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Sarah A. Nisly

Butler University, snisly@butler.edu

Alex N. Issacs

Kathryn Givens Merkel

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Use of web-based learning modules for a general medicine advanced pharmacy practice experience

**Sarah A.Nisly,PharmD, BCPS^{a,b,*}, AlexN.Isaacs,PharmD, BCPS^{a,b}, Kathryn Givens
Merkel, PharmD, BCPS^c**

a Butler University College of Pharmacy and Health Sciences, Indianapolis, IN b Indiana University Health—Methodist Hospital ,Indianapolis, IN c Pediatric Infectious Diseases, Seton Healthcare Family—Dell Children’s Medical Center of Central Texas, Austin, TX

Abstract

Objective: To implement and assess web based learning modules on baseline pharmacy student knowledge prior to a general medicine advanced pharmacy practice experience (APPE).

Methods: Three web based learning modules were developed for use prior to a general medicine APPE. Students completed pre- and post-assessments specific to each learning module. Additionally, students completed perception surveys at the conclusion of the APPE to determine the utility of these modules and the impact on student learning experiences.

Results: Use of the web-based training (WBT) modules resulted in a statistically significant improvement in post-assessment scores for two of the three modules ($p < 0.001$). Student participants found the modules easy to use and helpful in APPE preparation.

Conclusions: Utilization of a WBT module prior to a general medicine APPE improves baseline knowledge among pharmacy students.

Introduction

The Accreditation Council for Pharmacy Education (ACPE) requires all doctorate of pharmacy students to complete advanced pharmacy practice experiences (APPE). These experiences are structured to provide students with opportunities to apply pharmacotherapy knowledge and develop medication recommendations through direct patient care. Therefore, in order to excel during their APPE year, pharmacy students must have a sound therapeutic baseline. The ACPE Standards and Guidelines highlight specific skills that students must acquire prior to undergoing the APPE year in the Pre-APPE Performance Domains and Abilities Appendix (Appendix D). Students must be able to accurately dispense medications, perform basic patient assessments, demonstrate medication knowledge, identify and assess drug-related problems, act ethically and professionally, and communicate effectively with patients and other healthcare professionals.¹ The pharmacy curriculum is geared to prepare students for APPE and the workforce, but as therapeutic disease states are covered throughout the curriculum, long periods of time may exist between didactic lectures and application of the knowledge within the experiential setting. Additionally, newly published literature during this time provides additional opportunities to strengthen therapeutic knowledge base prior to APPE. Through reinforcement of didactic coursework before APPE, students will be better prepared for the provision of exceptional patient care with less direct instruction required by preceptors.

To fortify students’ clinical knowledge, educators must take into consideration the learning techniques of current pharmacy students. Millennial students, born between 1982 and 2001, are characteristically

different from previous generations, but educational techniques have struggled to adapt and create engaging opportunities for this demographic.²⁻⁸ Members of this generation are optimistic young adults, comfortable communicating through social media, e-mail, and texting.² In the classroom, Millennials are inviting a dramatic change in educational techniques.³ These students are active learners who prefer self-directed educational opportunities through interactive environments with immediate feedback.⁴ Utilizing a variety of teaching methods, including new technology, students with different learning preferences are able to understand complex material.^{4,5} However, this technology does not always transfer to the classroom, potentially leaving students disengaged. In the experiential setting, insufficient knowledge preparation may hinder student's ability to deliver effective patient care. Pharmacy school education must advance to provide interactive and challenging learning opportunities, ensuring the development of Millennial pharmacy students.

To adapt to students of this generation, healthcare education and ACPE accreditation standards (Guideline 11.2) highlight the need for active learning strategies via computers and other technological tools involving actual or simulated patients.^{1,2} These interactive educational techniques engage Millennial students and reinforce previously learned knowledge through application.^{1,5} Web-based didactic modules have been effectively evaluated in a variety of health care settings to provide interactive educational opportunities for the new generation of students.⁹⁻¹⁸ Within the pharmacy realm, web-based learning has been utilized for ophthalmic and otic patient counseling, pediatric disease states, medication therapy management, pain management, and assessment of critical thinking.⁹⁻¹³ A recent study of clinical topic modules prior to and during APPE illustrated pharmacy students' positive perceptions to the incorporation of technology into didactic and clerkship experiences.¹⁴ Web-based learning and patient simulations engage students to apply knowledge and synthesize pharmacotherapeutic recommendations, enhancing critical thinking skills vital for APPE.

At Butler University College of Pharmacy and Health Sciences (BUCOPHS), all fourth-year pharmacy students must complete an adult general medicine APPE. Students encounter a variety of disease states on their general medicine rotation that necessitates a well-rounded therapeutic baseline. Despite slight variability between patient populations at each site, students generally encounter patients for whom they must provide therapeutic recommendations for venous thromboembolism (VTE) prophylaxis and treatment, diabetes, acute and chronic kidney disease, and infectious diseases. For the BUCOPHS graduating Classes of 2011 and 2012, VTE and diabetes lectures were covered in the second professional year with three hours of lecture dedicated to each disease state. Acute kidney disease lecture content was delivered over two hours in the second professional year with no formal class time set aside for chronic kidney disease. Infectious disease education occurred over 30 hours during the students' third professional year. With the prevalence of these disease states, it is imperative that pharmacy students be knowledgeable prior to a general medicine APPE to ensure the delivery of optimal pharmaceutical care.

The objective of this study was to evaluate the efficacy of a web-based learning tool to educate and reinforce pharmacotherapeutic knowledge for BUCOPHS pharmacy students prior to an adult general medicine APPE.

Methods

Three web-based training (WBT) modules were developed for use on an acute care general medicine APPE. Topics included in each module are listed in Table 1. The topics were split into three separate

learning modules and designed to be approximately 60 minutes in length. Each WBT module contained content specifically created for the practice site and material was reviewed by a content expert prior to study implementation. Panopto©, a presentation capture platform, was used to synch narrative audio recordings with the presentation. WordPress™ web software was used to store the modules, assigning a unique web address for access. Institutional review board approval was obtained prior to study initiation.

Table 1
Module content

Module 1	Module 2	Module 3
Diabetes and anticoagulation	Disease state review	Review of infectious diseases (emphasis on institution-specific dosing and monitoring)
Goals of therapy	Acute kidney injury	Location of system resources
Treatment strategies	End-stage renal disease	Steps for appropriate literature evaluation
Monitoring parameters	Drug dosing in dialysis	Interpreting statistics in primary literature

The modules were provided with accompanying narration to supplement patient cases and provide additional details related to the presentation materials. The focus of the modules was case-based pharmacotherapeutic scenarios, workplace resources, and major inpatient internal medicine disease management.

Each module was developed to incorporate several key elements and common themes while accommodating both auditory and visual learners. Visual representations were utilized to illustrate concepts, such as mechanism of action. Many representations were animated and accompanied by narration to highlight and draw attention to certain aspects of the figure. Additionally, each module incorporated site-specific resources to familiarize students with treatment strategies and policies/procedures within the healthcare system. Resources included medication protocols, specific computer programs, and special documentation forms students could locate and review. Finally, each module included patient cases that prompted students to analyze the information presented and apply to a common scenario they might encounter during the APPE. Answers to the patient cases were presented and explained verbally within the recording. Overall, the modules were designed to convey information relevant to the management of general medicine patients, applying specific practice site nuances.

For each module, a ten question multiple choice assessment was developed to determine if the modules enhanced student learning. Students completed identical assessments before and after viewing each web-based learning module, scoring between 0 and 100 total points per assessment (ten points per question). The assessments were developed for each module by the respective content expert and based on the information included in each of the modules. The modules were to be completed by the end of week one, enabling the assessment tool to evaluate the impact of the WBT modules on baseline knowledge. This was done to limit the potential for confounding knowledge gained during the APPE. Upon completion of the general medicine APPE, students were surveyed to assess perceptions of performance on the rotation, attributable to completion of the learning modules. The general timeline for completion is shown in the Figure. The final survey was designed to measure responses on a 5-point Likert scale and allowed additional comments. Additionally, the survey contained questions to assess feasibility of module completion and impact of the modules on learning during the APPE. All assessments and surveys were delivered via SurveyMonkey™, a web-based survey tool.



APPE: advanced pharmacy practice experience

Fig. Timeline for completion

Individual preceptors were contacted to obtain a list of scheduled students for their general medicine APPE. Study personnel sent an email to each student to encourage participation in the study. Once enrolled, students were provided the web address to access the modules and given instructions for completion. For each module, students had to complete the pre-assessment in order to obtain the password to access each module. After each module was viewed, students were directed to complete the post-assessment. Pre- and post-assessment scores were matched utilizing the survey database. At the conclusion of the APPE, students were sent the web address to access the final online perception survey. Throughout the study, the preceptors and study personnel did not have access to student assessment scores or know participation status. A paired-samples t-test was used to compare pre- and post-assessment scores. Statistical analysis was completed using SPSS version 19. A $p < 0.05$ was considered statistically significant. Descriptive statistics were utilized for the students' final perception survey.

Results

Participants were recruited during a seven-month period from February to July, encompassing six APPE blocks and including students from two separate graduation classes. During the study period, 41 students were eligible for inclusion in this study, approximately 30% of each BUCOPHS graduating class. Thirty-three students gave informed consent. As completion was voluntary, participation decreased with each module. Nineteen students completed both pre- and post-assessments for module one. Modules two and three had 20 and 14 students complete both assessments, respectively.

Overall results are shown in Table 2. There was a statistically significant improvement in post-assessment scores for two of the three modules. The improvement in post-assessment scores was non-significant for module three, covering infectious diseases, statistics, and system resources. Within this module, 80% of the questions dealt directly with infectious diseases.

Table 2
Pre- and post-module assessment scores*^a

	Pre-module	Post-module	<i>p</i> -Value
Module 1 (<i>n</i> = 19)	66.5 ± 32	83.5 ± 29.8	<0.001
Module 2 (<i>n</i> = 20)	58 ± 13.2	79 ± 17.4	<0.001
Module 3 (<i>n</i> = 14)	70.7 ± 18.2	77.9 ± 13.1	0.2

^a Data are reported as mean + standard deviation.

The final perceptions survey was completed by 12 student participants (36%). Only one responder had completed a previous rotation within the institution. Overall, 83% of student responders felt the web-based modules were easy to use and 75% of responders agreed or strongly agreed that the modules helped in rotation preparation. In addition to assisting in rotation preparation, 58% of responders felt the WBT modules were an efficient way to complete site orientation and over 80% felt the information provided included appropriate site-specific nuisances. Lastly, half of student participants felt the modules did not improve their computer literacy skills and took more time than necessary to complete.

Discussion

Use of WBT modules has been previously described in the literature and successfully incorporated into APPE preparation. In 2009, Flowers et al. described the use of web-based vignettes in augmenting community pharmacy APPE. Assessment scores were significantly improved in participants using the vignettes, compared to the control group. The authors concluded that use of the vignettes improved knowledge about administration technique and allowed for standardization of experiences across multiple sites.⁹

In addition to use in community practice APPE, WBT modules have been successful in preparing students for a pediatric APPE. Student participants completed a pre-and post-assessment with each module. Statistically significant improvements were noted in three of the four WBT modules. Additionally, students found the WBT modules increased their comfort level in caring for pediatric patients and enhanced their overall pediatric APPE.¹⁰

Most recently, Gonzalvo et al. evaluated the perceived value of acute and ambulatory care WBT modules for third- and fourth-year students. Third-year pharmacy students viewed the modules during an introduction to APPE course and over 80% found the modules helpful in APPE preparation. Fourth-year pharmacy students had these modules available for use throughout their APPE year. Of the responders, the majority found the ambulatory care modules most helpful during their rotations; however, students would have preferred preceptors remind or require use of modules prior to initiation of the experience.¹⁴

Each of these studies demonstrates value in using WBT to augment the student APPE, with two specifically showing enhancement of student knowledge.^{9,10} Despite the aforementioned studies, there are no reported data for use of WBT modules in pharmacy students participating in an adult acute care general medicine rotation. To our knowledge, this is the first study that evaluates the utility of WBT modules in this core experience for graduating pharmacy students. Our study encompassed APPE

students early on in clerkship rotations and also nearing graduation, providing a diverse student population.

Significant improvement was seen in baseline knowledge for students completing the WBT modules, prior to starting rotation. Module three was the only individual module with a non-significant improvement in assessment scores. This module covered infectious diseases, statistics, and system resources. The assessment focused on infectious diseases, with eight of the ten questions relating to antimicrobials. In the current curriculum sequence, infectious disease is covered closest to the initiation of APPE. Topics covered in modules one and two are covered nearly 18 months prior to the start of APPE. This may explain the improved baseline scores for module three and the significant improvement in modules one and two. Future modules may need to focus on core topics covered early in the pharmacy curriculum.

Similar to other studies, students found the WBT modules helpful and easy to use. Overall, standardizing knowledge prior to rotations may have several potential benefits. First, preceptors often spend substantial time orientating students to practice site resources, protocols, and technology. Partial incorporation of this orientation process could be computerized and decrease demand for preceptor time. Secondly, students may enter the APPE with various rotation and course work background. Use of WBT modules can assist in ensuring all students on a rotation have similar baseline knowledge. Lastly, review of baseline assessment scores may assist in identifying problem areas for students. This information may help the preceptor best focus their efforts for student improvement.

Our study is not without limitations. Participation in each WBT module was voluntary, anonymous, and relied on student response to study recruitment e-mails and preceptor support. This may explain the inconsistency in module completion. Successful incorporation of WBT modules in the future may necessitate mandatory student involvement and require proof of participation. Additionally, the academic standing and month of module completion for specific students is unknown and may have impacted overall performance. Utilization of identical pre- and post-assessment questions may also reflect some strategic memorization, although answers to the questions were not provided during either assessment. Group participation in module completion was not specifically prohibited and may have contributed to assessment scores. To limit potential group work as a confounder, multiple assessments completed from the same computer were eliminated by the survey database. This may not completely eliminate the potential for sharing of answers; however, correct answers to assessment questions were never provided. Finally, preceptor perceptions were not captured and would be useful in determining the effectiveness of the WBT modules on perceived student performance. Future expansion of the WBT modules to incorporate various practice sites, APPE, and students are warranted.

Conclusions

This study demonstrates the role of web-based training modules in the assessment and preparation of students prior to a general medicine APPE. Use of the WBT modules may be an effective method to reinforce the knowledge and concepts necessary to manage patients while on an inpatient rotation; however, larger studies are needed to confirm this hypothesis. While Millennial students present new challenges to educators, the responsibility of lifelong learning ultimately lies with the student. WBT modules may be a strategy to successfully engage these students, incorporating a variety of active

learning techniques. Further use of WBT should be considered when creating multi-modal teaching experiences.

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