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Experiences in Teaching and Learning

Effects of Ebola Virus Disease education on student health professionals

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ABSTRACT

Background and purpose: Ebola Virus Disease (EVD) is a severe, often fatal illness. Studies have shown that healthcare professionals lack an in-depth knowledge of EVD. Countries in Europe, Asia, and Africa are beginning to emphasize the need to train healthcare professionals about EVD, but the United States still lacks formal training for healthcare students. There is little research about the effectiveness of EVD training to support this study. The purpose of this study was to examine the knowledge-base and attitudes of healthcare students concerning EVD.

Educational activity and setting: Two-hundred sixty-nine participants (including pharmacy students, physician assistant students, and nursing students) completed a pre- and post-survey. The survey measured both knowledge and perceptions. The post-survey was administered after the intervention to measure change. The intervention was comprised of a pre-recorded lecture about EVD transmission, prevention, and treatment.

Findings: All groups displayed significant changes in knowledge and perception, specifically in the areas of EVD transmission, prevention, and treatment. Pharmacy students' attitudes increased significantly over their baseline score for all three attitude questions, whereas there were no significant changes in attitude to EVD among nurses. Physician assistant students' attitudes changed regarding the topic of isolation.

Discussion: Education on EVD in pharmacy schools may provide beneficial results for students' knowledge, and it may also help schools provide evidence to meet current standards for accreditation.

Summary: This educational intervention represents an effective format that could be a useful tool to help enhance or augment knowledge for healthcare workers. This could lead to better care for patients.

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Background and purpose

Ebola Virus Disease (EVD), also known as Ebola Hemorrhagic Fever or simply Ebola, is a fatal disease. Ebola virus outbreaks are found sporadically in many African countries.¹ EVD is transmitted through direct contact with blood or bodily fluids, contaminated objects, or infected animals. EVD symptoms can appear anywhere from 2 to 21 days after exposure to EVD and include fever, muscle pain, diarrhea, vomiting, and unexplained hemorrhage.¹ There is no current vaccine for EVD, and standard treatment includes providing intravenous fluids and supportive care.¹ The case fatality average rate of EVD is approximately 50%.² Community awareness of prevention and control techniques is critical in preventing outbreaks and the spread of the disease.²

In 2014, an outbreak of EVD in West Africa generated concern that it might expand into a pandemic.¹ Videos shown in the news coverage, coupled with the growing influence of social media images, led to concerns about EVD in the United States.³ The Ebola-related news coverage incited thousands of internet searches and tweets, that appeared to amplify panic.⁴ This panic put a strain on many healthcare facilities and healthcare workers as they took on the added burden of educating patients and community members about a disease they knew very little about.⁵ This strain, along with limited supplies and inadequate training, led to several EVD infections of healthcare professionals.⁵ Due to their lack of training and preparation, many healthcare professionals expressed negative attitudes and perceptions regarding working with EVD patients.⁵

The recent EVD concern in the United States led to an interest in providing more effective EVD education for healthcare professionals, many of whom may have little or no understanding of EVD causes, treatment, and safety precautions.⁶ In a pilot study by Sodano et al.⁷ in Rome, only 32.9% of respondents had an acceptable level of EVD knowledge. The participants who had received prior training about EVD scored significantly higher than the participants with no prior training.⁷ In another study, emergency department staff supported EVD-based training and felt that they were better prepared for a potential EVD outbreak because of the educational intervention they had received.⁸

Less than 60% of college students in a school of public health in Iran had correctly responded to questions about EVD symptoms and populations at the most risk for EVD.⁹ This provides a challenge and opportunity for colleges offering degrees in health professions to provide education on EVD. Additional opportunities for interprofessional education could be potentially rewarding for many students in the health professions.

Outside the United States, greater emphasis has been placed on EVD training because governments have allocated funds and specified training regarding EVD prevention and treatment.¹⁰ This was demonstrated by one study in the Ivory Coast.¹⁰ Many resources have been allocated to increase the preparedness and education of individuals to better equip themselves to prevent ongoing outbreaks of EVD.

Educational interventions have been used to help increase the knowledge of healthcare topics in both students and healthcare professionals.^{11,12} One form of educational intervention is a recorded lecture. Students like recorded lectures because they have been shown to enhance learning and increase engagement with the material.¹² However, data is limited with regards to how well recorded lectures will enhance or engage learning specifically about EVD.

There is also limited information on how an educational intervention about EVD can influence students' perceptions and knowledge. The objective of this study was to provide guidance on the practical education of EVD to help improve the knowledge and attitudes of healthcare professionals as well as to assess the effects EVD education could have on the knowledge of healthcare professions students.

Educational activity and setting

Design

Due to the design and scope of this study, it was granted exempt status by the Shenandoah University IRB committee. The study consisted of a cross-sectional survey and a training intervention. The survey was administered pre- and post-intervention to measure the effect of training on the participant's knowledge and perception of EVD. A total of 550 students (390 pharmacy students, 110 nursing students, 50 physician assistant students) were eligible to complete the pre- and post-survey. The participants completed the pre-survey and then were provided a pre-recorded educational presentation on EVD transmission and treatment. The slide-based educational intervention lasted approximately ten minutes and was presented via E-mail so that students of different disciplines could all view the material at the same time. The intervention covered major content areas including background/history of EVD, diagnosis, symptoms, transmission, prevention, treatment, and travel precautions. Once the video finished playing, the survey redirected the students to the post-test. This survey was completed outside of the classroom during students' available time over the course of one month.

A survey was developed similar to the one developed by Akram et al.¹³ and Arief et al.¹⁴. The same survey instrument was used for the pre- and post-survey (Appendix A). The survey took approximately 20–25 min to complete and consisted of 47 questions in a web-based survey tool. There were five main sections in the survey, including basic demographics and questions related to EVD transmission, prevention, treatment, and perceptions/attitudes. The survey assessed knowledge of EVD through 10 transmission questions, 16 prevention questions, and eight treatment questions. For these knowledge questions, participants were provided three choices (yes/true, no/false, or unsure). True-false questions were used to increase the efficiency of the reader and because of the dichotomous nature of the questions.¹⁵ Some questions were worded in the negative so that not all questions had a "yes" answer. Students' attitude toward EVD was measured by three attitude statements. These three items used a 5-point Likert scale (1 = strongly agree; 5 = strongly disagree). A single question was used to determine students' source of information about EVD. Demographics

Table 1
Demographics and background characteristics at baseline (%).

	Pharmacy (n = 221)	Physician Assistant(n = 22)	Nursing (n = 26)	All (n = 269)
Male**	33.48	27.27	3.85	30.11
Age > 30	17.19	27.27	34.61	19.71
Resource of information about Ebola				
Internet	91.45	90.91	88.46	90.91
Radio and television	60.68	50	53.85	58.18
Seminars	8.55	9.09	7.69	8.48
Newspapers and non-professional magazines	27.35	40.91	34.62	30.3
Posters and - Pamphlets	15.38	9.09	26.92	16.36
Lay people	11.97	9.09	7.69	10.91
Healthcare professionals	51.28	54.55	69.23	54.55
Teachers	38.46	18.18	46.15	36.97

** p < 0.01, P-values reflect Chi-sqr test for categorical variables or Fisher's exact test for cells that had expected counts less than 5.

were collected at the end of the survey.

Statistical methods

The Chi-square test was used to examine differences in students' demographic characteristics between healthcare professional groups. The Fisher's exact test was applied when cell sizes were less than five. Students' knowledge of EVD was evaluated from the perspective of transmission, prevention, and treatment. A composite score was calculated for each of the three domains. No credit was given when participants selected the "unsure" choice. Differences in transmission, prevention, treatment, and attitude scores across discipline groups were examined using ANCOVA, controlling for age and gender. The paired *t*-test assessed within-group changes in transmission, prevention, treatment, and attitude scores before and after the intervention. The mixed-effect model was applied to examine differential changes between baseline and final measurement. This study used SAS 9.4 software for data management and analysis.

Findings

Of the 550 eligible students, 269 participants completed a questionnaire, including 221 pharmacy students, 22 physician assistant students, and 26 nursing students (response rate 48.9%). Table 1 shows students' characteristics by disciplines. Compared to pharmacy students and physician assistant students, there were significantly fewer male nursing students ($p < 0.01$). When compared by age, there were no significant differences between pharmacy students, physician assistant students, and nursing students.

Table 2
Changes in knowledge of Ebola from baseline to follow-up by group.

	Characteristics	Knowledge		
		Transmission mean (std)	Prevention mean (std)	Treatment mean (std)
Pharmacy (n = 221)	Pre	6.98(1.50)	10.28(1.51)	4.58(1.91)
	Post	8.61(1.05)	12.54(1.77)	6.40(1.53)
	Change ^a	1.63(1.59)***	2.27(1.90)***	1.82(2.10)***
Physician Assistant (n = 22)	Pre	7.64(1.40)	10.36(1.53)	5.32(1.13)
	Post	8.73(0.94)	13.50(2.11)	7.27(0.88)
	Change ^a	1.09(1.54)**	3.14(1.70)***	1.95(1.29)***
Nursing (n = 26)	Pre	7.81(1.41)	10.42(1.45)	6.04(1.00)
	Post	8.62(1.02)	13.12(2.03)	7.04(0.92)
	Change ^a	0.81(1.47)**	2.69(2.00)***	1.00(1.41)**
All (n = 269)	Pre ^b	7.11(1.50)*	10.30(1.50)	4.78(1.84)***
	Post ^c	8.62(1.03)	12.68(1.84)	6.54(1.47)*
	Change ^d	1.51(1.59)*	2.38(1.90)	1.75(2.00)

⁵std = standard deviation.

^a Paired *t*-test on change of pre and post scores.

^b ANCOVA analysis of difference in pre-treatment scores by discipline, controlling for age and gender.

^c ANCOVA analysis of difference in post-treatment scores by discipline, controlling for age and gender.

^d Mixed-effect model analysis of changes between of pre- and post-treatment scores by discipline (discipline*intervention), controlling for age, gender, discipline, and intervention).

* p < 0.05.

** p < 0.01.

*** p < 0.001.

Table 3
Changes in perception and attitude of Ebola from baseline to follow-up by group.

	Characteristics	Attitude		
		Isolating Mean (std)	Familiarizing Mean (std)	Communication Mean (std)
Pharmacy (n = 221)	Pre	3.74(0.53)	3.82(0.51)	3.79(0.52)
	Post	3.84(0.45)	3.87(0.42)	3.85(0.45)
	Change ^a	0.10(0.45)**	0.05(0.34)*	0.06(0.32)**
Physician Assistant (n = 22)	Pre	3.73(0.46)	3.86(0.47)	3.82(0.50)
	Post	4.00(0.00)	3.95(0.21)	3.95(0.21)
	Change ^a	0.27(0.46)*	0.09(0.29)	0.14(0.56)
Nursing (n = 26)	Pre	3.81(0.63)	3.77(0.65)	3.62(0.75)
	Post	3.85(0.61)	3.85(0.61)	3.73(0.67)
	Change ^a	0.04(0.20)	0.08(0.27)	0.12(0.33)
All (n = 269)	Pre ^b	3.74(0.53)	3.82(0.52)	3.77(0.54)
	Post ^c	3.85(0.45)	3.87(0.43)	3.85(0.46)
	Change ^d	0.11(0.43)	0.05(0.33)	0.07(0.35)

^sstd = standard deviation.

***p < 0.001.

^a Paired t-test on change of pre and post scores.

^b ANCOVA analysis of difference in pre-treatment scores by discipline, controlled for age and gender.

^c ANCOVA analysis of difference in post-treatment scores by discipline, controlled for age and gender.

^d Mixed-effect model analysis of changes between of pre- and post treatment scores by discipline (discipline*intervention), controlled for age, gender, discipline, and intervention).

* p < 0.05.

** p < 0.01.

Approximately 19.71% of respondents were above 30 years old.

Regardless of discipline, the “internet” was the most common resource of information about EVD (90.91%). More than half of respondents also learned about EVD from “radio and television” (58.18%) and “healthcare professionals” (54.55%). Other common resources included “newspapers and non-professional magazines” and “teachers” (30.3% and 36.97%, respectively).

Table 2 breaks down changes in knowledge and attitude between baseline scores and final scores by discipline groups. Results of paired t-tests showed significant changes in knowledge for all discipline groups, including the areas of EVD transmission, prevention, and treatment. Pharmacy students’ attitude changed significantly between baseline and final scores for all three attitude questions. However, there were no significant changes in attitude concerning EVD treatment among nurses (Table 3). The mean score for the attitude question about isolation as a treatment option was significantly different among physician assistants, while the other attitude questions about familiarizing and communication remained close to the same. From the results of ANCOVA analysis, there was a significant difference between the baseline and final scores in the knowledge areas of how EVD is transmitted and treated after adjusting for gender and age. There were no significant group differences in attitude toward EVD treatment between the baseline or final scores.

To examine differential changes in knowledge about EVD and attitudes toward EVD treatment, a mix-effected model analysis was conducted. The greatest improvement was observed among pharmacy students regarding EVD transmission.

Discussion

Knowledge about how EVD is transmitted and treated has a direct impact on the safety of healthcare professionals and is critical to educating the community and preventing the spread of the disease.¹⁶

Ahmad et al.¹⁷ demonstrated that EVD training for health professionals in India improves scores on EVD assessments, but this is the first study the authors are aware of that evaluated student health professionals in the United States. Our survey used fact-based questions about how EVD is transmitted, treated, and prevented as well as perceptive questions about participant's attitudes toward EVD treatment. With training, all sub-groups demonstrated improvement in knowledge awareness between the pre-survey and the post-survey. The highest change in scores was in the prevention category. Lower score changes were seen in the transmission category. This could be explained because news coverage about EVD was centered on disease transmission; therefore, students may have had less of a knowledge gap.¹⁻⁴ In addition, pharmacy students scored lower on the knowledge portion of the pretest compared to nursing and physician assistant students. Pharmacy students had more potential growth after receiving the intervention than other students. This sizeable potential growth by pharmacy students can provide valuable information on how to design curriculum content and continuing education for EVD.⁹

An interesting observation was that the attitudes of pharmacy students were changed in all three perception based questions about EVD, but not in physician assistant or nursing students. Physician assistants’ attitudes towards isolation changed after the intervention. Some evidence has shown that students are more malleable in their attitudes and perceptions before becoming a practicing professionally as opposed to once they are out in practice.¹⁸⁻²⁰ In a similarly designed study with an educational intervention, Bamgbade et al.¹⁹ noted that pharmacy student perceptions and knowledge changed after a presentation intervention in the

area of mental health. Based on our results and previous findings, pharmacy students specifically may be more willing to integrate new information into their practice than nursing or physician assistant students.

The educational intervention provided in this study could be a useful tool for presenting valuable information to healthcare professionals to help correct gaps in their knowledge. The effectiveness of the intervention could be due to the convenience of the presentation since it was available electronically, that made accessing the information quick and easy. The short length (10 min) of the presentation could also help explain the effectiveness of the intervention. Providing short presentations provides busy student healthcare professionals with a convenient tool to help increase their knowledge.^{21,22} Future studies may be warranted to determine if patient-focused interventions would be beneficial. This could involve assessing the knowledge and perceptions of patients instead of student health care professionals. A potential barrier to implementing EVD educational interventions is the need for this content in the pharmacy curricula. If EVD continues to be a significant threat to the United States population, proper education is needed; however, if the relevance of the disease wanes, then interest in teaching this topic may decrease.

A significant limitation of the study was the small sample size. Only one school of pharmacy was surveyed, which may limit external validity. The study also used a small sample size of students in the physician assistant and the nurse group. Another limitation of our study was the lack of clinical application skills assessment. Students were assessed only on their ability to recall correct information and not their ability to apply that information to help improve patient care. Future studies that also have students apply the information they learned using a role-playing exercise or case study may be beneficial to help assess the application of knowledge and may be an opportunity for an extra professional education activity.

Summary

The EBV educational intervention provided a significant increase in the knowledge of student healthcare professionals. Pharmacy students saw a significant change in their attitudes and perceptions of the EVD virus, while nursing and physician assistant students did not. Further development of educational interventions could be particularly useful for graduate schools to meet current guidelines and increase knowledge of students to better prepare them for practice. This educational intervention represents a potentially effective format to help minimize knowledge gaps for student healthcare professionals that may lead to better care for patients.

Conflicts of interest

None.

Disclosure statements

None.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.cptl.2018.01.011>.

References

- Centers for Disease Control and Prevention. Ebola (Ebola Virus Disease); Published April 2015. Available at: <http://www.cdc.gov/vhf/ebola/diagnosis/index.html>. Accessed 30 January 2018.
- World Health Organization. Ebola Virus Disease; Published June 2017. Available at: <http://www.who.int/mediacentre/factsheets/fs103/en/>. Accessed 30 January 2018.
- Science Daily. Ebola News Coverage Linked To Public Panic; Published June 2015. Available at: <https://www.sciencedaily.com/releases/2015/06/150615162858.htm>. Accessed 30 January 2018.
- Towers S, Afzal S, Bernal G, et al. Mass media and the contagion of fear: the case of Ebola in America. *PLoS One*. 2015;10(6):1–13.
- Otu A, Ebenso B, Okuzu O, et al. Using a mHealth tutorial application to change knowledge and attitude of frontline health workers to Ebola virus disease in Nigeria: a before-and-after study. *Hum Resour Health*. 2016;14(5):1–9.
- Iliyasu G, Ogoina D, Out A, et al. A multi-site knowledge attitude and practice survey of Ebola virus disease in Nigeria. *PLoS ONE*. 2015;10(8):1–13.
- Sodano L, Radici F, Rossini A, et al. Cross-sectional study on knowledge of healthcare workers about Ebola virus disease and its prevention: a pilot study in two hospitals in Rome (Italy). *Ann Ig*. 2015;27(6):814–823.
- Siddle J, Tolleson-Rhinehart S, Brice J. Survey of emergency department staff on disaster preparedness and training for Ebola virus disease. *Am J Disaster Med*. 2016;11(1):5–18.
- Holakouie-Naieni K, Ahmadvand A, Raza O, et al. Assessing the knowledge, attitudes, and practices of students regarding Ebola virus disease outbreak. *Iran J Public Health*. 2015;44(12):1670–1676.
- Kouassi D, Ekra K, Angbo-Effi O, et al. Preparation of healthcare workers against the threat of Ebola virus disease in Ivory coast. *Sante Publique*. 2016;28(1):113–122.
- Shehadeh M, Suaifan G, Hammad E. Active educational intervention as a tool to improve safe and appropriate use of antibiotics. *Saudi Pharm J*. 2016;24(5):611–615.
- Marchand J, Pearson M, Albon S. Student and faculty member perspectives on lecture capture in pharmacy education. *Am J Pharm Educ*. 2014;78(4):74.
- Akram A, Han H, Qadir A, et al. A cross-sectional survey of knowledge, attitude and practices related to cutaneous Leishmaniasis and sand flies in Punjab, Pakistan. *PLoS ONE*. 2015;10(6):1–8.
- Arief M, Hassali M, Saleem F, et al. A cross-sectional survey on the knowledge and attitudes towards Zika virus and its prevention among residents of Selangor, Malaysia. *JPPCM*. 2017;3(2):81–89.

15. The University of Texas at Austin Faculty Innovation Center. True-False Questions; January 30, 2018. Available at: <<https://facultyinnovate.utexas.edu/teaching/check-learning/question-types/true-false>>. Accessed 30 January, 2018.
16. American Society of Health-System Pharmacists. ASHP guidelines on pharmacist-conducted patient education and counseling. *Am J Health-Syst Pharm.* 1997;54(4):431–434.
17. Ahmad A, Umair Khan M, Qasim Jamshed S, et al. Are healthcare workers ready for Ebola? An assessment of their knowledge and attitude in a referral hospital in South India. *J Infect Dev Ctries.* 2016;10(7):747–754.
18. Scott D, Friesner D, Miller D. Pharmacy students' perceptions of their preparedness to provide pharmaceutical care. *Am J Pharm Educ.* 2010;74(1):8.
19. Bamgbade B, Ford K, Barner J, et al. Impact of a mental illness stigma awareness intervention on pharmacy student attitudes and knowledge. *Am J Pharm Educ.* 2016;80(5):80.
20. Brazinha I, Fernandez-Llimos F. Barriers to the implementation of advanced clinical pharmacy services at Portuguese hospitals. *Int J Clin Pharm.* 2014;36(5):1031–1038.
21. Karaman S. Nurses' perceptions of online continuing education. *BMC Med Educ.* 2011;11(86):1–6.
22. Ferranti E, Wands L, Yeager K, et al. Implementation of an educational program for nursing students amidst the Ebola virus disease epidemic. *Nursing Outlook.* 2016;64(6):597–603.