EMERGENCY SKILLS IN ATHLETIC TRAINING: PERCEIVED KNOWLEDGE AND CONTINUING EDUCATION

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Emergency Skills in Athletic Training: Perceived Knowledge and Continuing Education

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Abstract

Continuing education (CE) in healthcare, 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. The purpose of this study was to explore whether an interactive teaching strategy and various characteristics of athletic trainers affected the perceived knowledge of emergency skills among certified athletic trainers. The quasi-experimental study used a single group pretest-posttest design. Participants were recruited and data was collected from certified athletic trainers ($N = 81$) at the Great Lakes Athletic Trainers Association Annual Meeting and Symposium. Participants completed a pre-intervention perceived knowledge questionnaire (PKQ) which included background information questions. They then participated in an emergency skills practice session for anaphylaxis, opioid overdose, diabetes, and asthma and completed a posttest PKQ. 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, 103.02) respectively. Age and years of experience had a weak correlation with PKQ pretest scores ($r_s = .32$ and $r_s = .33$, 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. The use of an interactive teaching strategy in CE and certain athletic trainer characteristics significantly affected athletic trainers' perceived knowledge of emergency skills.

Keywords: Athletic training, continuing education, emergency skills, perceived knowledge

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Table of Contents

Emergency Skills in Athletic Training: Perceived Knowledge and Continuing Education

Continuing education (CE) is required by credentialing agencies for health care professionals such as physical therapists, nurses, physicians, and athletic trainers in order to maintain skills, knowledge, and certifications (Doherty-Restrepo, Hughes, Del, & Pitney, 2009; Forsetlund et al., 2009; Neil, Eberman, Games, & Kahanov, 2018). In order to stay current in their profession and to maintain certification athletic trainers must participate in 50 hours of CE activities every two years (Board of Certification [BOC], 2018). However, it can be difficult for athletic trainers to maintain their knowledge and skills when the amount of materials available to them nearly doubles every 18 months (BOC, 2018). The exponential growth of information available to athletic trainers creates a need for CE to be delivered in an efficient and effective manner (BOC, 2018; Institute of Medicine, 2010).

Despite the requirement for athletic trainers to maintain their knowledge and skills in order 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 (Edler & Eberman, 2019), and overall efficacy and feasibility of the activity (Armstrong & Weidner, 2011). Currently, CE opportunities in athletic training use teaching strategies that are considered to be either passive or interactive (Armstrong & Weidner, 2010). Athletic trainers report gaining greater knowledge through passive teaching strategies such as lecture-based programs, while experiencing greater skill development and implementation to clinical practice through interactive activities (Armstrong & Weidner, 2010).

Athletic trainers' over-perception and under-perception regarding their knowledge of emergency skills can cause lack of competency in performing a skill, and or an unwillingness to utilize a specific skill in a critical situation (Edler & Eberman, 2015). A knowledge gap is

demonstrated by a difference in the athletic trainer's perception of his or her knowledge compared to their actual knowledge of the same content or skills (Eberman & Tripp, 2011) and athletic trainers have been shown to display significant knowledge gaps, particularly with emergency skills (Edler, Eberman, Kahanov, Roman & Mata, 2015; Neil et al., 2018). Multiple studies have indicated that athletic trainers often overestimate their competence with emergency management skills (Edler et al., 2015; Neil et al., 2018) making it important to understand how CE effects athletic trainers' perceived knowledge of emergency skills.

The primary purpose of this study was to explore the effect an interactive teaching strategy used in a CE activity may have on perceived knowledge of emergency skills among certified athletic trainers. A secondary aim of the study was to see if there was a relationship between athletic trainer characteristics and perceived knowledge of emergency skills among certified athletic trainers. The study will address the following objectives:

1. To determine if there is a statistically significant difference in perceived knowledge of certified athletic trainers' emergency skills after participating in an interactive, hands-on CE activity.
2. To determine if certified athletic trainers' perceived knowledge of emergency skills is related to their demographic characteristics.

Significance

This study adds to available research by providing unique insights through investigating perceived knowledge before and after an interactive CE activity. This research design investigating perceived knowledge has not been used in the current literature with a CE activity as the intervention. The study provides information for CE programmers to guide the development of future CE activities, as well as provide insight to the athletic trainers' comfort

level with implementing the skills completed during the CE activity into clinical practice. This study also provides information for potential marketing strategies for CE programmers to identify individuals who may have varying levels of perceived knowledge and not feel the need for CE in emergency management.

Literature Review

The Institute of Medicine (2010) stated that healthcare CE as a whole does not provide consistent and adequate support to healthcare professionals. In athletic training specifically, available research on CE is limited. Researchers have investigated the effectiveness of various CE models (Armstrong & Weidner, 2011; Doherty-Restrepo et al., 2009; Frank et al., 2020; Pitney, 1997), athletic trainers' preferences for CE activities (Armstrong & Weidner, 2010; Armstrong & Weidner, 2011; Edler & Eberman, 2019), effect of perceived knowledge on performance (Neil et al., 2018), gaps between perceived and actual knowledge (Eberman & Tripp, 2011; Edler et al., 2015;), and implementation of adult learning theory in CE activities (Doherty-Restrepo et al., 2009; Frank et al., 2020; Pitney, 1997). While this is a broad range of topics discussed in the literature, the quantity of studies on each specific topic is limited. Therefore, it is valuable to consider the landscape of CE research of other allied health professionals, such as physical therapists, occupational therapists, nurses, and physicians. It is also important to discuss how athletic training educational competencies influence the athletic training knowledge base, the need for effective CE (National Athletic Trainers' Association [NATA], 2011) and how the implementation of adult learning theory, or lack thereof, impacts CE development and effectiveness (Doherty-Restrepo et al., 2009; Pitney, 1997; Samdperil, 2012).

Continuing Education Models

Various models of CE are used throughout athletic training and other allied health professions such as physical therapists, occupational therapists, nurses, and physicians. (Forsetlund et al., 2009). Existing studies have separated athletic training CE into various categories: formal and informal activities (Armstrong & Weidner, 2010, 2011), continuing professional education (Doherty-Restrepo, Hughes, Del Rossi & Pitney, 2009), and continuing professional development (Samdperil, 2012). Continuing professional education and continuing professional development are forms of CE discussed in literature which more commonly place an emphasis on adult learning theory as their foundation, and are more often comprised of informal CE activities (Armstrong & Weidner, 2010; Doherty-Restrepo et al., 2009; Samdperil, 2012). In athletic training, Armstrong and Weidner (2010) described formal CE activities as those approved for BOC credit and include small group activities and lectures which were instructor-centered and largely passive for the participants. Informal CE activities, not approved for CE credit for athletic trainers, include reading journal articles, serving as a clinical instructor for athletic training students, and mentoring (Armstrong & Weidner, 2010). Traditional, formal CE activities in healthcare are often teacher-centered lecture presentations (McLeod, 2004).

Several researchers have investigated effects of formal and informal CE activities in athletic training and other healthcare professions. Armstrong and Weidner (2010) found that both formal and informal CE positively impacted athletic trainers' practice. Athletic trainers perceived formal CE as having the greatest impact on knowledge, while informal CE was thought to have the greatest impact on clinical skills (Armstrong & Weidner, 2010). Most recently, Frank et al. (2020) demonstrated a significant increase in knowledge and skill development before and after two separate types of interactive CE activities. The study found that an in-person, interactive CE activity improved heart sound auscultation skills greater than the computer-based activity and

that these interactive opportunities achieved greater results than a formal, lecture-based CE course (Frank et al., 2020).

Research among healthcare professionals other than athletic training, such as physical therapists, nurses (Bahn, 2007; Forsetlund et al., 2009), occupational therapists (Andersen, 2001), and physicians (Forsetlund et al., 2009) have demonstrated similar findings. Occupational therapists reported that informal CE activities had a greater impact on clinical skills than formal CE (Andersen, 2001), while Bahn (2007) found that athletic trainers' and nurses' perceived informal CE as having improved patient care more than formal CE. A systematic review of nursing, physical therapy and physician CE by Forsetlund et al. (2009) found that a combination of didactic and interactive activities improved effectiveness of CE.

Adult Learning Theory and Continuing Education

Adult learning theory suggests that recognizing a knowledge deficit, or gap, prior to a learning activity can increase participants' effort (Knowles, 2011). Conversely, not understanding or recognizing that a gap exists, especially with respect to emergency skills, can put patients at risk (Edler et al., 2015). The gap between athletic trainers' perceived and actual knowledge of rarely used skills, particularly emergency skills, highlights a need for improved CE techniques. A variety of studies indicate that the incorporation of adult learning theory can have a positive effect on CE by including activities that are a self-directed, learner-centered, interactive experience, rather than passive and instructor-centered activities (Pitney, 1997; Sampdperil, 2012). The concepts of adult learning theory are often not incorporated into formal CE, which typically consists of lecture activities with little to no interaction by participants (Armstong & Weidner, 2010; McLeod, 2004). Davis et al. (1999) suggested that interactive techniques better align with adult learning theory, and should be incorporated into the CE

activities. This was further supported by study results presented by Forsetlund et al. (2009) that found adding an interactive component to CE activity increased effectiveness in nursing, physical therapy, and medicine. Previously, Davis (1998) also found that a combination of interactive and lecture in CE delivery for physicians significantly improved clinical performance. Doherty-Restrepo (2009) suggested that athletic training CE activities that do not incorporate adult learning theory may inhibit participants from effectively incorporating topics into clinical practice.

Perceived and Actual Knowledge

Despite efforts through various models of CE programming to keep healthcare providers up-to-date on skills and knowledge, gaps exist in providers' perceived knowledge and actual knowledge (Edler et al. 2015; Neil et al., 2018). Regardless of whether a study is 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 two concepts (Eberman & Tripp, 2011; Edler et al., 2015; Neil et al., 2018). Edler et al. (2015) 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 (Edler et al., 2015). In addition, it may increase the potential for clinician incompetence, which can have dangerous implications in emergency situations (Edler et al., 2015). These findings are consistent with Neil et al. (2018) who found clinicians were unable to accurately depict their actual knowledge. Eberman and Tripp (2011) also found that actual knowledge and perceived knowledge were poorly correlated and noted that the gap between them was strongly correlated to posttest

perceived knowledge and knowledge gap among athletic trainers. In a qualitative study, Edler and Eberman (2019) found that athletic trainers were confident about their knowledge following a CE session and had varying degrees of confidence in performing skills based on level of previous knowledge.

Reported within the existing literature is a consistent finding that athletic trainers have low awareness of their lack of knowledge with certain rarely used skills, such as the use of airway adjuncts and managing a spine-injured athlete (Edler et al., 2015, Neil et al., 2018). Frank et al (2020) did not assess perceived knowledge, but found that athletic trainers' actual knowledge of heart sound auscultation and ability to complete a comprehensive cardiovascular assessment was poor, noting the infrequent use of these skills as one potential explanation. It is important that researchers continue to explore the most effective means of educating professional athletic trainers on skills which are rarely employed but vital to patient welfare, specifically emergency care skills, (Edler et al., 2015, Neil et al., 2018).

Competency-Based Education

Athletic training education is based on specific competencies set forth by the NATA which were updated in 2011 to include skills such as emergency management, specifically the treatment of at-risk athletes with conditions such as diabetes and asthma (NATA, 2011). Maehle et al. (2017) indicated that professions whose initial level of education has expanded to cover a wider range of topics are at greater risk of skill decay. Frank et al. (2020) noted that a factor in athletic trainers' particularly low pretest scores of heart sound auscultation was participants never having learned the skills during their professional education. The implementation of other athletic training skills also face this dilemma. Athletic trainers who completed previous versions of competency-based education did not learn emergency skills, such as asthma and diabetes that

they currently need while athletic trainers who were educated under the most recent competencies have been educated on needed emergency skills (NATA, 2011). Therefore, it could be suggested that athletic trainers who have completed educational competencies more recently, would be more confident and knowledgeable about these emergency skills than athletic trainers who did not receive this formal education.

Expanded educational competencies (NATA, 2011) and CE initiatives for athletic trainers are aimed at reducing knowledge gaps, specifically with regards to emergency skills (Edler et al., 2015). Athletic trainers should have the knowledge to manage various scenarios, but the frequency of actual use of these skills is low (Neil et al., 2018). This study focused on the perceived knowledge of four specific emergency skills: management of anaphylaxis, management of a diabetic emergency, management of an asthmatic emergency, and management of an opioid overdose scenario. Several researches studied athletic trainers' role in emergency management of diabetes and asthma (Casa et al., 2012; Conley et al., 2012; Jiminez, 1997; Jiminez et al., 2007; MacKnight et al., 2009; Miller et al., 2005). In addition to addressing specific conditions, these studies include NATA position statements on general prevention of sudden death (Casa et al., 2012) and recognition of disqualifying conditions for athletes (Conley et al., 2014). To date, no studies have connected athletic training and emergency situations involving opioid overdose or anaphylaxis.

There are numerous factors that influence preference for CE in athletic training. Athletic trainers prefer CE opportunities that are grounded in adult learning theory principles, have the opportunity to impact clinical abilities, and are interactive in nature (Armstrong & Weidner, 2010). The literature also indicates that athletic trainers overestimate their knowledge in certain areas. Currently, no researchers have investigated the effect of an interactive CE opportunity on

perceived knowledge, and little is known about whether athletic trainers' characteristics effect their perceived knowledge of emergency skills. This study sought to contribute to the current literature by investigating a variety of factors within athletic training CE. It investigated perceived knowledge after an interactive CE activity, and examine how athletic trainers' age, years of experience, job setting, additional certifications, and actual emergency experience with each of the four skills discussed, shaped their perceived knowledge. The study will provide information for CE programmers to guide the development of future CE activities, as well as provide insight into athletic trainers' comfort level with implementing skills completed during the CE activity into clinical practice.

Athletic Trainer Preferences and Characteristics

Athletic trainers prefer to attend and participate in activities which are practical in nature, consequently aligning with adult learning theory principles (Armstrong & Weidner, 2010; Doherty-Restrepo, 2009). Armstrong and Weidner (2010, 2011) found that athletic trainers participated in informal CE activities more often than formal CE, but preferred formal activities due to the ability to receive credit. Within the category of formal CE, hands-on workshops were preferred but less commonly offered, and were perceived as having the greatest benefit to clinical skills (Armstrong & Weidner, 2010, 2011). Doherty-Restrepo et al. (2009) discussed the need for more athletic training CE opportunities that incorporate workshops and interactive programs, suggesting that athletic trainers perceived these activities as having the greatest practical applications. These findings are consistent in physical therapy and nursing indicating that hands-on CE activities were preferred by professionals and more effective than traditional seminar and lecture formats (Chau et al., 2012; Draganov et al., 2013).

Existing studies on perceived knowledge of emergency skills have not reported the presence of a relationship between reported perceived knowledge and health professional characteristics. Neil et al. (2018) reported the frequency of performing emergency skills experience for athletic trainers, emergency medical technicians, and dual credentialed providers, but they did not discuss the effects of characteristics on perceived knowledge. Armstrong and Weidner (2010) found that demographic data had no significant effect on the perceived effectiveness of formal or informal CE activities. Edler et al. (2015) found no significant difference between years of experience and actual knowledge of adjunct airway administration. These findings suggest that there is a gap in the existing literature regarding the influence of years of experience, job setting, and emergency experience on perceived knowledge of emergency skills.

Method

Study Design

This was a quasi-experimental study using a single group pretest-posttest design. The study, conducted in March 2020, evaluated athletic trainers' perceived knowledge of emergency management skills after participating in an interactive CE activity. Prior to the start of participant recruitment, the study was approved by the University of Indianapolis Human Research Protections Program (Minimal risk study # 01218; approved March 2, 2020).

Participants

A convenience sample of certified athletic trainers was recruited at the Great Lakes Athletic Trainers' Association (GLATA) Annual Meeting and Symposium in Wheeling, IL. This event was a networking and CE opportunity for certified athletic trainers and athletic training students (GLATA, 2019). During the GLATA symposium, there was an interactive lab during

which athletic trainers were given the opportunity to learn and practice emergency skills. To be included in the study an individual had to be an athletic trainer with up-to-date certification (self-reported), an attendee at the GLATA Annual Meeting and Symposium, and a participant in the skills lab offered during the GLATA Annual Meeting and Symposium. The following individuals were excluded from the study: 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.

To estimate the minimum sample size required to sufficiently power the study, G*Power 3.1 (Faul et al., 2009), was used. Based on conducting a paired *t* test to compare pretest Perceived Knowledge Questionnaire (PKQ) scores to posttest PKQ scores with an alpha of .05, effect size of .40, and power of .80, a minimum sample size of 52 total participants was required. To account for possible attrition, the minimum sample size was increased by 20% for a final minimum total sample size of 62. The effect size used for this study was based on previous studies utilizing a pretest and posttest PKQ scores. Eberman and Tripp (2011) reported an effect size of .45, based on a sample of 103 and Neil et al. (2018) reported an effect size of .64 based on a sample size of 726. For this study, a lower effect size of .40 was selected to be more conservative due to the smaller possible sample size.

Data Collection

Prior to data collection, participants were provided information about the study through an informed consent question in the survey (Appendix A). Participants were then given the option of giving consent, or opting out of the study. Demographic information, participant characteristics, and perceived knowledge were collected in Qualtrics® via computer, tablet, or smartphone. Participants who completed the surveys on their personal devices accessed the

survey page by scanning a quick response (QR) code or entering the website link. Researchers also had tablets with the surveys pre-loaded and available for participants who chose not to complete the surveys on their own device. After participants completed the pretest survey, they attended the skills lab at their scheduled time, or on a walk-in basis.

As participants exited the emergency skills lab, they had the opportunity to complete the posttest survey on a tablet or their own smartphone. Two hours following the end of the skills lab, participants were reminded via email to complete the posttest if they failed to complete it immediately at the conclusion of the intervention. Pretest and posttest surveys were linked by participant email addresses. The link to the posttest remained active for 12 hours following the clinical lab skills practice session.

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 four emergency skills: anaphylaxis, opioid overdose, diabetes and asthma (collected as four separate yes or no answers). Perceived knowledge was operationalized as the total score received on the PKQ. Participant email addresses, demographics, participant characteristics, and the pretest PKQ were collected at the same time, prior to the skills lab at the time of recruitment. At the end of the emergency skills lab, the posttest PKQ was collected. Demographic information, participant characteristics, and both pretest and posttest PKQ were collected using Qualtrics® software (Qualtrics, Provo, UT), an online survey platform.

Instrument

Perceived Knowledge Questionnaire. The PKQ used in this study (Appendix B) was a 20-item self-reported measure in which the items are scored on a seven-point Likert-like scale. The instrument is a variation of the subjective knowledge assessment tool which is designed to

be interchangeable between constructs and disciplines (Flynn & Goldsmith, 1999). Flynn and Goldsmith (1999) completed five studies in their development of the subjective knowledge assessment tool, demonstrating internal consistency (Cronbach's alpha = .88 - .92), test retest reliability (r = .79), criterion validity (r = .25), and construct reliability (r = .87-.93). The five studies that yielded these psychometric properties included several different constructs and content, expanding the generalizability of the instrument (Flynn & Goldsmith, 1999). These unique properties allowed the researchers of this study to insert the four emergency conditions as the content to be evaluated by the PKQ.

In athletic training, Flynn and Goldsmith's (1999) subjective knowledge assessment tool had been adapted by three previous studies to fit their content. Neil et al. (2018) used the instrument to demonstrate perceived knowledge of managing the spine injured athlete. Edler et al. (2015) implemented the tool to assess athletic trainer's knowledge of airway adjuncts; and Eberman and Tripp (2011) adapted the instrument to assess perceived knowledge of recognition, treatment, and management of exertional muscle cramping.

Procedures

Recruitment. Recruitment of participants began four days prior to the GLATA Annual meeting and the start of the emergency skills lab on the morning of March 12, 2020. Attendees of the meeting were asked to participate in the study if they intended to participate in the skills lab.

1) Individuals who signed up for the skills lab prior to the GLATA meeting were contacted via email (Appendix C) informing them of the intentions of the study and giving them the opportunity to begin their participation immediately via a link to the Qualtrics pretest survey. Emails were sent to potential participants on Sunday, March 8 and Tuesday,

March 10. The list of registrants and their email addresses were provided by the GLATA Education Committee.

2) The primary researcher (B. G.) and a research assistant recruited participants upon registration/check-in at the GLATA annual meeting on Wednesday, March 11. An easel displaying the survey flier (Appendix D), along with the survey QR code and website link, along with information about the study, was set-up adjacent to the registration area, where participants will be informed about the study and asked if they are interested in participating. Researchers also had tablets available with consent and surveys preloaded.
3) Prior to the start of the emergency skills lab activity, there was a one-hour lecture, entitled "Clinical Skills Primer", which prepared registrants for the interactive session. The researcher and research assistant verbally recruited participants for the study before and after the Clinical Skills Primer, and throughout the day at the entrance to the skills lab activity. An additional easel with the study flier was situated at the entrance/exit of the skills lab, so that participants could easily scan the QR code with their personal devices if they chose not to use the provided tablets.

Informed consent. Conference attendees who indicated interest in participating in the study, were provided a link to the online survey. The first page of the survey was the informed consent form (Appendix D). To complete the survey, potential participants read the informed consent and indicated their consent. Failure to provide consent did not allow participants to continue with the survey.

Incentives. Participation in the study was incentivized by offering participants the option to be entered in a drawing to win one of four $25 Amazon gift cards. Attendees willing to participate in the study had the option following the posttest survey to indicate whether they

wanted to be included in the drawing. The drawing took place at the completion of the study, and winners were notified via email. Gift cards were emailed directly to the winners following email correspondence.

Intervention. The GLATA Emergency Skills Lab was developed and administered by the GLATA Education Committee. The researchers of this study were not involved in the development or administration of the skills lab. The lab was conducted from approximately 10:00 a.m. to 5:00 p.m. on March 12, 2020, and each participant spent approximately 45 minutes participating in four 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 four skill stations.

The asthma station focused on signs and symptoms of an asthmatic emergency and the use of a peak flow meter, or how to use a toilet paper roll or similar item to substitute for a peak flow meter. The anaphylaxis station focused on the use of an Epi-Pen. 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 lab the posttest PKQ was completed.

Data management. Data were housed in the cloud-based University of Indianapolis (UIndy) Google shared drive on a secured server. Access to the UIndy Google suite is only available to UIndy employees and students, and only researchers for this study had access to the secured data. Data are securely stored and will be retained for a period of 3 years (Lin, 2009), at

which point it will be permanently deleted. Data were housed on a UIndy owned laptop with a secure login required to access data.

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to describe the sample and PKQ results. All comparisons were two-tailed and an alpha level less than .05 was considered to be statistically significant. Nominal data (job setting, and additional certifications, emergency experience) were presented as frequencies and percentages while normally distributed interval data (pretest and posttest PKQ scores) were reported as means and standard deviations and non-normally distributed ratio data (age, years of experience) were reported as medians and interquartile ranges. The Shapiro-Wilk test was used to determine normality of the data and the Levene's test was used to determine if there is equality of variance between groups for normally distributed interval and ratio data.

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, one-way ANOVA, and Spearman rho correlation tests were conducted, as appropriate. The interpretation of correlation coefficients was $r = 0$ - .25 - little or no relationship; $r = .25$ - .50 - fair relationship; $r = .50$ - .75 - moderate-to-good relationship; and $r >$ .75 - good-to-excellent relationship (Portney & Watkins, 2015). In addition, a two-by-two mixed design ANOVA was used to determine if there was an interaction between 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 (1992).

Due to low responses in the categories of two variables, professional certifications other than athletic training and job setting, some of the categories were collapsed. Responses to whether a participant held professional certifications other than athletic training were collapsed into "yes" or "no" categories. Job setting responses were collapsed into three groups: "athletics" (consisting of responses college athletics and secondary school), "academia" (consisting of responses college academics and college dual appointment), "clinical and outpatient" (consisting of responses public safety, administrative/rehab, occupational health, and physician practice). To determine if there was a difference in pretest PKQ scores between those who had any actual emergency experience and those who had none, a new variable "emergency experience" (yes/no) was created. Individuals who responded "yes" to at least one of the four emergency skills were categorized as having emergency experience while those who responded "no" to all four of the emergency skills were categorized as not having any emergency skills.

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 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 four emergency experiences, and overall emergency experience are displayed in Table 1.

To address the first objective of the 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), were statistically significant $t(80) = -8.62$, $p < .001$,) with a moderate correlation ($r = .66$). The statistically significant mean difference of 13.43 and a large effect size ($d = 0.91$) indicate that participants' PKQ scores were significantly higher following the clinical skills practice session.

To address the secondary study objective, pretest PKQ total scores were compared to each of the demographic and professional characteristics that were collected. There was a fair relationship between age and pretest PKQ scores ($r_s = .32$; $p = .004$) and between years of experience and pretest PKQ scores ($r_s = .33$; $p = .003$). Independent *t*-test results for participant background information and each of the four emergency experiences are displayed in Table 2. A one-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, $F(2, 77) = 2.27$, $p = .110$.

Two-By-Two Mixed ANOVA

For the following two-by-two 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 Levene's test of homogeneity and variances and Box's M test.

Additional certification. There was no statistically significant interaction between additional certification and PKQ scores from pretest to posttest, $F(1, 79) = 2.28$, $p = .135$, partial $\eta^2 = 0.03$. The main effect of time showed a statistically significant difference in mean PKQ scores at pretest and posttest, $F(1\ 79) = 53.56$, $p < .001$, partial $\eta^2 = 0.40$. The mean (standard

error) posttest PKQ score of 104.49 indicated that study participants had significantly higher PKQ scores after the CE activity compared to the mean pretest PKQ score of 92.09. The partial eta squared showed a large effect size. The main effect of group showed there was a statistically significant difference in mean PKQ scores between participants with and without additional professional certifications $F(1, 79) = 7.23$, $p < .001$, partial $\eta^2 = 0.08$. Participants with additional certifications, with a mean PKQ score of 13.17, had higher PKQ scores compared to the mean PKQ score of 93.42 for participants without additional certifications. Results indicate that study participants who had additional certifications had significantly higher perceived knowledge of emergency skills compared to 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. There was no statistically significant interaction between additional certification and PKQ scores from pretest to posttest, $F(1, 79) = 0.08$, $p = .785$, partial $\eta^2 = .001$. The main effect of time showed a statistically significant difference in mean PKQ scores at pretest and posttest, $F(1\ 79) = 42.05$, $p < .001$, partial $\eta^2 = 0.35$. The mean posttest PKQ score of 106.03 indicated that study participants had higher PKQ scores after the CE activity compared to the mean pretest PKQ score of 92.94. The partial eta squared showed a large effect size main effect of time. The main effect of group showed there was a statistically significant difference in mean PKQ scores between participants with and without actual anaphylaxis experience $F(1, 79) = 5.50$, $p = .022$, partial $\eta^2 = 0.07$. Participants with actual anaphylaxis experience, with a mean PKQ score of 104.53, had higher PKQ scores compared to the mean PKQ score of 94.44 for participants without actual anaphylaxis experience. Results indicate that study participants with actual anaphylaxis experience had significantly higher PKQ scores

compared to 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 main effect of group.

Diabetes experience. There was no statistically significant interaction between additional certification and PKQ scores from pretest to posttest, $F(1, 79) = 0.15$, $p = .703$, partial $\eta^2 = .002$. The main effect of time showed a statistically significant difference in mean PKQ scores at pretest and posttest, $F(1\ 79) = 70.95$ $p < .001$, partial $\eta^2 = 0.47$. The mean posttest PKQ score of 104.23 indicated that study participants had higher PKQ scores following the CE activity compared to the mean pretest PKQ score of 90.66. Partial eta squared showed a large effect size for main effect of time. The main effect of group showed there was a statistically significant difference in mean PKQ scores between participants with and without actual diabetes experience $F(1, 79) = 8.18$, $p = .005$, partial $\eta^2 = 0.09$. Participants with diabetes experience, with a mean PKQ score of 102.29, had higher PKQ scores compared to the mean PKQ score of 92.60 for participants without actual diabetes experience. Results indicate that study participants with actual diabetes experience had significantly higher PKQ scores compared to 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 main effect of group.

Asthma experience. There was no statistically significant interaction between asthma experience and PKQ scores from pretest to posttest, $F(1, 79) = 0.04$, $p = .843$, partial $\eta^2 = 0.04$. The main effect of time showed a statistically significant difference in mean PKQ scores at pretest and posttest, $F(1\ 79) = 73.32$, $p < .001$, partial $\eta^2 = 0.48$. The mean posttest PKQ score of 103.24 indicated that study participants had higher PKQ scores following the CE activity compared to the mean pretest PKQ score of 89.79. Partial eta squared showed a large effect size

for main effect of time. The main effect of group showed there was not a statistically significant difference in mean PKQ scores between participants with and without actual asthma experience $F(1, 79) = 3.90$, $p = .052$, partial $\eta^2 = 0.05$. Participants with actual anaphylaxis experience, with a mean PKQ score of 99.86, had higher PKQ scores, compared to the mean PKQ score of 93.17 for participants who did not have actual asthma experience, but this did not yield a statistically significant difference.

Overall emergency experience. There was no statistically significant interaction between additional certification and PKQ scores from pretest to posttest, $F(1, 79) = 0.13$, $p = .721$, partial $\eta^2 = .002$. The main effect of time showed a statistically significant difference in mean PKQ scores at pretest and posttest, $F(1\ 79) = 67.00$, $p < .001$, partial $\eta^2 = 0.46$. The mean posttest PKQ score of 101.70 indicated that study participants had higher PKQ scores following the CE activity compared to the mean pretest PKQ score of 88.42. Partial eta squared showed a small effect size for main effect of time. The main effect of group showed there was a statistically significant difference in mean PKQ scores between participants who had and did not have overall emergency experience $F(1, 79) = 7.94$, $p = .006$, partial $\eta^2 = 0.09$. Participants with actual overall experience, with a mean PKQ score of 99.87, had higher PKQ scores compared to the mean PKQ score of 90.25 for participants without actual overall experience. Results indicate that study participants who had overall emergency experience had significantly PKQ scores compared to 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 main effect of the overall experience group.

Opioid Overdose. There was a significant interaction effect for opioid overdose experience $F(1,79) = 5.37$, $p = .023$, $\eta^2 = 0.64$. The mean difference in pretest PKQ scores

between individuals with and without opioid experience was statistically significant 28.31 (p = .001) indicating that participants with opioid overdose experience scored significantly higher on the PKQ than those without opioid overdose experience. The mean difference in posttest PKQ scores of 12.60 between the groups was not statistically significant (p = .127) which indicates that while the posttest scores of participants with opioid overdose experience remained higher than participants without experience, the difference was not statistically significant.

Participants without opioid overdose experience had lower mean pretest PKQ score (88.17) compared to their mean score at posttest (102.40). The mean difference of 14.23 was statistically significant (p < .001). The mean difference of 2.00 between PKQ pretest and posttest for those with opioid overdose experience was not statistically significant (p = .770).

Interaction results show that before participating in the CE activity, those with opioid overdose experience perceived their knowledge of opioid overdose skills greater than participants without experience. Those 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.

Job Settings. There was a significant interaction effect for job settings $F(1,79) = 5.10$, p = .008, $\eta^2 = 0.12$. The mean difference between athletics and academics at pretest was 12.54, for athletics and clinical the mean difference was 0.18, and the mean difference between academics and clinical was 12.72. Bonferroni post hoc test results showed none of the comparisons were statistically significantly difference (p = .136, p = 1.000, p = .157, respectively). The mean difference between athletics and academics was at posttest was 1.30, for athletics and clinical it was 9.01, and the mean difference between academics and clinical was 10.31. Bonferroni post hoc test results showed none of the comparisons were statistically significantly difference (p =

1.000, $p = .055$, $p = .217$, respectively. The partial eta squared indicates a nearly medium effect size.

Participants working in athletics (mean difference 18.05, $p < .001$) and clinics (mean difference 9.21, $p < .001$) 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 (mean difference 6.80, $p = .113$).

Discussion

This study sought to address two specific research objectives with respect to athletic training CE and emergency skills: (a) to determine if a hands-on CE activity had an effect on athletic trainers' perceived knowledge of emergency skills, and (b) to determine if specific athletic trainer characteristics had an effect on their perceived knowledge of emergency skills. Limited research has been done on CE in athletic training, and this study is the first of its kind to explore how the implementation of adult learning principles in an interactive CE activity effect perceived knowledge. It is important to discuss how implementing these principles can influence the effectiveness of CE activities. Understanding how certain athletic trainer characteristics effect their perception of knowledge of these skills has the potential to assist CE programmers and educators for future CE development and marketing strategies. This study 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 impacts 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 which 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 research indicates that athletic trainers face numerous barriers when seeking CE such as costs and travel distance (Armstrong & Weidner, 2011), as well as time constraints and ability to implement skills learned (Edler & Eberman, 2019). Because of these challenges, it is important for all CE activities to not only 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 (Edler & Eberman, 2019).

Clinical Skills Practice and PKQ

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 lab. Results of the comparison indicate that study participants' perceived knowledge of the four 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 following this type of intervention. This study is unique as it is the only existing athletic training CE study to assess perceived knowledge with a pretest posttest design with an interactive 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 two CE activities with interactive techniques (Frank et al., 2020). 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 (Edler et al., 2015), knowledge, prevention, and management of

exercise induced muscle cramps (Eberman & Tripp, 2011), and management of spine-injured athletes (Neil et al., 2018). Results of this study differ from a study by Neil et al. (2018) who found a decrease in PKQ scores following an actual knowledge assessment and Edler et al. (2015) who found no difference between pre and posttest PKQ scores following 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, while 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 (Eberman & Tripp, 2011; Edler et al., 2015; Neil et al., 2018). Frank et al. (2020) found a significant increase in actual knowledge scores among participants in both in-person interactive and computer-based interactive intervention groups. However, the group which was given the opportunity to interact and have hands-on practice with the skills increased significantly more than the computer-based group (Frank et al., 2020). These findings are consistent with the existing literature regarding adult learning theory concepts and efficacy of continuing education (Davis, 1998; Forsetlund, 2009; Pitney, 2002).

Adult learning theory. The effectiveness of incorporating adult learning theory foundations into CE has been documented among other healthcare professionals such as nurses, physicians, and physical therapists (Davis, 1998; Forsetlund, 2009), but it had not been studied specifically in athletic training until a recent study by Frank et al (2020). Pitney (2002) theorized that athletic training CE should incorporate adult learning theory to maximize effectiveness. The intervention in this study utilized 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 (Armstrong & Weidner, 2010). The statistically

significant increases in PKQ score following 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 studies that suggests athletic trainers and other health care professionals such as physical therapists and nurses prefer hands-on CE activities (Chau et al., 2012; Draganov et al., 2013). These interactive activities have been discussed in the literature as traditionally being associated with non-formal CE, or those not approved for CE credit (Armstrong & Weidner, 2010; McLeod & McLeod, 2004). The significant PKQ change from pretest to posttest adds to the existing literature which advocates for the implementation of these types of CE activities.

Participant Characteristics and PKQ

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 four 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, while others displayed non-significant changes. While available research is largely limited, a few athletic training studies have incorporated participant characteristics into their research of perceived knowledge of emergency skills.

Age and years of experience. Participants' age and years of experienced displayed a significant but weak relationship to pretest PKQ scores (r_s = .32 and r_s = .33, respectively). Very little research has been done in this area, however there is one study (Edler et al., 2015) that discussed certain participant characteristics and their relationship to the use of airway adjuncts. Edler et al. (2015) found no difference in years of experience and the relationship to perceived knowledge of the use of airway adjuncts (N = 150, p = .98). The authors of this study expected

that younger athletic trainers', with less years of experience, would have had higher PKQ scores, as a result of more recent education and addition of diabetes and asthma as athletic training educational competencies in 2011 (BOC, 2011). To the contrary, there was not a strong relationship, possibly suggesting that more experienced athletic trainers have greater perceived knowledge as a result of increased experience. However, previous researchers (Edler et al., 2015; Neil et al., 2018) have demonstrated that this perception of adequate knowledge can be an overestimation, and that the actual skills and knowledge associated with that perception do not align.

Professional certifications. A number of 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 greater perception of knowledge. The results also suggest that these individuals with additional certifications may be more likely to have pursued continuing education on these topics previously, which would increase their perceived knowledge in those specific areas. While there is no existing evidence in athletic training on additional certifications and its effect on perceived knowledge of emergency skills, Neil et al. (2018) reported that dual-credential individuals scored higher on an actual knowledge assessment than other groups. Despite the lack of existing research in this area, literature in interprofessional education suggests that including individuals from a variety of healthcare disciplines has a positive effect on patient outcomes (Reeves, Zwarenstein, & Goldman, 2013). This finding suggests that this subset of participants has more experience with other professions,

which may contribute to their initially higher perceived knowledge of these emergency skills and subsequently higher scores at posttest.

Emergency experiences. Study participants' experiences related to each of the four emergency conditions addressed in the intervention had varying 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 continuing education 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 continuing education 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 two 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 over perception of knowledge. These findings are similar to previous studies in which perceived and actual knowledge were compared with previous use of emergency skills. Edler et al. (2015) found that athletic trainers who employed life-saving skills more often had higher actual knowledge scores than those who had not employed life-saving skills.

Opioid overdose experience. Participants with experience managing opioid overdose had significantly higher pretest PKQ scores compared to those without opioid overdose

experience, and a large effect size. This suggests 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 significantly significant increase in PKQ scores at posttest, while the group without opioid overdose experience demonstrated a significant increase in PKQ scores. This suggests that individuals with opioid overdose experience had an over perception 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 difference in pretest PKQ scores could be attributed to the fact that asthma can be managed by athletic trainers in both emergent and non-emergent 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. Lack of research on asthma management and continuing education 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 four emergency conditions had significantly higher pretest PKQ scores. Participants with and without experience in any of the four conditions had significant increases in PKQ scores from pretest to posttest. Similar to 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 (Edler et al., 2015).

Job settings. Participants' current professional job settings were recorded and they consisted of three groups: athletics, academics, and clinical outpatient. The athletics and clinical groups significantly increased their PKQ scores from pretest to posttest, while participants in academia did not demonstrate a significant increase. This finding suggests that participants in academia did perceive a significant benefit from the CE activity as compared to individuals in athletics and clinical settings. The effect size was nearly medium, indicating clinical relevance that the emergency skills session was less beneficial for individuals working in academia. These individuals, according to these findings, should be the target of those developing CE activities in the future, as they have the potential to get the greatest benefit from the activity.

There was no significant difference between the three groups at pretest. The authors 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 be able to educate students on these emergency conditions. However, the data collected did not produce the expected results with respect to pretest PKQ scores. This is consistent with Edler et al. (2015) who found no significant difference in actual knowledge among after stratifying sample by gender and employment setting.

In contrast, Neil et al. (2018) found that dual credentialed individuals, athletic trainers combined with either paramedic or emergency medical technician (EMT) credentials, had a higher knowledge with management of spine-injured athletes. This significant finding is likely due to the study's larger sample size with both single and dual credentialed individuals in the relevant fields: athletic trainer/EMT or athletic trainer/paramedic ($N = 29$) (Neil et al., 2018).

The current study utilized a small sample size ($N = 81$) and only had two individuals who worked in public safety, limiting the ability for statistical analysis.

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 lab. 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 Neil et al. (2018).

Another study limitation was the time between pretest and posttest PKQ and the potential for a recall effect. A majority of participants completed both the pre and posttest on the same day, 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 re-test reliability (Flynn & Goldsmith, 1999). The decision to utilize an immediate test retest method was based on previous athletic training studies (Eberman & Tripp, 2011; Edler et al., 2015; Neil et al., 2018) who utilized a pretest, 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. Previous athletic training studies (Eberman & Tripp, 2011; Edler et al., 2015; Neil et al., 2018), 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 four conditions. These limitations allow for numerous opportunities for future research.

Implications for Future Research and Continuing Education

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 studies can use evidence provided to develop studies incorporating actual knowledge assessments for specific topic areas. While this study did not assess actual knowledge, previous studies 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 (2011), Edler et al. (2015), and Neil et al. (2018) 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. (2015) found a poor positive relationship between perceived and actual knowledge. Consistently, Eberman and Tripp (2011) found a poor significant correlation while Neil et al. (2018) found a poor and insignificant relationship between perceived and actual knowledge. Additionally, Eberman and Tripp (2011) found that pretest knowledge gap (difference between perceived and actual knowledge) was a significant predictor of posttest knowledge gap.

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

Conclusion

The interactive CE activity, which utilized adult learning theory principles, had a significant effect on PKQ scores. This demonstrated that the implementation of adult learning theory concepts can have a positive impact on perceived knowledge of the management of specific emergency conditions. This study 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 perceived knowledge of relevant emergency conditions. This study has 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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Table 1

Participant Background Information and Emergency Experience (*N* = 81)

Characteristic	***N* (%)**
Job Settings	
Athletics	41 (51.3%)
Academics	10 (12.5%)
Clinical	29 (36.3%)
Additional Certifications	
Yes	23 (28.7%)
No	57 (71.3%)
Anaphylaxis Experience	
Yes	15 (18.5%)
No	66 (81.5%)
Opioid Experience	
Yes	4 (4.9%)
No	77 (95.1%)
Diabetes Experience	
Yes	31 (38.2%)
No	50 (61.8%)
Asthma Experience	
Yes	38 (46.9%)
No	43 (53.1%)

Overall Experience	
Yes	51 (63.0%)
No	43 (37.0%)

Table 2

Comparison of Pretest PKQ Scores by Participant Background Information ($N = 81$)

Characteristic		***Pretest PKQ Score***		**Effect Size**
		***N* (SD)**	***p***	**(Cohen's *d*)**
Additional Certifications			.012*	0.68
	Yes	98.43 (20.29)		
	No	85.95 (15.72)		
Anaphylaxis Experience			.036*	0.58
	Yes	98.27 (19.80)		
	No	87.62 (16.92)		
Opioid Experience			< .001*	1.76
	Yes	117.00 (15.98)		
	No	88.17 (16.84)		
Diabetes Experience			.025*	0.52
	Yes	95.19 (18.48)		
	No	86.12 (16.69)		
Asthma Experience			.109	0.36
	Yes	92.97 (19.19)		
	No	86.60 (16.21)		

*$p < .05$

Appendix A

Informed Consent

University of Indianapolis Doctor of Health Sciences Program

KEY INFORMATION FOR POTENTIAL RESEARCH PARTICIPANTS

We know that athletic training and health care continuing education often fails to meet the needs of its participants. This study will investigate the effects of a hands-on continuing education activity for emergency skills on athletic trainers' perceived knowledge. There are 20 pre-test and 20 post-test survey questions, along with 4 demographic and characteristic questions. Combined, both tests should take approximately 10 minutes to complete. There are no direct benefits for your participation, but your participation will help with this research. In appreciation, you will have the option enter a drawing for one of four $25 gift cards. The study is completely voluntary, and you are not expected to participate if you feel uncomfortable doing so. If you would like to volunteer for the study, please read the information below prior to beginning the questionnaire.

CONSENT TO PARTICIPATE IN RESEARCH STUDY

STUDY TITLE: Emergency Skills in Athletic Training: Perceived Knowledge and Continuing Education

PRINCIPAL INVESTIGATOR: Paul Salamh, Ph.D.

CONTACT DETAILS: Tel: 1 (317) 788-3379

Email: salamhp@uindy.edu

STUDENT INVESTIGATOR: Brian Gerlach, ATC

CONTACT DETAILS: Email: gerlachb@uindy.edu

PURPOSE AND DURATION: This study involves research on perceived knowledge of athletic trainers. The purpose of this study is to see if there is a difference in athletic trainers perceived knowledge after the clinical skills practice session, and to see if athletic trainer characteristics affect perceived knowledge. We hope that this study will provide information to guide future continuing education programming. We expect that the pre-test and post-test questionnaires will take approximately 10 minutes of your time.

PROCEDURES: You will be responding to 4 questions about your demographics and professional characteristics, along with a 20 question Perceived Knowledge Questionnaire before and after the Clinical Skills Practice Session.

RISKS AND DISCOMFORT: There are no foreseeable risks or discomfort associated with this study.

BENEFITS: There are no direct benefits to you, but your participation will help us with our research and is greatly appreciated.

COMPENSATION: You will not receive any compensation for participating in this study, but in appreciation, you will be given the option to enter a drawing for one of four $25 gift cards.

CONFIDENTIALITY: Any information that is obtained in connection with this study that can identify you will remain confidential. The results of this study will be used for presentation of my doctoral research project. However, your name and other identifiers will not be used.

FUTURE RESEARCH: It is possible that de-identified data from this study could be used for future research or shared with other researchers for use in studies, without additional informed consent. De-identified means that any codes and personal information that could identify you will be removed before the data is shared.

WITHDRAWAL OF PARTICIPATION: Your participation is voluntary. Should you decide at any time during the study that you no longer wish to participate, you may withdraw your consent and discontinue your participation.

REQUEST FOR MORE INFORMATION: You may ask more questions about the study at any time. Please e-mail the principal investigator at psalamh@uindy.edu or call either 1 (317) 788-3379 with any questions or concerns. In addition, if you have questions about your rights as a participant or any other pertinent questions, you may contact the Human Research Protections office by either emailing hrpp@uindy.edu or calling 1 (317) 781-5774 or 1 (800) 232-8634 ext. 5774.

CONSENT: Below you will be prompted to select, "Yes, I voluntarily consent to participation and wish to proceed" or "No, I do not consent to participation and am exiting the questionnaire."

Appendix B

Perceived Knowledge Questionnaire (PKQ)

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

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

*Item was reverse scored

Appendix C

Recruitment Email

Hello and thank you for Registering for the GLATA 2020 Clinical Skills Practice Session. My name is Brian Gerlach, and I am a doctoral student at the University of Indianapolis. I am writing to invite you to participate in my doctoral research project entitled "Emergency Skills in Athletic Training: Perceived Knowledge and Continuing Education."

Participation in the study should take a total of 5-10 minutes, including pre and post-tests. Data collection will consist of a perceived knowledge pre-test with demographic and professional characteristics survey, and a perceived knowledge post-test. Participation in this study is completely voluntary. The study will investigate the effects of the hands on continuing education as well as the effect of demographic and professional characteristics on perceived knowledge of emergency skills.

By participating in the study, you will be eligible to enter a drawing to win one of ***four $25 Amazon gift cards!!!*** To participate, please click the link below and you will be taken to the demographic survey and pre-test.

Pre-Test Link

https://uindy.co1.qualtrics.com/jfe/form/SV_7W1M3VQ2RKlLVM9

or

https://tinyurl.com/re65xtt

Post-Test Link

https://uindy.co1.qualtrics.com/jfe/form/SV_8zSJkgq5cALYn65

or

https://tinyurl.com/tftnzl7

If you have any questions about the study, please contact Brian Gerlach, gerlachb@uindy.edu.

Thank you!

Brian Gerlach

Doctoral Student

University of Indianapolis

Appendix D

Recruitment Flier