applied research approach should allow to unravel people's motivation to be physically active, study how this is experienced, and at the same time make the connection with concrete locations and times in order to give meaning to measured aspects.

Lesson 3: Take into account the diversity between users

Few studies of the urban built environment's impact on physical activity/sedentary behaviour pay attention to intrinsic differences between people. Although several studies focus on older adults [10, 15, 24, 31, 33, 34, 45, 50], children and adolescents [8, 20, 46, 49], or people with an impairment [13, 45], the majority take the concept of walkability as a given. Yet, this concept is defined based on able-bodied adult persons [10]. When correlations are sought between the associated spatial characteristics and physical activity for other groups, diverse in age or ability, not surprisingly these are found only partially. Researchers focusing on children and adolescents are already aware of this flaw, resulting in the introduction of the concept "playability" [46]. Apart from bodily differences, also someone's mobility mode – walking or cycling – affects what is perceived as activity space, and which spatial characteristics play a role in this [15, 29]. For a healthcare context, these mode-specific activity spaces could point at stimulating spaces depending on the use of a bed, wheelchair, walker, crutches etc.

Studies with children [46, 49] address the influence of parents as decision makers and gatekeepers. When drawing the parallel with healthcare environments, one can easily imagine at least some patients to be dependent on others to be physically active. Considering the social, in combination with the spatial, context is essential to understand (in)dependent mobility [20].

So, a third lesson to be learned is to consider diversity within and between user groups throughout the research. Especially in a healthcare context, diversity can be found with regard to participants' bodily specificities, the mode-specific way of moving throughout the healing process, and the shared (experienced) activity between patient and caretaker.

Lesson 4: Allow a broad view on the macro- and micro level

Viewing a hospital as a small city [2] makes the scale difference between urban built environment and healthcare building negotiable. Also on a healthcare campus, spatial characteristics will need to be addressed on a macro- and micro-level. To our knowledge, so far buildings' impact on physical activity has hardly been studied on the macro-level. One spatial organizational characteristic that has been identified as (negatively) impacting on patients' physical activity is to implement only single rooms [3]. Yet, this relates solely to the initial motivation to be active and does not reveal which characteristics play a role during activity. Articles about the neighbourhood might be too different in scale, but those respectively focusing on a university campus [27] or malls [12] could provide hints about the built environment design on an intermediate level, e.g., the presence of sheltered paths [27] to facilitate moving between buildings on a campus.

As studies on built environment and physical activity in health care mostly take place within a particular ward or centre, micro-scale features come to the fore more frequently. Some characteristics mentioned in this context correspond neatly with those identified in an urban context, e.g., avoiding obstacles or providing benches. Regardless of the particular characteristics, Koppen and colleagues [23] point out the importance of understanding how a space is being read. In their research on the accessibility of recreational landscapes, they describe paths intended to be official entrance routes being read as private by potential visitors, who were then not eager to continue their journey into the landscape. Similarly, few hospital corridors are read by patients as places where they should pass frequently for their enjoyment.

The fourth lesson is threefold. Regarding the macro-level characteristics, we learn about the importance of well-thought-out (new) typologies with specific attention for spatial interventions that facilitate connections between buildings. On the micro-level, the role of specific spaces as destinations (the room, a garden, a living area or cafeteria) or connecting spaces (like corridors and atria), and how they are concatenated, comes to the fore. Additionally, attention should be paid to how both levels interrelate.

Limitations

The study shows several limitations. By conducting a scoping review with a systematized search strategy narrowed down to the last 5 years, we limited the range of the selection, possibly leaving out highly relevant literature fitting the scope but older or using a different vocabulary. We believe, however, that the resulting articles are representative for what could have been found with a more open approach. This issue was also mitigated by opting to include reviews, a protocol, and a theoretical and methodological reflection. Although including reviews opened the perspective on older literature, it also resulted in a limited overlap with two individual studies [16, 31] being part of a selected review [35]. The translation of methods and outcomes from one scale to the other could be discussed. At this point the insights gained seem at least inspiring. We will be able to assess their worth only when further, in depth exploring the impact of healthcare facilities' built environment on patients' and other users' physical activity. Finally, some of the selected articles touch upon the benefits of physical activity for (mental) wellbeing [52] and its relation with fitness levels. Both are closely related to one's health and risk of physical decline. If we aim for future healthcare buildings that play a positive, maybe even preventive role in people's health, we should not lose sight of the bigger picture.

Conclusion

Studying the impact of urban built environment on physical activity allowed learning important lessons to further develop research about healthcare environments' impact on patients' physical activity. The selected articles are diverse in nature, which allowed considering the topic from different angles and identifying (combinations of) methods and outcomes worth to be further investigated. Even though most studies used multiple data collection methods and devices, many questions about the combination remain unsolved [17]. Especially in an explorative phase, combining a quantitative and qualitative approach seems most valuable. Our review showed that when both are used, there is often little interaction between the outcomes of the quantitative and those of the qualitative part, neither during data collection, nor during analysis or when reporting. When the approaches are related to each other, it is mostly quantitative research that is enriched with qualitative information [50]. None of the studies used quantitative data as part of an overall qualitative research approach. Future research should explore how this could be realised, what this would mean methodologically, and how it would affect the outcomes.

When focussing on spatial characteristics that impact on people's physical activity, one needs to make an important distinction between the macro- and micro-level without losing sight of their mutual influence. Which category should be prioritised in design will likely depend on particular circumstances. Designing an entirely new building allows approaching the macro-level, yet in many existing buildings small adaptations of micro-level characteristics will be more feasible, not in the least because of the lower cost and shorter implementation time [50].

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HEALTH-PROMOTING URBAN PLANNING: A CASE STUDY OF AN EVIDENCE-BASED DESIGN PROCESS

Anna Åshage [(1)*], **Anna Bengtsson** [(1)]

[(1)] Swedish University of Agricultural Sciences, Department of People and Society, Box 190, S-234 22 Lomma, Sweden

* Corresponding author e-mail: anna.ashage@slu.se

Abstract

Planning and building health-promoting, sustainable, and resilient urban environments is a complex challenge. Beside the negative effects caused by stressors in our urban living environments, health status also drops because of our way of life, e.g., stress-induced illnesses increase, we exercise less, obesity is a growing health problem, and loneliness and lack of human relations are also risk factors for disease and premature death.

A growing amount of evidence shows that access to nature and urban greenery has positive effects on human health and well-being. Hence, landscape design could contribute to meeting the goals for public health and well-being. This stresses the need to investigate methods and tools that aid the process of evidence-based planning and the design of health-promoting outdoor environments, as well as the need to consider how to incorporate such methods in planning and design processes.

This study explores the application of an evidence-based approach in urban planning for design of health-promoting urban green spaces, e.g., parks. A two-step study using participatory action research as the overarching method enabled us to take part in and observe a collaborative practitioner-research process in a municipal planning and design context. Use of evidence-based methods and tools for design of urban public spaces was explored, and experiences were shared and discussed between landscape architects and researchers.

The results show that evidence-based design principles are useful for guiding design interventions concerned with health-promoting environmental qualities in an urban planning context, for people in general and for specific user groups, e.g., intending to design health promoting environments for the elderly or to aid in stress relief. In addition, landscape architects found that the evidence-based process inspired design solutions and gave a higher sense of meaning to their work.

However, descriptions of the environmental qualities defined need to be adapted to the specific context, using descriptive examples of aspects more relevant for public spaces. The study also identifies a need to connect health-promoting environmental qualities to urban planning guidelines for access to green space and points out a need to identify preconditions in earlier planning phases that enable or limit landscape architects' ability to develop some of the health-promoting environmental qualities. Furthermore, to surmount the time-consuming threshold of learning how to use new tools and methods, landscape architects ask for more concrete and easily applied guidelines or checklists to aid design decisions. Altogether, the results presented illuminate possibilities for an evidence-based design process and shed some light on the factors that need to be considered in such processes.

Keywords: *Health-promoting | evidence-based design | landscape planning | urban planning | participatory action research*

Introduction

Building health-promoting, sustainable, and resilient urban environments is a challenge for modern city planners. Future cities are expected to meet the needs of fast growing urban populations, to resist the environmental degradation that follows with urbanisation, to be adaptable and resist climate changes, and on top of that form good and healthy living environments. To build cities that support and promote health and well-being for their inhabitants is a complex task; nevertheless, the need to do so is escalating [1, 2, 3, 4, 5, 6].

At the same time, health status is dropping due to increased lifestyle-related diseases. We live stressful lives, many feel lonely, we exercise less, and we are affected (biologically and psychologically) by negative stressors in our urban living environments. Health agencies report increased mental illness, especially among young people, citing stress-induced illnesses as one of the main reasons. Obesity is a growing health problem for over half the Swedish population and constitutes a risk factor for high blood pressure with increased risk for heart and cardiovascular diseases.

Loneliness and bad human relations are even more serious risk factors for disease and premature death than obesity or physical inactivity [7, 8, 9, 10, 11, 12, 13].

A growing amount of evidence shows that access to nature and urban greenery has several positive effects on human health and well-being [6, 14, 15, 16, 17, 18]. Urban green spaces can help to enhance the health condition of the public by providing close and easy access to urban nature and greenery with spaces designed to have health-promoting environmental qualities that support stress restoration, stimulate physical activity and promote social interaction [19, 17]. Research has pointed out the need to translate research into practice but has also identified challenges related to that process [20, 21, 22].

It is important to increase our understanding of how, in practice, to plan and design for environments that promote human health and well-being. Earlier research has pointed out the need to identify different specific environmental qualities that benefit health and well-being to enable future landscape design that take advantage of these benefits [23]. Other research has pointed out the need for models and tools that facilitate the use of evidence in participatory design processes [24, 25, 26, 27, 28]. This stresses the need to investigate models and tools that aid landscape architects in the process of planning and designing health-promoting outdoor environments [29, 30, 18, 31, 16, 32, 9, 20, 21].

Research question

This study aims to explore and evaluate the implementation of an evidence-based approach in urban planning for the design of health-promoting urban green spaces, e.g., parks.

Knowledge of the outdoor environment as a health-promoting resource is steadily growing, but how could this knowledge be put into practice? Are there existing models and tools for use in evidence-based design processes that could be tested? What could be learned from the process of trying to use such tools?

Method

A collaborative project between landscape architects in a municipality (in the Stockholm region) and researchers at the Swedish University of Agricultural Sciences (SLU) gave an opportunity to study the use of evidence-based models and tools in the planning and design of health-promoting urban, public outdoor environments.

Landscape architects in the municipality had recognised the potential benefits of health-promoting design and turned to researchers for support on how to translate research-based knowledge into design processes in urban planning. This initiated a collaboration between practitioners and researchers based on a mutual interest in developing evidence-based health-promoting public outdoor spaces.

Methodological approach

In order to study the possibilities and challenges of using evidence-based tools and models in urban planning, participatory action research (PAR) [33, 28] and case-study methodology [34] were used as overarching methods. The combined PAR and case-study approach enabled the researchers to participate in and observe the process in a real-life context, with the intention both to study the implementation of research, and to evaluate the practical use of tools intended to support an evidence-based design approach. Case-study research is known to be useful for finding knowledge useful for practical application in a real-life context [34] and was considered appropriate for the present study. Note that the intention was not to study the health effects of the design, but to study the use of evidence-based models and tools in a design process.

Activities performed in this case study were observed and documented in a research diary. The researcher's observations and landscape architects' experiences were analysed and evaluated in joint discussions during work meetings and workshops in different steps of the case study [34, 27]. The case-study set-up had an iterative approach, using the first part of the study as a pilot to inform the second part [35].

The possibility to study the use of evidence-based tools and models in urban planning was facilitated by the opportunity of the first author to take part in the study both as a participant working in the authentic development context in the municipality, as suggested by e.g. Ahnberg [27], and as an observer following, describing and analysing the process and the application of the tools and methods used, see e.g. Katoppo [28].

Tools and models investigated in this study

The Quality Evaluation Tool (QET) [36] was used as the framework for the present study. Earlier research has pointed out a need for models and tools for use in evidence-based design processes of outdoor environments [24, 25, 37, 38], and for identifying specific environmental qualities that benefit health and well-being [23]. The QET was developed to meet the above-mentioned needs [39].

Furthermore, since the QET has a holistic approach to design that includes aspects that are important both for health promotion and ill health prevention, it was considered a relevant and useful tool for the present study.

The Quality Evaluation Tool

Use of the QET involves three steps (see Fig.1); 1) making an inventory of existing environmental qualities identified to support health and well-being [36, pp. 881, Table 1], 2) investigating user-specific environmental needs in relation to four zones of contact with the outdoor environment, 3) proposing design interventions based on the result of the first two steps.

Environmental qualities	Step 1. Investigation of environmental qualities in the outdoor environment using the four zones of contact	Step 2. Evaluation of qualities' importance to potential users and in relation to the four zones of contact	Step 3. Suggested measures and design proposal
Section A. Six environmental qualities allowing people to be comfortable in the outdoor environment			A. Suggested measures for comfortable design
Section B. Thirteen environmental qualities supporting people's access to nature and surrounding life			B. Suggested measures for inspiring design

Figure 1. Practical construction of the QET – outline of steps supporting an evidence-based design process (Bengtsson & Grahn, 2014).

The QET highlights the importance of the relationship between indoor and outdoor environments by relating the user's health-promoting experiences to the following four zones of contact with nature (Fig.2) [39]:

- starting with the visual contact from inside a building (zone 1),
- including the connection between indoors and outdoors (zone 2),
- focusing on experiences in the closest outdoor environment, like a garden (zone 3),
- taking into account the health-promoting qualities of the surrounding environments (zone 4).

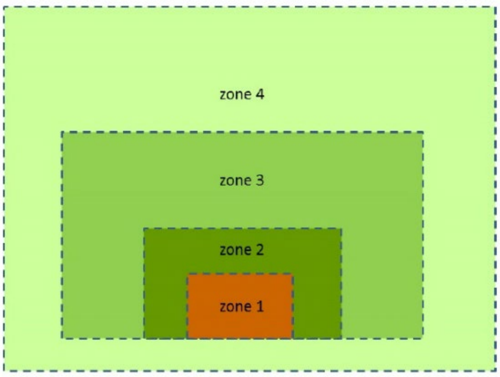

Figure 2. Model of four zones of contact with the outdoor environment (Bengtsson, 2015).

The holistic approach to the design process, including environmental qualities corresponding to needs and preferences of a wide range of users, makes it interesting to explore the use of the QET, and to investigate its potential value in the context of urban planning where the wide range of all the city residents' health and well-being needs must be taken into account.

Case study part 1 (pilot) – Evaluation of a design proposal based on QET

This study was set up as a case study in two parts, in an iterative process where the result from the first part of the study was used to inform the construct of the second part of the study.

Case study: part 1 (pilot) – case-study setting

A park (Fig.3) in a municipality in the urban Stockholm region, scheduled for future development by the municipality, served as case-study setting in the first part of the case study.

Figure 3. Site overview, park to be developed into a health park based on research knowledge on health-promoting environmental qualities in case study part one. Photo: overview in Orto-photo, provided by the municipality.

Case study: part 1 (pilot) – objective and work process

The main objective of the first part of the study was to identify aspects of importance for the implementation of use of evidence-based design in an urban planning context, both from a practitioner and research perspective.

Table 1. Case-study design and work process of pilot study following the QET design process.

Case study - part one
(Pilot study)

Main activity	Timeline	QET - STEP 1 Investigation of environmental qualities in the outdoor environment using the four zones of contact	QET - STEP 2 Evaluation of qualities' importance to potential users and in relation to the four zones of contact	QET - STEP 3 Suggested measures and design proposal	Evaluation	Activity performed by:
1.1	2015	Inventory of existing health promoting environmental qualities of Section *A: Comfortable environment*				The first author, as MSc student at the master program 'Outdoor Environ-ments for Health and Well-being' at SLU
1.2	2015	Inventory of existing health promoting environmental qualities of Section *B: Access to nature and surrounding life*				The first author, as MSc student at the master program 'Outdoor Environ-ments for Health and Well-being' at SLU

Main activity	Timeline	QET - STEP 1 Investigation of environmental qualities in the outdoor environment using the four zones of contact	QET - STEP 2 Evaluation of qualities' importance to potential users and in relation to the four zones of contact	QET - STEP 3 Suggested measures and design proposal	Evaluation	Activity performed by:
1.3	2015	Identifying the environmental relationship of *Four zones of contact*				The first author, as MSc student at the master program 'Outdoor Environments for Health and Well-being' at SLU
1.4	2015		Interviews with local key experts focusing on local priority target user groups' specific environ-mental needs in relation to the park. *Targeted user groups identified by the municipality*			The first author, as MSc student at the master program 'Outdoor Environ-ments for Health and Well-being' at SLU
1.5	2016, Q2			Developing a conceptual design proposal for development of an health park		Researchers at SLU as consultants for the municipality
1.6	2017, Q1				Presentation and evaluation of the conceptual design proposal. Workshop with local stakeholders in the municipality, both internal (politicians, municipality officials) and external (repre-sentatives from local interest groups with different user perspectives)	Facilitated by the municipality, held by landscape architects in the municipality and researchers at SLU together in collaboration.
1.7	2017, Q2				Citizens dialogue	Landscape architects in the municipality
1.8	2017, Q3				Synthesis – evaluation of conceptual design proposal in relation to result from citizens dialogue and feedback from internal and external stakeholder	Landscape architects in the municipality and researchers in collaboration.

Researchers followed the three steps of the evidence-based design process outlined in the QET (Fig.1), and developed a conceptual design proposal for a health park in dialogue with landscape architects in the municipality (see details in table 1).

Case study: part 1 (pilot) – documentation and analysis

The proposal, i.e., the result of the design process using QET, was presented, discussed and evaluated in several collaborative activities involving citizens (Table 1, activity 1.7) and local stakeholders representing specific user groups as well as politicians and planners (Table 1, activity 1.6).

Landscape architects and researchers discussed and evaluated the design proposal in light of the feedback from citizens and local stakeholders, e.g., planners and politicians, and jointly drew conclusions and summarised the results (Table 1, activity 1.8). Study visits to Alnarp Rehabilitation Garden and Kristianstad Health Garden served as reference objects in the discussions.

Landscape architects' and researchers' joint conclusions pointed out what aspects were important to consider in the second part of the case study in regard to the design process as well as design content.

One researcher (the first author) observed and documented all activities and all parts of the process.

Case study part 2 – Evaluation of the application and use of the QET in urban design processes

Drawing on the results from the first part, the second part of the study scaled up the perspective and investigated how the QET can guide planning in a wider context.

Case study: part 2 – case-study setting

The municipality's intention to produce a programme proposal to guide the municipality in future development of a larger urban area served as a case-study subject in the second part of the case-study. The programme (Table 2, activity 2.4) involved three centrally located parks (including the park studied in the first part of the study) with potential to form a cluster of connected health-promoting parks (see figure 4) serving as a 'green corridor for health' in the municipal city core.

However, feedback from landscape architects' experiences of using the tool (Table 2, activity 2.3) also included other sites in different ongoing development projects.

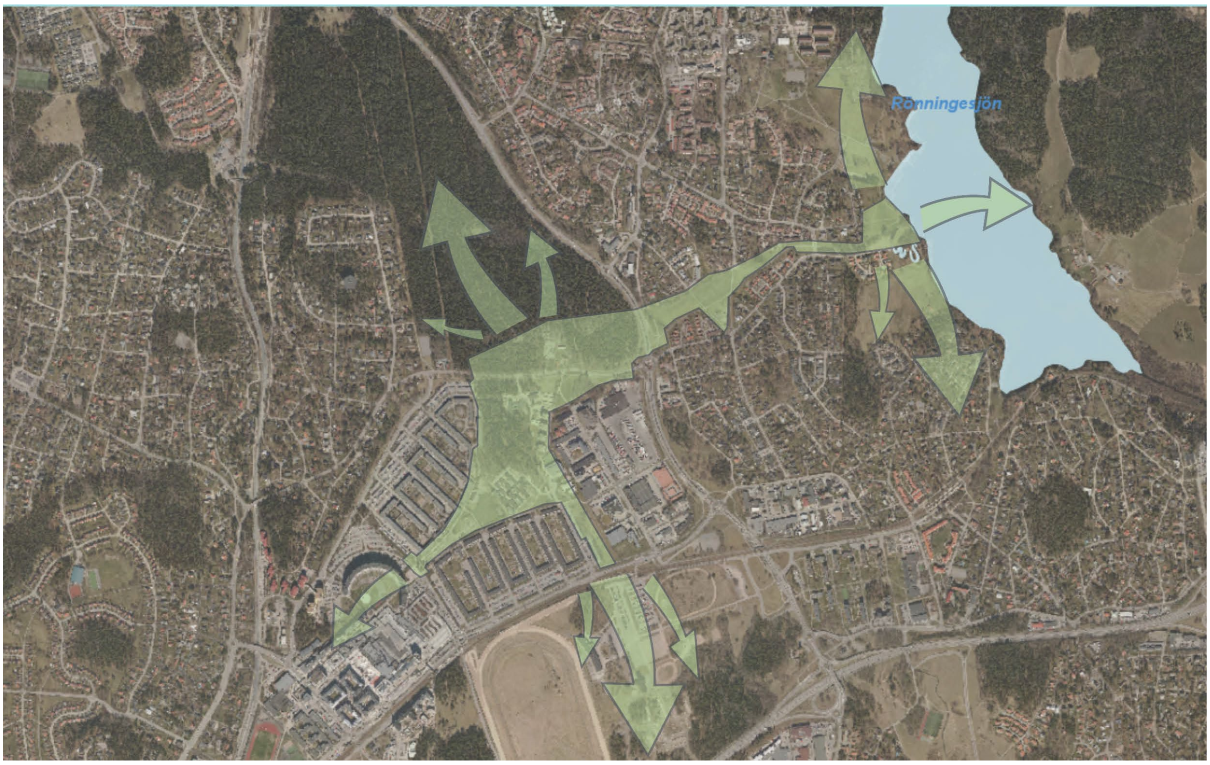

Figure 4. Area of connected parks serving as case-study object for evaluating the application of QET in the process of forming a programme proposal for development of a larger health-promoting park area in an urban city core in the Stockholm region.

Case study: part 2 – objective and work process

Based on the result from the first part of the study, the objective of this part was to evaluate the application and use of QET in urban planning and design processes, and to study landscape architects' experiences of using the tool. A second aim (based on the municipality's needs) was to form a development programme proposal for the overall structure and content of a larger health-promoting park area, to guide the municipality in future development of the area. Two main activities were planned to meet these objectives, see activity 2.2 and activity 2.4 in Table 2.

After preparatory educational activities, such as research seminars (Table 2, activity 2.1), where researchers presented research evidence and tools, and showed examples of how to use the QET [36, 40], landscape architects used the QET in ongoing development projects (Table 2, activity 2.2). Landscape architects in the municipality carried out QET steps 1 and 2 (Fig. 1), and from that devised a programme to guide consultants (following Swedish legislation on public procurement) in performing QET step 3 (Fig. 1).

In the other main activity, a programme for development of a larger health-promoting park area (Table 2, activity 2.4), was created in co-production between landscape architects and researchers, performing the QET steps together (Table 2, activity 2.4.1-2.4.5). A detailed inventory of existing health-promoting qualities (QET step 1) was made using different inventory techniques (Table 2, activity 2.4.1-2.4.3). Important user groups, and user-specific needs to consider in different parts of the area were identified (QET step 2, Fig. 1) on an overarching level (Table 2, activity 2.4.4). A development programme was produced (Table 2, activity 2.4.5), giving overarching design guidelines (QET step 3) for future development of the area. The programme described existing health-promoting environmental qualities of high value (QET step 1, Fig. 1), it pointed out challenges and weak spots important to consider from a health perspective, and suggested potentially important user groups to consider in different parts of the area (QET step 2, Fig. 1).

Researchers were available to support the work process (Table 2, activity 2.2 and 2.4.1-2.4.5). Landscape architects' experiences were presented to researchers and discussed in a workshop (activity 2.3, Table2).

Table 2. Case-study design and work process of part two following the QET design process.

Case study part two
Activities planned and performed based on the result of case study - part one

<table>
<tr><th>Main activity</th><th>Timeline</th><th>Learning, education</th><th>QET - STEP 1

Investigation of environmental qualities in the outdoor environment using the four zones of contact</th><th>QET - STEP 2

Evaluation of qualities' importance to potential users and in relation to the four zones of contact</th><th>QET - STEP 3

Suggested measures and design proposal</th><th>Evaluation</th><th>Activity performed by:</th></tr>
<tr><td>2.1</td><td>2018, Q3</td><td>Preparatory educational activity, educational seminar, theme: "Health promoting landscape planning"</td><td></td><td></td><td></td><td></td><td>Held by researchers, for the department of landscape architects in the municipality</td></tr>
<tr><td>2.2</td><td>2018, Q3-Q4</td><td></td><td colspan="3">Using/testing the QET tool in ongoing design and development projects in the municipality.</td><td></td><td>Landscape architects in the municipality. Researcher available to guide use of the tool/working in parallel in the municipality.</td></tr>
<tr><td>2.3</td><td>2018, Q4</td><td></td><td></td><td></td><td></td><td>Workshop, theme: "Health promoting landscape planning in practice"
Feed-back from landscape architects to researchers on their experiences of applicability and usability from using the QET in an urban planning context</td><td>Held by landscape architects in the municipality for researchers.
Joint discussions.</td></tr>
<tr><td>2.4</td><td>2018, Q1-2019, Q2</td><td></td><td colspan="3">Create/propose a development program to guide future design-interventions of three connected urban parks (including the health park studied in part one of the case study), with the intention to create a large health promoting park area/corridor for health close to the central city core under densification.</td><td></td><td>Landscape architects in the municipality and researchers in collaboration.</td></tr>
<tr><td>2.4.1</td><td></td><td></td><td>Inventory of existing health promoting environmental qualities of Section A: Comfortable environment</td><td></td><td></td><td></td><td>Landscape architects in the municipality and researchers in collaboration.</td></tr>
</table>

Main activity	Timeline	Learning, education	**QET - STEP 1** **Investigation of environmental qualities in the outdoor environment using the four zones of contact**	**QET - STEP 2** **Evaluation of qualities' importance to potential users and in relation to the four zones of contact**	**QET - STEP 3** **Suggested measures and design proposal**	Evaluation	Activity performed by:
2.4.2			Inventory of existing health promoting environmental qualities of Section *B: Access to nature and surrounding life*				Landscape architects in the municipality and researchers in collaboration.
2.4.3			Identifying the environmental relationship of *Four zones of contact*				Landscape architects in the municipality and researchers in collaboration.
2.4.4				Inventory of user specific environ-mental needs on an overall strategic level using GIS-data. Identifying user specific environmental needs along the area by mapping of municipal functions such as schools, different kind of housing areas, etc.			Landscape architects in the municipality and researchers in collaboration.
2.4.5					Forming a Program proposal that describe and guide future development of three connected parks into a health promoting park area/corridor for health		Landscape architects in the municipality and researchers in collaboration.
2.4.6	*2019, Q3-Q4 and onwards*				*Implementation of the 'Develop-ment program' in the municipal organization*		*Landscape architects in the municipality* *(Activity outside the scope of this case-study)*

Case study: part 2 – documentation and analysis

During the work of applying the QET to produce a programme for the larger park area, landscape architects and researchers worked closely together (Table 2, activity 2.4.1-2.4.5). They continuously discussed and reflected on the process.

The landscape architects' experiences of using the QET were also collected in a workshop (Table 2, activity 2.3) where they gave feedback directly to the researchers, and the application and use of the QET in an urban planning context were discussed.

One researcher (the first author) observed and documented all activities and all parts of the process (Table 2, activity 2.2 and 2.4). Then the documentation was analysed by the two authors. The overall intention of the analysis was to reveal challenges and possibilities experienced by the landscape architects using the QET.

Results from case study part 1 (pilot)

The results from the first part of the study are based on the evaluation of the conceptual design proposal developed by researchers applying research evidence on the health-promoting natural qualities in an urban planning context. With a focus on the process of implementing the QET in urban planning in the next step, the main outcome from the first part of the study (Table 1) is the construct of part two of the case study (described in Table 2).

Evaluation of a design proposal based on the QET

The conceptual design proposal developed in the project suggested an overall layout of the park using thematic areas guiding design interventions. Environmental qualities important to the concept and for specific user groups were identified (to keep, develop and/or add) in each thematic area, and health-promoting design interventions for different user groups were proposed and arranged in relation to thematic areas (Fig. 5).

Figure 5. Example of a conceptual design proposal for one thematic area in the park.

Local stakeholders in the workshop gave overall positive feedback on the proposal. General concerns related to feelings of safety based on lighting conditions, vegetation and low social presence were discussed and different user views were presented. Aspects related to practical landscape design and urban planning such as water flow management and traffic solutions affecting the design proposal were addressed.

Results from dialogue processes with local residents showed divergent opinions among local residents, some very positive to the proposal and some having concerns. Private one-family houses with gardens surround the park closely. The local residents' priority was to keep and renovate an existing playground. Several expressed a wish not to develop a health park, and comments such as "Don't make this into an attraction, we don't want anyone else to come here" expressed concern about how the proposed interventions might change the place and its content and attract new users.

Conclusions from evaluation of the design proposal in case study part 1

The results from case study part 1 (Table 1, activity 1.8), concluded by landscape architects and researchers, based on the evaluation of the conceptual design proposal and feedback from dialogue with citizens (Table 1, activity 1.7) and stakeholders (Table 1, activity 1.6), identified two main findings.

First, the place did not fit the aim of the conceptual design proposal. This was related both to local users' perspectives raised in dialogues with citizens and stakeholders, as well as practical aspects of municipal management, for instance political values or organisational aspects affecting the realisation of suggested service functions, e.g. public toilets and a manned greenhouse. However, an area comprising several parks was identified as possible to develop into a larger connected area of health-promoting parks, allowing for an overall layout that could provide a broader scale of health-promoting environmental qualities.

Second, the landscape architects raised concerns regarding lack of clarity on how to go forward with the conceptual design proposal in municipal design processes. Landscape architects who had not been active in the design process and had not used the tool themselves, experienced a limited ability to describe the proposal in dialogue with internal/external stakeholders and to explain design choices.

The joint evaluation by researchers and landscape architects informed the design of case study part 2, focusing on evaluating how the QET could be applied and used in urban (municipal) design processes. This led to an extended co-operation, aiming to create a programme proposal for a wider area of three connected parks, formed by landscape architects and researchers in co-production, and also initiated educational activities to enable landscape architects to use evidence-based tools that could help them to plan and design health-promoting outdoor environments.

Results from case study part 2

The results from the second part of the study reveal the challenges and possibilities that the landscape architects experienced using the QET.

Evaluation of application and use of the QET in the urban design process

Starting to use a new design tool was found to be an obstacle in itself. It takes some time to learn how to use the tool, which to some extent delayed or hindered implementing use of the tool. Landscape architects pointed out a need for more easily applied guidance from researchers on how to apply evidence-based tools in the context of designing public outdoor spaces. Landscape architects testing use of the QET in development projects also raised a need for support to make time estimations for performing the QET steps in order to aid work planning.

Landscape architects testing use of the QET in the municipality sometimes found that they were involved too late in urban planning projects. Some aspects that were important for design interventions of health-promoting environmental qualities were found to be limited by aspects defined in earlier planning phases. Land-use, and the size and localisation of green spaces in relation to the built environment are examples of aspects found to restrict landscape architects' freedom and to determine what health-promoting design interventions can and cannot be implemented. Involvement in early planning phases was found important in order to be able to identify and save existing health-promoting environmental qualities in a development site, and to create good pre-conditions for adding such qualities in design.

The landscape architects also found that using the QET helped to inspire the design process itself. They reported that using the QET in the process of analysing inventory results (QET step 1) to identify environmental qualities and evaluating user-specific needs in regard to the place (QET step 2), actually inspired new design solutions (QET step 3, Fig. 1). The landscape architects also said that using the QET to apply research knowledge gave increased understanding of how their design interventions could promote health and well-being for the public they serve. That also brought a sense of meaningfulness to the work and evoked positive feelings of being able to make a positive difference for local residents.

Evaluation of inventory of 'Four zones of contact with the outdoors' in urban planning

Using the model of 'Four zones of contact' (Fig. 2) in design processes normally starts by analysing the experience of the outdoors from inside a building, in zone 1, and builds on that with the connection to the outdoors via zone 2 and focuses on the design of the part of the outdoor environment closest to the building, zone 3. When the model is used in urban planning it needs to be reversed. Landscape architects in the municipality studied, work with public outdoor spaces, in Swedish defined as "allmän_platsmark", which included public outdoor environments such as parks, walking paths and plazas, but not facilities such as schools, health care buildings etc. In relation to the model 'Four zones of contact' this means that they mainly develop and maintain spaces defined as zone 4 areas, often without any access to or means to change the content of zone 1-3 areas.

Still, the model 'Four zones of contact' (Fig. 2) was found useful. In this study the model was used to identify specific user groups important to relate to in specific parts of the outdoor environment (Fig. 6). For example, the model was used to locate different housing areas and public service functions such as pre-schools or housing for senior residents in the park area and to determine whether they had access to their own zone 3 area or not. Such knowledge can guide the landscape architect when making design choices and identifying how the design or development of [a specific] urban public place (zone 4) can compensate for insufficient access to green space and/or lack of health-promoting environmental qualities that are important to nearby inhabitants/users.

Such information was found to guide the overall layout of public outdoor environments, helped identify focus points for certain user groups, and was used to identify how a public outdoor space can be developed to compensate for lack of access to appropriate outdoor spaces for especially fragile user groups in the surrounding built environment.

Figure 6. Example of access to zone 3 areas from housing or public service functions in the development area, with examples of identified user-specific groups important to consider in different parts of the environment.

Evaluation of inventory of health-promoting environmental qualities in urban planning using the QET

When the QET was used to investigate existing health-promoting qualities in the environment (Fig.1, step 1) [36, pp. 881, Table 1], the landscape architects sometimes found it difficult to translate the meaning of environmental quality [40, pp. 33-35] to the urban context. Some descriptions of environmental qualities were perceived to be specific to health care settings, or to more garden-like environments, which led to discussions on how to interpret them in this context.

Different approaches to inventory techniques were tested. Descriptions of how the investigated qualities were represented in the environment, accompanied by photos providing a comprehensive picture of the environments, were useful on a detailed level in later design steps. Other approaches applied, that were perceived as time-saving and that simplified use, were to grade the presence of the quality from e.g. 0-3, 0 corresponding to “not present” and 3 meaning “strong”, or to identify the presence of an environmental quality in terms of a “weak”, “medium” or “strong” presence (see example in figure 7). This was reported to be an easy and fast approach when applied in a park or larger urban area and was perceived as more useful when producing programmes to guide design by contractors and entrepreneurs used in urban development projects.

The inventory of qualities of a ‘Comfortable Environment’ (A1-A6, Fig.1) [36, pp. 881, Table 1 "Section A"], was found to be quite extensive since these qualities describe fundamental factors that make the environment accessible and user-friendly, which means that all six environmental qualities of ‘Comfortable environment’ were evaluated over the whole area (Fig. 7). This part of the inventory was found to be the most time-consuming part of the process. Important aspects to consider for each quality can differ between different user groups. To make a detailed analysis of a site, including all user perspectives, would mean making landscape analysis maps of all six ‘Comfortable environment’ qualities for each user group. In attempting to add or merge different user perspectives of the qualities to the analysis (Fig.1, step 2) the overall picture becomes very complex and difficult to use.

Using the applied analysis of ‘Four zones of contact’ (Fig. 6) was helpful in the process of identifying and prioritising user groups that would be especially important to consider in different parts of the area. This made it possible to make a more generalised analysis of the area, and yet be attentive to the special needs of different user groups in different parts of the area.

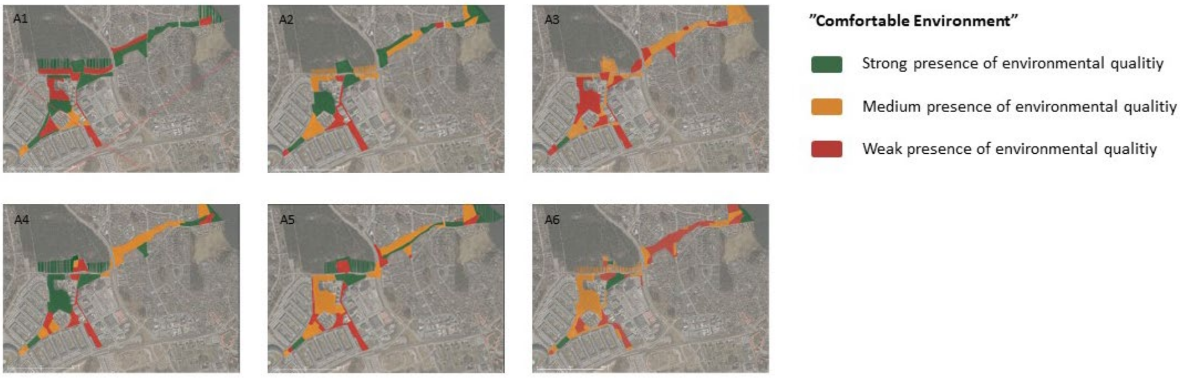

Figure 7. Example of inventory of six environmental qualities of a "Comfortable Environment" (A1-A6). The presence of each quality evaluated as 'strong', 'medium' or 'weak' over the whole area subject to development.

The qualities of 'Access to nature and surrounding life' (B1-B13, Fig.1) [36, pp. 881, Table 1 "Section B"], were perceived as more straightforward to identify. Here the inventory focus was on identifying where in the environment these qualities existed or not (see example in Fig. 8), and then identifying lack of access to these qualities in relation to different user-specific needs in different parts of the area. Again, the applied use of 'Four zones of contact with the outdoors' (Fig. 6) was useful.

Attempts were made to cluster health-promoting environmental qualities into categories that gave specific and targeted health-promoting effects, for instance some combinations of qualities build up restorative environments, other combinations stimulate social interaction and meetings, while others support physical activity. Information in existing GIS-layers was used to identify such clustered categories of environmental qualities. Using such clustered categories of health-promoting environmental qualities was found both to simplify the landscape analysis and to clarify the connection between health-promoting environmental qualities and health-promoting design interventions. From a pedagogic perspective it also eased internal dialogue processes between officials and politicians by providing a clearer explanation of how the suggested design interventions could contribute to meet public goals for health and well-being.

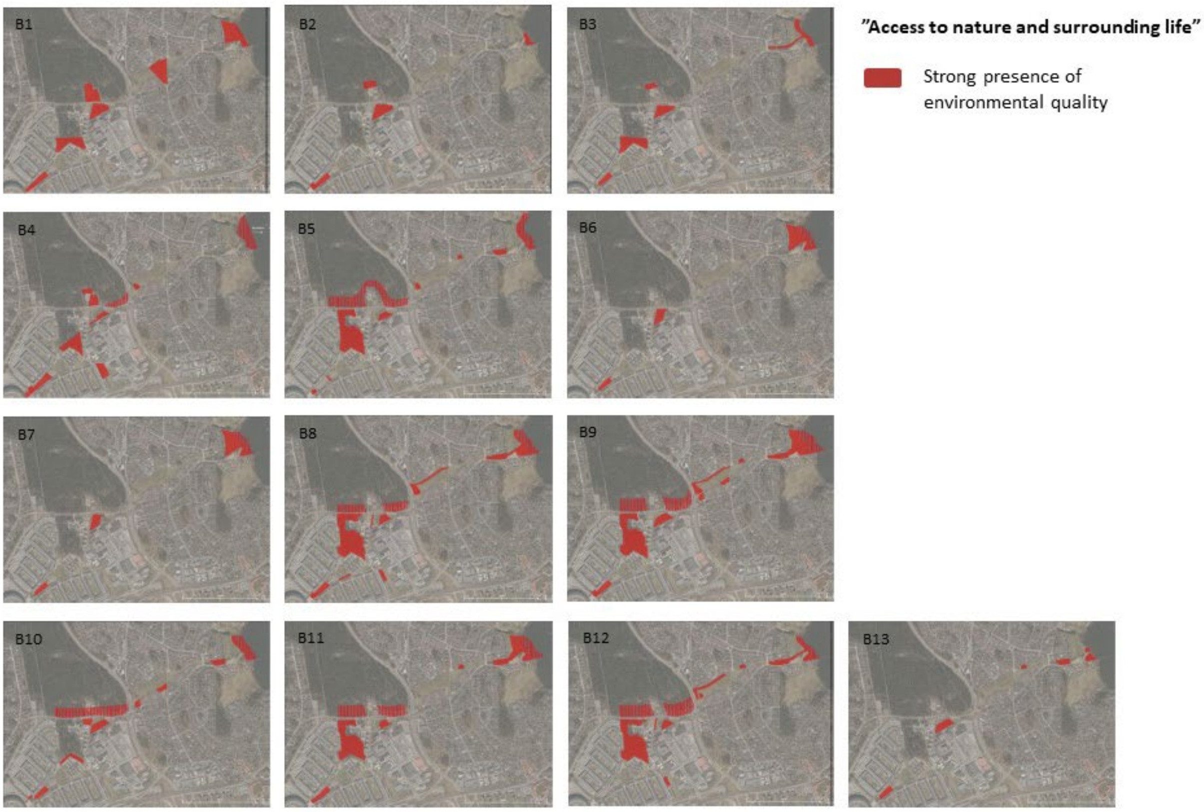

Figure 8. Example of inventory of 13 environmental qualities of "Access to nature and surrounding life" (B1-B13). For each quality, places with existing strong qualities are identified in the development area.

Discussion

Transforming research evidence into practical design solutions is not a straightforward process, and as put forward by Krizek et al. [22], to learn how research evidence can be included and used in planning processes, there is need for empirical research. Using a two-step design, the first part of the case study made it possible to identify what aspects were most important to focus on in the second part, both from a practitioner and a researcher perspective [20]. The co-production and prestige-less sharing of knowledge between researchers and landscape architects in this study has helped to increase practical understanding of how research can be translated into practical knowledge in urban design processes.

Application and use of the QET in urban planning

The results highlight a need to continue developing existing tools and methods to make them more effective and easy for landscape architects to use, and a further need to determine which environmental aspects are most relevant and important for the specific application and use in urban planning.

Environmental qualities in the QET

Overall, the practitioners requested more practical guidance on how to apply the QET [36], in urban planning contexts. For instance, important aspects of the environmental qualities need to be exemplified in relation to different user perspectives, and there is a need to show how environmental qualities relate to urban contexts, e.g., by clarifying the aspects or parameters of each quality.

As the result from inventories of environmental qualities of QET shows (see example Fig. 7 and 8), there is a difference both in aim and inventory method used, between the inventory of the six qualities of "Comfortable Environment" (A1-A6) and the thirteen qualities of "Access to nature and surrounding life" (B1-B13) [36, pp. 881, Table 1].

The qualities of 'Comfortable Environment' relates both to physical and mental obstacles and solutions in the environment that may hinder or enable users as they try to access and use the place and thereby benefit from any health-promoting qualities in the environment. Therefore, these qualities need to be evaluated over the whole area, using both a generalised perspective and paying attention to aspects that are important for fragile user groups.

The qualities of 'Access to nature and surrounding life' are qualities that together provide a broad variety of health-promoting activities and experiences on a scale related to a gradient of challenge. Different qualities, and combinations of qualities, give experiences that promote health and well-being for different users. The landscape analysis of these qualities focuses on identifying where these qualities exist strongly today, since they represent health-promoting assets to safeguard in the future development of the area. The analysis provides an overall picture of the distribution of these qualities over the area and also shows a lack of access to certain qualities that needs to be addressed in the development programme to guide future design of the area.

Four zones of contact

The study found that when applying 'Four zones of contact' in urban planning of public spaces the model needs to be used with a reversed perspective, approaching the built environment from zone 4. By locating focal points important to (locally) prioritised user groups and public service functions for specific user groups and identifying to what extent the surrounding built environment has access to their own zone 3 areas or not (as example in Fig 6), the landscape architects are provided with important information to guide design choices in the design process.

Using the QET to guide an evidence-based design approach in urban planning

Since aspects of the qualities in the QET could have different meaning and/or importance for different user groups, the person doing the analysis and interpreting the result for a design intervention is required to have good knowledge about different user group's special needs in regard to the outdoor environment. As put forward by Krizek et al. [22] it is relevant to discuss whether the concept of an evidence-based design can be applied at all in the context of urban planning. In the development process in the municipality landscape architects perform steps 1 and 2 in the QET design process, and from that form a programme to guide consultants that are contracted to transform the programme into a design proposal, a design proposal which will then be built by a (another) contracted entrepreneur. Such a process, with many actors involved in different and often totally separated steps, poses a challenge to an evidence-based design process, with a risk that important information may be lost or misinterpreted in the process.

A research-informed design is sometimes argued to be a more relevant concept to use instead of an evidence-based design. However, when comparing these concepts, as expressed by Peavey and Vander Wyst [38], it is relevant to reflect on the difference in ambition that lies within the definition of these two concepts. A research-informed design is based on "a narrow slice of information (research) that is being broadly applied (informed)" [38] implying a weaker base of scientific knowledge available to aid design decisions, while evidence-based design is based on "a broad base of information types (evidence) that are narrowly applied (based)". If we truly seek to create public outdoor environments that aim to support and promote health and well-being for all city dwellers, urban design interventions need to be motivated by the broadest scientific research findings possible and should be applied to serve both a general public, but should also be capable of being narrowed down to meet the unique needs of specific user groups.

Linking the parameters that make up the qualities of the QET to existing GIS data and clustering them into categories more directly corresponding to public health goals, as attempted in case study part 2, could be a way to simplify applied use of the QET in urban planning and design processes. Identifying such parameters (attributes that build up each environmental quality in the QET) and clustering them into categories to meet generalised public health goals, could aid the process of making inventories of health-promoting environmental qualities available in GIS data, enabling urban planners to plan for the distribution of health-promoting environmental qualities on a larger urban scale.

The landscape architects found that aspects such as land use, size and localisation of green spaces, that were defined in earlier planning phases, could limit the possibilities for health promoting design interventions. Thus, there is a need for future research to scale up from a detailed design to higher planning levels and identify what parameters in earlier planning phases need to be considered, on different levels, to enable the creation of health-promoting qualities.

Evidence-based design sometimes receives criticism for restricting creative freedom [22]. Interestingly, the landscape architects gave feedback that they found the discussions they had when using the QET to identify environmental qualities (step 1) and relate them to user-specific needs (step 2) actually inspired design solutions (step 3) and did not rigidly steer the design process.

To elaborate on the actual outcome of the planned design intervention, there is a need to follow up and evaluate the effects of built design interventions in the long term. This has the implication for a fourth step to be added to the QET design process, using for instance post occupancy evaluations, to allow study of the assumed positive outcomes.

Reflections on using Participatory Action Research methodology

Being involved in collaborative activities using PAR [33, 28] reveals aspects of practical usability and limitations of using the QET in this context. The traditional research role fosters objectiveness and ethical codes that stress the importance of not affecting your results. However, such an approach may not always be the most appropriate. As this study illuminates, translating research into practice requires teamwork between researchers and practitioners, where sharing of knowledge is key to mutual progress. For example, when researchers and practitioners evaluated the results and process together, some contextual aspects that need to be balanced against research knowledge in evidence-based design decisions were identified. Local residents' subjective views and practical management issues related to organisational issues or local political priories in the municipality are examples of such contextual aspects.

Confirming previous recommendations to bridge the research-practice gap [20], the results show the value that close collaboration between researchers and practitioners can bring to both parties, exemplifying how aspects of importance to the design process can be identified along with questions in need of further research. It was evident from the results that both the researchers' and the practitioners' perspectives are equally important in the process of applying evidence-based tools and methods in urban planning.

Conclusion and future research

Applying research evidence on nature's health-promoting qualities does not by default mean that you create an environment that promotes health for its users. Local knowledge is needed to identify important local user perspectives. Further, local political undertakings steer local priorities and organisational and management aspects may also affect development and design processes. Combining both research and practitioner perspectives aids understanding of how research can be practically applied in urban planning.

Using the QET to investigate health-promoting environmental qualities can guide urban landscape design processes and give landscape architects a greater sense of the meaningfulness of their work. However, more easily applied guidelines and contextualised descriptions are demanded. The results from this study focus on the application and use of the first two steps of the QET process (Fig. 1) from which landscape architects devise programmes to guide consultants and entrepreneurs in the urban development process. An important next step in future research would be to investigate how an evidence-based design process can aid consultants and entrepreneurs in the process of translating such development programmes (intended to be based on research evidence) into realised evidence-based design interventions.

The study also recognised a need to identify what aspects of earlier planning phases may affect the design possibilities of health-promoting environmental qualities, and a further need to investigate and provide practical guidance on different user needs that are important to consider in a public urban context.

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TALKING TO PRACTICE: EXPLORING CHALLENGES FOR PRACTITIONERS WHEN PLANNING FOR WALKING

Marianne Knapskog [(1)*], **Maja Karoline Rynning** [(1)]

[(1)] Institute of Transport Economics, Norway

* Corresponding author e-mail: mkn@toi.no

Abstract

Objective – To develop adequate knowledge and tools for practice, we need insight into how practitioners work and what their needs are. Here, we sought to explore the different ways in which practitioners' map and evaluate walking and walkability, as well as how they approach walking, in urban design projects.

Background – City planning for liveable and healthy cities that promotes walking requires sound evidence-based knowledge, empirical data, and adequate tools. For academic knowledge to be employed by practice, it is important that it meets practitioners' needs. Hence, we interviewed three experienced Nordic practitioners, working in government and private practice, who in different ways are experts on walking.

Research question – What tools and methods do practitioners use when planning and designing for walking? What kind of data do they employ? What do they point to as knowledge needs?

Methods – We used qualitative semi-structured interviews to gather the experiences of practitioners who have been 'early adapters' when working with walking and walkability.

Results – The practitioners' stories vary according to their different work situations and experience. Yet, there are many similar traits. Counting and observation are central to understanding how people walk in and use a place. The practitioners tend to adapt their approach according to a project's context and size, using a combination of walking-data depending on available sources. The practitioners all underline a significant lack of sound quantitative data on walking; pedestrians are generally not counted and observed enough. Which, in addition to a lack in data sharing, hinders building empirical knowledge on walking. This also call for more focus on and priority of pedestrians in city planning and development.

Conclusion – Our observations align with findings from previous urban design-research regarding the need for a more systematic approach on how to collect data on walking, and how to assess the walkability of public space. Yet more explorations are needed for a broader picture of current challenges. It is important that knowledge and tools are accessible and useable for practice, moreover, that methods can be adapted to context regarding scale and place. To ensure this collaboration between research and practice is crucial, for example through explorations such as those presented here. To this end, we will continue to our conversations and collaborations with practice.

Keywords: *walkability | evidence-based methods| urban design |planning practice*

Background

Walking and walkability has become an important part of the urban agenda [1-8]. It has been firmly established that walking is important for improving public health and for achieving sustainability goals, locally and globally. Consequently, cities worldwide are working to increase walking shares. Walkability describes to what extent surroundings promote and invite to walking [1, 7, 9]. To stimulate more walking, it is important to ensure that public spaces, and cities as a whole, are designed with a high level of walkability. We have previously explored the topic of walking and urban built environments, see for example [9-12]. One finding is that despite an abundance of literature, many knowledge gaps remain, on several geographical scales, which hinder research in informing and guiding practice. Another finding is that there is a lack of evidence-based tools and methods for mapping and evaluating walkability at the neighbourhood scale. Several design or community-led projects have addressed different ways of mapping neighbourhoods [13-16]. However, they have various shortcomings that must be addressed. As an example, previous research has shown the importance of collaboration between research and practice in developing knowledge and tools for city planning and development [12, 17, 18]. It is important that the knowledge, methods, and tools developed by research respond to the actual needs and requirements of practice to ensure their relevance and usability in projects [19-21]. As a step to enhance our understanding of the needs and preferences of practice, we decided to interview three acknowledged practitioners[1] with expertise within designing and planning for walking[2]. The aim was to explore the ways in which these practitioners map and evaluate walking and walkability in their practice, which tools and methods, as well as data, they employ, and what these practitioners point to as central knowledge needs. In the following, we first give a description of the three interviews separately. Then, we explore the findings from the interviews considering findings from previous research. Finally, we conclude on some important lessons for further research and works on walking and walkability to strengthen today's practice.

Methods

The interviews were undertaken as semi-structured conversations with a predefined interview guide that was slightly adapted for each interview considering the differences in background and current practice of the interviewees. However, the main topics, methods and data were always approached. Using semi-structured interviews to engage practitioners in talking about their work, methods and experience is a frequent approach within research on design and planning practice, see for example [17, 21-23]. It is particularly fitted to gain insight into the tacit or silent nature of practitioners' experience-based knowledge, which is often undocumented [18, 24-26]. With a small sample, our aim was not to generalise but to gather new insights from experienced practitioners to help further research efforts. The three practitioners were chosen based on their experience with planning and designing for walking, and because they work in a Nordic setting. We chose one from a large architecture practice that has published user guides, teaches, and been part of many projects on public spaces (Gehl Architects); one from a smaller firm that has explored new approaches to urban design (Léva Urban Design) and, a planner working in a municipality with strategic planning and mobility (Municipality of Lahti). All three of them have experiences as early adapters of working with walkability that can be relevant for developing methods further, adding new dimensions to research on walkability.

Results

In this section our aim is to show the experiences of the urban designers told as a story from practice [17]. The stories have been shortened, and centre around data collection and the use of tools when planning and designing for walking.

The architect from Gehl Architects in Denmark emphasises the importance of walking as part of everyday life. Walking is often linked to efforts to improve public health, but the effects of increased walking shares on public health is often difficult to document as the latter is influenced by a wide range of factors. In comparison, cycling is often measured in terms of money saved (for example by not driving). Moreover, there are many advocates for cycling but fewer for walking. Walking is, however, fundamentally interesting for practitioners as "everybody walks", even when they drive (to get to and from the car). In a project, Gehl Architects strives to see things from the perspective of the end user while retaining their expert view. They have developed their own methodology for mapping and evaluating walking and walkability in public space, which emphasises observing and counting dynamic and static uses of public space, pedestrian flows, length and purpose of activities, and so forth [27-29]. Gehl, both as a professional and as part of an architectural firm, has developed much knowledge on walking and public space, collected stories of best practice, and carried out numerous walking-mappings around the world. The method Gehl Architects applies is flexible but requires empirical data, generally collected by the architects and hired help. In a project, everything is context-dependent, and so they try to understand how a place 'works' (where do people move, stay, do not go, how is it used and the like). The practitioner will not have the local knowledge of the inhabitant. Which tools the architects at Gehl apply depends on the purpose of a project. In addition to existing data (when available), observation and interviews are the most important methods for measuring, mapping, and evaluating public space and walkability. It is important to find the right places for counting and observing, which is often combined with photo documentation for before and after studies. For walking, existing data is frequently lacking; cars are still, generally, counted more often than pedestrians. It is important to make people and human activity (in public space) visible through mapping. This makes sense everywhere, and is particularly important for political decisions, and for prioritizing projects that promotes walking. Gehl Architects uses GIS to some extent, if enough data is available from the client.

The environmental psychologist from Léva Urban Design in Norway explains how mapping walking in a project is part of addressing how a place is used, for instance where do people walk or not walk. Léva adjusts their methods according to the project and the budget, but always strives to combine social and physical aspects. Walking is often included as a small but integral part of a larger place-based analysis for larger zoning plans or projects on a neighbourhood level. Although there is rarely a direct transferability from one project to another, they usually look back on previous projects when starting a new one. It is furthermore important to focus on the user, and to include local knowledge in the analysis of a place, which the consultant will often lack. Léva generally use a framework based on Alfonzo's hierarchy of walking needs [30], which connects walking to feasibility, accessibility, safety, comfort and pleasurability. According to the environmental psychologist, Alfonzo's hierarchy provides a good representation of walking as part of everyday life. The framework is often combined with an approach that maps various qualities of streets, in addition to counting pedestrians or using mapping apps. There are several challenges, however, linked to

[1] Practitioners in this context comprises urban designers and planners working in public service or private practice, the terms are not differentiated between.

[2] The research has been funded by the Norwegian branch of Nordisk vegforum (NVF)

the transferability of methods and tools from a North American setting to a Norwegian (or Nordic) one. North American concepts such as ‘plaza’ or ‘backyards’ are, for example, difficult to translate. However, as few urban planners and designers work like this in Norway today, Léva – at least for now – uses North American tools. Participation is also an important part of Léva’s work, and they often triangulate mapping with qualitative methods like ‘walk along’. Léva Design would like to use more GIS-based tools and have done some tests with participatory mapping in recent projects. In projects, Léva frequently uses data from apps like Strava. They also use data from travel surveys and similar collected by others if possible. All of the above depends on the time and resources allocated to such work. In their experience, there is often an unbalance between how much time and resources are allocated to car traffic compared to walking; the former is generally prioritised. Walking is, moreover, often combined with cycling despite significant differences in needs and behaviours. The environmental psychologist calls for a more systemic approach to data collection on walking, preferably with a national registration form and database for quantitative data for practitioners to gather their data. This could help strengthen knowledge building on walking and urban design.

The interviewee from the Municipality of Lahti[3] in Finland is one of the chief urban planners of the city with a background, in part, from urban design and architecture. When talking about methods and tools, the urban planner focused on their experiences from revising the master plan (to be finished in 2020). For this work the municipality have combined mobility planning through the Sustainable Urban Mobility Plan (SUMP)[4] with physical planning via the Municipal Master Plan. The aim of the SUMP in Lahti is to reach a modal share of 50/50 between cars and sustainable modes. Integrating the two types of plans has led to a larger focus on mobility, including walking and walkability. Working on the current as well as the future municipality master plan requires much counting, but also qualitative analysis of the city development. Lahti has completed several mappings and counting of children’s movements since 2014. As an example, the municipality maps distances to schools, and has a buffer of one kilometre for walking to school to first and second grade and three kilometres buffer for larger children. Another objective is that people should live within 300 meters from a green space.[5] Currently, 90 percent of the population of Lahti lives within this distance. To follow these goals, the urban planner sees a need for new methods and routines for collecting data, including modal split. National travel surveys are, for example, undertaken every six to eight years, but should be complemented with more frequent local surveys. As an effort to improve their knowledgebase, Lahti is exploring methods to map and evaluate walking and walkability in collaboration with universities. This includes public participation GIS (PPGIS), which uses online tools for mapping by citizens. The next step here is to render the collected data publicly available for everyone who would like to use them. Finally, the urban planner underlines the importance of a constructive, ongoing dialogue with citizens, and to have conversations on all planning levels about the kind of city one wants and how to get there. As a planner one does not have the local knowledge about how it is to live in the area.

Discussion

There are many works on walking and walkability, as well as on the use of knowledge and tools by urban design practice (see for example [19-21]). The findings from the interviews largely align with previous research. There is less knowledge on how practitioners map and evaluate walking and walkability in their work, nor on the kind of data and knowledge practice needs. The interviews offer further insights, as well as new understandings of previous findings. Several issues stand out as important for further elaboration to improve knowledge production on planning and designing for walking. In the following paragraphs we reflect on three key aspects.

Methods must be easily available, simple to use, and adaptable to context

From the interviews we see how the practitioners often combine several methods to map walking and walkability. These span from Space Syntax, GIS and softGIS to more traditional fieldwork, often combining qualitative and quantitative methods. This is seemingly due to a lack of methods and tools that are capable of combing the different perspectives deemed necessary by the practitioners to adequately analyse how a public space ‘works’ – including walking and walkability. Counting and observation of people in public spaces, and how to best do so in different contexts, is a recurring theme. The interviewees underline the importance of being in the field to observe and experience a place in person to be able to properly address walking and walkability in a project; local context is put forward as highly important. Hence, the configuration of methods often varies depending on scale and place. Although certain topics and issues might be the same from one project to another, local variation and place specific challenges must be taken into consideration. It is also important to consider the user perspective and the local knowledge they have, but one must be aware of the multitude of opinions and interest different users might have. The significance

[3] Lathi is a municipality and a city in Finland with around 100.000 inhabitants. The city is on the same latitude as Bergen in Norway and is located inland from the coast. It is known for its winter sports. The municipality are participating in a research project with the University of Helsinki and Aalto University called Urban Aesthetics in Motion (UrAMo), that looks at the esthetical experiences and how to improve the walkability and bikeability

[4] Sustainable Urban Mobility Plans (SUMP) is legislation from the European Union (2013) that should to be integrated into the different member states legislation. In Finland the municipalities must implement these in the future strategic planning.

[5] The distance here was set by the Finnish Environmental Institute as one of several indicators of ‘wellbeing’.

given to the initial site-analysis to understand a site's functioning and needs – physical and non-physical – aligns with previous research[12]. Rynning [12] furthermore found that mobility is a central part of these kinds of analyses; establishing knowledge on how inhabitants in an area move around at different times of a day can, for example, provide valuable information on how a space is used and experienced. This resonates with our observations. The interviewees similarly highlighted the importance of exploring different kind of uses of public space to assess walking and walkability – and vice versa.

A larger firm like Gehl Architects often have their own approaches and selection of methods that they use. Many smaller private practices, however, like Léva Urban Design, depend on methodological approaches developed by others. Several current methods stem from a North American context, which is not always applicable to the Nordic context. We found similar challenges when reviewing the literature and existing tools for walking and walkability [9]. The need for context-based interpretation and adaptation can significantly influence the quality and robustness of a method, and in the longer run weaken its reliability and validity. Moreover, methods that are not relevant for the challenges and needs of a specific local context can result in problematising issues that are not important, in turn leading to the wrong decisions being made based on a weak (or wrong) knowledge basis. At the same time, developing specific methods or tool for 'every' urban context is unlikely. Rather, approaches and methods to map and evaluate walking and walkability ought to have a high capacity for adaptation to the context in question. Another important aspect, based on earlier research, is that tools intended for practice must be simple and easily accessible, quick and easy to use, relatively cheap (or free) to use, and not too technical [20]. This is furthermore important to ensure relevance for smaller firms and can – in a longer run – strengthen their competence as well as their competitiveness. Combining current physical planning and place-based analyses with softGIS can be an interesting approach to add a broader perceptive. SoftGIS can, for example, strengthen the user perspective to spatial analysis through participatory mapping. Finland has explored this from both a research and practice perspective with interesting results, as the example from Lahti shows. Other Nordic countries could likely benefit from their experiences if shared through the right channels. This could increase the integration of land use and transport planning at the strategic municipal master plan level as well as in place-based analyses on project level.

Data sources depends on availability

In addition to their own mapping, the interviewees employ data and information from publicly accessible sources or their contracting entity. As with methods, the kind of data they use depends on the context, but also on the project's scope, aim, and budget. The interviewees underline a fundamental lack of data on walking and walkability; this applies especially to the counting of pedestrians. Another problem is that if registrations are done, they are often not publicly available. Consequently, the urban designers depend on open access sources that provide limited data like Strava[6] or other apps that map activity in order to get a picture of who walks where. This is problematic for several reasons, for example the reliability of such data. The use of inadequate data can, as for inadequate methods, lead to the wrong decisions and priorities being made when planning and designing for walkability. According to the interviewees, another frequent approach is to count and observe pedestrians, but in their experience, this is rapidly limited by available time and budget. These aspects are some of the reasons why the practitioner from Léva Design called for a more systematic registration and sharing of data. Building a larger database could potentially strengthen knowledge on walking in various contexts. However, an important point for further discussions then is how to ensure the reliability and validity of such data.

The three interviewees all value the perspective and place-based knowledge of inhabitants and other users as an important supplement to the practitioners, as the former often have more detailed insight in how a place functions or is used. This is generally maintained by interviews or other forms of participation, which again demands much time and resources in a project. Mapping done by citizens is less common, apart from mapping done by children[7], which is sometimes used in Nordic settings. A possible approach is to use softGIS, for which Finland seems to be at the forefront among the Nordic countries [31, 32]. There are likely several reasons for the lack of use of softGIS (or GIS) among the interviewees, for example the often observed 'gap' between those who make the tools and the intended users (here practitioners). Previous research has uncovered that planners often think GIS-tools (and similar) are too technical, too expensive, too detailed or not contextual enough [33]. Moreover, they are often not seen as useful from the urban designer's perspective [20]. However, the interesting results so far, either it be as softGIS or other forms of participatory mapping, leads us to think this should be further explored for urban design practice. It could be particularly interesting to use inhabitants as data collectors as this is highly time consuming and expensive for cities and projects.

[6] Strava is an app where you can register your movements especially made for athletes
[7] Barnetråkk (Kids' Tracks), see https://www.barnetrakk.no/en/ (visited 17.03.2019)

Walking must be made more visible in city planning and development – for practice as well as for research

In general, the impression among the interviewees is that walking continues to be quite invisible in planning compared to cycling, public transport, and especially car use. The interviewees underlined that walking is part of every trip, but also that how this might influence, for example, travel choices seem to be underexplored. Their perspectives resonates with conclusions by for example Rynning [12] who found that there is a strong but under-exploited and perhaps overlooked potential for promoting walking (as well as cycling and public transport) through urban planning and designing project. Making it an active design objective from the early stages of a project could significantly contribute to unlock this potential. Moreover, that there is a strong need for more knowledge and insight on the relationship between walking levels and urban planning and design. The research agenda has for a long time focused on car use and how to limit this, and this primarily at the city scale. Consequently, there is a lack of knowledge – evidence- and experience-based – on city planning and development for walking and walkability. There is a growing focus on walking, with demands for cities to make walking strategies, specific criteria set for integrated land use and transport, and more. However, these efforts must be intensified in order to reach local and global objectives of more walkable cities and environments. An interesting approach could be to follow the example of Finland who employs the European rules for SUMP's, stating that these must be made on municipal level. This has enabled the joining of mobility planning and master planning a seen in Lahti where, for the first time, the revision of the land use element of the municipal master plan has been combined with the effort of making a SUMP. This has led to a larger focus on mobility on the strategic level, and to a set of indicators measuring the effect of the strategic planning in tune with the SUMP rules and making walking more visible. Whether using SUMPs or similar, cities must find ways to give heightened attention to and priority to ensuring walkability of public spaces.

Conclusion

Walkability is important for developing climate friendly and attractive cities, as walking is an important aspect of the liveable and healthy city. The interviewed practitioners emphasised the importance of increasing the focus upon walking in planning and designing to ensure a walking-friendly and -promoting urban development. Moreover, a need to enhance awareness and knowledge about walking and walkability and why these are important parts of a city. Quite a lot has been written about walkability, but more is needed. Knowledge gaps remain within the scientific literature, and there is a lack of adequate tools and methods for practice. Through our explorations we found that practitioners use a wide range of methods and data depending on previous experiences, availability, time, and budget. Moreover, that adaptation of methods and approaches to local context is crucial. Based on this, and previous findings, we believe that in order to be used in planning and the urban design process, methods and tools must be easily available, simple to use, and adaptable to the context. Moreover, that they must be developed, tested, and frequently improved in close collaboration with practice. We also see the need for more research on walking and walkability to strengthen such processes. Designing for walkability necessities reliable walking data, and thus continuous data collection – and sharing. Here too, there are significant lacks that must be addressed by research. Developing sound approaches for a more participatory mapping and data production might be a promising approach to address these issues.

Finally, we asked the urban designers about knowledge needs. These can be summed up as i) the need for a better understanding of walking and walking patterns, ii) the need for better tools and evaluations of walking and walkability to inform future practice, iii) the need for better data (see Figure 1).

Knowledge gaps and needs for future research according to the interviewees	
Knowledge on walking and pedestrians	Improved understanding of pedestrians and walking patterns, especially in a Nordic context including: - Where pedestrians walk or do not walk - When and why they choose to walk - How many walks - What advocates walking as a mode How to prioritise and make visible walking
Tools and methods	Tools and methods should include: - How to count walking and walkability - Before studies - Measure the effect of actions to improve walkability ex-post (after studies) When possible use open platforms to be enable collection surveys and registered data to be shared for common use
Future data needs	Increased and more frequent mapping and counting Standardising of mapping Sharing data platform in open access solution

Figure 1. Future knowledge needs

Our observations align with previous findings regarding the need for a more systematic approach on how to collect data on walking, and how to assess the walkability of public space. This is important to for a better understanding on how to plan and design walking-friendly and -promoting cities. Developing knowledge and tools must be continued, for practice but also for research. It is important that knowledge and tools are accessible and useable for practice; likewise, that methods can be adapted to context regarding scale and place. To ensure this collaboration between research and practice is important, for example through explorations such as presented here. To this end, we will continue to our conversations and collaborations with practice.

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UNIVERSAL DESIGN OF PUBLIC TRANSPORT SYSTEMS FOR PEOPLE WITH MENTAL HEALTH IMPAIRMENTS

Anja Fleten Nielsen*

Institute of Transport Economics, Norway

* Corresponding author e-mail: anja.fleten.nielsen@toi.no

Abstract

Objective – In this project we have examined what barriers people with mental impairments have in relation to travel, what can be done to make it easier for them to travel, and if today's understanding of universal design includes people with mental impairments.

Background – People with mental health impairments travel less often than the rest of the population. Lack of access to public transport leads to social isolation and worsening of symptoms, while high access to public transport is important for recovery. As such, how can we plan to increase mobility for people with mental health impairments? The field of universal design has done a considerable amount with regards to public transit for people with physical impairments, but more knowledge is needed about how people with mental impairments experience public transport.

Research question – What barriers do people with mental health impairments meet along the transport chain? What practical solutions can be used to get more people with mental health impairments to use public transport? Do today's understandings of universal design include people with mental challenges?

Methods – Nine semi-structured qualitative interviews were carried out with people with different types of mental impairments (depression, anxiety, Asperger's and bipolar disorder). Informants included both genders and a range of age groups and came from both urban and rural areas of Norway.

Results – Today's understanding of universal design—as seen in public documents, policies, research and support from the government—largely includes people with physical rather than mental health impairments. The main barriers identified for people with mental impairments included crowded spaces, lack of information, availability/frequency, waiting time—especially in relation to journeys including several different modes of transport, economic barriers and lack of understanding from staff. The train was considered superior to other public transport modes by most of the informants. The ability to travel by car is essential to the wellbeing of several informants.

Conclusion – We found several physical design measures that can improve travel for people with mental health impairments, including sitting area design, transport mode design and design of information systems. Other measures that can improve travel experiences for people with mental impairments were also identified, including economic support, training of staff and higher frequency of departure. We should therefore broaden our understanding of universal design, and not look exclusively at physical design without considering other factors that also play a role in actual usage.

Keywords: *Universal design | mental health | public transport*

Background

People with mental health impairments travel less often than the rest of the population [1]. Lack of access to public transport can lead to social isolation and worsening of symptoms. 83 % of respondents with mental impairments in a quantitative (n = 203) UK study said that access to public transport was 'very important' to their mental health [2]. As universal design at a macro level is not just an approach to developing technical solutions but is, rather, a form of ethics [3]. There is a need to extend our conception of universal design and evaluate the types of barriers people with mental impairments meet in transport systems. The literature on the travel experiences and behaviours of individuals with mental impairments is limited [4, 5]. Research, practical solutions and theoretic approaches concerning universal design have mainly focused on people with somatic impairments. Planners, designers and others working with public transport infrastructure have limited knowledge about mental health impairments [4]. Efforts to reduce barriers for people with impaired vision and physical illness often consist of technical solutions—for example, ramps—but these might not be as helpful for people with mental impairments.

The quantitative UK study mentioned above found a considerable number of barriers connected to participants use of public transport that were not directly linked to technical solutions [2]. These included cost, lack of understanding from service personnel, crowded buses/trains, lack of access to public transport in rural areas, lack of reliability and information about cancellations or delays, and stigma/discrimination. Penfold et al.'s (2008) qualitative study—also conducted in the UK—included interviews with people with mental health issues and their problems linked to transport and mobility [6]. All participants used either public transport or walking as their main mode of transport. The researchers found that self-confidence was a key factor in the participants' experience of the transport system, and they also identified three factors that were important with regards to participants' use of public transport. First, the ability to both plan the trip and potentially incorporate it into a routine was important—planning was especially important with regards to new routes, longer trips or travel requiring connections. Second, safety and control were important factors with regards to participants' ability to travel; this included mode of transport, traveling with a companion, attitudes of service personnel, and the ability to avoid rush hour traffic. Several participants felt that having an invisible impairment made it more difficult to get assistance. Finally, affordability and financial concerns played a large part in determining participants' mobility—this was related to the use of taxis, in particular, but also included participants' inability to drive their own cars.

Due to the extremely sparse number of studies done on mental health in relation to universal design, there is still a knowledge gap on how people with mental impairments travel and barriers related to use of public transport. Geographical context is very important when it comes to barriers related to transport, as transport systems differ greatly between countries. This is the first study not done in the UK that we are aware of. This study also includes people using car as their main mode of transport – which gives a slightly different perspective. This study also fills the knowledge gap on what measures that can be done to improve the public transportation system, as we asked the informants directly about this.

Methodology and research questions

The general public reports following problems in regard to public transport: low frequency, long travel time and journeys with many connections between modes of transport [7]. What barriers do people with mental health impairments meet along the public transport chain? What practical solutions can be used to get more people with mental health impairments to use public transport? Do today's understandings of universal design include people with mental challenges? To answer these questions, we have chosen to use a qualitative approach for several reasons. A qualitative approach is well-suited for research on topics that are underexplored, where flexibility and openness is required. This approach is especially suited both to the study of personal and sensitive subjects, and of vulnerable groups [8]. To answer our research questions, we conducted nine semi-structured interviews with individuals who had different psychological impairments: specifically, anxiety, depression, bipolar disorder and Asperger's. Our informants were recruited through local and national organizations for people with mental impairments.

Our aim was to have a variety of informants, since type of disease and severity can affect what kinds of barriers are experienced and what kinds of practical solutions can improve public transport for these individuals. The informants were from across Norway, around half of them living in cities. The youngest informant was 25 years old, and the oldest was above retirement age. The sample included more females than males, and most of them were unemployed - although some volunteered in different types of mental health organizations. Having people with different types of mental impairments could be a limitation, as it could be more difficult draw conclusions on types of barriers and practical solutions since different diagnosis might have very different types of problems. However, since this was an explorative study to find out if people with mental impairments are included in today's understanding of universal design, our goal was to get a variety of barriers. In retrospect, we found that barriers were similar across the different types of mental impairments, which is also an interesting finding.

We conducted semi-structured interviews over phone and did a thematic analysis of the answers. The themes were daily travel behaviour, main issues when traveling, coping strategies, how they perceived different parts of the journey and different modes of transport – including non-public transport. Finally, we asked for suggestions for improvement of the public transport system. We have not examined differences between diagnosis, social context, geographical location, gender etc.

Results

Do todays understanding of universal design include people with mental impairments?

The theoretical framework on universal design is equally suited for mental and physical impairments. This study is based on a relational approach where the interactions between the individual, social and material is in focus [3]. In this view, the impairment is something that can arise in confrontation with the transport system, even though one might function well in other situations. Therefore, it is possible to design the environment in such a way that people with impairments can increase their quality of life. As we will see there is a lot of practical solutions to physical, social, organizational and economic environment that can increase wellbeing when traveling with a mental impairment.

We carried out a literature study to determine the extent of existing research on mental health and universal design and to answer the question as to whether today's understanding of universal design includes people with mental challenges[1]. Research on mental health in relation to universal design and transport is very limited; we found 55 studies[2], of which only 2 were relevant for our purpose [2, 6]. We also conducted a review of Norwegian public documents used as guidelines for universal design in transport and construction [9, 10]. These guidelines mainly focus on people with physical or visual disabilities. Financial politics also reflects the difference in "status" between mental and physical illness, where only 5 countries in Europe use more than 10 % of their health budget on mental illness [11], even though between 30-50 % of the adult population will get a mental illness during their lifetime [12, 13].

Barriers when traveling with mental health impairments

People with mental health impairments travel less than others [1]. In this study, informants reported that they travel from once a week to every day. The reasons for their trips are mainly to cover basic human needs: doctor's appointments, grocery shopping, social meetings, volunteer work and workouts. Only one informant is employed. Several informants expressed that they feel ambivalent when deciding between the stress of traveling and meeting their needs, and that they sometimes choose not to make travels due to the extra burden of the journey. For example, as one woman said, 'If I'm going somewhere and I must take the bus, I feel I use all my energy for the journey. When I have arrived, I have no energy left... as it is now, I only do things I have to'. Even though the informants experienced considerable anxiety when traveling, they all stated that having the opportunity to travel was very important for their mental health and for not feeling isolated.

We identified six types of barriers that our study informants encountered while traveling. The first barrier—one mentioned by all of them—involved crowded spaces and (dis)comfort. To avoid traveling in crowded situations, many of the informants chose to travel outside of peak hours. The two primary concerns here concerned finding it stressful to have people physically close to them, and not being able to find a place to sit. The lack of available seating was a problem in the actual transport vehicle (i.e., bus or tram), but also in the waiting areas. As one informant explained, 'If there is no place to sit down, then I must stand. Then I'm absolute sure I will faint, even though that has never happened'. One of the informants also mentioned that she fears sitting in the 'wrong seat'—for example, the seats reserved for people with physical impairments and the elderly. Many informants wished to sit by themselves, without someone in the seat next to them, and several expressed the need to sit in specific places. Where this specific place is located in the vehicle varies: for instance, one informant said he prefers sitting in the back, so he can have control of everything happening in front of him, while another prefers to sit in the front, so she does not have to see the other passengers. The informants reported that congestion was more of an issue on buses than trains. On the train, people usually do not stand in the aisle, and the seats with armrests make the seating areas seem more spacious; the first-class cars on the train were considered positively regarding physical design.

The second barrier that we identified involved the informants' ability to access reliable information. Real-time systems that state when the bus or train will arrive and how much time is left until an upcoming stop were considered very positively by all informants for whom this was available; those who did not have access to this kind of real-time system expressed the desire to have one in their area. The informants explained that the real-time system helps them feel like they have greater control over the journey and makes it so they do not have to be nervous about when to disembark. This system also enables them to be less dependent on asking others for help, which they explained could be mentally challenging. As one informant told us, 'The system has made it possible for me to use public transport. Without it I would struggle'. When the real-time system does not work as intended, however, it creates significant stress and insecurity. Solutions for special situations, such as a 'bus for train', can also be an extra burden when it comes to accessing information about where to go. A further issue with real-time systems raised by informants is that information that is not on screens can be difficult to find, as it is not standardized; moreover, they described that reading small text on complex information sheets can be very difficult when one is feeling stressed. In these situations, there may not be anyone around to ask for help, which compounds the difficulty.

Availability in terms of both frequency of, and distance to, public transport represents a third barrier. The distance between the informants' homes and transit access points ranged from a five-minute-walk to far enough away that travel by car is the only realistic option. The frequency of public transport for our informants varied from between every 5–10 minutes to twice per day; most had low availability in terms of frequency—with at least one hour between departures—which increased the need for other transport modes if something were to go awry. One informant explained it in the following way: 'I am dependent on a high frequency of public transport. If I'm going to take a bus in the morning and I don't manage to get on it due to anxiety, then my whole day is ruined. Therefore, I need to have a car'.

A fourth barrier with regards to using public transport involves (un)predictability and waiting time. It was important to the informants that the transport vehicles arrive as scheduled, and with no unpredictable stops during the journey.

[1]We used the following words as search terms: transportation, architectural accessibility, environment design, concept formation, phobic disorders, anxiety disorders, universal design, transport, mental, anxiety, mental health, and public transportation. Nineteen databases were searched, including MEDLINE, Embase, PsychInfo, Sociological Abstracts, TRID, RIP, Transportation Sustainability Research Center, SWEMED, regjeringen.no, NORART, and DAAI.
[2]One study was unavailable.

Standing and waiting for the bus or walking a long distance to the station or stop was described as problematic for several of our informants, as this increases the time for them to think about their anxiety, and hence their stress levels increase. Direct routes or trips with minimal connections between different modes of transport also seem to be preferred by the informants. Long journeys with several modes of transport are particularly problematic. As one informant told us: ‘I am not afraid of flying, but it’s a very long process. I am not just taking the plane, I have to take the bus, train, airport bus, wait at the airport and travel on public transport again when I arrive at the other side’. The train was considered more predictable by many of the informants, as it cannot be stuck in traffic jams and its departure times are more exact.

Challenges within the informants’ social environment represent a fifth barrier—these include challenges related to personnel, fellow passengers and travel assistance. All the informants travelled by themselves, for the most part, but wished to have assistance on certain trips. Several of our informants found that personnel working in public transport generally lacked knowledge about how to behave towards people with a mental illness. They were often described as being of no help and a source of stress. One of the informants told us that he felt like the personnel became somewhat aggressive if he did anything wrong with, e.g., the tickets. Another expressed her worry that the driver would have a negative tone in his voice, as this would make her feel more stressed. 1 of 3 drivers report that they do not have enough time to assist passengers [14], which is problematic for people with mental health issues, since they are already feeling insecure about the journey. Loud noises, drunk people or dogs that might seem threatening were also mentioned as problematic, but none of them had experienced stigmatizing behaviour from other passengers. However, an informant with an HC card[3] has had people tell her that she is not allowed to park on the HC parking space—because they cannot see her impairments. The informants also mentioned that, in terms of service and assistance, it was better before everything became automatized. ‘It was better before when you could buy coffee and tickets and go inside. Now it’s just a machine and less human contact. I miss that [in relation to station area for the train]’.

Finally, financial barriers represent another important factor regarding the informants’ use of public transport. Their economic situations affected not just more expensive travel, such as holiday trips, but also trips to volunteer work. The possibility of owning a car to increase personal freedom was also limited by finances for some of the informants, and one of the informants was forced to borrow money from her parents to be able to buy the ‘long period’ bus ticket (which is less expensive in the long run but requires more money up front). While it is possible to get financial aid in the form of a TT card[4], the informants mentioned that it covers only some of the trips the informants would like to take to be able to participate in social life. In addition, several of the informants had never heard about TT cards. In general, the individuals we interviewed had the impression that is was more difficult to get financial aid for mental issues than physical illness, and in fact one of them had had their application for a TT card declined.

Differences between modes of transport

Most of the informants favoured the train over the bus, due to greater predictability, less crowding, higher comfort, rigid structure (as there is no unpredictable stops due to traffic jams etc.) and more seamless travel experience. Flying appeared to be the least-preferred mode of travel, even for the informants who did not have a fear of flying. The airport security screening was considered particularly stressful, due to the focus that is centred on one’s person and the general fear of doing something wrong.

The informants who owned a car stated that this was important for their feelings of freedom; they explained that, without a car, they would sit at home more often. Two of the informants held HC cards, and they both said that before they had been given the cards, they were much more dependent on taxis and asking family and friends to drive them to different places. However, it is not easy to get an HC card for a mental impairment; one of the informants told us that she ‘really had to fight to get it’—in fact, she was the first one in her municipality who obtained an HC card due to a mental health impairment. Having an HC card did not negate all transport-related challenges, however; as the other informant with an HC card explained, she has anxiety regarding parking inside, due to claustrophobia, and she is often very worried that there will be no available parking spaces, which would then force her to return home.

Measures to increase mobility for people with mental health impairments

The measures in this section is based upon the barriers mentioned by the informants and the informant’s own requests for reducing problematic aspects of their travel.

	Barrier	Problem	Practical solution
Physical environment	Crowding	Standing on public transport and not having enough space between passengers	Having enough seating areas and ensuring that some seats are screen from other. First class on trains are mentioned as a good standard for design.

[3]A card that allows parking in spaces reserved for those with impairments, free parking on public parking spaces and extended parking time where there are limitations on parking time

[4]A card that covers a certain amount of taxi travels a year. Only available for people who cannot use public transport on their own

	Barrier	Problem	Practical solution
	Crowding	Seating areas reserved for people with impairments are viewed as areas for the elderly and those with physical impairments only; and only exist in the front of the vehicle	Expand the number of disabled seats, locate seating areas both in the back and front of the bus and provide more information to the public explaining that the seats are also for people with 'invisible' impairments
	Crowding	Not enough seats in the station area/stop	Ensure seating area on all stops / stations
	Information	Lack of information and difficult to find information in new places and between different modes of transport	Realtime systems, standardization of information systems/design, integrated systems between different modes of transport and travel companies
Social environment	Information	Difficulties related to using technology-based information and i.e., buying tickets using technology	Available personnel for assistance
	Social environment	Not enough knowledge about mental impairments among transport personnel.	Include information about mental impairments in first-aid courses and education of drivers.
	Social environment	Difficulties related to asking for help	"Need-for-assistance card" to make it easier to contact personnel and also inform the personnel how to make it easier for the person in need of assistance.
	Social environment	Not being able to travel alone	Available assistance for the whole journey as a potential strategy to help the individual make the same trip by themselves in the future
Organizational environment	Availability	Some areas have very limited access to public transport and makes using a car the only possible alternative	Alternative options of transport for areas with too few passengers to increase the frequency of public transport: making it easier to access HC cards with 'invisible' impairments and increasing the financial support provided via TT cards
	Waiting time	Increased stress related to waiting time between different modes of transport	Increase direct lines and reducing transit time between different modes of transport
Economic environment	Economy	TT-cards does not cover enough trips	Increase financial support on TT-cards
	Economy	Financial support differs between municipalities according to informants	Standardization of financial support (i.e., TT-cards) to reduce 'geographical discrimination'
	Economy	Not being able to participate in volunteer work due to financial situation	Reimbursements for individuals with impairments doing this kind of work
	Information	Several informants do not know what kind of financial help they are entitled to	Need to disseminate information about what types of measures exist to improve the mobility of people with mental health issues

Conclusion

If we compare our results with those of similar studies conducted in the UK [4, 5], we find many similar challenges in Norway. Through our interviews we identified six main barriers for using public transport related to physical, social, organizational and economic environment. Crowding was seen as a major barrier to traveling and many of those whom we interviewed chose to travel outside of peak hours to ensure they would be able to find a seat. Lack of information was presented as another barrier—however, in areas where real-time systems are available, the situation has improved. Our informants living in rural areas pointed to a third barrier: namely, that limited access and frequency makes it difficult to use this public transport. A fourth barrier centred around (un)predictability – delays, waiting time between connected routes, unpredicted stops increase anxiety. Social environment – lack of knowledge among drivers and lack of staff to ask for help was mentioned as a fifth barrier. Finally, and in keeping with Penfold et al.'s (2008) findings, the sixth barrier related to travel concerned the informants' economic situations, as several of them were unemployed, and some had been deemed ineligible for governmental support. It should be noted that, while we did find lack of understanding from personnel to be an issue, stigma from other passengers was not mentioned—this contrasts with findings from the British studies. However, one informant, who has an HC card allowing her to park in spaces reserved for those with impairments, reported being told by some people that she is not disabled and should not park in those spaces.

Even though a lot of the barriers reported from people with mental impairments can also be found to be important for the general population: crowding, need for information, high frequency etc. The extent to which these barriers affect the person traveling seems to be of greater importance when having a mental impairment. Lack of seating area might be annoying for the average traveller, but for a person with a mental impairment a lack of seating can lead to extreme anxiety – thinking one will faint if they do not find a seat. Proper information and not having to wait between different modes of transport is also something the average traveller would appreciate, but usually the average traveller will not have their whole day ruined or panic if they do not find information immediately or they must wait an extra 20 min for the bus to arrive. Having to deal with anxiety in every part of the journey can therefore result in choosing not to travel at all.

In this study, some of the informants used cars as their main mode of transport. For these individuals, having a car increased their freedom considerably and made it possible for them to live a more normal life. Some stated that, as they were unable to use public transport, if they did not have the HC card they would choose not to travel. This finding is especially relevant today, considering the current political debate regarding car-free zones in city centres. If public transport options do not include all travellers before measures to reduce car use are implemented, individuals like those in our study will be excluded from participation in important social settings.

Universal design has largely been limited to physical design and to considering people with physical rather than mental impairments. In our literature and document review, we found this to be the case in public documents, existing research and public discourse about the topic. Our interviews also confirmed that people with mental health issues must fight to receive public assistance, such as HC and TT cards. Findings demonstrate that universal design is more than just an approach to designing physical structure but is also an ethical principle to include everyone in the society. As such, there is a need to include other types of measures to increase people's mobility. We did find some physical measures—for example, the design of certain transport modes and information systems—to be important for people with mental impairments, but there is no point in having a physically 'perfect' system if some still cannot use it. Following our findings regarding social, organizational and economic environment, universal design needs be considered not just by architects and designers, but by drivers, those working in the transport sector, municipalities workers, and politicians. To do this efficiently and effectively, user perspectives from people with a wide range of impairments must be included; as mental illness is one of the most common health issues in modern society, planning for universal design must by necessity include people in this category. Of specific interest here is that several the measures we identified that would improve public transport for people with mental health issues would also improve travel for other disabled groups, and for the public in general.

This study has given us insight on barriers and possible solutions for people traveling with mental health related impairments. There is still a need for establishing what types of barriers are most widespread for people with mental impairments and how many people will benefit from the practical solutions mentioned by our informants. As this is a qualitative study, we will not get a representative selection, which is important to answer these types of questions and this calls for further research.

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HOUSING DESIGN IN AN AGING URBAN CONTEXT

Ira Verma *

Sotera Institute, Aalto University, Finland

* Corresponding author e-mail: ira.verma@aalto.fi

Abstract

Objective – The aim of the study was to gain further knowledge on housing design supporting older people in their daily living. The physical condition and social situation of each person may vary during the life course. Housing design and urban planning need to anticipate the population ageing. The aim was to find design features in the living environment that support general wellbeing and self-contained life at old age.

Background – Inclusion is an important factor for life satisfaction and wellbeing at any age. Housing design and neighbourhood planning can enhance social and physical activities of persons who live in their own homes at old age or with disabilities. Access to local destinations and a walking friendly environment promote walking and independent coping. Moreover, access to local services and social activities may increase the sense of integration within a community.

Research question – The research question was: which features of the built environment promote daily coping, and how can urban planning and housing design support the older population?

Methods – Three case studies were carried out in Helsinki area. The study used qualitative and mixed methods: workshops, observational walking tours, interviews and questionnaires. The older people living at home, in ordinary sheltered housing and in a group home with 24-hour care were main informants in the study.

Results – The results indicated that the neighbourhood design, public transport network and proximity of green environment influenced the mobility of older people. The familiarity of the living environment encouraged residents to go for a walk and do their daily shopping alone event at very old age. Furthermore, the older residents used the local services that were the most accessible ones. Moreover, versatile neighbourhood environment with various activities enhanced cross-generational social encounters.

Conclusion – Comprehensive design of housing, local services and public transport may enhance the daily coping of frail persons. The access to services has to be considered primarily from the point of view of pedestrians. Furthermore, the access to green areas, local services and facilities enhance cross-generational contacts and feeling of inclusion. The ordinary housing developments with attention to Universal Design will enhance living at home and ageing in place policies. Furthermore, housing and services for frail people with high care needs in central locations enhances inclusion.

Keywords: *Older people | neighbourhood planning | housing*

Introduction

This paper is introducing a doctoral thesis in the field of architecture focusing on housing design in the context of an aging urban population [1]. The urban environment can offer many advantages to the growing number of older people. Architects and planners need to anticipate this demographic change and contribute to socially sustainable development in the cities. Previous research indicates that features of the urban environment e.g., accessible dwellings, public transport [2], access to services [3], and to the green environment [4] are enhancing mobility and the general wellbeing of older people. All these features are recognised as important for the development of Age-friendly cities and communities [5]. Housing solutions and neighbourhood environment, that support older resident's functional capacities may increase their mobility and social activities. Moreover, Buffel et al. (2014) argue that availability and access to services may increase the sense of integration within a community [6]. The natural neighbourhood networks [7] and cross-generational activities increase the general wellbeing of older people. Therefore, a comprehensive view of neighbourhood planning is needed.

The design of housing and shared outdoor spaces in the neighbourhood is important for creating an inclusive society. Smith, Rayer and Smith (2008) observed that the length of residence increased with age [8]. The older population tends to reside longer periods in the same neighbourhood than younger people do. This resident group in particular may be affected by the deterioration of the quality of the built environment and infrastructure. It can also benefit the most from improvements in the living environment. Successful renovations and housing alterations may lead to reduced needs for assistance. In Finland, urban densification and technical renovations of old apartment buildings from the 1960s and 1970s are current topics. Many of these buildings still lack lifts. Especially, neighbourhoods with a high proportion of the older population and an ageing building stock and infrastructure need an upgrade. However, the shared outdoor spaces are seldom included in the renovation projects. Universal Design (UD) is a relevant tool for planning inclusive neighbourhoods for people of all age groups, regardless of their age and functional and sensory abilities. It is a process to make the built environment suitable for people to the largest extent possible. In Finland, ageing in place policy aims at supporting older people to continue independent living in their current home, with support of care services [9]. Applying UD into neighbourhood design may promote the implementation of the ageing in place policy and enhance the integration of older people in society [1].

Background

Urbanisation and population aging are global trends. The majority of the world population live in the cities, and the older people as well are increasingly moving to urbanized areas [10]. In Europe between the year 2000 and 2015, the percentage of the older population in the cities has increased by 26 % compared to only 2% increase in rural areas [11]. This demographic development is going to shape our cities and communities and has direct implications for housing design. It represents a new challenge for architects and planners. Smith, Rayer and Smith (2008) estimated that due to population ageing by 2050, the percentage of the European population with significant limitations in performing daily activities, such as walking, climbing the stairs, or carrying groceries would reach 11.6% [8]. Therefore, it is important to provide living environments that enhance everyday life and support people with reduced functional capacities. The WHO guidance for Age-Friendly Cities highlights the importance of urban planning in terms of housing and land use, as well as public transport [5]. People's concerns about the aging process are related to maintaining independence and having control over one's own life. These are important factors for life satisfaction [12]. The home environment is the basis for independent coping and self-contained life. Therefore, the needs of the ageing population need to be anticipated by a comprehensive and inclusive design of the built environment.

In general, the economic situation of the older population has improved over the last decades, even though the personal situation of people may vary. The design and production of goods and services may need to be modified to fit their needs [13]. As an important consumer group, their needs and wishes will also influence the housing markets. For example, a recent Finnish study revealed, that majority of persons aged 75 years old and more, preferred apartment buildings in the walking distance of local services, in city centres and sub-centres near public transport [14]. The location of housing, access to services, and outdoor activities are major factors for everyday life for older people and young families. The study by Oswald et al. (2007) found that the oldest age groups had a tendency to spend more time at home and in the immediate outdoor environment than younger residents did [15]. Therefore, the courtyards and other threshold spaces in the living environment become potential spaces for daily encounters with neighbours. Gehl (2011) argues that the quality of outdoor spaces promotes optional and social activities, as people are spending longer periods in a good quality environment [16]. In the aging process, when the social relations are getting fewer, informal social contacts within the neighbourhood gain importance. To some older people, the local grocery shop or coffee shop keeper, or hairdresser may represent the only social contact. The possibility to remain living in the familiar neighbourhood may therefore enhance general wellbeing at old age.

Kajita points out that housing design with attention to accessibility promotes social inclusion and participation [17]. In Finland, more than 90 percent of persons 75 years old and over live in their own homes [18]. A home in this context is a dwelling in an ordinary apartment building or a detached house, an apartment in senior housing, or in ordinary sheltered housing. In an ordinary sheltered housing, people live independently in their own apartment. Home care services and assistance at home may be provided upon request. Whereas extra care sheltered housing, including group homes for people with memory decline, provide housing and care 24-hours seven days a week. The Development program for housing for older people (2013–2017) [18] and the implementation of the programme (2020 -2022) launched by the Ministry of the Environment aim at improving older people's housing conditions, accessibility in existing apartment buildings, and promoting age-friendly apartment developments. The program targets one million accessible dwellings by 2030. The estimation of housing needs is based on the population prognostics. By default, only the apartment buildings built between 2000 and 2030 are considered accessible, and the renovation of old apartment buildings and detached houses has been identified as the main challenge. They would need to cover one third of the housing need (Fig. 1). Furthermore, the Ministry of Social Affairs and Health launched a new development program to promote home care services and ageing in place policy (2017 – 2018) [19]. The aim is to develop remote technology and home care services that enable more people to stay longer at home than previously. Furthermore, informal care from family members and home help may support older people in their daily life. Nonetheless, the housing environment suitable for the resident's functional capacities remains the basis of daily coping.

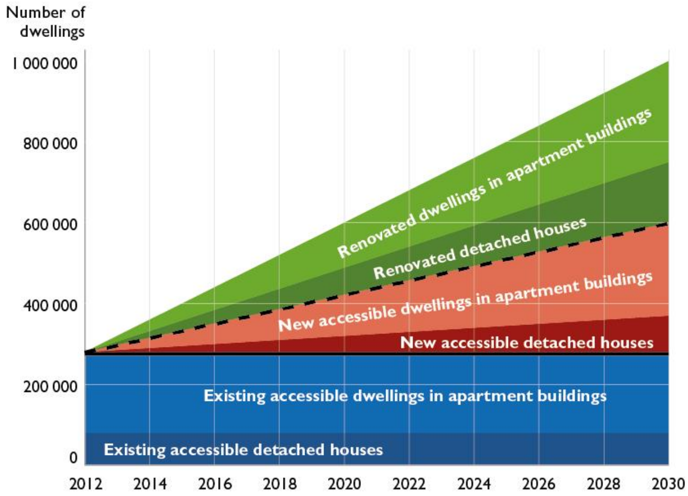

Figure 1. One million accessible homes include 1/3 of renovated housing, 1/3 of new developments and 1/3 of existing housing (Ministry of the Environment, 2013).

New housing solutions supporting residents with high care needs are required as well. The location of these housing services in the centre or in the sub-centre of cities, in the proximity of good public transport connections, promote residents' inclusion in the society. Central location enables older residents to feel integrated, and transport connections may enable older relatives and friends to make visits more frequently. Moreover, the recruitment of staff members might be easier in a central than in a remote location. The land use policies in municipalities can promote this development. [20]

Aim of the study

The objective of this study was to gain in-depth knowledge on housing design features supporting older people in their everyday life using older people themselves as informants. Qualitative research methods, self-reported experiences of residents, and observation in real life environment were expected to provide understanding of the needs of the older age cohorts, nonetheless with understanding, that the older people are not a homogenous group of people. The physical and mental functioning capacities and social situation of persons may vary but they still want to keep their self-determination and decision making on housing. The research questions were which features of the built environment promote daily coping and how can urban planning and housing design support the older population? The knowledge and self-reported experiences of older people living at home, in sheltered housing, and in a group home for people with memory decline were gathered to gain further knowledge on housing design supporting independent coping during the life course. The overall aim was to gain information for architectural practice, future housing developments and refurbishment of existing neighbourhoods.

Method

The case study method enables to have a comprehensive view of the challenges in the daily living environment in real life context [21]. This method was implemented in three different scales of the built environment: 1) neighbourhood, 2) immediate surroundings of apartment buildings, and 3) shared spaces in the sheltered housing. Each of the case studies used mixed research methods focusing on the living environment from the point of view of the older population in different stages of aging process and declining physical, sensory, or mental functional capacities. The case studies were carried out in Helsinki sub-urban area, Finland during the period from 2010 to 2015.

In the first phase, open access documents on population statistics, residential density as well as topographic maps were analysed. Moreover, architectural plans of buildings, information about apartment buildings with lifts, and public transport networks were studied for each case study area. In the second phase, workshops and observational walking tours were carried out with local residents 65 years old and over. Semi-structured interviews and questionnaires were used to assess their experiences in their current living environment. Mixed research methods and observation on site enabled to recognize features supporting older residents as well as challenges in the daily environment. Residents were regarded as main informants and their self-reported experiences provided knowledge of the positive and negative features in their living environment.

The study sample included people living independently at home (N=64), and older residents living in sheltered housing (N=36). Moreover, persons living in a group home for people with memory decline (N=4), their relatives (N=8), and care staff members (N=18) were invited to assess the shared spaces and outdoor environment in the group home. All participants were volunteers. The interviews of residents with memory decline and observations in the group home were carried out in collaboration with Helsinki city social services and health care division.

Results

The questionnaires and interviews were related to the themes of housing, mobility, and access to services. These were discussed more in detail in the workshops organised in each of the case study areas. This paper describes the findings of the triangulation of the data on these themes. The results indicate that the access to local services, walking-friendly environment, and public transport stop at a walking distance of home was enhancing independent coping of older residents.

Walking-friendly environment

The discussions in the workshops indicated that older people were choosing the local services that were the most accessible ones. The access to services was not always correlating with the distance to the destination. The topography, narrow pavements with slide slopes, and many ongoing renovations in the neighbourhood were hindering walking with a walking aid. Moreover, observation showed that steps at the entrance of the retail shops or other hindrances were creating obstacles in the built environment. These obstacles may in long term, have impacts on the local economy. The results of our questionnaire indicated that residents living at home in the familiar environment went to grocery's alone even at very old age. Some persons with mild cognitive decline reported however, having challenges in wayfinding, and having nobody to go with them. The residents living independently reported that access to public transport supported the use of local services, access to health care services and social activities.

The interviews with residents living at home indicated that familiarity with the living environment increased their feeling of safety, whereas residents reported themselves to be unwilling to walk alone in places that were unfamiliar. Especially, residents in ordinary sheltered housing who had moved from other parts of the city seemed to have poor knowledge of the neighbourhood. They were reluctant to go out alone. Many of the residents in sheltered housing had moved from other parts of the city and the neighbourhood was unfamiliar to them. The frail residents were reluctant to go out alone because of fear of getting lost or losing their strength. The main obstacles for going out self-reported by the residents were the fear of falling and physical pain. The results indicated that the people living in a sheltered housing used local services and public transport less often than older people living in ordinary housing.

Access to green environment

The walks and visits to the local parks and seashore were promoting the general wellbeing of older people. The green areas with various activities in the neighbourhood were observed to be spaces for cross-generational encounters (Fig. 2). However, some residents reported that the long walking distance to the seashore or steep climb to the parish hall made these meaningful places inaccessible to them. Furthermore, streets with heavy car and bicycle traffic were reducing the feeling of safety. The older residents reported choosing versatile and safe walking paths across green parks when possible. Short and direct connections across the parks to local services and destinations, like the library, enhanced walking. Moreover, older residents reported appreciating the sensory qualities of these outdoor spaces.

Sheltered sitting places in parks and benches in public outdoor spaces may encourage walking. The benches were often lacking along the walking paths. One of the major challenges for mobility in the Nordic countries is the winter conditions and the snow piled on the pavements and street crossings. The older residents reported the snow and slippery conditions being major risk factors hindering the use of walking aids. Yet, the participants in the workshop found that the walking paths in the parks were safer than narrow pavements in the winter. Good winter maintenance and mechanical clearing of snow made them walkable.

Figure 2. In the summer, the green areas are used as living rooms for the neighbourhood (photo: Verma, I.)

Immediate surroundings

Most older residents living at home self-reported visiting the courtyard daily. The participants in workshops expressed the desire to go out more often and wished more activities, especially in the courtyard. Yet, many residents in ordinary housing as well as in sheltered housing noted that there was not much to do in the courtyard. They self-reported to be interested in common activities, like urban farming and dining, which might enhance social contacts between neighbours of all ages. In sheltered housing scheme, the residents reported that the view from their room to the courtyard invited them to join activities taking place outdoors. The results indicate that the accessibility alone did not enhance the social activities in the courtyard.

One of the sheltered housing schemes had two similar size courtyards. The observation on site revealed that residents were passing through the wheel-chair accessible "stone courtyard" to spend time and socialise in the "green courtyard" (Fig. 3). Nature was an important factor for wellbeing and social activities. The visual quality and versatile environment of the green yard with sheltered sitting places was attracting the residents. The seasonal changes, natural light, sounds, and smells offered experiences for all senses. The accessible courtyard was inviting and appealing to the users. Furthermore, residents self-reported that gardening and outdoor games, as well as having afternoon coffee outdoors, were enjoyable social activities in the summertime. At the same time, they said that it was easy to withdraw from the activity, when one felt the need to do so.

The residents in the group home for people with memory decline were not able to go out alone. One of the interviewees, a resident with memory decline, reported to like gardening and another was wishing for an outing in the woods. The analyses of the case studies revealed that the outdoor spaces in the group home for people with memory decline were smaller and the destinations at walking distance fewer than in ordinary sheltered housing. Therefore, the possibilities for outdoor and social activities were limited. One of the relatives pointed out that there were no places to visit with the resident in the proximity. The nature, outdoor spaces, and coffee shops, or other services in the proximity would enhance the wellbeing of all users: the residents, staff members as well as relatives or volunteers.

Figure 3. Residents enjoyed having afternoon coffee in the courtyard (photo: Verma, I)

Shared spaces for residents

The observation in the group home for people with memory decline revealed that residents preferred sitting places where the visual control over the space was the best. Observation on site and discussions with the staff members revealed that the sitting places near windows with visual control over the entrance, and shared spaces were the most popular ones. The residents were spending much time in the shared spaces near the staff members, participating passively in the daily activities. One of the residents in our study expressed to enjoy watching people go back and forth. For privacy, she went to her own room. In the sheltered housing scheme, residents reported to use the shared spaces mainly for dining, meeting staff members and meeting other residents.

The indoor air, lighting, and temperature together with aesthetics are part of the quality of environment. The relatives and staff members in the group home were asked to evaluate the quality of the shared spaces. The results indicated that relatives' perception of the quality indicators of the premises was better than the perception of the staff members. The relatives reported higher satisfaction with the cosiness, lighting level, indoor air quality and acoustic qualities of the premises than the staff members did. This may be due to staff members spending longer periods in the premises daily whereas, the relative's visits are usually shorter and less frequent. The quality of the premises is important as it may also affect people's willingness to visit and spend time in the sheltered housing premises. (Fig. 4).

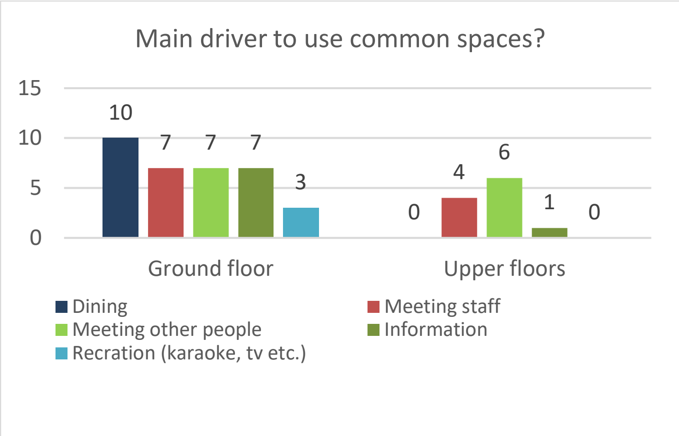

Figure 4. The residents (N=10) reported to use the common spaces for dining and social activities.

Furthermore, in addition to spaces for structured activity, the residents were pointing out the need to have intimate spaces for chatting and for informal meetings. A variety of shared spaces would accommodate the residents' need for social activities. The staff members pointed out, that most of the residents entered the dining room at the same time with their walking aid or wheelchair, which made the space very crowded. The dimensioning of shared spaces and a flexible design would allow various numbers of people to carry out different activities in the same spaces. Moreover, accessible shared use space for residents, relatives, and other people from the neighbourhood would promote resident's social activities and their inclusion in the neighbourhood.

Discussion

The results of this study are in line with the findings by Barnes, which indicated that an offer of series of private, semiprivate, and public spaces was connected to the well-being of residents [22]. Ryhl, Katjita and Sorensen point out that Universal Design is also about the physical quality of architecture as well as the sensory aspects of architectural experience [23]. Previous study by Piechniczek-Buczek, Riordan and Volicer found that the characteristics of the space, peaceful surroundings, cleanliness, and opportunity to go out make the visit of relatives and friends more pleasant [24].

Comprehensive assessment of existing housing provision, local services and transport network is necessary when designing new living environments or densifying old neighbourhoods. In the future, the living environments need to support independence and self-contained life of people at all ages. Mix of land use, accessible housing in the proximity of local services and public transport enhance daily coping of frail persons with mobility limitations. The Universal Design features in the built environment may increase independence and reduce the need for assistance in everyday activities. It may also enhance social participation within the community [25].

Housing for people with mobility limitations and sensory or cognitive decline integrated in the neighbourhood design may decrease segregation and feeling of exclusion. Access to green areas and public transport promote mobility of older people. The fear of getting lost may lead to immobility, isolation, and cause premature loss of functional capacities. Well-indicated, and safe network of walking paths to local services and meaningful destination encourage walking. Guided walking paths of different lengths around the building, in the immediate surroundings, and in the neighbourhood would provide a variety of choices for residents. The legibility of the living environment and landmarks along the walking paths may help navigation and wayfinding. Mitchell et al. (2004) observed that people with memory decline used landmarks and other environmental features to find their location and route [26]. The proximity of services and visual access to destinations may encourage walking of the frailest residents.

The hierarchy of the streets, separation of pedestrians from bicycle and car traffic would increase the feeling of safety of older people. Moreover, accessible open spaces in the neighbourhood may encourage social activities among people of different age groups. Inviting and versatile environment invites people to spend time in shared spaces. Sheltered sitting places, outdoor games and gardening in courtyards may enhance daily encounters with neighbours of all ages. The results are in line with the earlier observations by Gehl (2011), which highlighted the importance of qualitative aspects of the environment for social activities [16].

Figure 5. The multigenerational housing development in Helsinki (photo: Verma, I.)

The housing design needs to be accessible and targeted to all resident groups. Special housing construction for the oldest age cohorts alone is not a sustainable solution [1; 14]. Therefore, the design needs to take into account the variety of resident groups. Flexible design may enhance the shared use of local services and facilities for cross-generational social activities. *It should include accessible outdoor environments to* enhance the feeling of inclusion *of all residents.* Older persons and small children are both frequent users of the immediate surroundings. *Flexibility and adaptability of outdoor spaces for various activities may promote cross-generational encounters.* All age groups profit of easy access to local services and facilities, safe walking environment and good public transport network. Accessible walking paths of different lengths to various destinations in the living environment may enhance mobility of older residents. Helminen et al. (2017) point out that 200 m may be a long walking distance for the frailest [14]. Hierarchy of streets, separate lanes for pedestrians, bicycles and cars minimise the risk of accidents and enhance feeling of safety of both children and older people.

Shared spaces indoors and outdoors may enhance social and physical activities as well as cross-generational encounters. Ordinary sheltered housing schemes and group homes for people with memory decline integrated in the neighbourhood reduce the age segregation and increases the inclusion of older people in the society. Universal design of neighbourhoods enhances both sustainable development and Age-Friendly Cities. The challenge is to develop intersectional collaboration within the fields of urban planning, housing design, and traffic planning, as well as services for older people.

Conclusion

Older residents usually have long-term user knowledge of the quality of their own living environment, but they are seldom involved in the urban development processes. Universal Design of neighbourhoods can be related to accessibility of services, safe walking environment, and inclusive outdoor environment for all age groups. Future urban developments would profit from the participation and involvement of the older population as informants and partners in planning processes.

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ENCOUNTERS AND RETREAT IN THE LIVING ENVIRONMENT OF VULNERABLE ELDERLY

Birgit Jürgenhake*

Dr. Ing. Birgit Jürgenhake, architect, University of Technology, Faculty of Architecture and the Built Environment, Chair of Architecture & Dwelling, P.O.Box 5043, 2600 GA Delft, The Netherlands

* Corresponding author e-mail: B.M.Jurgenhake@tudelft.nl

Abstract

The objective of this conference paper is to discuss the problem of loneliness among vulnerable elderly and the question if and how architecture could offer a contribution to a better balance between encounters and retreat of the elderly in daily life. As the activities of vulnerable elderly are often much more dependent on their home and direct environment than those of vital elderly, the research focuses on the scale of the house and the direct neighbourhood. Aim of this paper is to elaborate on the phenomenon of loneliness, explain the research method and elaborate on a pilot study done by a master student of architecture under supervision of the author, concluding with first outcomes.

Background: We are rapidly moving towards an aging society. This trend is global and needs appropriate design solutions on different scales, from furniture up to the scale of the city. The living conditions of elderly, their homes, houses and neighbourhoods need to be reconsidered, especially for vulnerable elderly. In the Netherlands we can see a shift towards staying at home as long as possible. This causes several problems. The elderly lose connection with others and building up new social networks often is difficult. No matter if living in an elderly home or staying at home, the situation in which elderly live often causes loneliness.

The main research question is, how architectural design may help to avoid phenomenon of loneliness among elderly. Can architects contribute with their design to an optimal balance between encounters and retreat in daily life of them?

Methodologically the research is based on a theoretical study about public and private, crowding and isolation, and architectural elements that support encounters. In a second step public spaces were observed. Interviews were done in which design proposals were discussed with the elderly. The places visited were all in one neighbourhood where lots of elderly live, at home or in a and nursing home.

The first results show architectural answers that would help to empower the elderly in their choice between contact or withdrawing. One of the most important conclusions of the first sessions was the wish of the elderly to be absolutely free in choice when, where and how they encounter others, or choose for retreat.

Keywords: *elderly at home* | *loneliness* | *encounters* | *architectural design*

1. Introduction & Objective

We are rapidly moving to an aging society which will have certain impact on our living environment. Cities observe that the elderly are hidden, forgotten and, especially if vulnerable and less mobile, lonely. This paper investigates on how architectural design could support the moments of encounters in the everyday life of those elderly. At the chair of 'architecture and dwelling' of the Faculty of Architecture we want to discuss and rethink, together with our students, the way the elderly live today and in the future. Our students do interviews with vulnerable elderly in both situations, while living in a retirement house and while staying at home. The outcomes show that loneliness pops up in both situations. There are studies about loneliness in relation to elderly, mostly looking at the activities that 'work'. Study about how architecture could support the encounter in daily life is scarce. The goal is to bring together the pattern of daily life of (vulnerable) elderly with design proposals that enhance moments of encounter as a step in the social life of the elderly. With this paper the applied method and the results of a pilot, focusing solely on the problematic of loneliness, will be shown.

The paper will summarize the background on the example of the Netherlands (paragraph 2). Then the theory and the phenomenon of loneliness as well as privacy and isolation versus encounters and crowding are discussed (paragraph 3). The research question and the method, which is based on literature study, observation, first talks and interviews, is described (paragraph 4). The results of the fieldwork are shown. This leads to first design advice for architecture that fosters encounters (paragraph 5), and to conclusions (paragraph 6).

2. Background

The last decennia there is a shift recognizable in the elderly care which moves from institutional facilities of dwelling combined with care towards the separation of dwelling and care. In the Netherlands, this was even strengthened by a new law for long-term care, which caused that elderly who did not have a right on this financial support needed to move from retirement homes back to flats, or to stay where they were, in a flat. Care needed to be partly taken over by informal connections and supplemented by professionals.

Elderly, and especially vulnerable elderly, have more chance to feel lonely. Reasons can be individual ones like less self-confidence or social ones like the loss of their partner, a big distance to their children, and a smaller social network in general. Even the imago in society can play a role. In the Netherlands in 2012, 40% of the elderly between 65-74 and 60 % of all elderly above 85 felt lonely [1]. The four big cities Rotterdam, The Hague, Amsterdam and Utrecht did extra health monitoring which showed that migrants feel more lonely than autochthones.

This outcome motivated several Dutch cities to develop programs against loneliness: “Rotterdammers do not leave each other alone”; “Hague Community against loneliness”; “together against loneliness” (Amsterdam). Voluntaries visit the elderly and organize several activities. However, there are not enough helping hands. Cities need to empower the elderly to come out of their refuges and take an active part in the society on their own speed. Rotterdam therefore started the program of “Slow City Rotterdam” and the municipality started introducing a slow layer to walk and relax in certain neighborhoods, next to the high speed layer of the city. The question here is, how to introduce a slow network with places and slow city design to support the moments of encounters for the elderly and others.

3. Theories

This paragraph elaborates on the relevant theories of the phenomenon of loneliness. The main distinctions within the concept of loneliness are clarified. Then it elaborates on theories relevant for the concepts of the encounter and the retreat, public and private and crowding and isolation. Finally, it shows some architectural discourse related to encounters and relevant for this study.

The phenomenon of loneliness

Loneliness is a complex phenomenon. It is a subjective feeling which makes it difficult to define: “the subjective experience of an unpleasant and unacceptable missing of relationships” [2]. Relationships can be quantitative or qualitative. In case the amount of contacts does not meet the desired expectations we speak of *social loneliness*. In case the contacts do not give enough emotional support, we speak of *emotional loneliness*. Only if this feeling is a long-term feeling, this will have a negative impact on someone’s life [3]. Statistics show that elderly, low educated people and not western allochthones participate less in the society and therefore have more chance to feel lonely. Next to them the single elderly has a bigger chance to feel lonely. To answer the question of how architecture may contribute to an optimal balance between encounters and retreat, the *social loneliness* is the most applicable for solutions found in architectural design. As the daily life of vulnerable elderly is close to the direct living environment, this means that encounters should meet the everyday routine of the elderly. Here architecture can play an interesting and supportive role.

Encounters and retreat

A person needs a healthy balance between contact and retreat. His property is, if it is in balance, organized in such a way that this is possible. *Retreat* in this context means a *chosen withdrawal*. The *encounter* means to meet somebody *face-to-face*, expected or unexpectedly, it is a social connection with another person, visually, verbally and physically. In general – the visual contact is less satisfying as people want to communicate visually *and* verbally. Encounters with others can be seen as a first life need and can be organized (the expected encounters) but can also happen spontaneously (the unexpected encounters). These informal and unexpected encounters can stimulate the feeling of being member of a group or neighborhood and that can have a positive influence on the health of people [4]. The sporadic can be seen as the weave that creates a base and the nodes are the repeated encounter [5]. “Not being in each other’s house does not mean that people like to be completely anonymous sliding alongside each other. There is a need for meeting.[..] the American city architect William Whyte already showed in 1980 what a simple kiosk with folding chairs - no street furniture cast in concrete! - could mean.”[6] As the sociologist Talja Blokland argues the unexpected encounter, sporadic or repeated, are the fabric of the neighborhood. It is this informal encounter that happens on the way to the elevator, the postbox, the bus stop or the little park that planners and architects have to take into account when designing (residential) buildings and neighborhoods. With this in mind architecture may offer support to get out of the loneliness trap.

Public and private

The ideal dwelling should be a retreat *and* offer possibilities to contact and connect. "People need a private world with privacy. Therefore, distance is also necessary [...] in privacy it should be about the balance between showing yourself and hiding yourself. The architect mediates between city and intimacy. He does not make either, maybe the space in between" [7]. The social environment can influence how a person feels, as Sloterdijk argues. The gradation of closeness serves here to be adjustable. Moments of need for rest and contact are personal and unpredictable [8]. Private in general means that one has control over something. It can be a physical control like a space that is private, but also information about a person who must remain strictly private. The Latin word *private* means "withdrawn from public life, secluded" [9] , but also special, private, own. The Latin word *public* means "it is of the people" [10]. The public belongs or is accessible to the people. The philosopher Hannah Arendt distinguished between the *Vita Activa* and the *Vita Contemplativa*. For the public an active life in the public community is important. Retiring into the contemplative can lead to a turning away from the world [11]. As a human being, we would not see our uniqueness if we were not among the people, that is why public is so important. Only in the debate with others is this possible for us. As Arendt points out: "Where the plurality is contained, there is no public domain; loss of public domain is dangerous for plurality - then people are deprived of their freedom to develop their own unique biography in front of others and to integrate with them in the organized world" [12]. When our students went to fieldwork in elderly homes or nursing homes, they heard one very important complaint of almost all elderly they spoke to: "Only old people live here." When the plurality of life is absent and elderly only see or speak elderly, they cannot mirror their thoughts and actions to different groups of the society anymore. They are no active part of the society.

The balance between encounters and retreat is built up by visible mechanisms and invisible codes of behaviour. Together they regulate the privacy of people. We can see that non-verbal laws have affected our built environment. Distance in proximity ensures private life [13].

Figure 01. Altman, social distance [14]

Van Dorst argues that: "The occupant's need to interact with his living environment depends on how he feels or what he is doing at the time. A dwelling with interfaces that move from private to public scenarios enables him to regulate this interaction." As the occupant's needs may vary, the environment must be versatile enough to meet his different requirements [15]. Some fundamental laws for man and his environment are summarized [16]:

1. Man constantly wants to be able to intervene in his environment;
2. Man aspires his own territory;
3. Man needs contact with the natural environment;

Crowding and isolation

In daily life people are constantly trying to achieve the right level of privacy which always is striving for an optimum of balance between the *personal space* and *territory*, between *crowding* which means that the achieved privacy is less than desired, and *isolation*, meaning that the achieved privacy is more than desired [17]. Irwin Altman and E.T. Hall [18] introduced the *personal space* and the *territoriality* [19].

Personal space is defined by Hall as an *invisible space* around a person that can be felt by others. This *invisible space* is important for the personal privacy. In difference to this invisible bubble *territoriality* is the *visible space* of a person or a group, protected by elements like hedges or walls against others. Hall states that privacy can be arranged by *visible* and *invisible space*. The need for some kind of privacy works unconsciously but organizes spaces anyway. For the elderly the private territory is often limited to a small apartment, especially if less mobile. Once having opened the door of the apartment, the elderly is dependent on the spaces and attributes that are offered as privacy gradients for a smooth transition from private to public, leaving choice to the elderly at every stage and as well offering spaces for encounters.

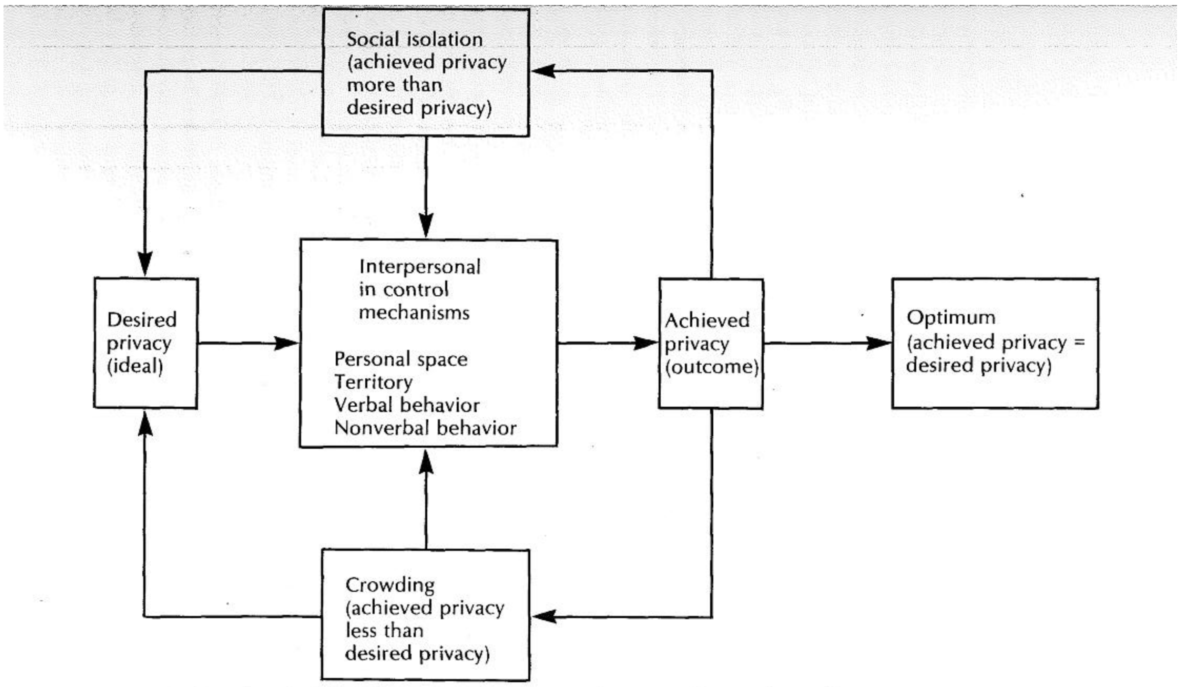
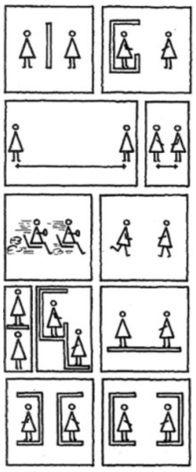


Figure 02. Relationships among privacy, personal space, territory, and crowding [20]

Architectural discourse related to encounters



The Danish architect Jan Gehl has done lots of research about the informal moments of encounter. In his study on ‘life between buildings’, he shows elements that function as *territory border* and others that invite to come closer. A short distance can invite interaction, as can elements like benches which are placed in a communal zone. The important fact lays in their visibility, and the consciousness as a designer to use them in the right way. The scheme shows some elements that hinder or support the encounters. The aspects he works out with this scheme are: separation, distances, speeds, spatial organization and orientation (back-to-back or vis-à-vis). However, Gehl did not specify the needs for special groups, like the elderly, which is the missing link that still needs to be elaborated.

Figure 03. Elements that hinder or support encounters [21]

The architects Aldo van Eyck and Herman Hertzberger always gave a positive notion on elements and spaces that offer the possibility to be appropriated by the users. The phenomenon of the *in-between* became an important theme in their architecture. Hertzberger suggested introducing elements that invite the resident to act. His slogan was: Making space - leaving space. A nice example is done in the project for vulnerable elderly ‘De Drie Hoven’, where the architect introduced low separation walls on which people can sit (fig.04).

The entrance doors to the private apartment consisting of two parts give an idea about the attitude of the designing architect (fig.05). The way residential buildings are designed today resonances our desire of privacy, comfort and individuality but less the support of meeting each other. For elderly this is a shortcoming.

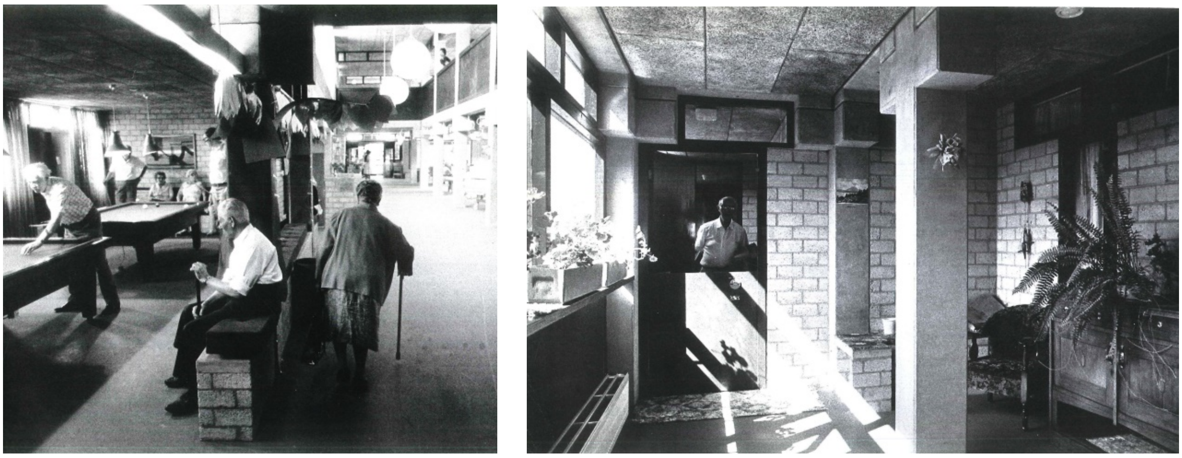


Figure 04 and 05. “De Drie Hoven”, architect Herman Hertzberger [22].

4. Research question and method

To answer the main questions - Can architectural design help to avoid loneliness among elderly? What kind of architectural solutions could be supportive to meet each other? The research had to be framed. We realized that including people with dementia would influence the outcomes, as this target group would probably have a different desire and within this group the range of cognitive and emotional challenges can differ a lot. As we wanted to start with a pilot, the choice was made to exclude them. The elderly that would be interviewed did not have any cognitive but mobility challenges.

The research method is a combination of several steps and techniques, from literature study about loneliness and about architecture that would support moments of encounters in daily life, towards observational study of the elderly in public and in their daily environment, combined with interviews and a questionnaire, combined in 7 steps:

1. Literature study to understand loneliness (paragraph 3);
2. Literature study to understand spatial conditions designing for elderly, spatial organization and supportive architectural elements (paragraph 3);
3. Observation of social spaces in public;
4. Design proposals for spaces within the daily living environment based on step 2 and drawn on postcards;
5. Interviews with the elderly using these cards;
6. Interviews about the daily routine and social contact, both to understand the social places and attributes that are important for the elderly.
7. A questionnaire was spread in the neighbourhood of the design site, to get to know what kind of infrastructure the elderly use and what they miss in their neighbourhood. 6 persons reacted among young people with children.

Finally, an architectural design was made for a site in Amsterdam West.

The pilot: preparation - execution - results

The pilot was done by the graduation student Sophie Dikmans [23]. In total seven elderly between 76 and 95 were interviewed, five of them living in a retirement house in Amsterdam, two in the same neighbourhood. Next to these 7 interviews, Sophie visited a day-care for elderly nearby which offered different activities. We are aware that this is a small amount of interviews, but nevertheless wanted to give the method a try.

The postcards seemed to be a success because this opened a discussion. Her interviews of the daily routine focused on: *The daily round*; *the social contacts*; *the activities and services.* In the following the prepared material of the steps are shown and the results will be summarized directly underneath.

5. Results

Results from theoretical studies (step 1+2):

- Focus on informal encounters. The daily routine of the elderly should offer chances for it.
- The encounter should not be the main function of a place.
- People need a private world. Therefore, distance is necessary.
- People must be able to intervene in the closeness and openness of their dwelling.
- A balance between privacy and contact is important, avoid crowding.
- Even less intensive contacts are important for a feeling of ‘Home’.
- Visual stimulation is very important as a stimulus to go outside or to a collective room.

- Diversity of people, not only the elderly.
- Leave space to appropriate by the users.
- Extend the *Home* to the outside as this may result in more use of these spaces and in unexpected encounters.

Results from the observation of social spaces in public (step 3):

Figure 06. Step 3 of the research method - discovering social spaces (Photographs: S. Dikmans).

- Public chess board was appreciated among the elderly
- Coffee at the supermarket often results in unexpected encounters
- Benches to rest
- Space and place to play together is necessary and needs to be visible

Results from the postcards (step 4 – 5):

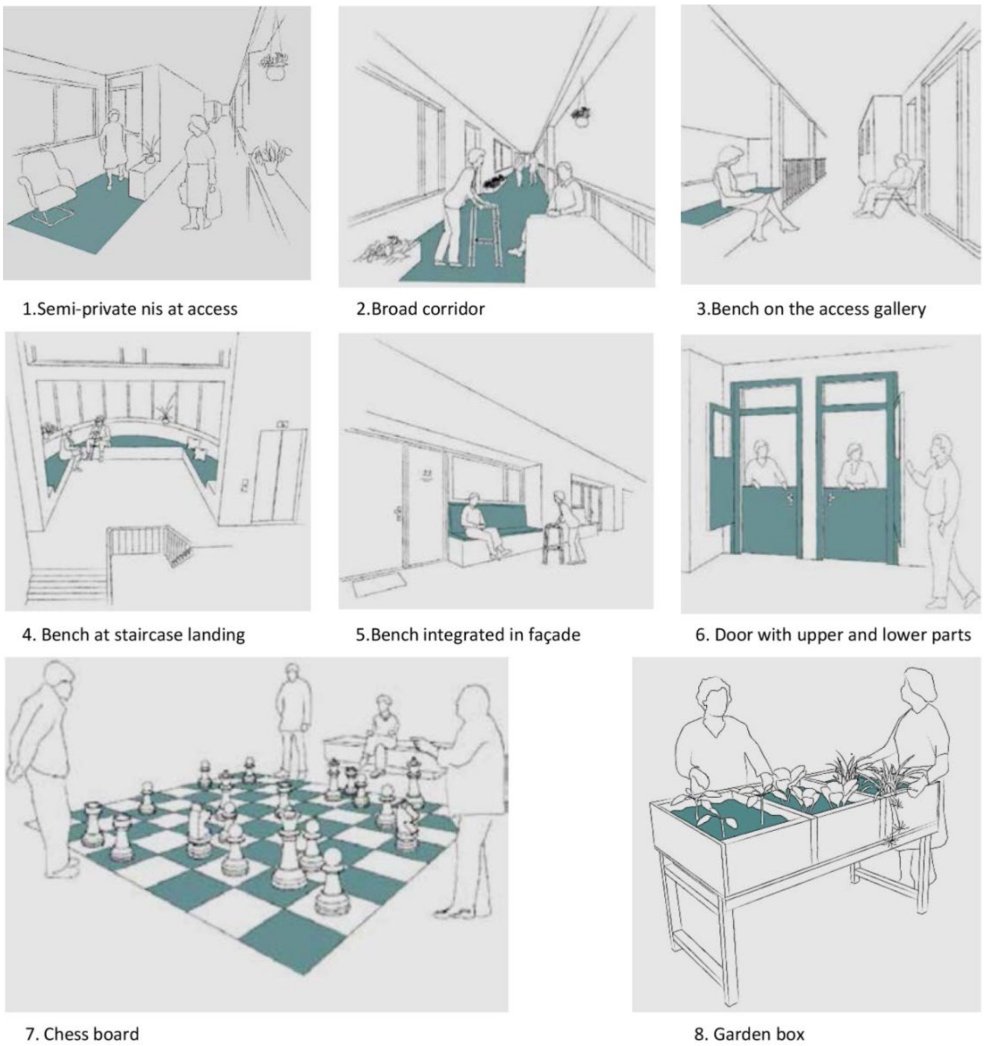


Figure 7. Step 4 – Sophie's postcards (selection)

In the talks with the elderly about design suggestions, the results are partly expectable, partly unexpected. Card 1 was not appreciated as "it would get a mess" and card 4 was valued as too impersonal. The double door was seen with mixed feelings (looks like a stable door), but finally valued positively. Most valued were the integrated benches (3 and 5) as they are for everybody, with the addition to have a nice view to nature or action. Broad corridors are important for all respondents. They loved the chess and the idea of a garden box. The elderly wish to be absolutely free in choice when, where and how they meet others.

Results of interviews (step 6):

1. The daily round:	**2. The social contacts:**	**3.The activities and services:**
Can you tell me what you do every day? Where do you go? What is the purpose of your daily round? What do you come across? Are there places where you stop? How far can you walk until you need to rest? At what places do you have a rest? Are there enough rest places? Benches? Street furniture? How often do you come outside your home?	How often do you speak with people? Do you have contact with your neighbors? Is there an opportunity in your residential complex to meet people? Where do you speak to people? At home or outside the door? What do you think is a pleasant place to meet people? How does it look like. Do you have spontaneous chat with someone? Are you missing places to talk to other people?	What kind of activities do you like to do? Do you find it important to have contact with other people during such an activity? Do you enjoy watching or listening to other people's activities? (playing kids) Are there facilities in your residential complex? Do you use it? Which facilities in the neighborhood do you use? Can you name three facilities that are important to you? Are you missing facilities in the area?

Table 01. Step 6 – interview questions about daily routine and contact

The importance of daily movement is well understood and all the seven have a daily walk. One needs a bench to pause, five of the seven have a maximal distance of 500 meters. The daily round is the social round as well. But 500 meters is not far. The daily contacts are mostly with the people living in the same house, all elderly. Six of them miss more choice of shops nearby (500 m). They miss views to activities, liveliness, other ages and diversity among residents. The surveyed all found a residential complex with only elderly no 'normal situation'. All of them would like to participate in society by doing easy voluntary work in the house they live.

Results of the questionnaire (Step 7):

The questionnaire showed that people make use of the supermarket, the library and the playground (younger person with kids). When it comes to the question what they miss, a centre for 55+ was mentioned, where you can go when feeling lonely. A place to sport was a wish of elderly as well as allotment gardens.

6. Conclusion

The combination of the different steps has led to interesting results. Six of the seven interviews showed that they miss views to activities, liveliness, other ages and diversity among residents. 'This is not a normal situation', was a common answer to the question about their daily life and their encounters. Changing this would mean not to design for the elderly, but for a mixed living. Especially the care needing elderly, who hardly go out, would be more integrated. The program should contain a mix of functions. Residents would be aware to help the more vulnerable. Professional care needs to be more flexible. Sophie's design focused on a mix. As there is an elementary school situated next to her site, she decided to bring an extra gym hall into the building, in the central area of her design, like a patio. Windows from every level offer a view to it (figure 10). The hall can be used by the elderly as well.

The wish of the elderly to be absolutely free in choice when, where and how they meet others, has consequences for the design. The architect may offer spaces for unexpected contact, but the resident must have a choice. Architectural elements like windows towards the access spaces to see somebody passing by, need a shutter. Collective living rooms need to be visible from the hall so that you can see who is sitting there and make your choice. In Sophie's design there a lot of openings to the corridors, however they can be closed by the residents, or the opening do not offer any chance to see the rooms inside (figure 8 and 9).

The elderly want to stay a respected person in our society and participate. This is a societal question. It shows the need to empower the elderly instead of making them passive members of an elderly home where everything is prepared, even the meals. Architecture could foster empowerment by visual stimulation, seeing others doing kitchen work may trigger them to join. Seeing an elderly in a workshop doing some reparation of bikes could make them step in and help. If the elderly wants to participate with voluntary work, space is needed where a slow working rhythm is fine and does not hinder others who like the rush. On a societal level we have to change our attitude. Not everything needs to be done in a rush.

Sophie's design provides places for small groups to cook and eat together. Each floor has a big roof terrace where herbs and little vegetables can grow in garden boxes. There is lot to do for the elderly within their own house. A Cafe and a shop offer interaction. We discussed the possibility to get a mix of target groups by offering different apartment sizes. To provide flexibility she designed one-person apartments that can be combined to get bigger apartments fitting for a couple or a little family.

The research definitively helped her to get more insight in how architectural design could help to avoid phenomenon of loneliness among elderly in daily life. Spaces for unexpected encounters within the daily round, which is short, are very important, as well as views towards the collective spaces, and possibilities for action space in the house. But there lies another challenge, namely, not to exclude the elderly in the way it is often happening today, but to develop towards an inclusive living environment.

Some impressions of the architectural design, made by Sophie Dikmans

Figure 8 and 9. The access gallery to the apartments with views from inside-outside to the gallery (little kitchen windows to the gallery), elements to sit, a double door, table gardens and a window at the end of the gallery.

Figure 10. A view to action – a new gym hall for the primary school.

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Housing for elderly and people with special needs

ELDERLY HOMES — ANTHROPOLOGICAL RESEARCH TO ACHIEVE AN ARCHITECTURE FOR THE ELDERLY

Birgit Jürgenhake*

Birgit Jürgenhake, Delft University of Technology, Faculty of Architecture and the Built Environment, Chair of Architecture & Dwelling, P.O. Box 5043, 2600 GA Delft, The Netherlands

* Corresponding author e-mail: B.M.Jurgenhake@tudelft.nl

Abstract

The **objective** of this conference paper is to report on the idea of combining visual anthropological research methods with architectural design processes in our masterclasses. We argue that the person whom we design for should be the first to focus on getting in depth information. We aim to show that this methodology may lead to unexpected results and helps the students to design new concepts for elderly living environments.

Background is the urge of housing the growing numbers of elderly, especially care dependent elderly. Locally and globally we are moving towards an aging society. This fact has severe implications for the organization of care and residential housing. Existing housing designs as well as public spaces generally are not well-equipped for accommodating growing numbers of elderly. In the Netherlands the demographic transition to an aging society runs parallel with transitions in the policy and practice of elderly care, which moves away from institutional buildings towards a more informal support network. As the chair of architecture & dwelling of the Faculty of Architecture first masterclasses working on this topic were set up 1,5 years ago. After an intensive phase of research the students translate the findings into a design for a new home for elderly with and without care.

The **research questions** that will be addressed in our work concern the everyday life of residents (and professionals and visitors of elderly care centers). How do older people move, use and share spaces? How do (sub)communities work in residential care settings? And how do personal worlds relate to the outside world of the city and the neighborhood?

Methodologically, the focus of this paper lies on the everyday life of those in care centers. We introduce three scales as a research frame: the body - the home - and the neighborhood, connected to the activities of the elderly. Aim is to understand, document and visualize the needs and living conditions of elderly today, to collect these data in a pattern language for the design of elderly homes, as well as translate this into architectural design.

The **results** give a first idea of our work with students by showing a selection of the material students came up with. In the conclusion some preliminary findings of a fieldwork study will be shown.

Keywords: *Aging society* | *anthropology* | *pattern language* | *architecture of care* | *neighborhood*

Introduction & Objective

A 'Pattern Language' as a guideline to design for the elderly

This paper concerns an exploratory study of the social and spatial living environment of the elderly which is done with a masterclass of the Faculty of Architecture. To understand and even change paradigms of care and develop new concepts for housing the aging society, there is a need to know more about the influence of the elderly body and mind and the perception and use of home spaces among older people. Therefore, the design discourse of architecture is connected with the human centered research of anthropology and the field of practice of elderly housing.

The goal of this long term study is to develop a 'Pattern Language'[1] as a guideline to design for the elderly, in which places and spaces, movement and actions of the elderly in everyday life are collected visually, and to come up with inspiring concepts for new homes for elderly. This will be elaborated within the time of several masterclasses. The guideline brings together research and design and has the intention to act as a contribution in the debate about and the development of new housing concepts in care for the elderly. The masterclass was developed in close cooperation with the Dutch housing corporation Habion, which is specialized in elderly care housing. The research studies are supervised by the author in collaboration with the anthropologist Dr. Leeke Reinders from TU Delft and lots of support by Peter Boerenfijn, director of Habion, who offered us access to his elderly homes to do research there. This is a search for new ways in which perhaps cohabitation relationships might take care of others, including the elderly. The wish is to shift the emphasis from care to residential and living concepts.

In this paper the theoretical and practical starting points for research on ‘the pattern language’ of the social and spatial organization of the everyday life of dependent elderly people and their support networks is described. The research focuses on the design of indoor and outdoor spaces, social relations and neighborhood networks. The intention is to acquire a finer-grasped insight into the living environment of the elderly by looking at the everyday living environment from their perspective, by observing, talking and walking with them.

The first masterclass is finished and a second and third is ongoing. The students were able to stay in several elderly homes, they had come back days and even made friends. The first outcome concerns sketches and photographs with observations and interpretations of the living of the elderly.

The final guideline is part of a long-term research project in which the goal will be a catalog that lays a comprehensive foundation and presents first proposals for new housing models for housing and care design. This paper elaborates on the method in which anthropological research is combined with architectural design processes and it reports on the first findings of fieldwork study on the everyday life of elderly in Dutch care centers to show how observational studies brought the students to insights they wouldn’t have got without it.

Background & Theories

The process of aging

The process of aging is a global phenomenon. We soon will have more older people than children and more people at extreme old age than ever before [2]. Globally “The number of people aged 65 or older is projected to grow from an estimated 524 million in 2010 to nearly 1.5 billion in 2050, with most of the increase in developing countries.” [3]

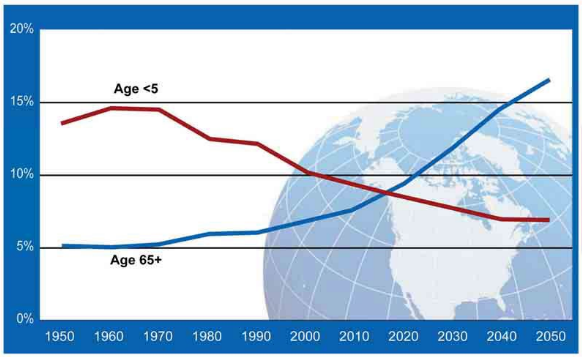


Figure 1. Young Children and Older People as a Percentage of Global Population: 1950-2050.
Source: World Health Organization. (2011). *Global Health and Aging*, p. 2.

We already can foresee that it will increase the demand for primary health care and long-term care. Our environment will need to be made age-friendly. Also, older people can still contribute, within their family, their local community or to the society in broader sense. We have to rethink the way we live together, the way in which care and housing must be organized and the way elderly still can contribute to society. Not only the reachability and accessibility of public spaces and facilities deserve attention, but there is also a need for new ways to integrate elderly and care in our society. We already can see the appearance of a shift in the policy of housing for the elderly from inpatient care, institutional settings and large-scale care complexes to private homes and small-scale organized care facilities. The plea is to arrange that care dependent elderly can live in their own homes and neighborhoods as long and as independently as possible. This process of ‘staying at home’ and having less care institutions and at the same time 'socialization' appeals greater demands on the independence and autonomy of the elderly, their own contribution, and their care-givers and supporters. Numerous initiatives have been taken to move elderly care from institutional settings to the more informally organized support networks in districts and neighborhoods. However, there is little insight into the use of space and the daily activities of the elderly and how knowledge can be incorporated into the design and the (re)development of the built environment. At the same time, the question arises of how the care and support of the elderly can be brought into the local contexts of the city, district and neighborhood.

Aging in the Dutch context

Due to the general appearance of a shift from institutional settings for housing combined with care to the current trend of staying much longer at home, specific problems arise in the Netherlands in housing elderly people in need of care. In particular, the elimination (meaning no governmental financial support anymore) of the so-called *retirement homes*, which were built on a large scale during the period of the post-war housing shortage and the welfare state cause problems. In 2013, the Foundation Berenschot predicted the demolition of 800 of these welfare state retirement homes [4], meanwhile it was already clear that the older population is expected to triple the number of over-85s over the next twenty years. The post-war retirement home should make room for home and informal care. Elderly living in retirement homes where even sent back home as a consequence of lack of financial support. Municipalities, housing corporations and developers therefore face the question of how to deal with the existing stock and infrastructure of these buildings. Can these large-scale housing complexes of the elderly be integrated into surrounding neighborhoods and be used in the future?

Housing corporation Habion, who's real estate is concentrated on the target group of older people (12,000 units, average age of residents 80+), supports this research. Habion is looking for innovation for its real estate. This becomes clear when you look at their transformations of a few 'old-style' retirement homes, such as the project *'t Kampje in Loenen*, where a library, a community center and a collective kitchen for the neighborhood are located within the walls of an existing retirement-/nursing home. Their transformations focus on using the existing real estate differently, often bringing the neighborhood into the building. This is done by giving the local society the facilities to give structure to the desire to grow old, asking what people need for it, and to what extent people want to shape it themselves.

Figure 2. The library of the elderly home 't Kampje in Loenen with on the right side the open corridor and the entrance to an apartment. Source: B. Jürgenhake

New concepts for the architecture of elderly living

In architecture a search for new residential concepts for more vulnerable older people started since 1990. One of these models is the *collective living* which can be found in different countries and in numerous forms. In the United States, numerous *assisted Living Residences for seniors* were built. They are similar to the Dutch retirement home. These are housing models for older people who want to retain some form of independence (a little apartment of 45 m^2 with a little kitchen, bathroom, living- and sleeping room), but can ask for care, often situated on the ground floor (*figure 3*). In Germany residential communities were developed as a model in which elderly people can continue to live in their neighborhood because homes are made life-proof and care can be purchased locally.

Such initiatives are based on the concept of *aging in place* with care in the immediate living environment. During the 2000s in the Netherlands *Residential Care Complexes* were established (*WoZoCo's – figure 4)* in which housing and care were separated, but care can easily be purchased through the service center which is in these complexes. The biggest difference with the *Dutch Retirement Home* is the market-size of the houses and the disconnected care.

Figure 3 and 4. On the left the Dutch "old style" Retirement Home from the 50th and 60th and right a Residential Care Complexes (WoZoCo's) built around 2000. Source figure 4: https://www.mvrdv.nl/projects/170/wozoco

In addition, we see new forms of living on a small scale such as the Multi-Generation Home, the Home House (a home combination of students and the elderly), the Kangaroo House (fig.5), the Knarrenhof (fig.6), and the Sheltered living in a former care home. For temporary care we know the Care Hotel and for the luxury residential care variant the Care Villas. In psycho-geriatric care the concept of Warm home has been developed: small-scale residential and care facilities for people with dementia, such as De Hogeweyk in Weesp (built in 2008), a nursing home with 23 small living groups for elderly people with dementia (fig.7).

Figure 5. Kangaroo House – Figure 6. The 'Knarrenhof' A living complex around a courtyard.
Source: Harkes, D. & Witter, Y. (2018). *Bouwstenen voor de toekomst*, p. 28. Printed by Aedes-Actiz. Kenniscentrum Wonen-Zorg. *Kangaroo House*

Figure 7. De Hogeweyk in Weesp – living for people with dementia. Source: B. Jürgenhake

Methodology

Research Question

Our research is a search for living in which the emphasis may shift from care to living. The main questions are: How do elderly people use their home and immediate living environment and what does this mean for the design of the spaces? What role do collective spaces play in the use and design of private and public spaces? Crucial elements in the research are the relationships between private and public spaces, between neighborhood and communities, and between the elderly and their supporters.

The research method

As Luigi Buti writes "The best source of information is the person for whom the designer is designing the product. And the best way to unearth this information is through market surveys […]. But they tell us very little about more subjective things."[5] We realized that relying on data from scientific literature would not bring the students into the real life of the elderly. In an earlier master pilot about loneliness among elderly, the research was built up very much by literature, the opinion was almost determined before visiting the elderly and most of the results were predictable. This showed how important a direct contact with the elderly themselves in an early stage of the research may be, because of the more or less unconditioned perspective the student has at the beginning of the research phase.

The scales of the body – the home – the environment: As we have the ambition to develop a catalog of results for the architectural design of elderly dependent on care, comparable and comprehensive data are needed. Within some similarity of the care dependent elderly, we may learn about their daily routines and spatial needs. The range of an elderly person in need of care becomes smaller (300-500 meters). It is therefore important for them to have meeting moments close to home. Activities cost energy. At the same time elderly do have a network outside their home. The design of a new concept for a home with care requires knowledge about the daily habits, activities and routines, routes and rituals of the elderly and their supporters from close to fare distance.

When Alexander made his 'pattern language', he distinguished between towns, buildings and construction. Because of the limited distances a vulnerable elderly will take in daily life we choose for the three levels: The body – the home – the environment. On the level of the body, the influence of the body (and mind) on the experience and the use of space (visual, touch) needs to be understood. The level of the home is an important level of action in daily life. Questions concern the use and preferences of spaces. The research on the environment focuses on the relation between indoor and outdoor spaces, private, collective and public domains, social spaces in the neighborhood. These levels will be set up in the catalog as well, and each situation will be shown by a photograph, an extended capture explaining the problem, and a possible solution in with a text or drawing.

The first fieldwork shows that lots of activities of vulnerable elderly are bound to the own room and the house, much less to the outside. Therefore, we suggest for next courses to distinguish as well between activities of the daily routine – frequent activities (ones or twice a week) and sporadic activities (ones or twice a month). With these levels the spaces according to the activities, and the meaning for the architecture may get clear.

Visual anthropology of living: Fieldwork and direct interaction with the target group has a very important place in the research. L. Reinders had experience using visual research methods like photography and photo rapportage in a study done in Brussels, where photo sessions and interviews were taken [6]. Interviews were done to get into contact with the elderly and win their trust, whereas the photos show sequences of the activities in their spaces [7]. We decided to let observation be a main tool of the research, supported by interviews. To collect the data, drawing, sequential photography, soft mapping or other pictorial techniques may be used. To make photographs comparable, the same angle had to be taken for several situations. As Collier states it, the benefit of photograph is that "any number of analysts can read the same elements in exactly the same manner."[8] However, we realized that in order to keep the privacy of the elderly, faces on photographs had to be blurred. In this pilot, students did not dare to take photographs of persons so much, in an ongoing course students over-draw the photos to make them anonymous (figure 13 shows an over-draw).

Analysis of the material: Series of photographs with the same topic will show easily the exceptions. Research on the spaces the elderly come across in everyday life can be done by using architectural drawings as this is a very common tool for architectural students. Analytical drawings can show general and specific findings, for example the analytical drawing of the common places for furniture (figure 11 – lay-out basic apartment).

A template to support fieldwork: We realized that students should and will have their own ideas about what kind of data to collect and wanted to leave space for the unexpected, but we developed a guideline that can function as a template for the research. Table 1 contains a clear structure with the three scale sequences, supported by questions. Table 2-3 contain levels of activities which we developed later, for the next course. The use of the visual anthropological method developed from the conviction that the daily life of people is a rich source of inspiration and that the visual way of noting is more direct and helpful for architectural students.

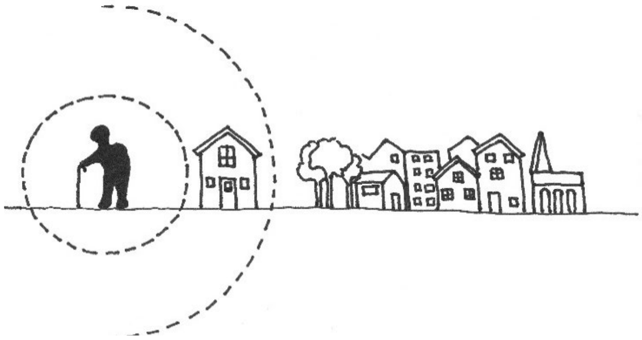


Figure 8. The body – the home – the wider environment. Source: B. Jürgenhake

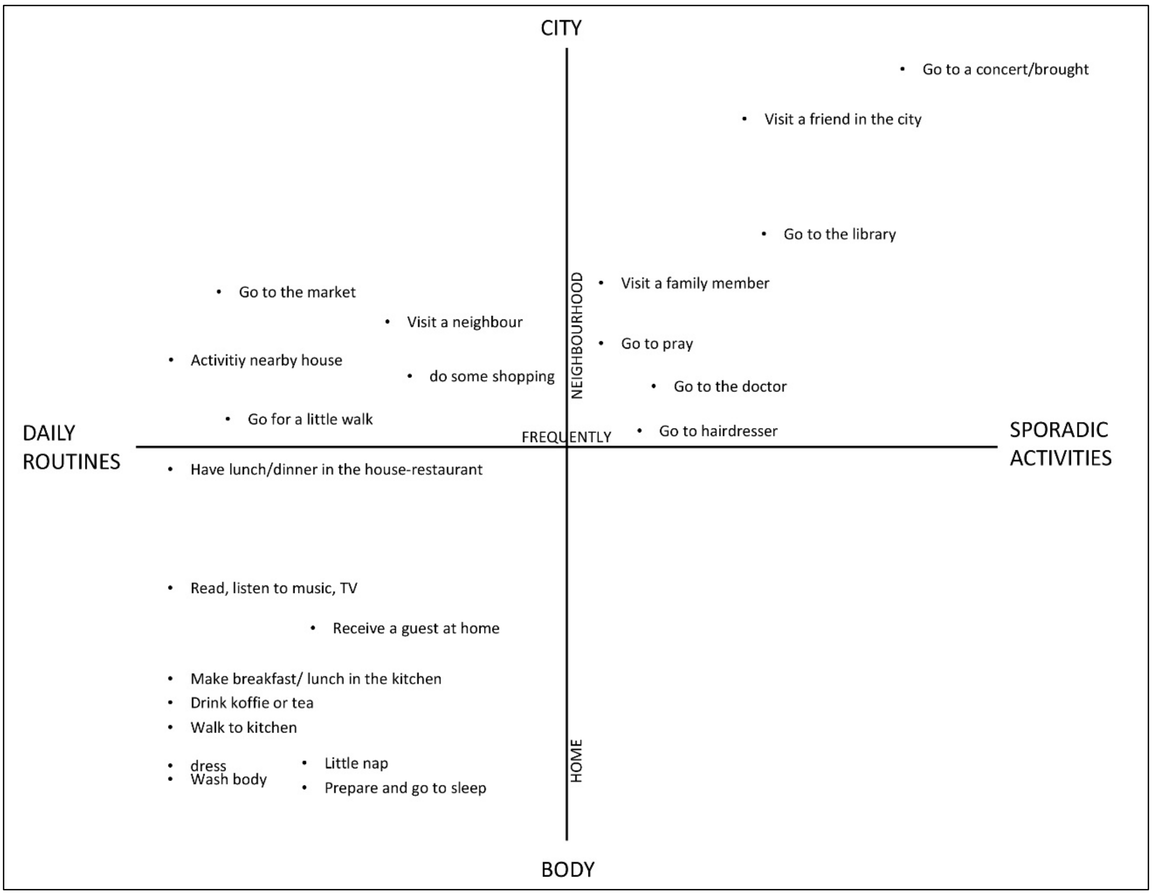
Table 1. Questions to support the fieldwork

The three scales:	**1 - *The body***	**2 - *The house as a room for action***	**3 - *The relationship with the wider environment***
	The influence of body (and mind) on use and perception of space The sensory experience of space (visual, touch)	How do older people use their home? What influence does aging have on the interior? Which rooms / spaces become important or redundant? Which routes and areas of use arise in the home? What are the daily customs and rituals of the elderly at home and where are these performed?	How do indoor/ outdoor spaces relate to each other? How do private and public domains relate to each other? How big are social distances for these people? How far does the environment of elderly people (care needing) extend? How do support networks emerge? Which routes and roads do they cover and which places do they use? How do older people orientate themselves in the city?

Table 2. The different activity levels

The activities on three levels:	**Assignments**
The daily routine washing and dressing, eating up to the moment of going to sleep at night	• Visualize the activities directly concerned to the body. • Ask about the visual and haptic perception of space • Investigate where these activities take place. • What kind of space is that? • Where and in what kind of space?
Frequent activities Walks and visits ones or twice a week	• Investigate where these activities take place. • Visualize the space.
Sporadic activities Walks and visits ones, twice or three times a month	• Investigate where these activities take place. • Visualize the routes and the spaces.

Table 3. Activities and their places (an example of the analysis)



The structure of the course

The study was part of an architecture masterclass (Spring semester 2018, 16 weeks, 2 day parts of contact per week, 14 students) with the design assignment of new ideas for the transformation of two Dutch retirement homes. In the first week we visited both homes and some examples of realized transformations, like 't Kampje (figure 2). We asked the students to note the user groups and what kind of functions they come across. In the second week we started to acquaint the students with the research method of visual observation by showing different examples how observation can be done by photography, film and sketches. We used film material made by William Whyte [9] and by Bent Hamer, his film 'Kitchen Stories' illustrates the different distances a researcher can take. We asked the students to do try-outs with these different distances. Main literature we offered was Collier's Visual Anthropology, Stanczak's Visual Research Methods [10], Makay &Reinders, and the studies of the architects Alexander, Gehl [11], and Hertzberger [12]. Next to this we showed film fragments, photography and examples of mapping.

We introduced photographers like Michael Wolf, who worked on different scales, from body to city. In week three we elaborated further on the methodology and the three scales of *body – home – environment* were determined as basis for the fieldwork. We discussed the different activity levels but wanted to keep this open for exploration. Fieldwork was done in week 4 and students had two more weeks and come-back days to finalize their fieldwork. The students showed the results in week 7 and discussed what this means for architecture. After the next four weeks students came up with first ideas for a transformation of one of the two buildings. The course ended with a final presentation of their design.

The fieldwork

By means of a three-days stay and two come-back days, the students collected data about the daily life of the elderly. Besides that they came up with information about the professional care and informal care-givers. While staying in the elderly houses the students realized that some information could only be observed (like unconscious movements and habits), while other came from the talks. Seven students and two teachers stayed in a nursing home in the city of Amsterdam, seven in a nursing home in Hilversum. In this paper the retirement home in Amsterdam will be documented (see figure 3).

The elderly were average 80+ and all dependent on care. A closed department of dementia, situated in a low-rise building, was excluded for our research. The elderly we participated with, live in a high-rise building and hire a two room apartment. Between low-rise and high-rise is a middle zone situated, which is the communal part of the building.

It contains a restaurant, bar lobby and sitting area, as well a small shop and leisure space. Meals are brought to the rooms or, if possible, the elderly go down to the restaurant.

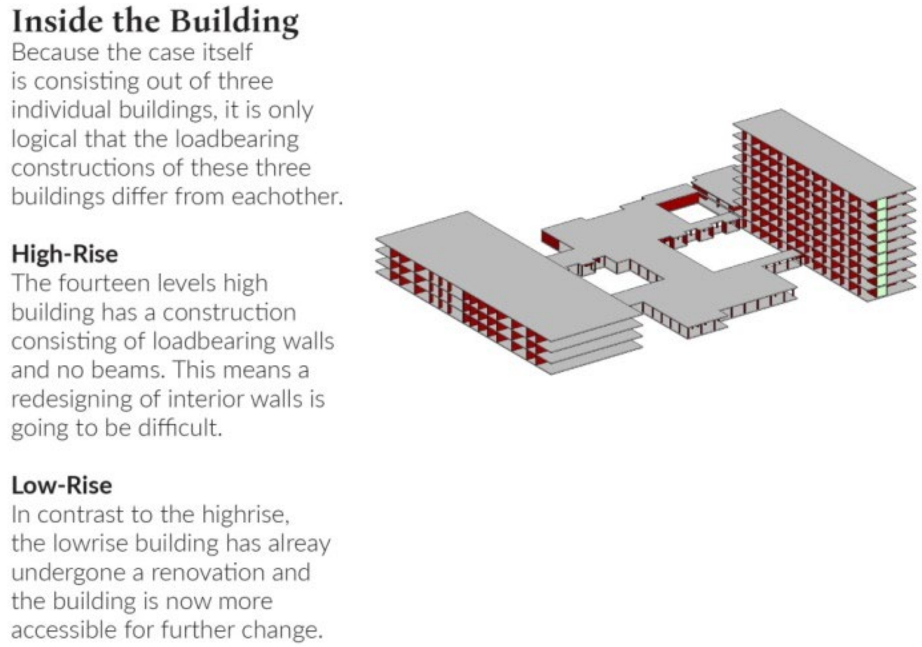


Figure 9. Overview of the nursing home, drawn by Sinan Aydin

1 – Scale of the body: Most activities were bound to the own apartment or the house. Although private rooms have similar floor plans, the use and decoration of space show many differences. When people are in a wheelchair or use a walker within the room, the room is set up more spaciously. By placing the apartment layouts on top of each other, a number of striking elements appear. First, people use all the wall surface. People place furniture against the wall and the window, which makes the balcony inaccessible. Second, often a corridor is created between the entrance door and bathroom door at the edges of the apartment.

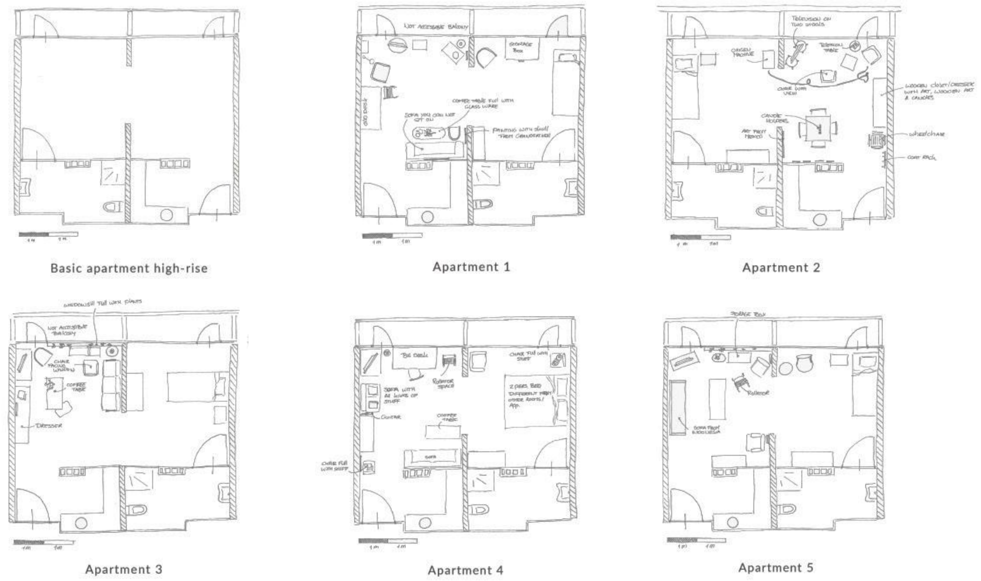


Figure 10. Different interiors of the same floor plan. Source: Different interiors of the same floor plan by Gitta Tolboom

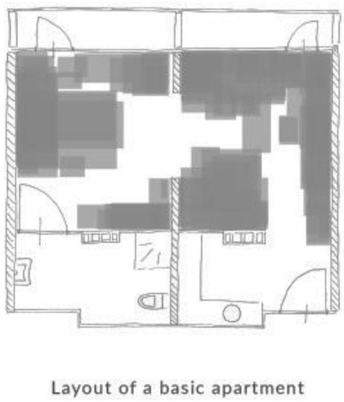


Figure 11. Analytical drawing and description of the common lay-out. Source: Different interiors of the same floor plan by Gitta Tolboom

2 – Scale of the home: The students started to understand the 'house as a room for action' by talking to residents about their daily routes within this complex. Residents generally follow specific pathways that lead directly from their private room to the service area on the ground floor, but don't use different parts of the building. Most of the day, the communal parts of the building remain empty. Some people who come for evening dinner wait a few minutes in the lobby. Only a few will make a chat or come for a drink.

The high-rise building has long hallways that are slightly differentiated by coloured panelling. One student photographed all corridors in the same way. Entrance doors to the private little apartments have no differentiation at all except the name boards and the personalized mailboxes. Students observed the emptiness in all hallways, no photographs, no place to meet. Neighbours scarily know each other.

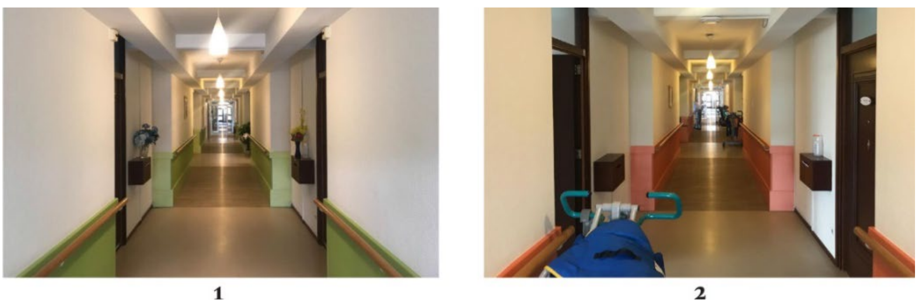


Figure 12. Selection of series of long hallways (the student made 12 photographs). Source: Selection of series of long hallways by Dobrava Kicinska

The students observed that most decorations in the collective rooms on each floor and throughout the building include flowers and plants, some of them fake. Many decorations contain abstract forms but are also brightly colored. Some images of animals are used as decoration or entertainment, like a fish in the aquarium and a parrot in a cage. Animal themes also appear in teddy bears, toys and sculptures placed in different parts of the building. These decorations are often associated with children. In general, decorative objects seem to be spread coincidentally around the building (One student photographed all decorations).

When it comes to the private domain, there are interventions of decorations, such as the mailboxes near the entrance doors of private rooms, on which plants and objects are arranged by the elderly. However, a hand disinfection bottle, used by caregivers, stood on lots of the private mailboxes.

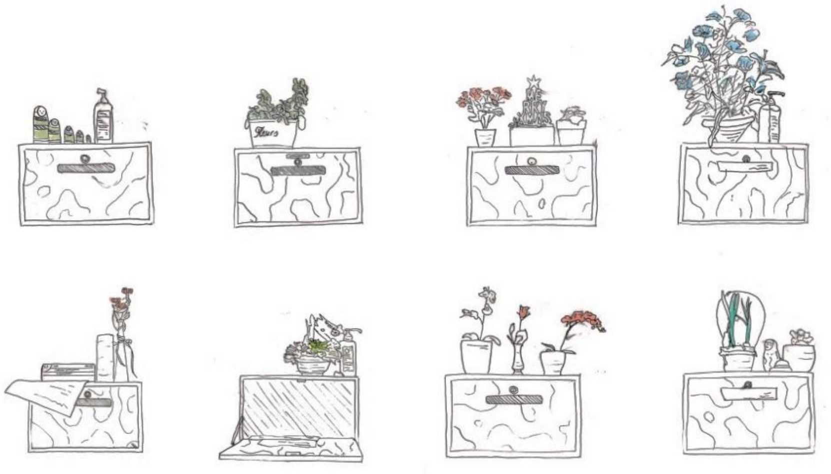


Figure 13. Series of different mailboxes. Source: Series of different mailboxes by Mark Breman

The three garden patios were not used. Asking why, the residents explained that they were windy and uncomfortable places to sit down. Walking through the corridors, especially one on the backside, several places were seen where laundry was collected in carts or mattresses were parked to be picked up. It clearly was a working route and not an access route to gardens. The interviews the students held showed that people are not active, and not motivated to be active.

3 – Wider environment: The building is directly next to a large park area which is inaccessible for most elderly living in the care facility. Most functions in the neighbourhood are located beyond a radius of 250 meters and thus difficult to reach by older people. Residents miss the connection and the atmosphere of the city they have lived in (Amsterdam). One resident who was born in the North of the Netherlands expresses a need for these sorts of rustic views. Asking her how often she is taken to the park, the woman stated she hasn't been in the park for two years, as it is difficult for her to come there. Barriers like a four-lane street and a bridge which is impossible to take for her by wheelchair make her dependent on the help of others. When she was taken to the park by us, a little train rail track for kids-tours through the park made it impossible for her to move around in the park.


Figure 14 and 15. Taking an inhabitant to the park – mission almost impossible. Source: B. Jürgenhake

Conclusion

The topics the students focused on were supported by the three scales, the body, the home, and neighborhood. The study showed us how especially the observation brought them insights they wouldn't have got only by talking to the elderly. More time is needed to collect information by asking family members and professional care as well. Students ended up with first suggestions for ideas about the living of the elderly, which need to be further developed.

- **Taking a break:** Niches for resting are very important in- and outside the building
- **Recognition** of well-known places like entrances, are important as well as clear and good readable signs.
- **Make short hallways:** Long corridors should be avoided. People experienced difficulties in orienting themselves in those spaces.
- **Readability** and **identity** are important advice. All the mailboxes were decorated by the owners. Personal post boxes should stay personal.
- **Stimulate interaction!** The building itself did not stimulate interactions. It was very much introvert and centered around unused patios. One student proposes an interior pathway as a series of scenic views, to the children's playgrounds next to the elderly home, to natural features and the people passing by.

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ETHICAL CHALLENGES CONDUCTING RESEARCH IN ENVIRONMENTS FOR INCARCERATED CHILDREN AND ADOLESCENTS

Kajsa Nolbeck [(1)*], **Franz James** [(2)], **Göran Lindahl** [(3)],

Stefan Lundin [(4)], **Sepideh Olausson** [(1,5)], **Charlotta Thodelius** [(3)], **Helle Wijk** [(1,3,5)]

[(1)] Institute of Health and Care Sciences, Sahlgrenska Academy, University of Gothenburg, Sweden

[(2)] HDK – Academy of Design and Crafts, Department of Design, University of Gothenburg

[(3)] Department of Architecture and Civil Engineering, Division of Building Design, Chalmers University of Technology, and Centre for Healthcare Architecture, Chalmers University of Technology

[(4)] White Architects

[(5)] Sahlgrenska University Hospital

* Corresponding author e-mail: kajsa.nolbeck@gu.se

Abstract

The objective of this paper is to describe and discuss ethical challenges when conducting research in the context of compulsory institutional care of children and adolescents (youth), more specifically on issues related to the physical environment.

Our interdisciplinary research group conducts a three-year research project within special residential youth homes provided by The Swedish National Board of Institutional Care (SiS). Their two-folded aim i.e., to (re)habilitate and to incarcerate, puts special demands on the physical environment, and adds to the ambiguous experience of care and incarceration for youth in these “total institutions”.

To capture the lived experience of incarcerated youth, aid to raise their voices, and make visible their everyday care environment, research needs to be conducted in place. In the research project so far, qualitative methods applied, including interviews with youth and staff using interactive tools (photos and sketches) and observations of interactions between the youth, staff and the physical environment have been used. Fieldwork and data collection in these settings are challenging processes, with a risk of being involved in critical incidents where ethical principles can come in conflict. Therefore, during the course of the research project the need of developing an ethical codex; a set of guiding principles, became evident within the research group.

In this paper, ethical standards and theories are used to critically analyse ethical challenges in the field through cross disciplinary discussions. The environments of involuntary care require a firm addressing of ethical stance and standards among researchers. Good ethical standards in research do not end with formal regulations or ethical approval. Rather is the starting point of an ongoing ethical dialogue, where an ethical codex can guide the researchers and help to maintain good ethical practice throughout a research project.

Research in the context of involuntary institutional care of youth requires ethical awareness and sensitivity. Irrespective of the research being qualitative and implicate close interaction between researchers and people in the field, or quantitative with access to highly sensitive large-scale data material, there is a necessity for the researcher to be power sensitive, self-reflective and to practice high ethical standards.

Keywords: *Design and care | ethical challenges | qualitative methods | involuntary care | youth*

Introduction

The objective of this paper is to describe and discuss ethical challenges when conducting research with children and adolescents in compulsory institutional care. The challenges addressed have their origin in a research project, with an interdisciplinary research team, focusing on incarcerated adolescents’ experience of the physical environment. The objective is to contribute to a discussion on researcher stance and ethical challenges.

In Sweden, The Swedish National Board of Institutional Care (SiS) provides compulsory institutional care for children and adolescents (youth). An overarching goal for the care provided by SiS is to promote a life without substance abuse, criminal activity, and violent or anti-social behaviour. The two-folded aim, i.e. to (re)habilitate and to incarcerate, puts special demands on the physical environment and adds to the experience of care and incarceration for youth in these ’total institutions‘ (1, 2). The total institution, according to Goffman, is defined as a closed world in relation to a wider society and includes a forced compulsory formalization of everyday life. To conduct research in this type of institutional settings is challenging from several points of view: the power structures embedded through incarceration; disciplinary distribution of space and a vulnerable group being researched with many times traumatized by self-destructive life.

Young people's rehabilitation and reintegration take place in a socio-spatial context where the interaction between physical and spatial conditions with social interrelation must be taken in consideration. This means that the socio-spatial context can either enhance or limit these social interrelations in terms of design and spatial layout. This also counts for staff's ability to use their competence and commitment to give care and establish supportive relations. To the best of our knowledge, the field of research regarding young people in compulsory care is scarce. Young people in compulsory care are identified with complex behaviour, psychosocial problems, and anti-social behaviour which causes great difficulties in everyday activities. From time to time, threats and violent behaviour, which may also be seen as resistance to loss of power, may cause a need for coercive measures, which means stress and discomfort for all involved. Violent and anti-social behaviour can as well be explained by a variety of complex factors, e.g., neuro-psychiatric diagnosis, learning disabilities, and stress, as well as untrained staff and a poor physical environment that lacks necessary features to support staff and youth.

As researchers doing fieldwork at the SiS homes, we have met youth who have witnessed of their experiences of harm and discomfort caused by the physical environment. We have also been told disturbing stories about maltreatment from staff. Within the research group we have been uncomfortable in how to handle the troubling information, as well as what we have witnessed and experienced ourselves in regard to incidents, but also how to handle a number of environments unworthy for youth that need care. We realised that we needed an action plan to handle what we experienced. As all researchers that do research with vulnerable groups, we are given life stories that rarely are positive. As any human being we bring these stories with us at the end of the day, and we are affected. This is another dimension we felt we needed to handle.

Rationale - General assessment and ethical considerations

This paper discusses ethical challenges in relation to research focusing on the physical environment's role for incarcerated youth, bringing on questions to ethical issues related to, in our case, qualitative methods during fieldwork including e.g., open-ended interviews and observations.

Ethical standards e.g., principle of research ethics: Respect for autonomy; Beneficence; Non-maleficence and Justice (3) are reflected upon. Further, the child rights perspective, especially through the Convention of the Rights of the Child is used to discuss and analyse ethical challenges in the field (4).

Research including children and adolescents should be guided by the aim to do good, not cause harm, and to empower the participants (5). In this specific context, the aim to do good means to raise awareness and expand the knowledge base to what prerequisites may be needed to promote care and rehabilitation for youth. Moreover, such research has an explicit child rights perspective. According to the Convention on the Rights of the Child (4), care environments aimed at rehabilitating vulnerable children must "promote the child's health, self-respect and dignity" (Article 39). This also, evidently, applies to youth who have committed crimes (Article 40). The best interest of the child, as a principle, should lead and the child protection aspect should be emphasized (4). This means not only to take in consideration the physical environment, but also to empower and support youth' voices to become heard, i.e., conducting research for and with these children and adolescents.

Youth under compulsory institutional care constitute a vulnerable group. To capture lived experience of incarcerated youth, research needs to be conducted in place. To understand, experience, and feel the physical environment through the youth's perspective, implicates a need to experience their everyday lived place and space together with the youth, that is to do research *with*, not on them (5).

Interactions between the youth, staff and the physical environment have been studied in the research project, as well as the youth's experience of their immediate surroundings. The qualitative data collection during fieldwork in the research project uses visual methods, Photovoice, "Sketch and Talk", since they have proven to be suitable when conducting research with children (6). Visual methods can reduce the imbalance in power between the researcher and the participant (7, 8), images can also facilitate talk about such abstract phenomena as the physical care environment and its details. Visual methods have further been found useful in relation to ethics and security restrictions in the study of prisons (9) and psychiatric hospitals (10). Photovoice invites participants to take images of what matters to them, in this case in relation to the physical environment, giving them ownership of the creation and interpretation of the image. The images taken are then followed up by open-ended interviews (11). This process is a means to empower and give voice to vulnerable groups when brought to decision makers and brings important democratic and critical issues in play (12, 13). "Sketch and Talk" is an ethnographic design research method for data collection. It consists of openended interviews with simultaneous sketching and note-taking by hand by the researcher. Mainly in the environment where the youth resides. The visual documentation focuses on phenomena of the physical environment that is essential to the participant. Moreover, the sketching is an open transparent visible process, thus giving the participant full insight to the collected data (9). Observations have also been used to collect data, setting the researcher in a position between youth and staff, sometimes an odd experience challenging loyalty and trust. Field-work and data collection in these settings have proved to be a challenging process, with a risk of being involved in critical incidents where ethical principles come in conflict. Through thorough dialogue within the research group a set of guiding principles have been discussed and decided upon. These principles, as well as the ethical codex, will be addressed further on in this paper.

Methods

The research project has ethical approval from the regional ethical committee (14) and the data collection is preceded by the young people's consent together with the aim of a dignified, respectful and reflective approach to not do harm. However, still there is a risk of ethical dilemmas during the data collection process for the researchers when witnessing incidents, or take part in stories of abuse or offensive behaviour, given in the interviews with the youth. However, it is important to stress the fact that the researchers have not asked for this type of information, the focus has solely been on the experience of the physical environment. Nevertheless, this information has become evident in stories related to the physical and socio-spatial environment. It may be in some situations obvious that confidentiality might need to be broken and measures taken immediately, while in other cases it may be that the child or adolescents would not benefit from such actions. This implies that a traditional and compulsory ethical approval to conduct these studies is not a sufficient in itself for guiding the research team. Rather, an ethical codex to guide in situations such above, was needed to guide and support the research team. For development of the ethical codex, ethical standards and theories were used to critically analyse ethical challenges in the field, through cross disciplinary discussions. Ethical standards e.g., principle of research ethics: Respect for autonomy; Beneficence; Non-maleficence and Justice (3) were reflected upon in relation to specific challenges experienced during data collection. Further, the child rights perspective, especially through the Convention of the Rights of the Child were used to discuss and analyse ethical challenges in the field (4).

Applied methods

In the research project both qualitative and quantitative data is collected, however, the main consideration for the ethical codex is related to the qualitative data collection.

Experiences, implications and ethical challenges

The social and physical environment of the special residential youth homes, differentiate in several ways from other care environments such as primary care clinics, hospitals and community social services. First, the youth are there involuntary, i.e., they are cared for under permit of law. Second, a majority of the children and adolescents are underage, the youngest being 12 years old or sometimes younger, and the oldest twenty-one. Third, the youth often suffer from psychosocial and cognitive problems and/or substance abuse, lack stable family situation and relations. Fourth, the Swedish National Board of Institutional Care (SiS), unlike other care facilities has far-reaching powers, e.g., to separate a child or adolescent from the rest of the group, use physical force, and to search the youths' mail and individual belongings, to mention a few examples (15, 16, 17).

From a research perspective, the above stated circumstances due to the specific social and physical environment are important to study, but also what constitutes the ethical challenges. First, the "involuntary aspect", creates an inevitable power imbalance and tension between the staff and the youth, as well as between the researchers and the adolescents. While "we" (staff, researchers) can pack our things and leave by the end of the day, "they" (youth) remain in the institution. These opposite "degrees of freedom" (ability to leave/forced to stay) creates an entrance to the research situation (for example the interview situation), characterized by a power imbalance. Second, the respondents (i.e. the youth) are young children and adolescents, whom we as researchers and adults encounter in a situation where they are far from their parents/guardians and friends. In addition, this research need to be conducted *in place* together with the participants, often in their rooms. With this comes a great responsibility and need for responsiveness to the specific terms of temporal reality for the youth, they need "hang around time" before getting down to the possible interview situation, and their plans can instantly be changed, moreover, time is needed to build trust. Adaptability by the researchers in terms of taking a break or ending the interview whenever the youth need or wish is a must. This, also, refers to the third aspect, concerning the youth's psychosocial and cognitive problems and/or substance abuse withdrawal. This aspect has two sides; first, the youth may have a "bad day", feeling sad or have received a troubling message; they may also have difficulties to understand the questions or the research information due to ADHD or autism with consequences as restlessness, difficulty to focus or communicate. Thirdly, due to the above-mentioned psychosocial and cognitive difficulties, there could be a risk of externalizing behavior, threat and violence. These two sides, put demands on the researcher. On the one hand, to be sensitive and responsive to the youth's needs and feelings, on the other hand, to take into consideration the researchers' own security. This sets certain difficulties to personal integrity, as well as to risk for the researcher to either be subject to provocations, or risk to be accused for improper behavior. The fourth and last aspect, concerning the caregivers' far-reaching powers to intervene, could lead to that the researchers may witness situations of misconduct where the personnel violate their power. This leaving the researchers in a difficult ethical situation. The decision to take action direct, or to await and write up the results from the research, constitute a careful valuing that needs to take place in every single situation. Direct action may benefit the child or adolescent in a specific situation of for example worn out physical environment. On the other hand it may not benefit the youth, whom is forced to stay in the institutional environment due to permit of law. Accordingly, the intention with our research being to raise knowledge and to contribute to improvement in the institutional physical environment, could potentially be challenged by direct action, through denied further access to the research field. Which in turn would lead to lack of knowledge and hence lack of potential improvements.

When doing fieldwork, how do we maintain our security but not communicate distrust? So far there have been a few incidents, though not severe. But we need to remember that we are the intruders, and violate private space. We also need to remember that it is possible that we might do harm unintentionally, or stir up something in the group of youth, leading to turbulence. We have also experienced situations where youth are corrected by staff regarding youth's behavior directed towards us. Where does that place us in relation to the youth, and their trust in us? Staff and leaders will also be provoked when/if we come with serious critique pointing out their failure to how the physical environment has been neglected. The ethical dilemma here is not so much communicating what we see, but if the research project gains by bringing up troubling issues with the physical environment now, or in our papers and final report.

Despite, that researchers in Sweden are not covered by the legislation (18) to immediately report suspicion when they see that a child may be mistreated, the research group found it necessary to state their respect for the young people in an ethical codex. First, the overall guiding principle stated in the codex is respect for the youth's integrity and autonomy. This shows in the "hang around-time" spent at the institutions and the wards, to create relationships and gain trust. Rather than the researcher wait for the adolescents to come to *them*. A necessary but gentle and sensitive process characterized by respect and dignity for the youth. The second guiding principle connected to data collection, regarding the researchers' safety and data reliability has developed to that two researchers always are present in interview and observational situations. The necessity to balance the teamwork in this intimate situation, with the respect for the respondent's integrity was discussed in the research group, resulting in practical guidelines aiming for power equalizing while maintaining security. This led to rethink how to approach the youth at the actual interview situation, e.g., the two researchers now sit on the floor, while the young person usually sits on the bed or on the floor. It is not only the difference in height that mitigates the imbalance in power, the researchers always ask if it is ok to sit on the floor, or enter the room, i.e., the respondent can place the researcher in the distance or place that is desired, or chose another place for the interview.

With the above principles in mind, the research group stated a step-by-step action plan. The action plan constitutes several steps, from open and continuous discussion of ethical dilemmas within the research group, to consulting colleagues and professionals and if needed, breaking the secrecy for the benefit of the child. In the case researchers note serious abuse or severe incidents during ongoing data collection, the ethical codex states a five-step plan. 1, discussion within the research group. 2, information to the head of the unit or the head of the institution. 3, if deemed necessary, the research and development manager at SiS is contacted. 4, in cases where the situation so requires, report to the Health and Social Care Inspectorate (IVO), 5, debriefing. If any of the researchers are subjected to offensive behavior or violence during data collection, the procedure is similar as to what was just described.

Besides the guiding principles, the ethical codex also states that the research group should establish a contact network with children's rights organizations. This partly in order to be able to convey to the youth what support they can get when needed and partly to exchange advice and experiences with regard to noted misconduct.

Conclusion

The objective of this paper was to describe and discuss ethical challenges when conducting research in the context of compulsory institutional care of children and adolescents, and issues related to the development and use of an ethical codex to handle those challenges.

The question addressed in the paper is relevant, not only related to the setting of children and adolescents in compulsory institutional care, but in every situation, that involves vulnerable groups' participation in research.

The environments of involuntary care require a firm addressing of ethical stance and standards among researchers. Good ethical standards in research do not end with formal regulations or ethical approval (14, 19). Rather is the starting point of an ongoing ethical dialogue, where an ethical codex can guide the researchers and help to maintain good ethical practice throughout a research project.

Research in the context of involuntary institutional care of youth requires ethical awareness and sensitivity. Irrespective of the research being qualitative and implicate close interaction between researchers and people in the field, or quantitative with access to highly sensitive large-scale data material, there is a necessity for the researchers to be power sensitive, self-reflective and to practice high ethical standards. As researchers, we need to remember that we are the intruders, and violate private space, though doing research on the physical environment can possibly be less provocative than other areas of research.

The context of compulsory institutional care of children and adolescents is a most relevant and complex context to discuss ethical challenges in conducting research regarding the physical environment. Researchers within this interdisciplinary team, considering their ordinary research fields, do not always have experience of these specific settings. The results of the cross disciplinary discussions and the ethical standards that derive from this, might also be applicable to other settings. To our knowledge this is a unique research project, and it should be said that we hope for more research in this field. We hope that the ethical challenges discussed in this paper can aid other researchers in the field of creating knowledge in similar settings.

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HOUSING AND LOW VISION REHABILITATION – ACROSS THEORIES, PRACTICES AND EVERYDAY SETTINGS

Turid Borgestrand Øien *

The Danish Building Research Institute, Aalborg University, Denmark

* Corresponding author e-mail: tbo@sbi.aau.dk

Abstract

Objective – The objective of this paper is to open up the 'black box' of low vision rehabilitation related to domestic lighting and to explore a current progress in practice.

Background - Alterations and adjustments of the home or working environment for people with low vision have been based on scientific diagnostics and the level of vision and translated into a level of required lighting. This narrow and technical approach have recently been challenged by rehabilitative initiatives from professional and political stance. The rehabilitation approach embraces the everyday self-reliance of the citizen, where the social and physical contexts play an important role. Since 2015, the Danish municipalities have been required to offer citizens with impaired functioning rehabilitative initiatives that are 'organised and performed in a holistic and interdisciplinary manner'. The methods and theories for handling this in a holistic and interdisciplinary manner have been missing. Consequently, some of the low vision services have developed their own methods to gain a better understanding of the social and physical context of low vision rehabilitation and the citizens' quality of life. In addition, the current practice is adapted along the way.

Methods – Two low vision consultants and their implementation of a recovery-based lighting assessment have been explored by participative observations in home visits and in the light lab, followed by a semi structured interview with the consultants. Drawing on the field of science, technology, and society studies the paper discusses different kinds of knowledge and their role in rehabilitation practices.

Results – By focusing on issues of domestic lighting in relation to everyday activities, the scientific diagnostics were translated to highly contextualised conditions. Different types of knowledge were addressed in the consultations, including tacit knowledge, embodied in the participants and embedded in guidelines, technologies and surroundings. The narratives of the citizen, accompanied with photos and lux measures were used to recreate the settings when moving to the light lab. Based on the specific activity, the consultant demonstrated different lamps and arrangements and was guided by the immediate feedback from the participant when different lamps were compared. The approach by large resemble the person-environment-occupation model, enabling different types of knowledge and the aspect of development over time.

Conclusion – By framing the visual impairment in terms of light and occupation, the consultants enabled a space for discussing challenges and testing possibilities regarding the citizens' physical and social context, and to co-create the most relevant knowledge.

Keywords: *Low vision rehabilitation | interdisciplinary research | housing | STS, co-creation of knowledge*

Background

Since 2015, Danish municipalities have been required to offer citizens with impaired functioning rehabilitative initiatives that are 'organized and performed in a holistic and interdisciplinary manner' [1]. In theory, rehabilitation and recovery-based services embrace the everyday self-reliance of the citizen, where both the social and physical context play an important role. However, low vision services are still largely based on diagnostics: a physical examination of the function of the eyes, which is measured at a distance of three metres in the clinical setting of an optometrist or ophthalmologist and is translated into a level of required lighting or recommended lux value. This narrow and technical approach represents a medical model of understanding, where the impairment is the focus of attention.

New approaches to low vision services are emerging locally, and this paper describes an initiative that argues that a) the need for light is different for different tasks, b) that people have different preferences for light, and different desires and interests, and c) that the role of relatives is critical concerning the success of the implementation of the recommendations. The services move closer to the everyday lives of the citizens and call for different approaches than the medical model.

The article is based on the initial fieldwork of an ongoing postdoc project on low vision rehabilitation following the vision department at the Centre for Special Education (CSU) in Slagelse and their development-project *Better light for better living* (BLBL).

Theoretical framework and methodology

The work of CSU has been explored through participative observation in eight home visits and seven consultations in the lighting lab, each for one to three hours. The focus has been the situated practice, the consultants' use of methods, and the different types of knowledge at play. In essence, to assess the interaction between consultant, citizen, relatives, and the home environment. The observations have been documented using audio recordings, photos, and field notes. An additional two-hour semi-structured qualitative interview with the visual consultants was conducted to reveal subjective understandings embedded in their practices, technologies, or spatial structures in which they work [2].

BLBL forms an instrumental case for understanding the nature of the development of recovery-based services, explored by the theoretical framework of science, technology and society studies. Knowledge and technologies are understood in their social contexts as shaping and as being shaped by social aspects [3]. This shaping or construction is practised by both human and non-human actors who translate, mediate, and negotiate different objectives and understanding [4]. The different actors are qualified and informed by different knowledge domains, or hinterlands, which work as standardised packages of collective understanding: 'The *hinterland* produces specific more or less routinised realities and statements of those realities' [5]. In the collective understanding, knowledge, technologies, and practices can constitute 'black boxes' where complex conditions are simplified into input and output. The most effective black boxes use *immutable mobile*s, inscriptions keeping their meaning when applied in different contexts: that are 'presentable, readable and combinable with one another' [6]. This applies to mathematical formulas, diagnoses, diagrams, and units.

Better light for better living

BLBL is a three-year method development for a recovery-based lighting assessment for low vision services run by two consultants at CSU. The service focuses on the role of lighting and the citizen's quality of life in everyday activities. During the winter seasons of 2017/18 and 2018/19, 60 citizens participated. Besides an initial visual function questionnaire, the study design includes three steps. 1) In the home environment of the citizen, guided by a narrative interview, the citizen described their challenges and desires, regarding light and vision. Together, the consultant and citizen identified and assessed three activities where they experienced challenges in their home and conducted two visual tests. The consultation was further documented by photos, light measurements, and drawings. Finally, the visual impairments were communicated to the relative by virtual and augmented reality. 2) The citizen and relatives were invited to the lighting lab. The lab included a kitchen-dining area and a living room with a range of different lamps and arrangements available to test the lighting. The consultants and visitors recreated three activities and tested different bulbs, lamps, and arrangements step by step. 3) A home visit was made two to three months after the lighting session to follow up on the process.

The complexity of the everyday

A multitude of different activities were identified through the narrative interviews: to see (your family or oneself in the mirror), to *socialise* (find the way, recognise people, travel, and play sports or games), read (recipes, books, newspapers, letters, instructions, email, subtitles, banknotes, TV programmes, and bus numbers), write (letters, messages, and diaries), do *handicrafts* (draw, sew, knit, and crochet), *locate things* (at home and in public), *prepare and eat food* (measure ingredients, avoid crumbs and food spills or burning food, and avoid toppling a water glass), *do housework* (handle laundry and dishes) and *handle self-care* (personal hygiene and getting dressed). For many elderly individuals, the variety of activities during a day influenced the quality of life because many were housebound. For the represented young individuals, it was also a question of obtaining an education, keeping a job, or forming their future lives. The needs and desires were individual, and the same diagnosis was experienced at different intensities and stages combined with other conditions, and most importantly, they were always in flux and changing. The home environment held different variables: size, organisation, and orientation of space; thresholds; window sizes and locations; interior arrangements; surfaces and finishes (colours and patterns); design, distribution, and position of lamps; and a range of different bulbs and light sources. Finally, to add to the complexity, the citizen's ability to handle the situation and cope with the challenges, involves not just bodily functions but also psychological and social processes.

Mapping different kinds of knowledge

The mapping of the 15 consultations showed a range of different types of knowledge addressed and used in the consultations.

Embodied knowledge

Relating the discussion and assessment of vision to everyday activities, the light, and the home environment, the home visits focused on the contextualised body. In the narrative interview, the impairment was described as a dynamic condition changing between painful days (headache, eye pain, and fatigue) and periods or even seasons when individuals were less affected, influencing their ability to endure or maintain an activity over time. Conditions between seeing and not seeing seemed to be a particularly individual kind of tacit knowledge that is difficult to describe or communicate and that individuals often kept to themselves because it was inconvenient or considered 'their own business'. Due to the light, some preferred stronger light, whereas others favoured twilight and had blurry vision from bright environments, and transitions between light and dark were a challenge. They were increasingly dependent on their interaction with their environments. The more they lost sight, the more they used other senses, but the interaction was also crucial for the residual visual function.

Embedded knowledge

The home visits and laboratory consultations also revealed a range of embedded knowledge or knowledge locked in processes, products, culture, routines, artefacts, or structures [7].

Everyday routines were largely mediated by light, and the participants described the change of seasons, daylight, sunlight, and artificial lighting, and the spatial organisations, thresholds, interior arrangements, textures, surfaces, patterns and colours as enabling or disabling their everyday activities. This knowledge was embedded in their interaction with their environment, and many of the participants were not aware of this embeddedness before the consultation. For the residual vision, the relation between lighting and the home environment was critical. Dark surfaces absorbed the light, a patterned tablecloth or floor covering obscured and disturbed their vision. A given bulb was interrelated with the lamp and its shade and the illuminated environment. A closed metal lampshade centred the light, while a frosted glass pendant illuminated the surroundings. The light source and how it was positioned could be crucial for a visually impaired person to see and work at the kitchen benchtop. In addition, the impaired person's position (e.g. in front of a TV or computer) and the position of a lamp on or over a table were also important. People experienced large differences in the illuminated environment inside and outside, which changed due to season and during the course of a day. Many experienced fewer problems in the summer, but the sun could also be an issue.

Medical knowledge was embedded in the tests and surveys, and physics was employed in the device for measuring light. The narrative touched on values, such as *identity* (baking, reading, participating, and contributing), *moods and emotions from 'not being able'* (feeling bored, annoyed, abandoned, passive, depressed, or less worthy), or *aesthetics* (the design or sentimental value of lamps or arrangements). In the interview, the consultants described cultural values in terms of 'cosiness' or different socio-economical categories affecting the character of the home arrangement. In a Muslim family, the closed curtains allowed the mother to take off her hijab at home. Values concerning impairment ranged from passively accepting the condition as part of ageing to fighting for equality and actively trying to improve everyday living, or a young single mother fighting to be a better mom. This revealed knowledge about the citizen's ability to cope and adapt and to include the social context, asking for help from close relatives or even volunteers.

The low vision consultants had *medical knowledge* of vision and of different types of impairments. They had *practice knowledge* of working with people with low vision, and with other consultants, ophthalmologists, and opticians. Moreover, they had *technical and functional knowledge* about light, light sources, and lamps, which was acquired as part of the BLBL project. They also held *practice knowledge* from working with light, by assessing and finding lighting solutions for people with visual impairments, including knowledge of human- environment interactions and the needs and desires for the home environment.

Explicit knowledge

The explicit or verbally expressed knowledge in the consultation included information about light. Using the spectrometer, the light levels were translated into a digit or a graph of colours that was explained to the participants informing them about light in different ways. This was also seen in the lighting lab in sharing knowledge about the lighting-technology.

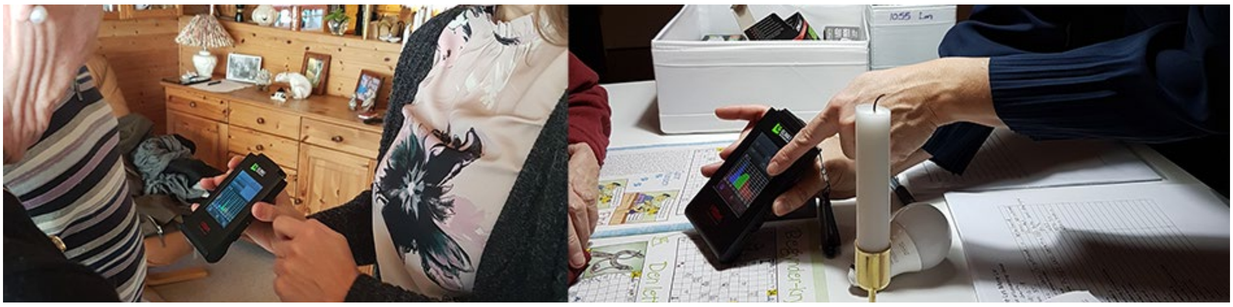

Figure 1. Using the spectrometer to communicate qualities and quantities of different light.

The diagnosis and data concerning the vision, from the optometrist or from CSU's database were also used in the consultations. In some consultations where the conditions were discussed, the consultant provided general knowledge of the disease or the expected development of it. In some cases, general knowledge also involved information about the opportunities for funding or support in the public health system.

Translation and coordination

The consultants performed a range of translations to decontextualise the conditions of the home environment and re-contextualise them in the lighting lab. Translations were contained in the transcriptions of the notes from the narrative interviews, test results, measurements, photos, and drawings. The embedded knowledge of the spectrometer and how it measured the specific lux value is in itself black boxed. However, when used as support for the embodied knowledge of the impaired, the everyday knowledge of the household, and the practice knowledge of the consultant, the explicit and scientific knowledge was contextualised and operationalised. Focusing on activities and how these were enabled or disabled by the interaction of the luminous environment and the vision the procedure of translation included the narrative and descriptions of the embodied experience, the observed occupational performance, and the measured light.

Figure 2. Testing different lighting in the lighting lab.

The sequence of the light lab was an equally important part of the translation process. The information from the narrative interview enabled the consultant to support and guide the citizens and to adjust the different solutions to fit the specific case. The focus on the possibilities allowed the citizens to feel less defensive and more able to engage in the process than if they had been focusing on the limitations. The citizens and relatives were 'taken by the hand' through their own home environment, which was re-contextualised in the lab concerning their own particular activities and challenges, using their body as a point of departure and as an instrument.

In summarising the lab visit, the consultant translated the results by drawing the suggested lamp, and its style and position on a printed photo of the home environment and added a list of specifications to each of the investigated activities. In this way, the assessment went through two rounds of translations: from the home environment to the lab and from the lab back to the home environment.

The citizens were able to compare and experience the difference immediately. They learnt about light and different arrangements. They were qualified and empowered to improve their surroundings, and with assistance from their relatives, they re-contextualised their new knowledge.

Mutable and immutable mobiles

The narrative interview, surveys, measurements, and final list of recommendations represents immutable mobiles that translate and translocate different conditions of the home environment to the laboratory and back again. They form inscriptions that can be presented, read, and combined without the additional knowledge of the specific context of time or place and are typically used for generalising and producing a scientific outcome across a number of samples.

In contrast, the practice of the low vision consultants demonstrated an open approach with adjustments from case to case and from citizen to citizen that resemble the mutable mobile that is enacted differently at different times and at different geographical locations [8]. The next section will further explore the role of the consultants.

The person-environment-occupation model

During the fieldwork and the later discussions with the consultants, it was clear that their role in interacting with the citizens was central to the outcome of the service. The two consultants had backgrounds as occupational therapists, and the analysis of their hinterland was based on a model used in occupational therapy: the person-environment-occupation (PEO) model. The PEO model has been developed as a practical analytical tool to assist in problem analysis, intervention planning, and evaluation or to communicate occupational therapists' practices [9]. Here, I use the PEO model as a framework for discussing the consultants' approaches in the BLBL compared to a purely medical model approach.

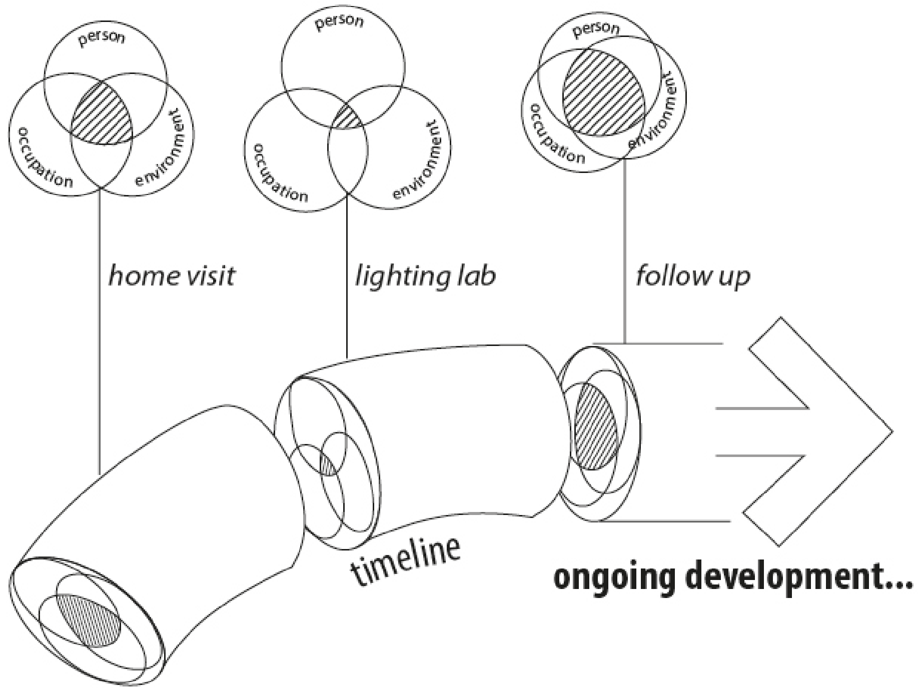

Figure 3. The PEO model, as a refinement of the diagram by Strong et al. [9].

Time and change

In PEO, people, occupations, and environments are understood to be in a dynamic and interdependent relationship. In contrast to the medical model, where the aim is objectivity and truth, the PEO model embraces the 'complexities of daily human experience', including the aspect of development or change over time, such as changes in self-concepts, disability status, environmental constraints, politics, and economics. Opposite the decontextualised and generic diagnosis, the everyday is all about context and specificity. As shown in Figure 3, the series of consultations in BLBL were scheduled over a period when the course of processing the assessments and suggestions was considered an important part of the intervention for the citizen concerning the learning-process and acquiring new knowledge about themselves and their situation.

The elasticity of the PEO model enables interventions that assess the congruence between the parameters in different contexts over time, where the notion of the mutable mobile seems useful. The context- and time-specific scope of BLBL in which the outcome of the service depends on the active participant also calls for a more collaborative approach. After all, citizens are the experts regarding their own lives, bodies, and everyday settings.

Co-creation of knowledge

An essential aspect of the PEO model is that it enables different types of knowledge in the BLBL, above all demonstrated in the open dialogue with the citizens. During the course of the sessions, the consultant supported the citizens concerning their future decisions. The consultant explained and demonstrated technical knowledge of the impairment, light, and illuminated environment and shared practice-based knowledge and experiences from former cases. In this way, they also engaged knowledge from the medical model. However, the consultants stressed an awareness of their own knowledge and when to use it: ‘Due to the medical knowledge, you can say we have it, but we do not apply it too early’. They also described an openness and curiosity about each encounter:

> *We have an idea of the diagnosis and the vision, but we are curious about what it means in relation to light. Two people with AMD [age-related macular degeneration] do not necessarily have the same needs, so we are interested, and very well aware of not getting disturbed of our own pre-existing knowledge.*

This awareness of their a priori knowledge was observed both in the narrative interview and when testing the light in the lab.

The purpose of the narrative interview was to obtain the citizens’ own descriptions of their everyday challenges related to light and vision and to identify two to three activities that are central for the further course. Therefore, it was stressed that the choice of activities was the citizen’s and not that of the consultants or relatives. In the laboratory, different kinds of knowledge were combined: the citizens embodied knowledge as they tested the light, supplemented by explicit information concerning different technologies and the relational aspect of light and activity. The attentiveness of the citizens was emphasised regarding what they felt or what worked better or worse. As the consultants stressed, these were aspects that they could not predict. Contrary to the medical model approach in which the impaired client is a passive receiver of the authoritarian professional’s knowledge and expertise, the co-creation of knowledge depends on an active client. The shifts between different types of knowledge were a way to make explicit knowledge relevant and let the citizens and relatives take part in creating knowledge.

Contextualising low vision rehabilitation

Latour described the theoretical sciences as faster and more immutable than empirical sciences [5]. Following this, the models work as immutable mobiles in the practices of low vision. Whether this is a medical model or a relational and dynamic model, such as the PEO, seems to be crucial because the models enable different aspects. This section will discuss the nature of the different models and how BLBL navigates between them.

Low vision is a concern for public health, and the medical model has been a way to conceptualise and classify diseases, such as in the International Classification of Diseases (ICD) [10], which initially was the standard for keeping track of the major causes of death. The model is deeply embedded in contemporary health systems and structures from diagnostics and paradigms for treatment and support to subsidies and insurances [11]. During the twentieth century, different alternative models have been developed, including a social model shifting the problem of a disease or impairment from the individual to the structures of society that are unable to handle the condition. The bio-psycho-social model has been described as a relational and complex understanding in which a condition is the result of dynamic interactions of body functions and contextual factors. This model is represented in most rehabilitative initiatives and in the International Classification of Function (ICF) [12]. The main use of the ICF has been to handle information and communication among health professionals and has been widely used in professional and political decision-making processes. The preceding procedures for investigation used by the two consultants were based on the ICF; however, the ICF is not in the language of a layperson and does not concern aspects of the citizens’ everyday lives: ‘Filling out all the different parameters was time-consuming and not very useful, other than to ensure that you got “it all” ‘. Developments in low vision rehabilitation have largely addressed the multidisciplinary and holistic aspects but only within the health professions concerning devices, training, and education [13-14]. Even though the ICF includes the social and physical environments, it is reduced to an ‘enabling’ or ‘disabling’ factor and does not operationally explore the everyday. In addition, the ICF is closely linked to the ICD and the medical model. The classification starts and ends with the impairment, no matter whether the responsibility is put on the individual or society.

By addressing light and activity, the BLBL opens up discussions concerning all of us, not just the visually impaired, and does so in a way that makes sense outside of ‘the medical domain’. The two consultants described the medical model as the overall framework for their work because the diagnosis and health structure both determine who receives the service. The bio-psycho-social model is present in the rehabilitative or recovery-based approaches as the overall paradigm for treatment or services, and they use both the medical and bio-psycho-social models in their cooperation and coordination with other health professionals. The BLBL, represents a part of the low vision services in which the encounter with the citizen is operationalised by a more relational and dynamic approach, as described in the PEO model. The model ‘embodies the principles of client-centred practice and supports the collaborative working’ [9] and is open to other professions working with person-environment relations. The occupational therapists have a special relationship with the occupation, and shared responsibility can be implied by focusing on all three spheres.

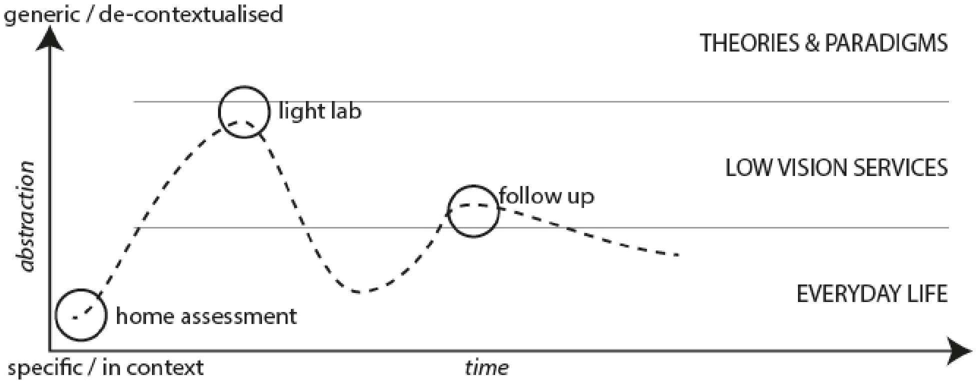

Figure 4. The three consultations navigating between everyday life, practices, and theories.

Figure 4 illustrates this process in which the consultants 'embody and carry a bundle of hinterlands' [3] and are able to navigate and apply the different kinds of knowledge across epistemologies and ontologies.

Conclusion

To open the black box of low vision services and apply 'their own model' to systematically analyse what the consultants see and do [9] has enabled the awareness of the otherwise tacit practice knowledge. Low vision services rely on medical understanding, where the diagnosis or impairment is the point of departure. However, different types of knowledge are coordinated, targeted, and, most importantly, co-created by the citizens and the consultant. By framing the challenges of visual impairment in terms of light and occupation, the consultants enable a space for discussing the challenges and possibilities regarding the citizens' physical – and social context.

The flexibility and elasticity of the PEO model constitute a mutable mobile, an essential characteristic for embracing the complexity of working across theories, practices, and everyday settings.

Acknowledgements

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DOUBLE DYNAMIC LIGHTING BALANCING DIFFUSE AND DIRECT LIGHT

Ellen Kathrine Hansen [(1)*], **Nanet Mathiasen** [(2)]

[(1)] Lighting Design, Dep. of Architecture, Design and Media Technology, Aalborg University, Copenhagen, Denmark

[(2)] Danish Building Research Institute, Aalborg University, Copenhagen, Denmark

* Corresponding author e-mail: ekh@create.aau.dk

Abstract

The **objective** of this paper is to investigate how daylight dynamics can act as a point of inspiration for developing a lighting design concept for work environments such as open space offices. Most often the dynamics of light in lighting design strategies are limited to the aspects of intensity (lx level) and colour of light (CCT). However, the natural variation of diffuse and direct light may also be of importance, since people have a general preference and a profound relation to the dynamics of daylight, given that perception and vision have evolved underneath changing sky conditions.

Based on this hypothesis, a **research approach** has been defined, investigating the relationship between the light distribution and light modelling qualities of daylight and how these qualities can be complemented by electrical lighting.

Four representative sky types have been studied to investigate the range of the light modelling qualities found in daylight. The ratio between diffuse to direct daylight has been examined through simulations and analysis of digital photographic images. Tests were then carried out exploring how the three-dimensional light modelling effects of these four daylight conditions can best be reproduced with electrical lighting sources in a lighting laboratory.

The survey suggested that the desired light modelling qualities are appearing, when the ratio between direct and diffuse light sources is above 13% and below 52% of the total amount of light. This initial finding indicates that daylight modelling qualities can be recreated in office environments with standard diffuse ceiling lighting by adding only 13% direct light on the work plane. The direct light must, however, have similar directionality as the daylight inflow through windows, to reinforce an experience of *flow of light*. The upper and lower perceptual boundaries of the diffuse to direct light ratio will be investigated further in relation to the dynamics of interior daylight illumiation patterns.

The qualities of daylight such as *light modelling* and the *flow of light* can thus be adapted into electrical lighting to develop strategies for double dynamic lighting, with the aim of creating work environments stimulating through a natural variating flow of lighting.

Keywords: *Dynamic lighting | double dynamic lighting | office lighting design | flow of light | light modelling*

Objective

The objective of this paper is to investigate how daylight dynamics can act as a point of inspiration for developing a double dynamic lighting design concept for work environments such as open space offices. The dynamics in question are the variation in light intensity, colour temperature and the distribution of light, the main focus in this study.

These dynamics are studied in relation to naturally changing sky conditions, and specifically the ratio and characteristics of two daylight components: direct warm sunlight and diffuse cold sky light. The core of the study is to illustrate how ratios of diffused and direct light can be used as variables when designing dynamic lighting to supplement and complement daylight in the interior space.

In this paper, we discuss how people inherently desire variation in light, as we are strongly predisposed by the natural dynamics of daylight. A logical consequence is to consider similar parameters for dynamics in electrical lighting for lighting design strategies. Most often the dynamic parameters of electrical light are limited to the aspects of intensity (lx level) and colour of light (CCT). However, the variation in the distribution of light is also important for light modelling qualities. Therefore, this paper investigates how a variation in diffuse and direct light can be integrated into lighting design strategies and thereby meet people's need for variation and light modelling qualities.

Background

Human perception and vision have evolved underneath the sky and in response to the dynamics of daylight. Tregenza and Wilson emphasize that the human body evolved in the diurnal cycle of light and dark and is tuned to the spectrum of the Sun´s radiation. They argue that we respond to daylight in many ways: *"our luminous environment affects our health; triggers responses in us that can be traced to requirements for safety and survival; it affects our interaction with other people; it determines the ease with which we carry out visual tasks. Crucial to all of these is that daylight is not a constant flow of light but something dynamic, varying with time and place."* [1]

We know that people have a general preference for and relation to daylight, and thus also the dynamics of daylight, as explained by Tregenza and Wilson: *"People like daylight….There has not been enough research to be certain why we have this desire for daylight. Strong but circumstantial evidence implies that changeability is crucial: the continual variation of brightness in a daylight room is literally, stimulating because our senses respond to change, not to unvarying conditions."* [1]

Today in the Western world people spend 90% of their time indoors in spaces typically designed according to quantitative standards for uniform distribution and light levels to meet standards for visual tasks. The standards are defined through experiments, where the tasks are intentionally isolated from any larger context. This approach to visual standards has therefore ignored the human preference for variation in light intensity and distribution. This study aims to expand our concept of dynamic lighting for interior office spaces, focusing on the qualities of light modelling in order to create a more stimulating light environment for the users of the space.

J. Vietch et al [2] have been exploring this field of visual comfort and they argue that most offices in the industrialized world enjoy conditions that are adequate to carry out visual tasks and which do not cause extreme discomfort to their occupants. However, Vietch also suggests the possibility that lighting conditions might be further improved beyond this minimum level, to the point at which they could become positive contributors to employee performance and well-being.

According to Tregenza and Wilson [1], there is strong evidence to indicate that dynamic light has a stimulating effect on people. Technological progress by the lighting industry now enables us to design and develop lighting concepts taking these human preferences into consideration.

The importance of dynamic light to support human health and well-being has been increasingly recognized. [3] The literature review conducted by PhD fellow S. Linnebjerg, analysed how 26 different concepts within *dynamic lighting for health and well-being* have been used in different areas of research. [4] The findings demonstrated that there is a significant interest in investigating the non-visual effects on health and well-being. 77% of the concepts included research on non-visual effects, though there is most evidence for visual effects that aim at psychological health referring to the visual effect of light. The review indicates that dynamic lighting has a potential for investigating experience-orientated, perceptual qualities of light. The variable parameter, intensity of light, is used in 25 of the 26 concepts to define the dynamics of lighting and 12 of the 26 concepts also address the correlated colour temperature. But very few studies have integrated the relationship between the distribution of light and the spatial perception of electrical lighting and daylight. While daylight as the optimal light source for humans is commonly acknowledged in the 26 investigated concepts, only 31% of the projects employ daylight as an impetus for variation on different levels. Only 2 of the 26 concepts operate with a total lighting environment that equally addresses both daylighting and electrical lighting. Based on this, a research approach was defined focusing on the distribution of light and how this affects the experience of the rich variation of light qualities. The light distribution was investigated by referring to changing sky conditions and how these qualities can be defined to support and complement the daylight intake.

The questions asked in this paper are: "How can the qualities of dynamic daylight be defined and characterized?" and "How can these dynamic daylight qualities best be translated into electrical lighting design concepts?" Our hypothesis is that much of the natural variation in light and the light modelling qualities of daylight can be defined through different combinations of diffuse and direct light.

Method

In the first stage of this project, extensive literature reviews [4] were conducted to gain knowledge of the dynamics of daylight and how to implement those qualities in lighting design. Firstly, a review created an overview of the many and diverse tools and criteria used for investigating the concept of dynamic lighting technology. Secondly, a review focusing on how human needs for dynamic lighting and lighting qualities referring to diffuse and direct light, flow of light and different sky types was carried out. Based on these initial investigations, light modelling qualities in different sky conditions defined as ratios of the balance of diffuse and direct lighting were investigated through three small explorative experiments using simulations as well as light settings on objects in respectively daylight and electrical lighting.

Four sky types were investigated and characterized. The four sky types have been chosen as they, according to Tregenza, have the highest frequency of occurrence based on English weather conditions. These sky types are CIE 1, 3, 8 and 13. [1] These four sky conditions are described in detail through mathematical models of CIE sky types. These models are envisioned into relatable sky conditions with literature references to their intensity and correlated colour temperature and descriptive remarks based on the experienced light. Based on these observations and data, daylight simulations are rendered as reference for further investigations of the perception of light modelling qualities under different sky types.

To investigate how the light modelling is perceived in a space with one side window opening, a visual study in a 1:1 day lit office space was carried out. Photography was used for comparing the appearance of the objects and the light modelling ability under different sky conditions, referring to three CIE sky types. Photos were taken of the view and sky conditions parallel to photos aligned of three spherical objects placed on a horizontal plane 0.85 m above the floor and with a 0.5 m distance from the window opening. Photos were taken with a Canon EOS 70D camera on HDR mode. The office space was established at Aalborg University, Copenhagen Campus. The dimensions of the space were similar to a small office, with a length of 4m, width of 3m and height of 2,6m. The window opening with a surface of 1,5m^2 was facing southwest. The walls of the space were freshly painted white and the floor was covered with grey textile, establishing a neutral space.

To investigate how light modelling established through daylight can be reproduced by electrical lighting, a small experiment was carried out in the lighting lab at Aalborg University in Copenhagen. The tests were conducted with a large-scale diffuse light source in the celling, 2x2 m tuneable and dimmable light. In addition to the diffuse light source, a single iGuzzini Palco spotlight fixture, ø 142 mm and with a 48-degree optic was mounted on a celling light track and used as direct light source. The laboratory tests were documented through digital photographic images. The three light settings in the experiment refer to the light modelling seen from the three sky types: CIE sky type 3, 8 and 13. The CIE 1 sky type was excluded, as the aim was to achieve one distinct directionality of light with reference to the window opening.

Dynamic daylight is a combination of sunlight and skylight

"Daylight can be divided into the two components, sunlight and skylight. Sunlight is light received at the Earth's surface, directly from the sun. Sunlight produces strong, sharp-edged shadows. Skylight is light from the sun received at the Earth's surface after scattering in the atmosphere. It is scattered light that gives the sky its blue appearance. Skylight produces only weak, diffuse shadows. The balance between sunlight and skylight is determined by the nature of the atmosphere and the distance with the light passes through it." [5]

The variation of the sky according to the relation between sunlight, skylight, cloud cover and light intensity has also been studied in the Ph.D. thesis by N. Mathiasen: *Nordic Light – and its impact on the design of apertures in Nordic architecture.* In the simulations below, Mathiasen illustrates how the cloud coverage affects the intensity of light defined by the two components: skylight and sunlight. The study demonstrates that the magnitude of light intensity does not vary drastically whether the clouds cover the whole sky or not, though the character of the light can differ drastically from a clear blue sky, characterized by sharp-edged shadows to an overcast sky with diffuse and soft shadows, modelling the surroundings in two completely different visual appearances. [6]

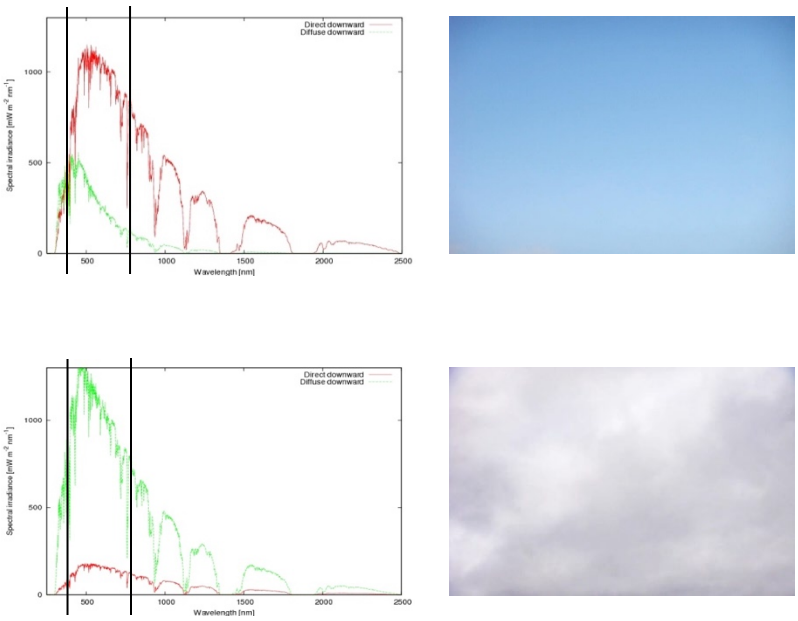

Figure 1. Simulations and photographic representation of a clear blue sky and an overcast sky. The graphs show spectral irradiance on the vertical axis and on the horizontal axis the wavelength of direct downward (red) and diffuse downward (green) and how the cloud cover affects these parameters. The simulations are made for Copenhagen 65˚N and a cloud cover that is neither very thick nor very thin. Illustrations from the publication "Nordic Light – and its impact on the design of apertures in Nordic architecture" [6]

These different qualities of daylight modelling are further investigated in the following section, where combinations of diffuse and direct light are investigated.

Diffuse and direct light balancing light modelling

The ratio between the intensity of direct and diffuse light is essential for how we experience and perceive our surroundings. Studies on perception and understanding of our visual environment has been a central part of the investigations.

V. Zaikina refers to the ratio of diffuse and direct light as *light modelling*, an important part of the lighting quality concept: "It determines not only the capability of the eye to detect any objects in a space but also its ability to discriminate contours, shapes and details, the most important visual characteristics of any object." [7]

Within the same field of interest, S. Frandsen describes the diffuse and direct light through an experiment of lighting up three different spheres: *"In parallel light the shadows are so sharp and so dense that the spheres almost lose their form….In very diffuse light the lack of shadows means lack of three-dimensional form. The spheres do not appear spherical and the texture is missing."* [8]

Similar statements are presented by C. Cuttle, when he defines the directional properties of a light source that generates shading patterns through interactions with three-dimensional objects. Cuttle states that this aspect of lighting is particularly associated with spaces lit by side windows. In this case, daylight creates a strong effect, which is characterized as *the flow of light.* [9] This flow of light is referring to the directionality of the light from a window, which traditionally is recognized as an important element when creating the visual environment and spatial appearance.

These references all emphasise light distribution and its qualities in a three-dimensional context, the light modelling qualities. They all point out the importance of combining the direct and diffuse light. When combining daylight and electrical light, the electrical lighting may potentially supplement the flow of light and light modelling qualities.

The optimal balance, in order to create a good light modelling of an object, is described in S*cale of Shadows* by Sophus Frandsen [8]. These optimal modelling qualities are defined in relation to the visual environment and the ability to see objects through a combination of direct and diffuse light where the shadow pattern is of particular importance for the definition of these qualities. The character of the shadow is established through the combination of direct and diffuse light, consequently the balance between the direct and the diffuse light, is crucial. Frandsen suggests that the diffuse light is combined with directional light where the angle of the directionality of the beam of light is between 11,5° - 40°.

The following initial experiments were made to investigate these light modelling effects within different combinations of direct and diffuse light modelling quality referring to the Scale of Shadow. The investigations were firstly made as simulations and photos within different daylight conditions and secondly reproduced with electrical light sources.

The dynamics of direct and diffuse light referring to different sky types

Daylight is dynamic by its nature. The International Commission on Illumination has defined 15 sky types, based on the variation of meteorological and climatic conditions. The first CIE standard overcast sky was defined in 1955, describing the luminance distribution of daylight in the sky and was subsequently followed by other more detailed definitions. [1]

In the matrix below, the four sky types are characterized by a definition of the sky types, a reference image, a specification of the characteristics of the light and its' dynamics, colour temperature, contrast, intensity and directionality.

Sky type	CIE Standard type 1 Overcast Sky Steep luminance gradation towards zenith, azimuthal uniformity	CIE sky type 3 Overcast, moderately graded with azimuthal uniformity	CIE sky type 8 Partly cloudy sky, no gradation towards zenith, distinct solar corona	CIE Standard type 13 Clear Sky, polluted atmosphere
Reference image				
Characteristic light	Reasonable intensity diffuse light soft scattered light. Ambient comfortable lighting	Lower intensity levels diffuse Light soft scattered light Uniform or even dull with lack of visual interest.	Cooler colors, and more diffuse daylight	Warmer colours. with high Contrast and intensity. Sharp edges on patterns interior reflected light from objects outside
Dynamics	Static subtle to slow and gradual changes	Almost none	dynamic patterns with change in intensity levels, color temperatures, and directionality resulting from moving clouds	Sunlight patches, strong dynamic patterns of filtered light ex. Through trees or from water
Color temperature	(6000–7000K)			Sun component (3000–5000 K) blue diffuse sky component (12000–18000K).
Contrast	Low	low	mixed	Glare due to high contrast
Intensity	1000 – 5,000 lux	1,000 - 2,000 lux varying in absolute brightness somewhat from sunrise to sunset	10,000 - 30,000 lux	30,000 - 130,000 lux
Directionality	Multiple directions reflected light	Uniform to none	Mixed and changeable directionality	Strong directionality

Figure 2. Characteristics of the four sky types.

To illustrate the light modelling qualities in relation to the changing sky condition, the four sky types were used as a reference to create daylight simulation of a sphere and its shadow pattern.

Sky type	CIE Standard type 1 Overcast Sky Steep luminance gradation towards zenith, azimuthal uniformity	CIE sky type 3 Overcast, moderately graded with azimuthal uniformity	CIE sky type 8 Partly cloudy sky, no gradation towards zenith, distinct solar corona	CIE Standard type 13 Clear Sky, polluted atmosphere
Lighting type	**Diffuse / diffuse** Balance between two or more diffuse sources.	**Totally diffuse** One or more fully synchronized sources.	**Direct / diffuse combinations** Multiple sources.	**Direct** Single primary directional source.
Reference image				
Characteristic light modelling / Shadow type	Attractive semi-soft lighting. Good definition of volume and detail both in shadows and for materials.	Soft light creates little form and volume lack of shadows and contrast makes the material details and qualities difficult to see.	Precise light. The correct balance allows definition without the loss of detail in the shadows and material detail.	Hard defined/dense shadows. Objects are less voluminous, material detail qualities are enhanced.
Dynamics	Static subtle to slow and gradual changes.	Almost none.	Dynamic patterns with noticeable change in intensity levels, colour temperatures, and directionality.	Strong directional bias which ideally would follow sun path although not necessarily a sunlight pattern.
Contrast	Low	Low	Mixed	Glare due to high contrast
Intensity	1000 – 5,000 lux	1,000 - 2,000 lux Varying in absolute brightness somewhat from sunrise to sunset.	10,000 - 30,000 lux	30,000 - 130,000 lux
Directionality	Multiple directions reflected light	Uniform to none	Mixed and changeable directionality	Strong directionality

Figure 3. Light modelling shadow pattern referring to the four different sky types are here reproduced and illustrated through renderings.

These different light settings on a sphere, combining direct and diffuse light sources, demonstrate how a balanced combination of diffuse and direct light influence the light modelling. Moreover, the character of light affects how we perceive an object. This highlights the importance of investigating a good balance between diffuse and direct light. It demonstrates how the shadow patterns of three-dimensional objects strongly influence how the visual perception process enables us to recognise object attributes, such as lightness, texture and form. Exactly the aspects Cuttle defines as the flow of light. [9]

From the renderings of the sphere, we can visually assess the directional and diffuse light condition of the CIE8 sky type to be closest to the best light modelling of an object. This lighting condition is characterized by creating a clear directionality of light, a shadow pattern, which is precise but not too hard and though creates an emphasis on the three-dimensionality and texture of the object, without overexposure of light.

Light modelling qualities and the directionality of daylight in a room

Figure 4. Different sky conditions, from the top and down referring to the daylight inflow with respectively CIE sky types 13, 3 and 8 and to the right photo illustrating how the different daylight situations affect light modelling qualities of the spheres. Photo: Mihkel Pajuste.

The spheres lit by three different sky types coming from a window opening results in shadow patterns which appear similar. Whether the sky is clear blue or cloudy, the light in flow from the window will create a soft shadow pattern on the spheres, though with a clear directionality of the light coming from the window opening. This demonstrates, that even without the direct sunlight in the space, the interior daylight illumiation has a distinct directionality. This directionality shows that the diffuse daylight produces a flow of light. A flow which has a direction related to the position of the window opening.

This points towards a potential for supporting the flow of the daylight from the window opening and the light modelling qualities from directional electrical lighting. This could be achieved by a light source creating a direct light with the same directionality as the daylight from the window and thereby support the flow of light as well as creating a more distinct light modelling and shadow pattern.

This leads to the question: How much direct light do we need to create these light modelling qualities? The following and last experiment therefore investigated the ratio between diffuse and direct lighting.

Light modelling qualities and ratios of diffuse and direct light

Firstly, a diffuse light setting was installed, with a reference to CIE standard sky type 3, an overcast daylight situation. This setting created diffuse and subtle shadows around the object. This lighting condition can often be referred to as the common office lighting, where uniform electric lighting is illuminating the space and objects on a working plane.

The second experiment refers to CIE sky type 8, a mix of clear blue sky and clouds. A low level of direct light from the spotlight is added to the diffuse general electrical light and thereby creating a well-balanced light with the mix of diffuse and direct light. The lighting condition is perceived as good and supportive for experiencing both space and objects. The qualities of the light is similar to the qualities described in relation to the Scale of Shadow [8].

And thirdly, the experiment referring to CIE sky type 13, a clear blue sky with sun, was carried out by increasing the intensity of the spotlight. This scenario is perceived to have too high contrast to create visually stimulating light modelling. To quantify the impact of the light modelling, data concerning the contrast values were auto-generated from the HDR photo by using the HDRScope program, developed at the University of Washington Seattle. [11] This tool enabled us to measure and compare the three light settings with approximate ratios of direct and diffuse light. The result of the study of the ratios illustrates that the directionality of the light within CIE Sky type 3 is 0%, CIE sky type 8 is 13%, and CIE sky type 13 is 52%.

This indicated that the direct light must be within 13-52% of the total lighting to create a sufficient and well-perceived light modelling. It is especially worth noting that 13% was perceived to be enough to create the desired light modelling condition. In figure 5 the photographs illustrate the different combination of diffuse and direct light where the photo in the middle refers to CIE sky type 8. And the contrast measurements’ matrix in Table 1 shows a contrast value component to be 13% in the same light setting, referring to CIE 8 (diffuse/ direct 1).

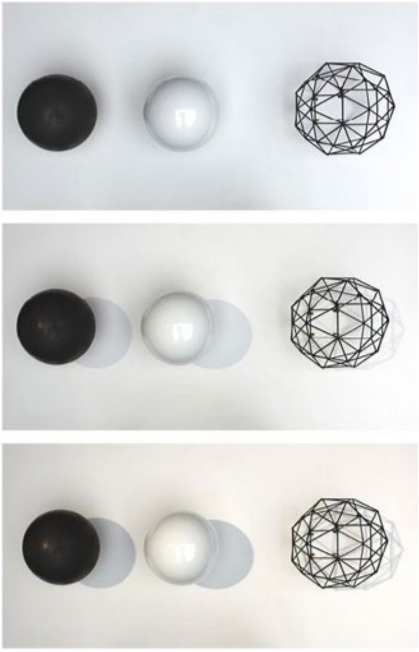

Figure 5. Light modelling experiments with different ratio of diffuse and direct light. From the top and down the electrical light setting referring to sky type 3, 8 and 13. Photo: Michael Cleary and Mihkel Pajuste.

	Diffuse	Diffuse/direct 1	Diffuse/direct 2
Minimum:	1.07	1.28	1.65
Maximum:	0.97	1.10	1.51
Mean:	0.97	1.13	1.52
Median:	0.97	1.11	1.51
Standard Deviation	0.79	0.34	0.87
Contrast	0.02	0.13	0.52

Table 1. Contrast measurements with HDRscope of fig. 5 images of electrical lighting made with reference to sky types CIE 3 (diffuse), CIE 8 (diffuse/direct 1) and CIE 13 (diffuse/direct 2). The qualitative balanced light modelling has direct lighting in a range of 13-52%.

Future work

The literature study as well as the conducted experiments described in this paper indicate a preference for a balanced light modelling combining direct and diffuse light. These findings lead to the hypothesis that dynamic light can be defined through the ratio of direct and diffuse lighting responding to different sky conditions, thereby creating a better visual appearance and a stronger relation to the outside. The daylight qualities defined as the ratio between direct sunlight and diffuse skylight are found stimulating and even vital for human beings. This forms the basis of future investigations of how diffuse and direct daylight and electrical lighting can supplement and complement each other to create visual stimulating environments.

Future lab tests will aim at defining the upper and lower boundaries for a ratio of direct and diffuse light sources and how these can respond to different daylight conditions in order to create a well-lit office space with a connection to the outside. In a controlled light lab, the boundaries for ratio between a warm direct spotlight on a work plane and cold diffuse ceiling lighting panels will be studied with reference to the two daylight components: skylight and sunlight. It will be investigated which range of ratios is preferred, referring to the perception of light modelling.

This will be followed by surveys on when and how the electrical lighting can supplement and complement the daylight intake. The initial scenario for testing both the ratio of direct warm and diffuse cold light in relation to different sky types could be described through a new concept of *double dynamic lighting*. And finally, the new double dynamic lighting scenario will be implemented in an office environment as an intelligent lighting system responding to daylight conditions. A LM-TLM outdoor sky sensor, placed on the rooftop will track the direct and diffuse daylight. The effect of the double dynamic lighting will be tested on people working in an office environment over a longer period of time to test the impact of the dynamic lighting over days, weeks, months and seasons. The results will be analysed and translated into a design guideline for a double dynamic lighting concept.

Conclusion

Most often the dynamics of light in lighting design strategies are limited to the aspects of intensity (lx level) and colour of light (CCT). However, inspired by daylight, more variation of diffuse and direct light is found to be of importance, since people have a general preference for and a profound relation to the dynamics of daylight, as human perception and vision have evolved underneath the changing sky conditions.

To study these qualities, the ratio of direct and diffuse light referring to CIE Standard sky types was investigated with the emphasis on light modelling and flow of light. The qualities of the light distribution of the different sky types were reconstructed in lab experiments with diffuse general lighting and direct light sources observed on the work plane. This study illustrated that the light modelling qualities were appearing, when the ratio between direct and diffuse light sources was above 13% and below 52%. This initial finding indicated that the light modelling qualities we are aiming at can be achieved in office environments with standard diffuse ceiling lighting by adding direct light on the work plane. The direct light must have the same directionality as the daylight coming from the side window. This illustrates a potential for complementing the daylight intake with electrical direct light, creating a flow of light and a more distinct light modelling.

The qualities of daylight described as *light modelling* and *the flow of light* can hereby be adapted into electrical lighting strategies, to generate a more stimulating work environments by complimenting the perception of interior space through the dynamics of natural lighting condition. In further investigations, this can be explored by defining upper and lower boundaries of ratios between diffuse and direct electrical light sources responding to the qualities of daylight as both the ratio of diffuse and direct daylight as well as the intensities and colour temperatures. Through that the electrical lighting design can establish a connection to the outside and at the same time create a better visual environment referring to the qualities of natural light.

Acknowledgements

The luminaire manufacturer Zumtobel, Fagerhult and iGuzzini and the component manufacturer Tridonic have teamed up with Aalborg University to take up the challenge of investigating how double dynamic lighting can meet human needs for a more natural indoor work environment. The literature review and initial tests presented in this paper could not have been carried out without the support from the partners. Thank you, Michael Clary for setting up these initial tests supported from Mihkel Pajuste and thank you Lisa Heschong for your valuable input.

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A FINAL MOVE TO YOUR OWN HOUSE

A residential care centre is often the final place where people end up living. This should be the most beautiful place where they have ever lived. In practice this is sadly not the case

Femke Feenstra*

Gortemaker Algra Feenstra architects b.v. Netherlands

* Corresponding author e-mail: info@gaf.eu

Abstract

Objective – What makes a house a home? Many residents of care centres do not feel at home. 'This is not my own house', is what we heard in many of our conversations with residents. What makes the current houses into homes? Probably not the fact that everyone enters through the same door and has to walk through a corridor devoid of any daylight to get to their room. Residential care centre Cornelia by Allévo in the city of Zierikzee is developing a new building that is aimed towards providing the residents with their own home in the last phase of their lives. A sense of ownership and control.

Background – A lot of people suffering from dementia are able to reside in their own house in the first phase. Once their situation gets worse or their informal carer becomes unavailable, people often end up in a residential care centre. Unfortunately, these people have to move from living independently to living in a small room in which they lose the feeling of having their own place or being able to manage their own lives.

Research question – How can you turn a care home into a home for people with dementia? Every house has a front door, this emphasizes their independence and autonomy. In the new building at Cornelia care centre all residents have their own front door leading to the park. Every visitor can use this front door and residents are able to go in and out of their own volition. The research question examines whether this concept provides a sense of ownership and control to the residents, a feeling of having their own home.

Methods – 93 residencies will be built in the care centre. The residencies have a front door to the outside and a back door to the inside, which is the central area of the building where the communal rooms are situated. With this chosen care concept, the residencies are not immediately situated next to a communal room, resulting into more possibilities to place the residents with like-minded people with the same interests, while also making it possible to switch in between. Visitors can park their cars near the front door or put their bicycles against the outside of their loved one's house. The covered area next to the front door makes for a space to sit outside. There is a small bench and a wooden frame offering enough protection from the sun. The residency is a studio in which the sleeping area is separated from the spacious living room.

Results & Conclusion – Can having a personal front door provide a feeling of an own home for the residents as well as their visitors? Does it help to choose freely when to go outside? Is it nice to be able to choose between different communal rooms to spend your days? This new building at Cornelia care centre is a search for returning ownership to people with dementia.

Keywords: *House | Home | Care | Dementia | Residency*

Many people wish to keep living in their own home until they pass away. Sadly, this is not an option for everyone. Moving to a residential care centre is usually not something to look forward to. Often, there is less space, luxury and privacy, which makes it feel like a downgrade. The feeling of 'being home' loses its meaning and whatever meaning is left is related to the house that was a home before moving to the residential care centre. The freedom to manage your own life, your personal habits and routines often get lost in the process. Instead of having everything to yourself you will find yourself having to share more often than not, like a shared entrance for instance, or a shared living room or kitchen. This feeling of ownership and control is very important to elderly people, something which is easily dismissed but actually makes for an immense change in the final chapter of their lives.

Care institution Allévo intends to turn that final move to a residential care centre into something positive. The idea that moving to a residential care centre is bad has to be changed; moving to a residential care centre is the icing on the cake! Care is important but in reality, it only takes up a rather small portion of the day. The main focus is on everyday life. The residents each have their own residency with all its regular features. A seat on the pavement in front of the residency, their own front door with their house number and a letterbox. The decision for individual front doors gives residents a feeling of their own place and control. In the residency there is a living area with some space for a table and a seating area and there is a sleeping area with a private bathroom. The residency is flexible and offers the owner a lot of space to put personal items. This shows the owner's identity and interests and creates a pleasant living environment with a feeling of ownership.

The elements of a residential care centre that is linked to health care, like providing meals, daily activities and therapy take place in a stimulating environment. The residency is not connected to one specific meeting room which creates the possibility to adjust to the resident's needs and interests or even to switch social group. To get to the meeting rooms in which food is served and eaten and activities take place, you pass green patios and recognisable markers with continuous daylight shining into the corridor.

Figure 1. Design residential care centre Allévo

Design for dementia

People who move to a residential care centre often suffer from mild to worse forms of dementia. Dementia is a disease that can develop slowly but can also suddenly strike, sometimes triggered by a certain event in someone's life. The progression of the disease is something that needs to be taken into account in a residential care centre, but most centres do not have the flexibility to adjust the living environment to the progression of the disease. People with dementia can change in character or need more peace and quiet than before. By not connecting residencies to specific meeting rooms, residents can switch social groups without needing to move within the residential care centre.

Freedom is one of the first things that gets limited for people with dementia. To prevent dangerous situations, measures have to be taken to ensure the safety of the resident and their environment. One of the possible dangers that often comes up is when someone with dementia forgets to turn off the gas after cooking which can cause fires. Or someone with dementia walks out the door without a coat on in the winter and forgets their way home, or even worse. To prevent these kinds of accidents, sections are locked up to make sure residents cannot just wander off, even though elderly people with dementia like to wander around. Wandering around in a familiar environment gives them peace and helps them get their important exercise in [1]. Additionally, fresh air and daylight – especially sunlight – is very important for the elderly because of their deteriorating eyesight which makes their need for enough light greater. To illustrate; on a cloudy day the luminosity is measured at 1000 to 2000 lux, in a typical living room inside a residential care centre this is around 100 to 150 lux. On top of that, a 70 year old person absorbs three to five times less light than a 20 year old because the cells that are sensitive to light deteriorate with age [2]. The combination of deteriorating eyes and lower luminosity in the elderly peoples' environment is alarming. Enough daylight keeps elderly people active and is good for their sleep pattern. Research shows that 25% of people with Alzheimer's have a disrupted circadian rhythm [2]. By spending 30 minutes outside, elderly people can create more melatonin at night to help them sleep better. Research and experience helped made it so that having enough daylight in the entire building was an important guiding principle in the design for the residential care centre for Allévo.

Another measure that restricts freedom, that usually follows, is not allowing people with dementia to cook anymore because this could lead to accidents. What gets lost is the ritual of preparing a meal, together with the stimulation of various senses that comes with it. This negatively effects the dementia since it is of the utmost importance to keep triggering and stimulating the senses. Smelling herbs, cutting a cucumber and feeling the fluids on your fingers, hearing a bean grinder. These all invoke the feeling of wanting to eat and drink. Including residents in the routine of preparing meals can help increase their appetite. Memories are brought back by stimulating the senses which can be revitalising for older people with dementia. They will be able to recognise specific elements, actions and physical objects which is comforting for them. In other areas of the building senses and memories are being incorporated as well. Corridors become interesting due to recognisable markers which improve orientation in the building at the same time. Residencies will feel more like home by offering the resident the possibility to put personal items by the front door for instance.

The shortage of staff or wanting to protect the residents are two reasons for deciding to take measures like locking sections up. But this should never restrict the freedom of residents who are still capable of going for a short walk outside. By utilizing home automation and re-evaluating our view of dementia a lot can be achieved, even with limited staff occupation.

How do you create the feeling of being home?

How can you ensure that for people with dementia, a home becomes their home? This is the central question in our research for the design for Allévo. Can increasing the feeling of control and ownership contribute to the feeling of being home? And in which ways can the design of a building influence this?

The research of creating a home for elderly people suffering from dementia started with questions care institution Allévo had, but it is also a continuation of an earlier study of dementia, Ontwerp & Dementie (Design & Dementia) in which stimulation of the senses was used in order to help elderly people with dementia recognise objects and recall memories [3]. This was tested in multiple phases in care home De Diem in the town of Diemen. Residents of the dementia department joined a smell workshop after which mock-ups were built of the most appealing memories from the results. Examples are a beach house with seashells and sand, a dressing table with perfume bottles and a table with jars and plants for gardening. In the final phase of the study Ontwerp & Dementie the dressing table has been developed as a memory place and by creating four dressing tables with different colours, shapes and designs, the study investigated which elements triggered memories for the elderly people. The findings of this study, playing into senses and memories amongst others, are the foundation for the design for the residential care centre for Allévo. By realising the building for Allévo a new phase begins in the current research. The results that will be tested when commissioning the new building will contribute to the development of knowledge.

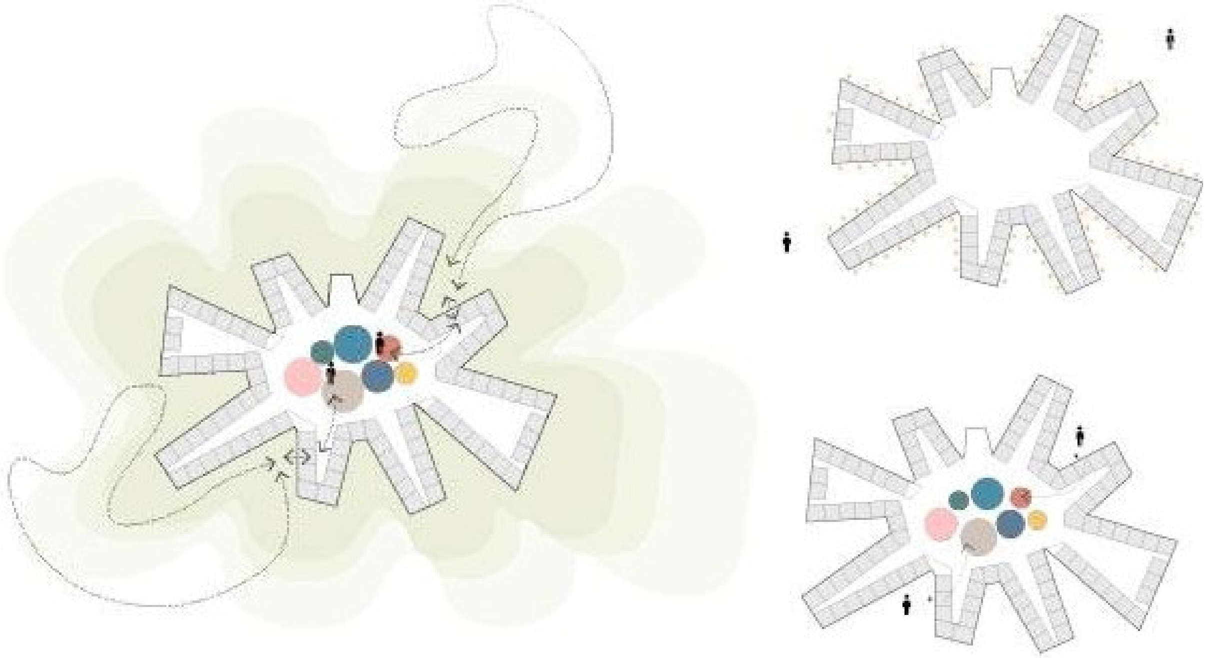

Figure 2. Blueprints building structure, garland of 93 residencies in a green environment with meeting rooms in the central location

The question how a house feels like a 'home' seeps through multiple levels in the design for the residential care centre for Allévo. On a large scale, in the organisational structure, a care concept has been chosen that will focus on the resident and their specific needs. The 93 residencies are positioned like a garland, draped around the central part of the building in which the different meeting rooms are located, giving everyone their own front door (figure 2). With this structure the residencies are not connected to one specific meeting room, meaning a resident can switch social group without having to move. The resident can, depending on their preferences and the extent of their dementia, be placed in a social group in which they feel at home between like-minded people. It is not up to the care centre, but the resident to choose their place to meet others. It also creates more flexibility for staff members because all meeting rooms are connected to each other with connecting doors.

The meeting rooms each have their own themes which play into different interests. There is, for instance, a 'sports rooms' (figure 3) and a 'hobbies & games room' (figure 4). All meeting rooms are suitable for the standard activities like preparing and eating meals and watching television, but the decorations fit the specific theme. Additionally, every meeting room has a special area in which a specific activity can take place. The music room has a seating area with a piano, the workshop has a workbench and a pallet rack (figure 5) and the gardening room has a large flower pot to pick herbs and tomatoes from (figure 6). Other meeting rooms are more focussed on peace, something that residents with a more developed stage of dementia often require. These rooms are themed 'harbour' (figure 7) and 'meadow' (figure 8).

The building structure is catered to older people with dementia. Around the meeting rooms runs a corridor designed for residents to wander around. In this corridor you will find the themes of a number of meeting rooms brought outside of the room to function as recognisable marks which are able to trigger the senses. The 'kitchen' for example, has a window through which freshly baked cookies spread their smell into the corridor (figure 9). A little further you will find the outside of the 'beach room' which is a wall decorated with real seashells that residents can touch (figure 10). The 'coffee house' has a chalkboard on the outside of its wall on which the coffee of the week is being advertised (figure 11). The 'Library' has a large bookcase that comes through the wall (figure 12) and the 'music room' has a window which serves as a rack for LP records with speakers beside it from which songs can be heard (figure 13).

Figure 3. Sports room, bench in the corridor

Figure 4. Hobbies & games room, old Dutch games

Figure 5. Workshop, pallet rack with artworks

Figure 6. Gardening room, flower pot to pick from

Figure 7. Harbour, nautical room

Figure 8. Meadow, natural materials

Figure 9. Kitchen, smell of cookies in the corridor

Figure 10. Beach room, seashell wall

Figure 11. Coffee house, chalk board in the corridor

Figure 12. Library, bookcase through the wall

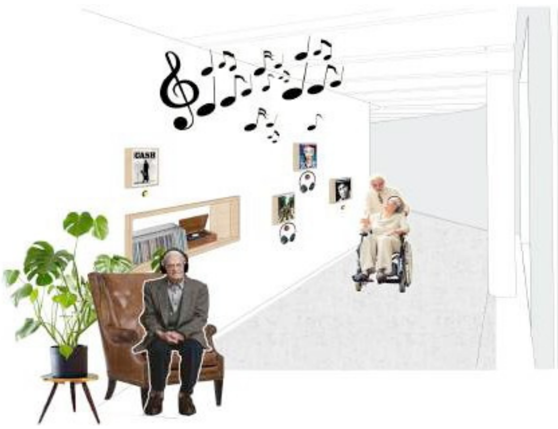

Figure 13. Music room, speakers in the corridor

The garland of residencies around the meeting area makes it so that all residencies have their own front door both on the inside, connecting to the central part of the residential care centre, as well as on the outside, connecting to the garden. A personal front door where residents can receive guests, retrieve their own mail and go outside for a short walk in the garden. The front door is shaded in a niche with a pergola for the wind. There is a wooden frame hanging in front of the bedroom window that can be used for seating while providing extra shade on sunny summer days (figure 14). There is a broad sidewalk running parallel to the façade around the building which gives access to the surrounding gardens. These elements in the design show that a lot of attention was paid to the outside of the residency in order to make the transition from inside to outside as smooth as possible. This encourages the residents to use their own front door which increases their feeling of ownership.

Figure 14. Personal front door, smooth transition between inside and outside

Care institution Allévo sees every resident as an individual and for each person they look at which measures are necessary. Allévo is planning on working with home automation with controls put into either bracelets or necklaces. This technology can be configured to be able to open certain doors while not working for others. Around the building, a zone can be configured in which the residents can walk around safely and freely with the help of GPS tracking, without having to put fences around the terrain.

The front door on the inside of the residency is made recognisable for the residents. Every corridor has an accent colour that corresponds with a painted strip on the wall next to the front door. Located inside this coloured strip is a glass showcase with wooden shelves which residents can position for their own personalised layout. In this glass showcase residents can put their personal items like plants, photographs or figurines (figure 15). The coloured strip combined with the glass showcase with personal items makes every residency recognisable for the residents and makes the corridor into an interesting area.

Figure 15. Glass showcase, recognisable mark next to the front door on the inside of the building

The layout of the residency is flexible and can be used by either one resident or a couple. The living and sleeping areas both have a large window looking out over the garden and the two areas are divided by a multifunctional cabinet. This cabinet offers privacy in the sleeping area without blocking all sight, so when the resident is bedridden they can still communicate with the seating area. In the cabinet there is space for a TV set up which can be turned to face either the seating area or the bed (figure 16). There is room in the other compartments for personal belongings. In the living area there is enough space for a table with some chairs and a seating area. This gives the residents their own place and the possibility to receive visitors.

The concept with all its elements of recognisability, keying into the senses of the residents and offering them the possibility to personalise their living environment has been developed with the hope of contributing to the feeling of being home for the residents of the residential care centre. These are elements that help create a feeling of ownership and control. These elements make up the foundation of the research on the feeling of being home.

Figure 16. Residency, living and sleeping area divided by flexible cabinet

Research methods

The research is following the design of the residential care centre and because the residential care centre is currently still under construction not all results are in yet. But the research methods on how to view the results have been determined. These methods concern both the preparatory phase as well as the commissioning phase.

Open day

To gain good insight into what goes on at the residential care centre the architects spent a day in the residential care centre prior to the design process. The architects followed several staff members like a caregiver, a physiotherapist and a policy manager during their everyday tasks. Aside from conversations with staff members, the communal living rooms and brasserie were observed as well.

User dialogues with staff members and representative of the residents' committee

User dialogues took place during different phases of the design process in which the architects went through their plans for the building structure as well as the layout together with staff members of Allévo and the representative of the residents' committee. Different designs were discussed, like the layout of the residencies, the themes and the layout of the meeting rooms and the brasserie. During the look & feel workshop, the guiding principle for the interior design was determined with the help of mood cards with images and text. Further along into the design process there was an evaluation of feedback during which all materials and finishes were tested against the guiding principles that were determined during the look & feel workshop.

Since not all current residents were approachable at all times and most likely would not all be moving into the new building, the architects started a dialogue with the representative of the residents' committee. This way, the voice of the residents was still heard and it allowed for the possibility to include certain wishes the residents had into the design.

The wishes of the staff members and residents were talked over with the policy makers and managers and tested against the new care view of Allévo to see whether they fit into it. The guiding principles to not connect the residencies to the meeting rooms and to provide a personal front door for every resident – on the ground floor – were talked over with the management before they were further developed. These guiding principles will not only affect the building, the organisational structure has to be adjusted for this to work as well.

Questionnaires

The research question whether residents in a residential care centre feel more at home in a building where control and ownership is the founding principle seems simple to answer when you would ask the residents themselves, but that is actually not the case. The residents that will move together to the new building will notice the differences but for the residents that will be new in the residential care centre there is no comparison to the old situation. Additionally, we are talking about residents with dementia who, as the disease develops, often change and do not have an unequivocal opinion themselves. Because of this, the staff members of Allévo and the caregivers that deal with the residents on a daily basis are called upon to determine the effects of the concept.

The caregivers will receive questionnaires on two separate occasions, prior to moving (during the old situation) and after the commissioning of the new building. These questionnaires will consist of statements for which the caregivers can indicate to what extent they agree or disagree as well as questions about the behaviour of the residents together with a subdivision about the expectations for the concept of the new building and how it actually played out in practise (in comparison with the old situation).

Observations

To expand their knowledge and experiences, the architects themselves will start observing after realising the design with the focus being on the residents. They will look at which interventions in the design have the expected effect on the behaviour of the residents and which do not as well as how these interventions can be optimised. Aside from observing specific cases or specific areas there will be an overarching structured observation in which things like how many residents wander around the building, how many residents stay in their residencies during the day or how many residents go for a short walk in the garden will be looked at.

Results & Conclusion

The research question cannot be answered at this time. As soon as the new building is completed, we can continue our research and measure the results. The personal front door and the freedom of choice to go outside is an aspect that carries a lot of expectations. No more closed off sections on the third floor of a care home in which a green environment with fresh air and enough daylight is far out of the resident's reach. The possibility to switch meeting rooms and the distinctive additions to the corridors and the residencies to create a feeling of recognisability are elements that should stimulate the feeling of ownership and control. After years of research and dialogue on this theme the time has come to realise the concept with enough confidence.

There are no results yet, but there are expectations. The sense of ownership will mainly be reflected in the homes. The display windows on the side of the inner door can start working as a showcase from the corridor, just like the widened windowsill next to the outer door. The cupboard that separates the living area from the sleeping area also offers possibilities for placing personal items. In anticipation of the sense of ownership, we expect that the sense of self-direction will be triggered by the front door on the outside of the home. The goal is for the resident to use this door just as in a normal home; to receive visitors, to greet the postman or to take a stroll through the gardens. In this way the resident will be less confronted with the fact that they live in a care institution. The gardens are designed to stimulate movement and to develop a better day and night rhythm through exposure to daylight. The variety of short and long walking routes and the many entrances and exits in the building are designed to offer the elderly residents the opportunity to exercise based on their personal fitness abilities. Local residents are also welcome to walk in the gardens. The contact between the neighbourhood and the residents can bring liveliness and create more social contact.

A lot of attention has been paid to the decoration of the meeting rooms in the central part of the building. By linking these to themes, we have tried to make them more attractive to residents. The hope is that these residents will revive certain activities or memories that evoke themes that make them feel comfortable and possibly delay the dementia disease.

When realizing the design for the Allévo residential care centre, many conclusions can be drawn that contribute to research into the effects of spatial design on dementia. In the following, it can be interesting to investigate how, with this target group, movement can be stimulated more and how the spatial structure of a building can contribute to this. You can also look at how the building can open itself more to the outside in order to attract local residents for more social contact. This allows society to come into greater contact with elderly people with dementia, so that even in everyday situations elderly people with dementia (also at an early stage of dementia) can count on more understanding and attention from their community.

People who suffer from dementia is a large target group for our architectural firm that we will be working with more and more in the future which provides us even more reason to start looking into how the built environment can affect this disease and how we can make the environment more pleasant for residents of residential care centres. All in all we are hoping that in a few years they will feel like their final home was the nicest!

Figure 17. Entrance square residential care centre Allévo

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Co-design strategies for the architectural design process

EXPLORING THE CONCEPT OF CUSTOMER-PERCEIVED INTIMACY IN HEALTHSCAPES

Carmen Martens (1, 2)*, **Jasmien Herssens** (1), **Cécile Delcourt** (2)

(1) Faculty of Architecture and Arts, Hasselt University, Hasselt, Belgium

(2) Department of Marketing, HEC Liège, Management School of the University of Liège, Liège, Belgium

* Corresponding author e-mail: carmen.martens@uhasselt.be

Abstract

Background —It is recognized that servicescapes (i.e., the manmade physical surroundings in which a service takes place) both affect customer and employee attitudes and behaviours. This is particularly the case in healthcare servicescapes (i.e., healthscapes) as studies demonstrated that an improvement in the servicescape can contribute to positive outcomes such as enhanced healing process. However, little is known about such a relationship can happen. Accordingly, we examine the concept of customer-perceived intimacy (CPI) as improving servicescapes can contribute to positive outcomes through the creation of CPI. Indeed, in healthcare, the intimacy of the customers (i.e., patients) is often under stress as they have to relinquish privacy by disclosing embarrassing personal information and/or intimate body parts.

Objective – The purpose of this paper is to explore—based on an extended multidisciplinary literature review— the concept of CPI in healthscapes. The authors offer a conceptualization of customer-perceived intimacy in healthscapes together with a conceptual framework to highlight both the antecedents (i.e., the design and architectural components of the healthscape) and the short-term and long-term outcomes of CPI.

Results – Customer-perceived intimacy defined as *"the feeling that combines the dimensions of mutuality, discovery, emotions and kindness, from a customer's perspective" are caused by a holistic combination of intangible (i.e., interpersonal) and tangible factors (i.e., design of the physical healthcare environment) within the servicescape. This leads* to higher levels of understanding of service systems and their fundamental role in human well-being. The authors argue that healthscape design focused on customer-perceived intimacy is necessary to make service systems more socially inclusive.

Contribution – We provide architects with theoretical insights on how to foster customer-perceived intimacy in healthscapes. In doing so, we aim to help hospitals to adopt a more patient-centric strategy by improving the patient experience. The insights from our study can be generalized to public servicescapes so that the experience of users is improved by fostering customer-perceived intimacy.

Keywords - *Customer-Perceived Intimacy | Healthcare Services | Healthscape | Servicescape*

Introduction

Both healthcare consumerism and the growing competition between healthcare providers challenge the healthcare industry [1]. Wolf [2] suggests that there will be a patient-led healthcare revolution that will change the way healthcare is delivered today. Patients will eventually grow into health consumers who have a careful understanding of their own wants and needs and expect the healthcare industry to react immediately and in a personalized, much more tailored way [2]. Therefore, healthcare providers continuously concentrate on patient-centred care and aim to enhance the quality of that care. One facet of the emphasis on patient-centred care is the focus on the customer experience [3]. Consequently, a change in paradigm emerges where "patients" are recognized as "customers" [1].

The growing interest in and efforts to improve healthcare facility customers' experiences has led to various design studies, including research that has examined the role of the environment in the healing process. Consequently, the healthcare sector acknowledges the servicescape (i.e., the design of the physical environment of a service organization [4]) as an important feature [5]. However, too little attention has been dedicated on how to create adequate tangible healthcare environments through an optimal architectural design to enhance the customer experience. As Khullar states: "Hospitals are among the most expensive facilities to build, with complex infrastructures, technologies, regulations and safety codes. But evidence suggests we've been building them all wrong — and that the deficiencies aren't simply anaesthetic or inconvenient. All those design flaws may be killing us" [6]. Insights in design strategies that link customer experiences with design principles are currently missing [7]. This is most visible in extreme situations such as hospitals in which "the utilitarian building types have generally led to the main attempts at system building" [8, p. 102]. Most hospitals are designed by means of using a rational problem-solving attitude, but it is this focus on rational use, modularity and standardisation which has led to the lack of experiences. Therefore, they lack a holistic approach with attention for social, cultural, physical, and psychological support, while a primary aim within a healthcare facility is to satisfy customers' needs for comfort, safety, security, convenience, privacy and support. Most patients arrive at healthcare facilities with feelings of stress, unease, and anxiety, and an unfamiliar environment will only strengthen their negative emotions. Furthermore, patients are less empowered and knowledgeable about their received service. They are often expected to cooperate and deliberately disclose very personal information or intimate parts of their body [9]. But these patients may feel highly vulnerable [10] and an inadequate perceived environment may increase uncomfortable feelings. In turn, they may not self-disclose personal information while this information might be key in the healing process.

The goal of this paper is to explore how supportive design solutions can foster customer-perceived intimacy (CPI) within a healthcare service context to—in fine— achieve enhanced customer outcomes, such as customer well-being. This study proposes to broaden the concept of customer intimacy by highlighting the customer perspectives and thus the customer outcomes, caused by both intangible (i.e., interpersonal) and tangible (i.e., design of the physical environment) factors. Therefore, the term customer-perceived intimacy is coined, defined as "the feeling that combines the dimensions of mutuality, discovery, emotions and kindness, from a customer's perspective. An extended multidisciplinary literature review was undertaken to offer a conceptualization of customer-perceived intimacy in healthscapes, supported by a conceptual framework to highlight both the antecedents (i.e., the architectural components of the healthscape) and the short-term (cognitive, emotional, physiological and behavioural responses) and long-term outcomes (i.e., wellbeing and repurchase behaviour) of customer-perceived intimacy (CPI).

Conceptual Framework

The conceptual framework focuses on healthcare servicescapes, hereafter referred to as 'healthscapes', and their effect on customer-perceived intimacy, including users' short-term cognitive, emotional, physiological and behavioural responses within the hospital and long-term outcomes, such as well-being and repurchase behaviour.

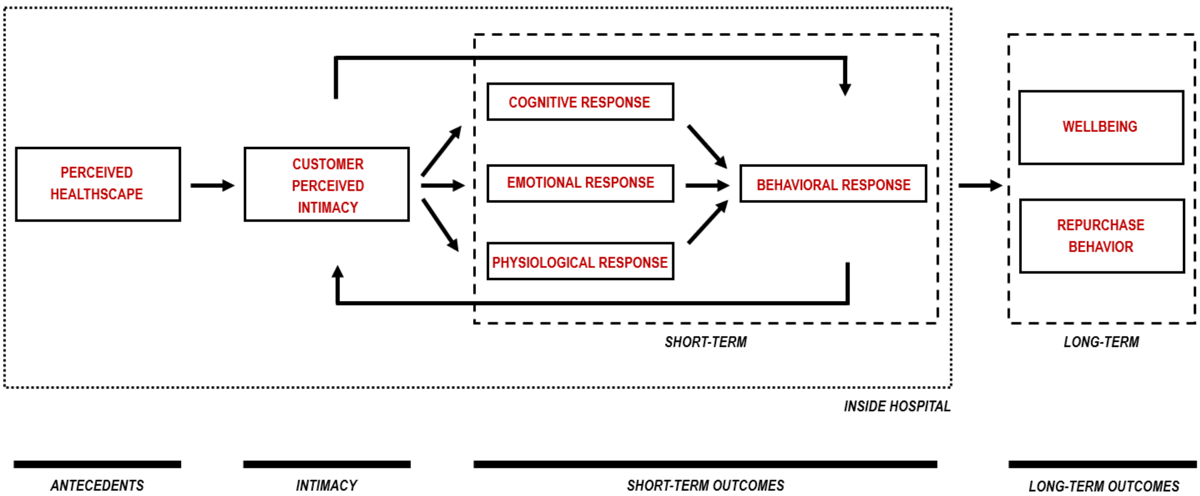

Figure 1. Conceptual Framework

Healthcare Services

Healthcare is an enormously expensive, highly complex, and universally used service that significantly affects economies and the quality of life. It may be one of the most personal, important and existing services, but one with high costs and too much errors, waste and discrimination [9]. Although this service context is evaluated in terms of customer satisfaction and loyalty, Anderson et al. [10] argue it is even more important to explore the effect on well-being outcomes.

Healthcare services differ from other services in several ways [9]. In the first place, (1) customers are sick, which causes them to be far more emotional, demanding, sensitive, and dependent. (2) The experiential quality of healthcare services forces customers and providers to co-create [11] and these interactive, potentially emotion-laden roles can have an impact on customers in many ways, including their emotional and physical well-being [10]. (3) The importance in relation to customer well-being derives from consumers' potential vulnerability [12]. Research finds that patients often lack a degree of control and agency and feel vulnerable because of their lack of medical knowledge [10]. As such, they seldom take the opportunity to challenge decisions about their own health (e.g. Adkins & Corus [13]) resulting in stereotyping and discrimination and can cause unproductive and stressful service encounters [14].

The service encounters (4) are difficult to measure in terms of satisfaction, even when a doctor delivers outstanding service from a customer-need perspective, the patient may not appreciate this at all (e.g., addicted patients who are not happy with their necessary treatment). Customers (5) may relinquish privacy (e.g., patients may have to disrobe and discuss highly personal matters with clinicians they are meeting for the first time). (6) Delivering quality service to patients also depends on the ability of clinicians and their willingness to connect knowledge of medicine with knowledge of the patient. They need to understand the individual customer holistically and correspondingly customize the service (e.g., fit the patient's medical condition, mental condition, age, personal traits and preferences, family circumstances, and financial capacity). Customers (7) are also at risk. The healthcare profession that is supposed to heal, too often harms (e.g. patients are harmed by medication errors [15] and communication errors frequently contribute to errors in diagnosis and treatment).

Customer-Perceived-Intimacy

With the emerging healthcare consumerism, a growing competitive healthcare market due to increasing service expectations, challenges the healthcare industry [1]. This leads to a focus on patient-centric care and the aim for improved customer experience. This focus on creating value for the customer as a strategy was already recognized in 1993 by Treacy and Wiersema. They identified 'customer intimacy' as a value discipline, which will enable the organization to meet and exceed customer expectations and thus add real value to the customer's experience. Organizations pursuing a strategy of customer intimacy, continually tailor and shape services to match the specific demands of the customer [16] and may therefore correspond to the emerging healthcare consumerism and improved well-being.

Until now, the concept of customer intimacy is mainly examined within various sectors (e.g., banking sector, the mobile telecom sector, the automotive sector, advertisement sector, …) but excluded the understanding of customer intimacy in healthcare service contexts. This is in contrast to what the definition of customer intimacy might suggest, as healthcare services are complex interpersonal services in which customer relations and customer experiences are on top of the priority list [9]. Further, the definition of customer intimacy highlights the customers' perspective by achieving and exceeding customers' wants and needs, but previous literature on customer intimacy mainly focused on corporate outcomes such as creating and maintaining successful customer relationships, customer loyalty, customer satisfaction, customer trust, word-of-mouth, commitment, information disclosure, customer availability, advisor status, repurchase intentions, and profitability (e.g. [17], [18], [19], [20], [21], [22], [23], [24], [25], [16], [26]). Actual customer outcomes are currently lacking in literature. Third, healthcare services are interpersonal services in which customers and employees interact with each other within the organization's physical facility. Thus, people's purchasing decisions include the "total product" [1], a holistic perception of both intangible (i.e. interpersonal) and tangible (i.e. design of the physical environment) factors. Previous research on customer intimacy mainly focused on these interpersonal factors and have stated intangible antecedents, such as customer knowledge, operational flexibility, and employee competence [27], [16]. A key parameter that is neglected is the tangible (i.e. design of the physical environment) factor, or what is referred to here as the servicescape [4] or healthscape [28].

Despite a lack of a clear definition of intimacy, the studies that have attempted to conceptualize intimacy do have some common characteristics. The four characteristics shared by the clearest examples of intimacy are 'mutuality', 'discovery', 'emotions' and 'kindness'. These characteristics intertwine because intimacy is not all or nothing. A clear existence of all four characteristics is the indication of intimacy at its most pure and distinct form. When one or more of them start to fade or blur, so will the experience shade into something else.

Mutuality

Intimacy is not a trait or a state, it is a rather mutual exchange. Love, like other emotional states, can be considered as an individual characteristic, because we can love someone without the other one loving us back. Intimacy on the other hand, requires a flash of mutual recognition, a knowingness that both parties are aware of what is happening between them. Therefore, intimacy exists between, rather than within, people [29]. This characteristic is important within a healthcare service context as customers use the dimension of mutual engagement in a joint venture [30] to evaluate their level of comfort with the service organization [31]. The "dyad" [32] exists in a way where each person is fully focused to the other. By contrast, within a group, even by only adding a third person, a different dynamic arises. There is now a group identity and structure that is somehow above and beyond the individuals themselves [32]. Therefore, intimacy is very exclusive. It exists between two people and thereby to some extent excludes others [29].

Discovery

Waring et al. [33] identified that self-disclosure was an important determinant of intimacy. Self-disclosure, that is "the act of revealing personal information about oneself to another" [34], includes cognitive self-disclosure (the revelation of private thoughts and ideas) and affective self-disclosure (the revelation of feelings) [35], [30]. Although, to know someone is to know their motives and desire, we keep much hidden from others to maintain a good reputation. One of the reasons why most encounters are not intimate, is because people play safe. The danger that comes from being unexpectedly revealed can create conditions for intimacy, but also for humiliation or anger [29]. Disclosure is important to the experience of intimacy and therefore, the feeling of discovery is so fundamental to the experience. Self-disclosure within a healthcare service context is not only crucial for (1) developing a sustainable relationship with the caregiver, (2) best understanding the health condition of the patient by the caregiver, but also for (3) the well-being of the patient as when patients reveal personal and emotional information to a caregiver, they report improved well-being [36].

Emotions

The rise of both emotions as inner drivers of human behaviour and the corresponding new discipline of psychology lead to an importing turning point. It is now possible to see emotion as both the provider of human goals (hopes, fears, desires) and their driving force. Emotions also influence customers' assessments of quality and value (e.g., decisions about using a service and recommendations to others). But too often organizations do not appropriately anticipate these emotions and therefore they cannot negotiate the negative ones. This is especially true for healthcare services, which can be categorized as high-emotion services. Those provoke strong feelings before the service even begins, and relate to major life events such as birth, illness, and death [37]. There are two reasons to link intimacy and emotions. First, emotions are an indication that we care. Caring promote feelings of comfort, which flow from the customer's sense of security in a relationship with a reliable and responsive partner [38]. The second reason is that emotion is not fully within our control. These basic emotions are not learned, and no person can be without them. Emotions allow the conditions of trust because they are hard to fake and so they become guarantors of sincerity [29].

Kindness

Intimacy and shame are often connected. Shame means being uncovered when you are not ready to be and having nowhere to turn. Without a kindness response, we have torture. Except for accurate diagnosis and effective treatment, which are principal in healthcare services, acts of kindness can be a powerful remedy to negative emotions and may improve outcomes for those experiencing a frightening hospital journey. On the other hand, Phillips and Taylor [39] argue that genuine kindness depends on its ability to contain hostility. Conflict is a likely event in intimate relationships [40], but it is the inability to resolve conflict that causes relationships to fall apart [33]. Strong relationships are ones that leave room for the open expression of disagreement. An important facet in healthcare services is the counseling style of interaction between the medical staff and the patients, in which a subsequent discussion might take place and where the responses (by the service provider) are valued and, potentially, sought [18]. So even when communication may be one-way (e.g., from patient to doctor) these relationships can be described as intimate. This is due to "sympathetic listening" [41], which is characterized by understanding (e.g., the doctor accurately comprehend what the patient says); validation (e.g. the doctor validates what the patients says as important); and caring (e.g., the doctor cares about what the patient expresses) and therefore evokes feelings of connectedness and liking.

Given the above, we propose the following working definition of customer-perceived intimacy in healthscapes: "Customer-perceived intimacy in the context of healthcare, is the feeling that combines the dimensions of mutuality, discovery, emotions and kindness from a customer's perspective, caused by a holistic combination of intangible (i.e., interpersonal) and tangible factors (i.e., design of the physical healthcare environment)."

Antecedents: Perceived Healthscape

The impact of the environment is already known since ancient times. Locations of the Asclepieia (i.e. the healing centres of ancient Greece) were carefully selected, using thermal springs, designed on spectacular views, and creating buildings for leisure activities, closely located to medical buildings [42]. Alvar Aalto and Richard Neutra, leading architects from the modern period, stress the advantages of well-planned architecture, and the influence of nature for healing in their architecture [43]. The relationship between humans and the design of the physical environment is also discussed in the management literature by Bitner [4], who first coined the term 'servicescape' referencing to the design of the physical environment, which affects both customers and employees in service organizations. The study shows how the design of the physical environment is a crucial component. However, this model mainly focuses on corporate outcomes.

While other service industries such as hospitality and retail have appreciated the role of the design of the physical environment, it was only later that the healthcare industry recognized its importance [5]. Hutton and Richardson coined the term 'healthscape' referring to the servicescape specific to any healthcare service, which concerns the 'tangibles' (i.e., the design of the physical environment) captured through our senses of sight, smell, sound, taste, and touch) [28].

Hospital design, in terms of its architecture, is a highly complex system because of its technical requirements, logistics and operation management. These "hard facilities" [44] usually work against the process of healing. Increasing interests in and efforts to improve healthcare facility users' experiences led to implementations of design research that have studied diverse user groups to explore the role of the environment in the healing process [45], [5]. Consequently, there is a growing acknowledgement that the design of the physical healthcare environments can affect patient medical outcomes and care quality [46], [47]. These studies are part of the domain of evidence-based design (EBD) and draws from various disciplines including environmental psychology, evolutionary biology, psychoneuroimmunology, and neurosciences. This increasing scientific evidence shows that poor design works against the well-being of patients and in certain instances can have negative effects on physiological indicators of wellness, such as anxiety, delirium, elevated blood pressure, and increased intake of pain drugs (e.g. [46], [48]). Design should do more than produce health facilities that are satisfactory in terms of functional efficiency, cost, and codes. Designers should promote well-being by creating physical surroundings that are "psychologically supportive" [49]. Examples of built-related stressors in hospitals are a lack of contact with nature, a lack of physical and mental stimulation, a lack of privacy, and noise [9]. Therefore, improving the design of the healthscape is integral to improving healthcare itself, next to intangible (i.e., interpersonal) antecedents such as, clinician competencies, service process design, organizational culture, and a host of other factors [47].

Short-term and long-term Outcomes

The environmental psychology literature argues that customers in service organizations react to the physical environment in a cognitive, emotional and physiological way. In addition, those responses are what influences their behaviours in the environment [4].

The perceived healthscape may evoke cognitive responses [50], [51] which (1) affects people's beliefs about a place, and (2) assists people by distinguishing an organization by categorization. For example, it helps people to distinguish the children's department from the radiology department within a hospital. Furthermore, it (3) allows the customer to classify the organizations mentality. This way, the environment can be seen as a way of nonverbal communication [52], [51].

Emotional responses refer to the subconsciously aroused feelings of the customer in response to a particular stimuli [53]. Emotion-evoking characteristics of environments include two dimensions: pleasure-displeasure and the degree of arousal (i.e., amount of stimulation or excitement). Environments that evoke pleasant feelings are likely to be ones where people prefer to spend time [54], [55], whereas unpleasant environments are avoided. Likewise, arousing environments are experienced positively unless the excitement is mixed with unpleasantness [56]. Unpleasant environments that are also high in arousal (e.g., noise, confusion) are especially avoided.

The perceived healthscape may affect customers in purely physiological ways. Physiological responses are the essentially uncontrollable bodily responses of the customer in response to particular stimuli [53]. Those physical responses (e.g., shivering because of low room temperature) may in turn directly influence whether or not people stay in and like a particular environment [4].

Behavioural responses are the controllable actions or reactions (e.g., verbal responses) of the customer in response to a particular stimulus [53]. Environmental psychologists argue that people react to places with two opposite ways of behaviour: approach (i.e., desire to stay, explore, and affiliate) and avoidance [55]. The behaviours of customers are to a great extent driven by individual internal responses (cognitive, emotional and physiological) to the environment. In addition, the healthscape can affect the degree of success customers experience in achieving their plans once inside [56], [57]. For example, when a patient enters a hospital and (1) is confused because he or she cannot find signage giving directions to the assigned care department and (2) is emotionally distressed because of crowds, poor acoustics, and low temperature, the patient is unable to carry out the purpose for entering the environment, at least not very easily or in time. Here the healthscape hinders the achievement of the customer's goal [4, p. 61). In addition, the perceived healthscape has an impact on all social interactions within the environment. Barker [58] suggests that recurring social behaviour patterns are related to particular physical settings and that when people encounter typical settings, their social behaviour can be predicted.

On the long-term, this may have an impact on customers' attitudes such as their overall well-being and customers' behaviour such as repurchase behaviour. A basic assumption underlying this exploration is that the customer has a choice among healthcare service providers; that is, the healthcare industry is competitive, and the customer has the option of switching healthcare providers after a bad experience (e.g., a woman giving birth in a windowless delivery room of 'hospital A', which causes her to choose for 'hospital B' for her second childbirth).

Conclusion

Given that we live in a time within a growing competitive healthcare market, the customer experience is on top of the priority list in healthcare services. Therefore, understanding the importance of customer-perceived intimacy is paramount, as customers are constantly exposed to intimate situations. The findings of this study suggest that there is considerable potential for such situations to be wrought with problems involving complexities associated with human cognition, emotions, physiological responses, and behaviours. As a result, this research provided a conceptual framework that raises many questions that need to be answered. However, in doing so, a solid foundation for future inquiry has been laid.

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HOW ARCHITECTS AND CLIENTS INTEGRATE USER PERSPECTIVES IN CANCER CARE FACILITY DESIGN

Pleuntje Jellema [(1)*], Margo Annemans [(1)], Ann Heylighen [(1)]

[(1)] KU Leuven, Dept. of Architecture, Research[x]Design, Belgium

* Corresponding author e-mail: pleuntje.jellema@kuleuven.be

Abstract

Objective – This paper seeks to investigate the extent to which architects and clients involved in the design of cancer care facilities integrate the perspectives of users generally, and people affected by cancer specifically, in the design process.

Background – Increasingly, hospital users contribute to design briefs and participate as stakeholders in design processes. If the best available research and experience is to inform the design of cancer care facilities and ensure quality improvement in care, it is essential that user perspectives are engaged. Cancer patients are interesting to consult as they are exposed to different aspects of healthcare environments in a wide variety of situations. However, the literature suggests that users are inadequately addressed in design briefs for healthcare environments.

Research question – What supports and challenges can be identified regarding the integration of user perspectives in the design of cancer care facilities?

Methods – A multiple case study enquiry analysed two cases. The cases are information-rich and unique examples of completed building projects that encompass cancer care facilities. They enable an in-depth study of the design process as the phenomenon of interest. One case is a new general hospital in which cancer care is integrated. The other case concerns a renovation of an oncology consultation in a university hospital. Interviews were conducted with the project's 'client' and 'architect' and project documents were analysed.

Results – The integration of user perspectives is supported by individual staff members, and by the use of mock-ups and 3D images. A major challenge is that patients are only consulted with indirectly. Care professionals are a primary source of knowledge informing the design process with their own perspectives and that of patients. The more tangible a design becomes, the more feedback is elicited. A tension results between care professionals' ideas to make the design (more) effective and the ambition of 'building oriented' stakeholders to finalise decisions. Also, matters of spatial organisation established early on make it difficult to respond to the evolving organisation of cancer care.

Conclusion – For clients and architects to develop an affinity with the perspectives of people affected by cancer, it is necessary to reconsider how knowledge about users is acquired. Our findings suggest attention for patient perspectives may require focussing on spaces other than those utilised for the delivery of care. The approach taken provided insights into current practice and further suggests clients distinguish between staff participation for organisational reasons and spatial design activities.

Keywords: *Cancer Care | Design, Hospital Building | Qualitative Research | User Perspectives*

Introduction

A product can be considered to convey its designers' intent. However, designers have little control over the context of its use. The individual user and their personal context affect how a product is interpreted [1]. As such, meaning intended by designers and meaning ascribed by users do not necessarily coincide [1,2]. Furthermore, people differ in their sensitivities, abilities, and the opportunities they see. Through use, sensations are linked with actions that affect them, new opportunities come to the fore (or recede), and varied choices are made [1,2]. The design outcome mediates between designer intent and user interpretations [3]. Although this observation originates in the context of product design, similar considerations hold for individuals' interactions with designed environments [3,4].

The communication-based model of design describes users' evolving interpretation as resulting from an iterative process of "acting, perceiving and reacting" [4]. This aligns with understanding experience of the built environment as entangled with time, movement, and the body [5]. Underlying this framing of design as communication is the idea that building professionals differ from users in their understanding of what a successful building is. Architectural education shapes style preference [6] and experts and 'lay people' evaluate buildings differently. In light of this, interest is growing in involving user perspectives within architectural design processes, and the role of empathy therein [7,8]. Particularly for care environments, consultation with different stakeholders is vital to the success of their design

[9,10]. In research and practice, healthcare professionals are consulted, while less attention goes to patients and family members [11].

For people affected by cancer, the experience of environments where consultations, examinations, and treatments take place can be highly stressful. Awareness is growing of how this group is affected by design and the resulting spatial and sensory qualities [12–15]. Previous work shows that cancer patients visit multiple facilities (or places within a facility) for their care and that perceptions of their environment change over time and are affected by illness or side effects [16]. This should also be seen in relation to the body of knowledge resulting from Ulrich's [17] seminal publication, linking window views and nature to patients' health and well-being. If knowledge regarding patient experience is to inform design and ensure quality improvement in care, user perspectives should be incorporated in decision-making regarding care facility design. When little is known about spatial aspects affecting patients' experience, it is also challenging for those involved to realise a patient-centred care environment [18]. However, the literature suggests that users are inadequately addressed in design briefs for healthcare environments [19]. More generally, knowledge about users in design processes is fragmented and intangible [20].

Aim

Assuming that experiences of people affected by cancer will increasingly be consulted to inform the design of cancer care facilities, this study seeks to investigate the extent to which architects and clients involved in such designs integrate the perspectives of users generally, and people affected by cancer specifically, in the design process. We report on two case studies addressing the following question: what supports or challenges the integration of user perspectives when designing cancer care facilities?

Approach and methods

Research design

We align this study with a socio-ecological conception of health [21] and an understanding of the relationship between the user of a built environment and the building as one that is reciprocal in nature [22]. Attention for spatial aspects in the experience of the built environment is primarily concerned, not with user satisfaction, but with the extent to which the built environment is effective in supporting the movement and activities use entails. 'User perspectives' refers to a spectrum of diverse and collected experiences (for more on the complexity of the user see e.g., [20]). Based on previous research we consider people affected by cancer as (a) having much in common with other patients, using general care services and varied spaces in the hospital environment, and (b) having specific spatial sensitivities.

Two cases were selected for the study, not to gain insight into their specificities, but to better understand an issue [23] namely, integration during design processes of spatial aspects in users' experience. The projects' 'client' and 'architect' were interviewed, and project documents were analysed. To address the research question, we adopt a constructionist approach, allowing meaning to be co-constructed in dialogue with the participants and the collected documents [24].

The cases

The first case study looked at a general hospital newly built to accommodate two merging care organisations. It took approximately 15 years from 'intention to build' to the opening. When this study was conducted the hospital had been open for one year. The 'full oncological care program' includes facilities for diagnosis, follow-up and treatment on site, with dedicated units for oncological care of in- and outpatients [25]. As the board of directors' representative in the 'building team' (see Figure 1) the chief operating officer was interviewed as 'the client'. The project architect and an interior architect were interviewed together.

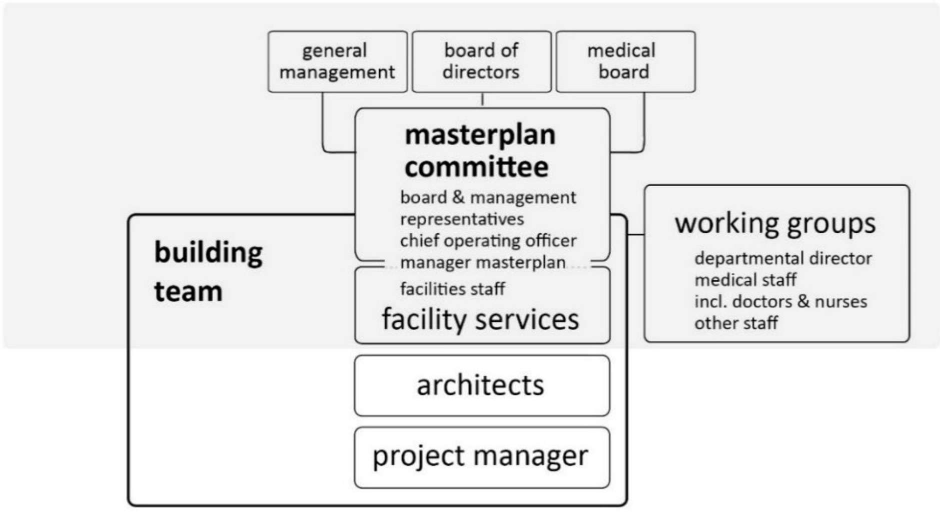

Figure 1. Organisational chart for the first case study, showing main actors in the design process. The grey rectangle indicates internal hospital association

The second case is an oncological consultation within a university hospital. A 34% increase in the number of consultations over 13 years (2001-2014) resulted in overcrowded waiting spaces and too few examination rooms. Reorganising available space allowed adding three consultation rooms and one room for bloodwork. A general refurbishment was also carried out. There were two years between initial conversations and moving back into the renovated space. During the renovation the consultation was located elsewhere in the hospital for eleven weeks. Interviews took place with the interior architect, working within the hospital's own spatial planning department, and the head nurse in the role of client (see Figure 2).

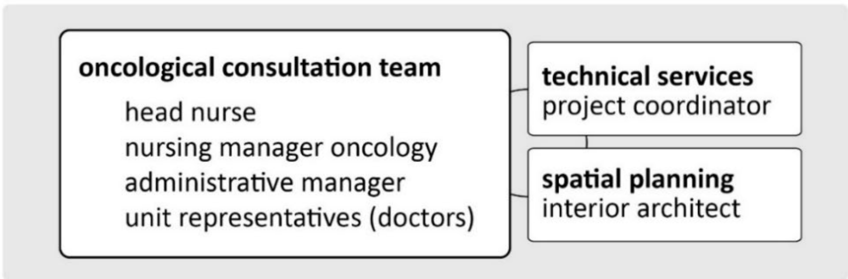

Figure 2. Organisational chart for the second case study, showing main actors in the design process. The grey rectangle indicates internal hospital association

Data collection and analysis

We used focused ethnography to identify supports and challenges regarding the integration of user perspectives in the design of cancer care facilities. All interviews were conducted by the first author (henceforth referred to as 'the researcher') and took place within the care facilities. For the first case additional visits included a tour by an oncology-coach, and a meeting with two members of the facilities department. Access to documentation regarding the design process was granted through the building team's file-sharing system. For the second case the researcher visited the consultation multiple times before and after the renovation and was granted access to the hospital's (hardcopy) archive of the project. Field notes made during visits to the facilities informed the analysis. Documents analysed included approximately 100 separate documents per case, each document consisting of anything from 1 (including images and plans) to 60 pages.

Data collection and analysis was conducted by the researcher who also translated excerpts included in the text from Dutch to English. NVivo software (version 11) was used to organise, search and code data. The qualitative analysis (roughly following the QUAGOL guide, see [26]) involved an iterative process of coding, memo-writing and the development of concepts and categories.

Results

Staff 'on board' in future-oriented design

The design of the new hospital was informed in a time-consuming and iterative process by 35 (initially 26) working groups comprised of staff. Doctors both participated in these groups and were consulted separately. Working groups offered input regarding their specialisation or unit, e.g., radiology, pharmacy or kitchen. Some had a broader scope e.g., circulation, cleaning and ICT. Generally, a unit's team was approached as a separate client whose requirements were integrated in the design within the conceptual guidelines of the hospital board, by and as shared responsibility of the building team (see Figure 1). The client and architect relied on the working groups to know what was best for their working environments and patients' use of the building. The documentation of the design process suggests that working groups differed considerably in terms of the amount of input they offered or attention they received. Reports of building team meetings also make clear that architect and client occasionally disagreed about whether or not to consult particular working groups again.

The architects spoke of their personal and professional experience regarding hospital environments as complementing staff members' input and supporting their understanding of use-related points of attention. They required negotiation skills to balance between those reasoning for 'the best for the patient', and others concerned with financial limitations. Different 'sources of knowing' about users informed the design, e.g., reference projects were considered valuable evidence of good and less successful examples, and necessary to verify working group input.

The integration of user perspectives in the design was supported by the approach of the hospital's master plan committee. The process of merging motivated them to encourage staff participation in the design process for organisational reasons. Staff perspectives were further integrated to ensure an ecological and ergonomically supportive employee-centred environment. The ambition to realise a healing environment that would minimise stress-inducing factors for patients relied on care professionals' knowledge. Simultaneously, the master plan committee seemed to play an important role applying guiding principles to decisions about daylight, air quality, accessibility, acoustics, orientation and circulation.

Mock-ups, realised at different points in the process, played a mediating role. Various room-types were built, tried out and feedback collected, which led to 'principal choices' for their layout (e.g., Figure 3), material finishings and the overall 'look and feel'. Individual staff members prioritised and repeatedly voiced concerns, translating their understanding of spatial aspects important to the experience of patients. Occasionally, 'claims' were backed by references to literature or related projects. For an atrium, it was decided to deviate from fire safety regulations and resolve compensatory measures. Future unknowns were dealt with by employing the concept of reconfiguration. For example, the hospital's skeletal structure was designed to accommodate changes and additions. Financial buffers allowed for unforeseen changes. Finally, communication throughout the decision-making process was helped by the use of file-sharing systems such as, filezilla, chapoo, and bricsys, and an external project manager who oversaw working group contributions.

Challenges regarding the integration of user perspectives were identified at multiple levels. Firstly, the working groups' scope of influence was limited by the spatial organisation established early in the brief. The chief operating officer (COO) explained:

> *The big picture had been sketched, the schemes were there, allocated surface areas had been determined per unit and at that moment it was discussed with the working groups as in, "within this part tell us what needs to happen but this is the philosophy we want to preserve and this is the structure that it'll have". So. There was an outline that they had to stay within but inside of that a lot of input was given.*

As a result, the care organisation ended up appropriating the building in a way that deviated from the design intentions. The initial allocation of square meters did not match the spatial requirements of units upon completion of the building. Secondly, tension existed between 'builders' (building oriented stakeholders) and 'carers' (care professionals).

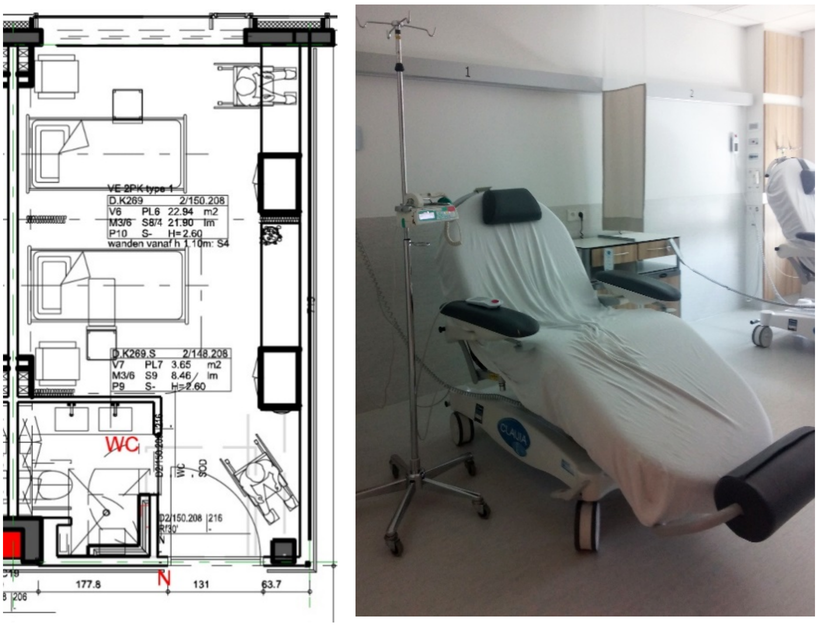

Figure 3. Plan of standard double room (left) where some beds have been replaced with reclining chairs (right) in the oncology and internal medicine day hospital

Builders, for example, sought to 'freeze plans', while the client aimed to continue integrating user-input resulting from evolutions in care. The latter stemmed from a desire to be a 'future-ready' hospital, requiring an openness to input from staff not previously involved. Finally, feedback from working groups was often seen to 'come late'. A discrepancy existed between the skills and availability of working group members on the one hand, and the expectations regarding their spatial insight and types of representations offered to them on the other. The architect indicated the inability to read plans was problematic:

> *The people can't imagine what it'll be like any earlier, they can imagine it only once it is almost finished right? When the room is there and they walk through it, only then do they see it, as in, oh it's like that?*

A puzzle to reorganise limited space

In the second case knowledge regarding patients was put forward by a variety of actors, based on their past experiences and interactions. In renovation design meetings, units functioning within the consultation were represented by a doctor (professor) (see Figure 2). Doctors' feedback was collected in an iterative process and focused on what was important for their care activities. The interior architect described it as follows:

> *For them it was like, "look that room has to be just so. I have to be able to work well in it and I shouldn't have to walk too far to fetch my patients and I need a back-office corridor so that they don't see me walking by".*

Nurses, repeatedly consulted by the head nurse, focused on practical details regarding their use of the space. The head nurse and nursing manager were considered guards of aspects that were important to patients. The interior architect supplemented this, for example, with recommendations to accommodate wheelchair users. Coordinating the temporary move during the renovation helped the interior architect gain insight into the consultation's way(s) of working. The current care practice, of one supervisor working with three assistants, largely determined the spatial re-organisation. The wish to realise an 'air bubble' for the overfull consultation provided a conceptual objective. To realise this, rooms adjacent to the consultation were incorporated to add new work spaces and square meters to the space available for patient circulation and waiting areas (see Figure 4).

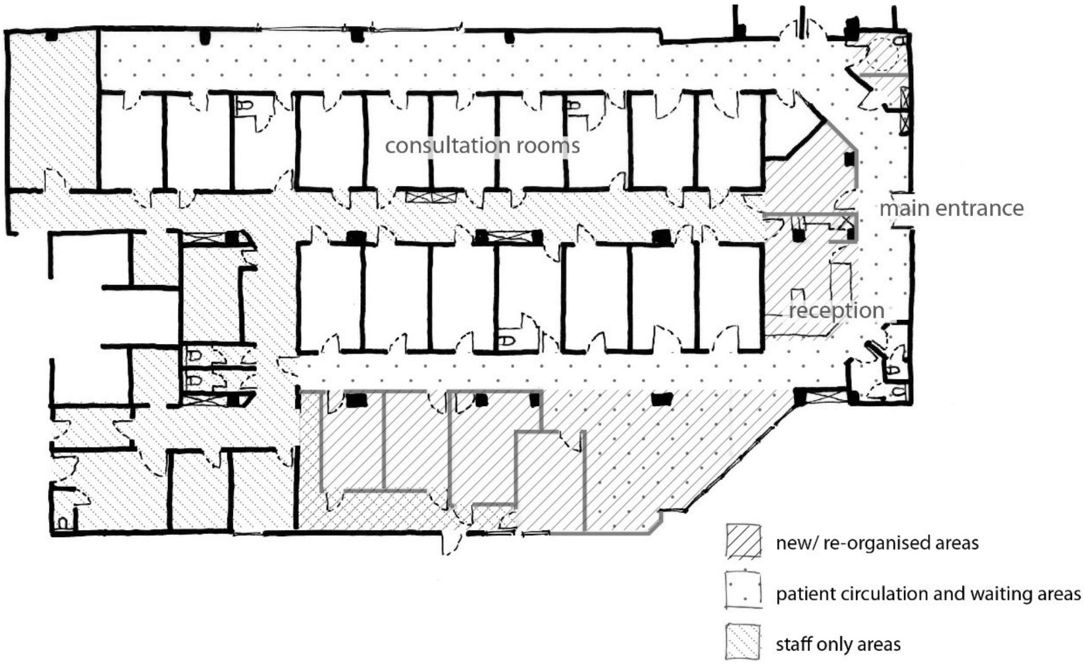

Figure 4. Plan of oncology consultation after the renovation highlighting patient and staff areas

For the interior architect, integrating users' perspectives in the design was supported by an openness to knowledge sharing, and an understanding of adjacent units and spatial developments elsewhere in the hospital. The interior architect and the head nurse were supported by frequent, responsive and multi-faceted communication and the feeling of shared responsibility. Discussions and negotiations allowed integrating different perspectives in the design. Negotiating with adjacent units and projects (for additional square meters, for another window) was necessary. Also, nurses successfully lobbied for a window in the staff kitchen after it had been removed from the plans for financial reasons. Design representations formed an important tool for those involved to know and communicate about requirements for the oncology consultation. Plans and 3D images elicited different concerns: for example, a plan elicited concerns about the workspace behind the reception counter, while notes on a 3D sketch focussed on the experience of approaching and using the counter (see Figure 5). Input from external experts included ergonomic advice, plans of examination rooms elsewhere in the hospital, and layout options for waiting spaces. When the exact use of an examination room was unknown, variants were developed to accommodate both types of medical examination conducted in the consultation.

Optimally integrating user perspectives in the design was challenged by spatial limitations. For the furniture in the waiting room, ensuring sufficient seating within limited space led to trading-off comfort. Although chosen seating was initially deemed suitable, cushions were ordered after patients complained. Acoustic issues for patients waiting near the reception area were also tackled as 'aftercare': design interventions added-on during and after the design was realised. Furthermore, prioritizing aesthetic reasoning led to underestimating the importance of daylight. The head nurse gives an example:

> *The disadvantage of some is … that they want it to be beautiful and the glass has to be positioned in such a way- Because, I, for example, didn't get a window because it would not have been synchronised. And then I think "guys! For me, if there had now been a horizontal window it would've given tremendous added-value to this office".*

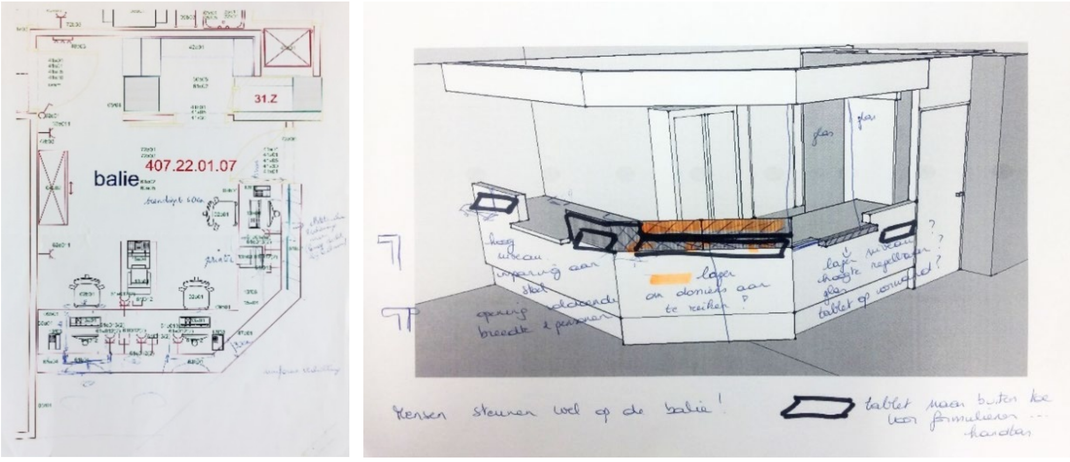

Figure 5. Annotated plan (left) and 3D sketch (right) of reception area.

The interior architect received requests as a fragmented stream of input. In most matters she had the final say. Aspects that could not be taken into account or fell outside of the program were carried forward towards a future design. Some staff members forced their input in the process. By deviating from usual communication procedures, they saw their ideas integrated, sometimes with negative consequences for others. For example, a receptionist refused to sit on a raised chair and therefore had a platform built behind the counter. This was not approved by the interior architect and created an unsafe situation. Ambiguity in the decision-making resulted from the project's open-endedness in terms of aftercare, and the fact that the project coordinator was responsible for the final phase of the renovation (paint colours, hanging of fixtures).

Cross-case analysis

Spatial implications of the evolution of care

In both cases, dealing with spatial implications of the evolution of care posed a major challenge. This challenge was characterised by open-endedness regarding the integration of user perspectives. The building projects were extended through last-minute input and aftercare, in response to users' feedback and complaints immediately following the design and execution of the plans for the (cancer) care facility.

In the new hospital, the sluggish building process conflicted with the future-oriented care vision. Emphasis lay on ensuring the design was updated to reflect the evolving care organisation, dealing with changing patient 'flows' and advances in medicine and technology. This was illustrated by the place of oncological care within the building. Initially, plans for a day hospital were developed, together with a working group. The day hospital, accommodating surgical and oncological/internal medicine significantly deviated from the layout of more standardised nursing wards. Eventually, the day hospital for oncology and internal medicine moved to a regular nursing ward. The COO explains the rationale:

> *At a certain moment you have to calculate your patient volumes, the relational matrix between wards A, B, C, you take all of that into account and then you know "OK, I want approximately that many wards with that content, this many patients and I'd like them positioned about there". Then of course, when new insights come, when you're looking for certain rooms but you run out of space then at a certain moment you have to start thinking out-of-the-box.*

In the new location, a lounge was added with reading materials, a kitchen counter, sofa's, a table and a space for facial/beauty care. It was considered important for the day hospital to be close to the nursing ward for oncology and respiratory care on the floor above.

Dealing with the spatial implications of the evolution of care was also challenging in the oncological consultation. Firstly, those involved recognized the renovation as a temporary solution situated within a greater whole. Their on-going engagement allowed the design process to be one of learning and interconnectedness, linked to past and future spatial and technological changes. Secondly, this case study highlighted a distinction between formal input applying primarily to back-office space and spaces where employees work, and much of the aftercare being necessary to improve patient experience in the waiting room.

A related challenge in both cases, albeit at different scales, links design representations with the input of care professionals. This may help to better understand the working group participants' tendency to focus on details more than the 'big picture'; the challenge of testing with the 'right people'; the difficulty participants had to recognise their own input; and the need to realise more mock-ups in order to fine-tune aspects of the design. In gaining understanding of, and applying knowledge about user perspectives, there was a clear value to using tangible representations or 3D images.

Wearing two hats

To integrate user perspectives in the design, clients primarily tried to meet the requirements of care professionals. Although patients were informally consulted, information about them came indirectly to architects. In the first case the architect said:

> *We build for patients while we ourselves never have contact with patients. The only thing we do is of course reflect on our own, personal situations where we may already have been in-touch with such situations and these influences we obviously include in our designs.*

The care professionals formed a large and diverse group and held the knowledge required to define units' functional use. For clients and architects, they were indispensable as addressing care professionals' needs within their design required detailed insights. Incorporating their understanding of patients was seen as the obvious way to create an environment optimised for the delivery of care. How the space worked was prioritised. The (cancer) patient was considered a customer. People accompanying patients were expected to manage independently. On the client's side, key individuals behaved as guards of user perspectives. These were staff members with an overview of the requirements of a particular unit (spatial) or patient population (pathological). Alongside their 'regular' tasks and responsibilities, they showed genuine commitment to the design process.

Discussion

In the cases studied, the experience of people affected by cancer does not seem to be a primary concern during the design. The design is aimed at the staff, facility management, and hospital board, indirectly referencing patients. Staff are involved as representatives of the organisation and as part of a team. The spatial organisation the designs build on, seems to result from a model of care focussed on efficiently producing medical care [27,28], where the experience of doctors and nurses (e.g., privacy and distance covered) is prioritised over that of patients. Clients and architects voiced the will to enhance patient experience but key aspects of the process did not reflect this. The reality preceding the formulation of the brief restricts the extent to which user perspectives can be fully integrated, and further research should explore the role regulatory agencies and policies have in this.

There is little attention for differences between staff perspectives on patient experience and direct input coming from patients and their relatives. When patients are indirectly represented, it is critical to consider how. Generally, care professionals are considered to be well positioned to voice patients' concerns and they regularly stand in as advocates for patients in healthcare facility design projects (e.g. [29,30]). However, in both cases studied, issues that patients raise (in retrospect), concern non-medical spaces. Spatial aspects of patients' experience that are pathology- and unit-specific, as in the case of the oncology consultation, are acknowledged by various care professionals; while little attention is paid to patients' journeys throughout the building and spatial aspects relating to the possible complexity of their care experience. Where staff is predominantly concerned with their work space, hallways and waiting rooms may require their own advocates.

Participating care professionals are expected to show a high level of commitment. Integrating their feedback is time-consuming and requires facilitation and project management. This aligns with findings of related work [11, 31]. Simultaneously, architects may have limited enthusiasm for more direct user involvement and, limited attention for diversity, as they consider themselves as 'serving a general public'[20]. In this respect, informing (cancer) care facility design with empirical material that distinguishes between user perspectives generally and patient perspectives specifically may be worth exploring.

Finally, the clients and architects in these cases employ user perspectives to anticipate future developments. Expecting users to know the needs and situations of their future fellows is problematic [32]. However, expecting architects to determine future use autonomously may be seen as equally problematic [33]. Mediating objects such as mock-ups enable integrating feedback loops within architectural design processes to inform the final building. Such objects, as representations of space, can facilitate different types of communication and can be expanded on when they are simultaneously developed as a representation for user activities [34]. With this in mind, integrating user perspectives could further be supported by employing spatial representation materials and user-oriented design activities more intentionally. Distinguishing between supporting objectives and activities related to organisational participation and supporting those focused on spatial design may help to channel limited resources.

Concluding remarks

For clients and architects to develop an affinity with the perspectives of people affected by cancer, requires considering, how knowledge about users is acquired. Clients' role is key to deciding when and which user perspectives are integrated. In the cases studied clients' support of staff participation prioritised the perspectives of care professionals and laid the responsibility for providing relevant patient perspectives with them too. Yet, aftercare suggests (cancer) patients' perspectives remain underrepresented. These may however, add value by alerting clients and architects to matters concerning experiences of hallways and waiting spaces. Adequately timing user perspective input remains a major challenge: early integration may solve problems before they arise, looking beyond matters of 'look and feel', whereas late input may delay the project while keeping up with evolutions of care.

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THROUGH THE EYES OF NURSES: USER-FOCUSED DESIGN APPROACH IN NON-CLINICAL AREAS OF PUBLIC HOSPITALS

Supuck Prugsiganont [(1)*], **Per Anker Jensen** [(1)], **Annette Krath Poulsen** [(2)]

[(1)] Technical University of Denmark, Denmark

[(2)] The Capital Region of Denmark

* Corresponding author e-mail: prug@dtu.dk

Abstract

Objective – This paper investigates nurses' perspective toward the concept of user-focused design approach implemented in hospital waiting areas. The study is based on perspective of nurses from ultrasound ward in a public hospital called 'Rigshospitalet', Denmark.

Background – Rigshospitalet has made a specific design guideline called 'the Design Manual' based on data collected by anthropologist researchers and hospital architects. The guideline has been applied in the redesign of non-clinical areas as part of renovation throughout the hospital.

Research question – How involvement of clinical nurses influences the design of waiting areas in a Danish public hospital and how the specific design guideline 'the Design Manual' can be implemented in the design process across disciplines.

Methods – This study was conducted by combination of methods starting with document analysis followed by empirical data collection divided into three steps. First, a brief evaluation of a waiting area in the ultrasound ward. Second, two meetings between researcher, clinical nurses from the ward, and a hospital architect. Third, interview with six nurses. Data from the meetings were analysed using interdisciplinary design approach and interviews were transcribed and analysed by use of open-coding.

Results – The brief evaluation of the ultrasound waiting area gave overview of the architectural quality. Meetings with nurses gave architects specific requirements and the design manual was used as communication tool across disciplines. The manual can help to accelerate the design process. Interviews with the nurses provided insights regarding patients' needs and specific requirements for furniture, zoning, and highlight that nurses understand the user-focused approach and underpinned important aspects for the design.

Conclusion – A design manual is a suitable tool that hospital architects and related professions can use to communicate with staff, patients, and caregivers during design briefing. The design manual can specify user profiles and their needs. However, the interviews with the nurses address that a design manual to bring benefits should be updated frequently to meet the needs of different group of users.

Keywords: *Nurse involvement |design manual | waiting areas | public hospital | Denmark*

1. Introduction

Visiting a hospital can be time consuming, as waiting is an integral part of the healthcare experiences [1]. Non-clinical areas such as restaurant, café, library, and waiting rooms are provided to support patients and their family during the waiting time. Waiting periods at the hospital are perceived as long, uneventful, and stressful [1][2]. Therefore, many hospitals intend to improve the quality of the physical setting of non-clinical areas, as this can improve the experiences of patient and family by reducing anxiety, boredom and similar negative emotions during the waiting time [3].

The rise of the Evidence-based design approach in the past decade amply supports the implementation of a patient-focused approach in the design of hospitals [4]. Planning and design of healthcare facilities have shifted focus to patients' needs, perception and satisfaction [4][5][6]. The user-focused approach has been applied in many hospitals in western countries to improve the physical setting of both clinical and non-clinical areas [7][8]. Patients' needs are key evidence in creating healthcare environments that improve the clinical outcomes. There is also an increasing involvement of clinical nurses during hospital design processes [9]. Clinical nurses' involvement during the design process can add value to the design discussions and create areas that are aligned with patient needs [9]. Clinical nurses are likely to be the most knowledgeable and experienced of all healthcare providers about the needs of patient since they are in attendance and provide care for patients 24 hours 7 days per week [6][9].

Denmark is one of the European countries that promotes the concept of patient empowerment as the Danish government support the concept of patient-centred design and patient empowerment through involvement. Danish hospitals aim to improve the quality of care in the hospitals. This includes different aspects, for example clinical services, patient safety, involvement and communication, information, discharge, inter-sectoral cooperation, free hospital choice and reduced waiting times [10].

Rigshospitalet is the main national university and teaching hospital in Denmark with 1,500 beds. It is located in Copenhagen and the main part of the present buildings were developed during the 1960's. The hospital currently undergoing major renovation and extensions. The hospital has recently introduced a specific design guideline called the 'Design Manual' for remodelling and improving the existing waiting areas of the hospital. The Design Manual gives thorough information about patient profiles and describes details regarding requirements and a list of furniture focusing on waiting areas. An example of a patient profile and example of furniture are shown in figure 2.

In an effort to improve patient's waiting experience and create supportive waiting environments at Rigshospitalet, this study is based on the researcher's participation in a professional practice of a real design process and the involvement of clinical nurses. The aims of this study is to investigate the impact of the engagement of clinical nurses during the design process and examine the perspective of nurses toward the concept of hospital waiting areas and user-focused design. The study took place in the ultrasound and nephrology outpatient wards at Rigshospitalet.

This paper provides details of the Rigshospitalet Design Manual and the implementation of the Manual during the redesigning of ultrasound waiting area where, clinical nurses from the ward were involved during the design process. Later, the perspective of nurses, who had been involved in the design process, were investigated by applying the concept of user-focused approach and the concept of hospital waiting areas.

2. Research questions

The specific research questions for this study are framed as follows:

How involvement of clinical nurses influences the design of waiting areas in a Danish public hospital and *how* the specific design guideline 'the Design Manual' can be implemented in the design process across disciplines.

3. Theory

This section provides a framing of the study in relation to theory of user involvement in sub-section 3.1. The design manual that forms the basis for the study as mentioned in the introduction includes a number of patient profiles. These can be seen as examples of 'personas'. The personas method was originally created as part of the development of user interfaces for computer software, but it has been used later also for example in marketing and service design [11]. Sub-section 3.2 provides a short introduction to the theory behind the personas method. The design manual is a communication tool, and can as such be regarded as a 'boundary object', which is an object to be used to bridge the boundary between different disciplines, including the boundary between users and professionals. Sub-section 3.3 provides a short introduction to the theory behind the boundary object construct.

3.1 User involvement

With a paradigm shift of hospital design in the past decade, patients are considered as 'end-users' [12]. Therefore, patients' needs are important aspects during hospital design processes in which the involvement of users can bring benefit and accelerate the design process [13]. A complex project like renovating a hospital has many stakeholders; medical staff and related professions are also considered hospital end-users, and their satisfaction and well-being can have impact on patients' medical outcomes. The involvement of medical staff, especially nurses, can underpin patients' need that has often been abandoned during the design process [6][9][14]. Clinical nurses that are involved in the design process will have more understanding regarding the design limitation and challenges.

The term 'user involvement' is aligned with 'focus on users' [15], 'consulting end-users' [16], 'contacting with system users' [17], and 'participation of users' [13][18]. User involvement can be seen as a general term describing direct contact with users and covering many approaches [13]. For example, in hospital design, users can take active roles in many design activities, but in other approaches, users are involved as providers of information, commentators or objects for observations. The level of user-involvement can broadly be characterized as being somewhere on the continuum from informative through consultative to participative [19].

3.2 Personas

Personas is a critical method for orienting design and development teams to user experience. They are useful when constraints, for example large development teams or diverse users, exclude participatory design methods [20]. Teams can apply Personas for user specific aspects during the design process, making efficient design decisions without inappropriate generalization, and communicating about users to various stakeholders [21][22][23][24][25]. The use of Personas does not require eliminating scenarios or any other method: It is a foundation on which to build scenarios and data collection. It is an infrastructure for engagement. Personas is also a means for communicating data that is collected using other user research methods [26].

Personas are fictional people or characters that are imitating existing person in real life. They have names, likenesses, clothes, occupations, families, friends, pets, possessions, and so forth. They have age, gender, ethnicity, educational achievement, and socioeconomic status. They have life stories, goals and tasks [26]. In order to construct personas to develop design processes, a concrete methodology is employed, for example the organisation of the data collection to develop the main users of particular design project and the development of user profiles and scenarios to facilitate the use of personas [27].

3.3 Boundary object

The term boundary object was developed by Star and Griesemer [28] as a concept of problem solving by means of translation. Boundary objects are described as media or communication between communities [7]. Boundary objects can enhance the capacity of an idea, theory or practice to translate across culturally defined boundaries, for instance between communities of knowledge or practice [29][30]. They can be abstract or concrete objects that arise over time from durable cooperation and understood or misunderstood in equality between the participants.

In term of briefing and design process, boundary objects are divided into five categories [7];

- Repositories (for example, cost databases, part libraries)
- Standardised forms and methods (for example, drawings, handmade sketches, lists of problems, questionnaires)
- Objects, models and maps (for example, slideshows, architectural drawings, and 3 dimensional renderings, fishbone charts, mock-ups)
- Discourses (for example, questioning situations, typical action situations)
- Processing (for example, prototyping, visiting other departments)

Four characteristics to analyze the boundary object in term of briefing and design process are [7][31];

- Boundary objects are not ready made, but objects-in-the-making, need to be created by participants
- Boundary objects have built-in affordances, possibilities for action, interaction instruments
- A facilitator of the events selects the boundary object, develops rule and instructions and guides the workshops
- Boundary objects are used in discrete events, workshop/meeting with a temporary learning space, enable a collaborative design process, enable participants into 'design mode'

4. Methodology

This study was conducted by the first and third author, while the second author supervised the research. The first author collected the empirical data and will, in the following, be called *the researcher*. The third author works as an architect for the hospital and will be called the *hospital architect*. Combination of two methodologies were applied in the study; the first part was document analysis of the Design Manual using interdisciplinary design approach. The second part was the empirical data collection, which was divided into three separate steps as follows;

Step 1 - *Brief evaluation of the ultrasound ward.* In this step, the researcher evaluated waiting areas of ultrasound and nephrology wards. These evaluations are mentioned below under data analysis. The data from the brief evaluation process narrowed down the requirement criteria for the redesign of the waiting areas. Based on the evaluation results, the hospital architect and the researcher developed a schematic design of the waiting areas using the evaluation data and furniture lists from the Design Manual.

Step 2 - *Meeting between researcher, hospital architect and nurses.* Two meetings (60 minutes each) took place in the ultrasound ward in September and November 2018. Four nurses participated in the meeting, including a head nurse and three registered clinical nurses. After the meeting, the hospital architect and the researcher further developed the design based on the discussions from the meetings.

Step 3 - *Interviews with nurses.* The researcher interviewed *six* nurses - four nurses from the nephrology and two nurses from the ultrasound outpatient wards. The interview questions highlighted the concept of hospital waiting areas, user-focused design, the involvement of clinical nurses during the hospital design processes, and context of the Design Manual. Table 1 illustrates details of nurses being interviewed for this study. The nephrology treatment ward had been through a similar process with step 1 and 2, but only the results from step 1 and 2 in the ultrasound ward is presented in this paper.

Table 1. Distribution of nurses interviewed and details regarding the interviews

Hospital	Ward	Number	Date	Duration (minutes)
Rigshospitalet	Ultrasound	2	November, 2018	15-30
	Nephrology	4	January, 2019 February, 2019	45-60
Total		**6**		

Data analysis - Two steps of data analysis were applied, the first step was analysis of results from the brief evaluation of waiting areas in the ultrasound ward and the meetings between nurses, the researcher, and the hospital architect. The analysis of the brief waiting areas evaluation was done using the criteria from Evaluation Aspect and Requirement of Health-care Facilities [32], the requirements for waiting areas from Rigshospitalet in 2017, and the requirements from the Design Manual. Discussion and notes from the meetings were analysed to develop the design of the waiting areas. The second step was analysis of the interviews with the *six* nurses. Data was transcribed and read line by line to find nurses' opinion regarding: (1) user-focused approach; (2) concept of waiting area; (3) what should be considered for design brief, and (4) concept of design brief. Later open coding was applied to conclude the theme that emerge during the interview [33][34]. Figure 1 illustrates the methodology and timeline of the study.

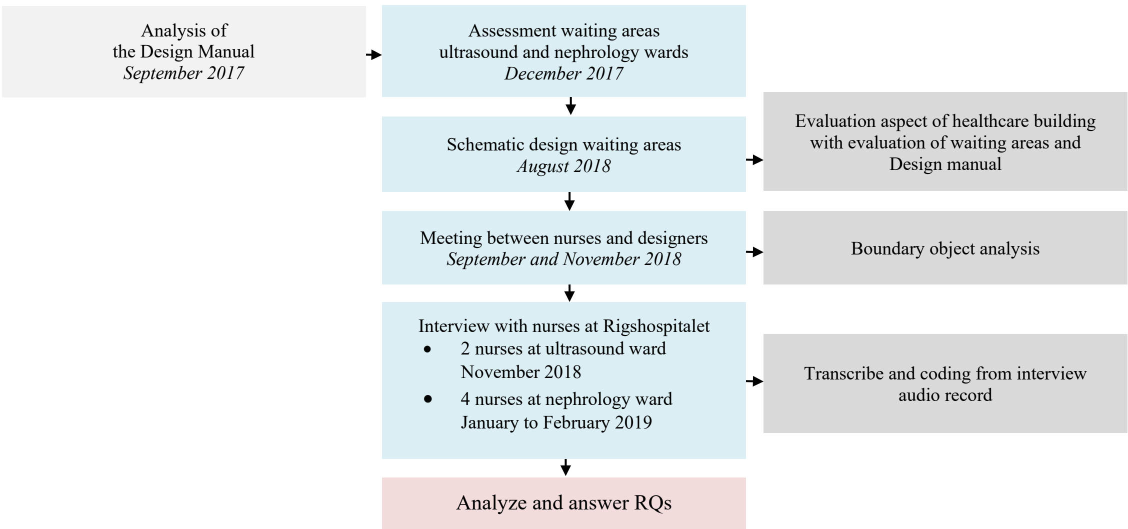


Figure 1. Methodology applied in this study

5. Case description

5.1 Rigshospitalet and redesign of waiting areas

Rigshospitalet's main building was built starting in 1960 with the design of two Danish architects Jørgen Stærmose and Kay Boeck-Hansen. The hospital was put into service in 1970 after the inauguration of the 16-storey complex buildings. Later, in 1975 a seven-storey south complex was added to the 16-storey building. The central and southern complex is connected by a four-storey building. The redesigning of the waiting areas of the hospital is the ambition from Rigshospitalet, aiming to meet requirement from the Capital Region of Denmark (CRD). The main task of CRD is to excel services of hospitals and healthcare throughout Copenhagen region. In 2015, CRD has launched the concept 'Waiting & Welcoming' together with the implementation of research in improving patient supporting physical environment, care and recovery, which is an on-going process since 2015.

5.2 The design manual

The manual is a specific design guideline created by Rigshospitalet's design team focusing only on waiting areas of the hospital. The manual has been developed through the involvement of users (nurses, clinical staff, patients) and experts (anthropologist researcher and architects). The manual was implemented in November 2017 and the manual provides information as followed;

- Patient needs through user-involvement: one chapter in the design manual provides patient profiles, furniture catalogue, and layout of the waiting areas. Twelve patient profiles cover most of the patients who visit the Rigshospitalet. Furniture catalogue divided into six categories (furniture, lighting, specially adapted inventory, various item, colour and material, inspiration for furniture composition). Figure 2 illustrate a patient profile, list of furniture, and layout of the waiting area.

- Clear guideline for meetings between different stakeholders: meetings should be conducted with a collaboration of different user groups representing medical staff (4 to 8 people), project manager and hospital architect. During the meeting, five topics (user wishes, patient profiles, purchasing process, removal/demolition/ recycling process) will be discussed and clarified.

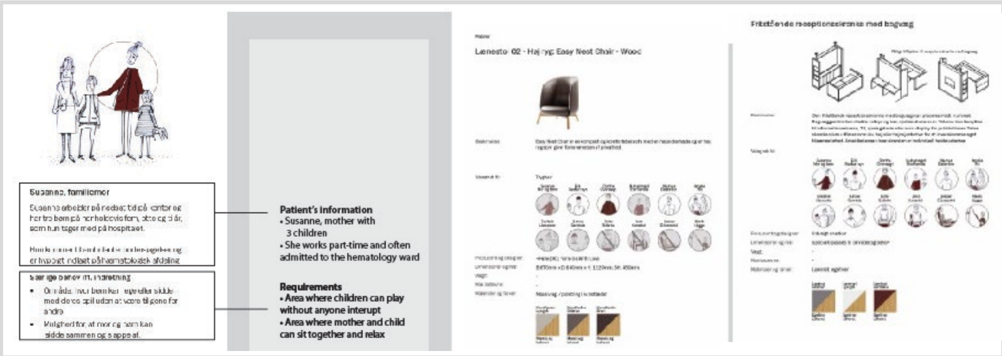


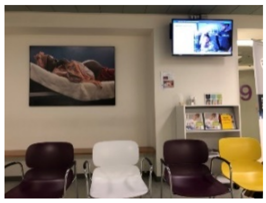
Figure 2. Example of a patient profile, furniture catalogue, and layout of the waiting room from the Design Manual

6. Results

6.1 Brief evaluation of the ultrasound ward

Before evaluating the waiting area of the ultrasound ward, the design manual was sent to the head nurses of the clinic. The nurses looked through the manual and contacted the hospital architect regarding three requirements, including: number of seats for patients; patient profile and requirement of special areas, for example, area for gurneys, children or family. The requests from nurses were included in the evaluation criteria. Table 2 illustrates results from the brief evaluation of the ultrasound ward waiting area.

Table 2. Brief evaluation of the ultrasound waiting area

Criteria	Ultrasound ward	Photos of the waiting areas
1. Reachability	• Ward located on ground floor easy access	 Figure 3: entrance of the ward  Figure 4: waiting area zone  Figure 5: patients can lie down at the gurney while waiting in case of emergency
2. Accessibility	• Waiting area is not suitable for patient in wheel chair or mothers who come with their children or stroller due to limited spaces	
2. Efficiency	• Wide corridor and easy to reach	
3. Flexibility	• Waiting area is flexible/easy to adapt with no built in furniture	
4. Safety	• Linoleum floor with anti-slippery material • Sufficient amount of light	
5. Spatial orientation	• Waiting area located in the middle of the ward • Patient are not exposed to public while waiting • Clear way-finding with sign	
6. Privacy	• Not enough space for privacy to discuss private subjects while waiting	
7. Health and physical well-being	• Hand gel, internet wi-fi, phone charger, queuing monitor, variety of drinks, furniture for pregnant lady, and more privacy zone are required • TV is provided for basic information of the hospital and also entertainment	
8. Architectural feature	• Waiting area in the middle of the ward • Three type of seats: plastic chair with metal legs, beds, and wooden bench • Gurneys for acute case • More zoning for patients required • Patients come in couples (husband and wife) more seats for couples and pregnant lady are required	

This step gives an overview of the waiting area and which architectural elements require an improvement. The waiting area is situated in the middle of the clinic, and patients are not exposed to public space. However, there is a lack of seating for pregnant woman - a comfortable chair with handles - and a couch for couples to sit together. The area requires zoning for patients, who comes individually or with company. The information was summarized and transferred into meeting agendas to be discussed with nurses.

6.2 Meeting with nurses

Two meetings took place at the ultrasound ward. Before the meeting, the design manual and conclusion of area evaluation were sent to nurses via e-mail. The hospital architect set-up a meeting agenda focusing on: (1) number and type of seats; (2) specific waiting areas, and (3) other topics related to the design of waiting areas. During both meetings, six people attended (four clinical nurses including a head nurse, the hospital architect, and the researcher). The structure of both meetings began with the architect explaining the overall idea of the schematic design and later nurses gave comments regarding the architectural plan and what they would like to add in order to amend the design by following the meeting agendas. Later the architect and researcher took notes and summarized the comments before completing the meetings. Four topics emerged during both meetings.

Improve seating:

- Replace the old seats with new seats from the design manual, nurses selected specific seats from the Design Manual and gave suggestions
- Increase number of seats, 55-60 seats for patients are required, at the moment 51 seats are available but, only 40 seats are usually occupied as patients refuse to sit next to each other.
- Specific seats for pregnant women with handles

Increase patient privacy through the design of the seats and partition:

- Replace gurneys with reclining chairs, replace curtain with partition, and add more seats for family members
- Specific couches where individuals or couples can sit with privacy

Improve quality of waiting area:

- Create zoning with seating in groups, couples, individual, and pregnant women
- Add table lamp to group seating zone and long waiting time zone
- Add water dispenser to the area
- Add handwashing station near water dispenser
- Add writing table at the entrance

Design manual: The design manual enables nurses to select specific patient profiles. Nurses pointed out that a pregnant women profile is lacking in the manual (see example of a patient profile from the design manual in Figure 2). The nurses also identified specific numbers and types of seats to select by looking through the manual (see example of furniture from the design manual in Figure 2). For the lying-down area, nurses mentioned inclining seats, where non-acute patient can also sit. During the meeting, nurses mentioned a type of seat that is similar to a gurney (i.e., reclining seat). Designer and nurses worked together to develop a layout of seating area and zoning. After summarizing each meeting agendas, the hospital architect and the researcher developed the waiting area layout. A schematic design was sent out to nurses, before the architect and researcher finalized the final layout. After the second meeting, the design was finalized.

The meeting with nurses gave specific information that was not investigated during the brief evaluation. Nurses working closely with patients know the exact number of patients, who would visit the ward each day, specific patient's profiles, requirement for furniture, and ideas about zoning. The design manual acted as a catalyst for the meetings, where architects presented the architectural planning and nurses pointed out the furniture from the catalogue, suggested which patient profiles were required, and indicated specific needs. The manual helped accelerating the design process and avoided unnecessary meetings. Figure 6 and 7 illustrates the waiting area at the ultrasound ward before and after the design intervention and collaboration between nurses and architect using the Design Manual for the communication across two disciplines.

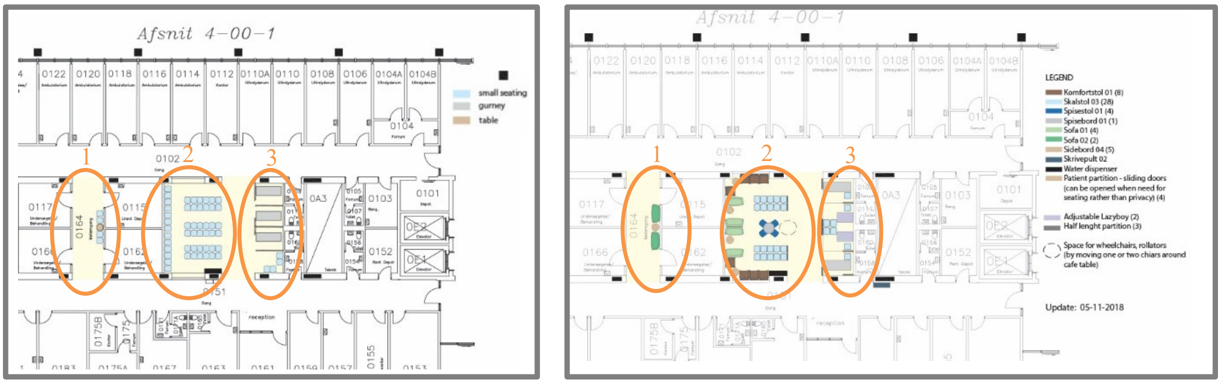


Figure 6 and 7. Plan of the ultrasound ward waiting areas before and after the design intervention

The original waiting area provided 51 seats (figure 6 on the left) including two benches and three gurneys. After the design intervention, the architect provides three zones with a variety of seats including couches and armchairs (figure 7 on the right). Small seats were replaced by couches for patients with long-waiting-time in the first zone. In the second zone, armchairs and couches are provided for pregnant ladies and their company. A round table was installed in the middle of the waiting area with room for patients in wheelchairs. The third zone includes two inclining chairs, which can be adjusted as normal seats are provided together with adjustable couches, and small seats are installed for patient's family and friends. The total number of seats in the new design is 56. However, patients have more seating choices and they can choose to sit in an area with more privacy.

6.3 Interview with nurses

This section explores the perspective of nurses using methods proposed by Fronczek-Munter [8] and Maben et al. [35]. Six nurses from ultrasound and nephrology wards, who had participated in the meetings in step 2, were interviewed. The interview questions were set to explore nurses' understanding of the concept of patient-focused design and the advantage and challenges of the design manual. Four topics emerged from the interviews.

Definition of user-focused approach and patients' needs:

- Involve patients in the design and medical processes of the hospital
- Create mutual design guideline that are aligned with patients' and staff's needs
- Understand individual patients

These findings indicate that nurses understand the concept of the user-focused design approach and see the importance of the involvement of patient and staff during design briefing.

Concept of user-focused design of waiting areas:

- Provide optimal physical comfort for patients
- Provide hospital hygienic standard
- Provide privacy
- Provide information

The nurses underpinned that ***privacy*** is the most important aspect for design criteria of waiting areas, followed by giving patient information (i.e., waiting time, queue) hygiene, and physical comfort. The interviews highlighted that nurses understand the concept of the user-focused design approach and know that the physical environment has impact on patients' well-being.

Important aspects that should be indicated in a design brief of waiting areas:

- Involvement of clinical nurses
- Number of patients
- Architectural quality
- Hygiene
- Privacy

These findings resemble the concept of user-focused design of waiting areas. The nurses indicated that they pay attention to patients' needs. They added that privacy and services are important for patients, while high architectural quality is a supplement to medical services, as one nurse said, "The reason that they are here is the treatment and we must do it as good as we can. And if the waiting areas are looking good and clean that is one-plus".

The design manual:

- Give nurses visualization
- Communication tool across disciplines
- Nurses become autonomous
- Give nurses evidence that the area will be amended

The design manual is a cross-disciplinary communication tool. It helps accelerate the design process. Nurses also suggested that it brings benefits, as nurses can be more self-autonomous for a simple design of a waiting area. It also brings the same understanding between architects and nurses. However, the manual needs to be tested regularly in order to keep it up to date. Therefore, the design manual can bring benefits to architects and nurses during the design briefing and it is a useful tool for clinical nurse involvement.

6. Discussion

The design manual is a combination of two concepts, which are user-focused design and personas. The integration of user-focused design and requirements from Righospitalet services for patients were implemented in the design of patient waiting area zones and furniture. Patient profiles represents a combination of the personas method and user-focused design approaches. The patient profiles elaborate the needs of each individual and represent a real person, who comes to the hospital. Nurses can easily identify who, when, what, and how patients will be using the waiting areas by looking through the design manual. As one nurse said, "it helps you visualize what the options are and ideas from the architects, it makes the idea more real".

Another finding is that the design manual was not used for design, but rather as a communication tool across disciplines, especially in Danish hospitals, where involvement of clinical nurses is integrated in design briefing process. Thus, the design manual is a boundary object that transfer research information to design ideas (furniture) and people (patient profile). It acts as a facilitator of the events. The manual gives the same understanding to architects and nurses - in this case meetings between architect, researcher and nurses. The design manual develops rules, instruction, and guides for the meeting. The manual helps nurses visualize and be more realistic of what furniture/solutions will be implemented in the areas, as one nurse said, "it helps you visualize what the options are and ideas from you guys. So, it makes the idea more real. I mean you can talk and describe colour, but when you see the manual you have clear idea about the design". Therefore, the design manual is a useful tool, when there is a cross-disciplinary involvement in the design brief.

7. Conclusion

This paper presented results of an investigation of clinical nurse involvement in design briefing by the use of a specific design guideline (the Design Manual). The research questions framed for this study were: How involvement of clinical nurses influences the design of waiting areas in a Danish public hospital and how the specific design guideline 'the Design Manual' can be implemented in the design process across disciplines. The following provides answers to the research questions.

Clinical nurses give specific information, which sometimes is neglected by architects, for example information about the actual number of patients, specific patient profiles, specific furniture, or zoning. Clinical nurses also have a better understanding about the requirements for the design, but they cannot translate it into design solutions. Therefore, architects fulfil that role and translate nurses' request into design solution or guidelines. The brief evaluation conducted as step 1 in this study gives overall information about the waiting areas, from which architects can understand what needs to be amended and improved. However, the meetings in step 2 and the interviews in step 3 highlighted specific information and illustrated that nurses understand the concept of user-focused design approach. Therefore, the involvement of clinical nurses in an early stage of the (re-)design of hospital spaces, such as clinics and waiting areas, is necessary and should be implemented.

The design manual helps architects and nurses to accelerate the design process. In the interviews, nurses mentioned that it gives them visualisation and understanding of what type of furniture will be implemented in the area. The manual is deployed as a communication tool across disciplines. Nurses can be autonomous for basic designs of the waiting areas, as they can look through the manual and select furniture that align with patients’ profiles. Nevertheless, the manual should be updated regularly and be tested in the different clinics throughout the hospital.

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DESIGN DILEMMAS IN MENTAL HOSPITAL ARCHITECTURE

Natalia Batrakova*

Tampere University of Technology, Finland; architect, Raami Arkkitehdit, https://raamiarkkitehdit.fi, Tampere, Finland

* Corresponding author e-mail: natalia.batrakova@raamiarkkitehdit.fi

Abstract

Objective – The paper identifies dilemmas facing architects, planners and medical professionals in the process of designing a new psychiatric facility.

Background – Rarely any other type of public building has had such a turbulent and complicated history of experimentation, and of design innovations being widely implemented all over the world during one decade and completely discarded in the following one. Everyone involved in the planning process has to make moral choices every step of the way, and those choices impacted design and subsequently the provision of care.

Research question – The paper seeks to condense and formulate the dilemmas architects face in design process. Should psychiatric hospitals be dense to ensure short routes, easy observation and fast reaction in crisis? Or alternatively, should the wards be spacious, giving patients enough room to walk around freely? Should the hospital look like a medical facility, transmitting the image of competence and temporality, or should it be more 'normal', home-like and non-institutional? How do we combine domestic character of the ward environment with necessary safety features? Should spaces be designed according to hospital hierarchy and provide the patients with a clear structure that is easy to comprehend, or should social interactions in the hospitals be more fluid, emphasising an equally important part patients play in the treatment process? Those and other dilemmas are presented and discussed in the paper.

Methods – The dilemmas were synthesized through historical analysis of both architecture and policy related to psychiatric facilities, literature, including the studies of mental hospital environment as well as accounts of staff and former patients, modern examples of behavioural facilities and personal professional experience of being involved in the design of several psychiatric hospitals.

Results – As a result, 8 pairs of contradicting environmental characteristics were identified: privacy/isolation, efficiency/spaciousness, structure/fluidity, medical/normal, domesticity/safety, stimulating/calming, communication/distraction, care/disability. These dilemmas are discussed in detail, with reference to existing studies. Also, the possible ways to study design dilemmas further are described.

Conclusion – The paper calls for the discussion and additional studies to help solve those dilemmas and equip planners with concrete evidence. Hopefully, further research will help us to design mental hospitals that will be able not only to provide excellent care, but also be flexible enough to adapt to future change.

Keywords: *psychiatric hospital | mental health | evidence-based design | literature review | hospital design.*

Introduction

Throughout the history, architecture has had different responses to the task of designing spaces for the mentally ill. At one point it was the spatial separation in custodial buildings that some would call 'an uneasy compromise between a general hospital and a prison' [1]. Then, the architects attempted to create an embodiment of 'three-dimensional reason' which would manifest in perfectly organised isolated asylum communities and grand rational structures. As an alternative, smaller institutions providing more humane treatment were designed. At many points in time, the direction of psychiatric treatment has changed radically. Various solutions were tried and then rejected, in a struggle to deal with the complicated nature of mental illness, which is both biomedical and environmental, physical and social. For years architects have been trying to combine conflicting tasks of care and confinement in spaces for mental health.

This article is written from an architect's perspective as it describes some of the dilemmas we face while designing a psychiatric hospital. Needless to say, this task will always be that of managing interests of very diverse groups: the service users need different types of care, the staff might prioritise their concerns over safety, the management can have various treatment models in mind, and the officials will often be constrained by the limited budget. In this process, everyone involved has to make choices every step of the way, and those choices significantly impact the design and subsequently the provision of care. As is discussed further, the dilemmas sometimes come down to moral or ideological questions. They could form a base for discussion among the stakeholders, or a starting point of the evidence-based research.

First, the paper talks about the existing debate around design for mental health. In the beginning it touches on the existing research methods of investigating how the physical environment can influence the healing process. Then it provides a description of the themes and topics that are often mentioned in the literature about mental hospital architecture. Finally, it makes a case for studying hospital environment through dilemmas – pairs of contradicting characteristics, rather than through single elements. The dilemmas are illustrated with the examples of contradictory recommendation found in existent research.

An overview of existing research methods

There is a growing number of studies addressing the effect that the physical environment of psychiatric facilities has on clinical outcomes. The knowledge of the subject comes from the fields of medicine, social geography, architecture and environmental psychology. Existing studies sometimes focus on how psychiatric spaces are used, what environmental features have a positive impact, how changes in the physical environment of a hospital affect communication between different user groups. Both qualitative and quantitative methods have been used to study psychiatric environments.

Qualitative studies can be considered to be a good tool to provide unbiased evidence on how the design of the psychiatric facilities influences the treatment and wellbeing of both patients and staff. They may be drawn upon to convince decision-makers that a measurable benefit arises from investing in design. Researchers typically strive to identify the connections between the presence of certain design characteristics and the number of negative episodes and accidents, the length of stay, seclusion rate and the use of medication. Several papers [2] [3] suggest creating an index to evaluate important design characteristics such as the institutional and therapeutic quality, and the level of security of the ward. The index can then be measured against clinical outcomes in order to discover possible relationships between these variables. In their book, Shepley et al. [4] list 11 evaluation tools that can be used to study built and social environment. For example, ASPECT, a tool developed in 2008, evaluates privacy, dignity, comfort, control, views of nature, and a number of other items among staff and patients. PFE, a tool developed for design teams and building occupants, is helpful in assessing the building pre- and post-occupancy.

Qualitative studies are valuable in gathering background information, identifying potentially important factors, uncovering insight and anecdotal evidence. This class of methods includes interviews with stakeholders, anthropological and environmental studies, as well as phenomenological research. Photos and videos are mentioned [5] as a promising but rarely used instrument. In one study [6] of somatic hospital environment patients were given camera phones to record their daily experiences. The photographs of hospital wards were also applied in a study of children and adolescents' experience of inpatient hospital environment. Participants were shown pictures of spaces they used to inhabit as a starting point of the conversation between them and the interviewer [7].

Studying psychiatric environment is a complicated task. The presence of researchers in and of itself can affect the results, since the service users might perceive them as hostile outsiders. In instances that would be deemed inadmissible under modern ethical guidelines, undercover work has been used in previous decades, when researchers gathered data while posing as patients or members of staff. Shepley et al. [4] write about difficulties associated with gathering data in medical settings, such as the privacy concerns related to the data originating with vulnerable populations and the ability of psychiatric patients to respond to questions. Other challenges include small sample sizes, limited possibility to have a control group, a chance that patients' response might be influenced by their symptoms and hospital hierarchy, as well as the possible bias of the staff against their patients or a less constant physical presence of the staff members in the ward. Existing studies have also been criticised for not taking all the possible factors into account that include patent's diagnosis, their symptoms, history of hospitalisation, patient's and staff's background, the amount of working hours, staff's level of training, the staff per patient ratio, the amount of contact with patients, ward population makeup, day schedule, medication, spatial privileges, length of time spent in different ward locations, weather and seasonal changes. Lundin [8] writes with scepticism about evidence-based design findings, arguing that they often state the obvious, and that it is almost impossible to conduct such research properly, since there will always be room for doubt over whether the changes observed are due to design interventions or due to the change in clinical practice. Papoulias [5] questioned the existing studies for the lack of proper methodology and for not being rigorous enough.

In architectural practice, however, decisions are mostly not based on scientific research, but on close case-by-case cooperation with the stakeholders. Co-design - collective decision making in a framework of frequent meeting with different stakeholders is a tool sometimes used by architects to gather expertise. Unfortunately, in this process the voices of service users are often ignored.

Boden et al. [7] write in their chapter about the ways of adapting co-design to identify key 'touch points' in the workflow of the facility, – the moments in space and process that require special attention to design and operation planning. In the course of this process, different groups are brought together to arrive at a common solution that is acceptable to all of them. Video interviews of the user groups are utilized at the initial stage of the process to reach common ground, and solutions were developed in a series of workshops. Another workshop-based project, 'Madlove:

a Designer Asylum' by James Leadbitter aimed at giving a voice to the service users, their families and care providers. In a series of workshops held at in different locations and involving various groups of people, participants were asked to imagine what their perfect asylum would look like, smell like, feel like, as well as what activities it would have available? The responses were recorded and illustrated by an artist during each workshop, creating a beautiful palette of ideas. Parnell and Rooney [7] describe their study of remodelling the sensory room in a child and adolescent mental health unit. In this case, the users participated in the design and continuous remodelling of the room, development and management of activities, which was regarded as a very positive practice. Generally, it has been reported that involving staff and service users in the design process, choosing the artwork and developing activities has had a positive impact [7].

Themes

Several literature reviews of research regarding mental hospital design [9],[10],[11] describe the findings and themes that are studied most often. Among the most mentioned are: topics related to general physical design (natural and electric light, noise levels, views of nature, domestic features, single occupancy rooms, good visibility, diverse spaces for different activities, clear layout and functions, design and position of the nurse stations); interior design elements (positive distractions, high-quality well-maintained finishes, presence of art, movable furniture) and; psycho-social and administrative (access to gardens, social interaction, models of care, deinstitutionalized environment, crowding, security, privacy, user engagement in design, therapeutic milieu). The reviews mention that some of those features made a positive impact on reducing length of hospital stay, use of medication, aggression and seclusion rate, and reported wellbeing of patients and staff [5].

Other researchers have grouped those characteristics in order to evaluate hospital environment more broadly. For example, Chrysikou [2] has studied whether treatment and patient satisfaction rates were better in hospitals with domestic or traditional institutional design. She developed an evaluation tool called the SCP model, where SCP stands for characteristics specific to psychiatric hospitals: security, which describes whether patients are seen as a potential danger to themselves or others; competence, which indicated whether patients have a degree of disability; privacy, which points to whether gradual reintegration to society is part of the treatment). Some authors have proposed to update the Ward Atmosphere Scale (WAS) which was developed by Rudolf H.Moss in 1960s and has since then become the most widely utilized tool for evaluation of psycho-social environment in inpatient wards [30]. Currently, the evaluation categories that constitute WAS include involvement, support, spontaneity (that is, the relationship dimension), autonomy, practical and personal problem orientation, aggression (the personal dimension), organisation, program clarity, staff control (the system maintenance dimension).

Several authors have written about issues that need to be considered in the design of new psychiatric hospitals. A group of authors involved in mental healthcare system reflect on emotions and experiences that service users encounter during the hospital admission in the collection of essays gathered in a recent book [7]. Emotions that can have a major impact on mental health of a service user are grouped into the following categories: status and value, which covers humiliation, equity, status anxiety, shame, utility, and stigma; trust and belonging, which brings together connection, cohesion, resilience, community, and isolation; power and agency for authority, entrapment, control, and powerlessness; safety, security and respite which includes threat, fear, instability. Studying hospital environment through the emotions it evokes in the users is a promising direction of research, given the potential benefit of well-designed spaces towards ensuring that the users retain dignity. Moreover, this approach can help to minimize the feelings of shame and powerlessness which are commonly associated with one's admission to a psychiatric hospital and already accompany so many mental illnesses.

Attempts to provide a summary of design concerns and recommendations have also been made. Shepley and Pasha [4, 9] list recommendations underscored by emerging evidence and based on the analysis of previously made studies. They could be related to psychological needs, such as those of stress reduction, personal space, security, choice, as well as to functional needs treatment and care, safety, access to nature and effective communication. In his book, Verderber [3] identifies 74 design considerations and classifies them into 7 groups: built environment (landscape, arrival sequence, private and public spaces, inpatient and outpatient wards) and diagnostics, treatment and management (art, music and horticultural therapy, specific trauma units, virtual reality therapy, disaster resilience, salutogenic partnerships, safety of patients, visitors and caregivers). He also criticizes previous studies for the lack of focus on staff wellbeing and the effect it can have on the patients. Karlin and Zeiss [13] put design considerations into in four groups – ambient (light, noise, air quality), architectural (layout and size of the wards, patient rooms, nature views, design of group rooms and location of isolation rooms), interior (furnishing, familiarity and colour), social and specific features. Lundin and Bergsland [14] also give a list of recommendations based on literature and personal experience: positive first impression, dignified environment, gradation of privacy in spaces, poetization of daily rituals, alternative routes, smaller units with own social spaces, separate entrances for the police and ambulance, short corridors, and building as low as possible.

Unfortunately, the totality of the recommendations mentioned above, design manuals and national regulations may at times represent numerous contradictory statements. Engaging in a though experiment to illustrate this point brings to life the following constructs: "the environment should be flexible and deinstitutionalised, allow spontaneity, but at the same time be ordered and organised"; "the furniture and finishes should be made damage-resistant and easily repairable, must also possess a home-like appearance", "there should be large low windows, but patients should not feel too exposed", "there should be places for respite, but the ward should be easy to observe while the social interaction should be encouraged". The striking logical incoherence of this emphasises the problem of correctly selecting those recommendations that must be given priority and those that we can afford to ignore. One has to ponder whether it is worth trying to find the general solution at all or whether a case-by case unpacking of design dilemmas might be a better approach.

Dilemmas

As Chrysikou [2] mentions in her book, the contradictions in design recommendations might stem from the dual nature of psychiatric treatment. On the one hand, patients should not be afraid of asking for help and admission to the psychiatric ward. They should feel safe, welcomed and retain their dignity. However, they will also be sometimes stripped of their privacy through checks during the night, personal items taken away and constant observation for security reasons. The patients need to have enough autonomy to feel self-sufficient and to retain skills, but the hospital usually cannot risk trusting them. Finally, sometimes symptoms of mental illness can prevent patients from performing everyday tasks, calling for assistance or additional control to be provided, again at the expense of their privacy.

At the same time, the ideals that have informed the design of modern psychiatric hospitals in the 2000s might presently be in danger. In Finland, the amount of hospital beds has been declining and is now less than 20% of what it used to be during the beginning of deinstitutionalisation process. As a result, the severity threshold for inpatient treatment is set at a very high level. Staff shortages shift the responsibility for ensuring patient's safety to the designers of physical environment. This leads to an increase in the risk of the environment of psychiatric wards becoming more institutional [15], [16]. Even if the architects incorporate therapeutic features, they will be sometimes removed or limited during the security checks. Curtis et.al. [17] cite interviews with hospital staff and users where they discuss not being able to use patient kitchen or open windows in patient rooms, including those that have protective mesh, because they are considered unsafe by the hospital administration.

Patients, staff and administration might have opposing perceptions of the mental hospital, a phenomenon that Nichols and Kidd term 'split milieu' [7]. For example, Poole and Reaveley [7] mention that while the staff sees isolation and use of the seclusion room through the lens of risk and safety, the service users always see it as a punishment. Dinesh [18] writes that the patients in the ward are always bored, while the staff are overloaded with paperwork. The staff focuses too much on safety and controlling behaviour of the users, so there is no time left for the meaningful interaction. The acute wards today tend to focus on crisis management rather than treatment, and that makes patients feel abandoned and not listened to when they are most vulnerable. The service user group is also not homogenous, some feel exhausted and in need of rest while others are agitated and demand constant interaction [18]. How those radically different groups will co-exist in the same space should be discussed during the design process of a new facility. All sides should be heard with respect to the common ideology, goals and treatment philosophy in the new hospital. Observing it from the perspective of the dilemmas, being aware of the sometimes conflicting goals, is important for finding a common ground. The following dilemmas (figure 1), – 8 pairs of environmental characteristics, - were produced on the basis of concerns voiced in the literature, as well as the contradicting design goals encountered by the author in her architectural practice.

Figure 1. Design dilemmas

Dilemma 1: PRIVACY – ISOLATION

Psychiatric hospitals have historically been placed in remote rural areas to both provide service users with a quiet space to heal and to shield them from the pressures of life in the society. Closed wards, common in Finland, may be regarded as the continuation of this trend. The question, therefor, is that of where the hospital should be built to ensure that the users have a peaceful stay, yet are able to maintain a connection to the community. First, some modern hospitals are still being built in the countryside, thanks to its suitability for generous gardens being established and their beautiful landscapes. However, a remote location makes it harder for the users to stay connected, or for the family members to visit and be present during the care process. Second, locating a hospital on the somatic hospital campus, or on a floor of a general hospital, normalizes the mental illness and provides possibilities for multi-disciplinary care. However, such campuses are often very dense and have limited access to the outside green spaces. Third, bringing hospital closer to the community, making it permeable rather than fortress-like helps to keep it accessible and its users connected to the outside world while not offering patients the same protection inside their own universe of a psychiatric institution. Service users treated in community care experience everyday stigma more frequently, since the 'healthy' population that rarely tolerates differences surrounds them. In terms of architecture, transparent buildings, living rooms with large windows, balconies, courtyards and gardens that are open to the outside can help to reduce the stigma, but at the same time they may make the service users feel as if they are being put on display. To sum up, this dilemma hints at a crucial question of ensuring the patients' privacy is protected without making them feel hidden away and isolated.

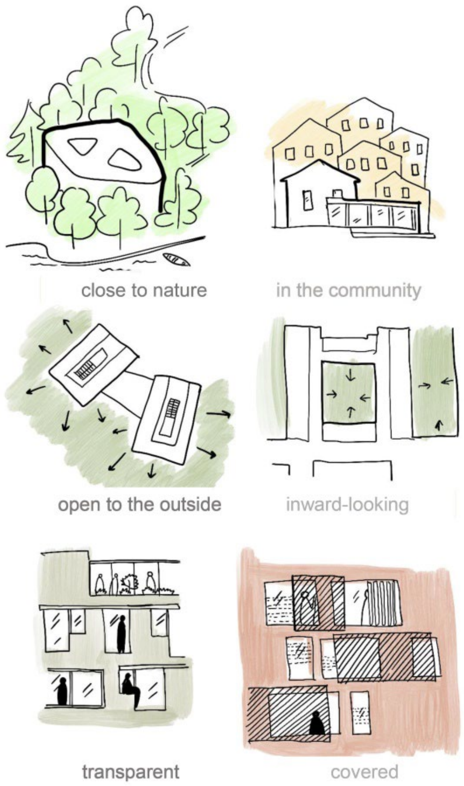

Figure 2. Privacy and isolation

Dilemma 2: EFFICIENCY – SPACIOUSNESS

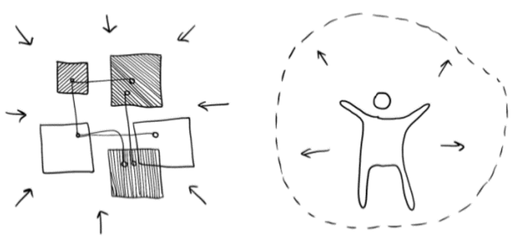

Figure 3. Efficiency and spaciousness

Hospitals today are prioritising efficiency of operation, short routes and simplified observation by a smaller number of nurses. The imperative that dictates that everything is to be placed next to everything else, is forcing architects to design dense and dark buildings. Truly, security is a big concern in mental hospitals, which makes the ability to quickly reach the patient and interfere in a crisis so essential. Therefore, short routes need to be a priority without a shade of the doubt. On the other hand, the service users need not to feel trapped; they need room to move freely and a variety of spaces for activities. Still, more space means that more staff is needed for observation. The lack of resources makes it almost impossible to follow the recommendations for therapeutic wards, instead settling for the bare minimum. There is also a danger in designing an extensive facility when there is not enough staff to maintain the operation. In case this danger materialises, courtyards and gardens end up being secluded because they would otherwise be difficult to maintain and control. Therapy and exercise rooms that might be shared with the clinic become out of bounds for the inpatient because there is no one to escort them. Family overnight stays become impossible because patient rooms are too small to house other individuals than the patient themselves. People with the experience of living both in old asylums and new mental hospitals report missing the sense of space and light, high ceilings and green spaces. '*Getting lost in the lovely gardens. There was plenty of places to look and come to terms with one's feeling. There was light in the old wards. New hospitals feel like being in an air raid shelter except you don't feel safe*' [19]. This puts an architect to the task of designing spacious wards with enough light in rooms and corridors while keeping the routes short and the building easily to monitor.

Dilemma 3: STRUCTURE – FLUIDITY

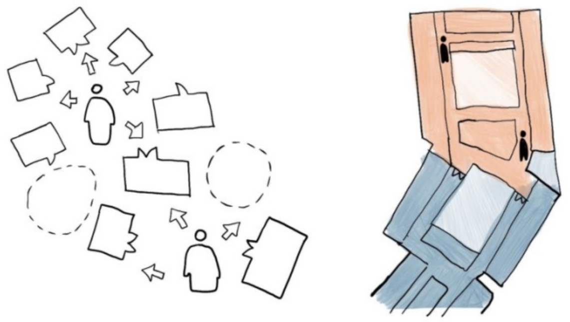

Figure 4. Structure and fluidity

Nowadays, both somatic and psychiatric hospitals are striving to move from hierarchical patient-practitioner relationship towards patient-centred care where the user is more informed and is an active party to treatment decisions. It is an especially important development for psychiatric care, since it is the service user who has the greatest degree of knowledge about what can help them to wind down, what triggers or motivates them. This calls on architects to deliver a response to that change. Designing less formal consultation rooms and providing spaces that can chance encounters, can help to establish trust, facilitate mutual understanding, and reduce the occurrence of abusive behaviour. Service users often mention that they find informal interactions more therapeutic than structured scheduled activities [7], [17]. On the other hand, studies on violence in mental hospitals [20] link unpredictability and the lack of structure to aggression episodes. Easy-to-comprehend layout, clearly demarcated rooms and functions are often mentioned in recommendations among the ways of avoiding confusion, anxiety and irritability. At the same time, hierarchy can provide a social structure that is simple to comprehend and adapt to – it is easier to know how to act when relationships have clear boundaries. The thinking behind rational asylums of the past was to provide the patients with the sense of structure, comprehensibility, and safety that mental illness strips them off. Architecture has a power to influence the social environment of the hospital. Therefore, what we have to do is successfully marry the need to design spaces that foster both equality and spontaneity with the desire to keep boundaries and regulations in place where necessary.

Dilemma 4: MEDICAL – NORMAL

This debate has existed as long as the field of psychiatric care itself, reflecting both medical and the environmental nature of mental illness. Many psychiatric facilities today follow the medical type of mental hospital which incorporates rational, form-follows function with minimalism. Designs, influenced by normalisation theory, which aim at making a hospital's appearance as close to a normal home as possible also exist. Solutions that follow salutogenic and antroposophic principles, where spaces are designed to be surprising, fluid, unusual, have also been suggested earlier. It seems that most presently operational mental hospitals are premised the medical model while retaining some cosmetic features of domesticity. Some would contend that the medical appearance of a hospital conveys a message of competence and scientific precision, while home-like facilities may appear to be a final destination, much like elderly care homes do [2]. However, service users sometimes spend months as inpatients and might begin experiencing the negative effects of institutional environment. Even though short-term admissions are the goal, it is not yet a reality for all patients. Psychiatry is constantly advancing and changing, but it is still unclear if it would shift closer to either medical or social care or would remain on the spectrum between those two fields. Many studies recommend ensuring that the mental hospital's environment is as close to normality as possible while failing to clarify what normality represents in that sense, whether it is the normality of a home where one resides or the normality of a hospital where one receives treatment. To conclude, we need to decide whether we should combine social and bio-medical nature of psychiatric care or prioritise either one of these instead.

Dilemma 5: DOMESTICITY – SAFETY

Figure 5. Domesticity and safety; domestic environment (left), institutional environment (right)

The conflict between the principles of therapeutic atmosphere and the attempts to create a harm-proof physical environment is one of the most widely discussed dilemmas in literature about mental hospital design. Hunt and Sine [21] argue that the attention dedicated to the safe design is disproportionate to its effectiveness, as suicide rates in US hospital have remained unchanged despite the new approach to design having been introduced. A common assertion is that the service users react to the physical environment and the signals embedded in it: for instance, if the hospital's security features are visible, if the staff are hiding behind the glass wall, patients may start to feel that they are feared, are expected to act negatively, which in turn induces them to respond with uncooperativeness and aggression. Simultaneously, the responsibility of staff to protect patients from risks, often by limiting their freedoms and rights, adds a great deal of stress to their work [22]. In traditional hospitals patients are vulnerable, and the medical staff are providing care. Given that the staff are always forced to perceive the patients as a potential source of danger, it is unclear who exactly is placed in a vulnerable position in a mental hospital and who is being protected from whom. The question then becomes that of whether there is a place for isolation room in a 'domestic' psychiatric ward. Architecture can have a big influence on the atmosphere and operation, whether it does so through installing physical barriers between user groups or by means of providing connections. The significance of safety cannot be underestimated, similarly to the personal relationships, trust, and positive interactions between service users and medical staff. All of these are essential for successful recovery and should be nurtured as much as possible by the facility design.

Dilemma 6: STIMULATING – CALMING

Psychiatric hospitals treat service users with very different symptoms. As a result, there is a variance in need in terms of their environment. For example, those in the manic stage of bipolar disorder require a calming and peaceful atmosphere, while those with depression need stimulation and opportunity to socialise. One distressed or manic patient, whose needs are not met, can disrupt the entire atmosphere on the ward. No clear guidelines exist pertaining to the separation of the users into different wards. There is a consensus that psychotic patients should be treated separately from those with mood disorders or cognitive disabilities, with some hospitals containing an intensive care unit for those in risk of harming themselves. However, such departments, as well as smaller mental hospitals and emergency units, do not usually possess the resources necessary to divide the users. Therefore, the problem that we have to tackle is that of combining those contradicting needs into a single design, especially under pressure from spatial and financial constraints, as well as that of prioritising the needs of one group of patients over another.

Dilemma 7: COMMUNICATION – DISTRACTION

Positive communication between users and care providers is a vital part of psychiatric treatment. Architecture can create spaces for different groups to interact and also create patient-only or staff-only spaces for quiet work and rest. This dilemma most commonly manifests itself in the question of whether to design open or closed nurse stations. Staff sometimes tend to prefer the nurse station with the glass partition, since they are afraid that patients will abuse any sort of increased access to them. Indeed, frequent interaction with patients has been linked to higher rates of burnout among the staff members. On the contrary, users often complain about care providers being unavailable, 'hiding in their offices as much as possible' [19]. Dinesh and others [18], [23], [24] write about the staff being burdened with filling forms and working with documentation, never having enough time to spend with the service users, while the patients often left to feel bored, misunderstood and abandoned. Patients mostly interact with one another; the same goes for the staff, since neither of the groups has enough physical and time space to dedicate to meaningful communication. The psychiatric ward needs to be an attractive place to work at, since many mental hospitals often find themselves desperately needing more staff. To archive that, spaces for respite and quiet work should be made available. This dilemma overlaps with that of privacy versus isolation. When resources are scarce, the complex trade-off must be made between prioritising patients' need for communication and emphasising the staff's need for the quiet isolated working environment, which also affects the number of private and shared spaces to be provided for the both of those groups.

Dilemma 8: CARE – DISABILITY

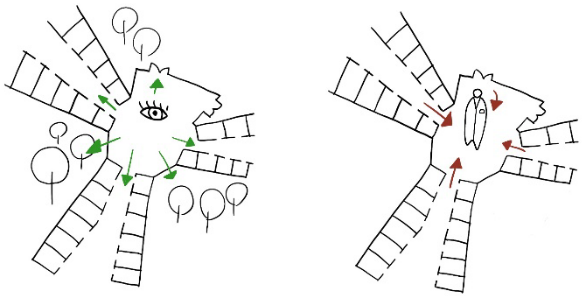

Figure 6. Care and disability

Preparing the service users for the life outside of the institution is one of the main treatment goals. However, guidelines regarding clear observation lines, control over entrances and the overview of the common spaces lead to a very staff-oriented design with the nurse station in the middle of the unit. Together with hospital policies, this places the focus on on-duty nurses, making them the solution to all the problems and concerns at the expense of fostering independence in the patients [25]. The symptoms of mental illness can suppress motivation and make it very hard for the patients to perform daily tasks, during which they might require assistance with dressing, cleaning and hygiene. However, if the patient is not encouraged to engage in this task independently whenever their condition allows them to, they might feel helpless, dependent, and lose their sense of self-esteem. Then, the issue in front of us is that of discovering the most efficient way of designing psychiatric facilities that patients can use with a degree of independence without undermining the patients' safety and simultaneously avoiding infantilising the service users while making the environment suited to their abilities. We need to find an optimal method of designing diverse spaces that reflect patients' path to recovery.

Conclusion

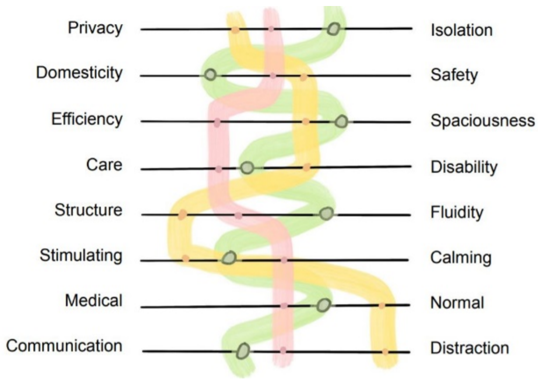

Figure 7. Possible balance between opposing environmental characteristics

The dilemmas discussed above could be used to shape the conversation with the stakeholders in order to reach an agreement on principles that we could implement to define the new institution of a psychiatric hospital. Creating a consistent building in which all elements work together without undermining its operation should be seen as the paramount aim. When it comes to architectural design, various groups might interpret what constitutes therapeutic environment differently. The dilemmas could be a start of the qualitative and quantitative exploration and evaluation of existing buildings and the therapeutic environments that they create. This approach could supplement the design guidelines that are usually discussed in the literature, since it helps to uncover the underlying motivations behind the ways the stakeholders try to influence the design. As we can observe from the new psychiatric facilities built worldwide, no single approach is currently found that is universally accepted. Different treatment philosophies manifest themselves in the contradicting recommendations that appear in literature. Could evidence-based design provide architects with the knowledge necessary to make more informed choices? Or should the decisions be made separately for each project, through co-design and close cooperation with the users? It would be helpful if we could see the motivation and thinking behind design decisions of newly built hospitals, and with respect to how those decisions affect the mental healthcare provision, the well-being of the staff and service users, as well as the public image of the institutions. More research, evaluation and knowledge-sharing between designers and practitioners would help to strengthen our understanding of the healing architecture.

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PATIENTS' DISSATISFACTION VERSUS TARGET VALUES FOR INDOOR ENVIRONMENTAL QUALITY: RECONSIDERING RESEARCH METHODOLOGIES

Sara Willems [(1)*], Dirk Saelens [(2)], Ann Heylighen [(1)]

[(1)] KU Leuven, Dept. of Architecture, Research[x]Design, Belgium

[(2)] KU Leuven, Dept. of Civil Engineering, Building Physics section

* Corresponding author e-mail: sara.willems@kuleuven.be

Abstract

Objective – To reduce the gap between patients being dissatisfied about hospitals' indoor environmental quality (IEQ) and hospitals achieving target values for IEQ parameters, this paper aims to identify possible improvements of applied research methodologies.

Background – Buildings' IEQ affects users' comfort, productivity, and well-being. Especially in hospitals this is crucial. A high IEQ contributes to patients' healing process and staff efficiency. However, even if target values for IEQ indicators are achieved, users are often not satisfied. Applied research methodologies should be reconsidered to address this gap.

Research question – The paper investigates how IEQ research and research about healing environments (HE) address people's experience of the indoor environment and how both views interrelate.

Methods – A scoping review was conducted. Methodologies applied in research concerning hospitals' IEQ and HE were studied critically, as well as the underlying philosophical assumptions and theoretical stances.

Results – IEQ and HE research adopt a different approach towards 'the environment', its 'perception' and its 'experience'. The mind-body problem lies at the heart of these differences. IEQ research considers mind and body as different in nature, while HE research views them as unified. Related to this, IEQ understands 'the environment' as the physical word that exists independently of subjects, while HE research investigates the lived world in which subject and building features are interrelated. IEQ treats perception as a causal, passive process, while HE research considers the epistemic act. In IEQ research experience is more than perception. The focus is upon having sensations at the level of individual senses. In HE research perception is coupled with action and cognition, thus perception and experience are inseparable. Sense perception, obtained by perceptual systems, as well as sensations, resulting from people's multi-sensory experience, are investigated. These assumptions are reflected in the applied methodologies and methods. IEQ research combines sensor measurements with surveys in order to relate, within a certain probability, values of objective physical quantities to subjective responses. HE research gathers in-depth data about people's lived experience. However, regardless of whether mental states can be described completely by brain states, both seek to understand how the built environment, existing independently of subjects, can be designed in a well thought out way.

Conclusion – As the purpose of IEQ and HE research corresponds and views upon 'experience of the environment' are complementary, they can mutually benefit from each other's approach when their methods are appropriately combined in a mixed methods research. IEQ research can inform about continuously changing fluxes and generalized subjective responses, HE research about information fluxes carry and individual differences. Incorporating these insights in future methodologies may contribute to reducing the gap between dissatisfied users and achieved target values.

Keywords: *Architecture* | *Healing environment* | *Hospital environment* | *Indoor environmental quality* | *Mixed methods*

Introduction

How people experience the indoor environment affects their physiological and psychological health, comfort, productivity, and well-being. Especially in healthcare facilities improving health and comfort through the built environment therefore requires attention. Hospitals rated with a high indoor environmental quality (IEQ) enhance patients' healing process and staff efficiency *[1]*. However, even if indoor environmental target values are achieved, users are often not satisfied [1,*2*]. Addressing this gap requires reconsidering applied research methodologies.

In hospitals the quality of the indoor environment is studied by IEQ research and research about healing environments (HE). Both domains investigate people's experience of the environment differently. **IEQ research** searches epistemologically objective knowledge within a certain probability about how the world 'really' is. In line with a mechanistic ontology, the world is considered as a system with causes and effects and deterministic connections between them [3]. This approach is based on physics and the 'information processing theory' of cognitive psychology. Physics strives to grasp the nature of the world reduced to its essential constituents of force, energy, and matter [4,5]. The information processing theory regards the human mind as an information processor: information is received from the senses as input, processed by the brain, and an output is delivered [6]. IEQ research focuses on the relation between environmental quantities – the input – and people's comfort – the output.

On the other hand, **HE research** is mainly inspired by the ecological approach of perception. This approach tries to understand the continuously changing relationship between a person-as-knower, who is a knowing-agent and not just as physical or biological object, and the environment-as-known. This is an attempt to 'ecologize' physics – to interpret physical phenomena in the light of their relevance to psychological phenomena [6]. Ontologically the interrelations cut across the dichotomy of subjective-objective [7*]*. Epistemologically this view has at least a subjective element in it, although objective knowledge about ontological subjective phenomena can exist [8]. How people's subjective and multi-sensory experience is addressed is influenced by post-phenomenology. The focus upon the environment's healing effect emanated from research inspired by Evidence Based Design (EBD), pioneered in healthcare architecture by Ulrich [9]. EBD-inspired research investigates how specific physical characteristics impact on health and comfort.

Based on a scoping review, we identified several themes concerning 'experience of the environment' which both research domains address differently. As they take other ontological and epistemological positions, which connect with researchers' theoretical stance, methodology, and methods applied [10], the difference is present on all these levels. For each identified theme we analyse how the two research domains relate to each other at these different levels. After explaining our methodology, we describe the mind-body problem, followed by what is understood as 'the environment', its 'perception', and its 'experience'. The discussion focusses upon how this analysis informs about how both research domains can complement each other, and how patients' experience of, including their satisfaction with, indoor conditions can be improved by basing design decisions on findings of research which makes use of this *complementarity.*

Methodology

To reconsider applied research methodologies, we focused on the questions 'how do IEQ and HE research address people's experience of the indoor environment?' and 'how do both views interrelate?' A scoping study seemed most convenient since it allows for conceptual mapping, i.e., establishing how a particular term is used in the literature, including literature with a variety of research designs, authors, research objectives, sources on which the research is based and types of evidence used [12,13,14,15]. Articles were searched via the authors' university's search engine, which includes the following databases: Directory of Open Access Journals; Medline (Proquest & Pubmed); OneFile (Gale); ProQuest Central; ProQuest Health & Medical Complete, ProQuest Research Library; Pubmed Central; ScienceDirect Journals (Elsevier); Scopus (Elsevier); Science Citation Index Expanded (Web of Science); and Social Sciences Citation Index (Web of Science). Since the aim was to explore the issue rather than synthesize all literature available on the topic, no inclusion criteria were predefined, but an iterative reading process was chosen. In a first phase of the study, the extent, range, and nature of applied IEQ and HE research activity were examined. Through this an understanding grew of the used methodologies and differences between them. In a second phase literature about underlying philosophical assumptions and theoretical stances was targeted. The stages of each phase are based on Arksey and Malley's framework [13], and its further enhancement by Levac et al. [12]. Figure 1 gives a more detailed overview.

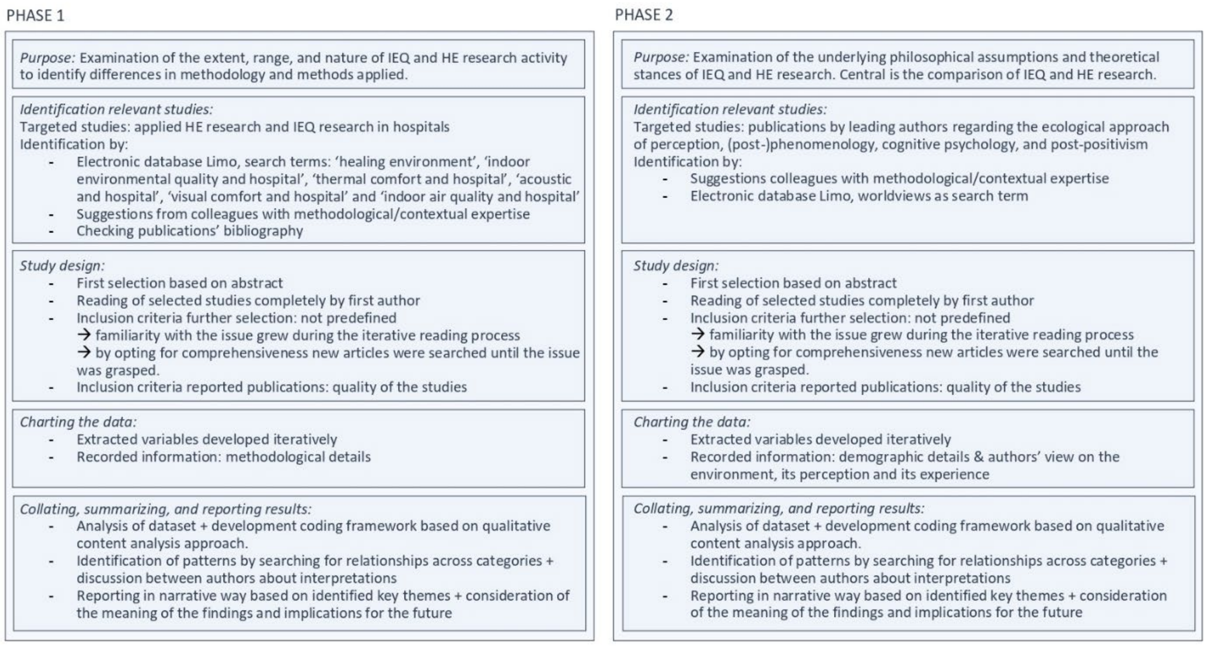

Figure 1. The two research phases and their stages, based on [12,13]

Key themes

The authors identified several themes which IEQ and HE research approach differently. These themes are summarized in Table 1 and are further explained below. For HE research the table has two columns: while mainly based on the ecological approach, for subjective sensations it falls back on post-phenomenology.

	IEQ research	Research about healing environments Ecological approach	 Post-phenomenology
Mind-body problem	Dualism	Monism	Monism
The environment	Physical world	Lived world	
Perception of the environment	Causal process	Epistemic act	
	Passive	Active	
Experience of the environment	Experience > perception	Experience = perception	
	Having sensations	Sense perception	Having sensations
	Sensory experience	Perceptual systems	Multi-sensory/whole-body experience

Table 1. Key themes which IEQ research and HE research address differently

Mind-body problem

At the heart of the differences between IEQ and HE research lies the philosophical mind-body problem, i.e., the question whether consciousness and intentionality can be found in the quantum-electromagnetic-gravitational field [16].

IEQ research supports Cartesian dualism: mind and body are thought to be different in nature [6]. Physical processes of the material world can be explained by physics, and mental processes by cognitive psychology's 'information processing theory' [4].

HE research is based on monism: humans are considered as unified organisms of great complexity and varied functioning, composed of a mind and a body which interact [17]. This stance is taken by both the ecological approach [7,18] and post-phenomenology [18].

Neither IEQ nor HE research requires an answer to the mind-body problem. Both are interested in people's experience of the environment and the physical environment itself, regardless of whether mental states can be described completely by brain states. However, the mind-body problem influences what is understood under the 'environment', its 'perception', and its 'experience', and consequently how research is conducted.

The environment

In **IEQ research** the term 'environment' refers to the physical world, which is ontologically objective. Reality is taken to be structured in various ways [5] and can be studied on different levels [19]. IEQ research focuses on fluxes such as energy fluxes (e.g., light, noise) and chemical substances (e.g., odour), broadcasted by a source and present in the environment. Focussing on fluxes acknowledges that the environment changes continuously. The fluxes can be described. A set of perspective projections, a field of sound waves, or the diffusion field of a volatile substance are perfectly objective physical facts [19].

In IEQ research the use of sensors reflects the view that the environment exists independently of subjects. Sensors gather data about the fluxes disposed by the physical world. The importance of using validated instruments and avoiding bias shows the wish to understand the world 'as it really is'.

HE researchers do not deny that a physical world exists independently from subjects, but understand the term 'environment' as ontologically interrelated with the 'animal' (e.g., the person) living in it [18]. An environment exists only in relation to the being whose environment it is [4,5]. Both are even mutually constitutive [20,21], or a meshwork – a term Ingold uses to bypass that mutuality still involves a separation of the elements whose constitution is at issue [4]. Baggs and Chemero stress the difference between the environment as it exists for a typical member of a species, and how it exists for a particular animal with its own abilities [5]. Interrelations with elements at the terrestrial scale, like objects and surfaces, are studied. The fundamental constituents of any environment are 'affordances' [19,22]: the possible facilitations or hindrances that the environment - the substances, surfaces, objects, and other living creatures surrounding the animal – provide in the immediate context of its current activity [4,20]. Affordances are properties of things taken with reference to an observer, but not properties of the observers' experience exclusive of the things. Therefore the debate whether values are physical or phenomenal, in the world of matter or only in the world of mind, does not apply to affordances [19]. HE researchers investigate the affordances of hospital environments.

Perception of the environment

1. Causal process versus epistemic act

In **IEQ research** perception is treated as a causal process (see Fig. 2). Like in information processing theory, physical objects or events in the world are considered the distal (external) stimulus. They modulate ambient energy and propagate it to the receptor organ, where it gives rise to a proximal (sensory) stimulus. The computational task of the brain is determining the distal stimulus from information contained in the proximal stimulus [23]. At the sensory level of processing, physical energy is detected and transformed into neural energy and sensory experience. At the organizational level, brain processes organize sensations into coherent percepts. At the level of identification, percepts of objects are compared with memory representations in order to be recognized as familiar and meaningful [23]. This results in a perceptual experience as part of the agent's state of phenomenological awareness [6].

This view underlies the methods of IEQ research. Sensors located near subjects are comparable with subjects' senses, and the data generated with people's proximal stimuli. People's subjective response, which arises from the stimuli, is questioned with questionnaires [24]. The survey results are comparable with the result of brain processes at the sensory level. Comparable with the brain processes at the organizational level, researchers define sometimes one total IEQ index by adding up the level of satisfaction with different IEQ parameters multiplied by their weighting factor [25].

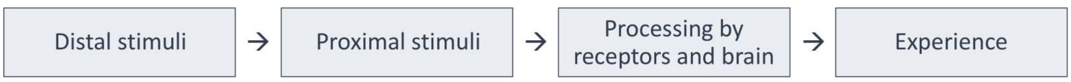

Figure 2. Perception as causal process

HE researchers do not deny that a causal process takes place. However, they focus on perception as an epistemic act: an act of apprehending the properties of the message conveyed rather than the properties of the medium by which they are conveyed [6] (see Fig. 3). The act of perceiving is mediated neither by the physics of the energy propagated (e.g., light, sound) from object to receptor system in the surroundings, nor by the properties of the medium, i.e., the physiology of the neural transmission from receptor to cortex [6]. The contact between the knowing-agent and the ecological significant properties of the world is epistemic rather than mechanical or causal in nature. 'What' the nature of processed information is receives attention [6].

This view underlies the methods applied in HE research. Document analysis informs about the physical environment at the level of stimulus information instead of stimulus energy. People's experience and how they apprehend the world is probed with open-ended questions, allowing them to describe what the physical as well as the social and cultural environment affords them.

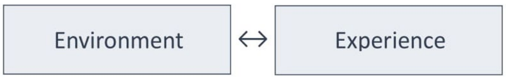

Figure 3. Perception as epistemic act

2. Passive versus active

In **IEQ research** perception is treated as passive and imposed. The way in which sensors work relates to the senses as passive receptors. Passive receptors respond each to the appropriate form of stimulus energy, which varies along dimensions like intensity and frequency, and have measurable thresholds [19]. Sensors located close to a person, as advised in ISO 28802:2012 [24], can approximately register the stimulating fluxes. ISO 28802:2012 recommends to measure for thermal comfort the air temperature, radiant temperature, air velocity, and absolute humidity; for acoustic comfort the A-weighted sound pressure level and equivalent continuous A-weighted sound pressure level; for visual comfort the horizontal illuminance; for air quality the CO2 level; and for vibration the acceleration in vertical, horizontal, and fore-and-aft directions. The stimulation targeted does not depend on subjects' own act of perceiving and is therefore imposed [19]. Rating the environment with 'right-now' questionnaires [24] considers people's perception as an accumulation of 'snapshots' taken from any number of points of rest.

HE research considers perception as an active process. According the ecological approach perception is fundamentally about movement [4,19]. First, people perceive and respond to permanent properties of the environment although sensations vary constantly [19]. Constant perception depends on active perceptual systems, which search out stimulus information in the array of ambient stimulus energy. To this end people orient the classical sense organs to the environment by moving the body, and use the organs actively by adjusting them and letting them explore. The obtained stimulus information is unlimited and of higher order than stimulus energy. It varies along innumerable complex dimensions which are not all amenable to physical measurement.

Second, stimulus energy varies across place and time as the individual goes about her business in the environment. People do not accumulate observations taken from successive points of rest, but perceive along a continuous itinerary of movement [4,19]. Shapes and forms of environmental objects are revealed by changes along this path.

Thirdly, next to picking up environmental information, stimulus input can be used to control the own, active movement of organs, called proprioceptive feedback [4,19]. The receptors therefore receive an intermixture of externally produced and activity-produced stimulation. However, people do distinguish between intrinsic stimulation (i.e., results of their own actions) and extrinsic stimulation (i.e., results of events other than their actions) [19].

Architecture is lived space and not just physical space [26]. People respond to architecture's extrinsic stimulus information with a bodily reaction causing activity-produced stimulation, and this as a consequence of actions the built environment implies. It is this lived space that HE research investigates. Defining contributing parameters is impossible, but, based on phenomenology, the essence of a conscious experience, or, based on post-phenomenology, the multi-stability (i.e., the differences in how people experience something) is described. To gain an understanding of someone's lived experience, in-depth data are gathered dealing with an extended period of time. Sometimes even walk-along interviews are conducted (e.g. [27]). Thus, people's perception is not taken as an accumulation of separate observations.

Experience of the environment

1. Experience versus perception

IEQ and HE researchers are interested in people's 'experience' of the environment, but understand it differently. For **IEQ research** ISO 28802:2012 recommends to include in questionnaires: a perceptual (How do you feel now? e.g., hot), affective (How do you find it? e.g., comfortable), preference (How would you prefer it to be? e.g., cooler), acceptance (acceptable/unacceptable) and tolerance (Is the environment tolerable?) Likert scale [24]. Thus, perception is assumed to be a part of people's subjective response.

In **HE research**, perception is not considered as the achievement of a mind in a body, but coupled with action as discussed earlier. Moreover, perception and action should not be set off from cognition: meaning is drawn from skilled subjects' productive engagements with the environment's 'affordances' [4,22] and can be directly perceived. The entanglement of perception, action, and cognition seems to make it impossible to let someone reflect on their perception alone. This may be the reason why in HE research the word 'experience' and 'perception' are used interchangeably.

2. Having sensations versus sense perception

When discussing people's experience of the environment with a focus on its sensory characteristics, Gibson distinguishes between having sensations and sense perception [19]. The former relies on the channels of sensation as the sources of conscious qualities of experience, the latter on perceptual systems as the sources of knowledge.

In **IEQ research** the focus is on people's sensations, i.e., the different modes of conscious qualities of experience which result from fluxes falling into passive senses. Modes of conscious qualities that are considered as having the main impact on people's subjective response include thermal comfort, indoor air quality (IAQ), lighting, acoustics, and sometimes vibration, but no agreement exists [1,24,28]. This disagreement resembles the debate about ways to categorize the (passive) senses. Traditionally five senses were distinguished – sight, hearing, touch, taste, and smell [19,29]. Over the years also other classifications are proposed (e.g. [26,30,31]).

For thermal comfort IEQ research refers to the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) [32,33,34,35]. Dissatisfaction can be caused by general and/or local discomfort [36]. IAQ relates to the amount of harmful substances and bad odour in the air [34,37]. Visual comfort considers illuminance levels and the absence of side effects like glare and blinding [34]. For acoustic comfort 'noise' refers to unwanted sound. For vibration, as for other environmental components, attitudes to what the person thinks is the source influence the response [34].

The relationships between people's subjective survey response and measured fluxes are analysed statistically. Generalized results enable to set up target values for which a certain percentage of people is assumed to feel comfortable.

Gibson considers inventorying modalities impossible because it includes neither proprioceptive feedback, nor perceptions obtained by the senses when they are active - when they adjust and explore so as to obtain information - instead of passive [19]. If one focuses on sense perception a catalogue of sensations is not needed. Sensations are only occasional accompaniments of sense perception [19]. Gibson distinguishes between five perceptual systems – the orienting, auditory, haptic, taste-smell, and visual system – classified by modes of activity instead of modes of conscious quality. In contrast to the way IEQ research understands the process of having sensations, perceptual systems do not consist of a specific set of nerves and neurons. **HE research** studies sense perception as well as the sensations accompanying it.

3. Sensory versus multi-sensory experience

Most frequently **IEQ researchers** treat IEQ parameters separately [24]. Attention can facilitate processing relevant stimuli and suppress processing irrelevant ones [23]. However, recent years have seen a growing understanding that the senses work together and influence each other [29]. For example, a higher thermal comfort is often associated with higher IAQ [32]. People are thus not always aware of which parameters influence their reaction and may have difficulty to isolate one sensory quality from another [38]. In IEQ research ways are searched sometimes to express people's overall comfort experience into one IEQ model or index, rating system, or scoring system [25]. Weighting factors represent each comfort factor's independent contribution to the overall comfort. The total IEQ index adds up the products of each IEQ parameter and its weighting factor – just like the brain is thought to sum the sensations resulting from different proximal stimuli.

Although the separate treatment of the senses does not correspond exactly with people's experience, it enables setting up target values for each type of flux. Moreover, in the context of human-technology relations it is argued that contemporary technology mediates what was previously 'unperceived' and what unmediated is directly 'imperceivable' [39]. Related with this sensors are able to single out, quantify and make perceivable one type of flux (e.g., the exact temperature of a room), while humans cannot.

In **HE research** interviews start with broad open-ended questions, allowing people to talk about their overall experience. Of interest are both people's sensations and sense perception. Concerning sensations, people's multi-sensory, whole-body, and embodied experience are discussed in (post-)phenomenology. Phenomenologists assume that as long as people are conscious, they continuously perceive multi-sensorially. Although they can switch attention from one sensation to another, what remains continuous is a whole-body experience. People can selectively focus upon one sensation, but cannot turn the other sensations off [40]. Moreover, the senses work together. For example, distance and spatial depth would be impossible if sight was detached from touch [4,26]. Furthermore, the information carried by the simultaneously transmitted fluxes is more than the sum of the separate fluxes. What is perceived too is the network of adjacent and successive relationships in which the individual components participate [6].

Concerning sense perception, the ecological approach argues that perceptual systems are not mutually exclusive, and work as a whole by cooperating in varying combinations [19]. When systems pick up the same information, this information is redundant for sense perception but not for experienced sensations. The problem of perception is no longer how equivalent sensations resulting from different stimulus energies are associated, but how the fluxes that specify an object or event are discriminated from all the other fluxes. Furthermore, it is hypothesized that a subject perceives an affordance more easily than its properties in isolation. What is 'meaningful' is the invariant combination of properties, not any single property [19].

Discussion

Although IEQ and HE research approach 'experience of the environment' differently, their view is not conflicting. Both acknowledge that experience results from different senses working simultaneously, that it is interlinked with the fluxes an individual obtains, and that a physical and material environment exists independently of subjects. Moreover, regardless of whether mind and body are different in nature, both domains are driven by a similar purpose. In essence, both want to improve people's experience of the built environment by designing the environment that exists independently of subjects in a well-thought-out way. Because of this similar purpose and differences in their representation of reality, both research domains can complement each other in a mixed methods research design. Making use of this complementarity in research allows improving the understanding of which indoor conditions are comfortable and which are not. We expect that, based on this improved understanding, design decisions can be made that lead to a more comfortable experience and less dissatisfied patients when indoor environmental target values are achieved.

IEQ research can contribute to HE research. Sensor measurements inform about which fluxes are potentially the input for experience and how they vary in time and space. Combining measurements with surveys and the possibility to generalize results allow to formulate recommendations for building design and systems. Furthermore, HE researchers seek to interrelate people's experience and their environment. At the level of building features, plans and building information can be used, but for sensory experiences they rely on (post-)phenomenological subjectivity. Sensor measurements can restore the missing link between subjective responses and fluxes, as well as between building features, fluxes, and people's subjective response. In addition, sensors can show that objects and building features are not static, as HE researchers currently assume, but also continuously in flux. By combining HE research with IEQ research in this way, stronger theoretical frameworks can be developed. These improved frameworks can enable designers to understand patients' experience of indoor conditions better. We expect patients' comfort to be higher in designs informed by this improved understanding.

HE research can be of added value for IEQ research since it can explore, e.g., why people experience the environment in a certain way, differences in experiences between people, which user requirements are important, how building characteristics - at the terrestrial scale - influence subjective responses, how people's multi-sensory experience can be understood, and which environmental parameters influence sense perception and whole-person experiences. Related to the latter, it can be argued that the fluxes measured by IEQ research are a selection of all available fluxes. The external world as explained by physicists is therefore only one representative model [29]. Rich qualitative data can allow IEQ research to engage more with the lived world and provide insight into how sensors can be further developed to become more accurate. Furthermore, criticism on the dualist perspective of cognitive psychology's 'information processing theory' fuelled new approaches such as situated, embodied, or distributed cognition [41]. In IEQ research these new approaches are not integrated yet. HE research can contribute to this since the new approaches align with the ecological and (post-)phenomenological approach. We expect that combining IEQ research with HE research in such a way will provide insight into reasons for discrepancies between (dis)comfort predictions based on target values and actual (dis)comfort. This insight is expected to allow improving IEQ design methods, which in turn is expected to result in a higher patients' satisfaction with indoor conditions.

However, it may be argued that the qualitative and quantitative methods are incompatible due to differences in the worldview adopted in both research domains [3,42,43]. Most frequently, researchers get around this problem by taking pragmatism as stance [3,10,44]: rather than the particular philosophical assumptions started from, of primary importance are the research questions asked, and the use of multiple methods of data collection to inform the problems under study [3,10]. However, as Biesta argues, pragmatism should be seen not as the philosophical foundation for mixed methods research, but rather as philosophical support [3]. It only emphasizes that different knowledge claims result from different ways of engaging with the world. Thus, ways of gaining knowledge can be mixed, but pragmatism should not be used as reason for not needing to consider the underlying philosophical assumptions of the mixed research approaches. As this paper suggests, the philosophical assumptions help to understand the reason for applied methodologies and methods, and how research domains can complement each other. This may support data integration – something that often leads to difficulties in mixed methods research [43,44,45].

Due to their complementarity, combining both research domains in a mixed methods research design may yield a more complete understanding of how to relate people's experience of buildings' (e.g., hospitals') indoor environment more accurately to measurable IEQ indicators, and how to reduce the gap between buildings achieving target IEQ values and dissatisfied users. The strengths of one research domain can offset the weaknesses of the other.

Conclusion

The scoping study revealed that although IEQ and HE research view 'the environment', its 'perception', and its 'experience' differently, their views do not conflict. Influenced by their worldview and theoretical stance, their methodology and methods rather investigate another aspect of people's perception and experience. IEQ research focuses on perception as a passive, causal process and sensations people have. Surveys inform about people's subjective response to particular indoor conditions. Quantitative sensor measurements offer an understanding of the physical environment surrounding them and changes in the indoor conditions across time and space. The combination of surveys and sensor measurements allows developing target values that allow predicting subjective responses within a certain probability. HE researchers view perception as an epistemic act. They consider sense perception as well as having sensations, the latter in the context of people's whole-body, multi-sensory experience. Qualitative, in-depth data provide insight into people's real life experience.

Both research domains can mutually benefit from each other's approach when their methods are combined appropriately in a mixed methods research design. To relate people's experience of buildings' (e.g., hospitals') indoor environment more accurately to measurable IEQ indicators, occupants' active perception and their multi-sensory and whole-body experience need to be integrated into IEQ research. Improving occupants' satisfaction through developing user-centric indoor environment solutions requires in-depth data about users' lived experience over an extended period of time. This will allow to take into account contextual, psychological, and emotional aspects, to consider the combined effects of IEQ parameters, to attend to the dynamics in IEQ parameters across time and space, and to combine often qualitatively described user experience not only with building features, but also with objectively measurable physical quantities like energy fluxes and chemical substances.

The insights reported in this paper can help raise IEQ and HE researchers' awareness of how they approach 'experience of the environment' and how combining IEQ and HE approaches may result in a more complete understanding of how indoor conditions are experienced by patients. This can inform future mixed methods research designs. In turn, the results can allow developing more accurate building standards and guidelines, and thus contribute to reducing the gap between buildings achieving target values and dissatisfied patients.

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Impact of architecture on healthcare services and health outcomes

HEALTH PROMOTION AND THE BUILT ENVIRONMENT – VIEWS FROM SWEDISH HEALTHCARE ORGANISATIONS

Elke Miedema [(1)*], **Göran Lindahl** [(2)], **Marie Elf** [(3)]

[(1)] Division of Architectural Method and Theory, Department of Architecture and Civil Engineering, Chalmers University of Technology, Sweden

[(2)] Division of Building Design, Department of Architecture and Civil Engineering, Chalmers University of Technology, Sweden

[(3)] School of Education, Health and Social Studies, Dalarna University, Sweden

* Corresponding author e-mail: miedema@chalmers.se

Abstract

Objective – The study examined the role and integration of the built environment in health promotion as perceived and described by representatives of Swedish health promotive healthcare organisations (HPHs).

Background – A majority of Swedish healthcare organisations have implemented health promotion strategies in their plans and actions. These HPHs engage in an ongoing reorientation from a disease focus to a health focus, which includes a person-centred approach that considers people as active participants controlling their own health and care.

Swedish HPHs are supported by the Swedish HPH network in introducing health promotion. The HPH network aims are guided by health promotion standards, which indicate the importance of creating health-promoting environments. These aims are confirmed in a letter of intent and membership contract. The aims are also expected to have implications for the planning of healthcare buildings. However, knowledge of the relationship between HPH strategies and the built environment is limited. Additionally, health promotion, when used by building designers, often seems to be reduced to a focus on the enhancement of health. To continue developing health promotion and fulfilling the intentions of the letter of intent as a driver for HPHs, it is important to understand and actively include the built environment in analysis, planning and design.

Research question – How do Swedish HPH representatives perceive and describe the relationship between HPHs and the built environment?

Methods – An explorative study including both qualitative and quantitative data was carried out. First, data were collected through a survey with county representatives of Swedish HPHs (n=17). Then, qualitative data were obtained from interviews with the Swedish HPH network committee members. The combined data were analysed through descriptive statistics and content analysis.

Results – The results showed varied and limited perspectives on the relationship between the built environment and health promotion and diverse HPH intentions related to health equity, health, empowerment, population health, and preventive measures. The results indicated that the documentation meant to support HPHs was not used or well known. Surprisingly, representatives who worked on healthcare building projects did not necessarily consider the built environment to be related to design strategies or characteristics or to their health promotion work within the framework of their HPHs.

Conclusion – The results indicate the need to recognise the diverse dimensions and interpretations of health promotion to be able to integrate the built environment in HPHs.

Keywords: *Building design | health services | health promotive healthcare | hospital design | salutogenic orientation*

Introduction

Health promotion is often defined as 'the process of enabling individuals and communities to take control over their health' [2]. Health promotion is often seen as a way to face complex public health problems [14], such as increasing health inequalities and increasing chronic disease. Healthcare organisations are therefore including health-promoting approaches in their services. This expansion includes an ongoing reorientation from a disease focus towards a person-centred approach, which emphasizes people managing their own health processes and care [2] in relation to their social, natural and built environments [15, 16].

The term ‘health promotion’ is also increasingly used by architects working with healthcare design [11]. Research has already linked the built environment of healthcare to the improved health-outcomes, such as healing of patients, stress reduction and improved safety for building users [17, 18]. The built environment is increasingly emphasised as important for health promotion [19], including for health promotive healthcare organisations (HPHs). However, it seems that architects often reduce ‘health promotion’ to ‘health enhancement’ [11].

The majority of HPHs are members of, and supported by, the Swedish HPH network [20-22]. The Swedish HPH network supports healthcare organisations to develop good, equal, and health-promoting healthcare [23], and most Swedish health care organisations are members of this nation-wide network [24]. Their membership means that they have agreed to focus on the implementation of health promotion strategies in their organisations [1], creating a health-promoting environment [4, 7]. The implementation of health promotion strategies may require adjustments in the organisational philosophies, values and practices affecting several organisational levels of an HPH [25]. In addition, a health promotion approach is also expected to have consequences for the built environment [10].

However, knowledge about the relationship between the built environment and HPH strategies on a broader scale is limited [26]. This study therefore focuses on the role and integration of the built environment for health promotion as perceived and described by Swedish HPH representatives.

Background

The term ‘health promotion’ is often used and discussed in the literature [27, 15, 28], and many definitions have been developed over time [15]. Health promotion is often confused with other concepts, such as illness prevention [29, 27]. The difference can be understood through salutogenic theory [27]. The term ‘salutogenic’ is derived from words meaning ‘the origins of health’ and refers to what keeps us healthy [29]. Health promotion should include a salutogenic orientation towards health [27]. In contrast, a pathogenic orientation concerns the causes of disease [29, 27, 30]. A pathogenic approach thus includes healthcare, prevention and health protection [30].

In Sweden, healthcare organisations are often considered the front runners of health promotion. These healthcare organisations appointed healthcare staff responsible for health promotion work within the organisations. Some of these staff also represent their HPHs in the HPH network. All these HPH representatives take up different roles in the HPH network. Some HPH county representatives are responsible for communication between the HPH network and the different HPHs in their county (n=21). Committee representatives are involved in the everyday management of the Swedish HPH network and relations with the international HPH network [31] (n=7). Other workgroup representatives are involved in the various workgroups in the HPH network (n=11), such as the group for health-promoting care environments.

As mentioned, Swedish HPHs are supported by the Swedish HPH network [32, 33]. The Swedish HPH network focuses its efforts on four population groups: patients, the local population, employees, and management [33]. The Swedish network is part of several HPH networks that support the development of the establishment of HPHs globally, regionally and nationally [20-22]. These networks, founded by the WHO [23], developed a set of HPH standards, including the Ottawa [3], Vienna [5] and Budapest versions [4].

Not all healthcare organisations that incorporate aspects of health promotion are HPHs [25]. A HPH should (1) offer health promotion for all building users and the local community, besides treatment for patients, (2) include salutogenic health approaches (3) play a representative role in the health promotive community, and (4) follow the HPH standards [25]. These standards are based on an environmental approach [15, 34] and refer to environmental aspects, such as the physical environment.

Previous studies on health promotion, healthcare and the built environment have shown several challenges, such as difficulties of using the concept of health promotion, as the interpretations are often implicit, unclear, inconsistent, or limited [35, 9, 10]. Moreover, the relationship between HPHs and the built environment seems underdeveloped within the Swedish HPH network [36]. There have been no studies investigating how healthcare organisations understand the relationship of the built environment to HPHs. This study therefore aims to examine the role and integration of the built environment in HPHs as perceived and described by Swedish HPH representatives.

Method

A cross-sectional design was employed. Quantitative and qualitative data were collected through an online survey and one interview.

Setting and sample

The study focused on Swedish healthcare organisations that are members of the Swedish HPH network. The HPH representatives’ names and contact information were assembled from the Swedish HPH network website.

A survey with county council HPH representatives was conducted to obtain quick insights on their interpretations of the role of the built environment as understood in Swedish HPHs. The county council representatives are supposed to have an overall view of what occurs in the organisations within their counties. Seventeen of 22 county council representatives participated in the online survey. These informants had different backgrounds and included health and nursing staff (n=8), physiotherapists (n=4) public health staff (n=3) and management or administration (n=2).

The interview with two of the seven HPH network committee members focused on their reflections and explanations of the survey results. The committee members are responsible for contact between the different HPH networks and the HPHs. They provide the supporting HPH documents and may have an idea of the inclusion of built environmental aspects in HPHs. The committee members received the survey data prior to the hour-long online interview.

Data collection

Data were collected between May and November 2018. Before the data were collected, all participants were provided written and verbal information concerning the study.

The data collection was performed in two steps. First, quantitative and qualitative data were obtained from a survey with the county representatives. The survey developed for this study included questions about topics such as HPH network members' understandings of the meaning of HPH network membership, the meaning and content of the letter of intent and European HPH network standards, and the built environment (see Table 2). All survey responses were compiled in a table.

Table 1. List of survey questions for the HPH representatives

HPH
How would you define an HPH?
What makes the HPH health promotive?
What does it mean to be a member of the Swedish HPH-network?
HPH documentation
Are you familiar with the letter of intent?
Are you familiar with the content of the letter of intent?
In what way do you base your work on these intentions stated in the letter of intent?
Are you familiar with the European HPH standards?
Are you familiar with the content of the l European HPH standards?
In what way do you base your work on these intentions stated in the European HPH standards?
Built environment
Do you think the design of the HPH relates to the success of health promotion?
In what way do you integrate aspects of the built environment in your health promotion aims and strategies?
If you would be part of a project to (re-)design a complete healthcare facility,
– What building design would limit health promotion
– What building design would support health promotion
Involvement in building project
Are you involved with building projects within your organisation?
Are there other HPH representatives involved in building projects within your organisation?
If you are engaged in a building project, is it as part of your role as HPH representative?
Do you have people who are working with the health promotive building environment continuously?

The next step of data collection consisted of the collection of qualitative data from a follow-up interview with the committee members. The interview was semi-structured [37] and based on the survey results. The members were asked to comment on the results. The subsequent discussion was recorded and transcribed.

Data analysis

The data were analysed by a combination of descriptive statistics [38] and content analysis [39]. The iterative process began with a translation of the text into English, followed by repeated reading of the text to become familiar with the content.

Descriptive statistics were used to summarise the quantitative data [40]. The quantitative data were nominal and ordinal [38]. For instance, yes/no answers were divided and counted (nominal). Then, we categorized the data related to value statements (ordinal), such as questions with Likert scales (e.g., the extent to which participants thought the design of the HPH was related to the success of health promotion), into hierarchical groups. Based upon these categories and groups, relations between answers emerged.

All qualitative data, from both the survey and interviews, were initially read by the first author to obtain a broad view of the data. Subsequently, a table was created based on the survey questions to identify different views as found in the descriptions. Then, similarities and differences were identified in the texts to develop categories to describe the respondents' views of HPHs, HPH network documentation, and the role of the built environment, as well as their involvement in building design projects.

Results

The combined analysis of the survey and the interview shows that the HPH representatives described HPHs differently. Additionally, not all HPH representatives were familiar with, or used, documentation to support their

HPHs, and only some of them considered the built environment to be a factor for health promotion. In addition, few HPH representatives believed that they should be involved in building design projects for developing health promotive organisations.

Descriptions of HPHs by the county representatives

The participants in the study described various views of HPHs, using terms such as ‘health equity’, ‘health orientation’, ‘empowerment’, ‘population health’ and ‘prevention’ (see Table 2). These terms, or similar terms, were often used in isolation and without further explanation. For example, health equity was expressed in terms of accessibility, and empowerment described as ‘mobilis[ing] patients' own resources to manage their lives and their health’. Most of the descriptions were related to either one or two HPH approaches. For example, one participant noted that an HPH involved both person-centred care and equal care. Other participants stated that a hospital considered to be an HPH should contribute to improved patient and population health and should not be focused only on medical diagnoses and treatments of diseases.

The participants mentioned different target groups in relation to HPHs. The majority mentioned patients (n =11), sometimes in combination with staff (n =4) and the population (n =5). For instance, one participant answered that an HPH is defined as a ‘hospital that contributes to better health for patients and the population and not only diagnoses and treats disease’. Only one participant’s response included all target populations proposed by the Swedish HPH network; this participant defined a HPH as an organization where ‘health promotion focuses on patients, employees, the population as well as management’.

Several participants mentioned that health promotion can be successful only if the entire organisation adopts and, ideally, embraces health promotion. Another added that management documents and policies must support health promotion work.

Table 2. Overview of HPH approaches mentioned by the participants

HPH approaches	Representative quote
Health equity	– considering equality and equal care – person-centred approach
Health orientation	– prioritise health outcomes rather than healthcare and production and costs
Health empowerment	– developing health knowledge, including healthy choices – staff receive support to motivate patients – patients at the centre of all meetings
Population health	– there is a focus on the population rather than just the patients – working with the community
Prevention	– prevent rather than just treat

The HPH network committee members noted two main descriptions of HPH approaches: a health orientation approach and a health empowerment approach. One committee member argued that the distinction is important; health orientation prioritises improving health-related results, such as lowering blood pressure, while a health empowerment approach prioritises empowerment outcomes, such as being in control of one's own health development. The respondent added that these priorities can lead to different actions even if the approaches are closely related.

The two committee members also observed that only one participant referred to all target populations proposed by the Swedish HPH network. They reflected that it seems that these groups receive unequal attention within HPHs.

Familiarity with and use of HPH documentation

The data show that neither of the supportive documentation provided by the HPH network are familiar to, or used by, all HPHs. The HPH network letter of intent was familiar to 13 participants. Twelve participants used the letter in their health promotion work, though with dissimilar interpretations. One participant reported using the letter of intent to clarify to the healthcare management what health promotion work encompasses. Another participant described difficulties in understanding how to work with the statements in the letter.

Ten participants were familiar with the HPH standards, and four participants stated that they based their health promotion work on these standards. They described in various ways how these standards governed their work. They argued that collaboration, preventive work, patient and relative involvement in care, knowledge development, and the development of routines were governed by the standards. The majority (n = 13) of the participants did not use the HPH standards at all.

The network committee members attributed the lack of familiarity and uses of the support documentation to the limited promotion of these supporting documents by the Swedish HPH network. They suggested that these documents were considered to have a narrow view of health promotion limited to preventive approaches. The committee also reasoned that these HPH documents lacked clear guidance for how to implement health promotion in the organisations. They explained that the HPH network therefore encouraged HPHs to develop their own, hopefully more holistic, definitions of health promotion and HPHs.

HPHs and the built environment

The survey participants described a number of aspects of the built environment that can be related to HPHs (see Table 4). These aspects can be divided into descriptions of what the design should achieve (objectives) or the design characteristics (features). Design objectives included categories related to prevention, restoration and health education approaches, as well as patient-centredness, health behaviour and health equity. Most participants listed only one category. For instance, one participant suggested that there should be 'access to many stairs to stimulate physical activity for those who can use them'. Another described the need to 'ask the employees and the patients how they want the [healthcare] environment to be'. Six representatives indicated that they lacked the knowledge of what building aspects would support or hinder health promotion.

Table 3. Design objectives mentioned in the survey of HPH county representatives

Design objective category developed by the research team	Aspects used by the HPH county representatives
Protective	Safety
	Attentiveness to allergies (protective)
Preventive	Support to quit smoking
	Tobacco prevention
	Designated outdoor smoking areas
Restoration	Animal and nature rehabilitation
Prevention healthcare	Access to health information
	Health education
Patient perspectives	Patient perspectives (walk in patients' shoes)
	Freedom of choice (autonomy)
	Balance between different human values
Healthy behaviour	Promotion of physical activity, (in)activity
	Healthy nutrition in food areas
Health equity	Accessibility for all people
	Availability
	Affordability
Health empowerment	Engagement of citizens
	Patient involvement
	Agency

The participants addressed a variety of design features for HPHs (see Table 4), such as visibility, cleanliness, scale, and finishing. One respondent listed 'stairs in the centre' to promote physical activity, in addition to 'light and healthy food in the restaurant/kiosk'. Only a few design features were mentioned more than once, including acoustics, art, and nature.

Table 4. Design features mentioned in the survey of HPH county representatives

Design feature category developed by the research team	Terms used by the HPH representatives
Acoustics	Music
	Sound
Visibility	Stair placement
	Views
	What the patient can see
Cleanliness	Sterile environment
	Hygiene
Scale	Large building
	High walls
Nature	Lack of nature
	Nature art
Finishing	Colour
Furnishing	Art
Opening	Closed doors
Location	Location

Involvement in building design projects

The results showed that several of the participants in the survey were involved in building design projects. None of these linked this task to their roles as HPH network representatives. However, the majority believed that there is a strong connection between the built environment and the success of health promotion work (see Table 5). Some participants were involved in building projects but had not considered the existence of a relationship between the built environment and HPHs. Unfortunately, the survey did not ask for the reasoning behind these answers.

Table 5. Relating project involvement to the perceived role of the built environment for HPHs

Involvement in building design projects	Perception of the relation between the built environment and the success of HPHs		
	Strong	Neutral	Weak
Has been involved	5	1	2
Has not been involved	7	1	1

In addition to the reflections on the abovementioned topics, the HPH network committee members also noted the difficulties of working with these different perspectives and their intentions. One secretary mentioned that the HPH intentions shown in the survey results may have conflicting implications. She argued that 'it is our role [as an HPH network] to support people working with health promotion to see how some health promotive intentions can be mutually beneficial for other professionals'. She added that health promotion professionals should be able to translate and combine health promotion intentions to make them important to the main stakeholder. For instance, when health promotion intentions can be shown to contribute to economic goals, they might be easier to 'sell' to stakeholders who are not familiar with health promotion.

Discussion

The study examined the role and integration of the built environment in health promotion as perceived and described by Swedish HPH representatives. The study questioned how these representatives perceive and describe the relationship between HPHs and the built environment. The presented results indicate that HPH representatives

- have inconsistent interpretations of HPHs,
- may not be supported by some of the HPH documentation,
- have diverse interpretations of the role of the built environment for HPHs and
- do not necessarily relate their involvement in healthcare building projects to their health promotion work.

Inconsistent interpretations of HPHs by the participants

The results showed that people who work with health promotion in HPHs interpret the meaning of health promotion in various ways. As mentioned, the HPH network also stimulates the development of individualized, holistic interpretations of health promotion and HPHs. However, the results indicate that some interpretations of HPHs do not address the multiple dimensions of health promotion or HPHs.

Not all healthcare organisations that incorporate health promotion aspects should be considered HPHs [25]. For instance, HPHs should consider the local population and effects for the natural environment [25]. However, the results show that the representatives referred mostly to one or two pathogenic aspects, such as safety or health education, or when they had a salutogenic orientation, they reduced this orientation to either working with the community or supporting healthy choices.

Based upon the results and previous research, we emphasise the importance of considering diverse dimensions of both health promotion and HPHs, thus including both a pathogenic and a salutogenic orientation. HPHs should pay attention to employees, the local population, and management in addition to patients. Additionally, HPHs should include consideration of outcomes for the natural environment.

Limited support from HPH documentation

The results indicate that the HPH documents, meant to support HPHs, are not widely known or used. As mentioned, these formal HPH documents are not promoted within the Swedish HPH network, as they are considered to give little guidance and lack a holistic view on health promotion. In particular, the HPH standards list the need to create an HPH environment, which includes the built environment [4, 7]. However, it seems that the built environment is easily neglected without these HPH standards. Nevertheless, the results suggest that the only strategic supportive documents for HPHs that do mention the built environment are not useable.

A recent study indicated that the inclusion of aspects of the built environment in healthcare strategies can improve the quality of care [41]. Reports have stated that to continue developing health promotion and fulfilling the intentions of the letter of intent, it is important to include the built environment in healthcare strategies [12, 13]. The HPH network, as well as HPHs, should include both health promotion and the built environment in their strategic material.

Lack of knowledge relating to HPHs and the built environment

The results suggest that health promotion representatives lack the necessary comprehension of the built environment to relate their health promotion work to aspects of the built environment. As mentioned, the health promotion representatives referred to either design objectives or design features. For instance, one representative mentioned the ‘healthy inside and outside environment’. However, this intention does not say anything about *how* the built environment should do this, nor do they give directions for design decisions. The representatives’ restricted consideration of built environmental aspects may be related to their professional backgrounds; none of the representatives were building designers, nor were they experienced or trained to deal with the planning and design of healthcare buildings. Nevertheless, they might have been able to indicate what the built environment should do, although they might not have had the competence to indicate how these objectives should be achieved and what that would look like.

Involvement in building design projects as HPH representatives

The results unexpectedly showed that HPH representatives involved in building projects did not necessarily consider the built environment as important for health promotion (Table 5). Moreover, they also did not see their involvement in building design projects as part of their health promotion responsibilities. It could be that they were involved in these building projects based upon other roles they had within the HPHs. Nevertheless, surprisingly, they did not relate these different roles. Consequently, the risk is that health promotion is neglected within building projects.

Previous studies have indicated that the design process for healthcare facilities may be used as a health promotion strategy [9, 10, 19]. Furthermore, some studies have emphasised the need for cross-disciplinary collaboration relating to health promotion [15], HPHs [42] and healthcare building design [9]. Nevertheless, HPH representatives’ involvement in building design projects should make it less difficult to develop and build collaboration between health promotion and building design professionals that hopefully will based upon a multi-dimensional interpretation of health promotion and HPHs, with a distinction between the setting as place and the built environment as object.

Conclusion and recommendations

This study indicates that the Swedish HPH network representatives: (1) have inconsistent and limited interpretations of what an HPH entails; (2) use HPH documentation, which is meant to support them, only to a limited degree; (3) have difficulties understanding the role of the built environment for HPHs; and surprisingly, (4) do not relate their health promotion work to their involvement in building design projects.

Nevertheless, healthcare organisations are increasingly introducing health promotion approaches [20-22]. This introduction of health promotion will have implications for the built environment [9, 10]. People working with health promotion, including those in HPHs, should therefore consider their work in relation to the built environment.

Previous studies have already noted that health promotion is a complex concept [43, 44], also in relation to healthcare building design [35, 9, 10]. This paper compliments the limited amount of available studies with the insights of Swedish HPH representatives and their perceptions and descriptions of the relationship between HPHs and the built environment. This study indicates gaps, such as the underdeveloped, incoherent perspective of HPHs in relation to building design. The combined findings might contribute to the development of a common understanding of the relationship between health promotion, HPHs and building design. Moreover, this improved understanding may prevent the execution of healthcare building projects that may restrict health promotion interventions [10].

Based upon the outcomes of the study, directions for those working with health promotion issues in an HPH context should include definitions for health promotion and HPHs that are clear and operational. Then, they should relate their health promotion strategies to the built environment and intended outcomes. This approach will, however, require specification of different strategies for different target groups.

To continue HPH development, the HPH network may want to reflect upon the use and possible support of HPH documentation. The HPH network might want to add aspects of the built environment to the overall strategies, including in the letter of intent. Furthermore, the HPH network should consider which knowledge surrounding the health promotive built environment should be shared within their network with those involved in new HPH facilities. Additionally, the HPH network should consider whether professionals concerned with building healthcare facilities should be included.

Nevertheless, more research is needed on the built environment of healthcare in relation to HPHs. Future research could focus on investigating best practice cases of built environments that promote health, or other perspectives on the role of the built environment for health promotion, such as building users or the community.

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IMPLEMENTING CIRCADIAN RHYTHM LIGHTING – TWO HEALTH-CARE CASE STUDIES

Kathrine Marie Schledermann (1)*, **Michael Finbarr Mullins** (1), **Jan Magnus Sjögren** (2), **Pernille Bech-Larsen** (3), **Anton Flyvholm** (4)

(1) Department of Architecture, Design and Media Technology, Aalborg University, Denmark

(2) Region Hovedstadens Psykiatri, Psychiatric Unit Ballerup, Denmark

(3) Henning Larsen Architects, Denmark.; (4) Light Planner ApS, Denmark

* Corresponding author e-mail: kmsc@create.aau.dk

Abstract

The studies derive from two larger Danish cases, which evaluated the application of circadian rhythm lighting in sensitive health care environments and highlights the difficulties that can be experienced in the implementation of entraining, or shifting of the timing, of the biological clock through lighting design. The paper focuses on the effects of introducing new 24-hour light and dark patterns on patients and residents in the two institutions, a home for the aged with dementia and a psychiatric facility for eating disorder patients. Data was gathered through ethnographic interviews, questionnaires, mappings, and structured observations. While positive benefits for health were an intended effect of implementing 24-hour biologically attuned lighting into these two environments, its introduction was also experienced negatively by staff and patients, particularly in the early stages of implementation, by affecting the patients' everyday routines and feeling of ownership. The paper lays out the foundation for current research projects by the author, by comparing the perceived comfort and experiences of the patients with the documented laboratory effects of the design of circadian lighting system. The paper concludes with preliminary recommendations for future implementations of circadian lighting designs, including the consideration of the context, the users' adaptation of the technology, communication with staff, usability and personal control.

1. Introduction

1.1 Circadian Lighting

The application of electric lighting to adjust or entrain circadian rhythm, by maintaining biological processes and behaviors relative to the 24-hour day/night cycle, has well-reported effects on health [1], [2]. Circadian rhythm lighting (CRL) has also shown promise to be effective as an integrated part of care and treatment of dementia patients (Sander et al., 2015), seasonal affective disorders, psychiatric and long-term hospitalized patients [3]–[5]. As most of the work investigating the impact of light on health and well-being has been performed in the laboratory [1], the authors' current work prioritizes research in natural settings [6]–[8], with the objective of applying and optimizing CRL's impacts on health and well-being outside laboratory conditions. However, research in natural environments presents a larger degree of complexity when dealing with patients in sensitive situations, such as resorting to the installation of lighting equipment late at night [9]; or where an experiment indicated that in the treatment of 'sundown syndrome' among elderly with dementia, and in order to have a maximum effect of circadian lighting on the sleep-wake-cycle, relatively high levels of illuminance were needed [10]; or where Alzheimer patients have been often treated with increased lighting by sitting still in front of a light box for relatively long periods [11].

This paper focuses on how the implementation of CRL influences the everyday life, the acceptance and adaptation of the patients and residents, and well-being of patients and staff in two specific healthcare contexts. This is explored through their everyday practice of light sources, and predominantly their use of electrical lighting, since the methods used in the studies attempt to identify effects of circadian adjusted lighting, where changes in daily routines and rhythms can serve as indicators for their wellbeing. This paper does not therefore present data on the effects of the intervention on the participants' health, nor does it set out to prove or disprove effects of CRL on patients' well-being and psychological health. The aim is rather to provide descriptions of how the implementation of this welfare technology influences everyday life of staff and patients, through interviews and observations.

1.2 Case-studies in healthcare environments

1.2.1 Case 1: LIGHTEL (Albertshøj) care facility for elderly dementia patients in Albertslund, Denmark.

The sub-study derived from a larger transdisciplinary intervention control trial [6], [12](approved research protocol) and investigates the effect of the introduction of CRL in a care facility on residents with varying degrees of dementia (43% Dementia, 13% Parkinson's, 47% Apoplexy and 23 % other neurological diseases, where some patients had more than one of these afflictions).

The large intervention trial collected both medical, anthropological, and sensor-based data in a concurrent research design, where CRL (Figure 1, 2 and 3) was installed on a single floor, in residents' private rooms, common spaces, living rooms and dining room. Previous research [10], [13], [14] shows that patients with dementia often have an abrupt circadian rhythm, due to deficient exposure to daylight [15], making them an interesting target group for light exposure treatments.

As care for dementia patients encourages secure and homely environments, the sub-study examines the influence of the CRL intervention on the residents' "practice of home" [16]–[18] and their perceived reality and experiences of light, from an anthropological viewpoint. Residents were interviewed about their daily lives and routines before the installation, during the control trial and the intervention. This was carried out in order to uncover how the implementation of CRL affected the residents' acceptance of the new lighting technology and the effect on their everyday lives and well-being.

During the study, the residents and staff were encouraged to have the pre-programmed lighting on at all times, and only to turn it off (by a switch on the wall) in case of emergencies. The care facility had large window sections illuminating rooms with daylight, and besides the CRL the residents were allowed to use their own lamps brought from home.

Baseline	Control Period: Static lighting setting	Intervention: CRL (Dec.11th 2017 – Feb 4. 2018)	Control Period: Static lighting setting
1 week	8 weeks	8 weeks	8 weeks
Group A			
	Group B		

Table 1: Research design for case-study 1. Oct. 2017 - Marts 2018.

1.2.2 Case 2: Ballerup Psychiatric Centre, Eating Disorder Unit

Although very little lighting research has been carried out on patients suffering from eating disorders (ED), they pose an interesting case, as Anorexia Nervosa and Bulimia Nervosa can be linked to comorbidity in disorders including depression and sleep deprivation, insomnia, obesity, diabetes, bipolar disorder and seasonal affective disorder [19], [20], many of which, in other types of patients, have previously been shown to be affected by 24-hour patterns of light and dark [10], [21], [22]. The objective of this particular study was to introduce two different CRL programs, to be able to compare and investigate if exposure to the two schedules (Figure 4. and 5.) would show effects on the activity and wellbeing of the hospitalized patients, through entrainment of their circadian rhythms.

These two CRL schedules were implemented in a newly built psychiatric treatment facility for ED patients. The facility offered CRL in private patient rooms, dining room and an open office, whereas corridors, courtyards and a lounge area had access to dynamic lighting and high levels of daylight.

Data were gathered through structured ethnographic observations, interviews, questionnaires, mappings, acoustical sensors, CO2 sensors, occupancy sensors, daylight sensors, thermal sensor imaging (Figure 6.), flow data, and clinical measurements, including regular blood and urine analysis. This paper focuses on the ethnographic results gained through observations carried out during the introduction of the CRL programs during May to July 2018.

1.3 Summary

In both cases, the newly installed technology was intended to implement new standards and practices for circadian light exposure in healthcare facilities. The two facilities described in this paper are both clinical units where residents are of a vulnerable group of citizens. However, in case 1 the lighting intervention was a retrofit solution installed on the 5th floor of an existing eldercare facility, built in 2015. Whereas in case 2, the entire facility is new and was finished in 2018.

While the aim is not to make a 1:1 comparison of the two case-studies, they are examples of user experiences of situations where circadian lighting systems were installed and illustrate the heterogeneity and complexity of such health-care facilities.

2. Case 1

2.1 Circadian Light Intervention

The circadian rhythm lighting was implemented in all rooms on the single floor of Albertshøj. It followed planned lighting schedules throughout the intervention (see Figure 1. showing changes in Correlated Color Temperatures (CCT)), designed to follow the day/night cycle. The CRL (see Figure 2 and 3) is presented in concordance with the CIE S 026:2018 α-opic toolbox (International Commision on Illumination (CIE)) [23] that describes the stimulus from the CRL on each of the 5 photoreceptors in the human eye; displayed as five alpha-optic curves. Furthermore, the CRL curve has been adapted to the elderly residents based on a large randomized control study on depression and anxiety in poststroke patients [4], [5]. During the morning hours, illuminance was slowly increased adding CCT with relatively shorter wavelengths of the light spectrum, peaking at 5500 K. between noon and 2pm. At night, the light contained a maximum of 1% of the spectral energy below 520 nm to minimize impact on patients' non-visual systems. The lighting schedule was carefully designed to entrain the circadian rhythms of the residents, while supporting the daily activities in the facility. The residents were able to turn the light on and off whenever preferred. Additional 8 static light settings were installed to supplement the activities when the CRL was insufficient. During the control periods, the lighting was programmed to have a static illuminance level and 3000 K. All 180 lamps and 150 wireless wall switches were individually controlled by a central, DMX-based lighting controller that automatically coordinated the CRL and static light settings.

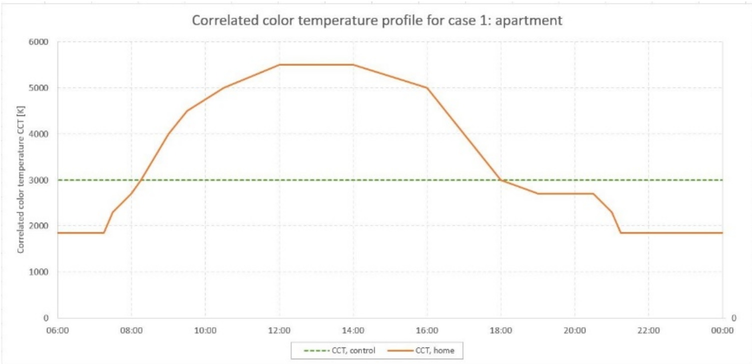

Fig. 1. CCT

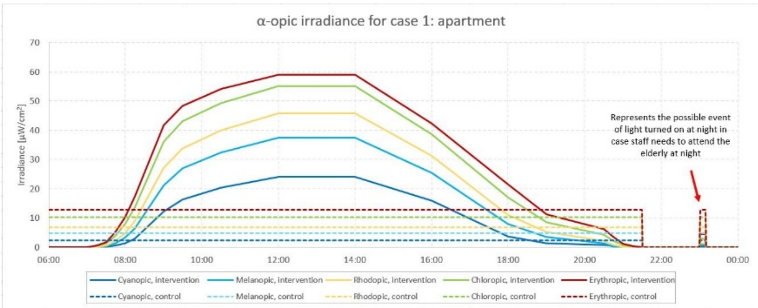

Fig. 2. Alfa-opic irradiance in apartments

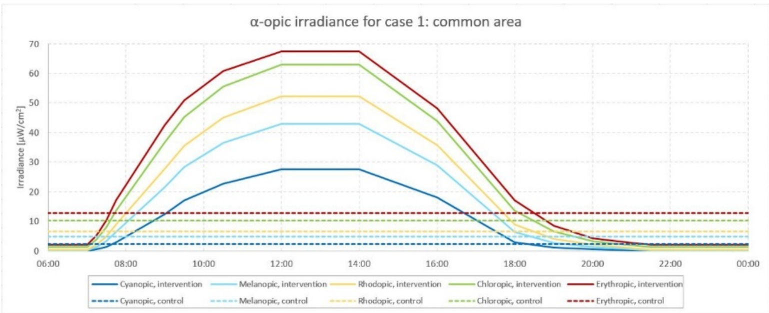

Fig. 3. Alfa-opic irradiance in common areas

2.2 Residents

Consent to participate in the intervention trial was obtained from the ethical committee VEK in 2016. IRB approval includes the interviews and observations. Seven frail elderly residents (+65) with varying degrees of dementia participated in interviews during the intervention study. Because the residents were vulnerable study-subjects, the sample size partly depended on the staff's evaluation of the resident's wellbeing, whether they were able to be interviewed for 15 minutes or more, and able to provide a detailed account on their daily activities and experience of the lighting. These recommendations from staff reduced the participants appropriate for interviewing from 15 to 7 informants, due to severe cognitive disabilities and health-related issues. By the end of the study only 5 participants were interviewed in person about their perception of the lighting. 10 of the 15 residents, who the authors were unable to interview in person, were instead observed and surveyed through proxy interviews with staff [24].

2.3 Procedure

Interviews

Participants were given a verbal explanation of the project on the first encounter. The five participants were each interviewed 7 times over the course of 17 weeks from October 2017 to beginning of February 2018. The interviews, typically conducted after 10 am, lasted between 30-50 minutes depending on the resident's current physical and cognitive state and willingness to answer our questions. Semi-structured interview guides [25] were designed to cover themes of the residents' everyday life, relating to their routines, activities in their apartment, socially and outside the nursing home, their experience of the facility and their sleeping patterns.

The main topics during the interviews were the residents' understanding, evaluation, and practice of the installed light sources, both their own as well as the new CRL. Mappings of the light sources and perceived luminous intensity were used as a supplementary tool to communicate about the resident's perception of the lighting in their homes. The mappings (handwritten sketches) were conducted in the resident's apartment by the interviewer together with the interviewee and included noting of the arrangements of lamps in the resident's home and the perceived luminous intensity (assigned with colored stickers). The residents were asked a set of the same questions for each encounter, with small variations, to maintain consistency in the data. As more interviews were held, participants were asked about whether anything had changed in their routines: for example, relating to sleeping patterns, daily and nocturnal activities, physical health or mood. The 5 residents included in the study were also frequently reviewed with their responsible caregiver, whom they were in daily contact with, and who helped by providing their account of the situation.

Observations

Observations were gathered by two researchers, three times for control and intervention periods respectively (morning, lunch, and dinner) lasting 1,5 hours each. The meals were the central gathering point of the day for residents and staff. The notes were re-written soon after collection, and while the information was still fresh.

Analysis of data

The results transcribed by two researchers who also conducted the fieldwork, then coded into 6 themes, where this paper focuses on two of the themes: (1) Acceptance, adaptation and tolerability; (2) The impact on work environments and wellbeing of the staff. The researchers transcribed each other's interviews, and conducted a thematic analysis using NVivo software, first individually, then in collaboration to form a synthesized analysis of larger themes. The quotes used in the following text were selected to exemplify the analyzed themes, rather than attempting to generalize for a generic, elderly and institutionalized resident.

3. Case 2

In a newly built psychiatric unit for eating disorders, CRL was installed in patients' rooms, the dining room, and common areas. The lighting profile [26] was developed based on work in Case 1, the Lightel project and previous research recommendations from the field of chronobiology and cognitive research [27]. The lighting was programmed with a KNX-based lighting controller that automatically coordinated light settings to follow two CRL schedules 'L1' and 'L2' respectively for periods of 3 weeks, spread over 3 months (see Figure 4. and 5.). The CRL was validated with light measurements using an Asense TEK ALP-01 spectrometer and a Hagner EC1 luxmeter. During the test period, patients in the facility were not able to turn off the lights in their private rooms from 7am - 9pm, except during medical attention where higher light levels would be required; in these cases, staff could override the CRL.

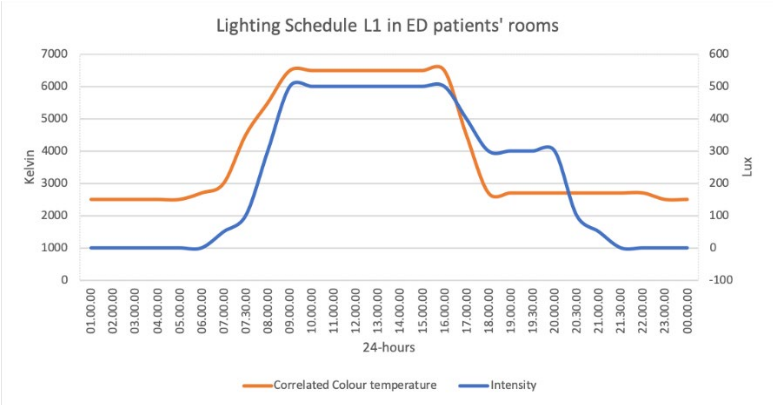

Fig. 4. Natural course of the day/night cycle

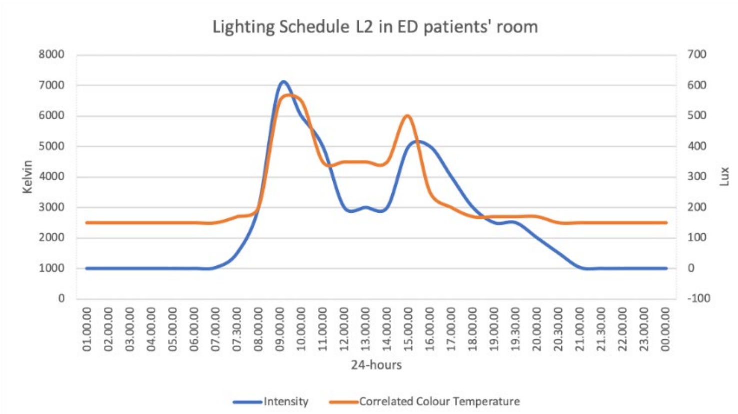

Fig. 5. Two daily 'light boosts' of higher CCT and illuminance levels

The first schedule L1 (Figure 4.) follows the natural course of the day/night cycle, with higher color temperatures and illuminances during the day than the second schedule. L2 (Figure 5.) was designed to match the strictly structured daily program applied by the medical staff in the facility and provided two daily 'light boosts' of higher CCT and illuminance levels: a strong peak in illuminance during the morning and another peak in the afternoon. The test period ran from May to July 2018 (12 weeks in total) at the Mental Health Center in Ballerup, Denmark.

3.1 Research Design

CRL Scenario	Test	L1a	L2a	L1b	L2b
Time period	6 weeks (March-April)	3 weeks (April-May)	3 weeks (May)	3 weeks (June)	3 weeks (June-July)

Table 3, research- and test design for case study 2

The experiment was based on a framework of A-B-A-B phased design, or withdrawal and reversal design [28, pp. 1-2], where each phase lasted three weeks. This design enabled a comparison of the observations and data collected from the two differing lighting programs. Each schedule was carefully designed to accompany and support the daily activities in the facility. A baseline was initially proposed prior to the data collection, but due to delays in completion of the new buildings, together with technical changes in the building, the data collected from the baseline has been discarded.

3.2 Patients

Due to the project timelines, 11 out of original 16 patients with ICD-10 diagnosis of eating disorders were exposed to both L1 and L2 and participated throughout the complete intervention period [26]. The patients were selected based on a predefined set of criteria. Inclusion criteria included: (a) Primary diagnosis of AN or BN or EDNOS; (b) (Eating Disorder Not Otherwise Specified); (c) Age ≥18 and <65. Exclusion criteria included: (a) Forced care; (b) Non-primary psychiatric disorder other than anorexia nervosa (AN), Bulimia nervosa (BN) or Eating Disorders Not

Otherwise Specified (EDNOS); (c) Binge Eating disorder; (d) somatic unstable condition; (e) High suicidal behavior or risk [26].

3.3 Staff

Psychiatric assessments by medical research assistants were carried out through interviews and questionnaires to measure and track changes in anxiety levels and wellbeing. As mentioned previously, these results will be published elsewhere. The staff are trained in assessing patients with eating disorders and have weekly internal meetings to harmonize assessments. Staff were always present in the facility. Only the night-time shift-workers had consistent work shifts, whereas the daytime (morning - afternoon) staff had rotating shifts.

3.4 Procedure

The structured observations were collected by one researcher, carried out in time slots during the period 08:30-00:30, allowing observation of the interaction patterns between patient-to-patient, staff-to-staff and patient-to-staff, at times where the electric lighting was dominant.

Figure 6. Thermal camera image of lounge area (observer seated in upper right corner)

4. Results

4.1 Adaptation and tolerability

The findings from Case 1 illustrate the difficulties for the residents in adapting to the circadian lighting. The discontent with the new lighting was exemplified by resident 1:

"Yes, you know what? When I am seated here by myself, then I let this be turned on, and it is on all the time [table lamp with green glass-shade and brass lamp base] because I like the lighting that it provides, and then no more lighting is needed. Likewise, in the bathroom you know what? I have tons of light in there, where a lamp has also been installed. It is completely insane. It is too much."

Resident 3 explains her thoughts about the process of adaptation: *"But whether I can get used to it, that I do not know. Whether I will say: 'oh, how pleasant it is', that I am afraid that I will never really do, but you never know".*

The time needed for adaptation to the CRL was generally longer than hypothesized; at the end of the intervention, all seven of the residents who underwent the complete study period, and were more independent of staff, still preferred their own lighting and daylight, rather than the circadian lighting.

Lighting controls and modern dwelling

The issues of acceptance and tolerability were not only connected to the residents' light culture but were also affected by their fear of using modern technology: "*The top switch is the new one. That one you must not touch!"* (Resident 1). Residents' insecurity towards the new CRL systems were especially revealed when it did not work: *"I thought in the beginning that it was my mistake, and I did not want to say anything".* Likewise, Resident 2 did not know how to use the lighting switches with the intention of turning the lights off in the bathroom. This resulted in distress, and decreased her feeling of autonomy and her ownership of the home:

"*It functions differently, I think. It seems to work opposite of what I have experienced my entire life where you turn it on by pressing up and you turn it off underneath. To me, it seems a bit inverted and wrong because I cannot simply turn it on and off. […] I have had some issues figuring it out and I am still fumbling with the bathroom light. To turn it on you must press up or down or how? At some point, it succeeds. […] As so many other things here in life, I will find a way to live with it, but it was also difficult for the residents to become accustomed to living in a modern dwelling."*

Resident 3 explains how she needed to get accustomed to living at the nursing home: *"Beforehand I lived for five and a half year at Aldbo (previous care facility) and now I have to get familiar with using an access card to get in and out* *and to using the elevator constantly. There is one new thing after the other in this place. Then there is this new lighting installed, I think it is a radical change."*

The residents referring to their previous homes, such as the quote above, could be caused by the institutionalization and modern technology that makes it difficult to feel truly at home. Jacquelyn Frank [in 29] argues: *"Elderly persons who move into life care facilities do not automatically feel at home in their new living arrangements. Frequently, the cause for this discomfort is the physical environment: it is too institutional and too unlike their former homes"* (p. 166). Vacher [18] argues that the notion of home is strongly related to a space that residents are in control of. Thus, the loss of control characterizes a movement away from home.

This feeling of home is seen through the residents' affection towards their own lamps and lighting fixtures, as exemplified by resident 3: *"If you take my lamps from me then I will move home".* The residents' own lamps neutralize the perception of institutionalization, even though in some cases the lamps were not even connected to the electrical plug points.

Analysis of the ethnographic observations from case 2 indicates that the implementation of CRL had a self-perceived negative and disrupting effect on patients and staff, particularly for those patients who were in mid-treatment and moved into the new buildings directly from the previous facility. Patients that entered the facility later in the process had fewer negative comments and were observed to have an apparently better adaptation to the system.

Technical issues in the initial phase often resulted in negative comments related to the autonomy of the system, the lack of on/off switches and thus lack of control over their private areas. ED patients are sensitive to losing control [30] and the dynamic lighting that was "prescribed" in the entire building triggered complaints, such as some patients felt that lighting levels should be a matter of personal choice.

However, the patients were observed to become generally more positive towards living in the building and the dynamic lighting system (CRL) during the trial. Although this was empirically observed in social activities, talk and inter-group dynamics, no bio-data or questionnaires showed any positive change in anxiety levels [26].

4.3 The Influence of Staff on Residents' Acceptance

In case 1, the interviews and observations showed that the residents' attitude towards the light, and thus their process of acceptance, were affected by the staff. The interviews with the staff uncovered that as a part of their work routines they strived to maintain a positive attitude and good atmosphere, because this affected the residents' behavior. This relationship was particularly observed with those residents suffering from severe dementia. These spent most of their day in the common area and were highly dependent on the staff for daily tasks and navigation, compared to the less frail, who spent most of their day in their private spaces. Because of the staff's positive attitude and reactions towards CRL from the very beginning, it was observed that this group of residents was more tolerant of the CRL being implemented. The difference in how the lighting was accepted can thus be prescribed by the degree of autonomy, and independence from staff. In general, the staff attempted to encourage the patients to keep the lighting on as much as possible, with the exception of those patients with special needs. Despite the staff's encouragement, the frail elderly who were interviewed showed skepticism and negativity towards the lighting.

In case 2, it was observed that the patients reacted strongly to the attitudes of staff in the facility. The new digital systems and dynamic lighting were on several occasions overridden to meet the wishes of patients, for example by not having dynamic lighting in their personal rooms. When the CRL system was turned back on, this was not always supported by the staff, affecting negatively patient attitudes towards the CRL.

In spite of several introduction courses, pamphlets and informal meetings, technical errors in the initiation phase and the implementation of the CRL led to misunderstandings in the staff and patient groups, resulting in an overall negative mood in both the patient and staff group. The patients in the facility were observed to have very close relationships with some members of the staff, creating a strong connection of security and trust. For this reason, the pre-implementation education of staff is considered highly important, so that they can support patients during the transition to the CRL. Investing time and resources in informing the residents several times during the study and during changes between intervention and control period should be considered in future projects, in order to potentially reduce the negative experiences related to the implementation of the lighting.

Observations in case 2 showed a difference between the patients that moved into the new building as "first movers" and patients that entered later in the process. Where the CRL caused disruption to begin with, a more harmonious adaptation was observed later in the trial. In the first phases, where the dynamic lighting was tested and calibrated, the patients and staff were heavily affected by technical issues, creating a difficult work environment for staff, and simultaneously causing impatience and anger from patients.

Nightshifts and sleep disturbances in residents

The observations and interviews with the staff indicated that the lighting not only affected the residents but also affected their working routines. For example, the night-shift workers had observed a reduction in nocturnal activity among the residents with a severe degree of dementia between control and intervention period. Prior to the installation of CRL, the night-shift workers emphasized during interviews the frequent issue of residents' nocturnal wandering, where staff found the residents walking in the hallways or being seated in the common area at night. During the intervention period of the CRL, nightly wandering was not reported (8 weeks in total) at all, corroborating previous research, which has shown that circadian entrainment has a significant effect on sleep quality, PSQI scores, agitation behavior, time spend out of bed, daytime napping and sleep efficiency in elder residents with moderate to late-stage of Alzheimer disease and related dementia [14], [15], [31]. Therefore, a probable effect of CRL can be found in measures of the staff / caregiver's workload and stress levels; that is, where lighting affects the residents and patients' behavior, it will also affect staff working routines and consequently their quality of work, as also indicted in a newer research study [8].

5 Conclusion

Although CRL has well documented health related effects in the laboratory, challenges can emerge during implementation of CRL programs, relating to acceptance, adaptation, and usability of the technology. These are issues, which need to be carefully addressed by lighting designers and decision makers when implementing lighting solutions that stimulate circadian rhythms. It is relevant to consider how the increasingly common inclusion of CRL in health care facilities may be perceived by the residents / patients and how disruptive effects may be minimized, in order to optimize the benefits of CRL.

While both the studies showed entrainment effects of CRL, these effects were not all positively perceived by patients and staff. When implementing CRL in facilities where the patients live permanently or for a longer period, it can be reasonably anticipated that its introduction will influence the everyday routines of patients and staff. While this influence is an intended effect of CRL – namely the entrainment of 24-hour biological rhythms, with ensuing positive benefits for health - it can also be experienced negatively as an unwanted disruption by both patients and staff. This poses the question of whether the design of luminaires and software programs for circadian entrainment should prioritize that of evidence-based practice or focus on the comfort of the occupants, including staff. This is particularly of concern in the implementation phases, where disruption effects are most likely to be experienced.

Observations from both cases indicate that the participants displayed difficulties in accepting the change of routines and habits entrained by the CRL. Firstly, the installation of the lighting affected the patients' everyday routines, as their daily routines adjusted to the automated light and dark programs. Secondly, the implementation of the lighting challenged the everyday work-routines of the staff, particularly as the automatic nature of the lighting, without the possibility of personal control, was experienced as a reduction of both staff and residents' independence. As discussed above, CRL is not only beneficial for the patients and residents but has promising effects on staff's working routines and health, as a direct circadian stimulus in reducing sleep disturbance in patients.

Communication with staff should be prioritized in future projects which implement CRL to create better transitions for the patients to the new systems and lighting conditions. Future projects need to carefully consider this challenge when implementing circadian lighting in settings such as psychiatric and elderly care facilities.

While differing in many respects from lab experiments, CRL studies in the natural environments offer new perspectives on its implementation in the context of vulnerable and frail subjects, particularly where staff actively negate effects of translocation, disorientation, and lack of control. 'Being at home' is a continuous practice built up over a longer period, where a sense of control over one's environment is an important factor. This is especially evident for the elderly, where new technologies are often a radical and confusing change, making it difficult for them to feel truly at home. The future challenge is that of moving from a 'one size fits all' approach, toward integrating circadian lighting with personalized systems that allow for individual control and interactions, while maintaining the improvements to human health and wellbeing.

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WOOD IN PSYCHIATRIC IN-PATIENT ROOMS MAY REDUCE THE LENGTH OF STAY FOR PATIENTS

Nyrud, Anders Q. **[1]*, Lundin, Stefan [4], Blomdahl, Christina [3], Caira, Cristiana [4]**

[1] Faculty of Resource Management and Nature Conservation, Norwegian University of Life Sciences, Norway

[2] Centre for Healthcare Architecture, Chalmers University of Technology, Gothenburg, Sweden

[3] Adult Psy-chiatric Clinic, Södra Älvsborgs Sjukhus, Borås, Sweden

[4] White arkitekter AB, Sweden

* Corresponding author e-mail: anders.qvale.nyrud@nmbu.no

Abstract

Objective – To outline a study of healthcare outcomes for psychiatric patients within an in-patient psychiatric ward. The planned study was initiated as a follow-up of the design process, where emphasis was made to use interior surfaces of wood in a new Swedish psychiatric building.

Background –The influence of the physical environment for treatment outcomes within somatic care has been acknowledge for decades. Today there is also a growing amount of research within the field of psychiatric health facilities. View of, and access to, nature have shown to be of major importance. Recent research suggests that wood in patient rooms may have a healing effect.

Research question – Does the use of wood in psychiatric in-patient rooms have positive health outcomes, such as reduced length of stay for patients and reduced stress levels?

Method – The quantitative study will be executed in a new Swedish psychiatric building with 96 in-patient rooms in 4 wards. Each ward is divided into modules (6 patients/module). The study has a comparative approach: treatment outcomes in a module where patient rooms with wood covered facade-walls (n=2) will be compared to rooms with painted plaster façade-walls (n=2) and artificial wood panels (n=2). Patients in the module, intended for a special but general diagnosis, will be placed randomly in rooms with or without wood surfaces. All patient rooms are én-suite rooms. The staff is identical between rooms. All patient rooms have identical orientation.

Results – An outline of a study in a psychiatric hospital is presented. This includes aspects related to research design, participation from patients, ethical considerations and statistical power of the planned experiment. Final outcomes from the study will be carried out after the new psychiatric building is inaugurated in 2020.

Conclusion – Choice of building material can be an important measure to include in the design of health facilities. The study will provide new insights into what materials can be used and how they should be used to maximise possible beneficial health effects. Several aspects of architectural design can influence users in the built environment. Thus, there can be confounding factors influencing patients´ health and psychological well-being.

Keywords: *Healing Architecture | Psychiatric Wards | Wood | Construction Materials*

Introduction

The impact from built environments on public health is a complex issue that involves a large number of factors, some of which are physical and others psychological. Positive relationships between aesthetics and occupant wellbeing have been identified [1]. Over the past decades, several empirical studies have documented that both passive and active experience of nature may be beneficial for human health and wellbeing, cf. [2], [3], [4], [5], [6]. Psychological benefits have been reported on the basis of surveys and experimental data with regard to different nature experiences and in environments of varying scales, from wilderness to gardens and window views, e.g. [3].

Elements of nature and natural building materials are frequently considered to be aesthetically pleasing, cf. [7], and can thus have a positive influence on occupants´ wellbeing and health. Building materials do impact on how buildings are experienced by users and can influence the indoor environment through aesthetical properties and psychological outcomes/effects. There is a growing body of research that investigates health effects of wood in the build environment, e.g. [8], [9]. A literature review conducted in 2015 concludes that there probably are benefits from using wood in healthcare environments [10].

The connection between views to nature and improved therapeutic outcomes does, however, not mean that the use of wood necessarily would contribute to similar outcomes. In particular, the healthcare context presents complexities especially in relation to infection control, which is one of the most important constraints for most healthcare environments. Wood is a porous material and therefore very difficult to pass infection control, on the other hand recent research provide some evidence about possible benefits from wood with respect to microbial safety in hospital settings [11].

There is a body of research on architecture for psychiatric environments and therapeutic spaces, cf. [12], [13]. Sherman concludes that objective measurement of the built environment in inpatient psychiatric settings is feasible and can be used to identify features that increase user satisfaction [14]. Design aspects in psychiatric ward design have been studied by design can promote healing and support treatments [15], and a recent Swedish study concluded that psychiatric ward design can reduce aggressive behaviour among occupants [16].

Biophilic design emphasizes the necessity of transferring the beneficial experience of nature to the built environment [7], [17]. The use of wood does to some extent mirror previous results from exposure to other natural elements, such as views and plants, cf. [18]. A seminal study was conducted by David Fell in Canada [19], he found lower stress reactivity in the autonomic nervous system for interiors with visual wood or green plants. Lower sympathetic activation and higher parasympathetic activation resulted in measurably lower heart rate, lower blood pressure, lower skin conductivity, and higher heart rate variability, cf. [10]. These results have been linked to exposure to wood. However, lower stress activation due to views and plants have also been shown to increase the ability to concentrate, lower pain perception, and speed recovery times. Though these benefits have not been identified for wood, they are tied to the same autonomic responses to nature seen with wood. Therefore, it is reasonable to expect that future research on wood will find many of these same results.

In healthcare environments, natural materials and views are associated with better patient outcomes with respect to recovery times, lower pain perception, and positive dispositions, cf. [9]. This alone can be a reason for including more wood in in these buildings.

This paper aims at providing an overview of a study that is planned carried out in and environment for psychological patients, an in-patient psychiatric ward. The paper outlines research hypotheses on wood use in healthcare environments, more specific in hospitals and psychiatric wards. The following research questions will be analysed:

1. Does the use of wood in patient rooms reduce the duration of the hospital stay?
2. How does the use of wood and visual wood surfaces affect patients and staff at the hospital?

Theory and Methods

Hartig defines restoration as a process of renewal that replenishes a depleted social, psychological or physical resource [14]. These resources have most often been depleted by an individual's effort to adapt to their environment. Early restoration theories focused on recovery from psychophysiological stress [15] and attention restoration [3]. Psychophysiological stress recovery theory posits that natural environments, and even views of these environments, will aid recovery from stressful events, including psychological stress and physical stress (e.g., recovery from surgery) [2], [4], [20].

Attention Restoration Theory (ART) focuses on understanding how individuals replenish their ability to exert attention on common tasks, such as those at the workplace that require directed attention [3], [20], [21], [22], [2], [24]. In an extensive review of the psychological benefits of indoor plants, Bringslimark et al. determined that although the evidence suggests indoor plants can provide psychological benefits [25], the heterogeneity amongst the methods and results may imply the benefits are contingent on the context of the encounter with indoor plants and the participants in the experiment. These concerns extend to experiments with wood or other natural materials indoors. Many studies have found empirical evidence to support these theories, but the theories themselves remain open to elaboration as more evidence is collected regarding the restorative effects of nature [20]. Studying the effects of wood on attention and psychophysiological stress restoration in the built environment may produce helpful and enlightening results.

In the case of both ART and psychophysiological stress recovery theory, the natural environment provides the individual with a means to restore themselves to a more complete state. These restorative environments exist in nature and provide a model for bringing the desired effects indoors. According to Kaplan [24], the components of a restorative environment are:

1. Being away - the sense of being in a different environment (distance is not a necessary component of being away.)
2. Fascination - when ones´ attention is effortlessly focused on something.
3. Extent - feeling an area to be large. Well-designed paths can be used to make a small area seem larger.
4. Compatibility - the natural affinity humans seem to have for nature makes it a compatible environment.

While many of the elements of restorative environments may seem challenging to incorporate into building design, biophilic design provides guidance on how to bring nature indoors therefore a means to produce restorative indoor environments. Biophilic design is the incorporation of the principles of biophilia into building design [7], [17]. These principles are built around the concept of an innate human attraction to life and life-like processes [17]. To create restorative indoor environments with biophilic principles, Wilson suggests being away can be addressed with indoor gardens, views of nature, and other features occupants can view or visit, which differ from a typical workstation [26]. Similarly, design features may provide extent by varying ceiling height, including natural lighting, and other mechanisms [26]. Natural patterns, shapes, and forms all provide targets of fascination, while compatibility is derived from evolved human relationships with nature [17], [26].

The use of wood as a construction material, and how wood can be implemented in biophilic design is for example discussed by Salingaros and Masden [27]. They pointed out that wood is relevant both for structural and aesthetical purposes, but the design should be accommodated appropriately. There are six guiding principles of biophilic design [8], using wood as a natural construction material is relevant for at least four principles (1, 2, 3 and 5):

1. Environmental features - making design choices, which reflect readily recognizable as aspects of nature. These features may range from views of nature, to water features within the building, to including a wide variety of indoor plants.
2. Natural shapes and forms - using elements of the built environment to replicate naturally occurring elements (such as trees).
3. Natural patterns and processes - using elements of design (such as materials, spaces, lighting, etc.), which through visual recognition, touch, scent, or sound remind occupants of growth, life, natural motion, and other elements of nature.
4. Light and space - diversity of colour, natural light, and variability in lighting levels are reminiscent of nature. Further, difference in size and shape of spaces in the built environment also remind us of nature.
5. Place-based relationships - connections to cultural and ecological elements linking geographically distinct locations with the built environment.
6. Evolved human relationships with nature - the connections humans have developed throughout the evolutionary history. For example, natural settings, such as forests, have provided shelter and safety, food and materials for survival.

One way to implement biophilic design in contemporary buildings is the Restorative Environmental Design (RED) paradigm, which brings together the ideas of sustainable design and biophilic design [17].

Study at psychiatric ward

Most empirical studies addressing the psychological effects of wood-use have been conducted in laboratory settings. There is a need for studies conducted in real-life settings. In order to achieve this, an empirical study is planned in an in-patient psychiatric ward. The study will focus on evaluating how the use of a natural construction material in patient rooms can provide beneficial health outcomes, such as reduced duration of stay and reduced stress. Natural material will be compared to a generic interior design. The study is to some extent comparable to [2] study of the healing effects of window views in hospital settings.

The study is planned to take place in Södra Älvsborg Hospital, Borås, Sweden, and the study is conducted in cooperation with the hospital owner and the hospital architect. Södra Älvsborg Hospital is currently in the process of renovating and building designated for in-patient care. The buildings, which will gradually be finished until year 2021, are constructed at Södra Älvsborg Hospital in Borås, Sweden (cf. Figure 1). The project has a long history. Already in 2008, discussions began with the precondition to refurbish and extend the existing in-patient psychiatric care facility. This was proven disadvantageous, both functionally as in regards of facility managements costs. Therefore, it was decided to plan for a new building for the in-patient care. At the same time, discussions were put forward to connect in-patient and out-patient care in one building and, furthermore, to add the children- and adolescent psychiatry to the complex. Continuity and well-being for the patients as well as an effective use of the facilities spoke in favor for this joint solution. A, for the project, conceptually important decision was taken, meaning that the entrances for the children and adult psychiatry, as well as for the extensive out-patient care, were merged in a shared entrance hall. This works also as an entrance for the hospital's dining hall and conference facilities. To add, and underline, the public concept of the entrance hall the hospital's study and university areas for teachers and students are positioned here.

The new complex is shaped by three buildings. The out-patient care is positioned in the current in-patient building while the inpatient care for adults, children and adolescents are placed in a new star shaped building with four floors. Between the two, a one floor entrance hall building is positioned. Moreover, the in-patient care building houses the psychiatric emergency on the ground floor, the first and second floors contain the in-patient care for adult psychiatry, with a total of 72 beds, with two wards in each floor. At the upper, third floor, the children- and adolescent-psychiatry is positioned with out-patient care, daycare and eight in-patient care beds.

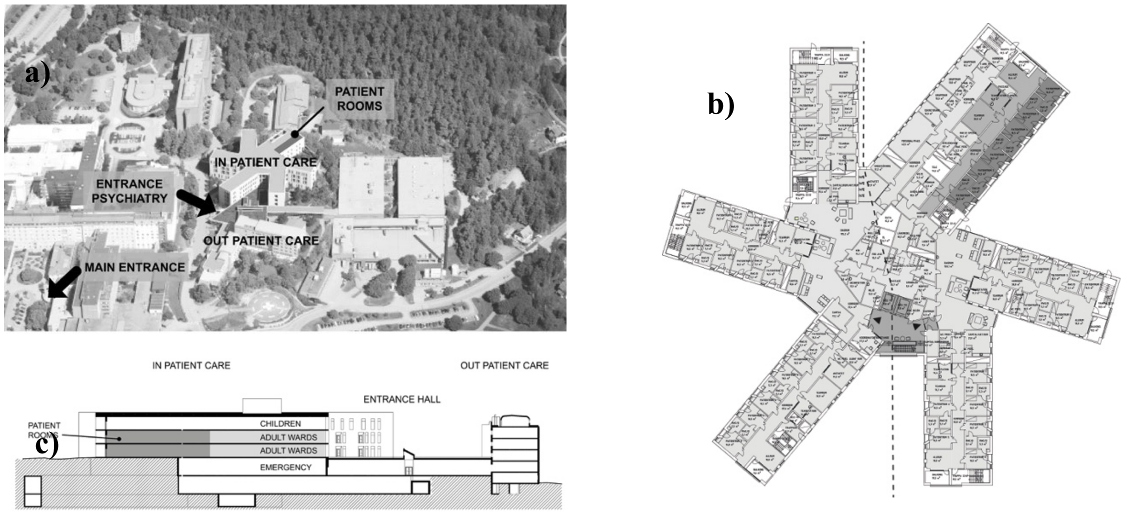

Figure 1. Overview of Södra Älvsborg Hospital, Borås, Sweden. a) Aerial overview, b) Plan of in-patient care building, c) Cross section of in-patient ward. Pictures: White arkitekter.

In-patient rooms

The six rooms for the planned study are positioned in a unit in one of the six arms of the adults' psychiatry in-patient care (Figure 2). The unit is one of the three units making up a ward, with in total 18 beds. The six single patient rooms, with en-suite bathroom, are all positioned at the south eastern façade. In addition, there is a joint dayroom with balcony within the unit. The staff areas consist of a glazed team station with a back-office and a team-room in the building's darker core. For the patient group there are also common dining- and living areas as well as activity rooms and other supportive functions. The idea with smaller patient groups, team stations and team rooms, is inherited from the successful somatic wards located in the existing so-called T-house at the hospital area.

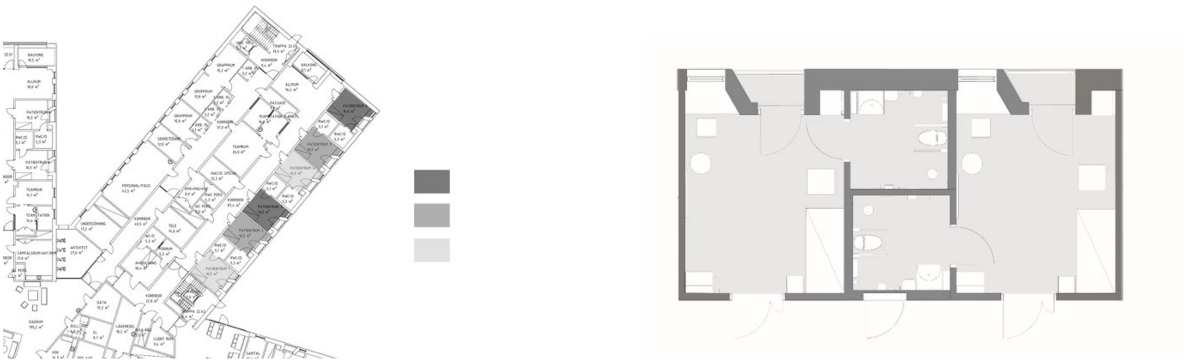

Figure 2. Plan of the ward that will be used in the study. Right: overview of ward. Left: Plan of two én-suite patient rooms. Pictures: White arkitekter.

Research design

The six rooms in the research study are divided in three types. The first one will have a slightly white-stained and lacquered birch plywood cladding on the façade wall (Figure 3). The second type will have the same wall cladded with a plastic laminate imitating birch plywood. In the third type of rooms, the wall will have a painted plasterboard in a light warm beige tone. The façade wall, in all rooms, have a door to a smaller, private balcony. The rooms are additionally furnished with a bed, an upholstered armchair with a lower table and a fixed writing desk with a chair. There is also a built-in wardrobe as well as a built-in locker and wash basin unit for staff. The walls are painted white, except for the wall towards the corridor which has a light grey colour.

Figure 3. Intervention room with wood. Picture: White arkitekter.

This study will be designed as a randomized, double-blinded experimental study. The intervention is the room with birch wood panelling, i.e., a typical patient room interior with wood on the surface of the façade-wall (Figure 3). Two types of control rooms will be fitted for the study furnished with (1) a generic material, painted plasterboard, on all four walls and (2) imitated wood panelling on façade-wall.

Participants will be recruited from the group of patients that are assigned to the psychiatric ward. Since the participants are hospitalized patients, it is of great importance that they are treated with respect and in accordance with current ethical standards. The study protocol and the informed consent procedures will be subject to approval by the Swedish Ethical Review Boards. In order to participate on the project, all participants must sign a written informed consent before moving into the rooms. Participants will be entitled to withdraw their consent at any time during the stay.

The patients will be assigned to a room upon arrival. Patients participating in the study will stay on the same ward and will be treated by the same personnel/hospital staff. Patients will be assigned to one of the three different room types. The orientation of the rooms used in the study will be similar for all rooms, and the rooms are all located on the same floor. Exposure time will be the duration of the stay of the patients and may vary between patients.

The study will utilize both quantitative and qualitative data. Data on patient´s health will be collected. In particular, the duration of the stay will be recorded in order to determine whether the material use influences the length of the hospital stay. In addition, interviews and questionnaires will be conducted. Through interviews and questionnaires, data on patients´ subjective evaluation of the in-patient rooms will be collected. Furthermore, the personnel working in the ward will complete questionnaires about the general state at the ward. Indoor climate will be surveyed through continuous measurements of indoor climate factors, such as temperature, relative humidity in indoor air, indoor air quality etc.

There are few studies that are relevant for a priori strength calculation. As a starting point for the calculation of strength and estimation of sample size, Ulrich's study from 1984 is used [2]. Ulrich's study comprised a total of 46 matched patients (23 pairs). All the patients had performed a gall bladder operation. Half had window views to nature (trees) ($n = 23$), while the other half ($n = 23$) had a view to a brick wall. The outcome measures were the number of days for admission, number and strength of analgesic drugs, number and strength of sedative drugs, minor complications such as persistent headaches and colds, and nurses' notes on patient condition.

There were statistically significant differences between the two groups in the number of days for admission (Wilcoxon matched-pairs signed-ranks analysis, $T (17) = 35$, $z = 1,965$, $P = 0.025$). The patients who had a view to the brick wall averaged 8.70 days in the hospital compared to 7.96 days for those who had a view to nature. The Wilcoxon matched-pairs signed-rank test is a non-parametric estimator and it does not specify either T-value or standard deviation that can be used to estimate the effect size based on these results [28].

There were also statistically significant differences between the groups with respect to the other outcome measures studied [2], but insufficient results (standard deviations and t-values) are reported to allow accurate calculation of power size. Ulrich's study had significant results with a relatively modest selection, but in order to minimize the possible effects of confounding factors, such as window view, and demographic factors, gender, age, ethnical background, the sample should be larger than for Ulrich´s study. For the current study data collection is therefore expected to last for two to three years

Discussion

The planning of the study will render if the study is possible. Great effort should be taken regarding choosing the right parameters for evaluating the research question. The group being subject to investigation consists of patients with severe health problems, and does not necessarily want to, or are able to, provide credible data on their own health. Objective outcomes will be collected, such as duration of stay. Information from patients will be collected by qualitative measures, such as interviews, in order gain an understanding of their perception of the interior and possible beneficial psychological effects. Furthermore, data will also be collected by staff in order to gain a continuous feedback on the patients.

The duration of the study will be fairly long, due to the fact that only six rooms are available for the study. Consequently, the data collection is expected to last for two to three years.

Different aspects of architectural design can influence users in all types of buildings, as described in previous research, e.g. [1], [29], [30], [31]. Thus, there can be various factors influencing patients´ health and psychological well-being, for example the window view in each room, the location of the hospital in an area with access to nature, general aspects related to architectural design or the fact that the ward is renovated/new. Furthermore, the amount of wood used in the interior (on the façade-wall) might not be sufficient to yield a significant on the patients.

Material choice can be an important measure to include in the design of health facilities. The study will provide new insights into what materials can be used and how they should be used to maximize possible beneficial health effects.

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TOWARDS A MULTI-STAKEHOLDER APPROACH IN HEALTHCARE FACILITIES PLANNING AND DESIGNING

Nicole Gerber (1)*, **Monica Anand** (1), **Susanne Hofer** (1)

(1) Zurich University of applied Sciences (ZHAW), Institute of Facility Management (IFM), Switzerland

* Corresponding author e-mail: nicole.gerber@zhaw.ch

Abstract

Objective – With this paper, the authors seek to raise awareness of the need for a multi-stakeholder approach and an interdisciplinary exchange in the construction context of healthcare facilities. This is critical to ensure smoother and more efficient non-medical service provision, as well as to facilitate future service innovation throughout the operational phase after finalising the building phase itself.

Background – At present, many hospitals in Switzerland are in the process of being renovated or being completely rebuilt. However, in many projects, the architects, designers and/or managers failed to involve non-medical support service providers throughout the planning and designing process. Consequently, the service provision and innovation in this area will continue to suffer as corresponding processes cannot be executed as effectively and efficiently as required due to limitations imposed by restrictive structural conditions and design elements. Projects conducted so far have shown that it is crucial to find out how to better involve non-medical support service providers in the planning and designing process of hospital facilities at an early stage and to clarify their role.

Research question – How can non-medical support service providers be involved, and their role be clarified, at an early stage of the planning and designing process of hospital facilities.

Methods – The research conducted was of an exploratory nature. Six experts involved in both nonmedical support service provision [Facility Management (FM)] as well as construction in healthcare (HC) facilities were interviewed, based on semi-structured interview guidelines. The Five-W-and-1-H (5W1H) technique – also known as the Kipling method – was applied for data collection as well as data analysis.

Results – The main research findings of this pre-study showed that firstly, many different inhibitors for non-inclusion of FM in HC at an early stage of construction have to be considered; secondly, that multiple stakeholders have to be involved in the planning, design and construction process in HC facilities and thirdly, the importance of communication in the whole context.

Conclusion – Three main conclusions can be drawn from this pre-study. Firstly, the role of a qualified construction-accompanying FM in HC user representative of the whole discipline, should be developed and established. Secondly, a specific HC construction project stakeholder management and communication concept including FM in HC should be developed. Thirdly, further training and advancement of current FM in HC roles should be arranged.

Introduction

Currently, several billion Swiss francs are being, or are planned to be, invested in healthcare (HC) infrastructure (new buildings or renovations) in around 70 major new healthcare constructions [1], [2], [3], [4]. Reasons for that are ([5], [2], [6], [7], [8], [9]):

- the aging physical substance of many hospitals
- the introduction of Swiss DRG in 2012 leading to more competition and therefore greater pressure to be cost efficient and thus the need for more process efficiency
- increased demand for attractive and qualitatively superior service provision including higher comfort (the building has become a competitive factor)
- currently low interest rates

This leads to more pressure on building planners, as they are increasingly forced to prove the compliance of the building design and substance in terms of [10], [5]:

- efficiency

- functionality
- attractiveness
- flexibility
- sustainability
- facilities
- allowing new forms of cooperation.

In order to cope with the challenge of more competition, there is not only rising pressure for cost and process efficiency, but also the need for attractive service provision and comfort, increasing quality requirements with respect to the medical core processes as well as non-medical service provisions [11], [5], [12]. When talking about non-medical services, the definition of Gerber and Kuchen [13] is chosen. The service allocation model represented in Figure 1 clarifies the understanding of non-medical support services or FM in hospitals [13]. Referring to the yellow section, the non-medical support services in HC have been subdivided into four major areas:

1. Logistics, comprising procurement, inventory management, transport and distribution of goods and disposal & recycling services
2. Infrastructure, with operation and maintenance services, space management and supply, and energy and water supply /disposal services
3. Hygiene, Safety & Security, including cleaning and disinfection activities, preparation of medical devices, safety and security services
4. Hotel Business, with catering services, textile supply, accommodation, administration and operation of properties, and various other hotel services

Through the function of tactical resource management, all the non-medical support service areas mentioned above are coordinated, and systematic measures with respect to process improvement and resource optimisation are undertaken [13].

In recent years, it has become clear in numerous publications and projects undertaken by the authors that the non-medical processes in hospitals (FM in HC) can contribute to process optimisation, quality improvements and cost-cutting [14], [15], [16], [17], [18], [19], [20]. However, it is obvious that the contribution can only take effect if the infrastructure accommodates the optimised processes. In old buildings, this is not easily possible as they were planned with different perspectives. However, with new buildings, the harmonisation of the processes with each other as well as with the infrastructure is a great opportunity for more efficient and qualitatively enhanced service delivery at a lower price [11], [21]. This, however, requires the appropriate and early involvement of all the necessary stakeholders in the area of non-medical support services [11], [22], [21]. The already established norm SIA 113 [23] identified the value of FM in construction projects and defined the activities and roles in different phases of construction (“strategic planning”, “preliminary studies”, “project planning”, “tender”, “realisation” and “management”), although not particularly dealing with healthcare construction [23]. The importance for (multi-)stakeholder involvement and management has been acknowledged for quite some time and different general frameworks have been presented:

- **in general** ([24], [25], [26], [27]). In (lean) construction (e.g., [28], [29], [30])
- **in Facility Management** (e.g., [28], [31], [32], [33], [34], [35])
- **in healthcare** ([36], [37], [38], [39], [40], [41], [17], [42], [43])
- **in healthcare construction** ([44], [45], [29], [46], [30])

However, in many projects, the architects, designers and/or managers failed to involve non-medical support service providers throughout the planning and designing process. Consequently, service provision and innovation in this area will continue to suffer as corresponding processes cannot be executed as effectively and efficiently as required due to limitations imposed by structural conditions and design elements. Projects conducted so far have shown that it is crucial to find out how to better involve non-medical support service providers in the planning and designing process of hospital facilities at an early stage and to clarify their role.

Research Problem, Research Question and Objectives

Previously conducted projects have shown that although the above-stated benefits of non-medical service involvement in the healthcare infrastructural planning and designing have been identified, there is a gap in determining how exactly the process of integration needs to take place during the planning and design phases of the construction [47], [48], [49]. This also involves the conflict of interest that might exist between different stakeholders involved in the process of planning and construction [50].

The goal was therefore to conduct a pre-study to investigate the probable ways of including FM in HC (very) early into the planning and design activities of healthcare facility construction. The research question was therefore formulated as:

"How can non-medical support services be better integrated into the planning and design stages of construction projects involving healthcare facilities?"

This includes the following sub-questions:

- "Who" needs to involve whom in the process of project planning to ensure the early involvement of FM?
- "What" has to be done to involve FM very early into the planning phase of construction process?
- "When" should the FM be integrated into the planning phase with reference to the SIA norm 113?
- "Why" is this early involvement of FM considered important to hospitals?
- "How" can this goal of early involvement be fulfilled?

With this paper, the authors seek to raise awareness of the need for a multi-stakeholder approach and an interdisciplinary exchange in the construction context of healthcare facilities. This is critical to ensure smoother and more efficient non-medical service provision, as well as to facilitate future service innovation throughout the operational phase after finalising the building phase itself.

Methodology

The choice of the research study adopted for this paper is of exploratory in nature with an aim to provide deeper insights into the research problem, to offer opportunities for additional projects and to the community for further research direction rather than underlining conclusive answers to the research problem [51], [52].

Therefore, the research design accommodates a qualitative approach following in-depth semi structured interviews as a method of data collection [53], [54], [51], [55], [52]. The interview guideline was developed with a focus on relevant areas of the research topics that were necessary to answer the research questions using an adapted problem analysis technique for questioning based on the Five-W-and-1-H (5W1H) technique [56], [57]. The 5W1H technique - also known as the Kipling method – helps to explore a problem with simple, but open-ended questions such as What?, When?, Where?, Who? and How? [58]. The goal of asking such open-ended questions is to gather as much information as possible in a short time frame, to challenge the current perspectives of people, to view a certain problem from different perspectives and to generate new ideas [58]. The reliability and validity aspects of the guideline was addressed by reviewing the questions for its subjective relevance by an expert [59].

A purposeful non-random sampling was applied to identify those experts who were able to provide useful insights towards answering the research question and meeting the research objective [54]. Six experts involved in non-medical support service provision as well as construction activities within hospitals in Switzerland were interviewed.

The authors used a deductive-inductive hybrid approach to analyse the qualitative data. The interview transcripts were analysed deductively based on pre-set categories (based on the multidimensional classification of 5W1H information "who", "when", "what", "why" and "how" according to Walter [57]. Moreover, the construction phases as described by SIA 112 [60] "strategic planning", "preliminary studies", "project planning", "tender", "realisation" and "management" were used as a reference. Furthermore, inductive analysis was applied for categories generated outside this framework that emerged during the coding process [61]. In order to increase the validity of coding, the coding process was re-iterated and refined by consolidating coding with two methods - thematic and open coding. The coded data was classified into the two-dimensional matrix illustrated in Table 1. It aims to provide a holistic overview of the multiple stakeholders interacting with each other in different phases of planning, design and construction of healthcare facilities, delivering the necessary arguments to meet the research objectives and answering the main research question. The X-axis in the matrix concerns the aspect of "who" and the Y-axis concerns the aspects of "when" referring to the six phases of the norm Swiss Association of Engineers and Architects – SIA 112 [60]. The performance Model SIA 112 clarifies service planning in different phases of construction [60].

Table 1. The two-dimensional matrix representation of results using 5W1H technique

5W1H multi-dimensional classification						
	When?					
Who?	Strategic planning	Preliminary studies	Project planning	Tender	Realisation	Management
	Interacts with **Whom? Why? What? How?**					

Inductively generated categories were clustered separately. Primary data collected was compared to secondary sources to validate the congruency of its findings, mainly to the SIA Norm 112 Construction Planning [60] and SIA Norm 113 FM-adapted Construction Planning and Realisation [23].

Results

The research findings of this pre-study are manifold. The most important findings are:

Many different inhibitors for non-inclusion of FM in HC in an early stage of construction

Even though a limited number of experts were interviewed, many different inhibitors for the current non-involvement of FM in HC in an early stage of construction were brought up, the most important ones being lack of:

- time and resources due to intensive involvement in daily business and day-to-day operative functions
- long-term strategic thinking, planning and responsibilities of FM in HC
- innovation-oriented attitude; prevalent traditional mind-set of FM in HC
- FM conceptualisation, including awareness of interfaces between operational and strategic functions, future trends, and processes by all stakeholders
- alignment and voicing of opinions, and measurable contribution to medical core business
- role and project definitions in HC construction projects
- overall know-how of HC business and hospital workflows by FM in HC
- necessary competencies and skills as well as project and business experiences by FM in HC
- willingness for co-ordination, collaboration and interactions with interdisciplinary functions by all stakeholders involved

Who-should-involve-Whom-When-Why-and How

In order to answer the research question, the key stakeholders identified were assigned to the different phases of planning and construction process according to SIA 112 [60] as described in the Methodology chapter. The results of the sub question "Who" should involve "Whom" is described in the following section. The aspect of "When" to include could also be clustered and is illustrated in Figure 2. For the sub-questions "What", "Why" and "How", insufficient generalizable data was available to make a differentiated statement. However, the aspect of communication was stressed – the results on this topic is summarized below.

Multiple stakeholders involved in the planning, design and construction process in HC facilities

According to the experts interviewed, the main stakeholders responsible identified in the process of construction in HC and FM involvement are as follows:

- owner-representative(s)
- user representative(s)
- architect(s)

- planner(s)
- project manager(s)
- members of building project organisation
- hospital managers

The crucial role of the "FM user-representative", who is rarely involved, was highlighted. It was suggested that in the future, this role should fulfil the following requirements:

- Systematically represent the needs and requirements of non-medical support services in the planning and design phases of construction
- Be someone who has a feeling for the context through experience and understands what FM information is needed in what phase of the construction project
- Possess the ability to see the interfaces between operations and hospital construction strategy.

Importance of communication

As a general aspect within the whole process, the need for effective communication among various stakeholders internally and externally was brought up repeatedly. Effective communication including discussions, addressing issues and making critical decisions to stay in course of the plan seems crucial in every phase of a construction project. Those interviewed, highlighted the importance of communication between all the stakeholders involved in the construction project and they emphasized the need for communication between interdisciplinary units. In terms of FM in HC, the urgent need for a more holistic understanding of the entire hospital workflows involving different business units was stressed.

Conclusions

The claim that non-medical services are not well integrated into the planning and design phases of HC facilities construction projects was affirmed also in the Swiss healthcare context through the input given by the experts interviewed. Applying the simple questioning framework of 5W1H, numerous indications could be determined as to why this seems to be the case and what the possible measures to be undertaken in order to overcome this in the future could be. The most important and valuable measures were:

- the definition and establishment of the role of a qualified construction-accompanying FM in HC, who shall be regarded as a user representative of the whole discipline
- the development of a specific HC construction project stakeholder management and communication concept including FM in HC
- further training and advancement of current FM business competencies in HC roles

Definition and establishment of the role of a qualified construction-accompanying FM in HC user representative of the whole discipline

The role of a qualified construction-accompanying FM in HC user representative should be defined by consulting different stakeholders involved in HC facility constructions. Consulting a wide variety of stakeholders could not only ensure that the role would be defined in a holistic, suitable and practicable manner, but could also mean that collaboration during the definition process would enhance the acceptance of the new role. As a basis, the SIA113 which was developed in co-operation of 26 project partners as a practical guide to include FM into constructional planning phases ([62], [23]) could be used as a conceptual framework, however developing it more in depth with reference to the HC context. The benefit of such a new role that is able to identify (e. g. more efficient processes in the operational business phase, better life cycle costing, more use of synergies) should be clearly stated and promoted from the beginning. The definition of the role should also include the ideal profile of a person taking over this role (e. g. experience and understanding of FM in HC overall, know-how of healthcare organisation management and HC service provision). Figure 2 illustrates the conclusion that the qualified construction-accompanying FM in HC user representative should cover the whole areas of nonmedical support services in hospitals presented in detail in Figure 1, which is schematised in yellow in Figure 2. Facility Management should systematically be involved in the "Lifecycle Management" according to SIA 113 [23] from strategic planning all the way to the building management.

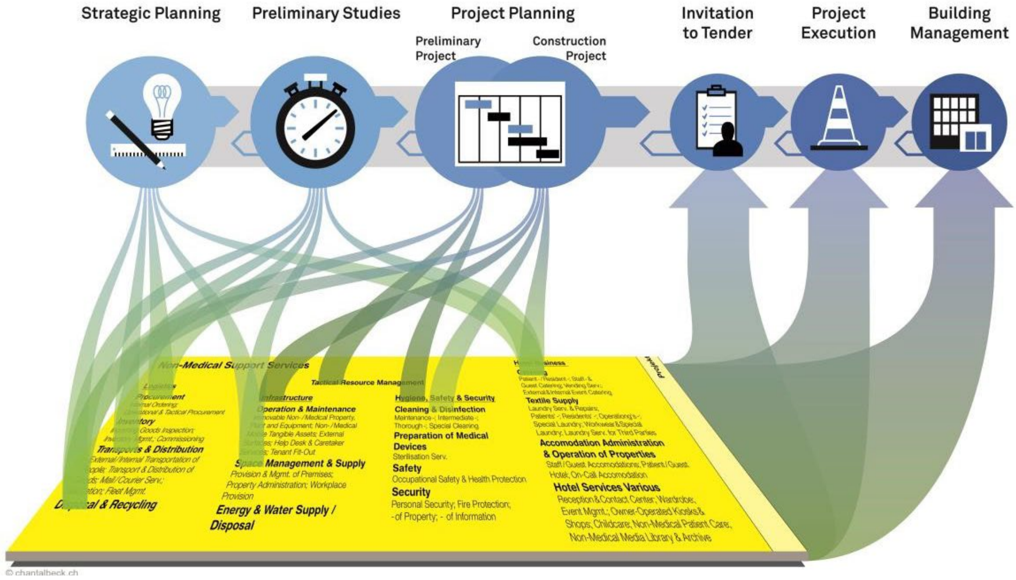

Figure 2. Context of qualified construction-accompanying FM in HC user representative of the whole discipline, suggested to be involved throughout the Lifecycle Management according to SIA 113 [23]

Development of a specific HC construction project stakeholder management and communication concept including FM in HC

Based on existing (multi-)stakeholder management and communication concepts, a specific framework should be developed which provides the context-specific information for HC construction projects, including all the important stakeholders including FM in HC. It should also take into account the specific situation of a hospital which provides services 24 hours a day, 365 days a year with the corresponding implications of staff availability and the thus necessary communication channels.

Further training and advancement of current FM business competencies in HC roles

Looking at the different inhibitors for the non-inclusion of FM in HC in an early stage of construction stated in the Results section, specific further training for people working for FM in HC should be offered in order to initiate a change of mind-set within the discipline and the entire HC sector. Particular aspects to be trained should, among other things, involve:

- overall holistic understanding of the HC business and role of FM in HC within the service delivery
- innovative thinking, future trends
- awareness of interfaces and potential synergies between operational and strategic levels voicing of opinions
- project management knowhow
- ways of co-ordination, collaboration and interactions across disciplines and with internal and external consultant
- dealing with change management

Critical reflection, limitations, outlook

The research presented can be seen as a starting point for further developments. The small sample size, as well as the limited perspectives involved in this explorative research, cannot be seen as generalisable result. However, tendencies and crucial points could be determined, giving clear indication on where and how to proceed. In a next research iteration, the following aspects should be further investigated and developed individually:

the role of a qualified construction-accompanying FM in HC user representative of the whole discipline the development of a specific HC construction project stakeholder management and communication concept including FM in HC programs for further training and advancement of current FM in HC roles

It seems important that all the HC facilities construction stakeholders identified are consulted and involved in the development process. Once the frameworks are developed, their application in practice should be investigated by researchers, validating the results, and eventually providing evidence-based guidance on adapting the frameworks in a systematic manner wherever necessary.

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FUTURE-PROOFING IN HEALTHCARE BUILDING DESIGN

Saga Karlsson (1, 2)*, **Göran Lindahl** (1, 2), **Marie Strid** (1, 2)

(1) Division of Building Design, Department of Architecture and Civil Engineering, Chalmers University of Technology, Sweden

(2) Centre for Healthcare Architecture (CVA), Chalmers University of Technology

* Corresponding author e-mail: saga@chalmers.se

Abstract

Objective - The objective of the study is to explore how future-proofing (FP) in healthcare building design is approached by Swedish architects.

Background - Buildings are changing due to physical, economical, functional, technological, social and legal drivers. These changing circumstances results in new requirements on the buildings and drive change in healthcare building design projects. This results in a need to consider future-proofing (FP) approaches to manage this situation. Previous research on FP approaches has mostly focused on the importance of FP as such. There has been little attention on how the architectural practice actually worked with healthcare buildings related to FP, or their interpretations of related concepts to FP, such as flexibility.

Research question - How do Swedish architects approach and address FP and what design strategies have they applied in healthcare projects?

Methods - The paper is an explorative, qualitative, multi-case study of planned and/or built Swedish healthcare buildings. Data has been collected from presentations of healthcare building design projects encompassing FP approaches and through semi-structured interviews with architects designing healthcare buildings. The interviews were transcribed and analysed through content analysis focussing on the architects view and interpretation of FP in their projects.

Results - Sixteen different types of building design strategies addressing future changes were identified in the projects that were studied. The differences in the design strategies related to dissimilar contexts, budgets, stakeholders and design processes.

Conclusion - The view among the architects, that were included in the study, on FP approaches is found to be based on a narrow scope and include a vague terminology. While it is difficult, even impossible, to predict all future changes in a healthcare building design project, there is a need to develop design strategies that can address FP. However, and herein lies the challenge, an FP approach needs to be broad enough to allow for variations and defined enough to be justifiable from a project cost and delivery perspective as well as enabling a design supporting the healthcare activities.

Keywords: *flexibility* | *generality* | *elasticity* | *healthcare building* | *architecture*

Introduction

Future-proofing (FP) is a relatively new concept in design of hospitals. It encompasses such approaches as flexibility, generality, but also claims to be a somewhat more overarching approach. To address this, and which strategies Swedish architects use in health care building design, a study project was designed. This paper presents results from this project.

Buildings are affected by changes related to physical, economical, functional, technological, social and legal drivers [1]. Healthcare buildings in particular are exposed to changes, such as development of medical technology, delivery models of care, changing conditions for healthcare finance as well as organizing of the healthcare system and disease developments. Coupled with long planning processes of up to 10-20 years [7], it is also a challenge for healthcare buildings to be up-to-date in every aspect, even at the inauguration [4].

Whereas historical changes can be traced back in time, future developments are almost entirely unknown. By designing with the future in mind, design strategies encompassing FP approaches could reduce new construction, reactivate underused or vacant buildings and ease refurbishment processes (demount or replace components) [1].

It is argued that participants in design processes should address FP, or concepts related to FP, in longer and more complex design and construction projects [2, 3]. However, as identified in research, there is a vague FP terminology amongst stakeholders in design and construction processes in general [1, 5]. Furthermore, while closely related concepts to FP such as flexibility are commonly used in the design processes, they are rarely interpreted in the same way by the people involved in the projects [1, 6, 7]. This may cause unclear goals early in the design process and as a result; give rise to misunderstandings between the participants.

Studies of how participants in design and construction processes address, understand and use FP in Sweden has not been found. Nor has any studies been found covering FP of healthcare buildings in Sweden. As a consequence, this paper aims to shed light on FP approaches and how they can contribute to building design processes in a Swedish context. The study focus on a key actor in the design process, the architect, to study what strategies are used to address FP.

Background

Effects of FP approaches on buildings will vary depending on different priorities and focus during the design process [1]. As healthcare buildings vary depending on function, size and form they all require different design strategies. The challenge then in the design process is to have a clear approach to FP as well as a common understanding of how to deal with FP in the design team.

Few studies in healthcare care literature have analysed commonly used concepts and definitions to FP [6]. In those cases, when related concepts to FP – such as flexibility - has been studied, the definitions of concepts often varies. For instance in recent peer-reviewed healthcare design literature, flexibility is used as an umbrella-term defined as adaptability, convertibility and expandability [5, 6]. Adding research from the building research discourse, show that flexibility has also been used as equal to adaptability [1]. Additionally, flexibility has been used more generally as an umbrella-term including terms like; multifunctional, intelligent and universal. [8]

In Swedish architectural practice, there have been attempts in documents to define concepts linked to FP. An often-applied document is the *Locum Concept Program for Healthcare Buildings* published by Stockholm Region real estate organization, Locum [9]. Their concept program is commonly used by consultants, clients and users in design processes of new healthcare buildings. It focusses on open-building strategies (core/shell-building). Whereas generality and flexibility are described as follows:

Flexibility – *Possibility of adjustment in construction over time when new circumstances occur.*

Generality – *Possibility to be used diversely without changing construction when new circumstances occur.*

A recent published report by the organization of Swedish municipalities and counties; SKL, on FP is *Fully flexible – flexibility and generality in healthcare buildings* [10]. This report aims to provide a knowledge overview for those working with healthcare buildings in Sweden. The report includes four core concepts; flexibility, generality, elasticity and redundancy. Flexibility and generality are described as above, while elasticity and redundancy are described as:

Elasticity – *Possibility for buildings to meet organizational changes.*

Redundancy – *Double functions or overcapacity in building systems stabilizing service functioning and diminishing the risk for shut downs.*

Based upon the above findings, a study was prepared that took its outset in the descriptions above. Focus was on which FP design strategies were used by architects and how they related to the terms *flexibility, generality, elasticity* and *redundancy.*

Method

This paper explores the current situation of how Swedish architects designing healthcare buildings approach FP in relation to terms used in existing Swedish documents. This paper does not intend to evaluate design strategies focusing on uncertainty, nor asses certain design strategies over others for policy-making.

In this study architects have been asked to present and discuss FP in relation to the healthcare projects they worked with. Architects interpretations of closely related concepts to FP have been analysed. Moreover, design strategies linked to FP have been mapped and categorized according to the terms flexibility, generality, elasticity and redundancy.

The paper is based on an explorative, qualitative, multi-case study of architects descriptions of intentions related to FP in planned or built Swedish healthcare buildings (n=7). Data has been collected from 1) presentations (n=6) on FP building design and 2) semi-structured interviews (n=6) with architects designing FP in healthcare buildings.

Sample and setting

At the start of the project, five architectural offices that are regularly engaged in healthcare building design were asked to provide examples of what they considered to be the most relevant project considering flexibility and generality. Two architecture firms decided to present two projects each instead of one. In total, seven healthcare projects from different cities were presented:

Table 1. Healthcare projects discussed in this study

Project	Building type	Type of project	Sqm	Building phase during presentation date 150908
A	University hospital	Reconstruction and extension of existing healthcare building within existing hospital area.	25 650	Consecrated
B	Regional hospital building	New healthcare building within existing hospital area.	47 000	Under construction
C	Nearby hospital	New healthcare building in a new hospital area.	18 500	Under construction
D	Regional hospital building	Reconstruction and extension of existing healthcare building within existing hospital area.	30 000	Under construction
E	Psychiatric building	New healthcare building within existing hospital area.	33 000	Consecrated
F	University hospital	New healthcare building in a new hospital area.	300 000	Under construction
G	Regional hospital building	New healthcare building within existing hospital area.	20 000	Under construction

In addition to choosing and describing the projects, they were also presented at a conference, a thematic day on ‘Flexibility and generality in healthcare buildings’ organized by the Centre for Healthcare Architecture at Chalmers. This was done in September 2015.

Two years later the presenters were asked to participate in a semi-structured interview with questions focusing on FP approaches. This interview aimed at follow up on statements done during the presentations. In two cases the architect did not have the possibility to participate, in those two cases a second architect from the same architecture firm, working with the same healthcare project, did participate in the interview. It was considered a benefit that some time had passed between the first and second time. This enabled on the one hand the projects to be more completed and on the other hand that the architects could have experiences and reflections concerning the projects. In total eight architects participated in the study:

Table 2. Architects who participated in this study

	The architects role in the healthcare project	Date of presentation	Date of respondent in interview	Healthcare project
Architect 1	Senior project manager	150908	180212	A, B
Architect 2	Senior project manager	150908	170929	B
Architect 3	Project manager	150908	-	C, D
Architect 4	Senior project manager	-	180116	C, D
Architect 5	Project manager	150908	-	E, F
Architect 6	Responsible architect	-	171010	E, F
Architect 7	Facility planner (architect)	150908	171009	G
Architect 8	Responsible architect	150908	171009	G

Data collection

Data has been collected from presentations (n=6) addressing FP building design and semi-structured interviews (n=6) with architects utilizing FP approaches in healthcare buildings. The data collected from presentations and interviews focused on the narrative of the seven healthcare building projects. The character of a narrative can be described as *“how everything started”, “how things developed”*, and *“how things ended up”*[11].

Data analysis

The recorded presentations and interviews were transcribed, and collected in one table. The transcriptions have been analysed through content analysis [12]. First the data was categorizing and test coded in relation to the framework used in Swedish practice; flexibility, generality, expandability and redundancy. After the test coding an evaluation was done, modifying sub categories for the coding structure. See below:

Table 3. Categories and subcategories used in coding

CATEGORIES (First coding)	SUB CATEGORIES (Second coding)
Flexibility	New openings in slabs Demountable walls
Generality	Facade pattern Floor heights Module grid Position of shafts Load bearing capacity General plan solutions General rooms Oversized shaft Flows/logistics and layout design
Elasticity	Building modules Building volume which can be expanded Building volume which can be divided Ward unit which can increase or decrease
Redundancy	Installations

Results

During presentations and interviews, when Swedish architects talked about how buildings should meet future circumstances, they repeatedly came back to two concepts: generality and flexibility. *The notions of generality and flexibility seemed hard to grasp for the architects in the study. Definitions of the concepts were either metaphorical or incomplete, for instance "Generality is like a box one can use for many purposes, you can either keep it to store things or use it as a table. Flexibility is when one has decided to use it as a box, but now one has the possibility to store different things in the box.".* Generality and flexibility were also described as *"…generality is the possibility to use the space without changing too much and flexibility is…eh…? I have it in my documents somewhere…".* The last quote shows a mixed use of both concepts; generality is defined as flexibility as it is described in Swedish literature; and despite the common use of flexibility the concept still lacks a clarity and definition.

The concept of elasticity was only used in one of the presentations and in one interview (same healthcare project). In this case, the architect described elasticity as *"…is about adding".* The concept of redundancy was not found to be used by the architects in the study at all.

The term FP was not used by any of the architects in their presentations. Later, during the interviews when FP was added in the questions, most of the interviewed architects were not sure how to interpret FP. One architect said *"…for me future-proofing is something more [than elasticity, flexibility, generality]. I would like to add the connection to the users of the building. I have experienced that users of the healthcare buildings have not fully understood their new building. I believe doing a user manual can be one way to FP."*

Even if the architects used concepts related to FP in different ways, many of the architects still claimed the importance of a common understanding of FP between all participants in a healthcare project. Furthermore, several architects in the study witnessed and noted, as result of unclear definitions and goals of FP in healthcare building projects, too high ambitions of FP early in the projects in relation to budgets. One of the architects stressed that unclear definitions in pre-studies generates high ambitions, or even demands, that could lock-in for a long time in the design process in unwanted, too costly, design strategies. In some situations, this could have consequences such as expanding time schedules due to retakes, or result in keeping certain characteristics of the building even if FP design strategies no longer are wanted.

In addition to the focus on understanding the concept and use of FP among architects, the aim of the study was also to identify how architects have worked with FP in their healthcare projects. From the text data analysed in this study, 16 different design strategies were identified. The design strategies were then sorted under the four categories identified from Swedish practice oriented literature; flexibility, generality, elasticity and redundancy. How the different design strategies are related to categories and the seven healthcare projects, is presented in the table below. Design strategies are marked as either discussed and implemented in the healthcare project, discussed but not implemented in the healthcare project or not discussed (during presentation or interviews). Additionally, the differences in the design strategies were shown to relate to dissimilar contexts, budgets, stakeholders and design processes.

Table 4. Identified design strategies for FP in presentations and interviews regarding 7 Swedish projects.

Categories and definitions found in Swedish literature describing how buildings can be prepared to meet future circumstances	**Design strategies for FP architects discussed in presentations and interviews**	**Healthcare building (A-G)**						
		A	**B**	**C**	**D**	**E**	**F**	**G**
Flexibility *"Possibility of adjustment in construction over time when new circumstances occur."*	New openings in slabs	-	-	-	-	**X**	-	-
	Demountable walls	**X**	**X**	-	**X**	**X**	-	**X**
Generality *"Possibility to be used diversely without changing construction when new circumstances occur."*	Façade pattern	-	-	-	**X**	**X**	**X**	**X**
	Floor heights	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	Module grid	**o**	**X**	**X**	**X**	**X**	**X**	**X**
	Position of shafts	-	**X**	**X**	**X**	**X**	**X**	-
	Load bearing capacity	-	-	**X**	-	**X**	**X**	-
	General plan solutions	**X**	**X**	**X**	**X**	**X**	-	**X**
	General rooms	**X**	-	**X**	-	**X**	-	-
	Oversized shaft	-	-	-	**X**	-	**X**	-
	Flows/logistics and layout design	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Elasticity *"Possibility for buildings to meet organizational changes."*	Building modules	-	-	-	-	-	-	**o**
	Building volume can be expanded	**o**	**o**	**X**	**X**	**o**	**o**	**o**
	Building volume can be divided	**X**	-	-	-	-	**X**	-
	Ward unit can increase or decrease	-	-	**X**	-	**X**	**X**	-
Redundancy *"Double functions or overcapacity in buildings systems stabilizing service functioning and diminishing the risk for shut downs."*	Installations	**X**	-	-	-	-	**X**	-

(-) *Not discussed by the architects in the presentations/interviews, (X) Discussed by the architects in the presentations/interviews and implemented in the project, (o) Discussed by the architect in the presentation/interviews, but not implemented in the project.*

Table 4, *Identified design strategies for FP in presentations and interviews regarding 7 Swedish healthcare projects,* shows that three of the design strategies (module grid, floor heights and flows/logistics and layout design) were discussed in all the seven healthcare projects. The purpose of a module grid was to ease future rearrangement of rooms. The size of a module grid varied between projects and in some cases between functions, such as in-patient wards (low-tech) and Intensive Care Units (high-tech). Floor heights was described as facilitating future addition of building systems. Both higher floor height and module grid have in common that it eases changes during the design process as well as changes of the building after inauguration. The idea of flows/logistics and layout design were described differently by the architects in the study. Some architects talked about double escape corridors in case of emergency, one discussed flow as a possibility to reach patient rooms directly from exterior corridors to decrease the risk of contamination and one added open-ended corridor as a possibility for future flow to work when expanding the building.

General plan solutions and position of technical shafts were other commonly used design strategies. Identically designed floorplans that could accommodate both in-patient and out-patient wards is one example of a general plan solution. The position of technical installations and vertical communications was described as highly relevant for FP. Placing vertical ducts close to staircases and elevators created *"free areas"* and higher freedom in case of change in the layout.

The possibility to expand the building volume was discussed by all architects in the study, on the other hand expansion of building volume was only implemented in two of the seven projects. Narrow sites (vertical expansions) and costly construction/advanced installations (horizontal expansions) was in five of the cases reasons to not expand. In the two projects who applied the possibility for the building to be added, the main reason was unclear programming during design process. Decision makers were not sure about the future catchment-area or future use within the building.

Only one architect discussed 3D building modules. The project, which was referred to, was initially planned as a temporary building. During the entire design process the client had asked for a building that could be disassembled and that a 3D module was therefore preferred. Both the buildings module grid and floor heights were a result from how big the 3D elements could be, considering it had to be transported on roads. But later, during procurement, the clients decided to go for the best price, and the company with best price was not delivering 3D modules but prefabricated concrete walls. At this stage the drawings were not redeveloped and many of the measurements were results of the maximum dimensions of the 3D modules. The architect described it as*: "If we would have had the possibility to change the design after the decision to not build it with modules, then we would have had a totally different project today. On the other hand, we wouldn't have been able to design the project during such short notice. Since we were limited by the modules the project goal was very clear."* Consequently, she argued, that in one way the project became much more flexible with concrete walls in the façade, since this allowed a pillar structure with plaster walls. *"Additionally, we would have lost the flexibility in the next step if we would have built modules, we would have much more difficulties to change, like adding doors within walls or move inner walls."*

Discussion

In the study presented, we have studied concepts related to design strategies focusing on how a building could meet future circumstances. As an umbrella term to those concepts, we have used the concept of FP. However, the architects in the study were either unfamiliar with FP or questioned the concept by thinking it should be used in a broader context. While it is difficult, even impossible, to predict all future changes in a healthcare building design project, there is a need to identify design strategies that approach the challenge of FP. Just as the architects in the study, we argue that FP should be considered in a much wider scope in comparison to what Swedish praxis has published until today. However, and herein lies the challenge, if an FP approach is to be developed, it needs to be both broad enough to include variations and narrow enough to be justifiable from a project cost and delivery perspective at the same time, as it creates a design that supports healthcare activities.

Results of this study show that different building design related concepts published up until today in Swedish practice, such as generality, flexibility, elasticity and redundancy, are too broadly and vaguely used amongst architects to be useful in a communication between actors in design processes. But on the contrary, even when the vocabulary is unprecise and vague, this study shows that actual design strategies aimed to meet future circumstances are many, with different focuses and precise definitions on project basis.

We ask ourselves, could a broader framework have given other results concerning how FP was interpreted? A possible interpretation of a broader framework is that architects use design strategies that they do not think of as being approaches for FP. Maybe, a broader and more open framework based on a clear definition of FP, a framework that includes other categories than flexibility, generality, elasticity and redundancy, can enable other results and insights.

Conclusion

The representatives from the architectural practices in this study had no clear view on FP and what it could include, nor was it evident that there was a common understanding of everyday terms like flexibility. However, compared to the research-based literature, the architects had an understanding closer to the practice-based literature where fewer terms are used, e.g., flexibility encompasses also terms like adaptability and convertibility, which in the research based literature represented clearly different aspects.

To sum up, as straightforward as the area of changes of built environment may seem, it does become quite complex when FP approaches shall be defined in relation to effectiveness and efficiency as there is a lack of such studies. There is a need to further study FP approaches for enabling them to become a practical basis for discussing options and testing design solutions.

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SMART HOSPITAL CONCEPTUALISATIONS BY EXPERTS IN TEAMS

Johan van der Zwart *

NTNU Norwegian University of Science and Technology, Norway

* Corresponding author e-mail: johan@van-der-zwart.eu

Abstract

Objective – The concept of Smart hospitals looks to future hospitals as infrastructures for effective and efficient clinical processes as well as infrastructures for supportive social interactions between patients and health professionals with the objective to design places that increase health service quality, productivity and patient's positive experience. This requires teams of experts that bring in knowledge from different disciplines like medicine and healthcare sciences, Information and Communication Technology, Social Sciences and Architecture.

Background - One of the biggest challenges in healthcare is the rising demand for services, while there is a decrease in workforce due to an aging society. Given the current budget constraints, healthcare systems are therefore under pressure to provide cost effectively high-quality services which requires fundamental reforms. When healthcare process data becomes more detailed and accurate, leveraging the concept of smart hospitals could contribute to better use of healthcare resources, including the hospital buildings.

Research question - What is a smart hospital? How can various disciplines contribute to smart hospitals? How will healthcare processes change by applying smart technologies?

Methodology – 5 interdisciplinary student groups of in total 28 students (12 medicine, 5 economy, 5 social sciences and 6 Technology) explored the concepts for future Smart Hospitals during a 4-week intensive course in Experts in Team. The projects included 3 phases: (1) conceptualisation; (2) writing an article based on literature research and; (3) integrating the findings in a proposal for a product.

Results - The 5 projects reflect the students' research on the application of smart technologies in future hospitals, ranging from: (1) the use of drones for acute healthcare: (2) application of artificial intelligence for improving diagnosis; (3) use of Building Information Models to optimise use of healthcare resources; (4) reducing hospital acquired infections by tracking flow of objects and people and; (5) home delivery of diagnostic services to reduce number of patients in the hospital.

Conclusion - The link between healthcare services and the physical environment has the potential to be re-invented through digitalisation and analytics of hospital process data leading to predictability and reduction of variation to support decision making. This requires cross-cutting solutions from healthcare management, logistic management and facility management in combination with ICT and social sciences.

Keywords: *smart hospital | Enterprise Building Information Model | Experts in Team| architecture research | education*

One of the biggest challenges in healthcare is the rising demand for services with meanwhile a decrease in workforce due to an aging society. As a consequence, healthcare systems face many challenges to produce the same quality of healthcare services in the future within a challenging labour market [1]. In Norway for example, the proportion of the population aged over 70 increases from 12% in 2018 to 21% by 2060 [2]. This increasing proportion of elderly patients will lead to an increased demand on hospital services. According to the Norwegian Ministry of Health and Care Services, spersons over the age of 70 use twice as many healthcare services than people in their 40's. Compered to today, estimations show that in Norway there is a need for an additional 25% full-time healthcare employments in 2035. Currently, approximately 11% of the working population in Norway works in the healthcare sector, based on the statistics, this percentage increases to more than 30% in 2060 [3].

Given the current budget constraints, health systems are under pressure to provide cost effectively high-quality healthcare which requires fundamental reforms in healthcare services [4]. New innovations and treatment options increase the expectations of the performance of hospital services [5]. At the same time, it is assumed that technological solutions can help to increase effectivity and efficiency of healthcare systems. When healthcare process data becomes more detailed and accurate, leveraging the concept of smart hospitals could contribute to better use of healthcare resources, including the hospital environment.

Next-generation smart hospital technology has the potential to redefine healthcare services. Smart hospitals are conceptualized as infrastructures for effective and efficient clinical processes that support social interactions between patients and health professionals. The main objective of future smart hospitals is to design places that increase health service quality, productivity and patient's positive experience. Realization of this concept requires teams of experts that bring in knowledge from different disciplines including medicine and healthcare sciences, Information and Communication Technology, Social Sciences and Architecture. Increased knowledge on Smart Hospitals, applied to how hospital buildings support or impede optimal delivery of healthcare services, assumes a great societal impact on the quality of healthcare outcomes as it contributes to efficient working conditions.

Therefore, the research question of this paper is threefold:

- What is a smart hospital?
- How can various disciplines contribute to smart hospital design?
- How will healthcare processes change by applying smart systems?

One of the innovations that are tested in this context, is the use of Building Information Models (BIM) for operational purposes during the operational phase of hospital buildings Smart management and organisation of healthcare services can benefit from applying EBIM and ICT technology to better understand and manage patient-professional interactions, healthcare processes and the physical setting in which all this takes place. Now indoor track and trace of equipment becomes possible on a large scale due to IoT technologies; the time is ready for a breakthrough in the development and utilization of analytical, simulation and design tools for the efficient operation of hospitals, in which 'monitoring' healthcare services is vital for management and planning to filter out workflows that are at face value efficient but are too demanding on personnel.

Core to this approach is the development of knowledge about, and innovation of, an Enterprise Building Information Model (EBIM) for hospitals that connects patients' treatment processes to healthcare professionals' working processes related to the physical built environment [6]. EBIM uses a virtual representation of the built environment (BIM) for the organisation and optimisation of facility management and healthcare management processes. So far, many architectural offices and construction companies have used Building Information Models (BIM) for design and construction phases of the buildings' lifespan. EBIM on the other hand looks how these models can be adapted to optimise healthcare delivery for the purpose of economic and effective use of resources during the occupancy phase of the buildings' lifespan, i.e., the time that the hospital buildings are used for actual patient care. The use of EBIM makes it for example possible to measure the use of equipment in the hospital, how professionals currently are using the available spaces and how this can be improved in the future based on big-data analytics.

Experts in Team

During an intensive course of four weeks in January 2019, five interdisciplinary student groups of in total 28 students (12 medicine, 5 economy, 5 social sciences and 6 Technology) explored different technologically innovative concepts for future Smart Hospitals.

Experts in Teamwork (EiT) is a compulsory master's degree course for all students at the NTNU Norwegian University of Science and Technology in which students carry out a project and meanwhile develop interdisciplinary teamwork skills by reflecting on and learning from specific cooperative situations. Students work in teams with participants from diverse disciplines on relevant societal and scientific problem areas. In these interdisciplinary teams, the students get an opportunity to sharpen their skills on major real-life challenges facing society. Each member of the team contributes his or her own academic competence. The aim is that students will take advantage of the interdisciplinary skills in their team to find solutions for a specific project. The results achieved by the teams are often used to benefit internal and external partners (https://www.ntnu.edu/eit).

The projects included three steps: (1) conceptualisation; (2) writing an article based on literature research, and (3) integrating the findings in a proposal for a product.

Conceptualisation of smart hospitals was the first step for the students in this project. This started with one day of developing individually ideas and brainstorming in couples and groups. After this the teams were created, and the team were free to choose their own focus area within the given topic.

Conceptualisation has many different meanings, within this project it is used in the connotation of the act of creating something by thinking, i.e., ideas or actions intended to deal with a problem or situation by the formulation of plans and important details. As such, conceptualisation is used in this research to describe an elaborated concept coming from an abstract or general idea derived from specific instances. This is similar to the use of concepts in architectural design, which can be linked to the ideas about design thinking.

The second step in this project consisted of writing an article based on a literature search within the involved disciplines. In this step, the teams elaborated the initial concept.

In the third step of this project, the students were challenged to find a way of presenting their research in a proposal for a product that contributes to future smart hospital environments. The five projects reflect the students' research on the application of smart systems in future hospitals, ranging from: (1) Drones to support acute healthcare: (2) Artificial Intelligence to improve diagnosis; (3) Building Information Models to optimise use of healthcare resources; (4) Tracking flow of objects and people to reduce hospital acquired infections, and (5) home delivery of diagnostic services to reduce number of patients in the hospital.

Below, the five EiT projects on the conceptualisation of Smart Hospitals for the future are summarised following the three steps

Research results: Five conceptualisations of Smart Hospitals

1. eDrones for better patient flow in acute situations

A. Lilleeidet Røyland, I.A. Legran, N. Aanderaa, N. Molnes Hol, P.A. Nordlund, Ås. Heir

Concept – the application of drones as tool for improving patient flow in acute healthcare. As concrete example, this project focussed on the situations of opium overdoses and heart failure in Trondheim. The emergency drone (eDrone) reduces the time that patients can receive the antidote in case of an overdoses or a defibrillator in case of heart failure, and as such reducing complications.

Research – Besides literature and calculations of response time and spread around Trondheim, the project group interviewed personnel from the Emergency call centre. Although automated drones might be a future possibility, the use of eDrones would require drone-pilots at the emergency call centre to fly and navigate the drones. Especially in remote areas in Norway, drones might be a good addition to the ambulances, helicopters and boats that cover currently the area. A previous study shows the benefits of using drones for transporting defibrillators to people with heart failure, which could reduce reaction time and as such complications afterwards [7]. Given the condition of the patients, the emergency department regarded this a more realistic scenario compared to situations of opium overdoses.

Product – In this project, an interactive simulation model calculates response times by drone and ambulance for the Trondheim area for the two situations of overdoses and heart failure. Further research is recommended in the development of drone technology, patient safety, economic consequences and organisation. Crucial question should be how to get acute care the fastest way to the specific place. In addition, the drones could give people instructions how to handle until the ambulance personnel arrives. This requires cameras and communication possibilities, in addition to equipment such as for example ECG to give ambulances information ahead for arrival. The drones can also help with localisation of patients and routing for ambulances.

2. Artificial Intelligence in healthcare

E.C. Gudding, E. Hjort Mathiassen, C.H. Svedsen, J. Bjaarstad Nikolaisen, K. Erlendsdotter Urke, M. Galta

Concept – The application of Artificial Intelligence (AI) as support-tool for medical specialists to reduce over-diagnostics and prevent unnecessary diagnostic test due to better access to latest literature on evidence-based medicine. Research – This project reviews literature on Artificial Intelligence in the context of healthcare diagnostics. Alan Turing describes AI as the science and technology to create intelligent machines, especially intelligent data programs [8]. Simply explained, AI applies computers to do intelligent assignments that normally are done by humans, like planning, analysing, communication and interpretation of pictures. Deep learning based on Artificial neural networks is often used as AI technology in healthcare [9]. The biggest benefit of deep learning is the possibility of AI to understand and manipulate large amounts of data. The developments of AI in healthcare are progressing fast and current results show that, for example in the case of screening for diabetes retinopathy, AI performs better on determining whether or not a patient needs treatment based on an Iris-scan, compared to traditional screening by medical specialists. Another application area for AI is efficient use of time of healthcare professionals. Studies estimate that nurses lose 10% of their time due to inefficiencies in the physical infrastructure [10]. Based on analyses, efficiency of medical specialist could increase with 17% and nurses with 51% by using AI in their working processes [11].

Product – This EiT project proposes a support tool that gives medical specialists the possibility to orally discuss their diagnosis with an AI digital assistant, which can answer questions, connect information and knowledge from literature to the specific patient's health record and advice on possible diagnosis or treatments. The final decision is up to the medical specialist, however, based on better and more accurate information.

3. AI-BIM - optimisation of resource distribution between departments in a hospital

J.F. Korneliussen, R.X. Hagen, S. Knutsen, M.c. Løver Thu and M. Kristinesdatter Bolstad

Concept – Application of Artificial Intelligence in combination with Building Information Model (BIM) of the build environment to optimise the distribution of resources within the hospital. Hospitals face large challenges related to allocation of physical equipment between departments, which results in lack of required equipment, or opposite, place consuming congestion of unused resources.

Research – Connecting smart sensor technology, AI, informatics and telecommunication to BIM builds the platform to analyse and estimate the use of resources within a hospital building. Within a hospital, there is a lot of data available, however the big challenge is to change this data into information, information into knowledge and knowledge into wisdom [12]. St Olav Hospital applies an Enterprise Building Information Model (EBIM), which is an extension of existing BIM models with a focus on a digital integration of building related information and healthcare processes during the entire lifespan of the building. The EBIM model of St Olav Hospital includes buildings and transportable equipment. The system is based on Wi-Fi and communicates by sensors attached to the equipment.

Implementation of BIM is time-consuming and costly. However, the visualisations of information connected to the model server makes the development of integrated individual applications possible, which are now often supported by separate systems. Implementation of EBIM makes it possible to analyse where and when certain equipment is being used in the hospital. It can contribute to changing the architecture of patients' rooms or support management in decisions on infrastructural and process changes based on real-time data on hospital performance [13]. There is a broad consensus that the technological development of sensors, informatics and communication will make it possible to collect large amount of medical and context related data. Both timeliness as accuracy will increase. Observations of medical personnel shows that nurses use up to 30% of their time for searching for necessary equipment [14]. Tucker [10] observed different hospitals and concluded that it would be possible to deliver more patient oriented healthcare with less personnel if processes were organised differently. She refers to the automobile sector, where they estimate the amount of equipment that is needed each day in order to reduce time for searching for equipment. Product – This EiT project proposes a hospital AI-BIM and presents this concept by a case-study of one patient, which shows how AI in combination with BIM and patient records could predict the need for resources for one specific patient, based on patient journeys of previous patients with similar diagnosis, age and gender. Another application possibility is to use the same technology for allocation of resources on regional or national level. One of the main objectives of this proposal is to increase bed-side time of nurses, by reducing the time for searching after equipment. This could result in more attention for patients, shorter stay and an increase of the hospital's capacity to treat patients. Developments within AI would make it possible to better predict the needed resources per patient, based on previous similar cases. AI could define more efficient procedures based on big data analytics of existing processes and experiences.

4. HospiPal to reduce nosocomial infections in smart hospitals

E. Hernes Berre, N. Buer Haugen, T.C. Ottersen, S. Vatn, M. Høiberg ødegaard

Concept – Reduction of nosocomial (hospital acquired) infections by the use of a Building Information Model connected to a track-and-trace system for portable equipment and persons in the hospital.

Research – This research focusses on reduction of infections in a hospital in a post-antibiotic era by analysing flow of equipment in the hospital. It looks to different sources of infection, like equipment transported through the hospital, hand hygiene and infection control in case of an outbreak. The project shows how smart-BIM could contribute to the safety of patients a reduction of hospital infections. Already in 1945, Alexander Flemming warned about the potential risks related to over-use of antibiotics. Since 2013, we live in the post-antibiotic era, which implies that the antibiotics we have relied upon for decades, are not effective anymore [15]. Knowledge on flows of equipment and people within a building can contribute to improve procedures and compliance to the procedures of hand hygiene and cleaning of rooms and equipment, which could reduce the risk of antibiotic resistance [16]. Research shows that patients in a room that was used previously by infected patients, have 40% more risk of infections [17].

Product – This EiT project proposes a HospiPal system that includes a Building Information Model with a 3D virtual representation of the buildings, track and trace sensor technology, tagged equipment, a program that analyses the data, and interfaces that communicate the information to the users. The proposed application areas are a warning system for hand hygiene to help healthcare professional reminding to wash their hands; improving cleaning routines for portable medical equipment related to their actual use in infected areas, and isolating infections by mapping all rooms, equipment and persons that had been in contact with an infected patient.

HospiPal is presented by means of a board game which is similar to a combination of Monopoly and Trivial Pursuit, with questions that makes the players aware of the issues related to nosocomial infections and how the application of HospiPal could contribute to reducing risks.

5. EIR – an Automated Healthcare Mobile Diagnostic Unit

K. Bekkeheien, I. Aschehoug, I. Heimdal, S. Haugen, T. Torvik and L. Fønhus

Concept – Using existing technology on AI, automated cars and wearables as start point, Eir introduces a concept that transports simple hospital functions to the homes of patients. Supported by continuous monitoring of personal health data AI, patients receive diagnostic tests and treatment at home.

Research – This project gives an overview of existing technologies and integrates these into a vision of what becomes possible if these technologies were combined. In their description of smart hospitals, Frost and Sullivan [18] predict that in the future patients do not go to the hospital anymore, healthcare services will be brought close to the patients home and working environment, performed on a distance by the service provider. Research shows that already 46% of today's treatments in hospitals can be done at home [19]. Treatment at home has many positive effects, like increased patient satisfaction, reduced risk for infections, reducing costs and more effective use of existing capacity in the hospital buildings [19]. Within healthcare, new technologies become available on large scale that makes continuous monitoring of basic functions of the body possible, like for example blood pressure, pulse, infection- and inflammation parameters [20]. Implementation of AI makes it possible to automatically analyse these body functions data, more effective and precise then health professionals [21].

Product – This EiT project combines continuous monitoring of body functions with AI analytics to support automated and mobile hospital services. The mobile units can include different functions and services that can be done without healthcare personnel. Patients will be guided through their diagnostic process or treatment by voices, virtual persons on screens or holograms. Based on the requirements, different units can be created for different diagnostics and treatments. A basic supply of medicine will be available as well or could be delivered afterwards.

Reflections from the Experts in Teams

People are a social species with complex desires, among which personal human contact is one of the most important. Patients within a health system are often confronted with insecurity and worries about their health situation. One of the questions to keep in mind in the development of smart hospitals is how the use of new technologies have a positive impact on the interaction between patients and professionals, with mitigating the negative impact that these new technologies could have as well.

Collecting bigdata on healthcare processes within a hospital could have implications for personal health data, as even anonymised data could be sometimes retraced to individuals. How to deal with patient-data security is therefore a very important aspect of future smart technologies, which requires the development and utilisation of high-level data-security and encryption systems for a system in which secure storage and exchange of personal data is guaranteed and in which patients determine themselves the purposes for which their personal data can be used.

Each implementation of new concepts, innovations and organisational changes has to deal with the tendency that people resist and are sceptical towards alterations of their work processes. Therefore, it is important that both patients and healthcare professionals understand how the new developments improve both on individual level, as the quality of patient care on the level of the healthcare system.

Whether or not smart hospital technologies can be realised in the future, is also a economic question both on the level of individual patients and society. In addition, the pace of development of new technologies is also something to take into account. For example, it is difficult to predict when Artificial Intelligence will be at the level of real implementation for performing planning and other intelligent tasks. However, some researchers predict that this will be possible around 2050 [22].

Implementing new systems and technologies means that employees need to change their working day and introduce new routines. In complex organisation like hospitals, several reforms take place in parallel, and this is often burden on the employees. To avoid this, it is important to find the evidence of the positive consequences that smart technologies will have on individual level in an easy-to-understand and educational manner.

The notion that the introduction of smart technologies often requires large initial investments is obvious at the purely technological level, but also applies to larger expenses on the staffing, as highly educated employees at hospitals need time to learn to work with new technologies, instead of spending their time on what they specialized in. However, when there is evidence that implementation of smart technologies in the long run proves to be beneficial, this could motivate hospitals and releases additional funds for the initial phases.

In addition, systems using AI work initially less optimally than it will eventually. This is due to AI's nature, namely that it takes time before the system has acquired sufficient information and that it only can learns while it "works".

Another contemplation is that optimisation of efficiency and effectiveness in healthcare has two sides. One side is that increased efficiency could result in lower needs, and therefore less money could be allocated to the individual health organisations. This might have positive financial outcomes at a national level but will not benefit the hospital and the patient. As, for example, nurses do not need thirty percent of their working days to search for equipment, this does not necessarily mean that all this time will be spent on extra bed-side time. It may be that time is spent on other work tasks, or that a health service under financial pressure plans less nurses to patients. Therefore, it is important that when implementing smart technologies, it is important to focus on the importance of increased direct patient care.

Conclusions

Besides the exploration of relevant literature and technological developments, the combination of these Experts in Team projects on Smart Hospitals for the future show a diversity of conceptual application possibilities of smart technologies in future hospitals. The link between healthcare services and the physical environment has the potential to be re-invented through digitalisation and analytics of hospital process data to support hospital design and hospital management optimization.

The strength of the conceptualisations is their interdisciplinary character which directly results from the course setup which first and fare most stimulates the use of knowledge form different disciplines into one integrated project. All proposed concept and products come from existing technologies that are combined within a hospital setting. This requires however cross-cutting solutions from healthcare management, logistic and facility management in combination with ICT, architecture, and social sciences.

The combination of concepts sketches a broad spectrum of hospital services from acute treatment, diagnostics, effective and efficient use of resources, increasing safety by reducing infections in a post-antibiotic era and availability treatment and diagnostics at home. The use of AI to support better, safer, effective, efficient and more patient oriented healthcare seems to be a common factor in all projects. In connection to AI, the use of big-data and patient information to predict outcomes and resources seems to be an important aspect. In connection to the build environment, also the use of Building Information Models and the possibility of smart sensors to register events within a hospital building as source of information about equipment and processes can be perceived as new technology to make future hospitals smarter.

This study is first and fare most an exploration of future smart hospital concepts, which is also directly its most important limitation. The interdisciplinary approach resulted in many different perspectives and contemplations, which are, however, due to the short period of only four weeks not all fully developed. Nevertheless, the conceptualisation of smart hospitals resulted in different perspectives and ideas for application possibilities, which can be basis for further research and development. The conceptualisation of these ideas was an important step in understanding the broadness of smart hospitals and the variation of application possibilities. Although the teams had different ideas, some shared aspects can be recognised, such as the use of AI, the application of sensor technologies and the way this can optimise the effective and efficient use of healthcare resources.

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Architectural evaluation of healthcare facilities

EVALUATION OF DESIGN INTERVENTIONS FOR HOSPITALITY AND PRIVACY AT INPATIENT WARDS

Eijkelenboom AnneMarie (1)*, **Geke Blok**(2)

(1) EGM architects, The Netherlands

(2) Reinier de Graaf Hospital, The Netherlands

* Corresponding author e-mail: annemarie.eijkelenboom@egm.nl

Abstract

Objective – Inspired by the strong vision of the hospital organization on hospitality, a new hospital was built with the intention to provide an open environment which supports privacy and interaction between the occupants. This study evaluates the satisfaction of patients, visitors and nursing staff with shared and single bedrooms, regarding privacy and interaction with others.

Background – The hospital organization and the architecture firm, responsible for the design of the new hospital, initiated the study in order to receive high quality feedback on design interventions. The design intended to support both social and professional interaction while safeguarding sufficient privacy for the patients. Privacy of patients was evaluated as one of the aspects which may affect the experience of hospitality.

Research question – To what extent do layout aspects of single and shared bedrooms support privacy and social interaction of the patients, visitors and staff?

Methods – The study was an observational study comparing evaluations of three types of users of the hospital building: patients, visitors and nursing staff. A questionnaire was developed consisting questions about personal characteristics of the respondents, satisfaction with building and care related aspects and a number of statements that had to be rated on a 5-point scale. The study was approved by the Medical Ethical Test Committee of the hospital.

Results – 195 nurses, 154 patients and 150 visitors completed the questionnaire. Generally, all three groups were satisfied with the level of privacy and interaction, supported by layout aspects of the single and shared bedrooms; patients were most satisfied. Differences in the rating of importance of privacy related aspects were statistically significant between patients, visitors and staff.

Conclusion – The findings contribute to improvement of design interventions in future hospitals. Layout related aspects as well as organizational aspects contribute to improve satisfaction with privacy and interaction. Generally, staff was less satisfied than patients and visitors; more involvement of nurses in future design processes is most valuable.

1 Introduction

It is well known that the built environment affects comfort and satisfaction of occupants in hospitals (1-4). Therefore, it is relevant to take evaluations of previous design interventions into account during the programming and design phase. In order to receive high quality feedback on design interventions, which may affect comfort and satisfaction, it is necessary to perform objective measurements (5). The hospital organization and the architecture firm, responsible for the design of the new hospital, initiated this study in order to evaluate design interventions regarding the patients' privacy at inpatient wards. This study intends to provide information for future hospital design, as well as for the hospital organization.

According to Woogara (2001) ''privacy is vital for patient's physical, mental, emotional and spiritual wellbeing''(6). As patients experience many interactions with physicians, nurses and visitors, loss of privacy may affect their perception of hospitality (7). In designing the building, it was therefore important that patients and visitors would experience an open and hospitable environment with ample opportunity to interact as well as sufficient privacy. For the staff it was essential to be able to easily communicate with patients and to have sufficient space and privacy with the patient to provide the necessary care. Traditionally, privacy was seen as a personal process; this was challenged by Altman (8) who defined privacy as an intrinsically social process, involving people's interaction, their social world and environment. He argued that the desired privacy level changes with time according to environment. Information is scarce about the relationship between the spatial structure of hospital wards and patient preferences for privacy. In the literature, a number of design characteristics that may affect privacy in relation to the social environment are mentioned, such as noises, the possibility to talk without being overheard, to interact with others and to be seen or unseen (9,10). Privacy in this study is defined by two of the four aspects of patients' privacy in hospitals stated by Woogara (2001): first, ''the right to expect treatment with dignity during intimate care'', second ''the right to control one's personal space and territory" (6). Both aspects relate to the lay-out of the rooms and the perception of personal privacy. Due to differences in duration of stay, health status and performed activities, the perception and needs of patients may differ from those of visitors and staff (11). Few studies have been conducted with both patients, staff and visitors (12). Therefore, this study compared privacy and satisfaction with layout aspects of patients, visitors and staff at inpatient wards in a Dutch hospital.

2 Methodology

2.1 Study design

The observational study was conducted in February and March 2016 in a teaching hospital in The Netherlands.

The participants in the study were patients of nine different inpatient wards, their visitors and the nursing staff providing care to these patients. Excluded were patients and their visitors who did not speak or read Dutch. 195 Nurses, 154 patients and 150 visitors of the hospital participated in the study.

Instrument

For the study, a questionnaire was created based on previous questionnaires, such as the Pembury questionnaire for staff at inpatient wards (13), European OFFICAIR (14) and a pilot study in an academic hospital in the Netherlands. In addition, the wards were visited before and during occupancy. The project architect of the hospital provided information about the design of the building as well. The first and second author created the questionnaire in 2015. Five nursing students were involved and added a few questions.

The language of the questionnaire was Dutch, the national language of the hospital. A small pilot was conducted, before the study started.

The questionnaire consisted of different parts: satisfaction with environmental conditions (such as the location of the bathroom, or place around the bed to provide care), personal questions (such as gender, age) and questions about care (such as the importance to have a view on patients, while entering the bedroom). The participants had the opportunity to add remarks, suggestions or an explanation at the end of each part. Questions were formulated as neutral as possible, in order to avoid bias. The comparison of satisfaction with comfort, appearance, layout and control between staff, patients and visitors is presented in another paper (10). This paper focusses on privacy and satisfaction with single and shared bedrooms, related to the layout of the rooms.

Questions used for rating satisfaction or importance had a five-point rating scale (very unsatisfied, unsatisfied, neutral, satisfied, very satisfied, or, strongly disagree, disagree, neutral, agree, strongly agree). If participants considered the question unsuitable for their situation, they could choose 'not applicable'. Examples of questions are: 'To which extent are you satisfied with the available place for the visitor?' or, 'To which extent are you satisfied with the location of the bathroom?' An example for a statement about importance is: 'I consider it important to have a view on handhygiene'. The questionnaires for patients, visitors and staff were similar, except for questions related to the work performance of the nurses.

2.2 Hospital building

The hospital building studied was delivered in March 2015 and since August 2015 operational (Figure 1). The hospitals' vision was to provide a safe, comfortable and hospitable environment for all users with opportunity for both social and professional interaction while safeguarding sufficient privacy for the patients. The building comprised of outpatient and treatment areas and inpatient wards (480 beds). A combination of single bedrooms and shared bedrooms was realized at the inpatient wards on the upper three floor levels of the building. Both types of patient rooms had all sorts of orientation: north, east, south, and west (Figure 2).

Figure 1. Exterior of the building

Figure 2. Fragment of inpatient ward

The views from the single bedrooms and shared bedrooms varied from a wide view to a view on another wing of the hospital building, mostly at a distance of 28 m, incidental at 21 or 15 m. The colours, finishing materials and furniture in all bedrooms were similar, intended to provide a warm and professional appearance (Figure 3). Finishing of the cupboards and bed panel had a light coloured, wood-like appearance.

Patients in the single bedrooms had their own, direct accessible bathroom. Patients in the shared bedrooms accessed the bathroom from a niche in the corridor. The cupboards for personal items were located near the entrance of both bedrooms. The shared bedrooms comprised two cupboards, both divided vertically in two. For every bed, half a cupboard was available. The single bedroom comprised one cupboard, half the width from the one in the shared bedroom, over the full height. The sink, soap and alcohol dispenser were located parallel to the beds, in order to provide a view on hand hygiene from the patient beds. In both rooms the beds were positioned parallel to the window (Figure 4). The surface area of the single bedroom was approximately 17 m^2, the shared four bed bedroom was approximately 42 m^2; both exclusive the bathrooms.

Figure 3. Colours in the patient room

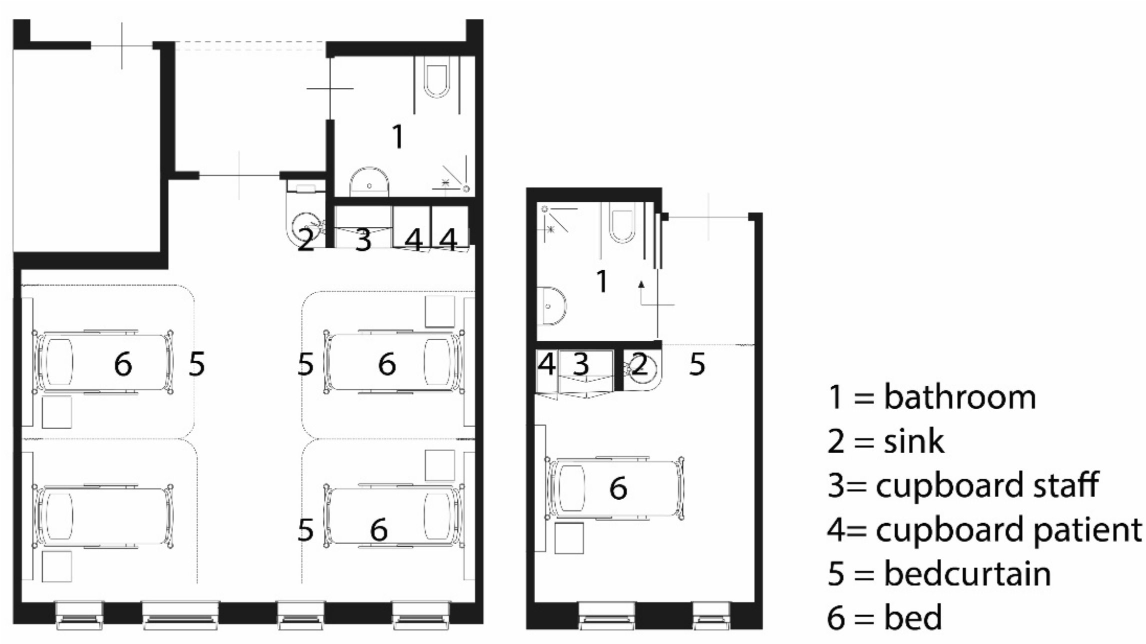

Figure 4. Layout of the single and shared bedroom

2.3 Procedure

A week before the study started, the hospital organization published an announcement and explanation of the study on the Intranet, which is accessible to the complete hospital staff. Additionally, the team leaders received an email in order to motivate the nurses to participate. The questionnaires for patients and visitors were distributed at nine different inpatient wards (e.g. neurology, lung care). Hardcopies of the questionnaire were distributed personally to patients and visitors by the research assistants; a digital version was sent to the staff (nurses) using Survey Monkey. During distribution, the researchers informed the nurses of each ward before they started to invite participants. The researchers invited all patients and visitors personally to participate. Patients who were sleeping or had their bedcurtains closed, were not disturbed. The participants needed 10-15 minutes to complete the questionnaire.

2.4 Data management and analysis

The data from the questionnaires of the patients and visitors were manually fed in SPSS 25.0. A second person systematically checked the input of the data. The digital questionnaires of the nurses were imported in SPSS from Survey Monkey. Section 3 provides an overview of differences between the groups and rooms for each question regarding privacy and social interaction. Therefore, the tables in section 3.2 report the numbers of participants as well as the numbers and percentages of dissatisfaction, reported as ’’ –‘’ (based on very unsatisfied and unsatisfied), neutral, reported as ‘’0’’, and satisfaction, reported as ‘’ +’’ (based on satisfied and very satisfied. A chi-square was calculated for the differences in importance between the three groups of participants for layout related aspects, as the number of participants of each group was sufficient. All data collected were anonymous.

2.5 Ethical aspects

In autumn 2015 study was approved by a Medical Ethical Test Committee.

3 Results

3.1. Participants

The number of respondents was 532. Exclusion of incomplete questionnaires (<30%), resulted in 499 participants (195 nurses, 154 patients, 150 visitors).

The distribution of gender and age of nurses was different from patients and visitors (see Table 1). More than 94% of the nurses was female, which is representative for the complete nursing staff in the hospital. As the language of the questionnaire was Dutch, for nearly all participants (up to 98%), Dutch was 'the language most used at home'. In line with the ageing society and the generally increasing care needs related to age, more than half of the patient population was older than 65 years.

	Nurses	Patients	Visitors
n	195	154	150
Female	94.3%	53.3%	63.3%
Age			
18-40 years	50.0%	5.1%	18.3%
40-65 years	50.0%	39.7%	40.4%
>65 years	0%	55.1%	41.3%

Table 1. Satisfaction of patients with single and multiple bedrooms

3.2 Comparison of satisfaction with layout related aspects of single and shared bedrooms

The average satisfaction of patients on a scale of 1 to 10 with the single bedroom was 8,4 (sd1,29) and with the shared bedroom 7,7 (sd 0,70). Visitors were less satisfied than patients, for single bedrooms 7,8 (sd 0,95) and for multiple bedrooms 7,3 (sd 1,17).

Although patients and visitors were generally more satisfied with single rooms than with shared rooms, less than 9 % was dissatisfied with all layout related aspects of the shared rooms, except the place for personal items in single as well as shared rooms. Additionally, more than 9% of the visitors was unsatisfied with privacy during visits in the shared rooms (see Table 2). Both patients and visitors stated that privacy (80,7%, 79,9%) and place for the visitor (83,7%, 88,6%) were important. Contact with other patients was for patients less important (60,7%) than privacy and place for a visitor. Visitors were equally satisfied with the place for providing care in single and shared bedrooms, as shown in Table 3. Visitors were more satisfied with all other layout related aspects of single bedrooms than in shared bedrooms. Patients were more satisfied with place for personal items (cupboards) in the shared bedrooms, visitors were more satisfied with the cupboards in the single bedrooms.

Staff members were working in both single and shared bedrooms; therefore, satisfaction with the rooms was not reported for both room types separately. 52,2% of the respondents disagreed with the statement that there is no difference in working in a shared bedroom or a single bedroom, 19,2% was neutral about this statement, and 28,2% agreed (Table 4). Staff was less satisfied with the ability to keep privacy of the patient while providing care, compared to patients and visitors in single and shared bedrooms.

	Single bedroom n (%)				Multiple bedroom n (%)			
	n	-	0	+	n	-	0	+
Place for personal items	17	3 (17,6)	3 (17,6)	11 (64,7)	91	13 (14,3)	13 (14,3)	65 (71,4)
Place for the visitor	17	1 (5,9)	2 (17,6)	14 (78,3)	92	6 (6,5)	15 (16,3)	71 (77,2)
Privacy while receiving visitor	17	0 (0,0)	1 (5,9)	17 (94,1)	88	5 (5,7)	25 (28,4)	58 (65,9)
Place for care	17	1 (5,9)	4 (23,5)	12 (70,5)	96	2 (2,1)	17 (19,8)	77 (80,2)
Privacy while receiving care	18	0 (0,0)	1 (5,6)	17 (94,4)	94	4 (4,3)	14 (14,9)	76 (80,8)
Safety	18	0 (0,0)	1 (5,6)	17 (94,4)	92	3 (3,3)	24 (26,1)	65 (70,7)
Privacy curtains	18	0 (0,0)	1 (5,6)	17 (94,4)	94	4 (4,3)	14 (14,9)	76 (80,8)
Location bathroom	18	1 (5.3)	1 (5,3)	16 (88,9)	95	3 (3,2)	19 (20,0)	73 (76,8)
Place for personal items in bathroom	18	0 (0,0)	1 (5,6)	17 (94,4)	92	3 (3,3)	24 (26,1)	68 (70,7)

Table 2. Satisfaction of patients with single and multiple bedrooms

	Single bedroom n (%)				Multiple bedroom n (%)			
	n	-	0	+	n	-	0	+
Place for personal items	34	5 (14.7)	8 (23,5)	21 (61,8)	92	16 (17,4)	28 (30,4)	48 (52,2)
Place for the visitor	37	0 (0,0)	6 (16,2)	31 (83,8)	102	6 (5,9)	16 (15,7)	80 (78,4)
Place for care	30	1 (3,3)	7 (23,2)	22 (73,3)	75	4 (5,3)	16 (21,3)	55 (73,3)
Safety	36	0 (0,0)	8 (22,2)	28 (77,7)	99	3 (3,0)	26 (26.3)	67 (72,7)
Privacy during visits	37	0 (0,0)	2 (5,4)	35 (94,6)	98	13 (13,3)	27 (27,6)	58 (59,2)
Privacy curtains	29	1 (2,7)	5 (17,2)	23 (79,3)	94	7 (7,4)	24 (25,5)	63 (67,0)
Location bathroom	35	1 (2,7)	2 (5,7)	32 (91,4)	81	7 (8,6)	18 (22,2)	56 (69,1)
Attractive for visit	36	0 (0,0)	5 (13,9)	31 (86,2)	94	7 (6,4)	24 (25,5)	63 (67,0)

Table 3. Satisfaction of visitors with single and multiple bedrooms

	n (%)			
	n		0	+
Place for visitors	186	53(28,5)	55 (29,6)	78 (42,0)
Place to provide care	194	44 (22,7)	38 (19,6)	112 (57,7)
Able to keep conversation of physician or nurse with patient private	187	96 (51,3)	30 (16,0)	61 (32,7)
Able to keep visual privacy for patients in shared rooms	185	32 (17,3)	38 (20,5)	115 (62,2)
Able to provide visual privacy with bedcurtains	190	33 (17,4)	49 (25,8)	108 (56,8)
No difference working in single or shared bedroom	177	93 (52,5)	34 (19,2)	50 (28,2)

Table 4. Satisfaction of staff with single and multiple bedrooms

3.3 Importance of layout related aspects, supportive to privacy or social interaction

The possibility to have the door of the bedroom open or closed enables staff to regulate the extent of privacy and visual contact with patients from the corridor to the bedroom. Staff (87,2%) and visitors (84,0%) stated that this was more important than patients did (62,5%) ($p<.000$), as shown in Table 5. The position of the sink was similar in both bedrooms and enables staff to look aside towards the patients in the room, while they are cleaning their hands. Additionally, the position of the handbasin enables patients to see staff cleaning their hands. More patients (76,5%) than staff (63,1%) and visitors (67,0%) stated that a view on hand hygiene of staff was important ($p<.01$). For staff it was more important to see the patient at the entrance, than providing a view on hand hygiene.

		n (%)			
	n	**-**	**0**	**+**	**p-value**
View on hand hygiene					
Staff	182	12 (6,6)	55 (30,2)	115 (63,1)	p<.01
Patients	145	1 (0,7)	33 (23,4)	111 (76,5)	
Visitors	127	13 (10,2)	29 (22,8)	85 (67,0)	
Ability to have the door open					
Staff	180	8 (4,4)	15 (8,3)	157 (87,2)	p<.000
Patients	136	16 (11,8)	35 (25,7)	85 (62,5)	
Visitors	137	5 (3,6)	17 (12,4)	115 (84,0)	
See patient at the entrance					
Staff	184	36 (19,6)	19 (10,3)	129 (70,1)	

Table 5. Perception of importance

4 Discussion

4.1 Strengths and limitations

The aim of this study was to gain more insight into which extent layout related aspects of shared and single bedrooms contribute to privacy and satisfaction with the layout. The number of respondents for single rooms was relatively low, compared to the respondents for shared rooms. Future research with equal numbers of participants for both rooms may identify differences, which can be tested on statistical significance.

Although previous validated questionnaires formed the basis for the questionnaire designed, this study comprised additionally new questions, specific for patients, visitors and staff. Because the questionnaire reflects on the integral perception of the bedroom and the intention to limit the time needed for completing the questionnaire, the question about hand hygiene was limited to only one question, as well as the question about differences between single and shared bedrooms. The importance to see the patient at the entrance of the bedroom would have been relevant to ask visitors as well.

The importance for staff to have the bedroom door open towards the corridor may be explained by the findings of Maben et al. (2015) [15]. In that study staff stated that the limited vision on patients was a disadvantage of single rooms, compared to bay wards. The findings on privacy of patients in single rooms are consistent with that study as well. The importance for patients to have a view on staff, while they are cleaning their hands, is consistent with the improved satisfaction of patients with rooms facing staff, compared to rooms facing the back of staff or staff cleaning their hands in the toilets (Mac Allister et al.,2018) [16]. The low satisfaction of staff with the ability to keep the conversation with patients private while providing care, may be explained by the large number of shared rooms in the hospital building, compared to single rooms. Van de Glind et al. (2008) suggested that verbal and nonverbal communication of physicians with patients improved in single rooms compared to four bed rooms [17].

4.2 Applicability

The differences between patients, visitors and staff in satisfaction and importance with layout related aspects contribute to a better understanding of the needs during the programming and design process of hospitals. Organizational measures as well as layout related measures may contribute to the patients' privacy. The results of this study indicate that it is important to locate the sink and alcohol dispenser parallel to the patient beds, in order to provide a view on the hand hygiene performance. Doors with free wheel closers may support satisfaction of staff, due to their perceived importance on the ability to have the doors open. With regards to ''control one's space and territory'' detailed study on the following aspects may contribute to improved privacy in future design projects:

- Appropriate dimensions of the cupboards in combination with organizational measures on patient information of items needed during an inpatient stay.
- Schedules for visiting hours in shared patient rooms.

As staff was less satisfied with the ability to provide visual privacy during care than patients were with their privacy while receiving care, it is relevant to provide insight in the difference in perception of staff and patients within hospital organization and education. This insight may contribute to patient and work satisfaction, with regards to ''the right to expect treatment with dignity during intimate care.''

4.3 Research and education

Within the hospital organization, the study improved collaboration between the science and nursing education department. The connection with the local nursing school improved as well, as their students were involved in the questionnaire design and distribution of the questionnaires on paper (for patients and visitors) at the wards.

5 Conclusion

Layout related aspects as well as organizational aspects contribute to privacy and interaction for patients in single and shared bedrooms. Staff was less satisfied with privacy in single and shared rooms than patients and visitors. Detailed study on organizational as well as spatial aspects may improve privacy in single and shared bedrooms in future. As staff was less satisfied than patients and visitors, involvement of nurses in future design processes may contribute to improved satisfaction.

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A COMPARATIVE EVALUATION OF INTERNAL MEDICINE WARDS IN SPAIN

Laura Cambra-Rufino [(1)*], **José León Paniagua-Caparrós** [(2)], **César Bedoya-Frutos** [(1)]

[(1)] Universidad Politécnica de Madrid, Spain

[(2)] Instituto de Salud Carlos III 2 Affiliation, City, Country

* Corresponding author e-mail: lauracaru@hotmail.com

Abstract

Objective – This analysis investigates the functional and environmental quality of several internal medicine wards in Spain.

Background – Despite the economic recession, the Spanish healthcare system has proven to be resilient. In the near future, Spain will be faced with the demographic challenge of an ever-ageing population. Further efforts should be made to ensure a sustainable and affordable healthcare system. The elderly population is the group that requires the highest rates of healthcare resources, especially in acute-care hospitals, with the maximum hospital attendances and the longest average length of stay. Since there is scientific evidence that links healthcare outcomes with design (evidence-based-design), one way of improving the efficiency of healthcare delivery is by enhancing the quality of existing internal medicine wards as it is usually the place where the elderly inpatients are cared for. Post-Occupancy-Evaluation (POE) tools have been used globally to assess the performance of existing buildings but little has been applied in the Spanish context.

Research question – How well do existing internal medicine wards perform in relation to guidelines and research on functional and environmental quality?

Methods – Both quantitative and qualitative methods have been used in this case study for the triangulation of data. Four internal medicine wards have been evaluated with the following methods: architectural layout analysis, photo analysis and a POE tool designed for the Spanish context (CURARQ-H).

Results – Not surprisingly, the oldest ward scores lower than the most recent buildings. The analysis reveals that the patients' area is the one that gets better grades while the access area scores the lowest marks. Further details on improvement measures are given for each ward area.

Conclusion – Compared to Scandinavia, USA or Canada, healthcare architecture in Spain is being slow to embark on EBD. This evaluation method together with CURARQ-H tool could be an enabler for generating synergies between healthcare staff and architects in Spain and work as an accelerator in the use of EBD at a national level.

Keywords: *Internal-medicine ward | post-occupancy-evaluation tool | evidence-based design | design evaluation | evaluation tool)*

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1. Background

1.1 Spain vs. Scandinavia

The following table shows several national indicators for Spain, Denmark, Norway and Sweden.

		Spain	Denmark	Norway	Sweden	Unit
Population (2013-2014)		46.464	5.614	5.137	9.609	Inhabitants, thousands
Life expectancy at birth (2016)	♀	86,3	82,8	84,2	84,1	Years
	♂	80,5	79	80,7	80,6	Years
Health expenditure and financing (all functions 2015)		9,1	10,3	10,1	11	% (Share of Gross domestic product)
		3.175,5	5.000,8	6.239,4	5.271,9	US Dollar (Per capita, current prices, current Purchasing Power Parity (PPPs))
Total hospital beds (2016)		138.008	14.871	19.303	23.207	Number
		2,97	2,6	3,69	2,34	Per 1.000 population
Average length of stay (inpatient care, hospital aggregates 2016)		7,3	5,4	6,9	5,8	Days

Table 1, National indicators: comparison between Spain and Scandinavia [1].

The numbers reveal that even though Spain has one of the longest life expectancies at birth, its health spending is the lowest (about half of US dollars per capita compared to Norway) and the average length of stay, the longest. These indicators demonstrate that there are plenty of opportunities to improve in the Spanish healthcare system.

1.2 Spanish healthcare system

Spain has a decentralized national health system or “Sistema Nacional de Salud” (SNS) in Spanish which is funded by taxes. This public system is based on the principles of “universality, free access, equity and fairness of financing” [2]. The SNS is organized independently by the 17 regions of the country with a national institution responsible for the overall coordination and monitoring of its performance.

After the economic crisis in 2008, measures were taken for reducing public expenditure in the SNS. It was not until 2014 that public spending on health started to increase again. Despite the budget reductions suffered over this time, the SNS has proven to be resilient [2]. This resilience could be caused by the strength of primary care and its close coordination with acute-care hospitals, as both care levels belong to the same public system.

Acute-care hospitals accounted for over 25 % of health spending in 2014 [3]. That is why efficiency measures have targeted this expensive sector. The SNS joins the global trend on hospital bed reduction (from 3,68 beds per 1.000 inhabitants in 2000 to 2,97 beds per 1.000 inhabitants in 2016 [4]) and shorter average length of stay. The possibility to free resources in the inpatient area of an acute-care hospital has been made possible thanks to the moving of many diagnostic and therapeutic procedures to the outpatient care (both in the acute-care hospital and in primary-care centers). However, clinical advances have increased the need for intensive beds in acute-care hospitals as more severe and critical illnesses can now be treated [5].

In the near future, Spain will be faced with the demographic challenge of an ever-ageing population. Even though health expenditure is expected to rise, further efforts should be made in order to ensure a sustainable and affordable SNS [3].

1.3 Internal medicine ward

The internal medicine ward in a Spanish acute-care hospital is usually the place where the elderly inpatients are cared for. These patients may suffer from two or more chronic conditions and hence have higher functional limitations [6]. Figure 1 shows the data provided by the survey of hospital morbidity carried out by the Spanish Institute of Statistics in 2016.

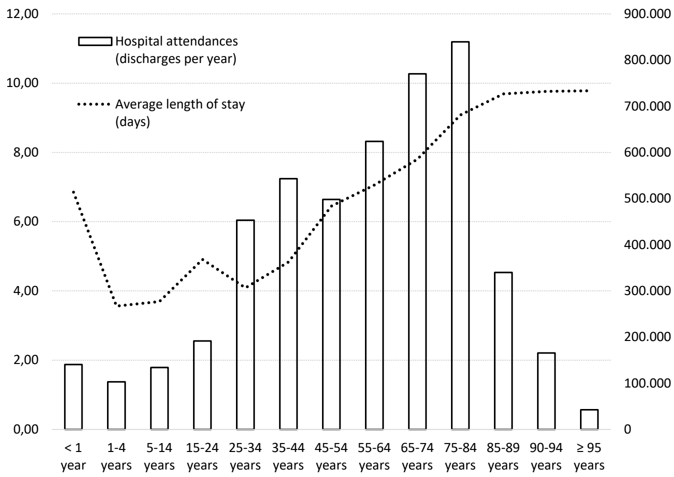

Figure 1. Hospital attendances and average length of stay according to age in Spain in 2016 [7].

The figure illustrates that the highest hospital attendance rates (discharges in 2016) occur in the age range of 55 to 84 years. Furthermore, even though the attendance for patients aged over 85 is lower, their average length of stay reaches its maximum duration (9,78 days). Those facts corroborate that the usage of acute-care hospital resources is not distributed homogenously among the Spanish population. In fact, it is the elderly population group that requires the highest rates of healthcare resources. Thus, improvement measures in the internal medicine ward (along with other approaches) might increase the quality of the caring process and ensure a cost-efficient usage of healthcare resources.

1.4 Evaluation tools

Given that there is scientific evidence [8] that links healthcare outcomes with design (evidence-based design), one way of improving healthcare delivery is by enhancing the quality of hospital environments.

Despite the fact that design quality is still an imprecise concept [9], there are many tools or instruments targeted to measure the quality of the physical healthcare environment [10]. The Post-Occupancy Evaluation (POE) [11] is the most extended method in use for assessing the performance of buildings. Since the introduction of the POE at the end of the last century, there has been a proliferation of different tools. There is even a model (the Focus Flower [12]) for organizing the different evaluation methods according to their main focus (beauty, durability or utility). More specifically, POE tools have found an important niche in the healthcare sector, where small building improvements might result in financial gains. Thus, pinpointing the design features that might have a return on investment over the lifecycle of the building [13] has become of paramount importance. Subsequently, there is a growing interest in the development of evaluation tools for every different context as there is no “one size fits all” solution [14].

1.5 Research question

The aim of this paper is to investigate the functional and environmental quality of several internal medicine wards in Spain. The research question is:

How well do existing internal medicine wards perform in relation to guidelines and research on functional and environmental quality?

With this research question we address how to include the organizational learning collected mainly by the national guidelines into the evaluation of four individual projects. The aim of guidelines is usually to translate and applicate research into design [15]. This study analyzes existing design to test the application stage of the guidelines and other research.

2. Methods

Both quantitative and qualitative methods have been used in this case study for the triangulation of data. Four internal medicine wards have been evaluated with the following methods: architectural layout analysis, photo analysis and a POE tool designed for the Spanish context (CURARQ-H).

2.1 CURARQ-H

CURARQ “Arquitectura para curar” or architecture for cure is a post-occupancy-evaluation tool available online [16], which methodology has been previously published [17].

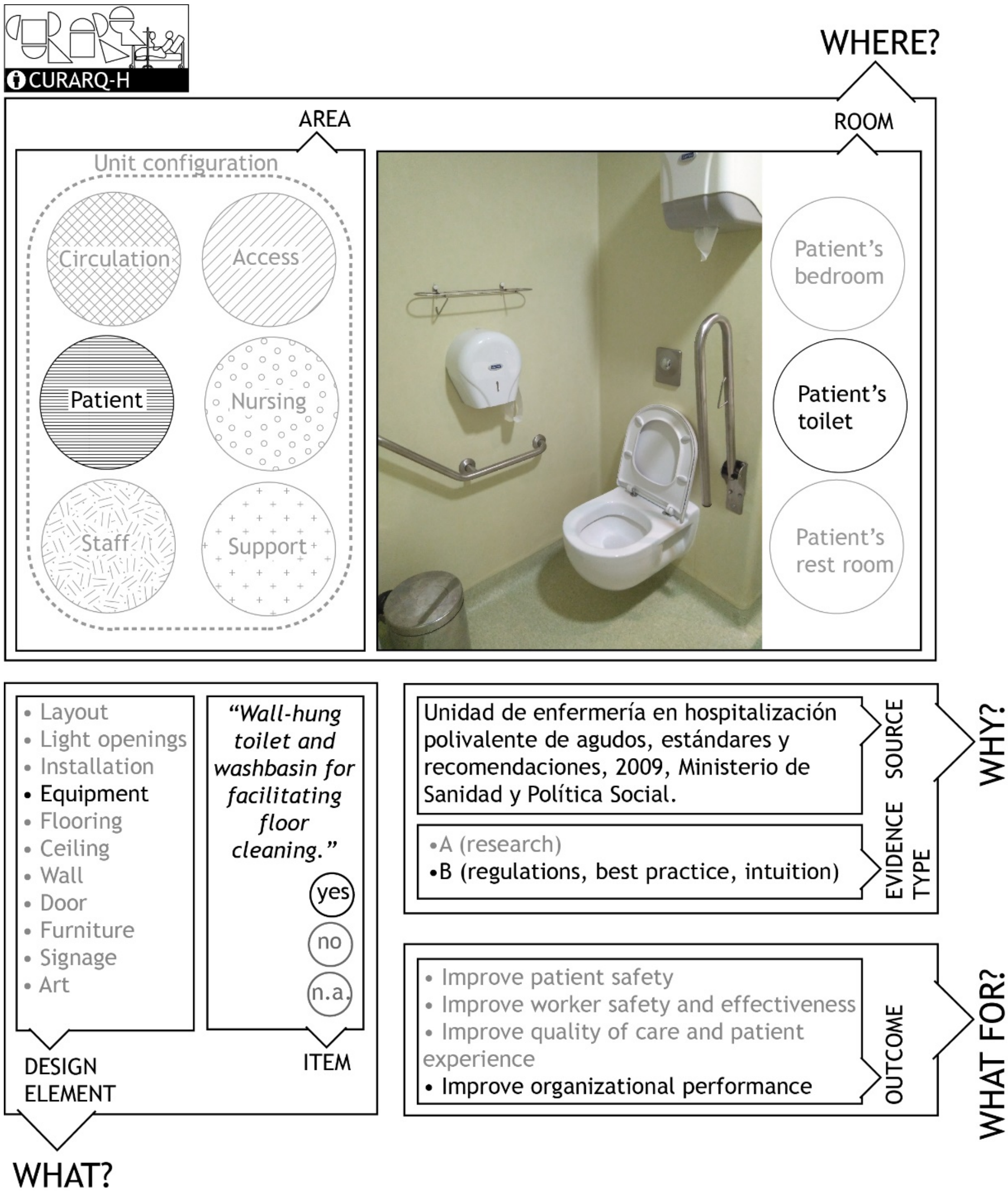

Figure 2. CURARQ-H content structure.

The data collection starts with a tour across all the rooms of the ward. For each room there are several items that can be checked. The total number of items for the whole ward is 213 and they are organized according to four questions: where? why? what for? and what?

Where?

The information is organized according to the room that is being analyzed, which in turns is part of a functional area of the ward. The rooms that can be found in any of these areas are:

- Unit configuration (10 items): an overall category for general features (signage, art) the planning layout of the unit and its relationship with other units of the acute hospital.
- Circulation area (17 items): internal corridor for inpatients and staff.
- Access area (21 items): external lobby and entrance (for visitors or relatives), waiting room, public toilet and interview room.
- Patient and family care area (74 items): patient's bedroom, patient's toilet and patients' rest room.
- Nursing control area (55 items): counter, nurses' office room, medicine preparation room, staff rest room, head nurse's office, staff toilet, treatment room and assisted bathroom.
- Staff area (8 items): doctors' office room and staff changing room.
- Support area (28 items): internal lobby (for staff, inpatients and supplies), regeneration kitchen, dirty utility room, cleaners' room, dirty linen room, linen store, clean supply room and large equipment store.

Why?

Specifies the source from where the item has been taken. The summary of references used are shown in Figure 3.

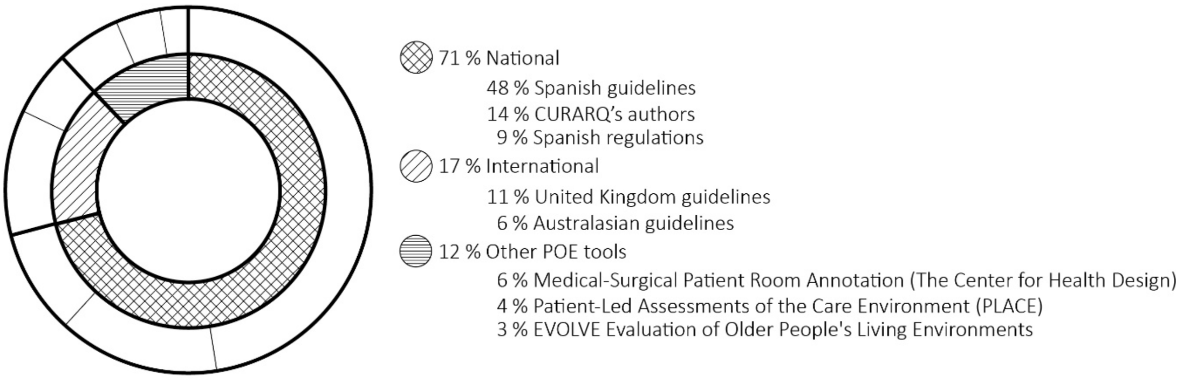

Figure 3. Sources of tool content.

Type of evidence states whether the item considered comes from research (A) or regulations, best practice and intuition (B). According to the type of evidence, each item scores points (10 points for an A item and 1 point for a B item).

What for?

Determines the objective the item aims at. These objectives have been taken from an existing tool [18]:

- Improve patient safety.
- Improve worker safety and effectiveness.
- Improve quality of care and patient experience.
- Improve organizational performance.

What?

Identifies the design element that concerns the item (layout, light openings, installation, equipment, flooring, ceiling, wall, door, furniture, signage or art) and the item description. The answer to any item can be “yes”, “no” or “not applicable”. Each design element has a cost associated according to Table 2.

Cost	Design element
5	layout
4	light openings, installation
3	equipment, flooring
2	ceiling, wall, door
1	furniture, signage or art

Table 2. Cost category for each design element.

2.2 Study cases

Four different hospitals (Table 3), which are geographically close and managed by the same healthcare regional department, have been selected for this comparative evaluation.

Hospital short name	HCUV	HUPF	HD	HUV
Year of building or pavilion opening (year of renovation works)	1960 (1994)	2010	2009	2010
Assigned population	341.972	281.720	166.108	154.017
Installed beds	582	1.050	262	230
Nº registered emergencies	161.488	237.328	58.544	89.467
Nº outpatient appointments (first + successive)	574.215	618.050	207.668	240.761
Ratio successive / first	2,17	2,24	1,66	2,13
Nº hospital admissions (urgent + planned)	24.105	45.109	11.908	12846
Average length of stay (days)	6,39	6,48	5,54	5,09
Evaluation date	January 2018	January 2018	June 2016	February 2018

Table 3. Hospital data [19] for Hospital Clínico Universitario de Valencia (HCUV), Hospital Universitari i Politècnic La Fe (HUPF), Hospital de Dénia (HD) and Hospital Universitario del Vinalopó (HUV).

Figure 4 shows the location of the evaluated ward within each the acute-care hospital floor.

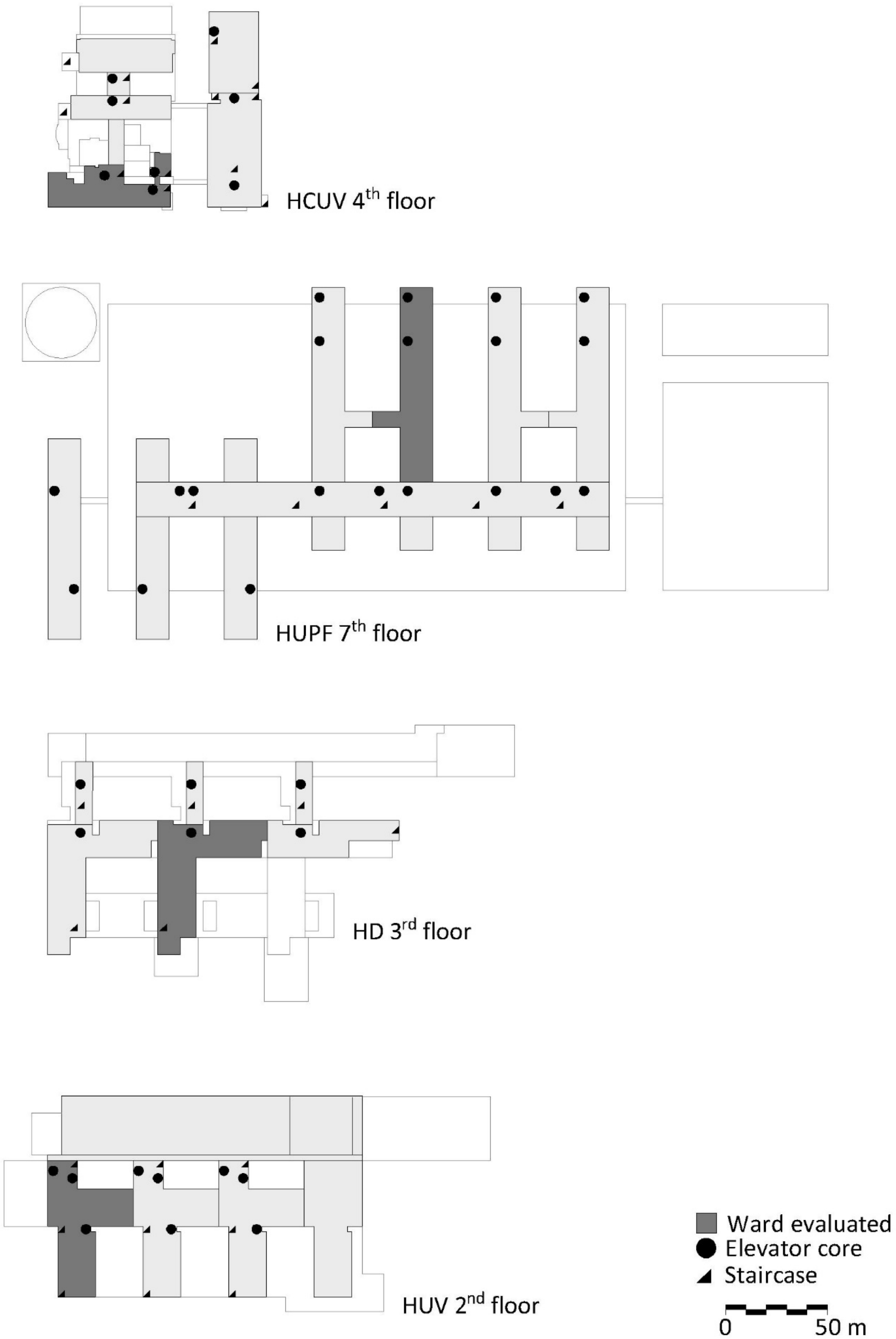

Figure 4. Ward evaluated location.

Hospital Clínico Universitario de Valencia (HCUV)

The ward evaluated in HCUV is located on the fourth floor of pavilion B. On this floor there are another three inpatient wards and outpatient care at pavilion D. Directly above and below the internal medicine ward there is another inpatient ward with the same configuration.

There are three elevator cores that serve the unit. The main elevator core has a mixture of public and private flows and is served by four bed elevators and two passenger elevators. There is another bed elevator in the middle of the ward that opens directly onto the corridor (without lobby) and a passenger elevator for the treatment area of the unit.

The ward has an F shape and the corridor has patient bedrooms on both sides. In the central part of the ward the corridor has patient bedrooms on one side and the staff area and the circulation core on the other side. The staff support area is centralized and there is only one nursing station. There is a variety of patient bedrooms: two triple rooms, fourteen double rooms and three individual rooms (two of them without shower in the toilet room).

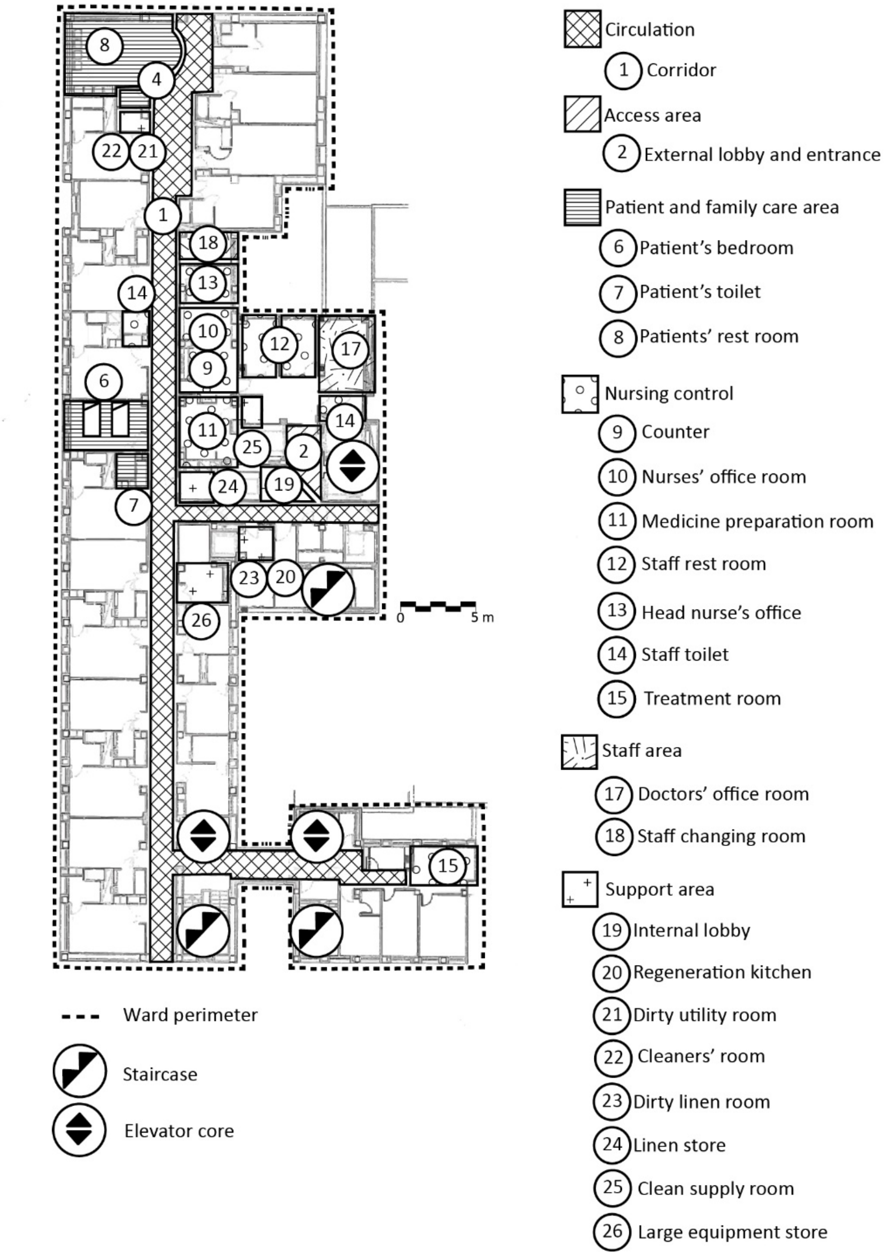

Figure 5. Hospital Clínico Universitario de Valencia (HCUV) layout and rooms evaluated.

Hospital Universitari i Politècnic La Fe (HUPF)

The internal medicine ward in HUPF is located on the seventh floor of tower E. On this floor there are another three wings for inpatient care and two wings for outpatient care. Directly below the internal medicine ward there is another inpatient ward with the same configuration. The seventh floor is the last one of the whole acute hospital.

There are four elevator cores that serve the unit. One core for public access (with two passenger elevators for visitors) and three cores for private access. Two of the three cores for private access consist of two and three bed elevators (for staff and inpatients) and the third core is served by two service elevators (for staff and supplies).

The ward has an F shape. The corridor has one part with patient bedrooms on both sides and another part with patient bedrooms on one side and staff support area on the other side. The staff support area is centralized and there is only one nursing station. There are 35 individual patient bedrooms and 20 of them have an anteroom for the isolation of infectious patients.

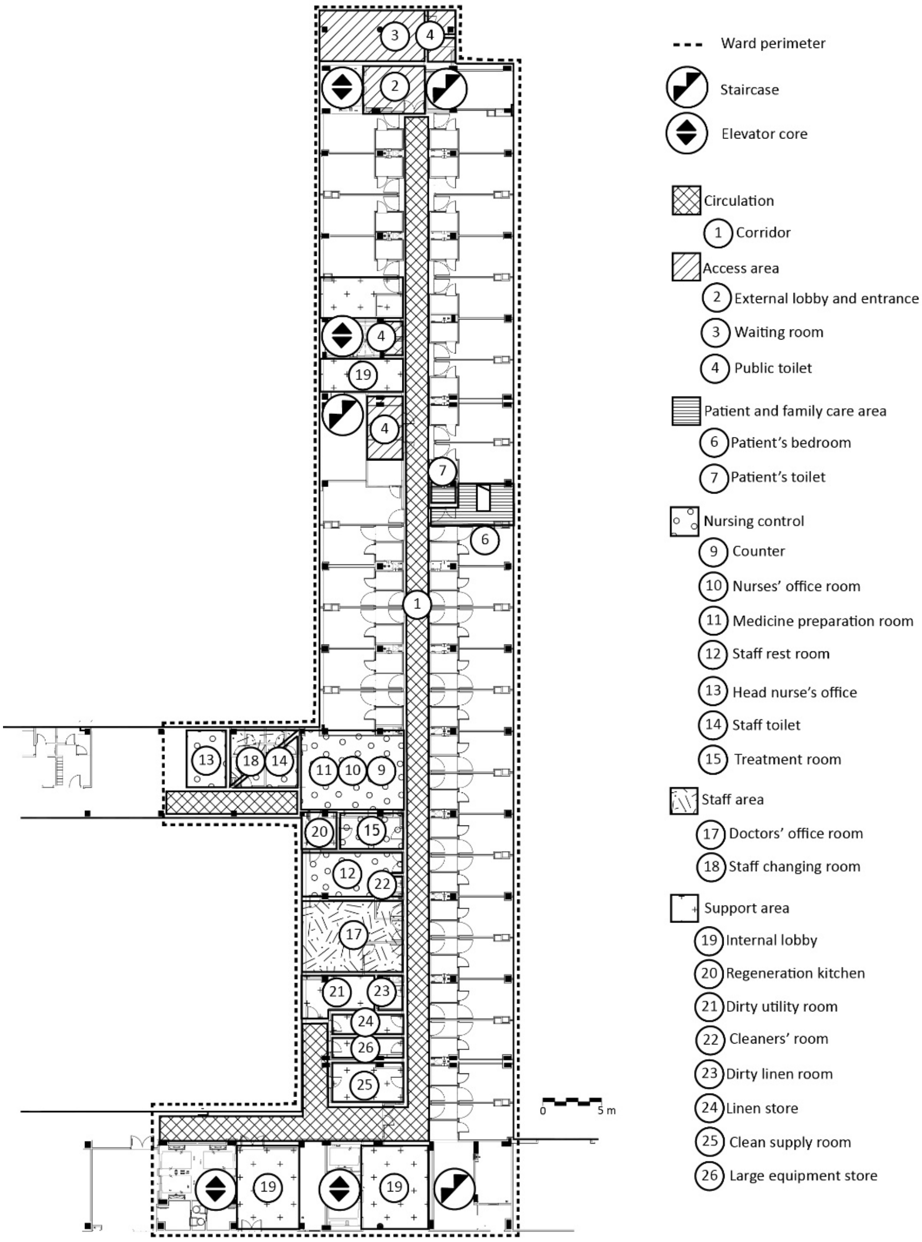

Figure 6. Hospital Universitari i Politècnic La Fe (HUPF) layout and rooms evaluated.

Hospital de Dénia (HD)

The internal medicine ward in HD is located on the third floor of the B hospitalization wing. On this floor there is another internal medicine ward and the psychiatric ward. Directly below the internal medicine ward there is another inpatient ward on the second floor. The third floor is the last one of the whole acute hospital.

There are two elevator cores that serve the unit. One for public access (two passenger elevators for visitors) and another one for private access. The private core is served by a service elevator (for staff and supplies) and a pair of bed elevators (for staff and inpatients).

The ward has an L shape with a double-loaded corridor (with patient bedrooms on both sides). The staff support area is centralized and there is only one nursing station. There are a total of 37 patient bedrooms. All patient bedrooms are used individually even though they have double capacity to cope during peak seasons.

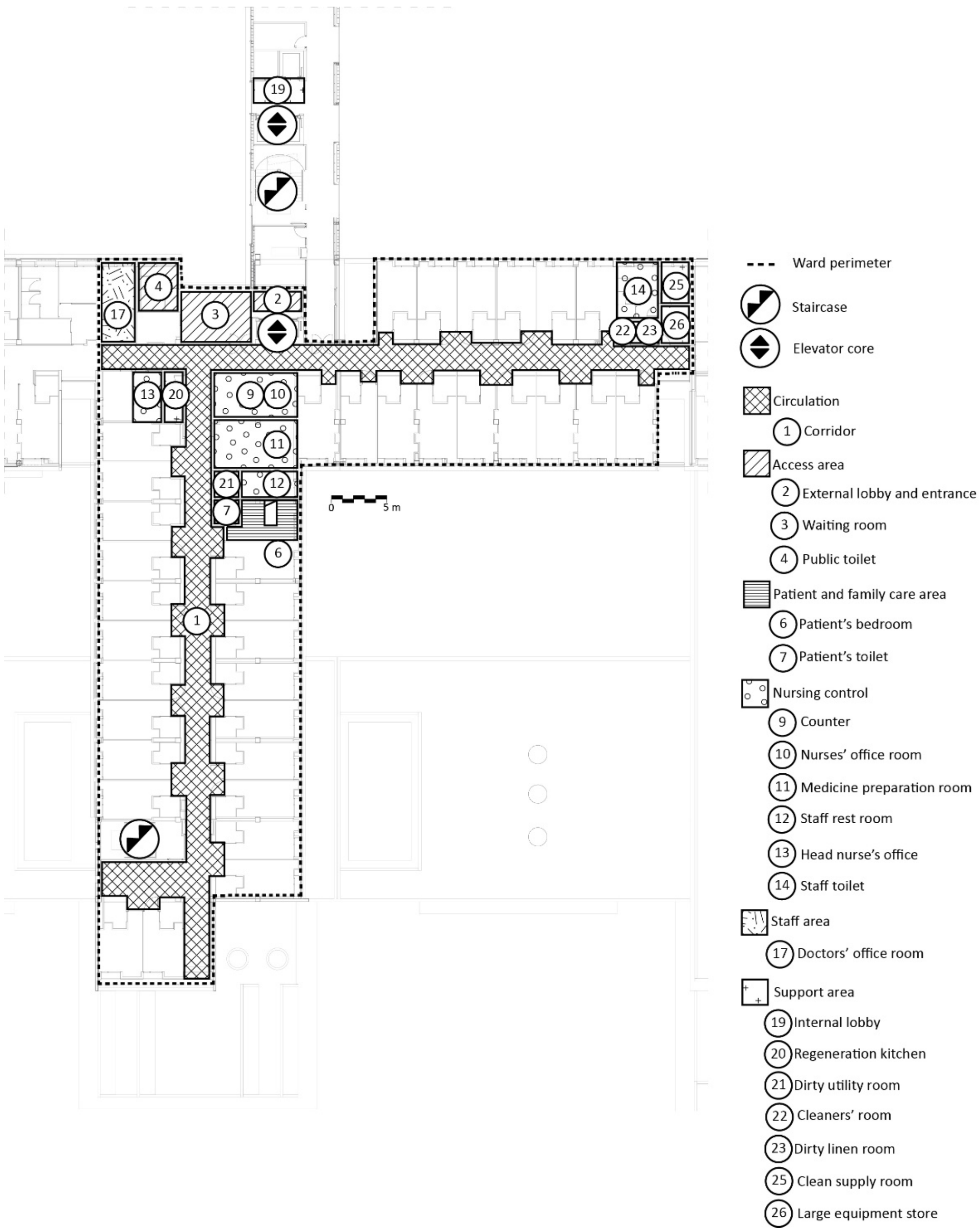

Figure 7. Hospital de Dénia (HD) layout and rooms evaluated.

Hospital Universitario del Vinalopó (HUV)

The internal medicine ward in HUV is located on the second floor of the blue hospitalization wing. On this floor there are more inpatient wards (adult, obstetric, pediatric and neonatal), the operating theaters and the labor unit. Directly below the internal medicine ward is the outpatient area on the first floor. Above, on the third and last floor there is another ward with the same structure.

There are three elevator cores that serve the unit. One for public access (two passenger elevators for visitors) and another one for private access. The private core is served by a pair of service elevators (for staff and supplies) and another pair of bed elevators (for staff and inpatients).

The ward has a Y shape with a double-loaded corridor. The staff support area is centralized and there is only one nursing station. There are a total of 30 patient bedrooms. All patient bedrooms are used individually even though they have double capacity to cope during peak seasons.

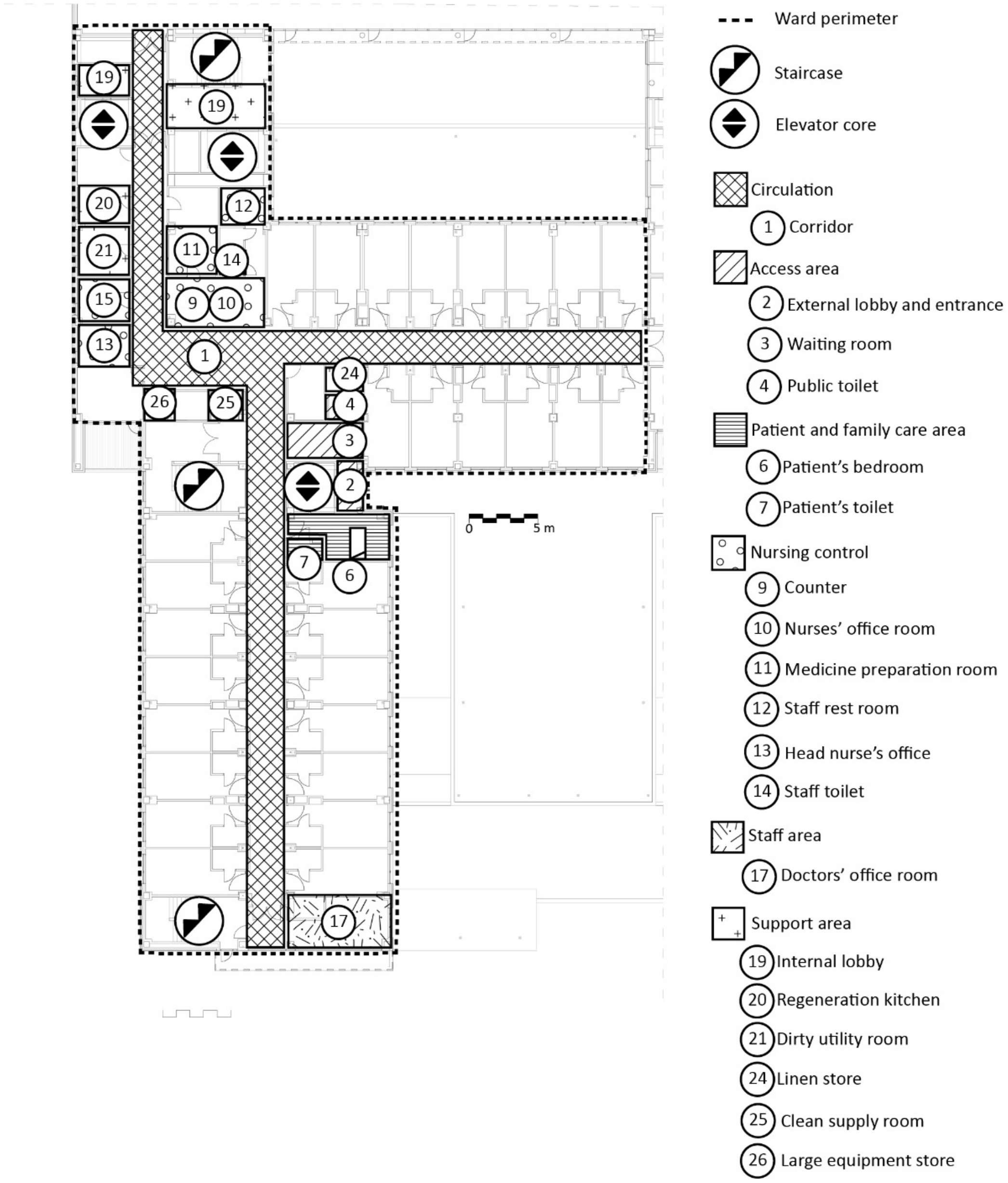

Figure 8. Hospital Universitario del Vinalopó (HUV) layout and rooms evaluated.

3. Results

Figure 9 represents the results obtained by each ward with the tool CURARQ-H.

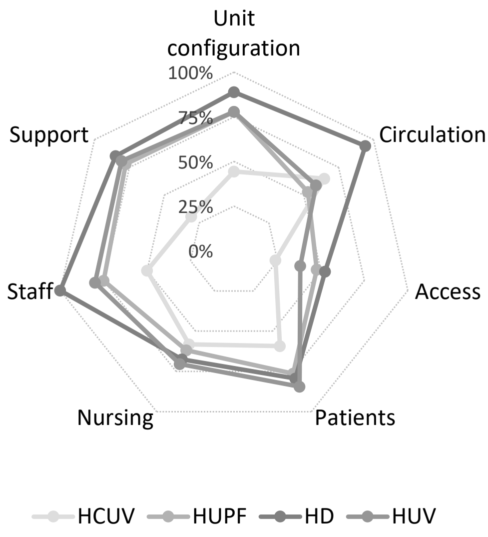

Figure 9. CURARQ-H results for the wards evaluated.

The results show that HD scores the highest percentage in almost all areas. HUV comes next, with the circulation and access area slightly lower. The HUPF has similar results to HUV but lower marks for staff and nursing areas. HCUV receives the lowest grades in almost all areas.

Comparing now between areas, the patients' area is the one that gets the best grades while the access area scores the lowest marks. Next, we analyze the results of each area in more detail and illustrate the best design strategies in the photographed rooms.

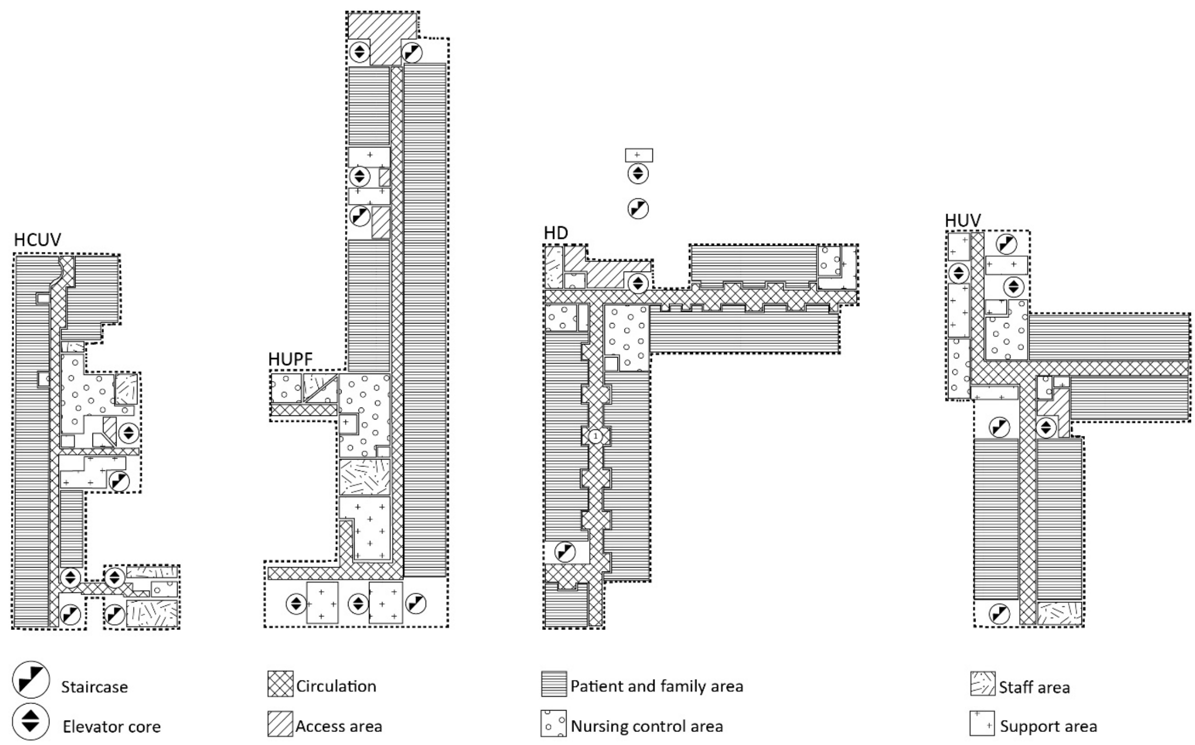

Figure 10. Functional diagrams of ward areas.

3.1 Unit configuration

The unit configuration of HCUV is weaker than the others because there are not different access points for external and internal flows. In this acute-care hospital, the hospitalization wards have different layout arrangements which makes it more difficult for staff to get used to. There is not any form of art in the ward and the maintenance status of some signage systems is poor.

3.2 Circulation

Figure 11. Corridor at HUCV, HUPF, HD and HUV.

HD gets the highest percentage as its internal corridor has natural light, not direct artificial light from the ceiling, handrails and there is even a widening of the corridor at each inpatient bedroom. This space facilitates the manoeuvrability of the bed, gives privacy to relatives and a soft transition between the room and the corridor.

3.3 Access area

Figure 12. Waiting room for relatives and visitors at HUPF, HD and HUV.

The access area at HCUV does not have a waiting room for relatives and visitors, the other three hospitals do have one but the qualities of the room could be better. None of the hospitals has a dedicated interview room and the staff use other office rooms for private conversations.

3.4 Patient and family area

Figure 13. Patient's bedroom at HUPF, HD and HUV.

The HCUV is the only one that has an inpatient rest room, in the other hospitals, patients share the waiting room in the access area. However, the overall quality of that room, the patient's bedroom and the patient's toilet room at HCUV is quite low compared to the newer hospitals. HUV is the one that scores the highest grades. Its inpatient bedrooms comply with all but four items: the size of the room and the bed should be bigger, the switches should be located at a higher level, there is not a secure locker for valuable items and the door does not have a quiet closing system.

3.5 Nursing control area

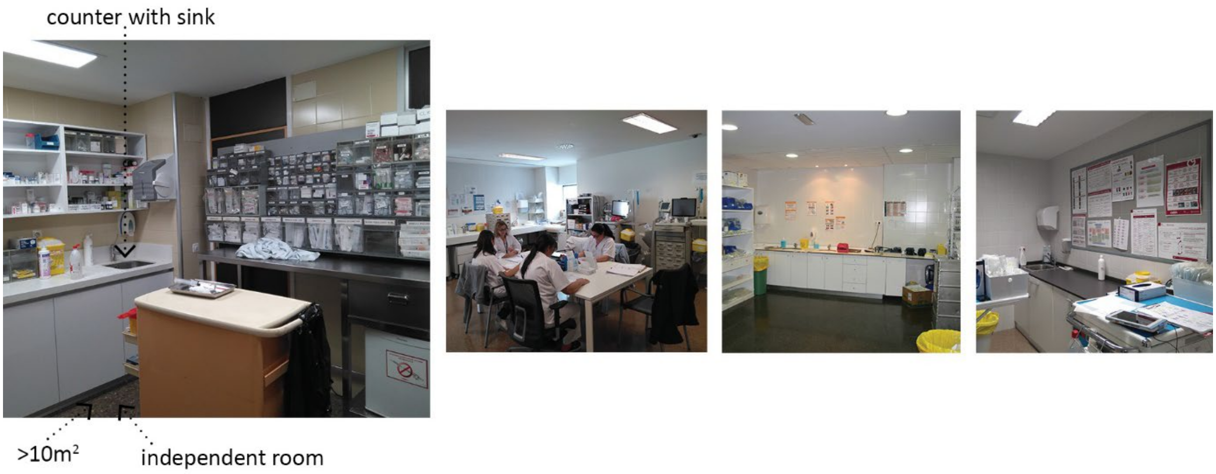

Figure 14. Medication room at HCUV, HUPF, HD and HUV.

It is the area with more similarities among the four wards analyzed. In all hospitals the counter and the nurses' office room are shared in the same space. In HUPF and HD even the medicine preparation room is combined with the nurses' office room and the counter while the HCUV and HUV have the medicine preparation room in an independent location.

3.6 Staff area

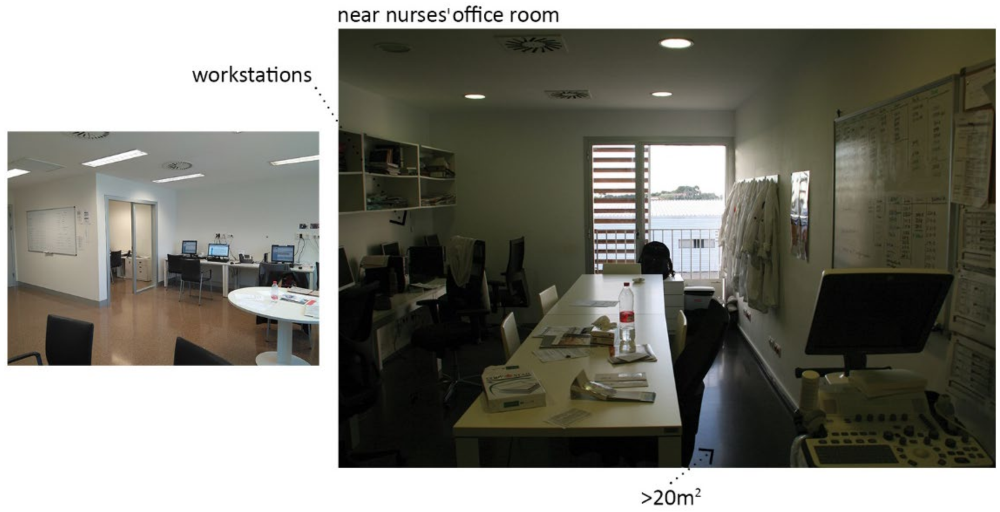

Figure 15. Doctors' office room at HUPF and HD.

The doctors' office room in all four hospitals complies with almost all the tool items. Regarding the staff changing room, only the HUPF has a specific room. HD and HUV have a centralized system and no changing room in the ward. Originally, the HCUV had a centralized staff changing room for the whole hospital but in response to staff demands there is now a small changing room that does not meet the tool's requirements.

3.7 Support area

Figure 16. Dirty utility room at HCUV, HD and HUV.

HCUV gets the lowest grades as there is not enough room for support activities. The lack of space means that different functions are shared in the same room without adding extra space.

4. Discussion

Not surprisingly, the HCUV receives the lowest grades in almost all areas, which could be due to its age (about 15 years older than any other hospital). In all four wards, the patient area gets the highest grades. This could be because the patient's bedroom and the patient's toilet are the most researched rooms nowadays. On the contrary, the access area scores lower than any other area. Space for relatives is scarce and the functional and emotional demands of family members are usually overlooked. Family presence and engagement in the care of dependent patients could be promoted by design and hence improve the patient's hospital experience and the efficiency of healthcare staff.

Regarding the usability of CURARQ-H tool, the support area is the most difficult area to evaluate because the tool's rooms schedule does not always match reality. The lack of space is usually proportional to the clutter found in support rooms that share different functions. Moreover, the staff area room's schedule is limited to two rooms (doctors' office room and staff changing room) and so few items (8) can be evaluated.

5. Conclusions

This study investigates the functional and environmental quality of four internal medicine wards in Spanish acute-care hospitals. Using a POE- tool designed for the Spanish context (CURARQ-H), layout analysis and photos analysis the results depict the improvement measures that could be carried out in any of the evaluated wards.

The main limitations of the study are:

- Even though the tool item generation was undergone from a review of relevant literature [20] and provided that CURARQ-H is available online [16] further studies should assess its content validation and test reliability.
- Alternative evaluation methods (questionnaire, interviews and/or observation) could have been used for strengthening the results.
- It would be interesting to increase the site scope and replicate the study in multiple facilities.

The implications for practice:

- Given that there is an urgent need for delivering more efficient healthcare resources in Spain, internal medicine wards in acute-care hospitals should be updated to cope with the new demands of an ageing population.
- Compared to Scandinavia, USA or Canada, healthcare architecture in Spain is being slow to embark on evidence-based design. There is no specific training for healthcare architects and little collaboration between healthcare staff and design teams. CURARQ-H tool could be an enabler for generating synergies between healthcare staff and architects in Spain.
- The tool's structure for organizing the information could be replicated in an international context. But only at a national level could the tool be used for updating the guidelines on healthcare facilities as it is customized to the economic context of Spanish society. The tool's usage could be a way to test current guidelines and provide feedback to facilitate the review processes for the improvement of national documents.

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EVALUATION OF HOSPITAL WARD LAYOUTS IN RECENT NORWEGIAN HOSPITALS

Aneta Fronczek-Munter [(1)*], **Tone Opdahl Mo** [(1)], **Unni Dahl, Rita Konstante** [(1)], **Hilde Tradin** [(1)]
[(1)] Sykehusbygg HF, Norway

* Corresponding author e-mail: aneta.fronczek-munter@sykehusbygg.no

Abstract

Objective – This paper presents current results from evaluations of two recently built Norwegian hospitals and aims towards collecting data to develop guidelines for hospital ward layouts.

Background – There is a growing interest in making decisions on hospital design based on evidence and post occupancy evaluations.

Research question – Which design solutions, investigated in evaluations of different hospitals, can give valuable input to guidelines for best design and layout principles of hospital wards?

Methods – Six hospital cases were chosen to represent different layout solutions of ward design. This paper presents and compares two of them. The methods included assessment of floorplans, walk-through evaluations with hospital staff, semi-structured focus group interviews and individual interviews. The combination of methods was used to investigate layout of wards, workstations and patient rooms. Focus was also on patients' comfort and possibilities of observation of patients as well as work processes in the workstations. Data and photos of specific areas were collected, interviews transcribed, analysed and summarised.

Results – The results show both similarities and variations in design solutions concerning architectural layouts of wards, workstation, patient room and bathroom.

The cases have following common features: Single-bed patient rooms, large windows providing daylight and view, wards divided into 3 smaller units – bed clusters organized around workstations, each monitoring 8-9 patient rooms. Both hospitals have open workstations located in the corridor and including a small glass-sheltered work area and 'support rooms' nearby.

Differences: The distance and visual contact between the workstations and the patient beds vary. One ward case provides bathrooms shared by two adjacent patient rooms, the other a private bathroom for each patient room. Furthermore, one ward includes a centrally placed patient leisure/waiting room with library while the other offers several small social areas for patients in addition to kitchen/dining room.

Perceived comfort, satisfaction and functionality differ relating to the design solutions. The linear design of wards gave a better overview and shorter walking distances than the L-shape. Open workstations functioned well and made the staff available for patients and nearest relatives but showed challenges with confidentiality and capacity. Both patients and staff were satisfied with single-bed rooms and report improved rest, confidentiality and containing infections.

Conclusion – The current evaluation provides preliminary results for design solutions concerning layout of wards, workstations and patient rooms. These solutions are associated with positive impact on experiences of architectural quality, functionality and patient and staff satisfaction and may therefore influence current guidelines for hospital wards.

Keywords: *hospital ward layout* | *evaluation* | *satisfaction*

Introduction

A knowledge-based design process

There is a growing interest in making decisions on hospital design based on evidence and post-occupancy evaluations. In the Norwegian guidelines for hospital planning there is from 2017 onwards a claim that all new hospitals should be evaluated, to contribute to the re-use of best solutions and to a knowledge-based design- and building process [1], 2018). On this background, the Norwegian agency for hospital planning and construction (Sykehusbygg HF)- has done evaluations of new hospitals, focusing on experiences of the built solutions, as well as evaluations of the extrapolated capacities compared to actual activity. The knowledge that stems from these evaluations is used to develop guidelines to help decision processes related to design of functional areas in hospitals.

This paper will focus on the design of wards (bed areas). The aim of the paper is to identify important design features of the ward, the workstation (a separate work area for nurses and other staff) and the patient rooms, based on existing research and recent evaluations done in Norwegian hospitals. The knowledge from the study aims to contribute to the development of guidelines for hospital ward layout in future new or rebuilt hospitals. This is a work in progress, and data from more hospital cases will be included at a later stage.

Hospital ward layout

Several relatively new Norwegian hospitals are built with bed clusters (sengetun). Important reasons for a change from traditional nursing units to bed clusters are to facilitate a closer contact between patients and staff, to improve observation of patients, increase safety and a feeling of security for patients, and to improve bed utilization. Typical elements in the design of bed clusters are:

- Clusters of patient rooms surrounding a decentralized workstation
- Decentralized equipment storage

Normally 3 or 4 bed clusters share common clinical 'support rooms', e.g., a group/meeting room, kitchen/dining room for patients, medicine room, and rooms for soiled and clean utilities. The bed cluster is not meant to be a separate organizational unit, but part of a larger hospital ward [2].

Research on ward layout shows that an important factor in developing functional ward areas is the location and design of the workstation. A general advice is to build decentralized workstations close to patient rooms. Studies have proved that this may reduce walking distances and improve the possibility to observe patients [3], [4]. Decentralized storage facilities for linen, medical supplies, and equipment are also shown to minimize walking distances [5]. Factors contributing to medical staff efficiency and satisfaction are workstation design, an integrated team approach and the overall physical layout of the space on walkability, allocation of caregiver time, and visibility [6]. Furthermore, Copeland and Chambers [7] found that nurses were more content with decentralised workstations compared to centralised ones.

In general, hospital buildings should contribute to environments that support work processes and interaction between staff and patients. Hua et al. [8] describe communication between different staff (nurses, physicians, physiotherapists mm) as an important aim of the development of wards. Communication between different staff is crucial for efficient patient care, and accordingly it is important to plan areas that provide space and overview (see also [9] and [10]). Research on this subject shows that communication may be influenced by different designs. Real et al. [11] found that centralized units facilitate nursing communication while decentralized units seem more supportive to proximity to patients.

Several studies over the last decades have analysed different aspects of design of patient rooms, particularly single vs multiple patient rooms, e.g., [12]. Research has proved that single-bed rooms help to reduce hospital-induced infections, noise, room transfers and associated medical errors, improve confidentiality and patient privacy, facilitate social support by families, improve staff communication to patients, and increase patients' general satisfaction with health care [13]. Research has also suggested that it is more expensive to run single-room wards as it entails a need for increased numbers of personnel. However, the research on this subject is not univocal [14].

Several guidelines have been developed to help knowledge-based design choices. One example of this is Health building notes in England, that give detailed best practice guidance on the design and planning of new healthcare buildings and on the adaptation or extension of existing facilities [15]. In Sweden, Chalmers technical college in cooperation with PTS (Program for technical standard) has developed research-based "concept programs" on specific functional areas in hospital, and among these, ward areas [16].

Choice of hospital cases

We recognised several concept solutions of ward layout and we chose to evaluate six recent Norwegian hospitals with focus on different ward design and their impact on daily practices in the hospital. Figure 1 shows the cases with their unique layout design solutions and distribution of wards. This preliminary study focuses on 2 cases: The St. Olavs Hospital (St. Olavs) phase 2 and Nordland Hospital Vesterålen (Vesterålen), the first with "L" layout and second with a linear layout.

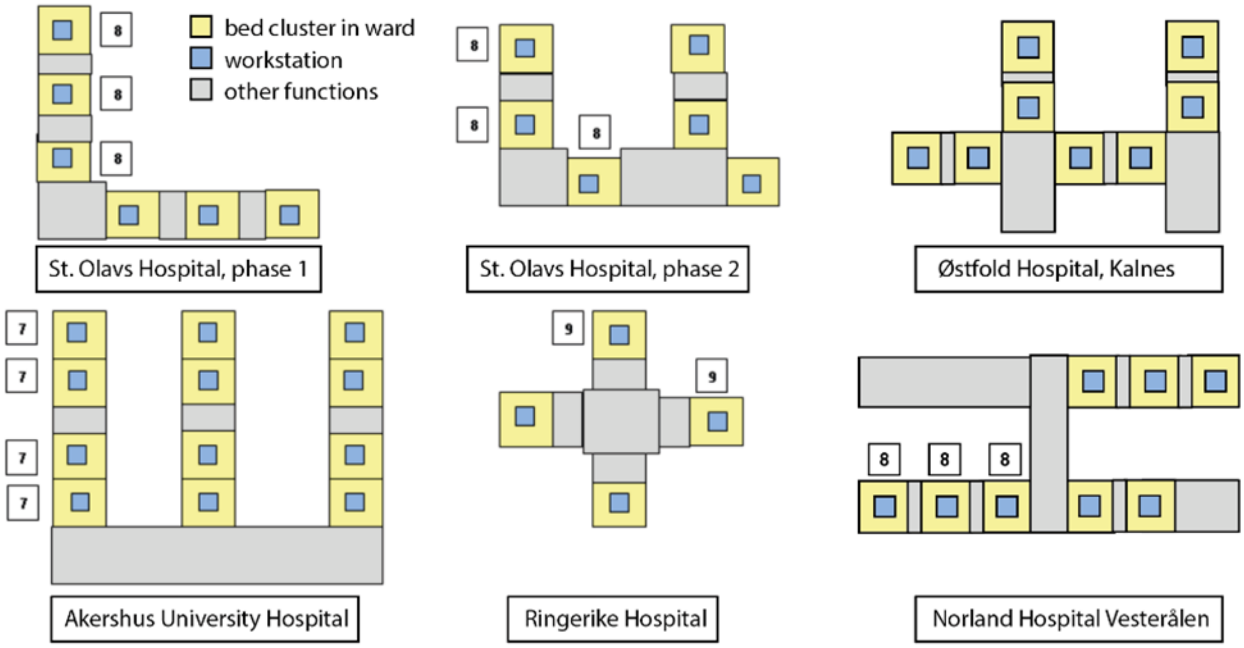

Figure 1. Different concept solutions of ward layout with bed clusters at six recent Norwegian hospital cases

Research question

We have decided to focus on the following research question: Which design solutions, collected from evaluations of different hospitals, can give valuable input towards current and future guidelines for best design and layout principles of hospital wards?

By evaluating different hospital cases we collected information about the experiences of the different solutions and their advantages and disadvantages. We focused on several topics to study. In this paper we will describe the following: the layout of wards, location and design of the workstations, the form and materials of patient rooms with special focus on bathrooms, the social areas and dining areas for patients, and the walking distances between those functions.

Methods

The most known evaluation methodology for buildings is POE – Post Occupancy Evaluation, as defined by Preiser et al. [17]; [18]. They define Post Occupancy Evaluation as "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time".

Recent research sees POE as “one of the tools to measure building performance and should be used in conjunction with other methods to evaluate all aspects of a building, including the social, psychological and physical” [19]. They suggest a combination of objective building performance data and subjective satisfaction ratings to achieve a valid and reliable evaluation of a building. There are over 150 POE techniques available worldwide [20]. The numerous existing methods often have one focus area that is evaluated more accurately than others. This is illustrated in the Evaluation focus flower model [21], where many of the existing evaluation methods for buildings have been mapped according to their main focus, see Figure 2.

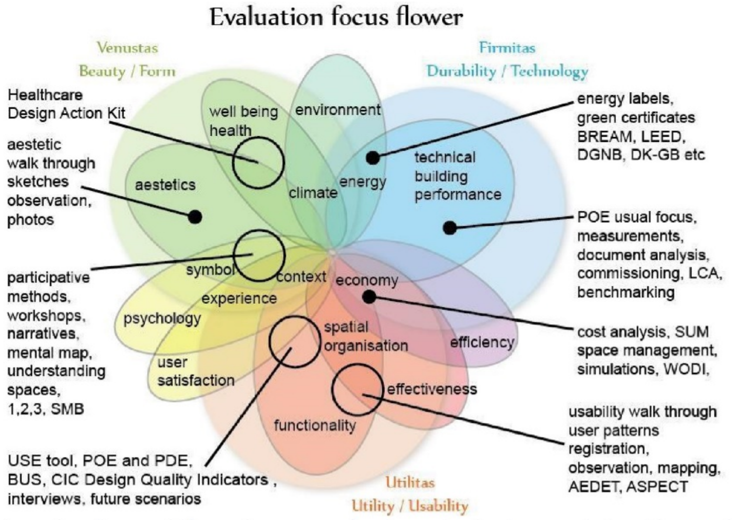

Figure 2. Evaluation focus flower model (Fronczek-Munter, 2013), with examples of different evaluation methods and their main focus.

As this is a work in progress, data from two hospital cases is included in the present study and four more cases will be included at a later stage. The cases are presented in Figure 1. The different hospitals represent different layout solutions to ward design.

The choice of methods for this study, following literature on evaluation methods, consisted of first choosing the focus areas: functionality, user satisfaction, aesthetics, well-being, and health. This was followed by choosing appropriate methods for collecting the data. The methods subsequently comprised a comparison of floorplans, visits to each hospital, and interviews with staff, managers and patients to evaluate the usability of the wards. This includes examining patient and staff satisfaction and collecting opinions on the ward's architecture, layout and functionality, and specifically how well the layout supports the daily practice in the hospital.

Overview over data from the two hospitals included in the current study is presented in Table 1:

	Vesterålen	**St. Olavs hospital, phase 2**
Floor plan analysis	x	x
Visit	x	x
Staff and manager interviews	x	x
Patient interviews	x	

Table 1. Overview of data sources from the current two hospital case studies included in the study, April 2019

Methods included walk-through evaluations with hospital staff members, followed by semi-structured focus-group interviews and individual interviews, to compare results on patient's comfort, safety, heath promoting architecture, workstations, efficiency, and physical solutions supporting or obstructing work processes.

In Vesterålen 21 interviews were conducted with managers and staff, partly in focus groups and partly individual. This comprised 9 managers from three different levels, and 12 employees (physician, nurse, nurse aid, and nurse specialist from anaesthesia, intensive care, emergency and wards). Three walkthroughs were made in the wards, in day surgery and the operating suite. Furthermore, 17 interviews were conducted with patients from medical and surgical wards (8) and day surgery (9).

At St.Olavs hospital three visits/walk-throughs were conducted, in the neurology/stroke department, in the department of vessels and endocrine surgery at the heart and lung centre, and in the gastro centre. Three in-depth interviews were conducted with two managers and one nurse in the gastro and neuro/stroke departments.

Data and photos of specific areas were collected, interviews transcribed, analysed, and summarised. Results were compared with recent scientific literature on hospital design and ward layout.

Results and analysis

Vesterålen hospital is part of Nordlandssykehuset HF in Nordland county. It was built between 2010 and 2014 and was evaluated in 2017, three years after occupancy. The size is 15000 m^2. The hospital consists of 79 beds, 69 are in the wards.

St. Olavs hospital HF is a large university clinic in Trøndelag county. It was built in two periods, between 2002-2006, and 2008-2013. It has 737 beds (2017) The size is 226000 m^2. The case included in this paper is from phase 2.

Figure 3. Overall views of the two studied hospitals – Vesterålen and St. Olavs Hospital, Photo 1: Evaluering av Nordlands-sykehuset Vesterålen, Sykehusbygg 2018, Photo 2: Helsebygg Midt-Norge, Synlig.no

Criteria for analysis:a

Several topics were analysed. In this paper we will describe the results with the following focus criteria:

1. Architectural layouts of wards and overview plan. Comparison of shape, visual comfort and main impressions. Measuring shortest and longest walking distance from patient bed to workstation, and from patient bed to social rooms/dining rooms.
2. Workstations. Location and design, layout, visibility, overview, description of workstations and staff experiences with layout and place – closeness to patient rooms, view to patient rooms, confidentiality, number of workplaces, and access to clinical support rooms. Furthermore size, distance from workstation and functionality.
3. Patient rooms and bathrooms, the social areas and dining areas for patients, and the walking distances between those functions. Patient and staff experiences with patient rooms and possibility to observe the patient and secure safety. Window and view to nature.

Architectural layouts of wards

The study in Vesterålen was done in the medical and surgical wards, which both have three bed clusters organised in a linear layout, along a corridor (Figure 4). Each bed cluster consists of 8 beds (single-bed rooms with private bathrooms), a decentralized workstation, storage for daily utilities, a social area for patients, and a combined work room/meeting room for staff. In addition, three bed clusters share clinical support rooms: A medicine room, equipment storage, room for soiled and clean utilities, disinfection room, and kitchen/dining room for patients (Figure 5). There is one staff manager office in each ward.

Figure 4 Vesterålen overall plan, level 2, including wards

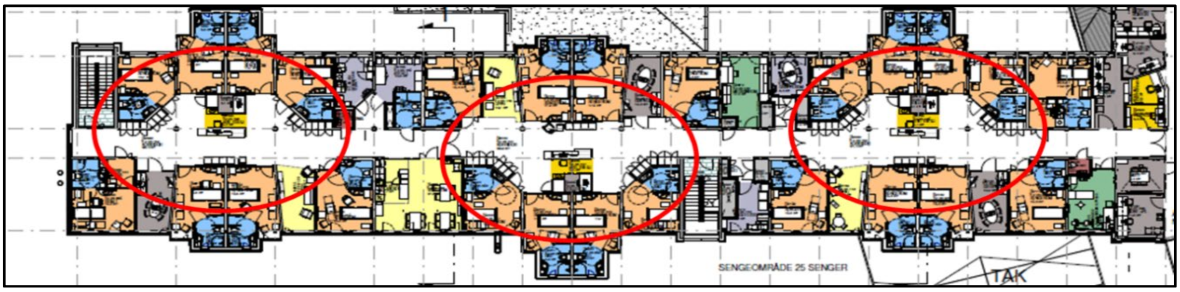

Figure 5. Vesterålen -plan of ward with three bed clusters

The ward studied at St.Olavs hospital is from building phase 2. The ward is L-shaped with three bed clusters, used for patients from the vessel- /endocrine section: Endocrinology and thorax (chest, heart, and lungs). The middle bed cluster is shared by patients from the two specialities endocrinology and thorax (Figure 6 and 7). Each bed cluster has 8 single-bed rooms, 6 of them share bathrooms and 2 rooms in each cluster have separate bathrooms (including one isolation room).

Figure 6. St. Olavs Hospital, plan of the Acute, Heart and Lungs Center building, case level 5

Three bed clusters in the ward share clinical support rooms: A medicine room, disinfectant room, equipment storage, room for soiled and clean utilities, personnel room, a room for teamwork, and kitchen/dining room for patients. There is staff manager office and a shared reception in each ward. Common rooms are shared across specialities.

The main impression from interviews in both hospitals is that the staff is satisfied with the general design and layout of the wards. The areas are light and airy with art and furniture in vivid colours. In Vesterålen it is possible to see across bed clusters and workstations, and it is easy to get an overview over patient rooms. Staff at St. Olav point out that one part of the ward is behind a corner, which prevents an overview over the ward. Consequently, it has been necessary to hire more personnel in the afternoon/evenings. In both hospitals patient rooms and support rooms are within short distance. It must be mentioned that at St Olav, the endocrinology has needed more patient rooms and expanded with four rooms in the thorax department.

St. Olavs hospital has wards including bathrooms shared by two adjacent patient rooms, Vesterålen provides a private bathroom for each patient room. The ward in St. Olavs hospital additionally provides a centrally placed patient leisure room including a waiting area with library.

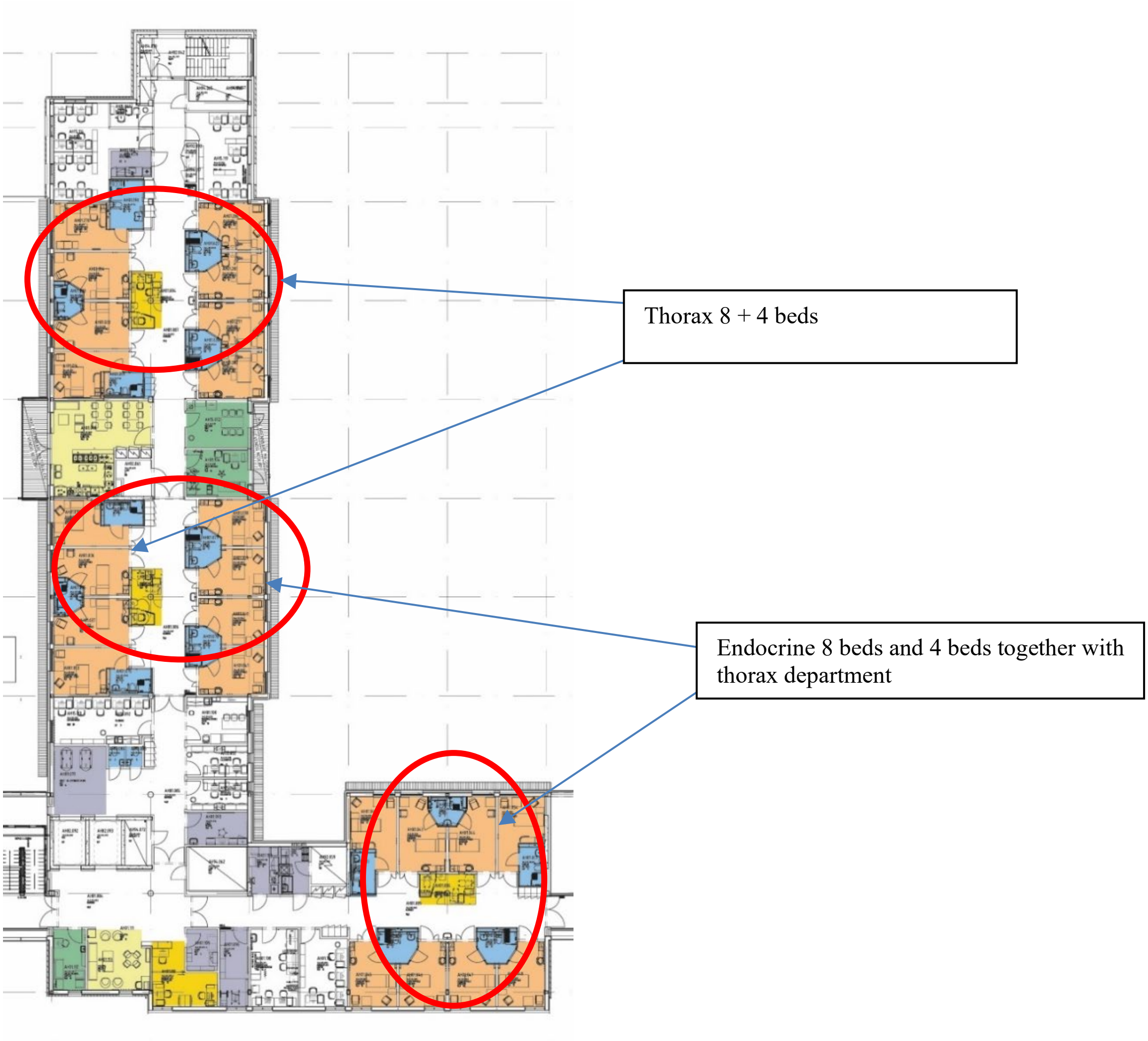

Figure 7. St. Olavs Hospital, plan of the ward of endocrinology and thorax, level 5

Measurements of walking distances

The distance and visual contact between the workstations and the patient beds vary. The measurements of shortest and longest walking distances from patient bed to workstation, and from patient bed to social rooms/ dining rooms are presented in Figures 8 and 9.

At St. Olavs Hospital (Figure 8), the walking distance from a workstation to closest patient bed is 9,6 m and to the furthest patient bed (in same bed cluster) is 14,8 m. The distance from workstation to furthest patient in the neighbouring bed cluster in nighttime is 62,8 m. According to staff, the layout is challenging in nighttime as shifts for staff are smaller, and a nurse needs to walk around a corner, making visibility and accessibility for other patients more difficult. The walking distances from patient bed to common social area, kitchen and dining area are marked with a blue line. The shortest distance is 17,1 m and longest is 75,2 m. According to staff, both the distance and visual barrier caused by the turn of the pathway makes it difficult for the furthest patients to walk to the dining room.

In Vesterålen (Figure 9), the walking distance from workstation to closest patient bed is 7,7 m and to the furthest patient in neighbouring bed cluster in nighttime is 43,2 m. The walking distances from patient bed to common social area, kitchen and dining area are marked with a blue line. The shortest distance is 12,9 m, longest to small social area is 25 m and longest distance to main dining area in the ward is 57,2 m. The ward in Vesterålen offers several small social areas for patients in addition to kitchen/dining room. The small areas are sometimes used for storage of equipment and, according to staff, are not often used by patients.

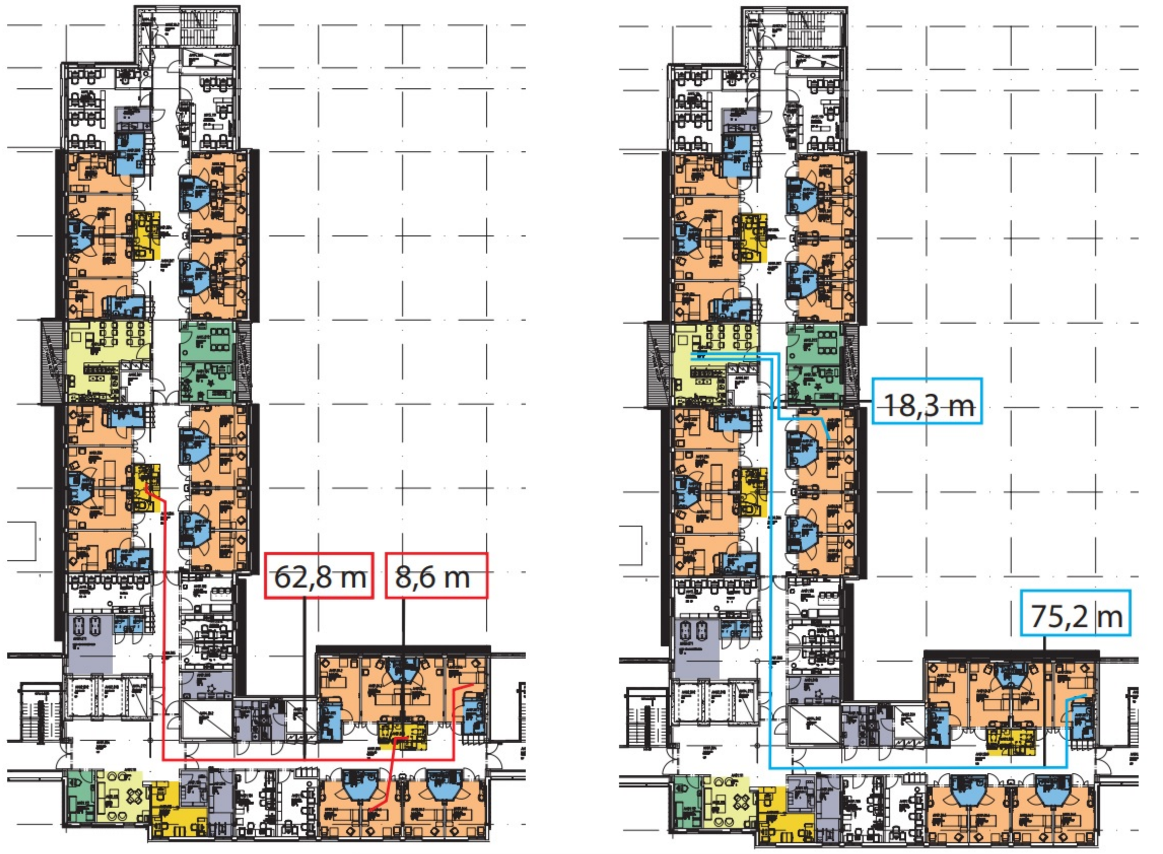

Figure 8. St. Olavs Hospital, measurements of walking distances, in meters; red line: from workstation to patients in bed cluster during daytime, to furthest patient in night time, blue line – walking distances from patient bed to common social area, kitchen and dining area, marked shortest and longest distances

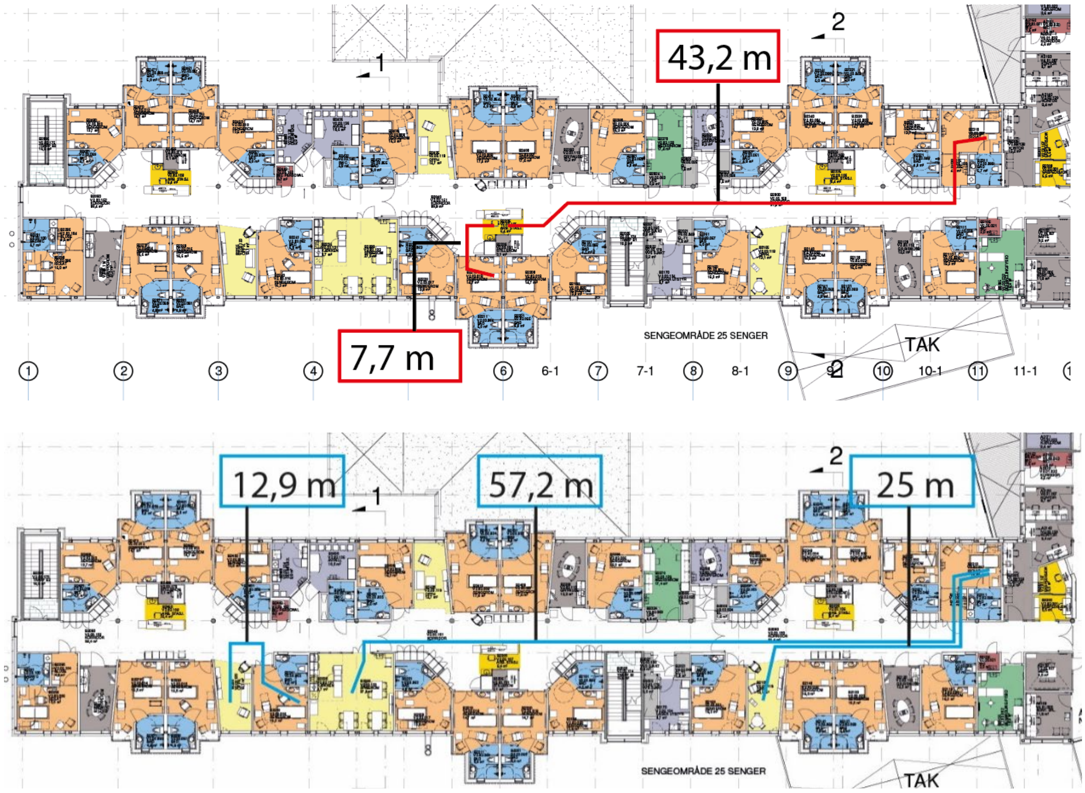

Figure 9. Vesterålen, measurements of walking distances, in meters. Red line: From workstation to patients in bed cluster during daytime, to furthest patient in nighttime. Blue line: From patient bed to closest common social area and main kitchen and dining area, marked shortest and longest distances to small and large areas

In Vesterålen the ward is designed to support flexible use of personnel across bed clusters. Storage in different bed clusters was equipped in a similar way to enhance recognizability across bed clusters. During nights staff would gather in the middle bed cluster to be able to see the whole bed area. There was an agreement that medical patients could use surgical beds if the medical bed area was full. However, the interviews showed that there was a relatively limited use of personnel across bed clusters. This was because personnel preferred working with patients within their specialist field, and there was limited time to provide extra training across specialities.

In both hospitals there is room for equipment storage close to the workstation, and storage for bed linen close to the patient rooms. Interviews showed problems with capacity of storage, both for linen (Vesterålen) and equipment (both). This was caused partly by routines of delivery and partly by planning and building too small storage space. In Vesterålen observations showed that wheelchairs and large equipment was stored in corridors and patients' social areas. Due to lack of storage, St Olav had placed an extra cupboard in the corridor.

Both hospitals have one kitchen/dining room for patients per ward. Staff in Vesterålen experienced that there were more patients who needed food served in the patient room than they had anticipated before moving in. In both hospitals staff pointed out that there was a significant walking distance to the kitchen. At St. Olavs this was especially noticed in the bed cluster behind the corner from the kitchen area.

The medicine room in both hospitals is shared by three bed clusters. The bed cluster farthest away use an electronic medicine trolley to minimize walking distances. The medicine rooms in both hospitals were said to be small, particularly if several nurses worked there at the same time.

In general, there were temporary solutions to minimize walking distances for the bed cluster farthest away from the clinical support rooms. Staff explained this with the need to stay close to the patients.

Workstations

In both hospitals each bed cluster has a decentralized workstation, and the patient rooms are placed facing the workstation, which gives a direct view to most patient rooms (Figure 5 and 7).

At St. Olavs hospital the open workstation has three computer workplaces, and one of them is partially closed in. Documentation work is done here or in a separate workroom. The design and form of the workstation is welcoming and pleasant, inclusive, with accessible design for wheelchair users, and uses natural materials as stone and wood. Interviews with staff at St. Olavs hospital showed that there were not enough workplaces in certain periods and in general a lack of facilities. For instance, an examination room was taken for documentation and meetings.

In Vesterålen each bed cluster has five computer workplaces that are used by nurses, physicians, occupational- and physiotherapists. Two computers stand in the open workstation, and one is placed in a small glassed-in cubicle behind the workstation. Another two computers are in a group room across the corridor from the workstation. This group room serves multiple purposes for staff: Meetings, pre-rounds, lunch breaks, computer work etc. In daytime all the workplaces in the workstation in Vesterålen are normally in use, and interviews with staff showed that the need for computers has increased over time, because of an increase in need for documentation and supervision. The workstation is particularly busy during and after doctor's rounds. The doctors have workplaces further away in the hospital, but the nurses prefer the doctors to remain in the ward after rounds, because it makes them available for questions and clarifications.

In Vesterålen, staff described open workstations as demanding for them, but positive for the patients. The patients were content that staff appeared available for contact, but some of the staff could wish for more shelter for concentration work. However, they saw that this might put off patients who might not dare to contact them behind a closed door. Several staff also said that it was difficult to maintain confidentiality in open workstations, particularly the hours after rounds, because all available rooms were busy. Conversations with patients were conducted in the patient room, but telephone calls and other confidential conversations was more problematic. Patients commented that it was easy to hear conversations from the workstation in the patient room when the door was ajar. The location of chairs in front of the workstation was not optimal for the staff, who could feel observed and suboptimal for confidentiality of staff interactions.

Interviews with staff at St. Olavs hospital confirmed that securing confidentiality in open workstations in busy periods was particularly challenging.

Figure 10. St. Olavs hospital workstation, photo and plan

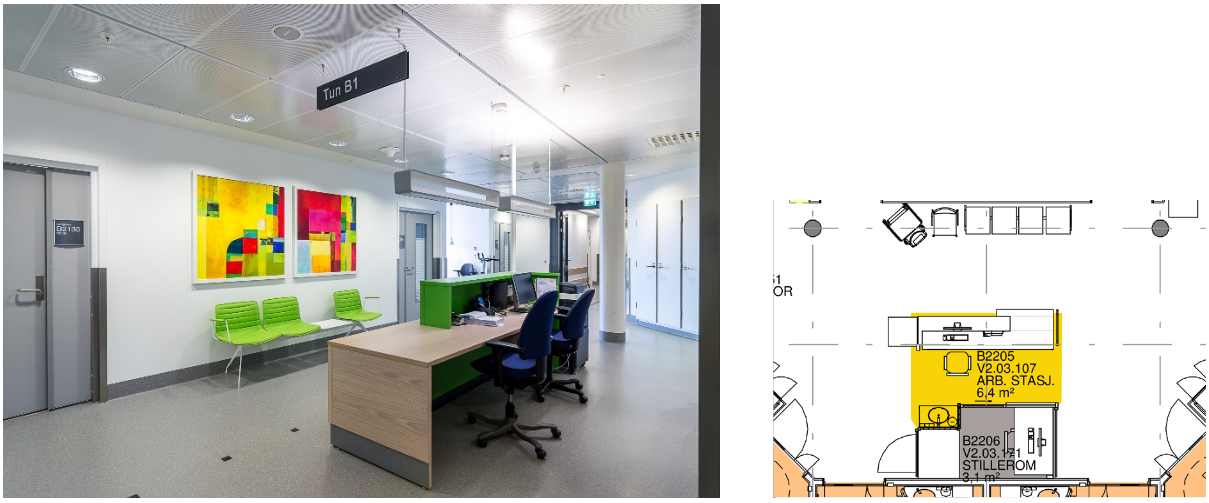

Figure 11. Vesterålen hospital work station. Photo: Svein Erik Tøien – www.setoien.com, plan

Patient rooms

Staff (both hospitals) and patients (Vesterålen) expressed positive experiences with single-bed rooms. Patients said that they were content, that it was calm, easy to sleep, easy to have visitors and to talk to health personnel in confidence. They were content to have a private bathroom. Staff in both hospitals pointed out that single-bed rooms make it easier to secure confidentiality, and that single rooms can be used for examinations, preparing for surgery, etc. Both hospitals confirm that the intention to document more in the patient rooms has not been achieved, mainly due to cultural conditions and existing habits.

In Vesterålen hospital staff experienced that patients stayed more in their rooms compared to the old hospital with multiple-bed rooms. Some patients with longer hospital stays, said that they would like to have a common living room.

In Vesterålen each patient room has a private bathroom. In some rooms the bathroom faces the outer wall, in others it faces the corridor, which makes a variation in the amount of daylight and outer landscape view in the different patient rooms. The doors to the patient rooms have a window with adjustable blinds, and staff can observe patients lying in bed without entering the room and disturbing the sleep. This observation contributed to the patients' health and safety.

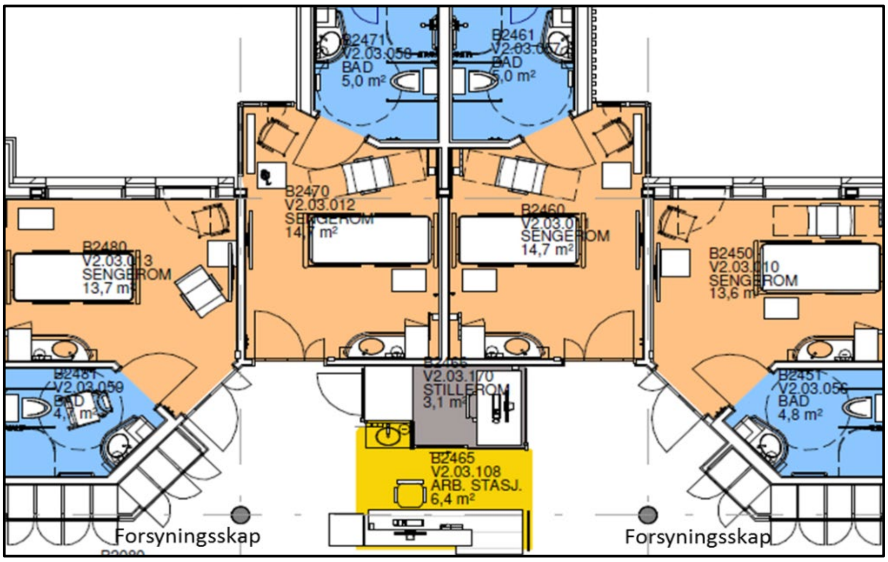

Figure 12. Vesterålen – view of workstation and patient rooms

In the St. Olavs hospital case, 6 of the 8 patient rooms in a bedcluster share bathrooms, and 2 rooms in each cluster have separate bathrooms (including one isolate) Some rooms have bathrooms facing the corridor and others face the outer wall of the room. That makes a variation in the amount of daylight and outer landscape view, due to shorter facade and possible size of windows. There are 4 different room designs, which could be problematic, referring to automatic orientation of nurses in all the different patient rooms and finding right location of supplies. There are small windows looking into two of the patient rooms from the workstation, with adjustable blinds. Staff said that patients with a particular need to be observed are placed in these rooms.

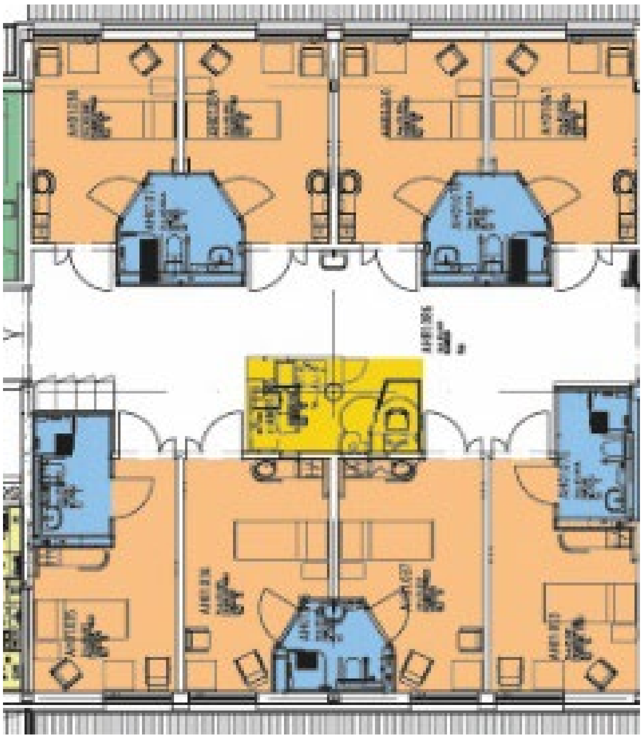

Figure 13. St Olavs hospital bed cluster, workstation and patient rooms

In Vesterålen staff pointed out that they had no outbreaks of gastrointestinal virus infection since they moved into the new hospital with single-bed rooms. This was also the case at St. Olavs hospital. However, at St. Olavs hospital, if there was a case of infectious disease in a room with a shared bathroom, the patient that had not been infected would have to use a bathroom somewhere else in the ward. Staff experienced this as very unpractical and troublesome.

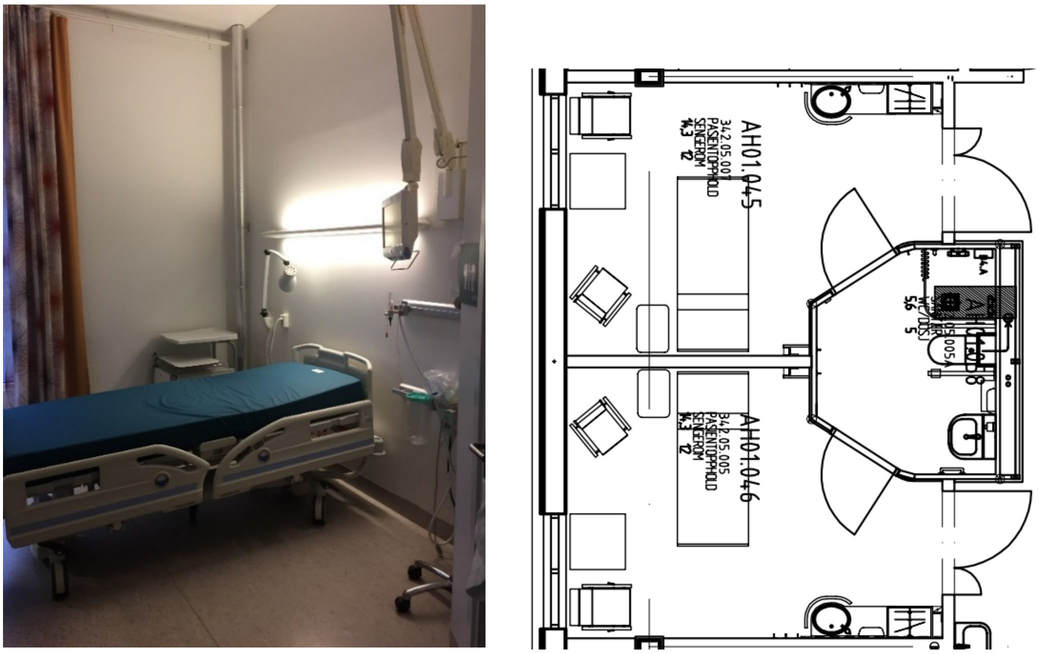

Figure 14. St Olavs hospital, patient room with shared bathroom

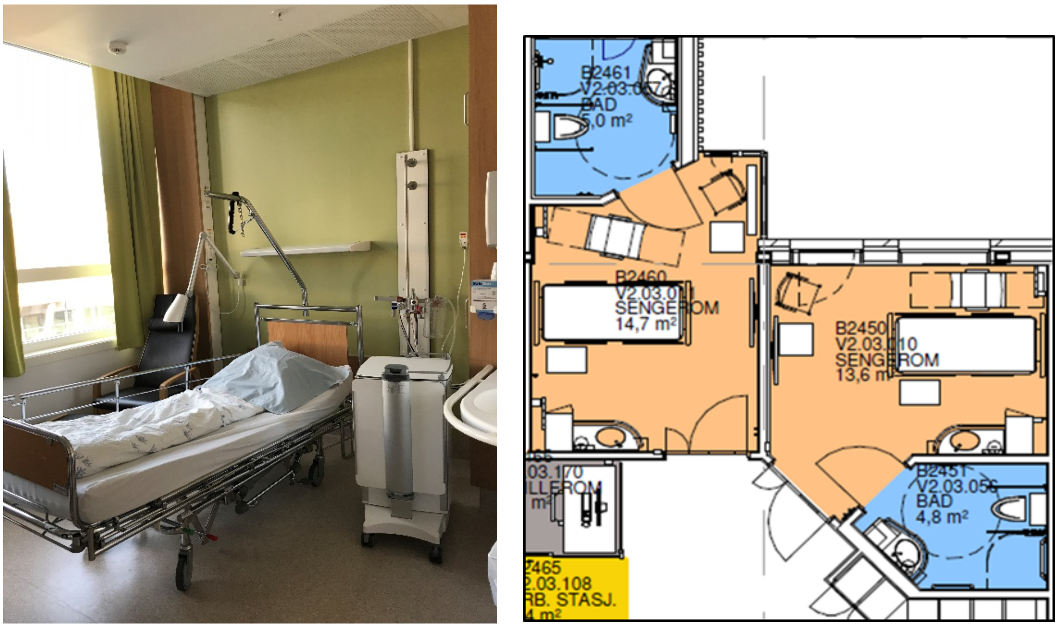

Figure 15. Vesterålen hospital, patient room

Discussion and conclusion

In this paper we have focused on a limited number of factors that are important for the design of functional wards. These factors are: Architectural layouts of wards, the design and place for the workstation, and the patient room and bathroom.

It is important that the ward layout and design of specific areas contribute to achieve the aims of the health services. The design needs to support the quality of patient treatment and care, patient security and safety, and positive experiences with the working conditions for the staff.

Our findings in architectural layout and overall design of wards are that the linear design of wards seems to give a better overview over the ward than the L-shape, which confirms previous research, e.g., [6]; [4].

The distance and visual contact between the workstations and the patient beds vary. The measured walking distances from workstation to patient bed vary from shortest 7,7 m to longest 62,8 m - to furthest patient in neighbouring bed cluster in nighttime. The walking distances from patient bed to common social area, kitchen and dining area are following: The shortest 12,9m and longest 75,2 m. In St. Olavs hospital case, both the distance and visual barrier caused by the turn of pathway make it difficult for the furthest located patients to walk to the dining room. The small social areas located along the ward in Vesterålen are sometimes used for storage of equipment and, according to staff, does not seem attractive for patients to visit.

In both hospital cases there seems to be problems with storage space. A general experience seems to be that there is too little space for equipment and room for daily utilities. Both the problem and the solution could involve a combination of existing or new routines and actual space size and location.

Findings about workstations in both hospital cases are the following: Patients and staff have positive experiences with decentralized workstations. However, there are some important conditions to make them work: Proper capacity and room for computer work across professions, and sheltered workplaces for concentration work and confidential conversations. In busy periods it is challenging to secure patient confidentiality. Specifically, in St. Olavs hospital, the staff would strongly wish a larger sheltered area for confidential work. Thus, the present design seems to challenge communication in certain situations, as in [8].

In evaluations of patient rooms our findings confirm the positive experiences from earlier research, as in [13]. Both patients and staff are satisfied with single-bed rooms. The staff has originally had ambitions to do more documentation work in the patient rooms – this has not been achieved. Nevertheless, multiple other tasks are done here, and private conversations between staff and patients are encouraged. A window in the door to patient rooms gives a possibility to see the patient in the bed without entering the room, and thus enhances patient safety (as also noted in [8]). It has been noted as positive to both patients and staff to observe/be observed without disturbing the patient.

Our evaluations prove that experiences of staff and patients with private bathrooms are more positive than with shared bathrooms, both regarding privacy and containing infections. In St. Olavs hospital the risk of infections because of shared bathrooms is prevented by referring the neighbouring patient to public accessible corridor toilet, which is problematic both because of privacy and extra walking distances for the patient.

Both hospital cases provided results on flexibility and durability of the ward concept, by proving that two medical disciplines can share one ward. In the case of St. Olav, the ward was dividing the three bed clusters and sharing similar design and storage capacities for two disciplines. Vesterålen as well uses the ward for two disciplines: medical and chirurgical.

The combination of presented preliminary findings from evaluations of wards in St. Olavs Hospital and Nordland Hospital Vesterålen will be developed further with addition of data from more case studies. These can form current and future guidelines for best design and layout principles of hospital ward layout, based on recent evidence.

Recommendation to further research

It would be valuable to include evaluations of more hospital cases and in particular recent cases from other countries, and with other ward layout principles, such as centralised workstations and touch down working desks, as seen in the UK.

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DESIGN FOR PSYCHIATRIC PATIENTS: THE COMPLEXITIES OF THERAPEUTIC ARCHITECTURE DECISION-MAKING

Dr Evangelia Chrysikou*

The Bartlett Real Estate Institute UCL, United Kingdom

* Corresponding author e-mail: e.chrysikou@ucl.ac.uk

Abstract

Objective - The research set to identify integrated methodologies for the design, planning and evaluation of psychiatric facilities in the community.

Background - De-institutionalisation resulted in care delivered in the community. Smaller-scale facilities, varying in terms of regime and place in the system, covered a broader spectrum of patients' needs, in a more comprehensive manner. This created an experimental network of psychiatric buildings in the community. These presented considerable variations both in architectural design and in care provision requirements.

Research question - In this complex context, how could we create a model that would:

- enable the planning, the design and the evaluation of psychiatric
- be flexible to use in such a variant framework
- be comprehensive enough to cover the various needs of the patient throughout the uneven path of recovery?

Methods - The research explored the concepts that dominated the thinking behind psychiatric treatments and care. It explored how these concepts influenced the design of psychiatric facilities and draw major themes in connection to their relation to treatment frameworks. These themes were synthesised in a model that could depict the main concepts and translate them in a specialised design decision-making tool [1]. This tool formed the grid of a purposely-designed, parametric checklist that could classify psychiatric buildings according to their institutional vs domestic elements. Also, a set of open-ended questionnaires aimed for staff and patients' views. These questionnaires could triangulate the user perspective to the initial theoretical model. The new tool was tested in two countries, in ten facilities with a sample of 115 patients and staff. Fifteen years later, the study was repeated in a second smaller sample that focused on the most acute spectrum of provision but which was also juxtaposed to spatial analysis [2].

Results - Both the theoretical model with their corresponding methodologies, i.e., patient and staff views, and the checklist when juxtaposed, tended to support each-other. Contrary, the spatial analysis was coming at odds with what was happening in the wards and with the other two methodologies.

Conclusion - Methodologies that were incorporating principles of non-architectural frameworks, in these cases the care models for mental illness, seemed to be more comprehensive and sensitive to the healthcare context, in this case psychiatric environments, than more generic architectural frameworks. This could be related to changes in the perception and physiology that relate to an illness and therefore, might require a more specialised approach for planning, design and evaluation.

Keywords: *Psychiatric design | healthcare architecture | therapeutic environments | psychiatric buildings | mental health buildings*

Introduction

Mental health provision has historically been determined by perceived risks, defined by each social context, rather than patients' needs. Until the first part of the 20th century, judges decided for referrals, to deal with dangerousness. We could name this model of care as jurisdictional. The establishment of psychiatry and the discovery of anti-psychotic drugs in the 1950s challenged that custodial model [1]. This created a paradigm shift establishing the medical model of care. Patients were transferred to the psychiatric ward of the general hospital [2]. When drugs proved ineffective to cure, psychiatrists realised the need for interdisciplinary therapeutic teams [3]. The psychosocial rehabilitation model that followed, introduced various care options, located inside the community.

This created unique and variant therapeutic networks, with an assortment of facility types. Mental health authorities acquired considerable freedom to plan their own models of provision. This prevented the development of well-established, evidence based design frameworks and typologies for psychiatric buildings [4]. The paper recognises these main concepts as drivers behind psychiatric architecture practices. It focuses on developing fit for purpose methodological tools to assist professionals involved in the planning, design and evaluation of psychiatric buildings deliver solutions closer to care and patient wellbeing requirements.

The origins of Community Mental Health Architecture

Baker and Sivadon [5] proposed to WHO a system of psychiatric care that included design guidance for a hospital integrated with satellite facilities. Among others, they introduced psychosocial theories and spatial situations to trigger clients' emotions for therapeutic purposes. Those theoretical concept designs feed the bipolar elements concept of Amiel' [6] "topotherapy". However, the concepts of Sivadon or Amiel were not widely adopted. Contrary, the newly established community mental health facilities were set up in storefronts, office buildings, former private homes or even self-contained luxurious clinics, providing in-patient and out-patient care, partial hospitalisation, emergencies or consultation [7, 8]. Moreover, there was a growing disillusionment on the actual possibilities for independent life after patients' discharge [9]. Zucker's institutional resistance to change was detected [10]. In these new premises, institutional practices could survive. Modernisation should target the social environment of the facilities as psychiatric buildings incorporated a significant level of socio-spatial complexity [11, 12].

The efforts of defining psychiatric space between two poles, i.e., hospital and home, constituted a discussion mostly among healthcare professionals and not the planners and architects who were providing for those. Therefore, the discussion did not involve the physical traits of these environments. To bridge this gap, "normalisation theory" architects referred to normalisation theory from the field of learning disabilities [13] to provide the context for planning and designing mental healthcare environments. Normalisation implied "homelike" environments but lacked a definition of what constitutes homelike in terms of built environment but also what homelike would mean in the context of psychiatric provision.

Eventually three options of mental healthcare co-existed: a) ordinary housing for all, b) care in the community but in co-operation with a hospital and c) modernised hospital care with its own community network [14]. So, when in the 90s medical architecture shifted from functionalism towards patient-focused environments, psychiatric theories could add to the dialogue by addressing the de-centralisation of provision and our limited and fragmented understanding of therapeutic space.

This diversity and limited interdisciplinary relations between architectural practice and health sciences, created an experimental, intuitive approach regarding the design of psychiatric facilities. This started to change in the last decade [15]. The gap of knowledge on psychiatric space was accentuated when interdisciplinary research combining methodologies deriving from medical sociology and architecture, found that even awarded psychiatric facilities might present strong institutional characteristics regarding building features and in terms of users' perspective [16]. To some extend this was expected, as there were no strong causal links between design and clinical outcomes [17]. Also, de-intitutionalisation was relatively new practice and there were no tested models of care. Third, there has been a lack of evidence-base culture in healthcare buildings competitions [18]. Finally, there was absence of vertical advocacy at planning stages. This resulted in disparity between the psychiatric principle of psychosocial rehabilitation, architecture, and user expectations or between the numbers of human resources in these facilities. It was also at odds with former practices of bottom up initiatives established as early as the mid of the previous century [19]. These generated the question on the relation of building layout to psychosocial performance. So, how could we create a model that would:

- enable the planning, the design and the evaluation of psychiatric facilities
- flexible to use in a variant framework
- comprehensive enough to cover the various needs of the patient throughout the uneven path of recovery?

Methodology

Initially we looked at key issues behind mental illness expressed by the dominant models of care as they evolved over the years. These three main concepts were the jurisdictional, the medical, and the psychosocial rehabilitation model, as introduced earlier.

An extended literature review looked at key concepts associated with the planning and the design of psychiatric facilities. This included legislation on psychiatric hospitalization from a historical perspective, psychiatric literature on spatial aspects, psychiatric care management on facility types and provision, environmental psychology and behavioural patterns of staff and patients in psychiatric wards to architectural publications on buildings for psychiatric uses. The review accompanied exploratory interviews with medical architecture professionals, visits to about 100 psychiatric facilities in the UK, Greece, Belgium and France. These highlighted potential conflict between various sources or ambiguity between different approaches. Those involved anything from the place of projects in the general context of care, the relationship of the facilities to their locus, the exterior, the services provided, safety issues, privacy, services and activities available to more private or intimate issues related to personal hygiene, sleep and relationships in the ward.

After the thematic analysis of the existing literature on mental health legislation and policy, provision as well as spatial considerations in relation to policy and treatment regimes, which constituted at that time, i.e., late 90s, the majority of the available literature, we produced a theoretical framework. That framework, was constructed as a means to classify all concepts related the spatial programming of psychiatric facilities. This was the SCP model. It was named after the acronyms of three variables: Safety and security, Competence and finally Personalization and choice. It was a three-dimensional model and each of these variables comprises one dimension of a cubic problem space occupied by three axes (x, y and z) (Figure 1), "where safety and security implies an opposite pole, where the building is unsafe and insecure, where competence implies a situation where dependency is fostered in patients, and where personalization and choice also implies a situation where no personalization and choice is allowed. Each building could theoretically occupy a unique position in the three-dimensional problem space of the model, which is therefore both more sensitive and more specific than the polar opposition between domesticity and institutionalization, previously described" [20] (Figure 2). The model could depict the quality of environment and its consequences to patients' life. The matrix formed by the three parameters did not cover the style of the facades as relevant but according to Shepley this was a reasonable decision [21]. Shepley has created a visual interpretation of the SCP model according to site scale features (Figure 3). Verderber characterised the analytical process and the research behind the SCP model as insightful.

At a second layer of analysis, the parameters corresponded to the basic needs related to mental health priorities as they relate to the main objectives of care (Figure 4):

a) Harm and self-harm prevention (essential for existence and therefore forming the basis of the pyramid), and corresponds to safety and security
b) Medical and nursing provision, to restore competence compromised by mental illness. The second parameter has been viewed by some scholars as relevant to the definition of environmental gerontologist Powell Lawton [18]
c) Social reintegration, promoting the personalization and choice that are lost in institutional environments, and correspond to wellbeing.

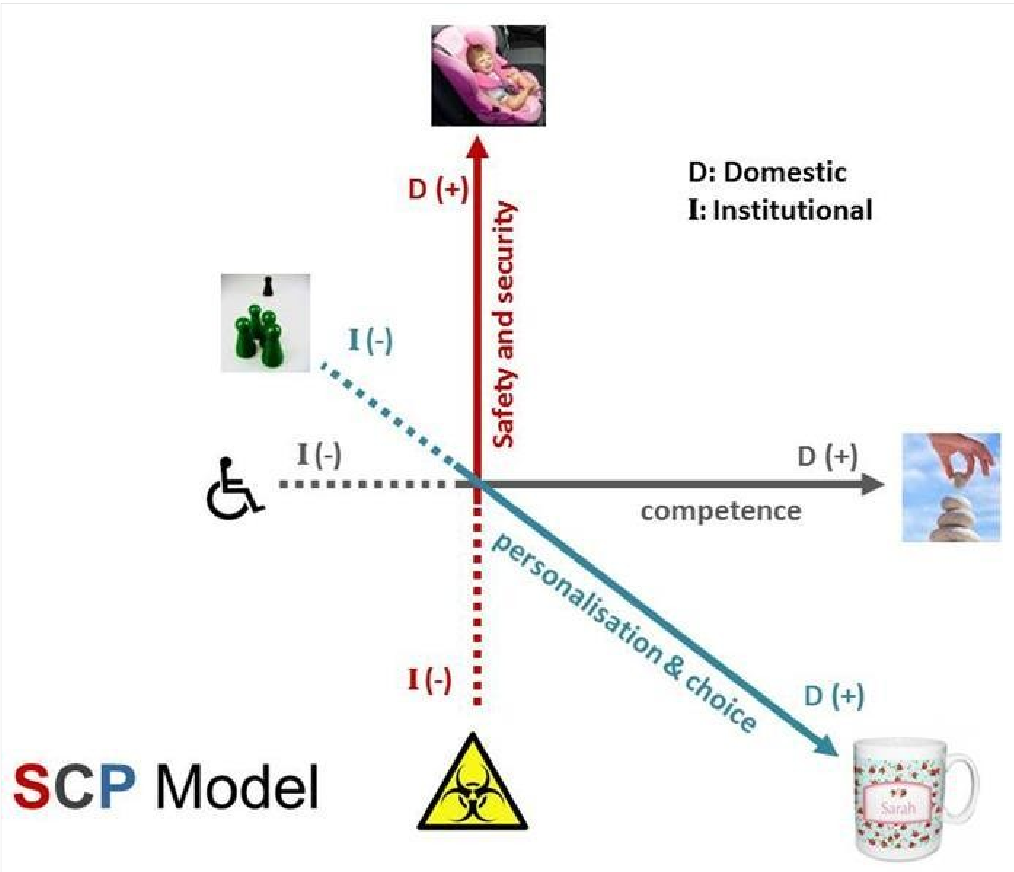

Figure 1. The SCP Model as a 3D space where psychiatric facilities can be placed according to their individual characteristics in domestic (+) vs institutional (-) scale

Even though, we moved over the years from custodial to the psychosocial rehabilitation models, elements of each still exist in psychiatric structures. The relationship of each facility or each care program to each of the three defines where each facility sits between the three. For example, a forensic facility might appear closer to the jurisdictional model and a serviced apartment is closer to the concept of psychosocial rehabilitation. Yet, each displays elements that belong to the other two. For example, a forensic facility might have an occupational or music therapy room or the serviced apartment might be visited by a social worker.

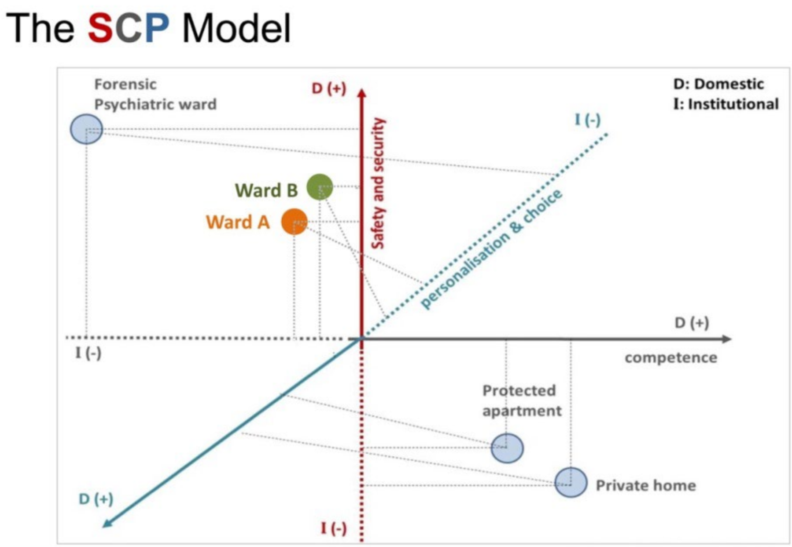

Figure 2. The case studies projected on the SCP model in relation to the spectrum of mental healthcare building stock

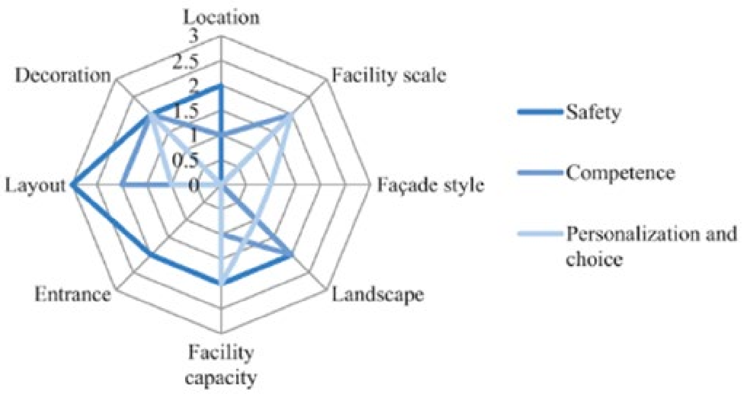

Figure 3. Shepley et al. graphic representation of the SCP model in relation to site scale features

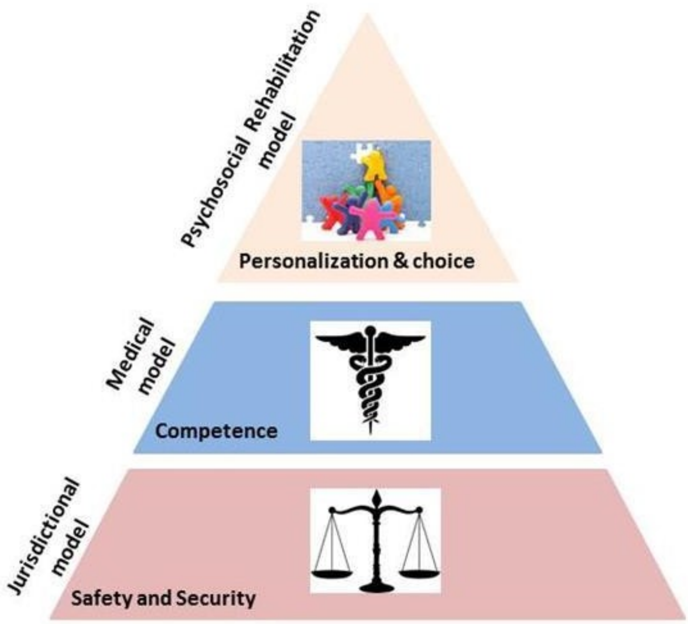

Figure 4. The SCP Model and the pyramid of needs: each tier represents a parameter of the model (named by the acronyms of the three parameters) and corresponds to a model of mental health provision

Case studies

For the second part of the research, i.e, the fieldwork, we concentrated on two countries among the sample, those with extensive networks of community provision, the UK and France. We selected ten case studies, the closest to the acute spectrum of in-patient care in the community. For the UK that community care included the provision for acute patients, this translated to mental health wards in the community and those hosted patients who were acutely ill and the majority were under a mental health section. For France, which still retained the psychiatric hospital and care in the community started mainly after patients' discharge from the hospital, the closest to the acute spectrum in the community would be the stage where people would be eligible for stay at the Foyers de Post-cure. Therefore, the French sample could be described as more stable than the UK sample, even though the projection of mental illness is not always linear and patients could relapse even at Post Cure.

Due to the considerable amount of speculation existing in the architectural press it was decided to use methodologies employed in psychiatric and healthcare provision research. For evaluating patients' needs and the compliance to care regime, patients, and staff were interviewed by the researcher using semi-structured interview questionnaires of 30 and 23 main sets of questions respectively. These questionnaires comprised three sub-sets of questions, each referring to one of the three parameters (security vs autonomy, competence vs dependency and restrictions vs opportunities for personalization and choice). The topics derived from literature on psychiatric rehabilitation and policies related to psychiatric inpatient environments and were then translated to spatial implications that were then juxtaposed with patients' and staff views. The interviews could define enabling environments for what staff considers best practice and patients perceive as suitable for their environments of care.

Additionally, the case studies were audited for their physical environment: Data on the physical environment and sense of place of the wards derived from a systematic architectural account for spatial organization, therapeutic regime, salutogenic qualities i.e., the building qualities that enhance health [22, 23, 24] such as day lighting, art, natural views, access to nature, etc. based on visits, photographical auditing, and plans. Regarding the plans, architectural blueprints were compared on their analogies of areas per use and user group.

Third, a detailed architectural checklist was used to identify the "normal" as opposed to the institutional traits of buildings. The checklist dissecting each building to 212 traits identified institutional physical characteristics in a comparative scale to the local norm as defined by the neighbouring or local residential buildings in parameters related to the exterior, the layout, and the design of the interior. The checklist had been adapted by a similar checklist of Robinson et al [25] researching residential environments for learning disabilities.

Fifteen years later, the study was repeated in a second smaller and different from the original case studies sample by the same researchers. This time, the research focused on the most acute spectrum of provision, i.e. the acute psychiatric ward in the community and the findings were juxtaposed to spatial analysis. This was because, the SCP model could use data from the previous study and add a longitudinal evidence of changes that happened, bearing in mind though the limitations as the facilities in both studies are of the same time but not the same buildings neither belong to the same health authorities. Also the SCP model bears limitations regarding the socio-spatial dynamics inside the wards and this was considered as a way to address them. One of the most widespread architectural theories associated with socio-spatial dynamics is the theory of space syntax [26]. This theory of architectural morphology has developed tools that could look in more depth on the opportunities for social encounters that buildings generate. This methodology has been widely used in urban and normative architecture settings but was seldom used in healthcare settings. The question would be if we could set more light to the socio-spatial angle of the institutions and whether we could identify any generators of institutional environments. This project for the first time brought together the two frameworks, i.e., the SCP model and Space Syntax, the former designed especially for mental healthcare and the latter for all spatial scale.

Space Syntax has a strong algorithmic toolsets, involving all scales of planning and design and all typologies looking at their spatial structure. According its theoretical framework the relation of space and society is interconnected. Hillier [27] suggests that to research buildings we need to find their social patterns, through their non-discursive contents. This is because human understanding of spatial configurations happens intuitively and we do not have the vocabulary or discursive mechanisms to express and therefore research it. The emphasis on layout irrespectively to other qualities of place-making that the SCP model addresses is an important reason of including Space Syntax in this project: data occurring from spatial analysis would be 'unpolluted' from pre-conceptions of medical architecture.

By combining these two methodologies, the second stage of the research –and the one we will focus here – set to investigate both patients' relation to the therapeutic regime, as on the first stage, and social relations to the spatial configuration, which was a new element. The SCP model constituted the basis of the evaluation, being more high-level in the aspects covered even though it is less generic when it comes to population and the building types. Space Syntax, on the other hand, has broader applicability in the build environment but is more focused on layout issues and does not cover issues such as fixtures and fittings, technologies, availability and types of human resources or aesthetics. Thus, it provided tools on observability, wayfinding, and social solidarity. The findings from that methodology enriched areas that come under the SCP parameters. Findings of agreement between the two frameworks might enable the formulation of an integrated model for mental health design and findings of non-agreement allow these theories to evolve by addressing the limitations that the research pointed out (Table 1).

Regarding the objective on the built environment in relation to psychiatric space, the research set to establish a valid framework of designing for mental health. To achieve that, this user- inclusive research involved academics and architects, health authorities, staff, and patients. The locus involved two secure acute facilities chosen according to pre-set criteria and permission granting, in line with the growing policy of community care. For the secure, acute parameter, the more severe the symptomatology is and the closer to the acute episode, the more important the therapeutic environment, and the more persistent the institutional regime might be.

Methodology for a psychosocially supportive design of mental health facilities		
Objective (reference to main research objectives)	**Methodology**	**Tools**
Personal milieu (I)	Evaluation of patients' needs and compliance to care regime	Semi-structured interviews of 30 (for patients) and 23 (for staff) sets of questions
Place-making for mental health (II)	Data on physical environment and sense of place	Visits, photographical auditing and architectural blueprints for calculation analogies of areas per use and user group
Domesticity vs Institutionalisation (I)	Architectural checklist	212 traits on building exterior, layout and design of interior
Social Milieu (I)	Space Syntax analysis	Convex graphs, axial graphs, visibility graphs and justified graphs

Table 1. Methodology in relation to main research objectives

Results

The locus of the research comprised two acute psychiatric wards in London, belonging to different Mental Health Trusts, all part of the public healthcare sector (Figure 5). The selection of the case studies was done by the two participating Trusts. Staff suggested a potential pool of patients well enough to participate. Then it was up to these patients to decide if they wanted to participate. Staff participated according to availability. Final sample comprised 11 patients, 4 from Ward A and 7 from Ward B and 10 members of staff, five from each ward. Ward A was single gender. The stage of the illness was the main factor that could affect preferences compared to age or gender in the previous study [20] with patients being less able to cope from non-fit-for purpose design. Therefore, this study focused on this patient group. The project was carried out following all ethical procedures and permission required by the Research Ethics Committee (REC) of the National Health Service (NHS).

Figure 5. Floorplans of Wards A and B. The architectural drawings are color-coded according to functions

Both wards, presented strong institutional character: an average of 60.85% and 54.72% according to the Institutional vs Domestic Checklist for Ward A and B respectively (Table 2). In terms of layout (building features) the wards have identical number of institutional features. Regarding the surrounding area and exterior (context and site), Ward A presents more institutional features than Ward B and this is similar when it comes to the interior design of each room in the building (space and room features according to Robinson classification) [25].

Regarding layouts, the two Wards presented similarities yet there are key differences too (Table 3).

Institutional features for wards A and B according to the Institutional vs Domestic features checklist Checklist				
Feature	Ward A		Ward B	
Context and site features	16/22	72.73%	14/22	63.64%
Building features	24/40	60%	24/40	60%
Space and room features	89/150	59.33%	78/150	52%
Total	129/212	60.85%	116/212	54.72%

Table 2. Institutional features for wards A and B

Similarities and differences in the layout of the two Wards			
	Description	Ward A	Ward B
Similarities	Ground Floor	+	+
	Single-storey	+	+
	Access to fully protected courtyard	+	(+)
	Cenntrally positioned nurse station	+	+
	Centrally positioned clinics	+	+
	Double loaded corridors	(+)	+
Differences	Office area: Offices integratted (as opposed to segregated or at the far end)	–	+
	Self-contained ward (vs dependent)	–	+
	Single bedrooms (vs sharing)	–	+
	Toilets: Individual (vs shared)	–	+
	Gender segregation: Single gendered ward (vs female only area)	–	+

Table 3. Layout similarities and differences for Wards A/B

Ward A presented wear and tear and demonstrated institutional traits such as dormitories and shared toilets, considered obsolete. On the contrary, Ward B was maintained in an excellent condition. Still, the number of its institutional traits was comparable to that of Ward A because of an extensive use of anti-ligature fixtures and fittings.

Interviews provided qualitative data. Passive behaviour was mostly encountered in Ward A and activities mostly common in case study B. Willingness to participate to interviews was also higher in Ward B. Dormitories as opposed to single rooms seemed to increase passive behaviour combined to the limited availability of staff. Both staff and patients in Ward B reported positive and frequent interaction between themselves.

Staff interviewed on the nursing station and its effectiveness in providing adequate control, were 7/10 satisfied. There were 3 staff, two in Ward B and one in Ward A who were dissatisfied with the control available from the nursing station. The latter pointed that the nursing station felt suffocating.

The justified graphs, a space syntax tool, present the spatial configuration of the wards. The two justified graphs (Figure 6) present similarities in their overall shape and relatively similar amount of depth. Yet, wards differ considerably on the placement of the private and intimate areas. Depthmap was used to indicate areas of higher or lower co-presence. In ward A, which was more institutional according to the checklist, we see that the most segregated areas were the clinical and staff areas at the rear of the building. In ward B, we see the least integrated areas being the en-suite toilets/shower rooms. In both wards the most integrated areas according to Depthmap were the areas outside the nursing station. Isovist analysis was then performed from points of highest integration and where visibility mattered such as the nursing station, such as the isovist from the nursing station.

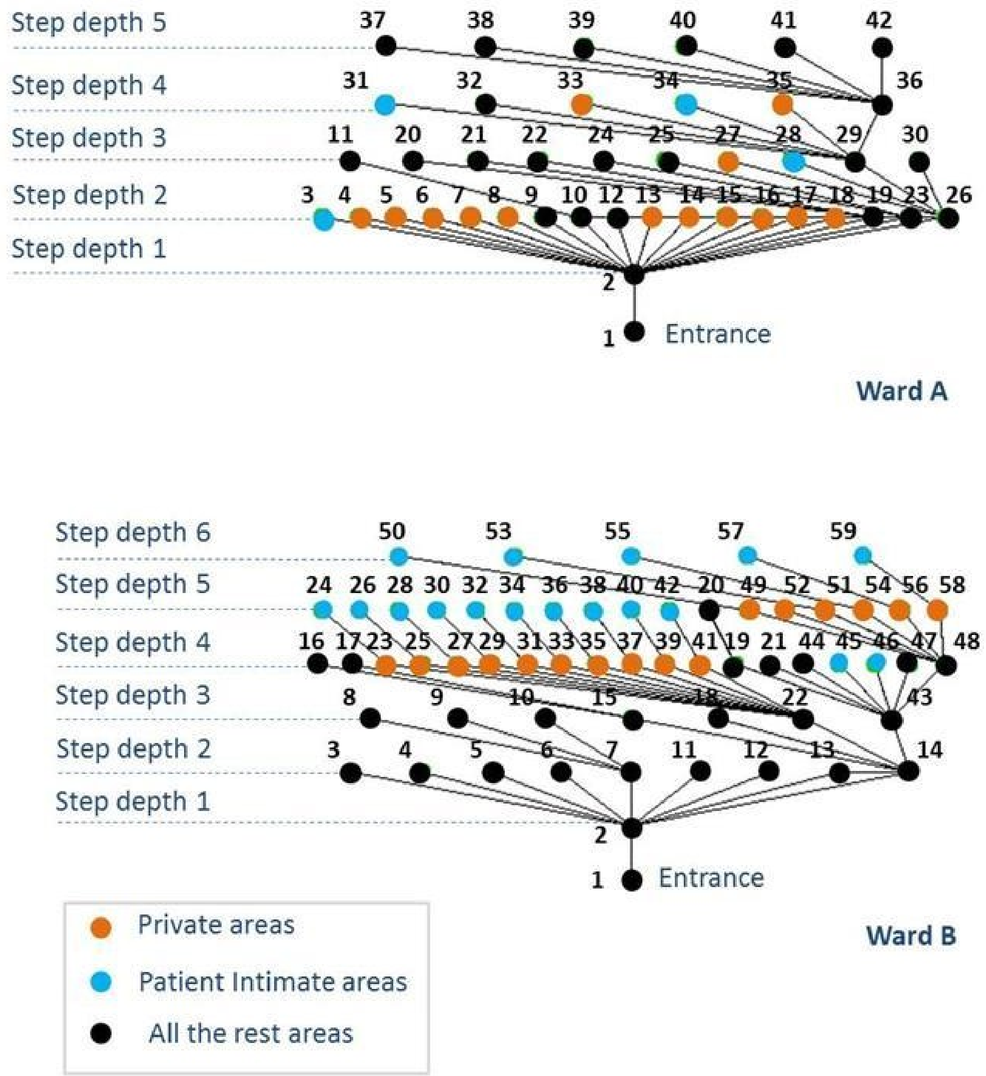

Figure 6. Justified graphs of Wards showing depths of private/intimate areas

Discussion

The research produced a significant volume of data, deriving from the checklist, the interviews, the architectural auditing and for the two recent wards, the spatial morphology analysis. These generated a comprehensive series of findings regarding architectural features, therapeutic regimes, layouts, relationship to care models, and to users' preferences, plus their relationship to the data of the early 2000s UK research [20,28,29] that used the SCP model and generated a comparable amount of data.

The two more recent wards are at the institutional end or very close to it when compared to the former UK sample, i.e., of the case studies that had been investigated using the same checklist 15 years ago (Table 4) [28]. This is even the case in the renovated ward. Yet, the number of institutional features alone could not convey the character of each facility.

Percentages of Institutional features per building	
Facility	Mean
Ward A (2016)	60.85
Ward I (2002)	56
Ward B (2016)	54.72
Ward II (2002)	48
Ward III (2002)	47
Ward IV (2002)	44
Ward V (2002)	26

Table 4. Mean institutional percentages for Wards A/B compared to earlier UK sample

There was an increased emphasis on suicide prevention through design and clearer gender segregation in agreement with the National Service Framework (NSF) for Mental Health [30]. Over the years, the dilemma between the safety-security (jurisdictional model) axis and the personalization and choice that occurred from the psychosocial rehabilitation model favoured the former. This happened despite studies supporting that homelike features together with opportunities for privacy increase social interaction and support wellbeing [17]. Moreover, research in German wards suggested that locked wards when compared to open facilities, do not seem justified to prevent suicide and absconding [31].

Wards A and B represented two distinct models of care provision: one pre-normalization providing low stimulation, limited privacy, and sociofugal design of sitting arrangements [31, 32] and one post-normalization featuring specialized psychiatric design, especially in terms of materiality. The latter could be described as a re-introduction of the psychiatric ward of the general hospital in the community: emphasis on infection control, anti-ligature, central nursing station, provision for various degrees of gender segregation, general hospital policies such as the non-smoking policies in all hospital outdoor areas.

The qualitative characteristics are mostly depicted by the analysis using the SCP model (where we can see for example where the ward sits compared to anti-ligature, medical or the rehabilitation models), the architectural morphology analysis, and in particular the analysis of user hierarchies (for example the integration value of the staff areas compared to the integration values of the rest areas) and policies such as gender segregation, smoking policy or access to the existing outdoor areas.

Additional findings

- One less institutional facility in terms of building features could demonstrate a strong institutional behaviour led by specific policies.
- Policies could generate social unrest.
- Policy and psychiatric buildings are interrelated. Yet, policies might change at any time during the building life-circle.
- Policy might affect the spatial use of mental health facilities considerably.

The integration of the nursing station could generate food for thought regarding the application of Space Syntax in psychiatric care. What Hiller and Hanson (1984) would describe as social logic of space might be severely compromised by top down imposed rules and movement restrictions. On the contrary Space Syntax identified as spaces generating social interaction the locations of actual institutional behaviours and anti-social outbreaks. For instance, in both wards, the most integrated spaces appear to be the spaces outside the nursing station (Figure 7). These were also areas of visibility (Figure 8). Similar to total institutions, patients gathered outside both nursing stations putting themselves in the surveillance “radar”. Visibility from those points might have been requirements of the architectural briefs. Yet, most staff did not gather there. Patients did not wait outside the staff office of Ward B, which was at a segregated part, neither outside the entrance connecting the ward corridor to the staff only part in Ward A, which appeared similarly segregated. Patients gathered at the most integrated point. It remains uncertain whether that was a demonstration of an institutional behaviour or a human need of meeting people at the point that spatially provided the highest chance of social encounters. The co-relation between the two, areas of high integration and anti-social behaviours is in agreement of the space syntax theory as space syntax indicates chances of encounters. However, space syntax does not specify if these areas of increased co-presence would translate to positive or negative encounters. This needs to be clarified especially since the Bill Hillier, the founder of Space syntax, uses the phrase-principle "people attract people" when explaining the conceptual origin of space syntax [27]. Bill Hillier and other space syntax scholars consider these interactions as positive, especially since several publications they attribute anti-social behaviours because of areas of low integration and areas of higher integration with increased safety [26,33, 34].

In the psychiatric context this attraction could be attraction for co-presence even if this co-presence results in anti-social behaviours. This could be attributed to two factors. One could relate to how mental illness affects perception. As psychiatric patients require more personal space compared to normative population [35, 36], anti-social outbreaks occur in spaces that their personal space is endangered by too many or too close encounters. The other is that we could broaden the perspective of space syntax scholars, including theory founders Bill Hillier and Juliane Hanson and accept that space syntax could highlight places for social encounters, both positive and negative. This research affirms these predictions with data of anti-social outbreak. However, this tendency for negative social encounters, where the space syntax scholars might predict positive encounters, might be related to the social fabric of psychiatric establishment and its generation of anti-social phenomena [37] or this could be an indication that these spaces comply with Goffman's definitions of Total Institutions [38]. The latter observation is in agreement with the amount of Institutional points scored by these two facilities at the Checklists. They performed on the top range of the sample even when compared to the sample of the initial part of the research in the early 2000. Moreover, showing negative interaction results, these two wards could also fall under the group of buildings Hillier and Hanson call "inverse" buildings. By those they mean buildings that correspond to what Goffman calls Total institutions and where institutional regimes and rules are over imposed normative human behaviour.

The above becomes more complex when we consider the visibility from the nursing stations. One of the key aims of a nursing station is surveillance (Figure 8). However, visibility from nursing station glazing to the corridors in both cases had been partially blocked by staff by furniture arrangement and pieces of paper taped on the windows of the nursing stations and in both cases staff had their backs to the corridors. Thus, staff lacked visual control.

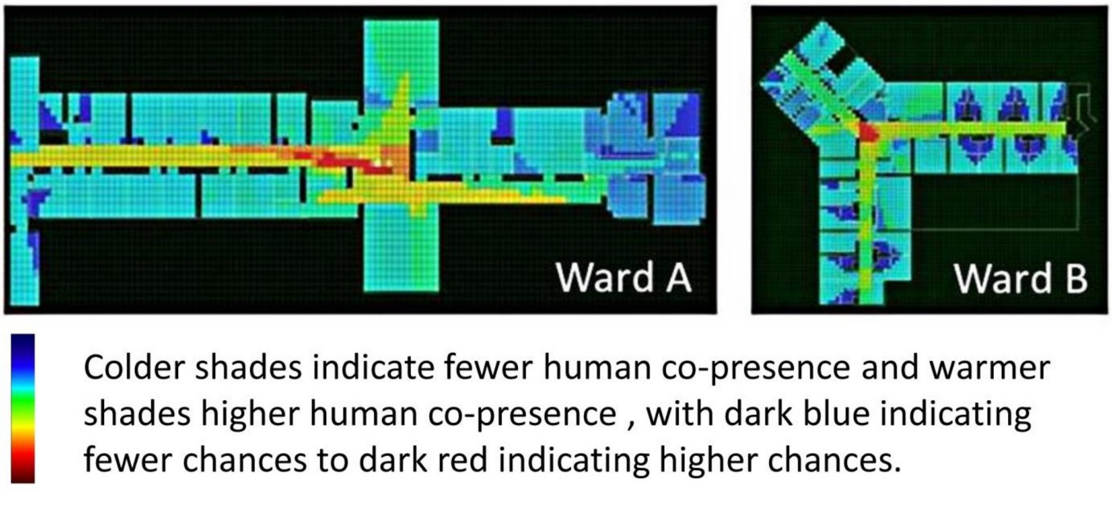

Figure 7. Integration of Wards A/B. The colours are computer generated from the shape of the plans and indicate chances of human co-presence (from dark blue indicating fewer chances to dark red indicating higher chances). From the plans it occurs that the most integrated space is the area outside the nursing station (red)

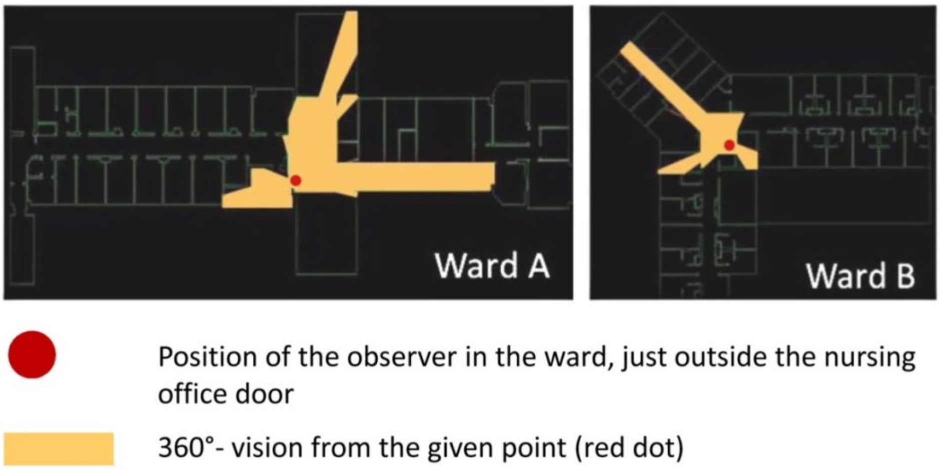

Figure 8. Visibility from the nursing station at Wards A/B. The dot on the two graphs represents the position of the observer in the ward. The raster shows the 360°- vision from that given point

Conclusions

Dangerousness still dominates the design of psychiatric wards in the UK, despite the optimism from psychiatric rehabilitation movements. The findings highlighted potential connections between policies, care-regimes, spatial configuration and social fabric. The research combined a tool specifically developed for the evaluation of psychiatric facilities to a generic architectural methodology. Institutional undercurrents inside psychiatric environments still survive, even when care in the community policy implies that institutions have been abolished. The tool, seen as a matrix ranging from normal to institutional could challenge the way psychiatric buildings are planned and designed from the current surveillance-led model to integrated design for patient wellbeing as is based on three dynamic axes rather than a dominant anti-ligature logic that tends to dominate psychiatric architecture at least in the NHS. From a clinical perspective, this would mean that each decision-making step would be weighed against the therapeutic plan and not pre-assumptions of those involved in the planning, design and building delivery process. Such a dialogue fostering process would be beneficial for all user groups and mostly the actual recipients of care.

Findings indicated that generic methodologies used without involving tools deriving either from medical humanities, such as medical architecture and medical sociology, or from a more clinical or healthcare management perspective could not provide results that could be used with confidence, as the healthcare context is a much more controlled and multi-parametric environment than normative urban or architectural planning.

The insights from medical architecture and healthcare facilities planning can outline institutional undercurrents and help make better sense of generic architectural methodologies, which on their own can been misleading. This is in agreement with the growing trend of employing comparative methodologies to conduct research in healthcare buildings [39].

Regarding limitations, the interconnection between design and social logic result in difficulty to establish cause and effect. Future research involving more case studies that vary considerably in spatial configurations, institutional levels, and regimes could gradually provide better understanding on the key determinants.

The experience of staff and patients, their interpersonal relations, health, and wellbeing, all are influenced by their environment. The research provides the ground for an integrated design framework for evidence-based mental health architecture to serve as a design and evaluation tool, immediately accessible to architects, planners, and stakeholders. Incorporating the full spectrum of patients' needs (physical, caring, wellbeing) and recognizing spaces as cells that allow mechanisms to operate and influence behaviour towards social integration.

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INTERDISCIPLINARY APPROACH TO EVALUATE ENVIRONMENTAL USERS' PERCEIVED RESTORATION IN HOSPITAL PUBLIC SPACES

Nicoletta Setola [(1)*], **Elena Bellini** [(2)], **Elizabeth Marcheschi** [(3, 4)]

[(1)] Department of Architecture TESIS Centre – University of Florence, Italy

[(2)] Department of Architecture – University of Florence

[(3)] Department of Architecture and Civil Engineering – Chalmers University of Technology

[(4)] Centre for Healthcare Architecture, Chalmers University of Technology

* Corresponding author e-mail: nicoletta.setola@unifi.it

Abstract

Objective – The study aims to: 1) assess the relationship between the quality of hospital's public spaces expressed in terms of accessibility and visibility of art and greenery and users' restorative experiences; 2) highlight how physical environment may promote health and wellbeing of patients and staff/user.

Background – The issue of public spaces in hospitals is very debated today: the direction taken by a few decades is to implement these spaces giving them a humanization feature to promote the well-being of patients and staff. Architectural trends have developed around the creation of halls, mostly glazed, with more volumes appearing, and large dimensions. The importance of restorative spaces as a mediator factor for health outcomes among the users is increasingly recognized.

Research questions – 1) Which public spaces are perceived to be more restorative? 2) Does familiarity with a place affect the users' perception of restoration in hospital public spaces? 3) To what extent does the perception of restoration vary across settings that support similar functions but present varying levels of art and greenery? 4) How does the combined use of Technical Environmental Analysis (TEA) and Observed Based Environmental Assessments (OBEA) measures support our understanding of perceived restoration across different public spaces in hospital settings?

Methods – A cross-sectional investigation was performed in seven public spaces of the Santa Maria Nuova Hospital (IT) by adopting TEA and OBEA tools.

Technical Environmental Analysis:

- Visits on site to evaluate the quality of the space, to assess the presence of artworks and/or greenery and to describe the historicity of the space
- Spatial analysis: Space Syntax evaluation parameters (Hillier, 2007) to evaluate the integration of the space (e.g., visibility, accessibility) and to quantify the presence of artworks and green view (% isovist area from key points), performed by Visibility Graph Analysis (VGA) and Isovist Analysis.

Observed Based Environmental Assessments:

- This type of assessments implies an evaluation of public spaces done by the users (n = 327) (i.e., outpatient, staff, relative, volunteer and social services). Their recruitment was done in place.
- Adapted version of the Perceived Restoration Scale (PRS) (1-5 Likert scale).

Results – Overall the results seem to suggest that the public spaces had relatively high restorative qualities. However, significant higher perceived restoration was also found for the Medicherie cloister, suggesting that some architectural and natural features affected the result. In order to gain a better understanding of what aspects of the physical environment of hospital public spaces might have had an impact on users' perception of restoration TEA and OBEA, data were merged together and their interaction was discussed.

Conclusion – New insights about the concept of restoration and its interaction with physical characteristics of hospital's public spaces is put forward. Furthermore, the methodology proposed by linking TEA and OBEA data contributes to a more reliable understanding of the influence that existing buildings might have on users' well-being.

Keywords: *Hospital public spaces |physical environment influence | evaluation tools | spatial layout | users' perception*

Introduction

The hospital public spaces

Only recently in the hospital building sector has there been talk of public spaces within hospitals in terms of a functional area that is as important as the areas dedicated to care [1] [2] [3]. This is due to the tendency to accentuate the humanisation of all hospital spaces, including those whose function is not chiefly related to healthcare, in that they act to promote the well-being of patients, staff and caregivers.

We can define the public spaces of a hospital as all spaces that are accessible to all users, that represent connections between the different functional areas of the hospital, and that represent the interface between the external city and that inside the hospital. Their function is to welcome users (entrance halls) who come to the hospital for a variety of reasons, to guide them along highly visible routes (corridors, elevators, stairs) to the different services, and they act as places for resting, relaxation and coming into contact with nature (atria with furniture/shops/artworks, and patios/healing gardens).

Public spaces are important not only because they perform a wayfinding function [4], but also because they are places of public life where relations among people occur [5], and where the right to health is protected [6].

Architectural trends in designing public spaces have developed around the creation of halls, mostly glazed, with more volumes appearing and of large dimensions. Many architectural elements come together to create them: canopies, covered squares, double-volume halls, hospital streets, galleries, loggias, and patios.

Some architectural studies have highlighted the relationship between aspects of the spatial layout and the behaviour of the users who spend time there in terms of visibility, accessibility and relationability [1] [7]. As of today, only a few studies have been carried out on the users' perception of these spaces, for example we can recall the experience of users in a children's hospital [8], the positive impact of art on users' psychological stress and overall satisfaction [9], and the contribution of the healthcare environment to wayfinding for visitors [10].

So it is difficult to identify which architectural characteristics (use of materials, morphologies, dimensions) of these public spaces have a positive effect on people. As a result, it is difficult to give design indications in this regard.

Interdisciplinary studies are therefore needed, which helps us to understand a phenomenon through the use of different methods that reveal the different factors in play belonging to the sphere of people's perception and of the built architectural object. This relationship should be investigated further for this type of space which, relatively speaking, has a fairly recent history.

Perceived restoration in healthcare settings

The importance of restorative spaces as mediator factors for people's health and well-being is increasingly recognized in healthcare settings [11].

Restoration has been defined as the process of recovering depleted psychological (i.e., cognitive and emotional) and physiological (i.e., stress) resources by means of interactions with environments that hold restorative qualities (e.g. greenery elements) for the individual [11].

Predominant theories in the field of human restoration are: attention restoration theory (ART) and stress reduction theory (SRT), which have highlighted the health-related outcomes of restoration processes linked to millions of years of evolution and our psycho-physiological responses [12] [13] [14]. Both theories sustain that nature supports bottom-up mechanisms of human restoration, implying that restorative processes are triggered by visual information and thus occur without conscious responses.

The body of evidence on how nature influences human health has recently given rise to a wide range of nature-assisted interventions, which are now being tested in healthcare settings across the world (i.e., horticulture therapy and green exercises). Nature is therefore incrementally considered as part of the treatment options for a variety of medical conditions [15].

Recent theorizations on the construction of restoration based upon knowledge from the fields of social psychology and ecology are however of interest to this work. These latter theorizations stress the importance of other mechanisms involved in restoration processes, such as connectedness and the feeling of belonging to a place [16] [11].

This supports the opportunity to discuss restorative mechanisms that are not linked exclusively to the power of nature over other settings' qualities and meaning. By also considering how the role of human cognitive top-down processes affect restorative experiences, an opening towards other types of human-environment interactions and restoration outcomes can be discussed. For example, the role of the heritage and cultural meaning of a place, as well as that of attachment and identification with a place, acquires a new critical role in the discussion of what can be experienced as a restorative setting.

This work is an attempt to expand our understanding in regard to the role played by historical architecture and artworks of hospital public spaces in supporting restoration, and consequentially health-related outcomes among the users.

Objective of the study

This paper focus on the topic of restoration and how different architectural qualities, such as the presence of artworks, historical architecture and greenery, might promote healthier human-environment interaction through the mediating effects of perceived restoration.

By investigating the specific case of Santa Maria Nuova Hospital in Florence (IT), which encompasses a significant number of heritage features and natural elements, the objective of this work is therefore to increase our understanding of the relationship between hospital public spaces, art, greenery and users' experiences.

For this purpose, an interdisciplinary investigation approach was developed, based upon merging theories and methodologies from the fields of architecture and environmental psychology.

The case study: Santa Maria Nuova Hospital in Florence

The hospital of Santa Maria Nuova (SMN) is one of the most important hospital facilities in Florence. It boasts of a long history, starting with its foundation in 1288, and has undergone numerous expansions and evolutions over the years due to the lack of space or inadequate consideration of medical and technological innovations. From the outset, the hospital was structured around a cloisters and courtyards system that represents a genuine block of the urban fabric of the city. The hospital contains numerous artworks such as paints, fresco, sculptures and bas-relief from the XIV to the XVIII century.

In 2000, a complete renewal project was launched, which resulted in the complete redevelopment of the facility. The hospital was reorganised into three main functional areas: the emergency area, which includes the Emergency Department, intensive care, emergency radiology, surgery in the day hospital and operating theatres; the outpatient and services area, including the reception, samples collection centre, dialysis and pharmacy, on the ground floor; spaces for the different departments on the floors above. The connection between the emergency and outpatient areas is the most public area, which also leads to the museum and café, and is the focus of this research.

The entrances to the hospital are divided between the emergency area, spaces for patients, visitors, logistics, guiding the internal distribution along vertical and longitudinal axes (Fig. 01).

The vertical connections added with the reconstruction, in turn divided into three different blocks (emergency, staff and patient/visitor areas), did not alter the original structure, but they solved the problem of differentiating the flows with distribution in line with that of the floors above.

The distribution system therefore represents the cornerstone of the restructuring project, disrupting the idea of a Hospital as a "closed" building and making it accessible, from both a physical point of view and in terms of its function, giving it an identity for the city and citizens.

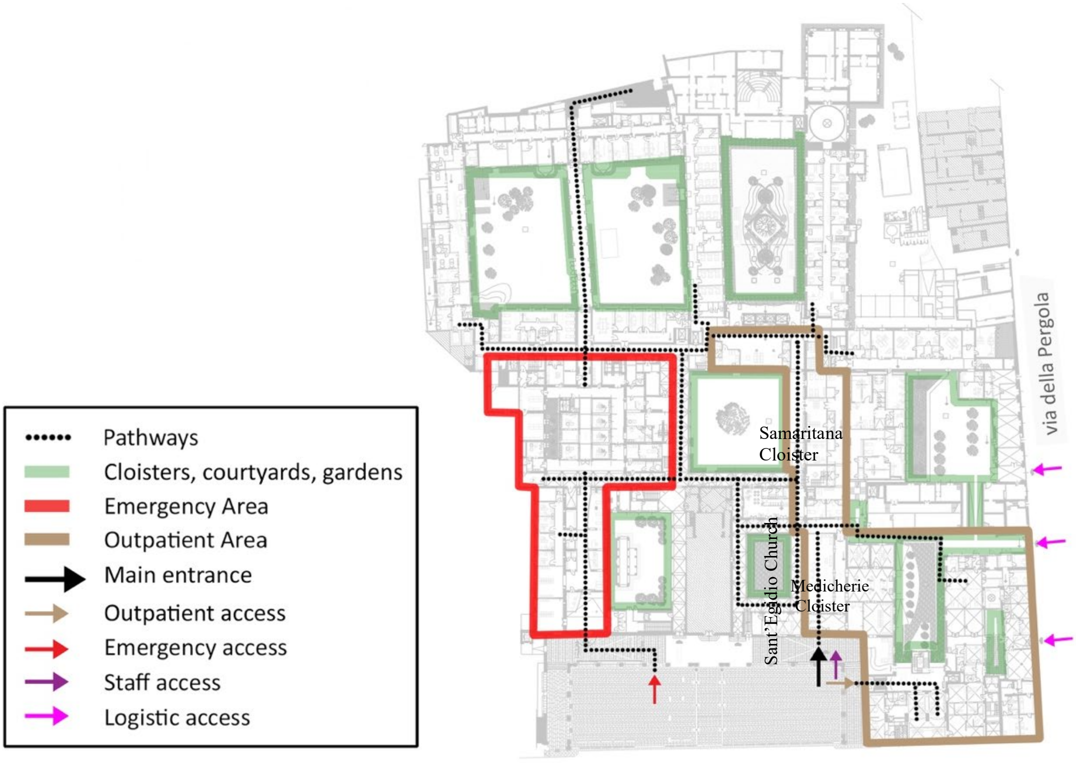


Figure 01. Plan of the hospital with accesses, areas, paths and courtyards

Research questions

This work is part of a broader research project in which hospital public spaces are evaluated in terms of spatial parameters, environmental quality and users' experience of them.

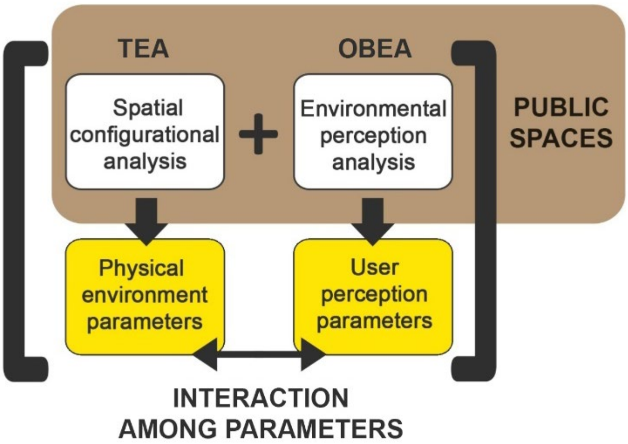
This specific paper focus exclusively on the restorative possibilities experienced by the environmental users during their visit to the hospital. Research questions are the following:

1) Which public spaces are perceived to be more restorative? 2) Does familiarity with a place affect the users' perception of restoration in hospital public spaces? 3) To what extent does the perception of restoration vary across settings that support similar functions but present varying levels of art and greenery? 4) How does the combined use of Technical Environmental Assessments (TEA) and Observed Based Environmental Assessment (OBEA) measures support our understanding of perceived restoration across different public spaces in hospital settings?

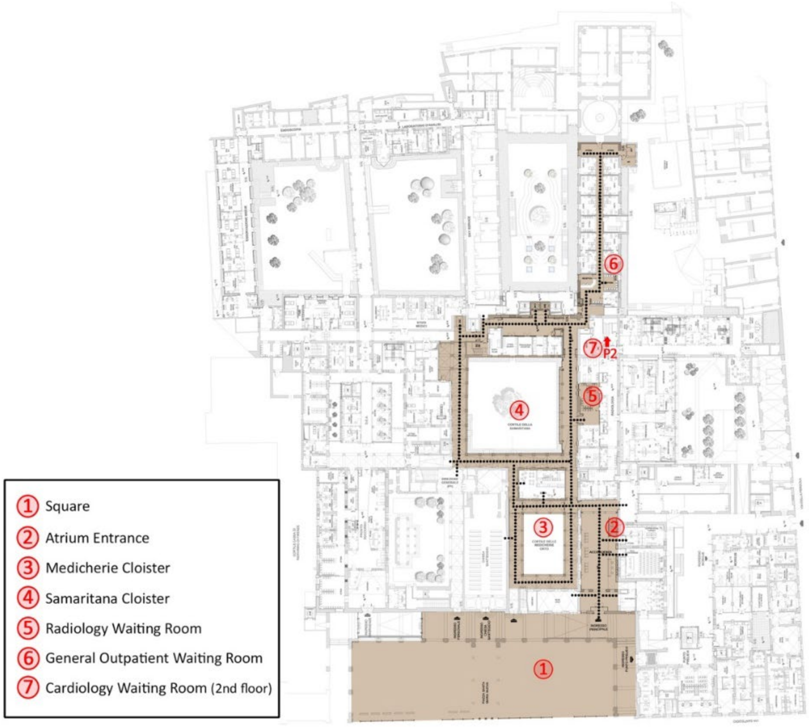
Methods

The study has a between subject cross-sectional design and adopts a mixed-method approach of investigation, which implies the use of different methodology, such as Technical Environmental Assessments (TEA) (i.e. space syntax) and Observed Based Environmental Assessments (OBEA) (i.e. self-report questionnaires), to understand the human-environment interactions occurring.

A summarised visual representation of the interdisciplinary method developed is provided in Figure 02.



The setting investigated is SMN Hospital, where (N = 7) public spaces were evaluated using TEA and OBEA measures. These seven public spaces support different functions: entrance to the building, transition and connection spaces, and waiting areas. A short description of each setting is provided as well as a visual overview (Fig. 03). This work focuses on the overall perceived restoration across these settings and then takes a deeper look at the specific restorative value of the cloisters, (i.e., number 3 and 4 in Fig. 03).



Public space entrance

The entrance hall (Fig. 04) is the area that benefited the most from the restructuring, becoming a hub of the hospital environment, not only in terms of admission but also for resting and access to the museum area/bookshop. This area, in fact, is not only used by hospital users but also by citizens and tourists, representing a place of identity for the city and the quarter. It is a monumental and representative space, also due to its dimensions and volume, large but not oversized, and enriched by works of art (since 1300), use of the colour red and warm materials such as wood, and finally the harmony of the clever relationship between modernity and the ancient. The location of the fresco by Bicci di Lorenzo at the end of the hall represents a fundamental point of reference as it marks the junction between two routes: the main one towards radiology and the elevator system, and that towards the vertical route to the medicine and cardiology department.

Public space transition and connection areas

The cloisters instead represent two hinge areas for the hospital system. The Medicherie cloister (Fig. 05) has retained its original structure and historical morphology and represents a resting and meeting place thanks to the hospital's café and the garden created with aromatic plants of historical value, where patients, visitors and staff members alike habitually stop to take a break and rest.

The Samaritana cloister (Fig. 06) on the other hand was completely changed by the restoration and represents the main connection to reach the different departments. The vaults were partly covered by the typical false ceiling of a modern hospital facility, the pillars were clad, and the central courtyard was screened and closed off by glass sheets with metal fixtures. In the centre of the cloister there is a magnolia tree in a green grass around. In one side of the cloister is the ancient fresco of the Samaritana, which cannot be seen directly from the entrance as it is positioned in the side corridor where user flows are low. Finally, there are no resting areas along the route in this area.

Public space waiting areas

The waiting rooms on the ground floor are represented by rather small spaces which are often overcrowded. They have no artworks and no particular attention was paid to the choice of materials or colours, the openings to the outside or the lighting. The waiting room of the Radiology department is directly accessible form the Samaritana cloister and has two glazed portion of the walls connecting visually to the side of the cloister. (Fig. 07)

Technical Environmental Assessments (TEA)

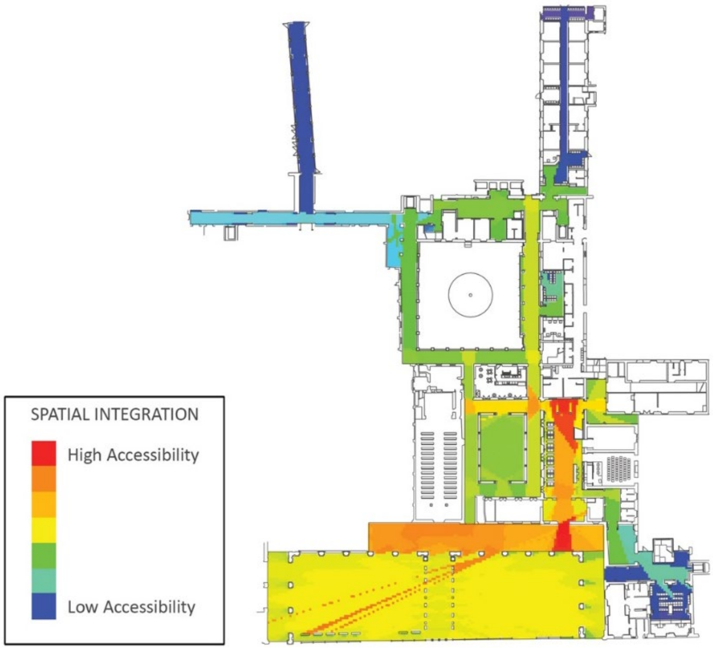
The technical assessments of hospital public spaces aimed to understand some quantitative and qualitative characteristics of the built environment, and were performed using some tools of the architecture discipline, such as:

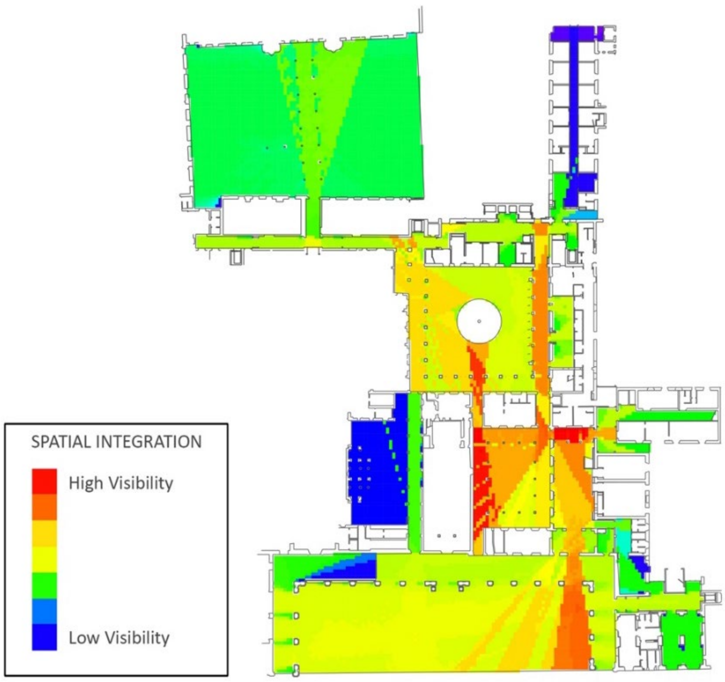
- Onsite visits to evaluate the quality of the space, assess the presence of artworks and/or greenery and describe the historicity of the space (see the description of places above).
- Spatial Analysis using Space Syntax evaluation parameters [17] to quantitatively evaluate the layout and the presence of artworks and views of greenery. Two different types of analysis were conducted, a VGA (Visibility Graph Analysis) and an Isovist analysis, the results of which were represented with coloured maps.

The Spatial Analysis highlights the qualities of the spatial layout that are not directly visible to the naked eye in that they derive from the geometry and permeability of the individual environments and the relationships between the environments as a whole. The Space Syntax theory, based on the concept of spatial configuration [18], was taken as a reference and as a method of conducting this analysis in that it describes the potential of the spatial layout through some quantitative parameters. In particular in this study, we investigated the integration and visibility parameters using the VGA technique.

The integration map (Fig. 08) shows how accessible each individual portion of space in the system is from all the other spaces in the system. The degree of spatial accessibility within the spatial model considered is described using a scale of values (corresponding to a scale of colours on the map) which gradually shifts from the most integrated spaces, namely those that are more easily accessible (conventionally the red ones), to the less integrated spaces, namely those that are more difficult to access (conventionally the blue ones). The “degree of accessibility” is a property of the space calculated by considering variables such as changes in direction, length, distance, depth, connections and the size of the angles of intersection between spatial elements.

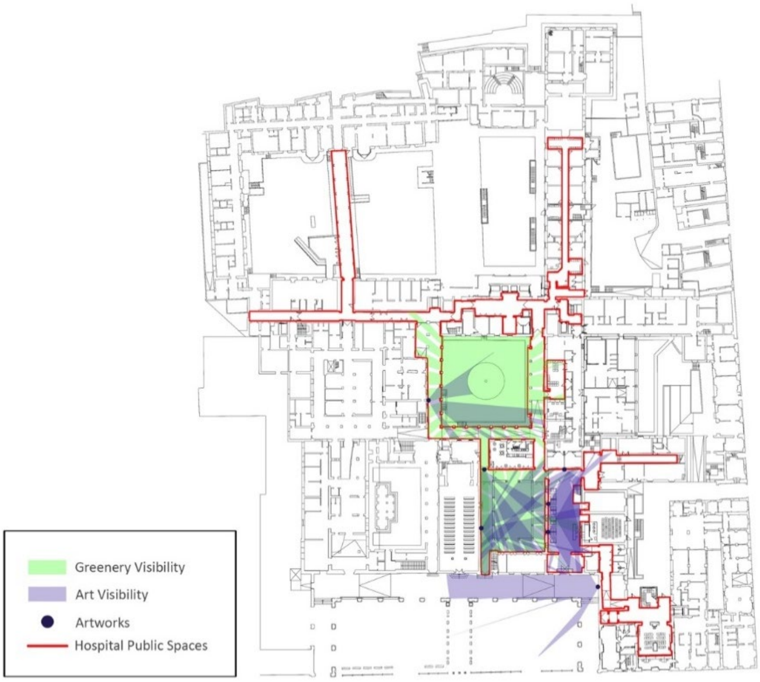
The visibility map instead (Fig. 09) represents all the visible spaces, even those that are not accessible, for example because they are behind a closed glass wall. In the hospital context, visibility as a syntactical property is related to the perception of quality of care, people's behaviours and movements, and to spatial cognition [1].





Referring to the concept of restoration, and in order to more explicitly understand how much time users in the public space of hospitals spend in contact with green areas and artworks, the isovist technique was used [19], which allowed us to identify the number of surfaces from outside green areas and works of art that are visible to a user (Fig. 10). The percentage of these surfaces was then calculated with regard to the total public space area and the area of each individual environment taken into consideration.

The isovist technique was applied inversely: the point of view is not that of an observer who moves through the space, but rather the location of the green area or work of art. From these points, 360° angles for green areas and 160° for works of art were then traced.



Observed Based Environmental Assessment (OBEA)

The hospital users' perception of public spaces was captured in self-report questionnaires handed out onsite (i.e. between subjects' study design, which implies that each of the seven public spaces were evaluated by different users) (Tab. 01) during the period 21-31 May 2018. Four researchers from the TESIS centre in Florence were involved in recruiting participants and collecting the data.

Hospital Public Spaces	Frequency of answers
Square and Loggia	11
Atrium Entrance	56
Medicherie Cloister	57
Samaritana Cloister	50
Radiology Waiting Room	49
General Outpatient W. R.	50
Cardiology W. R.	54
Total	**327**

The questionnaires were developed in order to understand users' background information: type of user (i.e., patient, staff, relative, volunteer and social services), gender, age, and familiarity with the place. Moreover, questions related to perceived pleasantness, attachment and identification with the place and perceived restoration were included to account for the interceding psycho-social processes that are known to mediate the influence of the environment on health-related outcomes [20].

This paper focuses exclusively on the construct of perceived restoration captured by means of an especially developed instrument based on the Perceived Restorativeness Scale (PRS) [21]. The original PRS accounts for several dimensions of perceived restoration: being away, fascination, coherence and compatibility, whereas the instrument developed for this specific study focuses on fascination and coherence in order to match the setting investigated. The result is an instrument made up of 10 items (i.e., statements about perceived fascination with a place and coherence) on a 5-point scale where ´1´indicates 'totally disagree' and ´5´totally agree'. Four of the items on the scale were reversed before the scale score was constructed. The overall perceived restoration score was calculated by adding together the items and then averaging them (Cronbach's alpha = .75).

An overview of the items making up the perceived restorative instrument is provided in Table 02.

Dimensions of perceived restoration	Items
Fascination	The setting has fascinating qualities. My attention is drawn to many interesting things. I would like to get to know this place better. I want to explore the area. There is much to explore and discover here. I would like to spend more time looking at the surroundings.
Coherence	There is too much going on. It is a confusing place. There is a great deal of distraction. It is chaotic here.

Table 02. Items making up the perceived restorative instrument

Participants

A total of 327 subjects participated in the study; 62% were female and 37% were male, and the mean age was 51.1 (range 17-90). Approximately 56% of the entire sample was made up of patients and their families (i.e., 34% patients and 22% relatives). The remaining 44% was made up of different types of staff and volunteers. Furthermore, 55% of the sample was not familiar with the hospital's public spaces.

The total number of participant answers for each of the seven public spaces investigated is reported in Table 01.

Statistics

Missing values for a single scale were replaced with the series mean (missing values < 10%). The analysis of variance (ANOVA) and T-test statistics were adopted to detect differences in terms of perceived restoration across the hospital public spaces. The data collected through self-report questionnaires was analysed by using SPSS, Statistical Packaged for Social Sciences for Windows, version 22. The p-value criterion for significance was set to $p = .05$ (Field, 2009).

Ethical considerations

The study was approved by the University of Florence's Ethical Review Committee (Commissione Etica per la Ricerca) with the no. 23/2018 act. Approval for the data collection was also granted by the Health Board of SMN Hospital. The hospital's managerial board, together with doctors, nurses and experts from the *Centro di Documentazione della storia della sanità*, actively participated in the discussion on how to better design the data collection of users' experience of public spaces.

Results

TEA Results

The visit on site showed that the greenery in the Samaritana cloister is composed by a big Magnolia tree and a not well-finished grass around it, while in the Medicherie cloister the greenery constitutes a botanical vegetable garden made up by vases of medicinal plants. The quantity of greenery area is quite different in the two cloister presenting in Samaritana the highest surface of greenery (480mq) and in Medicherie the lower (10,5mq).

Another factor that emerged from the onsite visits is the different historical value of the two cloisters: the wing of the Samaritana cloister where the questionnaires were handed out (Fig. 06) has the typical characteristics of contemporary hospital buildings: the fixtures have been replaced with aluminium ones, the ancient pillars have been clad and plastered, and a false ceiling of modular panels has been installed to accommodate the lighting and systems. So the medieval groin vaults and stone pillars, which can instead be found in the other wings of the cloister, were not visible to the people when they filled in the questionnaire. Instead in the Medicherie cloister the groin vault, stone cornices, bas-relief tondi and arches were restored but have remained exactly as they were in the Middle Ages.

The spatial analysis revealed that the cloisters and the atrium entrance have the highest accessibility and configurational visibility values in comparison to the other places. However, some differences were noted between the two cloisters with regard to accessibility (Tab. 03): while the average visibility value was similar (3.9 and 3.8), the accessibility value varied from 3.5 for the Medicherie cloister to 3.1 for the Samaritana cloister. The internal courtyard of the Samaritana cloister is not in fact accessible to the public, and the green space inside is therefore visible but not accessible.

	Area (mq) (1)	Height (mt)	Art Visibility Area (mq)	Art Visibility	Greenery Area (mq)	Greenery Visibility Area (mq)	Greenery Visibility (2)	Layout Accessibility Integration value	Layout Visibility Integration value
Medicherie Cloister	383	5,2	327	85%	10,5	352	92%	3,5	3,9
Samaritana Cloister	307	4,8	61	17%	480	212	69%	3,1	3,8

Table 03. TEA results. (1) is the accessible surface for people, (2) is the ratio between the visibility of green surface and the area of the environment

The isovist analysis showed the percentage of surfaces from which artworks are visible (blue on the map in Fig. 11) and the percentage of surfaces from which a view of the green areas can be enjoyed (green on the map in Fig. 11). While in the Medicherie cloister the presence of both artworks and green areas is high (85% and 92%), in the Samaritana cloister the only work of art present is barely visible (17%) and the greenery visibility area percentage is quite high (69%).

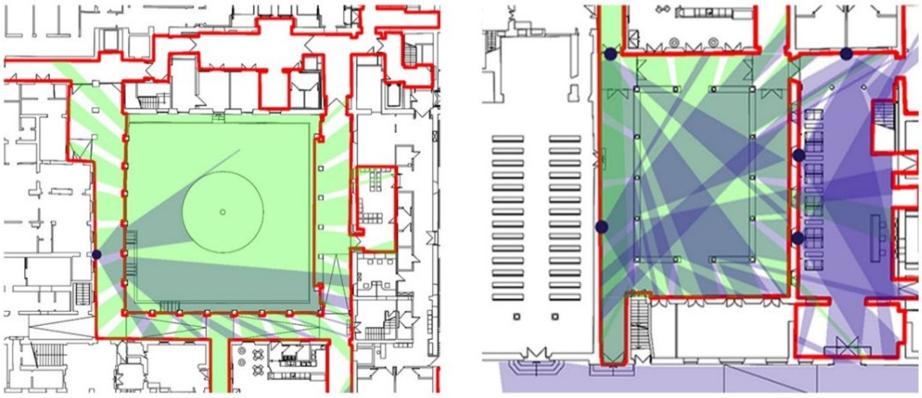


Figure 11. Details of the Samaritana (on the left) and Medicherie (on the right) cloisters representing visibility of artworks and greenery

If we look at the map of the atrium, we see how it is dotted with works of art whereas the green area is not very visible, only from the windows on the side adjacent to the Medicherie cloister.

OBEA Results

On the whole, the results suggest that the environmental users perceived the overall public spaces of SMN Hospital as relatively restorative ($M = 3.34$, $SD = .73$, range 1-5).

Of the seven public spaces, the Medicherie cloister was reported to be the most restorative ($M = 3.76$, $SD = .57$, range 1-5). No significant differences were found in regard to familiarity with the place and its perceived restoration ($F(3, 305) = .381$, $p > .05$).

However, some significant differences in terms of perceived restoration were found when comparing settings that support similar functions (for example transition and connection spaces and waiting areas). In this regard, the Medicherie cloister ($N = 53$) ($M = 3.76$, $SD = .57$) was found to be significantly more restorative than the Samaritana cloister ($N = 46$) ($M = 3.41$, $SD = .75$), $T(97) = 2.6$, $p = 0.1$.

TEA and OBEA interaction

The significant differences in terms of perceived restoration found between the two cloisters suggest that some architectural and natural features of the environment affected users' perception. If we look at the results from the TEA analysis, it is possible to see how the cloisters differ in terms of spatial accessibility, percentage of surfaces from which artworks can be seen, and historical quality of the architectural elements.

The TEA suggests indeed that the Medicherie cloister provides greater opportunities to visually see and physically access artwork and greenery, which in turn seem to have had a positive influence on users' perception of restoration, as reported in the OBEA results. Particularly, the visibility area where people can enjoy artworks, which is greater in the Medicherie cloister, seems to play a key role in restoring the users, in that the environments with the highest restoration are those with the greatest visibility of artworks, as Medicherie cloister is.

Despite the high area of greenery being present in Samaritana compared to that of Medicherie reported by TEA, Medicherie is perceived to be more restorative. The reasons appear to be related with the interaction between art and greenery and the greater possibilities to have visually and physically access to them, measured by isovist parameters. Also the maintenance of the greenery might have had an impact on such results, since the Samaritana green environment is not as well-kept as the Medicherie is.

Another crucial factor that might have had an influence on users' perceived restoration is that of architectural value and heritage differences of the two cloister. The Medicherie has a greater amount of perfectly preserved medieval elements, such as groin vaults, arches, bas-relief tondi, and stone materials, which show the value of the architecture as a work of art, in that it belongs to the past. While in the Samaritana some ancient pillars, vaults and fixtures have been replaced respectively with plaster, modular panels and aluminium.

All the above suggests that these environmental attributes, including the possibilities for the users to visually and physically access the places, played a fundamental role in the perception of restoration.

Discussion

A top-down cognitive process for restoration outcomes

The results from this study seem to bring new insights in regard to the topic of restorative qualities perceived by the users in the physical environment of hospital public spaces. The public space which had greater possibility to restore the users and therefore has more positive influence of health and well-being related outcomes is that of Medicherie cloister. By looking at the TEA results, it is clear that this cloister does not have the largest amount of greenery, which instead is acknowledged to be the main facilitator of restorative processes, as suggest by the classic ART and SRT theories [11]. However, in comparison to the other cloister, Medicherie has the highest percentage of greenery visibility and provides the users with greater possibilities to physically access and be part of the environment. In fact, people can access the internal courtyard of the cloister and enjoy the green space which, in this case, is made up of medicinal plants which recall the hospital's ancient vegetable garden. Moreover, the cloister provides also greater possibilities to visually access the full historical quality of its architectural elements (groin vault, stone columns, bas-relief tondi) and to a large quantity of artworks. Finally, the Medicherie cloister seems to be the result of the integration of art, history and greenery.

Based upon this mix between historical greenery and artworks, as well as, the greater possibility to visually and physically access the place, it seems that restoration for this specific cloister might have been supported by the activation of top-down processes. Such type of processes are linked to the development of feelings of identification and connectedness with place and its history, rather than automatic visual responses to nature (i.e. bottom-up processes and perceptual fluency account).

These results are in line with recent discussion regarding the restorative effects of places that have special meaning for their users, and thus, implying that not only nature has potential for restoration but also historical, cultural and heritage sites with meaningful artwork that connect past and present [22].

We could further argue that the feeling of belonging and identification with place might have played a crucial role for the restoration outcomes, due to the peculiarity of this specific hospital, which is so deeply integrated into the city and has special meaning for its users by supporting the historical tradition, continuity of place and people's interactions over time [23].

The design of hospital public spaces

The results of this study lead to a contribution on the designing of public spaces in hospitals in terms of three aspects which have a positive effect on people:

1) although artworks are included in the design of hospital spaces, in full recognition that they represent a beneficial element in a hospital, their visibility in relation to user routes is not consistently considered. This study proposes a new parameter to evaluate this aspect; 2) this study reveals the importance of spatial accessibility understood as how to create spaces and conditions in which it is possible to spend time and enjoy nature and works of art even in transition areas; 3) architecture has a historical value in of itself which, were present, should be enhanced.

Based upon the research results and ongoing discussions between the researchers involved and the managerial board of the hospital, some suggestions have been developed with the purpose of identifying potential improvements to other areas that scored significantly lower in terms of perceived restoration. For example, one suggestion was to improve the Samaritana cloister by making it possible to come into closer contact with the nature and artwork there by creating some covered micro-spaces with suitable furniture along the sides of the cloister for people waiting for relatives or to be examined, and by moving the fresco into a more central position.

A method to evaluate human-environment interactions and well-being

This work is an attempt to evaluate the extent to which art, historical architecture and greenery in hospital public spaces might affect users' perception of restoration. The place selected for this purpose was SMN hospital, a complex building with a long history and recently refurbished.

For this purpose, knowledge and methodologies from the fields of architecture and environmental psychology were merged together in order to develop a single protocol of investigation that integrates TEA and OBEA. These approaches were continuously merged throughout the entire research design, data collection and discussion of the results and publications. It was therefore developed as a form of interdisciplinary sharing from the very first discussion on the selection of the hospital public spaces to investigate, through to the operationalization of the concepts, and the measures administrated to the users and evaluated by the technical analysis, and finally, for the creation of visual maps that support our understanding of users' perception of hospital public spaces.

Although the case of SMN is unique in the world, the proposed methodology is applicable to evaluate public spaces of other types of hospital, such as modern and contemporary hospitals. It would be interesting to identify the differences in users' perceived restoration as the type of art and historic architecture varies.

Conclusion

On the whole, this work contributes to the development of a protocol of investigation that combines the knowledge and methodologies of two neighbouring disciplines; architecture and environmental psychology. It identifies methods and tools (TEA and OBEA) that support the possibility of evaluating the quality of existing buildings and suggesting which features of the physical environment might be more supportive for users' well-being-related outcomes, which in this specific work were operationalized in terms of perceived restoration. These features are related to some spatial layout properties such as good visibility of artworks and greenery, good accessibility of spaces and presence of historical architecture.

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ARCHITECTURE OF SPECIAL CARE UNITS FOR PATIENTS WITH DEMENTIA IN GENERAL HOSPITALS

Julia Kirch [(1, 2)*], **Gesine Marquardt** [(2)]

[(1)] Network Aging Research, Heidelberg University, Heidelberg, Germany

[(2)] Faculty of Architecture, Technische Universitaet Dresden, Dresden, Germany

* Corresponding author e-mail: kirch@nar-uni-heidelberg.de

Abstract

Objective – The aim of the study is to provide planning recommendations for special care units for patients with dementia in general hospitals. Therefore, (1) an overview of existing structural concepts and, (2) results of a systematic environmental assessment regarding the dementia-sensitivity of the built environment will be presented.

Background – Due to demographic change, the number of acutely ill, geriatric patients with additional cognitive impairments in hospitals is increasing. Since this patient group often shows adverse outcomes during their hospital stay, specialised wards ("special care units") have been implemented as part of dementia-friendly hospital concepts. In Germany, the number of special care units has been rising over the last years and more than forty units are currently known [12]. Research has shown positive effects on patients' self-care and mobility as well as a decrease in challenging behaviour. However, an overview of spatial concepts, which can serve as basis for planning recommendations, is missing.

Research question – What are architectural characteristics of special care units for the care of patients with dementia in general hospitals and how is dementia-friendly design implemented?

Methods – Site visits and interviews with responsible medical and nursing staff leaders of special care units in German general hospitals (N=20) were conducted. The implementation of dementia-friendly design recommendations based on publications by Hofmann et al. 2014 [23] and King's Fund 2014 [24] was systematically documented. Additionally, floor plans of the units were analysed regarding their integration into the building structure, spatial programmes and use of space. Implementation of design criteria was discussed in the light of planning recommendations for dementia-friendly hospital wards given by Büter et al. 2017 [25]

Results – The units differed greatly in terms of their building structure and their spatial programs. The floor space per unit varied from 120 to 1200 sqm depending on the number of beds in the units starting from 6 to 30 beds. Three types of structural concepts were identified which were characterised by their spatial organisation within the building and the resulting autonomy in the workflow of the units. Regarding the implementation of dementia-friendly design recommendation, it was found that especially interior design elements, such as colour contrasts or visual cues to improve visibility of patient-relevant objects, were often used.

Conclusion – A high number of individual spatial concepts for special care units exists in German hospitals. These concepts were highly dependent on specific building conditions and functional requirements, especially fire protection, hygiene and floor plan structure. The implementation of some core recommendations, such as a visual relationship between areas for patients and nurses, requires early consideration in planning processes as it refers to the building structure. Otherwise, these implementations may result in extra effort in terms of construction works and financial expenses.

Keywords: *Architecture | general hospital | dementia-friendly design | special care unit | environmental assessment*

Background

The concept of special care units

Due to demographic change, the number of acutely ill, geriatric patients with additional cognitive impairments in hospitals is increasing. Usually, symptoms of dementia do not represent the reason for hospital admission, however, these symptoms strongly influence the hospital stay and the treatment procedure. People with dementia often do not understand necessary therapeutic and medical procedures and feelings of excessive demands may result in negative outcomes, such as challenging behaviour or apathy. They reflect a highly vulnerable group of patients and considering their needs is not only beneficial for them but will also relieve caregivers and other patients. Since patients with dementia often show adverse outcomes during their hospital stay, specialised wards named special care units (SCUs) have been established as part of dementia-friendly hospital concepts. The concept originates from nursing homes where the integration of so-called “special care units” has been common practice for a long time and where positive effects have been observed relating to residents’ quality of life, behaviour or reduced use of psychotropic drugs [1]–[3]. In the acute hospital setting, the care concept needed to be adapted to different conditions, concerning privacy, hygiene and length of stay among others. SCUs in general hospitals can be found in a number of different countries [4]–[8]. All are characterised by a comprehensive care concept, but there are individual modifications, for example the number of beds, the integration of the unit in the hospital structure and its spatial demarcation, or additional occupational opportunities. Compared to regular hospital wards, special features of SCUs include special training of employees, day-structuring measures, extended geriatric assessment, patient selection and particular architectural features. Evaluation of these units has shown positive effects on patients’ self-care and mobility as well as a decrease in challenging behaviour [5], [7], [9], [10]. Cognitive impairment is the main inclusion criterion for the admission to an SCU. However, people were mostly moderately impaired and often physically mobile and thus able to benefit from the particular care concept, such as walking around independently or participating in group occupational therapies [11]. Since 1990 SCUs have been mainly established by geriatric departments in Germany and there are currently 44 known SCUs [12].

Dementia-friendly design in general hospitals

Common theories of human-environment research prove that well-being and behaviour of people depends on the interaction of environmental factors and individual coping skills [13]. Due to cognitive impairment, people with dementia are particularly sensitive to their surroundings [14]. Dementia-friendly design tries to compensate impaired coping skills by creating an environment that promotes orientation and safety and enables intuitive usability [15]. The systematic review of Marquardt et al. shows that effective dementia-friendly design interventions are manifold and reach from architectural features, such as building typologies and spatial layouts, to interior design elements [16]. The majority of research on dementia-friendly design was conducted in long-term care facilities. However, during the last years, dementia-friendly hospital initiatives have been conducted on an international level and the topic of dementia-friendly hospital design has raised more awareness [17]–[22]. Also, the comprehensive care concept of SCUs includes measures regarding the built environment as one treatment component [23]. Following a dementia-friendly design approach, spatial measures on the SCU were intended to, among other things, support patients in their independence and strengthen feelings of security and orientation. Although considered as a crucial component, an overview of their spatial attributes and the implemented dementia-friendly design measures is missing. The aim of the present work is therefore to summarize existing spatial situations of SCUs with special regard to dementia-friendly design measures and to use these examples as inspiring references for the further development of dementia-friendly hospital design.

Methods

The responsible chief physicians of all known SCUs in Germany were requested in writing to participate in the study. In 2018, on-site visits were carried out at 20 cooperating hospitals. These hospitals are distributed throughout the country and show a wide variety with regard to their hospital characteristics in terms of number of beds, construction period and hospital owners. The intention of the establishment of these units was to provide better hospital care for patients with dementia by implementing this specialised dementia-friendly ward concept.

Based on this sample of 20 SCUs, spatial characteristics and examples of dementia-friendly design interventions in general hospitals are provided. The following aspects were the focus of this research: 1.) conceptional and spatial data of SCUs, and 2.) implementation of dementia-friendly design recommendations. Therefore, site visits and interviews with responsible medical and nursing staff leaders were conducted on the basis of questionnaires regarding general hospital data and unit characteristics. Conceptional data was systematically collected on the basis of a position paper that gives recommendations for the operation of SCUs [23]. Spatial data were collected by documenting spatial programmes and floor plan structures. Depending on the autonomous workflow of SCUs, floor plans were analysed regarding their integration into the building structure. The implementation of dementia-friendly design measures was rated based on the existing environmental assessment tool “Is your ward dementia friendly” by King’s Fund [24]. With this tool, the built environment was evaluated in seven categories on a 5-point likert scale (1=criteria were barely met, 5=criteria were totally met). The data was further discussed in the light of design recommendations for dementia-friendly hospital wards published by Büter et al. [25]. Interventions were also documented photographically. Units where a high number of implemented dementia-friendly design measures could be found served as case-studies presented in the paper.

Rationales of spatial recommendations

Building layout

With regard to building layout, existing recommendations for dementia-friendly wards propose organising the unit as a spatially separated area in which patients can move independently. The building structure of dementia-friendly units should increase patients’ mobility and perceived safety through a clear building layout. It must therefore be designed in such a way that clarity, accessibility and visual connections to relevant places are ensured. The provision of a circular movement area is supposed to enhance patients' mobility. However, the entrance should be outside the visibility of movement areas so that patients are less stimulated to leave the ward independently. A further substantial aspect is the location of the nursing point and/or an obvious reception desk, which shall be positioned in such a way that there is visual connection from the nursing point to the joint living room, the entrance and the patient rooms. Also seating options are suggested to be placed nearby the nursing point. To enable patients to rest between their walk but also allow them to choose between different seating options and to observe the units' daily life, it is advisable that additional seating areas along the corridors are provided.

Orientation

People with dementia can easily develop fears in unknown environments. Spatial measures therefore seek to convey the situation in which the patient situates themselves and make it easier for patients to recognise relevant spatial and design objects. The subject of orientation can be meant in terms of place, time, date, local region, and situation. For this purpose, visual guidance systems, visual cues such as distinctive colours or pictures showing local landscapes could be used to help patients identifying their own room, bed or wardrobe. In addition, a high-contrast design of relevant room elements helps patients to recognize the room and its elements more easily, e.g., by contrasting the colour of the wall and the floor covering or by installing handrails with high contrast to the wall. Objects and rooms of patients' interests are visually highlighted whereas non-relevant objects are hidden through a discreet, unobtrusive design.

Ambience

It is recommended to create an atmosphere that conveys cosiness and familiarity to patients and their relatives in order to relieve anxiety and to evoke feelings of confidence. To achieve this in a hospital setting, a balance must be found between clinical functionality and a comfortable ambience. Recommendations therefore range from a joint living room and lounge as a space where patients can eat together, and chairs arranged in clusters to encourage conversation. Sound absorbing measures, occupational offers, for example board games, joint newspaper rounds, or supervised handicraft work as well as the provision of photographs depicting interesting topics or tactile artworks can support these efforts.

Results

Spatial characteristics

Structural concepts

A great variety of different spatial concepts can be presented. The floor space per unit varied from 120 to 1200 sqm depending on the number of beds in the units, starting from 6 and going up to 30 beds (mean: 14 beds, 666 sqm). On average 38 sqm per patient bed were needed and nearly half of that area is needed for patient rooms (43%) whereas about a quarter of it make up circulation areas (23%). The rest of the area was needed for rooms for hospital staff, storage and electrical supply as well as for building construction (34%).

Three different types of structural concepts were identified and characterised by their spatial organisation within the building and the resulting autonomy in the workflow of the units (Figure 1):

- Concept A typifies a spatially independent unit, where in addition to patient rooms and a living room, one can also find the nursing point, doctor and service rooms as well as examination and therapy rooms. Beds are exclusively provided for cognitively impaired patients (n=8).
- Concept B represents a spatially separated sub-unit. That means that there is a spatial separation at the end of a regular ward corridor. Patients' rooms and a joint living room were within the separated area, however, therapy and examination rooms are outside the sub-unit, although spatially nearby. In some cases, the nursing point is located within the area, but sometimes outside the sub-unit or located in a position that allows a common usage for both parts (n=9).
- Concept C instead illustrates a spatially open approach where a small number of dementia-sensitive patient rooms are provided for those with cognitive impairments. Dementia-friendly design elements were implemented, the number of beds per room is reduced and there is a joint living room close to patient rooms exclusively for the target group. The ward itself contained a mix of geriatric patients with and without cognitive impairments. Nursing point, doctor and service rooms, examination and therapy rooms were allocated to the ward and for the use of all patients (n=3).

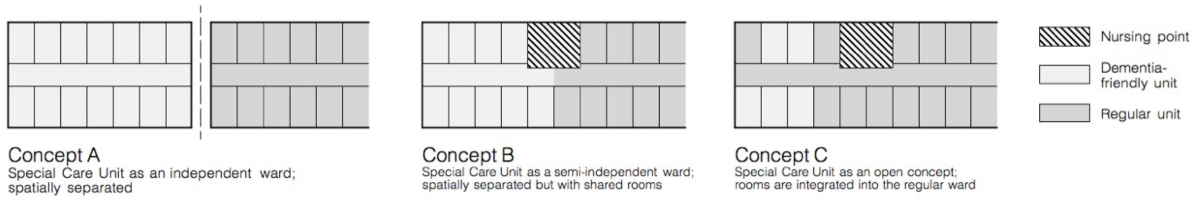


Figure 1. Three types of structural concepts of special care units.

Usually, the units were realised in existing buildings (17 out of 20), so that nearly all concepts needed to be implemented under given structural conditions. Only occasionally, the installation of a special care unit was set up in a new building, so that in most of the cases dementia-friendly design criteria regarding the building layout were not considered at the beginning of the planning process. In particular this refers to recommendations regarding clarity in visual directions, the provision of a spatial anchor point, and additional storage spaces.

Corridor types

To avoid traffic through the units, they were usually laid out on the far corner of the floor. The aim was to provide a quieter and more protected ambience for the patients. Depending on the size of the unit and on the existing building conditions, three different corridor types could be defined (Figure 2). Mostly there was a straight corridor with patient rooms on one side and functional and common rooms on the other side (type: “straight corridor”, n=10). Some corridors bended (n=6) and were mostly built either as L-shaped or T-shaped corridor. Another type with two parallel corridors (type: “U-shaped” or “square-shaped corridor”, n=4) could be provided when building depth is about 25-30 meters. The simpler the building structure is regarding the building depth and its linearity, the less patient beds could be placed in the unit. Only two parallel corridors allowed an increase in the number of beds to more than 30. Exclusively under this condition, the possibility of circular movement is given. Here, the patient rooms were often located at the outer side, allowing exposure to daylight, whereas utility rooms are located in centrally. This layout structure also sometimes contained an inner courtyard. Depending on fire regulations, units may require having at least two emergency exits. In these cases, one exit represents the main access to the unit and the second is an unobtrusive exit at the end of the corridor.

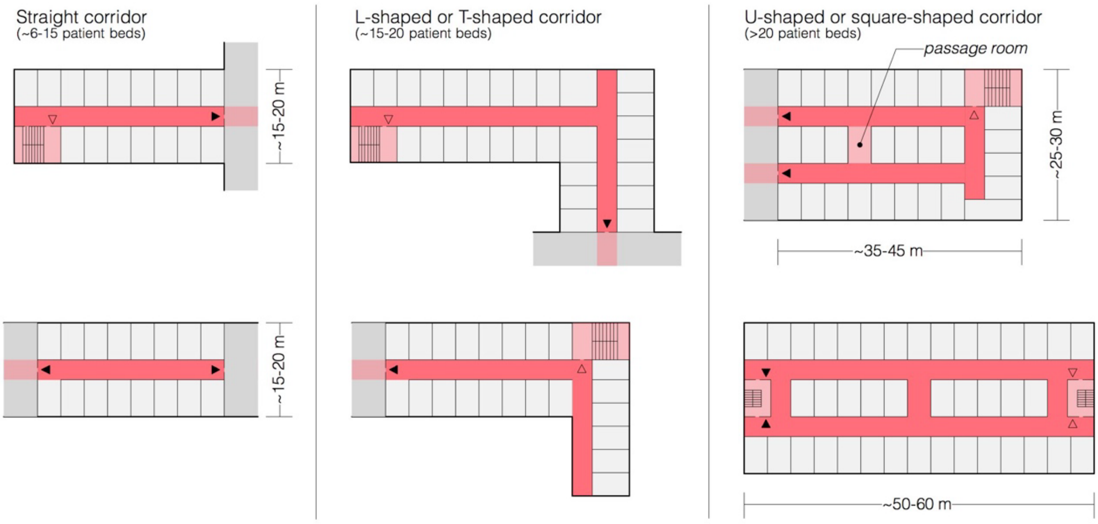


Figure 2. Corridor types in special care units and the related number of beds.

Implementation of recommendations for SCUs and space required

Building on existing recommendations, an SCU has ideally implemented the following spaces and architectural features [11]: size of the units should be about 8-12 beds, with a maximum of 20 beds. The findings of milieu therapy should be used to ensure a dementia-friendly surrounding. The focus here is ideally set on the topics of lighting and familiarity. This leads to a mandatory presence of a living and a therapy room, as well as the optional installation of a lighting system that has proven positive effects on people with dementia. In addition, an institutional-like appearance should be avoided by creating a homelike atmosphere.

The percentage of implemented recommendations can be seen in Table 1. Besides patient rooms, a joint living room is provided in each of the units. Therapy and examination rooms could be found in nearly half of the units (40%).

However, therapy rooms were often located nearby or in some cases these were not judged important, because therapeutic sessions were often conducted along the corridors (physiotherapy) or in the living room (occupational therapy). To create a cosy atmosphere was also a main concern on the units. The living room was therefore usually decorated with homelike furniture and seasonal and local decorative objects. In addition, colour design was used to evoke a feeling of cosiness. Because of fire regulations, decorative objects in the corridors often had to be limited to pictures and colours. Further requirements

The interviews and observation during the site visits revealed further spatial requirements. Firstly, there was an urgent need for more storage space because of extensive care aids in geriatrics. Often there was insufficient space for the storage of geriatric equipment, which meant that walking aids, such as wheelchairs or wheeled walkers, were located along the corridors so that equipment was nearby. Secondly, there was a lack of places where confidential conversations between hospital staff and family caregivers could be held. In addition, the importance of the physical presence of the nursing staff on the unit was emphasised because patients often sought social contact.

Dementia-friendly design in special care units

The evaluation of the units shows that a high level of dementia-friendly measurements were implemented in SCUs (Figure 3): the average score was 3.41 out of 5, with more than 3 points obtained for each of the seven categories. All of the units provided a joint living room with a lounge that was primarily designed to convey a familiar ambience. However, from an architect's view recommendations regarding the building layout have been implemented much less frequently. This includes, for example, the provision of a therapy room, additional storage rooms or the visual connection between nursing point and living room. In contrast, easily-applicable measures, such as colour cues, wall clocks or calendars, to enhance patients' situational and temporal orientation were found on nearly all of the units. Also, pictures, decorative objects and furniture unusual for a hospital setting were often used to evoke feelings of familiarity.

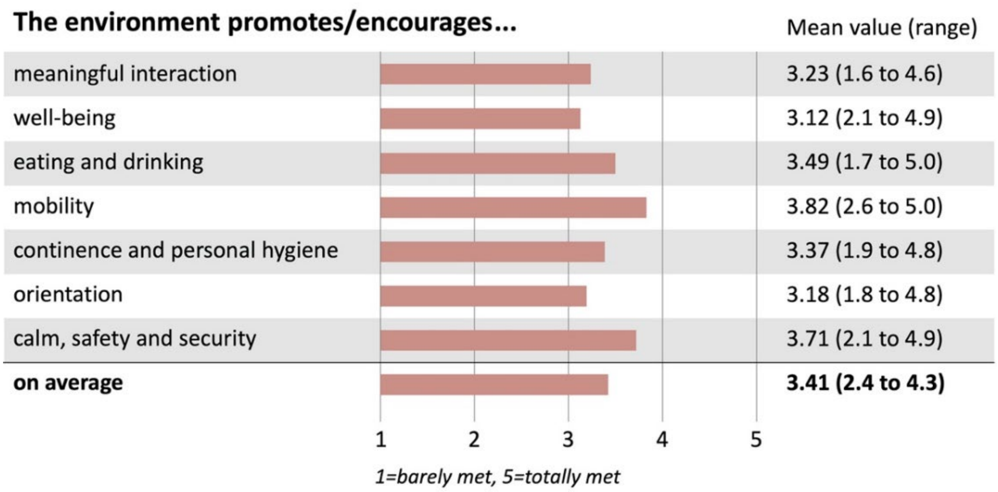


Figure 3. Level of implementation of dementia-friendly design criteria in special care units assessed with environmental assessment tool by King's Fund (2014) on a 5-point likert scale. Number of units N=20.

Building layout

To realise a dementia-friendly structural layout, measures require an early consideration in the planning processes. Some dementia-friendly design criteria could not be fulfilled, such as the provision of a therapy room or nursing point, because there were restrictions due to the building stock situations. In particular, the smaller units often had little opportunity to establish an additional nursing point in the unit because the nurse-patient ratio cannot be guaranteed permanently. However, for smaller units it is easier to provide a clear, easily understandable floorplan layout. The possibilities of a centrally located nursing point were found in newer buildings in particular, because this concept has now also proven itself for non-dementia-specific hospital wards and was established in many recently built hospital wards.

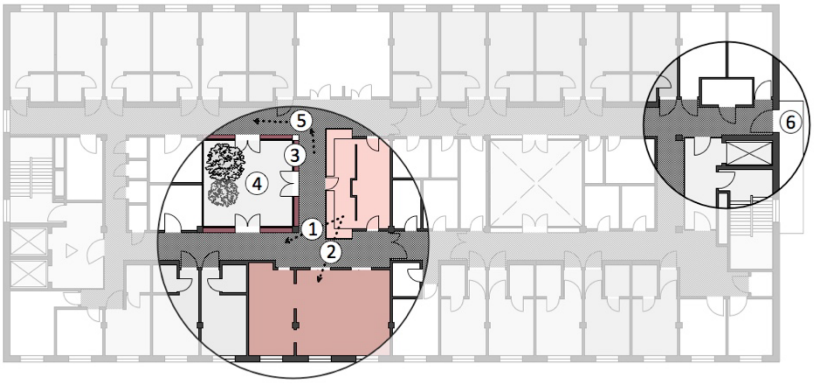
A great strength of the units was the location at the end of the hallway so that through-traffic could be avoided. Because of that and a decreased number of beds, the units provided a quiet and protective atmosphere to patients. A typical way of spatial implementation was the demarcation of a less frequented area without through traffic and keeping the ward door closed. Patients' rights prevented the locking of the patient or ward doors, but technical systems like numeric keypads or tracking systems at the ward door were sometimes used as a door safety device. Patients on these units were all allowed to walk in the protected space of the unit independently. To provide a visual connection between nursing point and relevant patient areas, the nursing point was often placed in the centre of the unit (Figure 4). A circular movement could only be observed in building structures with parallel corridors. In some cases, a room was turned into a passage to allow a circular movement (see “U-shaped corridor” in Figure 2). However, according to statements by the hospital staff, often patients did not consider this room as a corridor area, so it is difficult to judge the success of this measure. It can be concluded that more area is needed to allow for a circular movement. Access to the outside was possible either through a direct access to a safe outside garden, or – on higher floors - an inner courtyard or safe balcony, for example with vertical glass elements that prevented patients from leaving. Many units provided an additional seating area at the end of the corridors. A further possibility to provide seating options near to the nursing point is to use window recesses where patients can sit down.

The units shown in Figure 4 are built in different existing building structures, but present good examples for the realisation of a high number of recommendations relating to the square-shaped, T-shaped and straight corridor systems.

Table 1. Percentage of implemented design recommendations for the operation of special care units.

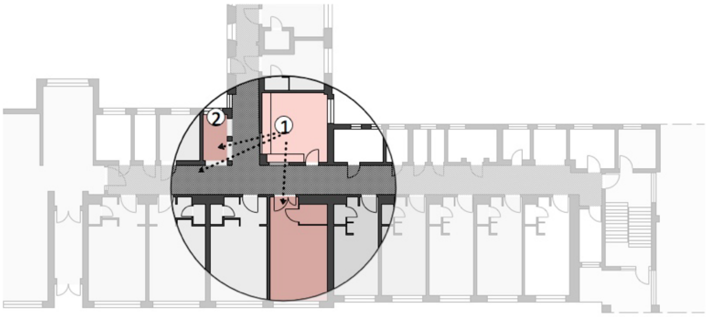
Spatial recommendations for SCUs according to Hofmann et al. (2014)	Percentage of units which implemented recommendations (N=20)	Required area per patient bed and/or further comments
	Obligatory	
8-12 beds, max. 20	8-12 beds: 35% (n=7) 8-20 beds: 70% (n=14)	- On average: 38 sqm per person with a number of beds of 14 (range: 6 to 30 beds). Compared to standard inpatient wards in Germany with an average ward size between 30 and 36 beds, the size of an SCU is about half.
Unit spatially separated	90% (n=18)	- Separation often realised by a closed ward door which was covered with decorative laminate
Joint living room	100% (n=20)	- On average: 3,2 sqm per patient (range: 0,5-10 sqm)
Therapy and/or examination room	40% (n=8)	- On average: 1,3 sqm per patient - Mostly room for physiotherapy - Examination room: ultrasound equipment was considered particularly useful
	Optional	
Homelike atmosphere	80% (n=16)	- Homelike atmosphere was confirmed when, for example, traditional furniture or decorative objects have created a domestic character. This was mostly implemented in the living room. The provision of untypical hospital furniture usually required special consultation with the hygiene department.
Particular lighting concept	50% (n=10)	- Lighting concepts could only be found in corridors or living rooms. In most cases the level of brightness could be adjusted in the corridors to reach a high level of luminance. Circadian lighting along the corridors was found in 3 units.

Example "Square-shaped corridor"



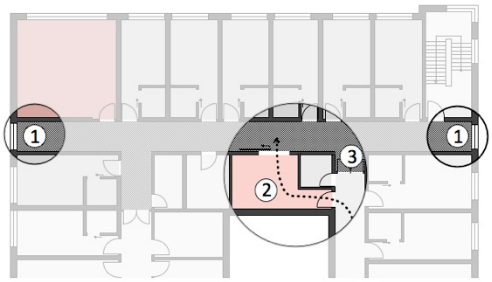
Strengths:
(1) Visual connection between nursing point and entrance
(2) Visual connection between nursing point and living room
(3) Additional seating options in window recesses
(4) Safe inner courtyard with seating options
(5) Possibility of a circular movement
(6) Access to a safe balcony, e.g. for smoker

Example "T-shaped corridor"

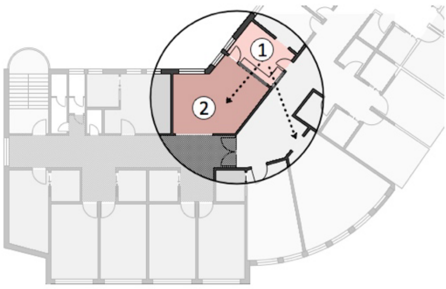


Strengths:
(1) Visual connection between nursing point and: entrance, living room, patient room
(2) Additional seating options near to the nursing point by re-constructing the corner room

Example "Straight corridor"



Strengths:
(1) Additional seating areas at both ends of the corridor
(2) Main entrances were less frequented, because the nursing point was used as passage to the ward
(3) Entrances out of visible patient movement areas



Strengths:
(1) Joint nursing point with access and visual connection to living room of the SCU and living room of the standard ward
(2) Large lounge with the possibility of both a dining area and a living room corner

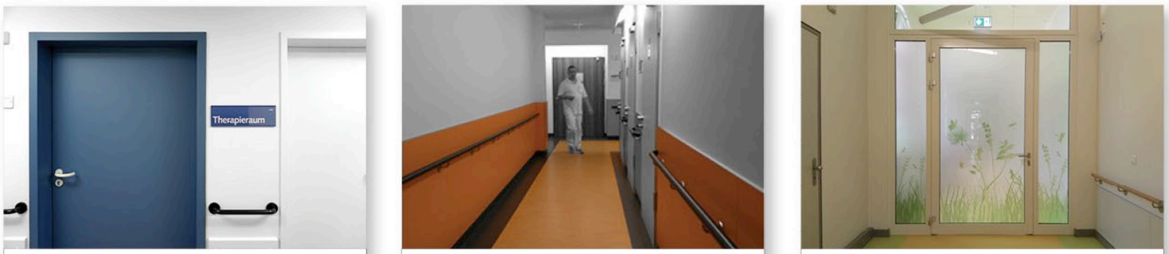
Nursing point | Living room and lounge | Patient room SCU | Patient room "standard" | Corridor of SCU

Figure 4. Examples of dementia-friendly floor plan designs.

Orientation

Exposing vs. hiding

Apart from the building layout, spatial orientation was also supported by outlining important architectural elements like floor, wall, ceiling and doors. Elements of space that are unimportant to patients should be designed in a discreet way, so that irrelevant objects do not raise patients' awareness. One way to achieve this is to paint doors and walls in the same colour. Elements may therefore optically disappear. Sometimes, patterns in floor coverings were intended to influence patients' walking direction, like a dark floor area in front of exit doors designed to discourage patients from leaving (Figure 5).



- Vision panel to show where the door lead to; signs and typo of a good size and a contrasting colour to the wall so as to be read easily
- Installed on an appropriate height
- Colour contrast from door handle to door and from handrail to wall

- Flooring matt and in a consistent colour, without any speckles
- Flooring designed in a distinctive way, so to be visually separated from walls
- Handrails in a colour that contrasts with the walls

- Covered with a semi-transparent foil, the exit door appears more unobtrusive
- Colour design matches with the colour concept of the unit

Figure 5. Examples of spatial measures to support patients' spatial orientation in special care units.

Identifying

In addition, colours or pictures can also be used to help patients identify their own room, bed or wardrobe. Examples include large images with distinctive motifs that were affixed to the doors, signs with patients' names or colour cues applied to beds, wardrobes and shelves in the bathroom. Although hospital staff mentioned that patients sometimes stopped recognising visual cues, they were also useful for caregivers or personnel (Figure 6). However, the patient's or caregiver's permission is required to display their names on doors or beds. Due to relatively short hospital stay and compared to stationary long-term care, it is very challenging to personalise patients' areas any further and would require more efforts from staff and caregivers.

- Personalisation through distinctive colour design of the wardrobe doors
- The same colour scheme is continued on the bed and on the bathroom shelves

- In addition to the colour design, individualisation is achieved by means of blackboards on which the patient names are written with chalk
- Chalk boards are also used on the room doors

- Door frames of the room doors clearly contrasted in colour
- Support of the recognition of the own room by large number and picture
- Floor covering patterns and green colouring around the door frame additionally emphasise the door

Situating

Another aspect is to give patients cues with regard to time, date and local region. The living rooms in the units had calendars displaying the present month, season, year and date, as well as wall clocks displaying the current time of day. Patient rooms had a large clock installed. Furthermore, large pictures in patient rooms, corridors and living rooms showed a mix of past and present local motifs. These pictures served to kindle conversations but can also contribute to supporting local orientation (Figure 7).

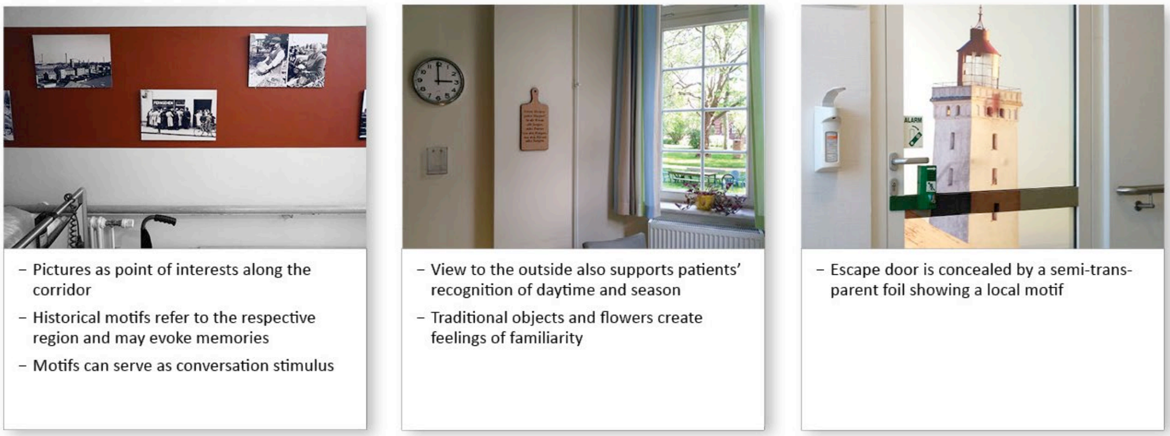


Figure 7. Examples of spatial measures to support patients' local and temporal orientation in special care units.

Ambience

A joint living room and lounge as a space where patients can eat together is of great importance and could be found in all of the examined SCU. In nearly all of the units, efforts intended to contribute to feelings of familiarity were observed. This was most evident in the design of the living room, which was often equipped with special furnishings and decorations. Shared mealtimes were an important part of the ward concept. A design to support these common lunchtimes included small seating arrangements and was extended to table decoration and tableware. These were consequently of familiar design and in a distinctive colour that contrasted with tables or trays. Where possible, bowls were used during meals instead of the usual hospital tray system. However, taking meals together in particular required more personnel and this need was often met by additional non-professional volunteers.

Some of the units offered a patient kitchen which not only created a cosy atmosphere but was also used for therapeutic purposes as part of occupational therapy, for example by cooking or baking together. The installation of luminous ceiling increases the luminous intensity in the room and thus contributes to the activation of patients. Luminous ceilings were often used in corridors and its activating effect was confirmed verbally by the staff. Moreover, distinctive spatial features were observed in the corridors, where points of interest were created by offering tactile artworks or photographs, as well as comfortable seating areas (Figures 8 to 10).

Figure 8. Example of a living room in a special care unit with various dementia-friendly spatial aspects, e.g., kitchenette, small seating groups and luminous ceiling.

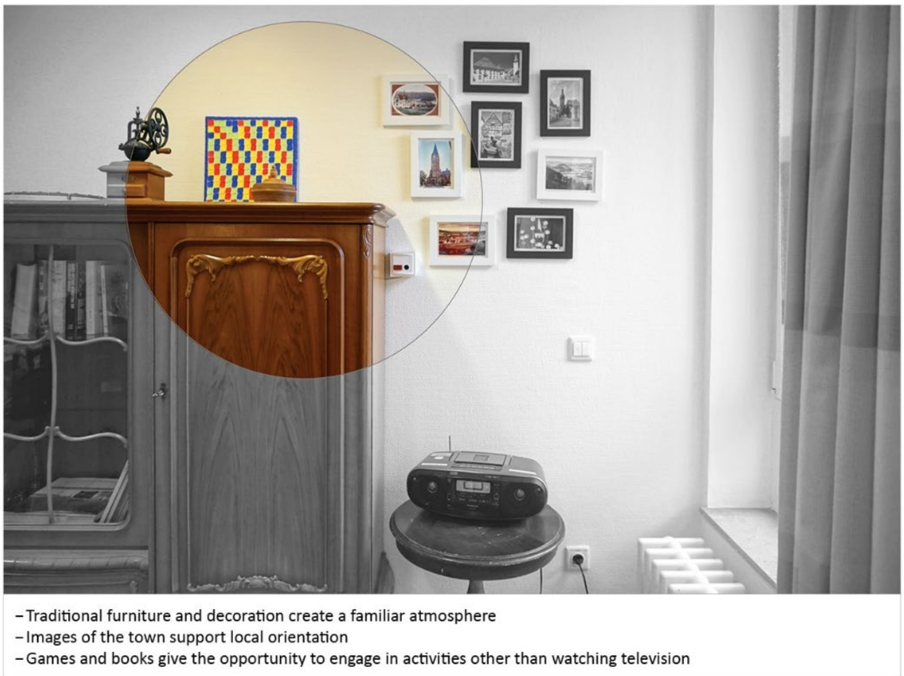


Figure 9. Example of traditional furniture and decorative objects to create a familiar ambience in the living room of a special care unit.

Figure 10. Example of a corridor in a special care unit where a seating group along the corridor is provided.

Conclusion

To our knowledge, this is the first study summarising spatial aspects and dementia-friendly design measures of SCUs for patients with dementia in general hospitals. A high number of dementia-friendly design measures was observed in the hospitals included in the study. The presented examples demonstrate not only that dementia-friendly design is possible under various conditions in acute hospitals, but also that there is a great leeway for design, as spatial concepts were adapted individually. Further, conversations conducted during the site visits revealed that dementia-friendly design measures on SCUs had met others' approval and were therefore implemented in non-specialised wards as well. Therefore, SCUs can be seen as inspirational examples of useful design because they show a thorough understanding of dementia-friendly environments.

Spatial concepts of SCUs need to be worked out not only under building conditions, but also in relation to the care concept. With regard to existing recommendations for the operation of SCUs, it is suggested that they are extended to include the presence of a nursing point. Otherwise, conditions might lead to conflicting demands with regard to a dementia-friendly care concept. For example, physical presence of nursing staff cannot be guaranteed for 24 hours in smaller units depending on a given nurse-patient ratio. In that case, the building layout should be designed such that the unit can be opened and combined with other wards in times of a lower nurse-patient ratio, specifically during night times.

Due to an expected increase of people with dementia worldwide [26] and the demographic change in many western countries, the number of geriatric patients in acute hospitals will increase and so will patients with dementia [27]. As patients with dementia are present in nearly all hospital departments and SCUs will most likely not become the standard care for all these patients, it is even more important to also consider dementia-friendly design in other hospital parts, especially on wards with a high prevalence of geriatric patients like internal or orthopaedic wards. Although the SCUs included in this study showed many dementia-friendly design interventions, it would be further enlightening to evaluate dementia-sensitivity of the built environment in other hospital departments, such as regular wards, emergency departments or intensive care units. We assume very strongly that significantly less dementia-sensitive design criteria would be found. The approach used in this study, including environmental assessment tools and photo documentation, could be used to assess other hospital departments and report the findings.

Research results show positive effects of dementia-friendly design approaches in hospitals [28], [29] and a lot of presented measures can easily be transferred to standard hospital wards, in particular visual cues and a contrasting design that both support orientation. However, regarding a dementia-friendly structural layout the present study emphasises the necessity of an early consideration in the planning process as it refers to the building structure. Otherwise these implementations may result in additional effort in terms of construction works and cost [22]. As research from stationary long-term care facilities strongly suggests that physical design is a contributing factor on the health status of people with dementia [16], we also recommend considering the built environment more seriously as one component of hospital treatment procedure. For example, corridors and staircases could be involved in physiotherapeutic measures as cognitively impaired geriatric patients often do not fulfill the requirements for usual therapeutic equipment in treatment rooms. Here, architects and designers could contribute through sophisticated hospital design to support these efforts. However, more research is needed on the impact of implemented spatial measures on health status and treatment results of patients with dementia in hospitals [21]. Whereas other studies judged the length of stay as an ill-fitting measure to assess the success of hospital wards [4], [30], possible outcome criteria could be the frequency of discharge to a patient's home or reduction of psycho-tropic medication [10], [31]. As a result, additional costs for spatial measures for this group of patients could prove as cost-effective.

Against the background of an ageing population, and the improved satisfaction and enhanced motivation of caregivers [32]–[34], as well as a greater satisfaction with the quality of care perceived by family carers [35], we assume that a dementia-friendly care approach can also benefit a larger group of people in general hospitals.

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PROCEEDINGS FROM THE 4TH CONFERENCE ON ARCHITECTURE RESEARCH CARE & HEALTH

In the early summer of 2019, the Norwegian University of Science and Technology (NTNU) hosted the 4th Architecture Research Care and Health Conference (ARCH19) at St. Olav's University Hospital in Trondheim. The objective of the ARCH conferences is to generate, share, develop and apply knowledge, methods and tools that link new research developments in architecture and urban design in care and health contexts to stakeholders such as municipalities, healthcare organizations and design firms, as well as user, patient and voluntary organizations.

The collection of thirty-five papers presented in these proceedings demonstrate the current progress in applied research into healthcare facilities and the planning and design of healthcare buildings and environments that promote health and well-being. The papers encompass a wide diversity of research methods related to healthcare architecture research and education, hospital design strategies, and user involvement in co-design.

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