ORIGINAL ARTICLE

TESTING THE KNOWLEDGE OF NURSES REGARDING THE PREVENTION OF FALLS

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Abstract

Objectives: The most frequent adverse events in the institutional medical environment are patient falls. The education of medical workers on this issue is an effective preventative intervention. One of the effective methods of education is e-learning.

Goal: The goal of this paper is the assessment of the features of knowledge tests of e-learning courses, which are focused on the prevention of patient falls and designed for nurses who work at ward blocks.

Methods: Statistical methods were used for the assessment of the features of knowledge tests of e-learning courses for medical workers (Shapiro–Wilk test, Cronbach alpha coefficient).

Results: The Cronbach alpha coefficient for the internal task consistency of the entrance test was 0.82 and 0.85 for the final test. The correlation coefficient between the results of the entrance test and the final test was not statistically significant (p = 0.179), but it was statistically significant regarding the total numbers of correct answers in the entrance test and the final test (p = 0.046). The coefficient value was 0.467, which means a weaker direct correlation. The positive dependence between the entrance test and the final test shows good test validity.

Conclusions: We found sufficiently strong results in test reliability and confirmed a positive dependence between the entrance test and the final test. We succeeded in compiling knowledge tests whose features are measurable and reproducible.

Keywords: *Education; E-learning course; General nurse; Prevention of falls; Reliability; Validity*

INTRODUCTION

The safety goals of the Ministry of Health of the Czech Republic aim to minimize risks in the most hazardous areas of providing medical care. One of the safety goals and indicators of the quality of the medical care provided is patient falls. The Czech Republic is not the only country where falls are considered one of the most frequent adverse events. Medical care providers are obligated to record all patient falls, regularly assess their causes and time frequencies, analyze them, create and accept preventative measures, carry them out and regularly check their maintenance and effectiveness (Act No. 147/2016 Coll.). As part of preventative measures, the American organization for the quality and safety of healthcare of the Institute for Healthcare Improvement recommends focusing on dominant areas regarding the quality and safety of healthcare, which are organizational culture and

education (Frankel et al., 2017). The prevention of falls and injuries should be included in the nursing curriculum and continuous education (Jarošová et al., 2014). The education of personnel is an effective preventative intervention regarding patient falls, which has been confirmed by foreign studies as well (Ang et al., 2011; Ohde et al., 2012; Quigley et al., 2016; Shee et al., 2014; Spiva et al., 2014; Toye et al., 2017).

In nursing, as well as many other fields, the demand for flexible and innovative educative methods is rising (Lahti et al., 2014). E-learning is considered one of the effective possibilities that are used to facilitate the acquisition of skills and competences in nursing (Jian-Fei et al., 2017; Ogura et al., 2018). The most used concept in the creation of e-learning courses is the ADDIE model. The title is the acronym of individual phases – analysis, design, development, implementation, evaluation (Budoya et al., 2019). It is a generally used model with a dynamic structure which ensures that creating e-learning courses will not be random. It is necessary to go through all phases. The absence of one might endanger accomplishing the goal. The most important phase is the analysis. In this phase, it is necessary to establish and define education goals. It is also important to carry out a content analysis of education needs, final groups, resources and limitations. These components should ideally correspond with up-to-date information, which is gained using evidence-based nursing. To confirm the efficiency of implemented preventative intervention in clinical practice, it is necessary that all research parts be included with respect to their maximum scientific level.

This article is part of a long-term intervention observational study that deals with medical e-learning as a preventative intervention regarding patient falls and increases the qualitative level of this implemented intervention.

The research process that assesses the efficiency of e-learning regarding patient falls was divided into a few phases (retrospective five-year analysis of patient falls, preparation and realization of the e-learning programme for selected workplaces, the assessment of the programme efficiency).In the first phase, we analyzed patient falls at selected healthcare providers. We then carried out a 5-year retrospective analysis of patient falls at a large ward block in the fourth largest faculty hospital in the Czech Republic (Pilsen). In 2019, this hospital had 1,739 beds at 21 clinics, 19 wards and 6 institutes. It provided basic, specialized and a super specialized medical care for catchment areas (approximately 800,000 Czech citizens). The analysis results were published in 2018 (Horová et al., 2018).

The issue of patient falls was analyzed using quantitative and qualitative methods. Regarding the qualitative method, we carried out group interviews with selected clinic managers (general nurses) who had the largest fall incidence (internal clinics, surgical clinics, geriatric wards and the long-term ill wards). The discussion topics were focused on the results of retrospective analyses of falls with the emphasis on statistically significant areas. This explorative technique enabled specific descriptions, new inputs and inspirations, and maximum information and suggestions from experienced experts.

The results of the quantitative and qualitative research phases enabled the assessment of five areas that were included in the e-learning programme (risk factors of falls, the assessment of the risks of falls, assessment tools, preventative measures and relevant legislation norms that served as motivation and emphasized the importance of education regarding the issue). Preparing the e-learning course, we considered the current expert recommendations and principles of andragogy (adults are pragmatically focused on specific needs from their specific practice). The course content respected the updated Bloom's taxonomy of education goals (remembering; understanding; analyzing; applying; evaluating and creating) (Marzano and Kendall, 2007).The asynchronous e-learning course was created in the Learning Management System (LMS) Moodle. The advantage of this system is the possibility of using it in lectures and adjusting it to different study styles.

The next phase enables all nurses at selected clinics to access the course for a set time period. The emphasis is on the dissemination of information and the support of the motivation to participate. The last phase includes the efficiency assessment of the e-learning intervention. Current studies that aim at assessing the level of knowledge of nursing staff (e.g. Bahrambeygi et al., 2018; Rouleau et al., 2019) have observed a certain educational

impact. However, the impact of educational intervention on particular areas of nursing practice has not been described (with certain exceptions).The effects of the e-learning course will be verified on direct clinical indicators – the evidence-based incidence of patient falls and their consequences.

The goal of this study was the assessment of knowledge test features of the e-learning course for general nurses working at ward blocks that is focused on the prevention of patient falls.

MATERIALS AND METHODS

Research organization

In the pre-research phase, we carried out the analysis of the features of preliminary and final knowledge tests. For a test to be part of an e-learning course that is supposed to serve as preventative intervention regarding the quality and safety of nursing care, it is necessary to ensure the searching of the best possible evidence (Houser and Oman, 2011).The basic features of a didactic test are reliability and practicality (Chráska, 2016). We also ensured validity, which indicates that tests are valid and show actual status (Test validity, 2011).

We carried out curricular validity of the tests. Curricular validity is based on the assessment of competent people of the curricular correspondence of the tests. In practice, experts assess curricular validity (Chráska, 2016).

The preliminary and final knowledge tests contained different questions. Both tests had 15 questions offering four response options (multiple-choice item). Only one answer was correct. The questions, answers and distracters (incorrect answers) corresponded with Bachelor's degree knowledge level in the Nursing study programme. The final test contained individual lessons from the e-learning course. The assessment of test results (excellent 80–100%; satisfactory/partial 60–79.9%; insufficient 0–59.9%) was based on the percentage of correct answers (strict classification) (Sedláčková, 1993).

Course participants took the test in LMS Moodle with set limitations (only one attempt with a password, time limit, finalization of the test only after answering all questions).

The respondents were general nurses with a minimum of two-year experience in the field. They were also simultaneously studying the master's degree in Nursing. They had access to the e-learning of the institution where the preparation and the course pilot version was being carried out. One of the conditions for the inclusion in the research was for the respondents not to be employed at a medical institution where the course was carried out. The group of respondents was homogeneous and the environment for testing was familiar. The participation was voluntary and anonymity was ensured (random draw for the access to LMS Moodle).

Methods

The knowledge tests were assessed for reliability (reliability and accuracy) and curricular and predictive validity.

Curricular validity was assessed by two independent competent experts. Their expert experience had to be longer than 10 years, their teaching experience longer than 2 years, and they had to be experienced in the matter. They focused on the curricular test congruity, representativeness and relevancy of questions and compatibility of answers.

They also assessed test reliability (reliability and accuracy) and predictive validity. Statistical tests were assessed using MS Excel (version 1908) and RStudio (Version 1.1.463, R version 3.5.2).

One of the conditions for normal data division was tested using the Shapiro–Wilk test. The monitored variables did not meet this condition. Therefore, it was necessary to use non-parametric tests in the following analyses. We used the Spearman's rank-order correlation coefficient, which is used for measuring the intensity of the rank dependence of variable indicators. We also used the method of Cronbach's alpha, which monitors the level of the mutual homogeneity of the content of test tasks. This reliability coefficient (in case of dichotomous variables) is equal to the Kuder–Richardson's formula. This formula for the calculation of reliability coefficient is suitable for tests that contain homogenous tasks regarding content. The coefficient value α was between 0 and 1. For individual testing, didactic tests require are liability coefficient at a minimum of 0.8. A lower reliability coefficient

causes a more sceptical assessment of measured results (Chrástka, 2016, p. 100).

To assess the knowledge in this pilot version, we used the Stuart–Maxwell's test. It is possible to use this test for the comparison of two individual scores that are assessed on a multiple-point scale. A necessary condition for using the test is the possibility of pair assessment, i.e. there are individual results in the first and second test (Reif, 2004).

RESULTS

In this pre-research phase, 30 respondents, who attended the e-learning course (which lasted 2 months) after passing an entrance test, filled in knowledge tests and a final test.

The curricular test validity was confirmed using expert assessments. They agreed that the test had a high curricular validity and recommended test distribution.

The *p*-value in the Shapiro–Wilk's test did not exceed 0.05 when reliability was tested. For this reason, the hypothesis of normal data division was denied and the variables did not meet the condition of data normality.

The value of the Cronbach alpha coefficient was 0.82 (in the final test, it was 0.85). The test questions were internally sufficiently consistent and the values show sufficiently strong results regarding data reliability in both test types. Table 1 shows the possibility of changes in the values of the Cronbach alpha coefficient if certain items were excluded. If the new alpha exceeded the original value, it would be suitable to remove such items, which was not necessary in any test.

Table 1 – Entrance and final tests – Cronbach coefficient alpha

Items	Cronbach alpha Entrance test	Cronbach alpha Final test
Question 1 excluded	0.8121	0.8443
Question 2 excluded	0.8003	0.8441
Question 3 excluded	0.8202	0.8328
Question 4 excluded	0.7991	0.8467
Question 5 excluded	0.8121	0.8410
Question 6 excluded	0.8201	0.8466
Question 7 excluded	0.8049	0.8291
Question 8 excluded	0.7976	0.8440
Question 9 excluded	0.7872	0.8307
Question 10 excluded	0.8032	0.8291
Question 11 excluded	0.7937	0.8412
Question 12 excluded	0.8142	0.8447
Question 13 excluded	0.8086	0.8275
Question 14 excluded	0.8103	0.8398
Question 15 excluded	0.8206	0.8276
Correlation coefficient 0.467; Sig. (2-tailed) 0.179; *N* = 30		

We also tested the correlation dependence between entrance and final tests to gain a total overview of the reliability and predictive data validity. We compared the final variables (which showed the number of correct answers from both tests) to the total results of both tests. The variables did not meet the condition of normal data division, so their correlation was counted using the Spearman's coefficient. The correlation coefficient between the results of the entrance and final tests (excellent 80–100%; satisfactory 60–79.9%; insufficient

0–59.9%) was not statistically significant (p = 0.179). However, the correlation coefficient between the numbers of correct answers in the entrance and final tests (which had 15 questions) was statistically significant (p = 0.046). For this reason, the correlation dependence was statistically significant as well. The coefficient value was 0.467, which indicates a weaker direct correlation. Nevertheless, the positive dependence between entrance and final tests existed, which shows good test validity.

In total, 50% (15) of the respondents had equal results in both tests, 7% (2) had worse results (from excellent to satisfactory/partial) and 43% (13) improved. The resulting p-value of the Stuart–Maxwell test was >0.05, thus, we can say that the test results are comparable. However, there was a low number of monitorings and we had a small possibility to observe differences.

DISCUSSION

Practice methods were based on the best scientific evidence. They are constantly developed and used in nursing as well. Every decision made by medical staff should be based on the best available scientific evidence, clinical experience and patient preference consideration (Marečková et al., 2015).The education of nurses regarding fall prevention and caused injuries is included in intervention preventative programmes (Becker et al., 2003; Quigley et al., 2010; 2016; Spiva et al., 2014).The research results present the comparison of the respondents' knowledge levels (*ante-factum* versus *post-factum*).The verification of the features of the used education tools/tests/questionnaires is mostly not mentioned.

Regarding the issue of falls, the Australian team of authors, Kiegaldie et al. (2019), presented pre-test results of clinical practice students (n = 178). The respondents filled in the tests in the context of a four-hour education workshop called The Safe Recovery Programme (SRP).The topic was the prevention of falls. The authors presented six research areas of education assessment (questionnaire, questions about self-confidence, motivation, self-assessment regarding achieving goals, the usefulness of activities and the assessment of educative experiences) and the use of Kirkpatrick's four-level education model for the assessment of education effect. The assessment of test features was not carried out in the research. Finnish authors of a descriptive study (Tuomikovski et al., 2018) assessed a tool developed for the auto-evaluation of mentor competences in conducting professional practical training of the students of nursing by testing 576 mentors. The research showed the 10-factor/item model has acceptable constructive validity. The Cronbach alpha coefficient for the observed partial scales was between 0.76 and 0.90. In this case, the assessment of knowledge tests was not dealt with. The important circumstance in this research is the authors' realization of the necessity of the assessment of the features and quality of the used tool.

The Cho and Jang (2020) Korean team of authors showed an exception. They verified the features of a 15-item questionnaire that assessed the knowledge of nurses (n = 162) regarding patient falls. The questionnaire was based on the consensus of two experts (professors) in nursing and two experts in patient safety. It contained 14 "multiple-choice" answers and 1 subjective assessment. The reliability coefficient by Kuder–Richardson was 0.76. The validity index was 0.80 for all items. A minimum 0.8 reliability coefficient in didactic tests is required for individual testing (Chráska, 2016).The presented result is close to this index. For this reason, it is possible to consider the used test a quality test that supports the scientific level of conclusions. In this research, we also used other tools for the assessment of the given issue (questionnaires to find out the approaches of medical workers and the activities and performances of nurses). The research team assessed test reliability in these areas as well (Cronbach alpha coefficients were 0.72 and 0.92). The result correlation of individual questionnaires showed no significant relationships between the knowledge of the matter and involvement of nurses in the prevention of falls (p = 0.267) or their approaches (p = 0.240).

The results of our research goal have shown a high level of curricular validity and reliability of the tests. If the reliability coefficient is lower, a more sceptical approach in the assessment of measured results is necessary. A high level of reliability does not guarantee a valid test (Chráska, 2016). The Cronbach alpha coefficient was 0.82 in the entrance test

and 0.85 in the final test. If the test is longer, it is more reliable. Test reliability can artificially be increased if the number of items, under the equal conditions, is higher (if there are no changes in the average correlation between individual test items). If we repeat the calculation of the coefficient and omit individual items, we can see how these items influence the total test reliability. The possible increase of the coefficient of test reliability indicates that an item is suitable to be omitted. This information should be considered during the construction of knowledge tests. The presented findings should serve for the realization of the importance of the verification of the educative tool features that are used due to the growing influence of education on the quality and safety of health care and related legislation requirements (regulation No. 262/2016 Coll.; act No.147/2016 Coll.).

CONCLUSIONS

The consensus of the team of authors and practical experts enabled the drawing up of knowledge tests, the features of which were measurable and reproducible. This article points out the importance of the analytical research phase. In this phase, it is necessary to use sophisticated research methods to verify the entrance and final knowledge of the respondents (in nursing and other fields) to validly establish their efficiency. Considering the requirement of evidence-based nursing, curricular validity and reliability of tests should always be established in research studies. The efficiency of preventative measures in healthcare is also based on the education of patients and carers. The process of education should always correspond with the current "evidence-based" information and be verifiable by empirical methods.

Conflict of interests
The authors have no conflict of interests to declare.

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