
This is an electronic reprint of the original article.
This reprint may differ from the original in pagination and typographic detail.

Hiltunen, Anna Maria; Laurila, Riikka; Silander, Katariina; Kuosmanen, Timo
Cost-effectiveness of digital wound care education in a healthcare organization

Published in:
MEDINFO 2019

DOI:
[10.3233/SHTI190720](https://doi.org/10.3233/SHTI190720)

Published: 21/08/2019

Document Version
Publisher's PDF, also known as Version of record

Published under the following license:
CC BY-NC

Please cite the original version:
Hiltunen, A. M., Laurila, R., Silander, K., & Kuosmanen, T. (2019). Cost-effectiveness of digital wound care education in a healthcare organization. In B. Seroussi, L. Ohno-Machado, L. Ohno-Machado, & B. Seroussi (Eds.), *MEDINFO 2019: Health and Wellbeing e-Networks for All - Proceedings of the 17th World Congress on Medical and Health Informatics* (pp. 1933-1934). (Studies in Health Technology and Informatics; Vol. 264). IOS Press. <https://doi.org/10.3233/SHTI190720>

This material is protected by copyright and other intellectual property rights, and duplication or sale of all or part of any of the repository collections is not permitted, except that material may be duplicated by you for your research use or educational purposes in electronic or print form. You must obtain permission for any other use. Electronic or print copies may not be offered, whether for sale or otherwise to anyone who is not an authorised user.

Cost-Effectiveness of Digital Wound Care Education in a Healthcare Organization

Anna-Maria Hiltunen^a, Riikka Laurila^{a,b}, Katariina Silander^a, Timo Kuosmanen^b

^a HEMA Institute, Department of Industrial Engineering and Management, Aalto University

^b School of Business, Department of Information and Service Management, Aalto University

Abstract

Advantages of digitalization are understood, but implementation to healthcare is slow. Cost savings and quality improvements are needed in healthcare. Continuous education of healthcare professionals is essential for quality, and digital education (DE) enables that cost-efficiently.

The aim was to evaluate the cost-effectiveness of a DE for wound care by comparing it to lecture education (LE).

DE enabled a slightly better learning outcome than LE. However, combination resulted in superior outcome. DE provided best cost-effectiveness.

Keywords:

Education, Continuing, Cost-Benefit Analysis, Information Science

Introduction

Continuous development of professional skills is essential to ensure good-quality care. Wound care is the key competence of nurses as it is estimated that approximately one percent of the population in developed countries suffer from a hard-to-heal wound during lifetime [1]. Wound care skills will be emphasized in the future as the population gets older.

Even though it is important that professionals are knowledgeable, lecture education (LE) is expensive and takes time. With digital tools costs can be reduced and education offering scaled up [2], especially as digital tools are as effective as traditional learning method in professionals' behavior [3]. Cost-effectiveness (CE) analysis is considered to be a good tool to help the decision making, and can be used to evaluate digital education (DE). The aim is to study the CE of a DE compared to traditional LE.

The three main research questions are:

1. What is the relationship between the wound care education method and health care professionals' knowledge level?
2. Do the costs of the DE differ from LE?
3. What is the CE of the DE in wound care compared to LE?

The study was done in a health and social care organization, which had two ways for educating professionals for wounds: 1) traditional classroom LE, and 2) a DE, which included three modules (ABC of wounds, Local treatment of open wounds and Prevention of pressure ulcers). The DE had written material and visuals to support the learning. The DE included final exam. Neither visits to the DE platform nor exam sittings were limited,

but the employee was allowed to visit the DE platform and sit the final exam as many times as they wished. The DE platform could be accessed from the organization as well as the employees' homes. The DE was provided by Duodecim Medical Publications Ltd (later Duodecim), a Finnish Company publishing information content for medical and healthcare professionals. Since 2017, the organization had shortened the LE from a day to half a day and decided the DE to be a prerequisite for the half day LE. Before 2017, the one-day LE alone covered the education in wound care.

Methods

Data on knowledge level and professionals' background factors were collected with a web-questionnaire, which was distributed to all healthcare professionals in departments possibly facing wounds regularly or randomly (approx. 2k professionals).

The knowledge was tested with a knowledge test, which was identical to the original final exam of the DE. The background questions related to demographics, experience in the industry, and the participants education. All the participants were categorized into groups based on completed wound education. First, the participant data was divided into three: 1) completed one-day LE, 2) completed half-day LE, 3) no LE. Second, the groups were split in two: 1) completed DE, 2) no DE completed.

The knowledge tests were graded and the data analysis was carried out by IBM SPSS Statistics. The average scores between different groups were tested by Kruskal-Wallis H-Test and Mann-Whitney U-test. Finally, a multiple linear regression model to control the background variables was conducted.

Information regarding education costs was estimated by the organization and Duodecim. The data included the costs of DE, one-day and half-day LE, and organizational cost of one nurse per hour. The estimated cost consists of the (1) direct costs from acquiring LE or DE (fees and teaching), and (2) indirect costs (working time). The estimated direct cost of one DE per participant was allocated from the total acquisition cost of the DE license. CE of the DE was evaluated with a CE ratio: cost of additional (incremental) intervention and the additional outcome (effect caused by the outcome, i.e., knowledge level).

Results

Description of the participants

In total, 94 professionals (=N) responded to the questionnaire, corresponding approximately 5% response rate.

The age range was from 23 to 64 years with a mean of 42. There were no great age differences between groups. The overall average of experience was 17 years, but the group with half-a-day LE and DE had lower average experience in healthcare industry than other groups. The participants had worked in the organization for 12 years on average, shortest in the group of DE and half day LE, longest in the group with only one day LE. On average, the respondents had worked in their current department for 10 years. Most of the participants were females (98%) and registered nurses (66%). The frequency of practical wound care work was divided more evenly between participants, and 52% announced to work with wounds at least once a week, 23% at least once a month and the rest less frequently. Total 20 respondents (21%) were wound care nurses. In DE, 60% had completed at least one of the module, and 33% had accomplished the organization's one-day LE about basics of wounds. Total 14% of the respondents had accomplished the half-day LE, which was available from 2017. The rest of the respondents (53%) had not taken part in the wound care LE in their organization.

Knowledge test outcomes

The distribution of the knowledge test scores is close to normal. The variation was -2 to 20 (out of 27). The average score was 10.05 points. The most frequently earned score was eight points. The more education the participant had, the higher the knowledge test score was. All the score averages in DE groups were higher than in the groups without any DE. Also, the longer the LE had been (one-day > half-day > no LE), the higher the scores were. The one-day LE together with the DE resulted in more points than the half-day LE and the DE combined (11.90 vs. 11.10). If the participant had only carried out the DE alone, the average (9.4) was still better than if the participant had carried out only the one-day LE alone (average 9.2). However, this difference was not statistically significant.

Statistical significance of the effect on knowledge was tested for six variables (research group, LE, work experience, wound care frequency, DE, and wound care nurse). The group with an accomplished DE had higher score average than without DE (10.7 vs. 8.9, $p=0.035$), and wound care nurses' average was higher than other respondents (12.1 vs. 9.5, $p=0.024$).

Cost estimation

The direct cost for the DE calculation was 0.55€ per person per one module. The referential time to execute the DE is three hours in total. Because mostly nurses are participating the DE and LEs, the cost of nurses is used to identify the indirect cost: it is counted from the average cost of a nurse per hour. The average cost (incl. side costs, excl. holiday compensations) is 17.85€ per hour.

The direct cost of LE per nurse consists mostly of the compensation for lecturer. The direct cost estimation per person for the one-day LE is 50€ and for the half-day 30€. The length of one working day is approximately seven, five hours and for half-day course it is four hours.

Cost-effectiveness analysis

DE is inexpensive and has good learning results, thus the DE cost (55.19€) per outcome (9.4) ratio was 5.87€ per knowledge unit, and the relative CE ratio was 0.29. The one-day LE together with the DE achieved the best absolute outcome (11.9). However, this combination was the most expensive (239.02€). Thus the cost per outcome ratio was 20.09€ and relative CE ratio was 1.

The half-day education is not typically executed alone without the DE, so it is irrelevant to be analyzed individually. The cost (156.57€) per outcome (11.10) ratio of a combination of the DE and a half-day LE was 14.10€ per one knowledge unit, and the relative CE ratio was 0.71. The cost for one-day education alone was 183.84€ and the outcome was 9.2. Thus the cost per outcome ratio was 19.98€ and relative CE ratio was 1.

The incremental cost-effectiveness (ICE) ratio was defined as the ratio between the additional cost and additional outcome. The additional outcome refers to the knowledge level of participants with education minus with participants with no wound education (8.9). The score from the DE is 9.4, so the additional effect on learning is 0.5 units. The additional learning was highest in DE and one day LE (3). For one day LE additional learning was 0.3, and in combination of DE and half-a-day LE 2.2. ICE ratio for DE was 110.37€, for DE combined with half-a-day LE 71.17€, for one day LE 612.79€ and for combination of DE combined with one day LE 79.67€.

Conclusions

The relationship of wound education and wound knowledge is proved to be positive based on the results of this study. The more education, the higher knowledge test scores. DE can enable cost savings, increase the amount of professionals trained or enable better learning outcomes. Even though DE performed well in terms of CE, the additional LE improved the outcomes. With the comparison of ICE ratios, the optimal choices for organizations would be the combinations of DE and either half-day or one-day LE.

However, the decision between the learning methods does not need to be fixed. A relevant response to the results is segmentation. Professionals could be segmented based on the different levels of requirements concerning wound care. The priorities of an organization and value judgments between cost and learning must be taken into consideration along with CE analysis.

Acknowledgements

This work was supported by a grant from Business Finland. We also acknowledge the support Kainuu Social and Health Care Joint Authority and Duodecim Medical Publications Ltd. provided us.

References

- [1] F. Gottrup, J. Apelqvist, and P. Price, Outcomes in controlled and comparative studies on non-healing wounds: recommendations to improve the quality of evidence in wound management, *J Wound Care* **19** (2010), 239–268.
- [2] D. Zhang, and J. F. Nunamaker, Powering e-Learning in the new millennium: An overview of e-Learning and enabling technology, *Inform Syst Front* **5** (2003), 207–218.
- [3] P.M Sinclair, A. Kable, T. Levett-Jones, and D. Booth, The effectiveness of Internet-based e-learning on clinician behaviour and patient outcomes: A systematic review, *Int J Nurs Stud* **57** (2016), 70–81.

Address for correspondence

Anna-Maria Hiltunen, anna-maria.hiltunen@aalto.fi, +358404109205