Nurse Education in Practice 38 (2019) 84–88

Contents lists available at ScienceDirect

Nurse Education in Practice

journal homepage: www.elsevier.com/locate/nepr

Clinical education

Rapid E-Learning for professional development in school-based diabetes management

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ARTICLE INFO

Keywords:
Professional development
E-modules
Nurse education
Diabetes education

ABSTRACT

The number of school aged youth in the United States requiring assistance in the management of diabetes has reached over 200,000. School nurses are often charged with the training of personnel and provision of assistance to children with this chronic disease. The need for quick, efficient, and accessible training methods is necessary to ensure school nurses have the most current information necessary to perform their duties. The purpose of this study was to assess the effectiveness of a rapid e-learning module for school nurse professional development in school-based diabetes management. A sample (N = 1977, n = 1127) of school nurses was asked to complete a module addressing current and/or changing information on diabetes management, the training of staff charged with assisting students, and the associated pre- and post-tests for the module. A total of 678 nurses completed the pre-test, while 449 nurses completed the post-test. T-test results for independent samples indicated a significant increase ($p < 0.001$) in knowledge at post-test. Results support the contention that e-modules are a convenient and effective way to provide professional development opportunities and improve nurses' knowledge.

1. Introduction

For children and youth, diabetes is a leading chronic condition that is increasing in prevalence around the globe. Global prevalence has doubled over the past couple decades (World Health Organization, 2016); and in the United States, about one in 400 youth are affected with either type 1 or type 2 diabetes. Global strategies for addressing the problem include establishing diabetes management protocols in primary care and improving prevention and management practices in a variety of settings, including the school site (World Health Organization, 2016). In addition, developing innovative provider education programs using current technology can help fill knowledge gaps and ensure broad message reach (World Health Organization, 2016; Bootle and Skovlund, 2015).

Because of the amount of time spent in school, school staff play a key role in effective management of chronic conditions in youth. This occurs through the provision of screenings, education, and treatment (Leroy et al., 2016). School personnel and programs, specifically school health services, can help meet the need for diabetes management and education in school-aged youth Edwards et al. (2014) note that interventions in the school setting, that follow expert guidelines and use school nurse support, seem to have at least short-term effects on student/staff diabetes management knowledge and self-efficacy, but evidence is limited.

During the school day, youth with diabetes need glucose levels monitored, insulin administered, and emergency treatment in the event of significant glucose reduction. Under federal law, schools must reasonably accommodate full participation of youth with diabetes, provide services, and keep medical information confidential (Jackson et al., 2015). Trained school nurses and school staff assist youth and families with implementation of their medical management plan and supervise their self-care. Keeping glucose levels optimal by balancing insulin, nutrition, and activity is the general management goal. Some youth may need more assistance than others to reach this goal, and all youth will need assistance in a diabetes emergency (Jackson et al., 2015).

Guidelines for diabetes management in the school setting instruct school staff to create a school health team consisting of the youth's health care providers and family, school administration, trained staff, and the school nurse. The team coordinates inter-professional implementation of the youth's "Diabetes Medical Management Plan (DMMP)" or "medical orders" (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK, 2016, p. 14). The school nurse

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https://doi.org/10.1016/j.nepr.2019.06.009
Received 28 February 2018; Received in revised form 14 May 2019; Accepted 9 June 2019

then creates an individualized care plan and an emergency care plan to meet health goals based on the DMMP (NIDDK, 2016).

Marks et al. (2013) report that although guidelines and laws are in place, most elementary-aged children with type 1 diabetes still may not receive adequate assistance with self-care due to lack of trained school staff. Lack of diabetic supplies, low nurse staffing levels, and lack of supportive policies are also challenges in providing quality support in the school setting. Previous interventions have focused on staff training in an attempt to address these issues. Improved knowledge and self-efficacy of school personnel have been demonstrated as a result. In addition, more comprehensive intervention programs in the school setting have recently been implemented. In 2015, a comprehensive review by Pansier and Schultz (2015) found that, while some programs had resulted in student improved management, care coordination, and glucose levels, there was not adequate evidence to demonstrate interventions in the school setting were significant. School-based interventions, therefore, need to be improved.

Most commonly in the school setting, the school nurse is tasked with providing direct care for injury and illness, including assisting children with diabetes (NIDDK, 2016). Nurses must first be familiar with all applicable laws pertaining to medical treatment of youth and have a thorough understanding of specialized care plans. As the coordinator of care, the school nurse plays a key role in ensuring staff and teachers are prepared to assist a student when needed. The school nurse must be able to identify staff members who are willing to be trained and provide assistance to students with diabetes. After members have been identified, the school nurse must facilitate the initial school health team meeting used for training personnel on the student's DMMP (NIDDK, 2016). All school personnel that will work with diabetic students participate in a three-tier training designed to instruct nurses on both their individual duties for implementing diabetes care and management as well as how their duties coincide with the responsibilities of others involved in the students' care (NIDDK, 2016). The school nurse must ensure all workers within the school have received the Diabetes Overview guide (NIDDK, 2016).

Some school districts have offered professional development activities to assist and support school nurses in the provision of care to youth with chronic conditions. However, as Jones et al. (2014) determined, professional development offerings are generally minimal and more likely to be offered in districts that require chronic disease health services provision. In national surveys, school nurses reported a preference for professional development opportunities that were self-paced, computer-based programs that worked around their schedules (Mangena and Maughan, 2015; Maughan and Mangena, 2014). In addition, more professional development in the areas of individualized education and health care plans as well as emergency care plans for youth with disabilities, including diabetes, was requested (Mangena and Maughan, 2015).

Participating in professional development opportunities as a school nurse can be challenging as days are often full. Green and Huntington (2017) state that the online environment may help meet educational needs if the activity can be accessed from anywhere and is learner-centered. Nurses' knowledge changes in the online environment have not been significantly different when compared to the traditional education setting (Lahti et al., 2014), and nurses seemed to be able to readily transfer knowledge gained from an online platform to the work setting (Lahti et al., 2014). Rapid e-learning is one way to deliver "just-enough/just-in-time" online training. For content that changes and updates quickly as well as small-budget projects, rapid e-learning modules are highly interactive, focused on a specific learning need, and presented in a relevant, meaningful context (Kuhlmann, 2015).

School health services personnel, specifically school nurses, must coordinate diabetes care management in the school setting by following laws and guidelines. As changes are made in laws, care plans, educational plans, and training requirements, school nurses need appropriate "just-in-time" professional development delivered in a manner that works best for their busy schedules. When specific changes were made to school-based diabetes management policies and procedures, school nurses in one state identified they needed a flexible, accessible, and convenient way to learn about those changes (NIDDK, 2016). The online platform, especially the rapid e-learning alternative, is an option for provision of continuing education that could give school nurses more control and flexibility over their learning and overcome previously-mentioned barriers. A barrier to some nurses participating in online learning may be lack computer experience or confidence. A rapid e-learning-style training would, however, allow the option of home or work access, provide only the most necessary content, and be easy to use and navigate. The purpose of this study was to assess the effectiveness of a rapid e-learning module for school nurse professional development in school-based diabetes management.

2. Methods

2.1. Sample and instrumentation

The state school nurse consultant sent invitational emails to 1977 school nurses in the state of Missouri. The learning module intended to update participants on the newest guidelines for school-based diabetes care as developed by the National Diabetes Education Program (NIDDK, 2016). The invitational email which included a link was sent with a cover letter/consent form, rapid e-learning module with pre-post-test, and downloadable certificate of completion. The study had Institutional Review Board approval. A reminder email was sent to all potential respondents encouraging them to complete the module over the summer break if they had not already done so. The final email reminder was sent early August as part of a back-to-school email newsletter. A total of 678 completed the pre-test and module and 449 completed the post-test.

The pre-post-test included 15 multiple-choice and five true-false items derived from the learning objectives, information, and resources provided in the rapid e-learning module. The test was reviewed by two state-wide nurse leaders, revised for content, pre-tested using cognitive interviewing technique with two health professions students, and refined for clarity before administration. Any questions left unanswered by the participants were scored as incorrect responses.

2.2. Intervention

The specific objective of the rapid e-learning module intervention was to improve respondent knowledge of the newest guidelines for diabetes management in the school setting. The rapid e-learning module was created with a next-generation authoring tool, and design followed the ICARE framework for scaffolding e-learning modules that has been emphasized in online nursing education (Salyers et al., 2014).

In the Introduction phase of the module, context was provided and learning objectives defined. The purpose of diabetes management in the school setting and training levels for school staff were reviewed. In the Connect phase, information and content was provided. Important updates and statements that have been recently changed were presented in detail (NIDDK, 2016). These changes included necessary diabetes management equipment, dietary practices, psychological impacts of diabetes, and type 2 management techniques (NIDDK, 2016). Additionally, the three levels of training for school personnel were highlighted, which include level 1 training needed by all school personnel, level 2 training for staff with direct oversight of students, and level 3, an in-depth training, for select staff on routine and emergency care for diabetic students (NIDDK, 2016). Ideas were synthesized in the Apply phase. All updated sections contained "how-to's" and ways to apply the updates. In the Reflect phase, questions were asked. In addition to the longer pre-post-tests, each section update contained a brief question or two at the end of the update as a check for understanding. In the Extend phase, real-world application was covered. Links to free resources from credible medical sources to support the updates were provided (Salyers

et al., 2014).

An instructional designer reviewed the module for creative interactivity in rapid e-learning design, and the tool was revised accordingly. The module was then pre-tested by a group of five health professions students for aesthetics, ease of use, appropriate feedback, and meaningful interactivity, and again revised. The module is available at: http://ccox.sites.truman.edu/2017/03/27/diabetes-e-learning-module-for-mo-school-nurses-6/

Responses to each item were coded as correct and incorrect, 1 and 0, respectively. Subsequently, each participant's responses were summed to create a total score for the pre- and post-tests. Possible scores ranged from 0 to 20. Data were analyzed using IBM SPSS Statistics version 24. Frequencies of correct and incorrect responses were computed for all items for both the pre- and post-responses. The pre- and post-tests were embedded within the learning modules, but after responses were submitted, they were exported into an external database that did not match pre-post responses. Since the researchers were unable to collect any identifying information and manually match pre-post responses, the pre- and post-test scores were not matched, but an independent samples *t*-test was computed to determine if significant differences existed between the set of pre-scores and post-scores.

3. Results

On the pre-test, seven items were answered incorrectly more often than correctly. The item that was most often answered incorrectly was, "The US Department of Agriculture (USDA) maintains a "National Nutrient Database" containing nutrient information on well over ___ foods and beverages" (NIDDK, 2016, p. 32) with 93.1% of participants answering incorrectly. The item that was most often answered correctly was the true or false item, "The Food and Drug Administration (FDA) requires "Nutrition Facts" labels on packages for most prepared foods such as breads, cereals, canned and frozen foods, snacks, desserts, and drinks" (NIDDK, 2016, p. 32) with 98.1% of participants answering correctly. See Table 1.

On the post-test, all items were answered correctly by 45.0–99.6% of the participants. The item that was most often answered incorrectly was, "Diabetes affects an estimated ___ people under the age of 20 in the United States" (NIDDK, 2016, p. 6) with 55.0% of participants answering incorrectly. There were two items that were answered correctly by 100% of the participants. These items were the true false items, "The Food and Drug Administration (FDA) requires "Nutrition Facts" labels on packages for most prepared foods such as breads, cereals, canned and frozen foods, snacks, desserts, and drinks" (NIDDK, 2016, p. 32) and "All foods sold at school during the school day now need to meet nutritional standards" (NIDDK, 2016, p. 33) See Table 1.

The independent sample *t*-test revealed a statistically significant ($p < 0.001$) difference between pre-test (M = 12.79, SD = 2.05) and post-test (M = 17.15, SD = 2.00) scores ($t(1125) = -35.19$, $p = 0.00$). This suggests that the module was effective at improving nurses' knowledge on the content of the module.

4. Discussion/conclusion

This project attempted to determine if an easily accessible online module, providing new and relevant diabetes management information, could be a successful tool for school nurses obtaining professional development. Certainly, with fewer than 75% of nurses responding correctly to half the items on the pre-test, there was a definite need for training on this topic. Initial results are encouraging. Overall, knowledge scores showed a statistically significant improvement between the pre- and post-test. Further, an analysis of individual items within the post-test revealed that for all but one question, over half of the nurses answered them correctly. The measurable increases in practical knowledge are also important to note. Four questions in the post-test were specific to diabetes or the management thereof. On average, 37% more participants answered the questions correctly on the post-test than pre-test. Seven questions in the post-test dealt specifically with the training component of the module. On the three questions where less than 75% of the participants knew the correct answer on the pre-test, post-test results showed an average improvement of 29%. In short, for items where initial knowledge was low, the module produced noticeable and measurable knowledge gains.

4.1. Implications for school nurses

Lacking essential knowledge pertaining to diabetes management and treatment potentially puts lives at risk. School nurses are frequently saddled with the oftentimes complex task of managing youth diabetes in the school setting. Keeping abreast on recent developments and recommendations for diabetes care, while essential, presents several challenges. Like other health professionals, school nurses maintain a demanding work schedule that does not permit for time-intensive professional development opportunities. Further, existing professional development options may be expensive, require travel, or in some other way may not be accessible. Rapid e-learning modules, which can be developed and maintained with minimal costs and basic technological requirements, present a unique opportunity to provide essential information in a short timeframe. In addition, these modules can be specifically tailored to address identified knowledge gaps among various groups and can be easily disseminated. The results of the present study suggest that these modules can be an effective method for educating school nurses in a time- and cost-sensitive manner. In comparison to other existing methods for online knowledge acquisition, these modules necessitate participant interaction with the material, therefore, reducing passive learning and enhancing comprehension.

4.2. Limitations

A limitation of the study includes the independent sample model. The lack of identifiers for subjects prevented the ability to match pre- and post-test. This made the independent sample procedure necessary. Further limiting the study is the volunteer nature of participation. The researchers cannot determine predispositions or characteristics of those choosing to complete the module. Furthermore, the sample represents nurses from a single state and, therefore, the generalizability of the results is restricted. Finally, while gains were noticeable, relevant, and significant, they were measured in the short-term. Thus, long-term retention of the information was not assessed.

4.3. Recommendations for future research

This project could be improved by matching individual pre- and post-tests and determining the significance of individual improvements in knowledge. An additional recommendation would be the creation of a time-function recall, investigating whether the knowledge is retained over time, as opposed to the immediacy of the module post-test. In addition to knowledge assessments, the usefulness of rapid e-learning modules for skill development and behavior change or adoption should be explored.

5. Conclusion

In conclusion, results support the contention that e-modules are a convenient and effective way to provide professional development opportunities and improve nurses' knowledge. The modules delivered the individualized, flexible, computerized information on diabetes and care plans that school nurses nationally have requested (Mangena and Maughan, 2015; Maughan and Mangena, 2014). Because the modules were learner-centered and able to be immediately applied to the work setting (Lahti et al., 2014), educational needs were met. Rapid e-learning is an appropriate educational strategy for school nurse

Table 1
Frequencies and percentages of pre and post test correct and incorrect responses.

	Pre-test n (%) n = 678	Post-test n (%) n = 449
"Diabetes affects an estimated ___ people under the age of 20 in the United States." (NIDDK, 2016, p. 6, p. 6)		
208,000	97 (14.3)	202 (45.0)
"Diabetes is caused by ___." (NIDDK, 2016, p. 6, p. 6)		
Defects in insulin production & Defects in insulin action	608 (89.7)	418 (93.1)
"For level 1 training, ___ should receive training that provides a basic understanding of diabetes, how to recognize and respond to the signs and symptoms of hypoglycemia and hyperglycemia, and whom to contact immediately in case of an emergency." (NIDDK, 2016, p. 7, p. 7)		
All school personnel	602 (88.8)	430 (95.8)
"Level 2 training involves all elements of level 1 training plus __." (NIDDK, 2016, p. 7)		
Training to carry out individual responsibilities & Whom to contact immediately in case of emergency	350 (51.6)	328 (73.1)
"Level 3 training should be conducted by __." (NIDDK, 2016, p. 7, p. 7)		
A school nurse & A Certified Diabetes Educator & A qualified health care professional with experience in diabetes	542 (79.9)	369 (82.2)
"Non-medical school personnel who receive Level 3 training can be supervised by a/an__ to perform diabetes care tasks safely in the school setting." (NIDDK, 2016, p. 7, p. 7)		
School Nurse	632 (93.2)	437 (97.3)
"Which level of training involves one or more school staff members receiving in-depth training about diabetes and routine and emergency care for each student with diabetes?" (NIDDK, 2016, p. 7, p. 7)		
Level 3	391 (57.7)	366 (81.5)
"Which of the following was recently added to care tasks that TDP should be trained on?" (NIDDK, 2016, p. 83, p. 83)		
Carb counting	514 (75.8)	345 (76.8)
"Which of the following groups of individuals were recently added as key persons who can recognize symptoms of hypoglycemia and be prepared to call for help?" (NIDDK, 2016, p. 33, p. 33)		
Staff supervising recess	126 (18.6)	265 (59.0)
"__ are now listed as the key staff member to lead and coordinate health care services for students with diabetes." (NIDDK, 2016, p. 42, p. 42)		
School Nurses	579 (85.4)	412 (91.8)
"Hypoglycemia is defined as a blood glucose level of __mg/dL or less." (NIDDK, 2016, p. 23, p. 23)		
70	405 (59.7)	430 (95.8)
"Students with type 2 diabetes usually still make a reasonable amount of insulin, and therefore ketone checks may not be prescribed." (NIDDK, 2016, p. 27, p. 27)		
True	281 (41.4)	430 (95.8)
"In section "Tips for Helping Students Reach and Maintain a Healthy Weight", time in front of the computer, tablet, smartphone, and TV should be limited to __ per day" (NIDDK, 2016, p. 34, p. 34)		
2 h	151 (22.3)	355 (79.1)
"The U.S. Department of Agriculture (USDA) maintains a "National Nutrient Database" containing nutrient information on well over ___ foods and beverages." (NIDDK, 206, p. 32)		
8000	47 (6.9)	302 (67.3)
"The Food and Drug Administration (FDA) requires "Nutrition Facts" labels on packages for most prepared foods such as breads, cereals, canned and frozen foods, snacks, desserts, and drinks." (NIDDK, 206, p. 32)		
True	665 (98.1)	447 (99.6)
"When using an insulin pen, the pen needs to be primed with __ units of insulin." (NIDDK, 2016, p. 29, p. 29)		
2	371 (54.7)	410 (91.3)
"Students with diabetes are at greater risk for developing eating disorders." (NIDDK, 2016, p. 35, p. 35)		
True	505 (74.5)	439 (97.8)
"The inability of parents/guardians to allow students to take control of their diabetes self-care, has been shown to lead to oppositional behavior and rebellion." (NIDDK, 2016, p. 35, p. 35)		
True	605 (89.2)	414 (92.2)
"__ is the key for students and their parents/guardians to achieve better health outcomes in terms of Diabetes management?" (NIDDK, 2016, p. 35, p. 35)		
Teamwork/Interdependence	578 (85.3)	409 (91.1)
"All foods sold at school during the school day now need to meet nutritional standards." (NIDDK, 2016, p. 33, p. 33)		
True	626 (92.3)	447 (99.6)

professional development when new knowledge or updates to nursing guidelines and procedures occur, and nurses need to quickly learn and adapt to the changes.

These results inform the conclusion that a module designed to provide necessary information, to a specific population, in a short time frame can promote short-term knowledge improvements. While it is unknown if diabetes management plans among nurses have improved because of the module, adequate knowledge of diabetes and best practices in diabetes management procedures are undoubtedly a necessary precursor to effective care plans.

Funding source

This work was supported by a very small research grant from the MO Association of School Nurses who had no involvement in the conduct of the research/study.

Declaration of interest

This work was supported by a very small research grant from the MO Association of School Nurses who had no involvement in the conduct of the research/study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.nepr.2019.06.009.

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