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ORIGINAL RESEARCH

# Professional Preparation Regarding The Recognition And Treatment Of Exertional Heat Stroke: The Student Perspective

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**Context:** Current evidence suggests rectal temperature($T_{re}$) and cold-water immersion (CWI) are the most effective means to diagnose and treat exertional heat stroke (EHS), respectively. Educators, clinicians, and students should be apprised of this evidence to guide their practice.

**Objective:** Investigate what athletic training students (ATS) are learning regarding EHS, both in the classroom and clinical settings that may one day influence their practices as athletic trainers (AT).

**Design:** Qualitative design using in-person focus groups.

**Setting:** National meeting in San Antonio, Texas, 2009.

**Patients or Other Participants:** Thirteen rising senior ATS in a Commission on Accreditation of Athletic Training Education (CAATE)-accredited athletic training education program.

**Data Collection and Analysis:** Interviews were transcribed verbatim and analyzed using open coding techniques. Peer debriefing and multiple-analyst triangulation were used to ensure trustworthiness of the data.

**Results:** Two higher order themes emerged from the data analysis: Lack of Experience and Educators' Influence. Lack of Experience summarizes the ATS lack of exposure, both in the classroom and in the clinical setting regarding the skills associated with EHS. It was apparent that the participant's lack of understanding of EHS was a direct result of a lack of time spent with the topic. The higher order theme of Educators' Influence highlights the role that educators play in influencing and shaping ATS retention of materials, competence, and future practice beliefs regarding EHS.

**Conclusion:** A cyclic reaction occurs with regards to EBP that directly influences ATS. Until the cycle is broken, ATs will continue to struggle implementing best practices identified from research into clinical practice.

**Key Words:** teaching style, sudden death, pedagogy

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# Professional Preparation Regarding the Recognition and Treatment of Exertional Heat Stroke: The Student Perspective

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We know that athletic training students (ATS) are diverse learners, with no one dominant learning style,[1-4] and require an authentic educational experience, which encompasses hands-on instruction with appropriate feedback, for the development of skill competence[3] and critical thinking skills.[3,5-6] athletic training education programs (ATEPs) often utilize both formal classroom instruction and clinical practicum experiences as means of educating the ATS. Combined didactic and clinical education provide the ATS with the opportunity to learn and understand the cognitive knowledge presented in the classroom, while having the ability to implement this knowledge into clinical practice occurs through supervised clinical experiences. Additionally, the clinical education component, which has been cited as the most crucial for student development,[7] serves as the conduit to formal, structured learning. These clinical experiences allow the ATS to, under supervision, critically apply their knowledge.[8-9] To facilitate this process, educators often depend upon teachable moments, which take advantage of real-world experiences and allow the ATS to demonstrate, in a real-time, knowledge and skill understanding.[6,10] Unfortunately, not all clinical skills, as outlined in the National Athletic Trainers' Association (NATA) Education Competencies, can be evaluated or practiced in a real-time setting. Regardless of their frequency of occurrence in clinical practice, those psychomotor skills and clinical competencies must be taught and evaluated during an ATS's educational experiences.[11]

Management of a cervical spine injury, exposure to a blood-borne pathogen, or performing CPR on an unconscious athlete are all examples of infrequently occurring events in athletic training. Despite this, ATS must be prepared to handle these situations, and ATEPs must provide learning opportunities, although contrived, to allow for a degree of realism in the student's learning process. Evaluating and managing a case of exertional heat stroke (EHS) is another example of an infrequently occurring medical emergency situation. Although the opportunity to demonstrate and apply the appropriate knowledge and skills associated with EHS in a real-life situation is limited, it does not mean that the ATS should not be afforded the opportunity to do so in a formal learning environment. Since 1995, an estimated 33 deaths have resulted from EHS within the confines of high school and college sport;[12] an unfortunate finding, as the condition is preventable and, recognized, easily treated via cold water immersion (CWI).[13-16] The condition is often a leading cause of sudden death in sport and was estimated as the second leading cause of death during the months of July and August.[12] Recognizing the fatal consequences of the condition, there has been an influx of research conducted in the area, including validation of core body assessment devices[17-18] and treatment measures.[19-20] In 2002, the NATA released a position statement on Exertional Heat Illnesses, which outlines proper assessment and treatment methods.[13] The American College of Sports Medicine (ACSM) position statement on exertional heat illnesses during training and competition, released in 2007, also outlines proper assessment and treatment methods.[14] Based on the most current literature, the NATA and ACSM recommend assessing core body temperature via rectal thermometers ($T_{re}$) and treatment with rapid cold water immersion, CWI.[13] Emerging data continually supports these recommendations.[13-16]

Athletic trainers understand that $T_{re}$ assessment is the most accurate estimate of core body temperature and that CWI is the most appropriate cooling modality.[21] Despite possessing accurate knowledge regarding these measures, ATs continually choose to use other assessment and treatment methods.[21-22] It appears as though a lack of formal instruction with appropriate feedback impedes the AT from feeling competent with the skill.[22] Korner-Bitensky et. al.[23] found that the most common reason clinicians implemented or selected a treatment technique was because they had previous training with the skill prior to actual use in a real-time setting.[23] This concurs with the previous study[21-22] which found that a lack of formal training or expertise in use of $T_{re}$ and CWI was a barrier to implementation in clinical practice. The perspective, although important, was from the practicing clinician, not the student currently engaged in formal educational training. For this reason, we chose to study the ATSs' perspective of current learning regarding EHS. The NATA Educational Competencies[11] encourage athletic training educators to incorporate the information presented in the position statements and consensus statements into their curricula. Athletic training students, regardless of the topic, should be receiving up-to-date information, but especially regarding EHS because of its seriousness and treatability. However, with previous literature citing a lack of formal training in the skills recommended,[22-23] it appears ATSs' experiences will shape their future professional actions. The objective of this research project was to investigate how ATEPs are preparing the ATS to recognize, assess, and treat a potential case of EHS. Special attention will be given to the level of understanding of the condition, comfort level the ATS possesses regarding the condition, and the likelihood of implementation of evidence-based practice (EBP) regarding $T_{re}$ and CWI.

## METHODS

### Design

In-person focus group sessions were employed to investigate the educational preparation of the ATS in regard to EHS. This was part of a broader purpose to explore the documented gap between actual clinical practice and the recommended practices regarding the recognition and treatment of EHS. This research design was selected for several reasons, including: providing specific examples of educational experiences encountered by the sample population, documenting benefits for in-depth exploration of a specific topic area with previously obtained data, and uncovering attitudes and beliefs of a particular population.[24-25] Qualitative data, specifically focus group sessions, can also provide enriched data due to the similar/shared backgrounds and common educational experiences[24] of the group, which can enhance discussions and willingness to share.

**Participants**

Thirteen students (8 male and 5 female) entering their final year [termed rising seniors] within a Commission on Accreditation for Athletic Training Education (CAATE)-accredited ATEP participated in this study. Their average age was 22 $\pm$ 2 years, and 5 NATA districts were represented. Table 1 provides individual participant information. A criterion sampling consisting of rising seniors were pre-determined to provide an appropriate population to answer the research questions. The rising senior would have taken a majority of the courses related to emergency care, clinical evaluation and diagnosis, and acute management as well as completed a variety of clinical experiences needed to help truly determine their educational exposure to EHS. Criterion sampling has been shown to improve quality assurance.[24] Programs are afforded autonomy surrounding curriculum design, and students may not all be exposed to EHS concepts at the same time; however, rising seniors should have had the most learning opportunities related to EHS in the classroom and clinical experiences without the influence of post-graduation influences or training. Data collected in the background questionnaire confirmed that all the participants had covered EHS in the classroom setting.

Using a convenient[24] and snowball[24] sample, the participants were recruited at the NATA's annual meeting in 2009. Due to the non-existence of a national database of all students enrolled in CAATE accredited programs, convenience sampling was used to identify students already in attendance at the NATA's annual meeting. Program directors were sent a recruitment letter explaining the study's purpose and data collection procedures via email to help solicit initial recruitment of students. Once a student meeting the pre-determined criterion was contacted, we used snowball sampling to help contact and recruit other students who fit our criterion.[24]

**Setting and Insrumentation**

The focus group sessions took place at the NATA's annual meeting in 2009. The semi-structured interview guide was developed based on the existing literature of EHS,[13-20] lack of implementation of EBP,[21-23] and the researchers' knowledge of EHS. A panel of experts (n=5) who consisted of heat and hydration researchers, AT educators, and a practicing AT reviewed the instrument for clarity and interpretability. The experts were selected based upon their scholarly record, years of experience as an educator and/or clinician (>10 years), and knowledge of EHS. Prior to data collection, the school's Institutional Review Board approved the study and a pilot study was conducted with a small group (n=3) of ATSs in the same CAATE accredited program. The data generated from the pilot study was not used in data analysis, but rather to ensure clarity and flow of the focus group session. Only minor changes and revisions were made to the interview guide.

**Data Collection Procedures**

Three focus group sessions were necessary to reach data saturation with 4-5 ATSs in each session. In each focus group session there were 2 researchers, including the moderator and 1 note-taker. Before entering the interview room, participants completed a background questionnaire and completed the consent forms. Data collected from the background questionnaire included general participant information, sequencing of courses related to EHS at their home institution, and awareness of and comfort level regarding the recognition and treatment of EHS. Comfort level was scored on a 10-point Likert scale ranging from not comfortable (1) to very comfortable (10). All sessions followed the interview guide as previously described in the setting and instrumentation section. Along with note taking, audio and video recordings were used to ensure accuracy with the transcription process. Note taking and audiotaping are traditional methods used during interview sessions to ensure accuracy and aid with data analysis. The third method, videotaping, was added to distinguish between focus group participants.[24-25,38] All focus group sessions were transcribed verbatim by one member of the research team.

**Table 1.** Individual Participant Background Information

| Participant | Gender | Age | NATA District | Academic Year | Covered EHS? | Aware of the position statement |
|---|---|---|---|---|---|---|
| Mary | F | 21 | 4 | Senior | Yes | Yes |
| Laura | F | 20 | 4 | Senior | Yes | Yes |
| Harry | M | 21 | 4 | Senior | Yes | Yes |
| Mike | M | 21 | 2 | Senior | Yes | Yes |
| George | M | 23 | 2 | Senior | Yes | Yes |
| Courtney | F | 23 | 6 | Senior | Yes | Yes |
| Don | M | 21 | 5 | Senior | Yes | No |
| JT | M | 21 | 5 | Senior | Yes | No |
| Sara | F | 22 | 5 | Senior | Yes | No |
| Sean | M | 22 | 1 | Senior | Yes | Yes |
| Tyler | M | 23 | 1 | Senior | Yes | Yes |
| Carl | M | 21 | 1 | Senior | Yes | Yes |
| Sue | F | 26 | 1 | Senior | Yes | Yes |

### Data Analysis and Trustworthiness

Data analysis procedures were guided by borrowing concepts from both Strauss and Corbin's[26] grounded theory approach and inductive content analysis.[27] Three researchers independently reviewed the transcripts to identify commonalities, a step utilized to ensure accuracy and reduce researcher bias during data interpretation.[24,28] The researchers' backgrounds included expertise in the field of athletic training and EHS and in qualitative research methodologies and analysis. Moreover, 1 of the researchers had more than 7 years of qualitative research experience. When an emerging theme was identified, a conceptual tag (category) was assigned to capture its meaning.[24-25] Once initial coding was compleleted, the categories were organized into lower-order themes,[28] and consistent with content analysis, all lower order themes were grouped together to derive the higher order themes.[28] Once the initial data analysis process was complete, the 3 researchers shared their findings to validate the study's findings. The researchers were in agreement with the study's emergent themes, and no changes were made to the analysis or the model derived. Several steps were included to establish credibility of the findings, including multiple analyst triangulation (as previously outlined in the data analysis section) and data-source triangulation. Data source triangulation was verified by utilizing multiple means of data collection, in this case a short background questionnaire and the focus group sessions. Also, the students who participated in the study represented a regionally diverse sample, helping to ensure the validity of the findings.

## RESULTS

Results revealed that there is a failure to provide the ATS with the appropriate educational experiences as related to the NATA and ACSM recommendations for recognition and treatment of EHS. Specifically, two higher ordered themes emerged from data analysis to capture this dichotomy between the scientific evidence and clinical practice. These higher order themes were: 1) *Educator's Influence* and 2) *Lack of Experience*. The higher order theme of Educator's Influence was developed by two specific lower ordered themes: 1) *Classroom Instructor* and 2) *Clinical Instructor.* Lack of Experience was derived from 2 specific lower ordered themes: 1) *Classroom Learning* and 2) *Clinical Education*. Figure 1 illustrates this relationship.

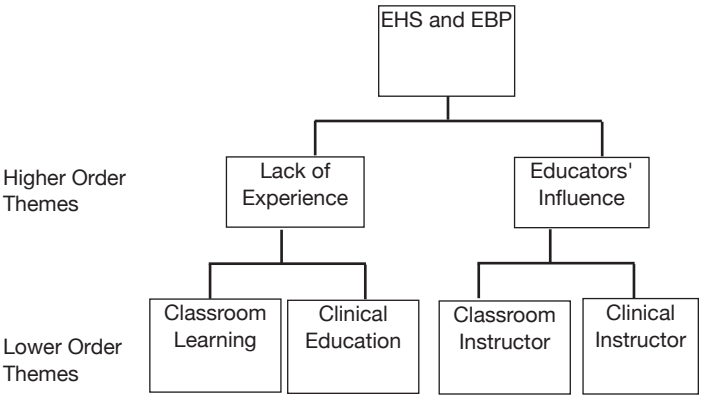


**Figure 1**. The relationship between factors influencing ATS learning experiences regarding EHS.

### Educators' Influence

The first higher ordered theme, educators' influence, highlights the role the educator plays in influencing and shaping an ATS's retention of materials, competence, and future practice beliefs regarding EHS. This theme is comprised of two lower-order themes, which describe the influence that both the classroom and clinical educator can have on student learning. The educators' decisions regarding materials and knowledge shared directly impacted the student's learning experience regarding EHS. The quotes presented below also highlight the misgivings associated with differentiating an EHS with other heat-related illnesses, which speaks to the information being delivered by the ATEP faculty and clinical instructors.

### Classroom Instructor

Classroom instructors, whether in the role of full-time faculty or dual position (both classroom instructor as well as clinical athletic trainer), make decisions regarding the information that is presented in the classroom setting. Based upon the data, it appears as though many of the athletic training educators are not providing the students with enough accurate information or utilizing appropriate teaching methods to encourage knowledge acquisition and skill competence regarding EHS. Although 10 of the 13 students were aware of the NATA's Position Statement on Exertional Heat Illness and 9 had read it, the students were only moderately comfortable with the information presented in the statement. When asked on a 10-point Likert scale, where 1 represented least comfortable and 10 most comfortable. Courtney replied, "I may have read it [NATA Position Statement], but it has been awhile since I've reviewed it." Sara bluntly said, "I don't know what their [NATA] position is [regarding EHS]."

The data collected from the student's perspective indicated that the educator placed less emphasis on the skill sets related to EHS, and there was often limited hands-on training included with the lecture. Also gathered from the data was a failure of the educator to stress the importance of the information presented in the position statement, which implied to the student that the recommended methods and/or the condition are less than important compared to commonly utilized techniques, such as oral or tympanic devices for temperature assessment or ice bag application for treatment. This influence is illustrated by George's comments when asked what could be done to improve their education regarding EHS, he said,

> *"I don't think we really go into as much depth regarding recognition and care, as much as we go into the signs and symptoms [of the condition]. [More focus needs to be placed on] … what you should do if you want to lower the body temperature and monitor vitals [and temperature]. But they don't really get into all the different things [equipment] you have at your disposal [to diagnosis and treat], here's different ways you can use it."*

JT explained that, "Maybe like a run-through, a scenario where you have this athlete, then someone videotapes it, then someone critiques it" would increase his comfort level with EHS, as they have done with other scenarios including spine boarding and other techniques. He went on to explain, "We've done a drowning, we've done stuff on the football field, I think that would be a really good way."

The students in this study were also misinformed regarding the signs and symptoms of EHS and the efficacy of oral and tympanic temperature assessment devices as compared to other devices. Seven students said that sweating cessation would be one of the biggest indicators of heat stroke, over heat exhaustion, in a differential diagnosis. Courtney specifically stated, "My main [criteria] would be if they're not sweating at all. Like it's a hot and humid day and they're not sweating." When discussing temperature assessment, George specifically stated, "For a true temperature then you don't want to go by the mouth because there's a lot of extra factors but at the same time, it's much quicker. It's easier to get at and you know just varying by 2 to 4 degrees depending on the situation."

**Clinical Instructor**

Often the ATS observed their clinical instructor utilize means other than $T_{re}$ and CWI to diagnosis and treat cases of EHS, which contradicts what is outlined in the position statement,[13-14] but reinforced what was being didactically presented in formal learning situations. Sue described what would be done at her clinical site to assess the temperature of an athlete with suspected EHS, "We'd probably do tympanic. We would definitely take something [get a temperature reading]. We know that [the device we select] it is not the most reliable but we wouldn't avoid getting an assessment." JT explained what would be done at his clinical site for the treatment of an athlete with EHS: "It depends on the level of consciousness I think. If he were unconscious I would leave him on the field and just get ice bags".

Students were also unaware of policies and tools available to them at their clinical site for the assessment and treatment of EHS. When asked about the specific emergency action plan (EAP) at their sites JT, Mary and Don said, "None," and Courtney stated, "I don't believe we have any." Along the same lines, students were also unsure if they had a $T_{re}$ that was available for them to use. When specifically asked if they had a $T_{re}$, Laura said, "I'm not really sure," and Mary echoed the same feelings, stating, "If we have one I've never seen it. We know where the other ones are, but it may be there." The clinical instructors' lack of use of EBP during the clinical education experience limited the exposure of the ATS to $T_{re}$ and CWI and decreased their comfort level to these techniques. Furthermore, it highlights the disconnect that exists between the NATA's position statement recommendations and implementation into everyday practice.[21-22]

**Lack of Experience**

The higher ordered theme of lack of experience summarizes the ATS's lack of exposure, both in the classroom and in the clinical setting, to $T_{re}$ and CWI. This encompassed all facets of the students' educational experiences, including a failure of the educator to utilize classroom time to practice the skills of $T_{re}$ and CWI, their limited exposure to an actual EHS, a lack of classroom activities, such as real-time scenarios or case studies to aid in critical thinking and application, and limited resources in the classroom and/or clinical setting related to $T_{re}$ and CWI. Although classroom learning and clinical education opportunities offer different styles for student learning, it is evident that the participants' lack of understanding of EHS was a direct result of a lack of time spent with the topic, regardless of the learning environment.

**Classroom Learning**

The ATS were given the basic cognitive knowledge regarding EHS, which included the signs and symptoms, prevention strategies, temperature assessment devices, and treatment options. Some of the information related to the differential diagnosis of the condition and accuracy of some temperature devices disseminated to the ATS, however, was inaccurate. In addition to some of the misgivings learned in the classrooms, the ATS's lack of hands-on learning also limited their development of clinical competency and confidence with the appropriate diagnostic measures and treatments associated with the condition. When asked how comfortable they were with assessing the core body temperature of an athlete, Sue replied, "Not at all, just because we haven't learned it." Mike echoed the same feeling by stating, "I know our NATA position statement is to do it rectally…. but as far as doing a rectal temperature, we were taught it but we've never . . .[actually done it]". Don also reinforced this theme when discussing if they were specifically taught to take a rectal temperature, "We talk about it; we don't do it [in the classroom]." The previous quotes speak to the importance of pairing student-learning activities with the content being delivered. In this case, the lack of hands-on experience in the classroom hindered the students' ability to gain competence, recognize the importance of the skill, and gain confidence in the skills they were taught to be most appropriate.

**Clinical Education**

Clinical education experiences are designed to compliment and reinforce the skills students learn in the classroom setting by providing additional time for practice. However, for this group of participants, it appears as though the opposite is happening in regards to the skills associated with the assessment and treatment of EHS. First, like other high-risk, medical emergency conditions, the opportunities to treat a patient with an actual EHS are limited. Mary simply stated, "I've never seen a heat stroke. All I've seen is heat exhaustion or heat syncope." Similarly, when specifically asked if they have ever had an athlete suffer from EHS, Carl, Tyler, Sue, and Sean all said, "Nope, I've never seen a heat stroke." Only 2 indicated they had exposure to an actual case of EHS. This lack of exposure created a sense of trepidation with their comfort level in handling a case of EHS. This is supported by the participants' responses on the background questionnaire regarding their readiness to assess a case of EHS, in which they rated their comfort level as 6 on a Likert Scale from 1 (least comfortable) to 10 (most comfortable). The lack of real-time exposure in the clinical setting also facilitated a lack of practice time with the skill sets associated with handling a potential case of EHS. Courtney said, "We've talked about it [$T_{re}$], but we've never done it [in the clinical setting/classroom]. I've never seen it [utilized clinically] either." Courtney's comments are reinforced by the data generated by the responses of the participants, when asked about their comfort and skill level with obtaining a $T_{re}$, as the mean was 3±2. The participants however, did feel more comfortable with treating a potential case of EHS, with a mean score of 7±3.

The participants recognized opportunities for real-time exposure to EHS would be limited, but many felt there are ways to increase their comfort level with the condition in the clinical setting. Overwhelmingly, the ATS felt they needed more hands-on, structured classroom, and clinical time. Sean specifically stated, "Practice, practice, practice." JT agreed by stating, "If I were the

head athletic trainer, I would improve the information kids get or how often they get it. Because the only time we ever really covered it in a class was a year and a half ago." Sue thoroughly explained this same idea by saying, "Maybe like a run-through, a scenario where you have this athlete, then someone videotapes it, then someone critiques it." Guaranteeing that an ATS's experience the assessment of a EHS is nearly impossible for an ACI, however the ATS' desire for practice scenarios does support the need for more hands-on education, whether this take place in the classroom or the clinical setting.

## DISCUSSION

The impetus for conducting this study grew from a previous study[21] which suggested that an athletic trainer's apprehension to utilize recommended assessment methods and cooling techniques for a suspected EHS centered on a lack of comfort with those devices, as well as misconceptions surrounding those methods.[21] Since ATS' skill competence and confidence often begin with their professional preparation and is directly influenced by these educators and practicing ATs, we chose to assess student perspectives on this topic.

The two higher order themes demonstrated the importance of both classroom learning and clinical application of knowledge and skills for an ATS to be comfortable with the assessment and treatment of EHS. They also illustrated the strong influence both AT educators and clinical instructors have on their students' understanding and practice beliefs. The Kolb Experiential Learning Theory reinforces this relationship, explaining that learning is a combination of knowledge and the experience of applying that knowledge.[35-36] The two must complement each other, and one cannot be lacking without negatively affecting the students' educational experience. Consistent, up-to-date information regarding the assessment and treatment of an athlete with suspected EHS should be presented to students in both the classroom and clinical settings.

### Educators' Influence

Athletic trainers are educators, regardless of whether it is in a formal classroom or clinical setting. Therefore, their actions can directly impact and influence the students' beliefs and future behaviors. The professional education for an ATS is continually developing and changing.[11,37-42] As the professional responsibilities and roles of an AT have evolved, so have the requirements and standards established by CAATE and the NATA's Education Competencies.[11,37-40] As the profession transitions to an EBP-centered patient care approach and continues to establish its position among allied health care professions, professional athletic training preparation will have to improve to meet the field's expectations. The 5th edition of the NATA education competencies was recently released, and for the first time, $T_{re}$ and CWI are included as mandatory skill sets to be instructed to the ATS. These changes, although monumental, are not required to be in place until 2013. Although the NATA education competencies have grown to reflect advancements in EHS recognition and treatment, current ATSs are held to the older 4th edition standards which do not include those skills. Moreover, these students' educators and clinical instructors, who are responsible for curricular development and mentorship, were held to even older and more different educational guidelines which did not include learning or using $T_{re}$ and CWI.[11] In theory, a lack of formal training should not thwart an educator from providing skill instruction in various areas. However, in this case, it appears that it may impact their ability to do so, as they could feel ill-prepared to provide appropriate instruction and feedback on the skill sets.[43] Despite this, it is the job of the athletic training educator, as either the classroom or clinical instructor, to stay up-to-date on the current research and guidelines which govern the education of an ATS.[44] This demonstrates life-long learning and professional development in adherence to the codes set forth by both the NATA and Board of Certification (BOC). Additionally, it is paramount that the athletic training educator, when developing course materials, ensures that the learning objectives are delivered with the most appropriate instruction methods. Otherwise, integration and retention may not be possible.[3, 5-6,35-37] This theory of inappropriate instructional methods utilized by the educator is most definitely visible by the results presented in this manuscript as well as the existing data.[21, 43, 45]

### Classroom Educators

From the classroom vantage point, the ATS appears to be receiving limited information about the current literature regarding EHS. This limited or misguided information was evident in all areas of EHS management, from improper signs and symptoms for the differential diagnosis, to invalid temperature devices and ineffective cooling methods. As discussed in a recent paper, an accurate estimate of core body temperature via $T_{re}$ is one of the few ways to determine the difference between a case of heat exhaustion and EHS.[46] Although the level of consciousness and response to more conservative treatment can guide the assessment towards heat exhaustion, studies have shown that time is of the essence in a case of EHS.[13-16,19-20,29,31,49-53] Proper assessment and rapid cooling is key to survival, and a dangerously elevated core body temperature could prove to be fatal.[13-16,19-20, 29,31,49-53] The fact that the majority of the students would still utilize cessation of sweating as a key diagnostic tool to identify the presence of EHS clearly shows that the chasm between the medical research literature and clinical practice is slow to close. The fact is that most EHS victims are still sweating at the time of collapse. The population we studied may mistake this for heat exhaustion and delay treatment.

Many ATSs acknowledged the importance of activating emergency medical services (EMS) as an important step, but the irony of EHS care is that immediate, on-site, and aggressive cooling is the most critical step in the acute treatment of EHS ("cool-first, transport second"[15 p. 331]). It is imperative, that from the moment EHS is identified, that aggressive cooling occur. Once the EHS patient is cooled, then transport to an emergency room is warranted. The decision to transport without proper diagnosis can prove to be fatal in some cases.[47] The proper assessment of an athlete's core body temperature can often be the only differential diagnosis between several conditions, both life-threatening and non-life-threatening.[47] Based upon the recommendation guidelines of the NATA Competencies, students should be aware of this.[11] With students having this knowledge,[11] and the research suggesting that clinicians practice what they learned in school,[23] we cannot expect these future clinicians to practice in an evidence based manner if they have not learned it in school.

Although autonomy is important in the educational preparation of the ATS, the education competencies were developed to help create a foundation of professional behavior and standard of care. This variability, particularly in the case of EHS, has created a dichotomy between actual clinical practice and the evidence. Again, many programs only capitalize on the didactic component

of education[43] to provide students with the appropriate knowledge regarding EHS, and at times this information is inaccurate or insufficient. This trend seems to influence the students' understanding of the topic, the importance of the topic, and their need to retain the information. This is particularly unsettling, as the literature suggests employment of a technique or skill into daily practice is a direct result of previous educational training, either through initial academic preparation or continued professional development.[23] It was quite clear, through the focus group interviews, that these participants were unaware and ill-informed about the necessary tools to appropriately evaluate and treat a potential case of EHS.

The education an ATS receives in the classroom should be the most current information available; this is particularly important as the profession moves towards the implementation of EBP. Evidence-based practice is now a content area in the 5th edition of the education competencies, which is a testament to the emergence of sound clinical practice. The previous version of the education competencies were vague, purposefully to recognize the continual emergence of best practices and uniqueness of each individual case. However, it is important for all clinicians to have a solid foundation of knowledge, skill, and confidence to properly handle any situation, particularly in the case of a life-threatening condition, as quality of care is often critical in reducing serious complications or even death.

As it currently stands in the 4th edition of the educational competencies, $T_{re}$ assessment and CWI are not specific skill sets noted through educational competencies or within the role delineation study; however, they are included in position statements, which are directly referenced within those educational competencies. Many students in our study spoke of the topic being discussed in a lecture format, but never receiving hands-on practice time to perform the skill in a controlled laboratory setting. This influences their confidence and beliefs that these methods are effective and simple to implement into clinical practice. The assumption is confirmed by the consistent finding that the AT recognizes $T_{re}$ and CWI as the gold standard, but due to lack of formalized training, avoids using them.[21, 45] Existing literature regarding instructional style demonstrates the ineffective nature of the lecture-based style of instruction, especially within the medical community.[46] Moreover, the lack of specific documentation of the skills of CWI and $T_{re}$ in the psychomotor competencies within the NATA education competencies was cited in an independent investigation with AT educators[43] as a major reason for the exclusion of practice time for the ATS.

**Clinical Education**

Clinical educational experiences are designed to complement and reinforce what is instructed didactically and provide the student with the opportunities to integrate knowledge into clinical practice. Unfortunately, with the case of EHS, it appears as though this is not happening, as current clinical practice demonstrates the failure to utilize best practices related to the recognition and treatment of EHS.[21,43,45] Furthermore, limited exposure to an actual case or simulation in the classroom, as well as the failure of the clinical supervisor to implement best practices, sends the message that what is taught in the classroom or outlined in the NATA position statements is subject to interpretation and not expected in daily practice. The experience of applying their education and the information in the classroom will reinforce an ATS's knowledge and skill set. This is meant to allow them ample time to practice the skills they have acquired in the classroom and learn from the ACIs while still having the supervision of the ACIs. When the students' experiences are different than that of the information taught in the classroom, a gap evolves between knowing and doing. This gap was previously shown in practicing clinicians,[24] and can now be linked back to ATSs.

**Lack of Experience**

Of the 13 ATS who participated in our study, none had any real life exposure to a case of EHS, and although this is not uncommon, it prevents the student from understanding the seriousness of the condition. Although 2 of the 13 ATSs mentioned having seen an athlete with EHS, it was later learned through discussions with both participants that the cases were potentially heat exhaustion not EHS. The improper diagnosis was a direct result of a failure of the clinical instructor to obtain a rectal temperature, and further highlights the need for educational reform regarding this topic. The situations involving heat illnesses described by the students are problematic for several reasons, as it highlights the clinical instructor's lack of knowledge of or disregard for the recommended diagnostic tools for a suspected case of EHS. The clinical instructors' previous experiences and practice beliefs served as reinforcement that, although the NATA recommends $T_{re}$ and CWI, they are not necessary or practical in clinical practice, which is not the case. In the end, these situations reinforce the negative stigma associated with the assessment devices and facilitate a continued disregard for the implementation of best practices. This failure to utilize the most current EBP not only negatively affects the ATS gaining experience, but also the athletes being treated by these clinicians. It is the professional responsibility of the clinician to provide competent care, follow established best practice, and participate in continuing education to enhance their skills.[44]

These students were also under the impression that they successfully treated a case of EHS without CWI or rapid cooling. When these students become practicing clinicians, they will likely continue this same practice. Students associating EHS with the heat exhaustion cases they witnessed in their clinical experiences is also dangerous because it demonstrates they are not being made aware of the seriousness and life threatening nature of EHS. This can be deduced since they believe they successfully managed a case of EHS without following the recommended practices established and endorsed by the NATA. They will likely continue to utilize what they believe was appropriate and successful despite the inaccurate diagnosis.

The students recognized their lack of experience, however, noting that increasing practice scenarios and hands-on learning will improve their comfort level in dealing with both the assessment and treatment of an athlete with EHS. Previous studies[54] examining the use of evidence-based practice (EBP) within various medical professions have shown that a lack of knowledge or skill, and lack of confidence as barriers in implementing EBP. Knowledge and skill can all be taught within a classroom or clinical setting but must also be reinforced through experience. Experience is what increases confidence.

In a medical profession, first hand experiences do not always occur, simply because you cannot ensure that every injury or illness will arise while a student is gaining clinical experience. In athletic training, you cannot ensure that every student will have the opportunity to spine board an athlete on the field, perform CPR,

use an AED, or even get a positive Lachman's test. However, the ATS is expected to be competent in these tasks regardless of real life implementation and evaluation. Due to the seriousness of a cervical spine injury or cardiac condition, students are given opportunities to practice those skills; the same efforts should be made to learn about EHS. Students are placed in situations where the likelihood of spine boarding is increased by working with a high contact sport such as football or men's lacrosse; the same can be done with EHS by having students cover road race events, such as a marathon. Even though many students will graduate with the probability of only spine boarding an athlete once, the technique is taught using a hands-on approach and is typically reviewed both in the classroom and the clinical setting. Instructors often utilize models to provide an authentic experience regarding management of an athlete with a suspected cervical spine injury. The situation is often made more realistic by adding equipment borrowed from the team manager. Students practice log rolling techniques, facemask removal, and immobilization while under the controlled supervision of an educator before they must be in charge of the situation themselves. The same educational opportunities can be provided to the ATS regarding $T_{re}$ and CWI.

Athletic trainers and ATSs are expected to maintain current CPR and AED certifications, which include practical scenarios using manikins and training AEDs. These same concepts should be true for the recognition and treatment of EHS. A recent published commentary has shown the efficacy of simulations for high-risk competencies.[55] Although this specific article was using blood-borne pathogens as the competency,[55] the idea of allowing students realistic hands-on experience but in a safe controlled setting is something educators should utilize more frequently when discussing EHS. More realistic opportunities for implementation of EBP regarding EHS can increase the likelihood of implementation, as comfort and skill competence increase. See Figure 2 for the relationship of the ATS, clinician and faculty experiences for EBP.

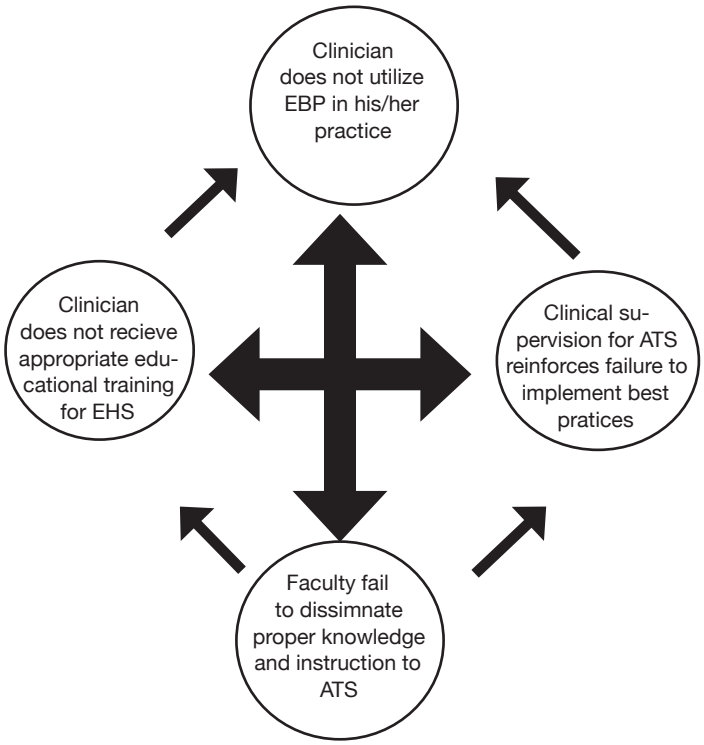


**Figure 2**. The cyclic nature of implementing EBP for EHS.

**Limitations and Future Research**

We recognize our study has some limitations. Our sample was purposefully small and with students who have yet to complete all their degree requirements; therefore, it may not fully capture all ATSs' educational experiences. The authors recognize that some programs, due to autonomy, wait until the senior year to discuss or teach the skill sets related to the recognition and treatment of EHS. However, all participants in this study acknowledged learning about the condition and never receiving any hands-on training regarding the condition. Moreover, we are confident that, due to data previously collected among other populations which cites a lack of educational training as the barrier to clinical implication,[21,43,45] these results are an accurate description of the educational preparation of the ATS regarding EHS. An additional limitation was related to participant recruitment. Attendance at the NATA's annual convention could also have influenced students' perceptions of EHS and their educational preparation. Based upon the existing literature on EHS and EBP, the results generated by our pilot study, the current study, and previous investigations,[43] our study's findings illustrate the current trend regarding academic preparation regarding EHS. Future studies may include a larger sample size and include students who have completed their degree programs to fully understand the implications discussed within our manuscript. Moreover, future research may investigate the differences in real-life exposure to EHS versus the use of simulations to promote critical thinking and skill competence. Athletic training students attending schools in the south or southwest may have more opportunities to be exposed to a case of EHS, which could influence understanding and willingness to comply with the current NATA standards. Geographic location has the potential to play a significant role, as the likelihood of EHS increases in places where the temperatures are warmer and more humid potentially making the condition more viable to the ATS. However, ATEPs should equally educate their students, as defined by the CAATE standards, and enable graduates to transfer their skills to any setting, regardless of location.

**Recommendations**

We hope this paper serves, as a catalyst for athletic training educators to reflect on the method in which they provide formal instruction and skill application for the recognition and treatment of emergency conditions, especially EHS. As highlighted in a separate investigation,[43] which examined the athletic training educator's academic background, practice beliefs, and comfort with the fundamental skills related to EHS, we recognize that many educators feel ill-prepared to provide formal training to their students due to their lack of training and expertise. Figure 3 illustrates the current barriers regarding EBP and EHS, as demonstrated by various studies, including this one.[43,45] We urge educators to seek out the necessary resources[56-59] to implement more hands-on instruction and practice time with these skills, which have been proven to be life saving for an athlete with EHS.[13-14, 60-61]

Exertional heat stroke is a medical emergency with an excellent prognosis if properly diagnosed and treated immediately. To reduce the number of unnecessary deaths associated with improper diagnosis or delayed treatment, we must break the vicious cycle, as highlighted in Figure 2, and prepare the future clinician to implement the best practices through formalized

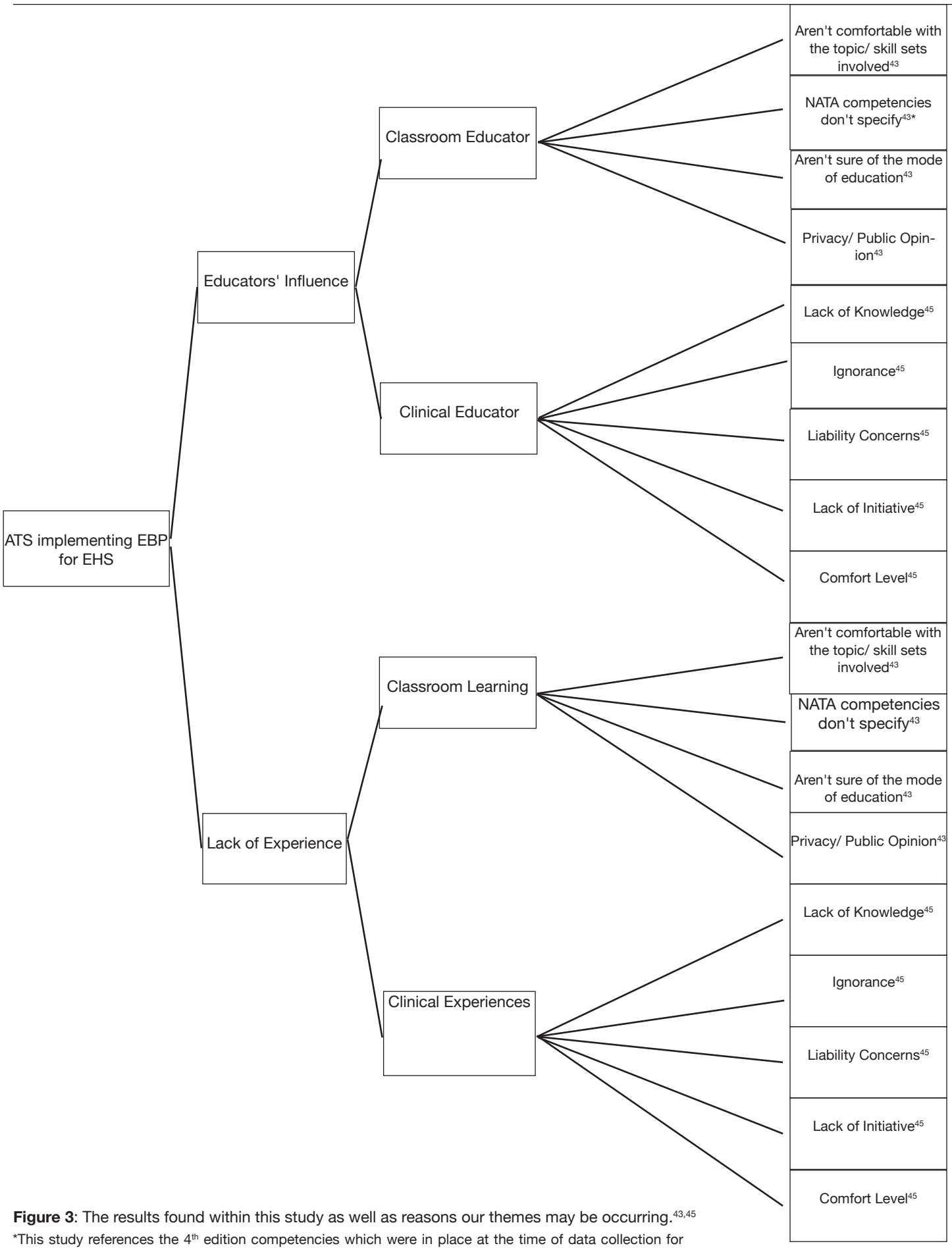


**Figure 3**: The results found within this study as well as reasons our themes may be occurring.[43,45]

*This study references the 4th edition competencies which were in place at the time of data collection for this study.

training. Thankfully, the next iteration of competencies include $T_{re}$ and CWI as psychomotor skills in order to reflect an EBP model of health care as it relates to EHS.

Educational seminars should occur at the national, regional and state levels for athletic training professionals and students. These seminars need to be hands-on and practical by nature. The hope is that, by educating AT instructors, the practicing AT and the ATS, implementation of EBP may be more likely. Despite the inclusion of the skill sets necessary to properly diagnose and treat a case of EHS in the 5th edition, until educators feel confident and prepared to educate their program students, the disconnect between EBP and actual practice may continue to exist.



**Appendix 1**: Interview Guide What do you think are some effective preventative strategies for exertional heat stroke?

Have you ever seen an athlete suffering from an exertional heat stroke? If so, please tell us about the situation, what signs and symptoms they were exhibiting, how you treated them.

What are the key signs and symptoms of heat stroke?

How could you rule in/out heat stroke from a differential diagnosis? Heat stroke vs heat exhaustion? Heat stroke vs hyponatremia? Heat stroke vs exertional sickling?

What would you do if you suspected an athlete you were working with was suffering from heat stroke?

What have you been taught in your classes? What have you seen practiced in your clinical setting?

Have you noticed differences between what was taught in your classes and what is practiced in your clinical settings? If so, what are they and why do you think this occurs?

How comfortable do you feel dealing with a heat stroke if it were to occur at your clinical site?

Why? What are some of your concerns? - What can be done to increase your comfort level? How comfortable do you feel with measuring core body temperature of an athlete (ie rectal)? Potential ways for temperature assessment? What works? What is used? - How comfortable do you feel with treatment of an EHS victim? (ie ice water immersion) Opinions on cooling methods? Knowledge of cooling methods? Use of these methods?

How comfortable do you feel with the NATA position statement on EHS in regards to where/how was it taught in your schooling?

What settings/ scenarios are you most likely to see exertional heat stroke?

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