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ORIGINAL RESEARCH

Emergency Skills in Athletic Training: Perceived Knowledge and Continuing Education

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Context: Continuing education (CE) in health care, particularly in athletic training, often fails to meet the needs of its participants. Rapid increases in available information make it necessary for CE to be delivered as efficiently as possible.

Objective: To explore whether an interactive teaching strategy and various characteristics of athletic trainers affected the perceived knowledge of emergency skills among certified athletic trainers.

Design: Quasiexperimental study with a single-group pretest-posttest design.

Patients or Other Participants: Certified athletic trainers (N = 81) at the Great Lakes Athletic Trainers' Association Annual Meeting and Symposium.

Intervention(s): Emergency skills practice session for anaphylaxis, opioid overdose, diabetes, and asthma.

Main Outcome Measure(s): Participants completed a preintervention perceived knowledge questionnaire (PKQ) that included background information questions and completed a postintervention PKQ.

Results: A statistically significant difference ($P < .001$) in PKQ scores from pretest to posttest was found with pretest scores being lower than posttest scores (89.59 and 103.02, respectively). Age and years of experience had a weak correlation with PKQ pretest scores (rs = .32 and rs = .33, respectively). Participant characteristics including additional certification ($P = .012$), anaphylaxis experience ($P = .036$), opioid overdose experience ($P < .001$), diabetes experience ($P = .025$), and combined emergency experience ($P = .029$) had significantly different pretest PKQ scores.

Conclusions: The use of an interactive teaching strategy in CE and certain athletic trainer characteristics significantly affected athletic trainers' perceived knowledge of emergency skills.

Key Words: Interactive education, anaphylaxis, diabetes, asthma, opioid overdose

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KEY POINTS

- The implementation of adult learning principles has a positive effect on athletic trainers' perceived knowledge of emergency skills.
- Interactive continuing education should be considered when instructing emergency skills for athletic trainers.
- Athletic trainers are more confident in administering emergency skills when learned via interactive continuing education.

INTRODUCTION

Continuing education (CE) is required by credentialing agencies for health care professionals, such as physical therapists, nurses, physicians, and athletic trainers, to maintain skills, knowledge, and certifications.[1–3] To stay current in their profession and to maintain certification, athletic trainers must participate in 50 hours of CE activities every 2 years.[4] However, it can be difficult for athletic trainers and other health care providers to maintain their knowledge and skills when the amount of available literature nearly doubles every 18 months.[4] The exponential growth of information available to athletic trainers creates a need for CE to be delivered in an efficient and effective manner.[4,5]

Despite the requirement for athletic trainers to maintain their knowledge and skills to remain certified, many CE opportunities offered fail to meet the needs of attendees in several aspects, such as perceived benefits, implementation into clinical practice,[6] and overall efficacy and feasibility of the activity.[7] Currently, CE opportunities in athletic training use teaching strategies that are considered either passive or interactive.[8] Passive CE opportunities are described as primarily didactic-style lectures, whereas interactive strategies have a hands-on component. Athletic trainers report gaining greater knowledge through passive teaching strategies, such as lecture-based programs, and experience greater skill development and implementation to clinical practice through interactive activities.[8]

The athletic trainer's level of perception regarding their knowledge of emergency skills can cause a lack of competency in performing a skill and or an unwillingness to use a specific skill in a critical situation.[9] A knowledge gap is demonstrated by a difference in the athletic trainer's perception of their knowledge compared to their actual knowledge of the same content or skills,[10] and athletic trainers have been shown to display significant knowledge gaps, particularly with emergency skills.[3,9] Regardless of whether researchers are investigating perceived knowledge, actual knowledge, or both, it is important to discuss the existing research regarding actual knowledge and knowledge gaps as well as the relationship between these 2 concepts.[3,9,10] Edler et al[9] found a weak relationship between perceived and actual knowledge in athletic trainers' emergency skills, suggesting overconfidence among athletic trainers may likely lead to improper administration of emergency skills. The lack of awareness of the presence of a knowledge gap may create a barrier to athletic trainers seeking out CE opportunities.[9] In addition, it may increase the potential for clinician incompetence, which can have dangerous implications in emergency situations.[9] Researchers of multiple studies have indicated that athletic trainers often overestimate their competence with emergency management skills,[3,9] making it important to understand how CE affects athletic trainers' perceived knowledge of emergency skills.

The Institute of Medicine[5] stated that health care CE as a whole does not provide consistent and adequate support to health care professionals. In athletic training specifically, available research on CE is limited. Researchers have investigated the effectiveness of various CE models,[1,7,11,12] athletic trainers' preferences for CE activities,[6–8] the effect of perceived knowledge on performance,[3] gaps between perceived and actual knowledge,[9,10] and the implementation of adult learning theory in CE activities.[1,11] Although the range of these topics discussed in the literature is broad, the quantity of studies on each specific topic is limited. This study adds to available research by providing unique insights through investigating perceived knowledge before and after an interactive CE activity. Here, we provide information for CE programmers to guide the development of future CE activities. The primary purpose of this study was to explore the effect an interactive teaching strategy used in a CE activity may have on the perceived knowledge of emergency skills among certified athletic trainers. A secondary aim of the study was to examine the relationship between athletic trainer characteristics and the perceived knowledge of emergency skills among certified athletic trainers.

METHODS

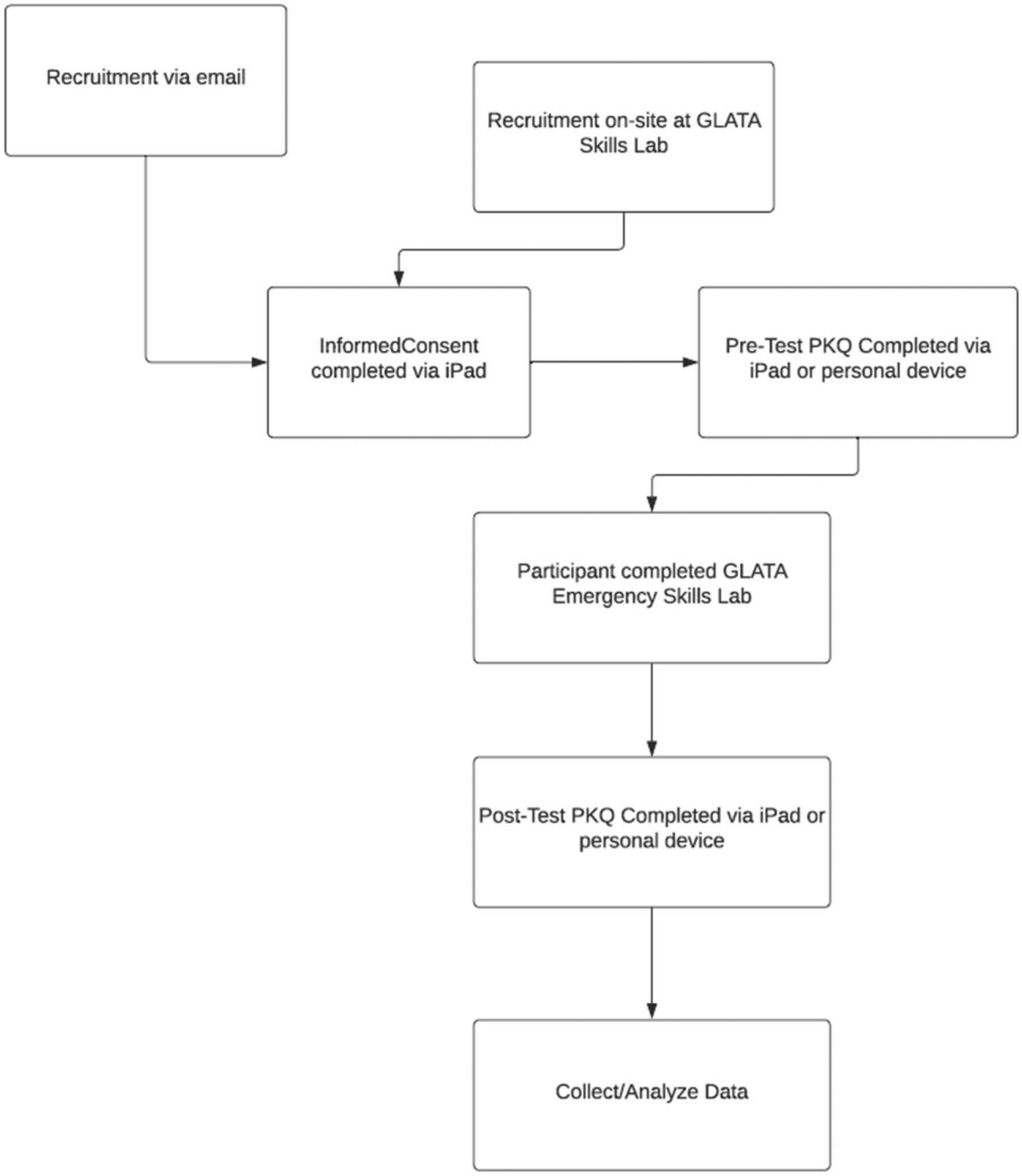
Study Design

Here, we used a quasiexperimental study design with a single-group pretest-posttest design. We conducted the study in March 2020 and evaluated athletic trainers' perceived knowledge of emergency management skills after participating in an interactive CE activity. A flowchart of the methods used in the study is displayed in Figure 1. Before the start of participant recruitment, the study was approved by the University of Indianapolis Human Research Protections Program and follows the guidelines of the JBI critical appraisal tool for quasiexperimental studies.[13]

Participants

A convenience sample of certified athletic trainers was recruited at the Great Lakes Athletic Trainers' Association (GLATA) Annual Meeting and Symposium in March 2020. Inclusion criteria for this study consisted of the following: (1) an athletic trainer in good standing and certified by the Board of Certification (self-reported), (2) an attendee at the GLATA Annual Meeting and Symposium, and (3) a participant in the skills laboratory offered during the GLATA Annual Meeting and Symposium. The individuals were excluded from the study if they were

Figure 1. Methods flowchart. Abbreviations: GLATA, Great Lakes Athletic Trainers' Association; PKQ, perceived knowledge questionnaire.



athletic training students, certified athletic trainers attending the conference as vendors or marketers, athletic trainers who were retired or not practicing, and members of the GLATA Education Committee. Participants were given the option of giving consent or opting out of the study via an informed consent form. Demographic and participant characteristics collected included age, years of experience, job setting, additional professional certifications, and self-reported actual clinical emergency experience with each of the 4 emergency skills.

Instrument

Perceived Knowledge Questionnaire. The Perceived Knowledge Questionnaire (PKQ) used in this study (Appendix A) was a 20-item self-reported measure in which the items were scored on a 7-point Likert-like scale. The instrument is a variation of the subjective knowledge assessment tool that is designed to be interchangeable between constructs and disciplines.[14] The instrument developed by Flynn and Goldsmith[14] used a variety of constructs and demonstrated internal consistency (Cronbach alpha: 0.88–0.92), test-retest reliability ($r = 0.79$), criterion validity ($r = 0.25$), and construct reliability ($r = 0.87$–0.93), allowing for generalizability of the instrument.[13] These unique properties allowed us to insert the 4 emergency conditions as the content to be evaluated by the PKQ. We administered the questionnaire before the participants' involvement in the skills laboratory and immediately after their completion of the skills laboratory.

In athletic training research, Flynn and Goldsmith's[14] subjective knowledge assessment tool had been adapted by 3 previous studies to fit their content. Neil et al[3] used the instrument to demonstrate the perceived knowledge of managing the spine-injured athlete. Edler et al[9] implemented the tool to assess athletic trainer's knowledge of airway adjuncts, and Eberman and Tripp[10] adapted the instrument to assess perceived knowledge of recognition, treatment, and management of exertional muscle cramping.

In this study, a maximum overall perceived knowledge score was 140, whereas the lowest overall perceived knowledge score possible was 0. For each individual emergency skill, the maximum score was 35, whereas the lowest possible score was 0. The highest possible score would indicate that an individual had excellent confidence in the specific skill, whereas a low score indicated that the participant was lacking confidence in the specific skill.

Intervention. The Emergency Skills Lab was developed and administered by the GLATA Education Committee. The researchers were not involved in the development or administration of the skills laboratory. Before participation in the skills laboratory, each participant completed the pretest PKQ. Each participant spent a total of approximately 45 minutes participating in the following 4 emergency skills stations: asthma, anaphylaxis, opioid overdose, and diabetes. Each station was overseen by an expert in the field of the specific emergency skill management. Participants received an overview and review of the skill and were provided with the opportunity to practice the skill under supervision. They repeated this process for each of the 4 skill stations.

The asthma station focused on signs and symptoms of an asthmatic emergency and the use of a peak flowmeter or how to use a toilet paper roll or similar item to substitute for a peak flowmeter. The anaphylaxis station focused on the use of an EpiPen. The diabetes station allowed participants to practice using a glucometer. The opioid overdose station focused on the use of intramuscular and intranasal naloxone, or Narcan, administration to treat victims of an opioid overdose. Upon completion of the skills laboratory, the posttest PKQ was completed.

Statistical Analysis

To estimate the minimum sample size required to sufficiently power the study, G*Power 3.1[15] was used. Based on conducting a paired t test to compare pretest PKQ scores to posttest PKQ scores with an alpha of 0.05, effect size of 0.40, and power of 0.80, a minimum sample size of 52 total participants was required. Data were analyzed using IBM SPSS Statistics for Windows, (version 25.0; IBM Corp). Descriptive statistics were used to describe the sample and PKQ results. All comparisons were 2-tailed, and an alpha level less than 0.05 was considered statistically significant. To determine if there was a statistically significant difference in PKQ scores from pretest to posttest, a paired t test was conducted. To determine if there were differences or correlations with pretest PKQ scores by participant demographics and characteristics, independent t tests, Mann-Whitney U tests, 1-way analysis of variance (ANOVA), and Spearman rho correlation tests were conducted, as appropriate. The interpretation of correlation coefficients was $r = 0$–0.25, little or no relationship; $r = 0.25$–0.50, fair relationship; $r = 0.50$–0.75, moderate-to-good relationship; and $r > 0.75$, good-to-excellent relationship.[16] In addition, a 2-by-2 mixed design ANOVA was used to determine if there was an interaction between the change in PKQ scores over time (pretest to posttest) and additional certifications and between job setting and emergency experience groups. As needed, pairwise post hoc tests were used with the Bonferroni multiple comparison adjustment. Effect sizes were calculated and interpreted based on recommendations of Cohen.[17] Missing or incomplete data resulted in the exclusion of the participant's responses from the study.

RESULTS

Eighty-two individuals completed the study. One participant answered *strongly agree* for all responses whether positively and negatively worded; therefore, data from that participant were removed from analysis. Based on 81 participants, the median age (interquartile range) was 33.00 (15.00) years and the median years of experience was 10.00 (14.00) years. Pretest PKQ scores had a mean of 89.59 (17.84), and posttest PKQ scores had a mean of 103.02 (16.08). Frequencies and percentages for job setting, each of the 4 emergency experiences, and overall emergency experience are displayed in Table 1.

To address the primary aim of this study, pretest PKQ total scores were compared to posttest PKQ total scores. The difference between mean pretest scores, 89.59 (17.84), and mean posttest scores, 103.02 (16.08), was statistically significant ($t_{(80)} = -8.62$, $P < .001$) with a moderate correlation ($r = 0.66$). The statistically significant mean difference of 13.43 and a large effect size ($d = 0.91$) indicate that participants' PKQ scores were significantly higher after the clinical skills practice session.

To address the secondary aim of the study, pretest PKQ total scores were compared to each of the demographic and professional characteristics that were collected. We found a fair relationship between age and pretest PKQ scores ($r_s = 0.32$; $P = .004$) and between years of experience and pretest PKQ scores ($r_s = 0.33$; $P = .003$). Independent t test results for participant background information and each of the 4 emergency experiences are displayed in Table 2. A 1-way ANOVA indicated that whether an athletic trainer was employed in an athletic, clinical, or academic job setting, there was not a statistically significant difference in pretest PKQ scores ($F_{2, 77} = 2.27$, $P = .110$).

The 2-by-2 Mixed ANOVA

For the following 2-by-2 mixed ANOVA results, tests of assumptions were met. There were no outliers, as assessed by a boxplot. Data were normally distributed as assessed by a Shapiro-Wilk test ($P > .05$). There was homogeneity of variances ($P > .05$) and covariances ($P > .05$) as assessed by the Levene test of homogeneity and variances and Box M test. Results are displayed in Table 2.

Additional Certification. Results indicate that study participants who had additional certifications had a significantly higher perceived knowledge of emergency skills than study participants without additional certifications. However, both groups had significant improvement in PKQ scores from pretest to posttest. The partial eta squared showed a small effect size.

Anaphylaxis Experience. Results indicate that study participants with actual anaphylaxis experience had significantly higher PKQ scores than participants without actual anaphylaxis experience. However, both groups showed significant improvement in PKQ scores from pretest to posttest. The partial eta squared showed a small effect size for the main effect of group.

Table 1. Pretest PKQ Scores and Background Information

Comparison of Pretest PKQ Scores by Background Information (N = 81)		Paired *t* test		
Characteristic	n (%)	Pretest PKQ Score (SD)	Cohen d	*P* Value
Additional certifications				
Yes	23 (28.7)	98.43 (20.29)	0.68	.012
No	57 (71.3)	85.95 (15.72)		
Anaphylaxis experience				
Yes	15 (18.5)	98.27 (19.80)	0.58	.036
No	66 (81.5)	87.62 (16.92)		
Opioid experience				
Yes	4 (4.9)	117.00 (15.98)	1.76	<.001
No	77 (95.1)	88.17 (16.84)		
Diabetes experience				
Yes	31 (38.2)	95.19 (18.48)	0.52	.025
No	50 (61.8)	86.12 (16.69)		
Asthma experience				
Yes	38 (46.9)	92.97 (19.19)	0.36	.109
No	43 (53.1)	86.60 (16.21)		
Job settings				
Athletics	41 (51.3)			
Academics	10 (12.5)			
Clinical	29 (36.3)			

Diabetes Experience. Results indicate that study participants with actual diabetes experience had significantly higher PKQ scores than those without actual diabetes experience. However, both groups had significant improvement in their PKQ scores from pretest to posttest. Partial eta squared showed a small effect size for the main effect of group.

Asthma Experience. There was no statistically significant interaction between asthma experience and PKQ scores from pretest to posttest. The main effect of time showed a statistically significant difference in mean PKQ scores at pretest and posttest with a small effect size.

Table 2. Mixed Model ANOVA Results

Characteristic	*F*	η^2	*P* Value
Certifications			
Interaction effect	2.28	0.03	.135
Within-groups	7.23	0.08	<.001
Between-groups	53.56	0.4	<.001
Anaphylaxis experience			
Interaction effect	0.08	0.001	.785
Within-groups	42.05	0.35	<.001
Between-groups	5.5	0.07	.022
Diabetes experience			
Interaction effect	0.15	0.002	.703
Within-groups	70.95	0.47	<.001
Between-groups	8.18	0.09	.005
Asthma experience			
Interaction effect	0.04	0.843	.04
Within-groups	73.32	0.48	<.001
Between-groups	3.9	0.05	.052
Overdose experience			
Interaction effect	5.37	0.64	.023
Overall experience			
Interaction effect	0.13	0.002	.721
Within-groups	67	0.46	<.001
Between-groups	7.94	0.09	.006
Job settings			
Interaction effect	5.1	0.12	.008

Opioid Overdose. Interaction results show that before participating in the CE activity, participants with opioid overdose experience perceived their knowledge of opioid overdose skills greater than those without experience. Participants without opioid experience increased their PKQ scores from pretest to posttest, but those with opioid experience PKQ scores remained relatively the same from pretest to posttest. The partial eta squared showed a large effect size.

Overall Emergency Experience. Results indicate that study participants who had overall emergency experience had significantly PKQ scores than study participants without actual overall emergency experience. However, both groups had significant improvement in their PKQ scores from pretest to posttest. Partial eta squared showed a small effect size for the main effect of the overall experience group.

Job Settings. Participants working in athletics and clinics significantly increased their posttest PKQ scores after participating in an emergency skills practice session. However, those working in academia did not significantly improve their PKQ scores.

DISCUSSION

Here, we sought to address the following 2 specific research objectives with respect to athletic training CE and emergency skills: (1) to explore the effect that an interactive teaching strategy used in a CE had on athletic trainers' perceived knowledge of emergency skills and (2) to examine the relationship between athletic trainer characteristics and perceived knowledge of emergency skills.

Limited research has been done on CE in athletic training, and we are the first, to our knowledge, to explore how the implementation of adult learning principles in an interactive CE activity affect perceived knowledge. It is important to discuss how implementing these principles can influence the effectiveness of CE activities. Understanding how certain athletic trainer characteristics affect their perception of knowledge of these skills has the potential to assist CE programmers and educators for future CE development and marketing strategies. We also sought to explore the frequency of athletic trainers' use of these emergency skills in real-world situations. This understanding can help educators decide which skills are most frequently used and whether frequency affects decisions as to which skills may be most beneficial to teach athletic trainers or if athletic trainers see more value in attending CE activities for skills that are more rarely versus more commonly used in practice.

In addition to selecting the most prevalent and relevant CE topics, it is vital that CE is delivered as efficiently as possible. Previous researchers indicate that athletic trainers face numerous barriers when seeking CE, such as costs and travel distance,[7] as well as time constraints and ability to implement skills learned.[6] Because of these challenges, it is important for all CE activities not only to be feasible for athletic trainers but also to be delivered in ways that make it possible for athletic trainers to easily implement new skills and knowledge into clinical practice.[6]

Clinical Skills Practice and Perceived Knowledge Questionnaire

The first study objective was to determine if there was a significant difference in pretest and posttest PKQ scores after athletic trainers participated in an emergency skills laboratory. Results of the comparison indicate that study participants' perceived knowledge of the 4 emergency conditions (anaphylaxis, opioid overdose, diabetes, and asthma) increased significantly after having the opportunity to practice the skills associated with managing these conditions. In addition to a statistically significant finding, the results were also clinically relevant, with a large effect size, indicating that athletic trainers are likely to experience improved perceived knowledge after this type of intervention. One recent study is the only study with a similar design, with the main difference being the collection of participants' actual knowledge, rather than perceived knowledge, of heart sound auscultation before and after 2 CE activities with interactive techniques.[11] Researchers of other previous studies investigated the effect of an actual knowledge assessment on perceived knowledge of specific topics in athletic training, including the use of airway adjuncts;[9] knowledge, prevention, and management of exercise induced muscle cramps;[10] and management of spine-injured athletes[3]. Although we did not use an actual knowledge assessment, the perceived knowledge of the individual is important, as it demonstrates confidence in the specific skill, which may result in the willingness to perform the skill in emergency situations. The results of this study differ from a study by Neil et al[3] who found a decrease in PKQ scores after an actual knowledge assessment and Edler et al[9] who found no difference between pre- and posttest PKQ scores after an actual knowledge assessment. These findings suggest that the use of an interactive learning activity is effective at increasing participants' perceived knowledge of those skills, whereas the use of an actual knowledge assessment as an intervention has the potential to decrease or have no effect on specific athletic-training-related skills.[3,9,10] Frank et al[11] found a significant increase in actual knowledge scores among participants in both in-person interactive and computer-based interactive intervention groups. However, the group that was given the opportunity to interact and have hands-on practice with the skills increased significantly more than the computer-based group.[11] These findings are consistent with the existing literature regarding adult learning theory concepts and the efficacy of CE.[2,18,19]

Adult Learning Theory. The effectiveness of incorporating adult learning theory foundations into CE has been documented among other health care professionals, such as nurses, physicians, and physical therapists,[2,18] but it had not been studied specifically in athletic training until a recent study by Frank et al.[11] Pitney[19] theorized that athletic training CE should incorporate adult learning theory to maximize effectiveness. The intervention in this study used interactive activities and self-directed learning, implementing the principles of adult learning theory, and was considered a formal activity because it was approved for athletic training CE credit.[8] The statistically significant increases in PKQ score after the self-directed, learner-centered CE activity in this study are consistent with these suggestions and previous findings.

It is also important to consider the previous researchers who suggested that athletic trainers and other health care professionals, such as physical therapists and nurses, prefer hands-on CE activities.[20,21] These interactive activities have been discussed in the literature as traditionally being associated with nonformal CE, or those not approved for CE credit.[8,22] The significant PKQ change from pretest to posttest adds to the existing literature in which researchers advocate for the implementation of these types of CE activities.

Participant Characteristics and Perceived Knowledge Questionnaire

To address the second study objective, several participant characteristics, including age, years of experience, job setting, additional professional certifications, and experience with each of the 4 emergency skills, were collected and their relationship to pretest PKQ scores were analyzed. Among these variables, results were mixed. Several participant characteristics showed significant differences in PKQ scores, whereas others displayed nonsignificant changes. Although available research is largely limited, researchers of a few athletic training studies have incorporated participant characteristics into their research of perceived knowledge of emergency skills. Participants' age and years of experience displayed a significant but weak relationship to pretest PKQ scores ($r_s = 0.32$ and $r_s = 0.33$, respectively), and several participants (N = 23, 28.7%) reported the possession of professional certifications in addition to their athletic training certification. These individuals scored significantly higher on the pretest PKQ than those without additional certifications, although both groups saw a statistically significant increase in PKQ scores from pretest to posttest. There was a medium effect size for those with additional certifications versus those without, indicating that these individuals may possess a greater perception of knowledge. The results also suggest that these individuals with additional certifications may be more likely to have pursued CE on these topics previously. Regardless of the type of additional certification, this finding potentially indicates a propensity to pursue CE in general, which would

increase the likelihood that they have had additional training to increase their perceived knowledge in those specific areas.

Participants' experiences related to each of the 4 emergency conditions addressed in the intervention had various effects on pretest and posttest PKQ scores. In addition to the pretest and posttest PKQ scores, the frequency of athletic trainers with experience managing the emergency conditions in this study is important to help determine the relevance of selected CE activities and topics. In this study, the frequency of experience was lowest among opioid overdose experience, followed by anaphylaxis, diabetes, and asthma. This finding should be noted and considered by CE programmers in deciding which skills are most prevalent among this sample of athletic trainers to guide development of future activities.

Anaphylaxis and Diabetes Experience. Participants with experience managing anaphylaxis and diabetes demonstrated significantly higher PKQ scores at pretest with medium effect sizes, suggesting that these 2 groups either have more knowledge or an inflated perception of their knowledge with emergency skills. Both groups' participants, with and without respective experience, demonstrated a significant increase in PKQ scores from pretest to posttest, suggesting that the participants did not have an overperception of knowledge. These findings are similar to those in previous studies in which perceived and actual knowledge were compared with previous use of emergency skills. Edler et al[9] found that athletic trainers who used life-saving skills more often had higher actual knowledge scores than those who had not used life-saving skills.

Opioid Overdose Experience. Participants with experience managing opioid overdose had significantly higher pretest PKQ scores than those without opioid overdose experience, and a large effect size was seen. These results suggest that these individuals had greater confidence in their abilities with the selected emergency conditions. However, the group with opioid overdose experience did not have a significant increase in PKQ scores at posttest, whereas the group without opioid overdose experience demonstrated a significant increase in PKQ scores. One plausible explanation is that individuals with opioid overdose experience had an overperception of knowledge and, as such, did not gain the perceived benefits as those with no prior opioid overdose experience. This finding suggests that individuals with no prior opioid experience have the potential to get more benefit from an interactive CE activity for emergency skills.

Asthma Experience. Participants with experience managing asthma had no significant difference in pretest PKQ scores as compared to those without asthma experience. However, participants with asthma experience demonstrated a statistically significant change in PKQ scores from pretest to posttest. The lack of a difference in pretest PKQ scores could be attributed to the fact that asthma can be managed by athletic trainers in both emergent and nonemergent scenarios, thus making it part of an athletic trainers' normal skillset, rather than a specialized and rarely used emergency skill. However, diabetes is a similar condition that yielded more significant results, making this finding difficult to explain. The lack of research on asthma management and CE makes it difficult to suggest the reason for these results. The authors suggest that further research is needed to determine an explanation. The small effect size suggests that these results have little clinical relevance.

Overall Emergency Experience. Participants with experience managing any of the 4 emergency conditions had significantly higher pretest PKQ scores. Participants with and without experience in any of the 4 conditions had significant increases in PKQ scores from pretest to posttest. Similar to results for diabetes and anaphylaxis alone, previous research supports these findings, as athletic trainers with more experience in emergency situations had higher knowledge than those who did not.[9]

Job Settings. Participants' current professional job settings were recorded and they consisted of the following 3 groups: athletics, academics, and clinical outpatient. The athletics and clinical groups significantly increased their PKQ scores from pretest to posttest, whereas participants in academia did not demonstrate a significant increase. This finding suggests that participants in academia did not perceive a significant benefit from the CE activity as compared to individuals in athletics and clinical settings.

There was no significant difference between the 3 groups at pretest. We anticipated that individuals in certain settings would have higher perceived knowledge of emergency skills due to their exposure to certain conditions and, for educators, the knowledge to educate students on these emergency conditions. However, the data collected did not produce the expected results with respect to pretest PKQ scores. This result is consistent with that of Edler et al[9] who found no significant difference in actual knowledge among after stratifying the sample by gender and employment setting.

Educational Implications

This study provides a foundation of evidence with respect to perceived knowledge, interactive CE, athletic trainer characteristics, and emergency experiences. In a field with little existing research, future researchers can use the evidence provided to develop studies incorporating actual knowledge assessments for specific topic areas. Although we did not assess actual knowledge, previous researchers have reported that an increase in perceived knowledge can be accompanied by an increase in actual knowledge. It is important to understand the previously established correlation between perceived and actual knowledge to help guide future research directions. Previously, Eberman and Tripp,[10] Edler et al,[9] and Neil et al[3] incorporated the use of an actual knowledge assessment as an intervention but also to analyze and discuss the knowledge gap between perceived and actual knowledge. Edler et al[9] found a poor positive relationship between perceived and actual knowledge. Consistently, Eberman and Tripp[10] found a poor significant correlation, whereas Neil et al[3] found a poor and insignificant relationship between perceived and actual knowledge. Additionally, Eberman and Tripp[10] found that pretest knowledge gap (difference between perceived and actual knowledge) was a significant predictor of posttest knowledge gap.

Results from this study also provide a foundation of evidence describing a set of emergency conditions that are often seen in clinical practice. This information has the potential to guide CE programmers' decisions on which conditions to highlight at seminars, symposia, and other CE events.

Limitations

One of the limitations of the study is that the convenience sample was not randomly selected, plus participants were a relatively homogenous group of certified athletic trainers attending

a CE conference. Although these participants had differences in years of experience, age, job setting, and other characteristics, they all displayed a desire to seek out CE activities by attending the conference and by participating in the clinical skills laboratory. The bias in sampling had the potential to affect the study results. The size of the sample added to the limitations of the study. A larger sample and a greater stratification of job settings would have allowed the authors to conduct additional statistical analyses similar to those by Neil et al.[3]

Another study limitation was the time between pretest and posttest PKQ and the potential for a recall effect. Most participants completed both the pre- and posttest on the same day, with many being completed directly before and after the intervention, a span of approximately 45 minutes. This timing was the most feasible from a logistical standpoint, but it was not ideal considering the original development of the PKQ instrument was shown to be reliable using a 4-week test retest reliability.[14] The decision to use an immediate test-retest method was based on previous athletic training studies[3,9,10] in which researchers used a pretest, an actual knowledge assessment intervention, and immediate posttest design and yielded significant findings.

Another study limitation was the lack of an actual knowledge assessment and skill assessment. Researchers of previous athletic training studies,[3,9,10] compared an actual knowledge assessment to perceived knowledge scores, but the relationship between perceived knowledge and actual knowledge was inconsistent. These previous findings combined with logistical challenges of collecting data from conference participants led to the decision to exclude the actual knowledge assessment from the study. Also, the addition of a skills assessment would allow researchers to determine if the intervention had a significant effect on the participants' skills for each of the 4 conditions. These limitations allow for numerous opportunities for future research.

CONCLUSIONS

The interactive CE activity, which used adult learning theory principles, had a significant effect on PKQ scores. This finding demonstrated that the implementation of adult learning theory concepts can have a positive effect on the perceived knowledge of the management of specific emergency conditions. Here, we also provided evidence that several different athletic trainer characteristics, such as additional certifications, certain emergency condition experiences, years of experience, and age, have an effect on the perceived knowledge of relevant emergency conditions. We have demonstrated that an interactive method of instruction should be considered for CE of emergency skills and that relevance and frequency should be discussed when selecting topics for athletic training CE activities.

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Appendix A. Perceived Knowledge Questionnaire (PKQ)

1) I know pretty much about anaphylaxis
2) I do not feel very knowledgeable about anaphylaxis[a]
3) Among my colleagues, I am one of the experts on anaphylaxis
4) Compared to most other ATs, I know less about anaphylaxis[a]
5) When it comes to anaphylaxis, I don't know a lot[a]
6) I know pretty much about opioid overdose
7) I do not feel very knowledgeable about opioid overdose[a]
8) Among my colleagues, I am one of the experts on opioid overdose
9) Compared to most other ATs, I know less about opioid overdose[a]
10) When it comes to opioid overdose, I don't know a lot[a]
11) I know pretty much about diabetes
12) I do not feel very knowledgeable about diabetes[a]
13) Among my colleagues, I am one of the experts on diabetes
14) Compared to most other ATs, I know less about diabetes[a]
15) When it comes to diabetes, I don't know a lot[a]
16) I know pretty much about asthma
17) I do not feel very knowledgeable about asthma[a]
17) Among my colleagues, I am one of the experts on asthma
18) Compared to most other ATs, I know less about asthma[a]
19) When it comes to asthma, I don't know a lot[a]

Items scored on a 7-point Likert-scale, 1 = Strongly Disagree, 7 = Strongly Agree.

[a]Item was reverse scored.