

SHORT REPORT

Effectiveness of e-learning in continuing medical education for occupational physicians

Nathalie I. R. Hugenholtz, Einar M. de Croon, Paul B. Smits, Frank J. H. van Dijk and Karen Nieuwenhuijsen

Background	Within a clinical context e-learning is comparable to traditional approaches of continuing medical education (CME). However, the occupational health context differs and until now the effect of postgraduate e-learning among occupational physicians (OPs) has not been evaluated.
Aim	To evaluate the effect of e-learning on knowledge on mental health issues as compared to lecture-based learning in a CME programme for OPs.
Methods	Within the context of a postgraduate meeting for 74 OPs, a randomized controlled trial was conducted. Test assessments of knowledge were made before and immediately after an educational session with either e-learning or lecture-based learning.
Results	In both groups, a significant gain in knowledge on mental health care was found ($P < 0.05$). However, there was no significant difference between the two educational approaches.
Conclusion	The effect of e-learning on OPs' mental health care knowledge is comparable to a lecture-based approach. Therefore, e-learning can be beneficial for the CME of OPs.
Key words	Continuing medical education; e-learning; mental health; occupational medicine; randomized controlled trial.

Introduction

In contrast to what is commonly believed, elderly physicians and physicians with many years of experience generally possess less factual medical knowledge [1]. Continuing medical education (CME), therefore, is widely acknowledged as an indispensable part of the working life of physicians. With the introduction of the Internet, e-learning, i.e. the use of Internet technologies that enhance knowledge and performance, can be integrated into CME programmes. Compared to conventional learning, e-learning has the advantage that participants can choose the place and time of education themselves. Within a clinical context, the effect of Internet-based CME programmes is comparable to traditional approaches of CME [2,3]. Although there are some initiatives among undergraduate occupational physicians (OPs) in using e-learning, until now the effect of postgraduate e-learning among OPs has not been evaluated [4].

The occupational health context differs from the clinical context or primary health care because OPs must, next to medical issues, consider the working situations of their patients, management priorities and legislation. Another barrier for e-learning in CME in occupational health care could be that OPs are not frequently using the Internet for obtaining information [5]. The aim of this study, therefore, was to evaluate the effect of e-learning on knowledge gain as compared to regular lecture-based learning in a CME programme on mental health care for OPs.

Methods

The study was a randomized controlled trial and was conducted in December 2006 during a meeting on mental health care within a series of four postgraduate meetings for OPs. OPs were randomly assigned to four different groups in order of arrival at the meeting, by means of a four-block randomization system. The OPs were unaware that two teaching approaches were compared during the meeting. Two groups received lecture-based teaching while the other two groups received individual e-learning in a classroom, both with the same

Coronel Institute of Occupational Health, Academic Medical Center, University of Amsterdam, The Netherlands.

Correspondence to: Nathalie I. R. Hugenholtz, Coronel Institute of Occupational Health, Academic Medical Center, University of Amsterdam, PO Box 22700, 1100 DE Amsterdam, The Netherlands. Tel: +31 20 566 5325; fax +31 20 697 7161; e-mail: n.i.hugenholtz@amc.uva.nl

content. The duration of both lessons was 30 min. Immediately before and immediately after the lesson, the OPs completed a knowledge test.

Since employees with mental health problems constitute a large part of the working population that visits the OP, we developed the website <http://mentalhealthandwork.com> (psychischenwerk.nl), covering three main topics: diagnosis, prognosis and treatment. The website includes an e-learning module which was designed as a self-directed teaching tool for occupational health care professionals. The module provides participants with information, invites to search for information on the website and asks to solve cases or answer multiple-choice questions using this information.

Each knowledge test consisted of 30 true/false questions and three open-ended ones. Two experts in mental health care and one expert in occupational health care education developed a pool of 66 questions. Two versions of the test, version X and Y, each containing different questions from the pool were generated. The use of the knowledge tests was counterbalanced: one e-learning group completed test X before finishing the e-learning module and test Y after finishing. The other e-learning group completed test Y before the e-learning module and test X after finishing it. The same procedure was used in the two lecture-based learning groups. For each correct answer, the score was '1' and for each incorrect answer the score was '0'. Sum scores were converted to a percentage of the possible total score.

Differences in baseline characteristics were tested with *t*-tests for continuous variables and chi-square tests for categorical variables. To determine whether 'test version' needed to be included as a covariate in the analyses, score differences at baseline between version X and Y were tested using a *t*-test. The effect of both learning approaches on knowledge was evaluated by comparing the change in knowledge between the two groups. Analyses were performed using the general linear model for repeated measures. Next, subgroup analyses were conducted within both learning approaches to investigate age and experience as an OP as potential predictors for change in knowledge. Data were analysed using SPSS version 13.0.

Results

In total, 74 OPs attended the meeting. Randomization assigned half of them to the e-learning and half to the lecture-based groups. Two OPs in the lecture-based group were excluded because they arrived too late. The baseline characteristics of the OPs are described in Table 1. Only the years of experience as an OP differed significantly between both groups.

As the baseline scores of both knowledge tests X and Y (mean 52.9, SD 9.2 and mean 51.5, SD 8.1, respectively) did not differ significantly, the variable test version was not included in further analyses. In Table 2, the scores of the four groups are shown. Although the scores of the

Table 1. Baseline characteristics of OPs

Characteristics	E-learning group (<i>n</i> = 37)	Lecture-based learning group (<i>n</i> = 35)
Age in years, mean (SD)	50 (4.3)	49 (6.9)
Women, <i>n</i> (%)	15 (41)	18 (49)
OP years of experience, mean (SD)*	18 (5.6)	14 (6.5)
Acquaintance with the website, <i>n</i> (%)	17 (46)	13 (35)
Previously used the website, <i>n</i> (%)	11 (30)	6 (16)

* $P \leq 0.05$ *t*-test.

Table 2. Total scores of the two e-learning groups and the two lecture-based learning groups at baseline and at post-test

Teaching approach	Total score, baseline (SD)	Test version	Total score, post-test (SD)	Test version	
E-learning	Group A	50.9 (8.3)	X	64.9 (9.2)	Y
	Group B	53.2 (8.6)	Y	65.3 (10.2)	X
Lecture based	Group C	55.0 (10.0)	X	63.8 (7.3)	Y
	Group D	49.7 (7.4)	Y	64.9 (10.5)	X

four groups differed at baseline, they differed not significantly within each teaching approach as well as between the two teaching approaches. Both learning approaches significantly enhanced OPs' knowledge on mental health care issues. The mean score for the e-learning approach was 52.1 (SD 8.4) at baseline and 65.1 (SD 9.6) at post-test ($P < 0.05$). For the lecture-based approach, the mean score was 52.3 (SD 9.0) at baseline and 64.3 (SD 9.0) at post-test ($P < 0.05$). The improvement in knowledge did not differ significantly between these groups. The potential predictors' age and experience as an OP showed no significant relation to knowledge scores over time within the two learning approaches.

Discussion

The results of this study show that for OPs, e-learning is just as effective in enhancing knowledge as lecture-based learning. This is especially of interest since the study was conducted in a group of OPs with a high mean age and assumed fewer computer skills. Earlier, a lack of computer skills has been identified as a major barrier preventing doctors to use computer-based learning methods, rather than a lack of preference for new technologies [6]. Since computer skills are part of the current vocational training and education, e-learning may play an even more important role in the CME of OPs in the near future. We did not include the participants' preference for, or satisfaction

with, the tested learning approaches. Nevertheless, the meeting itself was rated 7.1 (0–10), which was in line with the rating of the other three meetings that year.

This study is the first to demonstrate that e-learning can be useful for CME in the occupational health care setting. It will enable OPs to choose the place and time to educate themselves. Recently, Fordis *et al.* [7] found that web-based CME can lead to behaviour change as well as sustained knowledge gains that are superior to traditional approaches. A next step within occupational health care may be to study the effectiveness of different forms of e-learning and also the persistence of obtained knowledge over time. Even more important is to study the impact of e-learning on professional practice.

Funding

Funding to pay the Open Access publication charges for this article was provided by the OA (Open Access) Fund of the University of Amsterdam.

Key points

- Within the complex setting of occupational health care, postgraduate e-learning is just as effective in enhancing knowledge as lecture-based learning.
- Since the lack of computer skills of OPs will decrease, e-learning may play an even more important role in the CME of OPs in the near future.
- Although our e-learning module enhanced the knowledge of OPs, the effectiveness of different forms of e-learning, persistence of obtained knowledge over time and the impact of e-learning on professional practice should be further explored.

Acknowledgements

The researchers would like to thank the Netherlands School of Public and Occupational Health and especially Jac van der Klink, Suzanne Lagerveld, Kitty Meulenbeld, Erik Noordik and Frans Vlek for organizing the CME meeting.

Conflicts of interest

None declared.

References

1. Choudhry NK, Fletcher RH, Soumerai SB. Systematic review: the relationship between clinical experience and quality of health care. *Ann Intern Med* 2005;**142**:260–273.
2. Wutoh R, Boren SA, Balas EA. eLearning: a review of Internet-based continuing medical education. *J Contin Educ Health Prof* 2004;**24**:20–30.
3. Curran VR, Fleet L. A review of evaluation outcomes of web-based continuing medical education. *Med Educ* 2005;**39**:561–567.
4. Kolb S, Reichert J, Hege I *et al.* European dissemination of a web- and case-based learning system for occupational medicine: NetWoRM Europe. *Int Arch Occup Environ Health* 2007;**80**:553–557.
5. Schaafsma F, Hulshof C, van Dijk F, Verbeek J. Information demands of occupational health physicians and their attitude towards evidence-based medicine. *Scand J Work Environ Health* 2004;**30**:327–330.
6. Mamary EM, Charles P. On-site to on-line: barriers to the use of computers for continuing education. *J Contin Educ Health Prof* 2000;**20**:171–175.
7. Fordis M, King JE, Ballantyne CM *et al.* Comparison of the instructional efficacy of Internet-based CME with live interactive CME workshops: a randomized controlled trial. *J Am Med Assoc* 2005;**294**:1043–1051.