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Team Physicians' Practice Beliefs Regarding the Recognition and Treatment of Exertional Heat Stroke

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**Team Physicians' Practice Beliefs Regarding
the Recognition and Treatment of Exertional Heat Stroke**

Lindsey H. McDowell

B.S., University of Connecticut, 2009

A Thesis

Submitted in Partial Fulfillment of the

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APPROVAL PAGE

Master of Arts Thesis

**Team Physicians' Practice Beliefs Regarding the Recognition and Treatment of
Exertional Heat Stroke**

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TABLE OF CONTENTS

CHAPTER

1. ABSTRACT.....	v
2. REVIEW OF THE LITERATURE.....	1
a. EHS Prevention.....	3
b. EHS Diagnosis.....	7
c. EHS Treatment.....	11
d. EHS Return to Play.....	14
e. Education.....	18
f. Evidence-based Medicine – Physicians.....	28
g. References.....	35
3. INTRODUCTION.....	39
4. METHODS.....	43
5. RESULTS.....	50
6. DISCUSSION.....	61
7. REFERENCES.....	69
APPENDIX A.....	71
Institutional Review Board approval letter	
APPENDIX B.....	72
Letter of Informed Consent	
APPENDIX C.....	74
Email Recruitment Letter - Team Physician	
APPENDIX D.....	75
Background questionnaire	
APPENDIX E.....	77
Interview Guide	

Recognition and Treatment of Exertional Heat Stroke: A Perspective from the Team Physician

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Context: Rectal temperature assessment (T_{re}) and cold-water immersion (CWI) are the gold standards for the recognition and treatment of exertional heat stroke (EHS), but athletic trainers (ATs) are reluctant to implement them regularly into clinical practice.

ATs work under the guidance of a physician, but little information is available regarding the perceptions of the aforementioned methods from the team physician's perspective.

Objective: To investigate team physicians' practice beliefs regarding the recognition and immediate treatment of EHS and the ways to increase the use of best practices. **Design:**

Exploratory study using semi-structured focus groups and follow-up phone interviews.

Setting: College, university, and secondary school clinical setting. **Patients or Other**

Participants: 13 team physicians using criterion, convenience, and snowball sampling technique were included in the study. The criteria included the title "team physician" for a college/university or secondary school, at least 3 years of full-time work experience beyond their residency and possession of a family medicine or internal medicine specialization. Seven were involved with the focus groups and 6 completed phone interviews. The mean age was 44.2 ± 3.8 with 10.2 ± 7.1 years of sports medicine specific experience. Participants represented 11 states. **Data Collection and Analysis:**

Data analysis included open coding procedures by a 3-member research team. Credibility was established by member checks and multiple analyst triangulation. **Results:** Two main themes emerged to explain the viewpoint of the physician on best practices: 1)

Supervisory role of the physician and 2) *Core body temperature*. Participants strongly

agreed that the role of the physician does not include educating the AT on proper T_{re} implementation, but instead must enforce a protocol that includes evidence-based medicine. Two major themes materialized to explain how ATs can be encouraged to use T_{re} assessment and CWI in clinical practice: 1) *Pre-certification* and 2) *Post-Certification*. Pre-certification was supported by two lower level themes including: 1) *Real-time experience*, and 2) *Skill set mandate*, while the Post-certification theme was illustrated by one lower theme: *Professional development*. **Conclusions:** The sports medicine physician is in support of T_{re} and CWI and believe it should be performed by the AT. Physicians, in recognition of the dichotomy between best and actual practice, believe that to increase the use of best practices the AT must receive formal training with those skills in a structured learning environment as well as gain real life exposure to the implementation of the methods. Physicians also recognize the dynamic nature of medicine and development of best practices, therefore they recommended for the AT to maintain current through professional development. Future studies should investigate the practice beliefs of emergency room physicians as well as those physicians employed within the secondary school setting without a sports medicine specialization. **Word Count:** 447.

REVIEW OF THE LITERATURE

Sudden death of an athlete is rare, but still does exist and in some cases is preventable, especially in the case of exertional heat stroke (EHS). As estimated by the National Center for Catastrophic Injury Research, EHS, is the third leading cause of death and during the preseason months of July and August, and is the second leading cause of death in athletics. In fact, the worst 5-year block in the last 35 years is the previous 5.¹ The NCAA Handbook reported 77 exertional heat stroke deaths at the high school and college levels during the period of 1959-1985.² In 2008, 12 high school football players, two youth-leaguer football players and two soccer athletes died; 3 were directly related to EHS.³ Data tracked since 1995, estimates that 33 deaths have resulted from EHS.³

Exertional heat stroke can be prevented if proper measures are taken, such as addressing predisposing factors and undergoing proper acclimatization. Due to the seriousness of the condition, and strong prognosis if recognized early and treated properly, there has been an influx of research conducted in the area, including validation of core body assessment devices and efficacy of treatment measures.⁴ The National Athletic Trainers' Association (NATA), released a position statement of Exertional Heat Illnesses (EHI) in 2002, which outlines proper assessment and treatment methods. The document strongly recommends assessing core body temperature via rectal thermometry and rapid cooling by cold water immersion (CWI) for the assessment and treatment of EHS.^{5,6} Research continually supports the NATA's recommendations and proves that rectal temperature is the gold standard for body temperature assessment for athletes exercising in the heat. Immediate rapid cooling through cold water immersion is the gold

standard for treatment of a heat stroke victim.⁴ Furthermore, its success in the clinical setting is well documented, as the Falmouth Road Race, which has seen over 400 cases in 40 years, has yet to see a death, due to the combined use of rectal temperature assessment and cooling via CWI.^{7,8}

Despite these recommendations, deaths are still occurring. Trying to gain an understanding of why, recent literature suggests that due to a lack of formalized training with the skill as well as misconceptions regarding its effectiveness and cost, has led Certified Athletic Trainers (ATs), the first responder in many of these cases, to avoid implementing these best practices.⁹ It was also found that athletic trainers tend to use cooling methods that have inferior cooling rates compared to cold/ice water immersion.

Although ATs are a crucial part of the sports medicine team and can be responsible for recognizing and immediately treating EHS, they often function in concert with EMTs and practice under the supervision of a licensed physician. Moreover, in some cases, the EMT is the lone responder, as we know many high schools do not employ the services of an AT, despite recommendations by the NATA.⁴ Still, recommended practices for the diagnosis and treatment of EHS are not being implemented in the clinical setting.

It has been suggested by previous literature, that the practice beliefs of medical care providers is related to their academic and continuing education experiences, which lead to skill competence and expertise.¹⁰ Additionally, it has been suggested that an AT's decisions to use the skills of rectal temperature and CWI are related to their Emergency Action Plans (EAP) and standing orders, which are developed with a licensed physician.⁹ So hypothetically, the practice beliefs of the physician can influence an AT's use of these practices clinically. This theory, however, is anecdotal, and warrants further

investigation. EMTs, ATs, and team physicians work together as part of the sports medicine team to provide optimal care for athletes as well as other physically active individuals; currently we understand why ATs are apprehensive to implement the best practices related to EHS, but do not completely understand what influences team physicians and EMTs in the recognition and treatment of the exertional heat stroke.

There currently is a disconnect between evidence-based medicine that is taught and what is actually practiced clinically within the medical field for both athletic trainers and physicians. We hope to investigate reasoning as to why proven and effective methods of recognition and treatment are being substituted with other methods in hope to quell or eliminate athletic death by exertional heat stroke.

Exertional Heat Stroke - Prevention

Predisposing factors

Exertional heat stroke is a highly preventable illness.¹¹ There are various factors that must be considered by the medical and coaching staffs. First of all, it is important to identify predisposing factors that athletes may have. Rav Acha et al. composed a table that outlines what factors had the greatest likelihood of leading to EHS in six fatal cases of the illness.¹² Six out of the six cases presented with physical effort unmatched to physical fitness and absence of medical triage. Both of these factors are important considerations that need to be addressed. Intensity of exercise can directly affect the rate at which core temperature increases. A fitness regimen that is more demanding will require the athlete to work harder, driving the core temperature much higher and faster than his or her teammates.¹³ An absence in medical attention can be detrimental to an

athlete with exertional heat stroke. Time is of the essence when treating this condition and quick diagnosis will lead to proper treatment and favorable outcomes.¹³ Table 1 also shows percentages of patients whose predisposing factor for EHS proved to be nonfatal. Of particular note are the factors that resulted in low nonfatal percentages including improper acclimatization (13.7% nonfatal, 13/95 cases), heat load corresponding to green flag or above (WBGT $\geq 27^{\circ}$ C) (16.5% nonfatal, 17/103 cases), improper rehydration regimen (16.4% nonfatal, 14/85 cases), absence of proper medical triage (15% nonfatal, 18/120 cases), and improper treatment (15.1% nonfatal, 15/99 cases). Factors that should be addressed by physicians include the absence of proper medical triage and improper diagnosis and treatment of EHS. These three factors had low survival rates as noted in Table 1.

Table 1. Prevalence of predisposing factors for exertional heat stroke in six fatal cases (compared with nonfatal cases).

*Used from Casa et al. 2005.¹³

Predisposing factor	Patient						Total	Nonfatal, % (N)
	1	2	3	4	5	6		
Physiologic individual limitations								
Underlying illness	+	-	+	-	+	-	3/6	17.9 (21/117)
Low physical fitness	+	-	+	+	+	+	5/6	71 (66/93)
Dehydration	-	+	+	-	-	-	2/6	21.4 (19/89)
Sleep deprivation	+	+	-	+	+	+	5/6	40.3 (29/72)
Overweight	+	+	-	+	-	-	3/6	64.7 (68/105)
Improper acclimatization	+	-	-	+	+	+	4/6	13.7 (13/95)
Total background factors	5	3	3	4	3			
Environmental factors								
Heat load corresponding to green flag or above (WBGT $\geq 27^{\circ}$ C)	+	-	+	+	+	+	5/6	16.5 (17/103)
High solar radiation	+	+	+	-	+	+	5/6	28 (35/125)
Organizational factors								
Physical effort unmatched to physical fitness	+	+	+	+	+	+	6/6	21.6 (23/106)
Improper work/rest cycles	+	+	-	-	+	+	4/6	23.8 (20/84)
Improper rehydration regimen	+	+	+	-	-	-	3/6	16.4 (14/85)
Absence of proper medical triage	+	+	+	+	+	+	6/6	15 (18/120)
Training at hottest hours	+	+	+	-	+	+	5/6	35 (42/120)
Disregarding regulations	5	5	4	2	4	4		
Treatment factors								
Improper diagnosis	+	+	-	+	-	-	3/6	21.2 (20/95)
Improper treatment	+	+	+	+	-	-	4/6	15.1 (15/99)
Total risk factors	14	11	10	9	10	9		

WBGT—wet bulb globe temperature.

Acclimatization

Proper acclimatization to the heat will help prevent EHS from occurring in the athletic population. Heat acclimatization includes gradually increasing athletes' exposure to the duration and intensity of activity in a heat-stressed environment. Several factors are improved when an athlete undergoes heat acclimatization, including physiologic function, exercise heat tolerance, exercise performance, and the risk for exertional heat illness is decreased. This period usually requires the first 14 days of preseason practice.¹⁴ Table 2 outlines heat acclimatization guidelines for the secondary school athlete.

The National Collegiate Athletic Association (NCAA) also compiled recommendations for heat acclimatization in collegiate athletes. The recommendations are not as specific as those outlined for secondary school athletes by Casa et al. and include a lessened recommended time period of acclimatization. In 2002, the NCAA provided recommendations for the sports medicine team in regards to proper heat acclimatization. Their recommendations include gradually increasing exercise intensity over a 7-10 day period in the hot and/or humid environment. Gradual increases in exercise intensity and duration are continued until the practices are comparable to that likely to occur in competition. If conditions are extreme, practices should be held at cooler time of the day. It is also advised that excessive equipment like shoulder pads, shin guards, and dark colored clothing be avoided and worn at a minimum during the acclimatization period.¹⁵

In 2004, the NCAA developed a policy for football heat acclimatization. The NCAA recommends a five-day acclimatization period for Division 1-A and 1-AA. The policy outlines the following points¹⁶:

- Institutions may not conduct administrative activities (e.g. team pictures, equipment issue, academic orientation, etc.) or conditioning/testing on any day prior to the start of the acclimatization period.
- During the five-day period participants should not engage in more than one on-field practice per day, not to exceed three hours in length.
 - One exception: During the five-day acclimatization period, an institution has the option of conducting one on-field practice per day, not to exceed three hours in length, or one on-field testing session (speed, conditioning, or agility tests) per day, not exceeding one hour in length and one on-field practice, not to exceed two hours in length.
 - On days that an institution conducts testing and practice sessions, student-athletes must be provided with at least three continuous hours of recovery time between the end of the testing session and the start of the practice session occurring that day.
 - During this time, student-athletes may not engage in other athletically related event or attend any meetings.
- First time participants and continuing students shall not be required to practice separately.
- During the first two days of the acclimatization period, helmets should be the only piece of protective equipment student-athletes may wear.
- During days three and four, helmets and pads may be the only equipment worn.
- During the final day of the acclimatization period, full pads may be worn.

Table 2. Heat Acclimatization Guidelines for the Secondary School Athlete.

*Adapted from Casa et al. 2009.¹⁴

Days 1-5

- Days 1-2 of the heat acclimatization in sports that require shoulder pads or helmets, a helmet should be the only protective equipment worn at this time.
- Field hockey goalies and other athletes in related sports should not wear protective equipment or do activity that necessitates protective equipment
- Days 3-5: shoulder pads and helmets only should be worn
 - Football only: days 3-5 contact with blocking sleds and tackling dummies may commence
 - Full contact: 100% live contact drills can begin no earlier than day 6
- Athletes may not participate in more than 1 practice per day
- Total practice time should not exceed 3 hours during any 1 day
- 1 hour maximum walk-through allowed during days 1-5. A 3 hour recovery period should be inserted between the practice and the walk-through

Days 6-14

- Single-practice days can allow for 1 walk-through, separated from the practice session by at least 3 hours of continuous rest
- Double-practice days must be followed by a single-practice day
- If double-practice day is followed by a rest day, another double-practice day is permitted
- On a double practice day, neither practice should exceed 3 hours in length and athletes should not participate in more than 5 total hours of practice.
- Two practices in 1 day should be separated by at least 3 continuous hours in a cool environment
- Warm-up, stretching, cool-down, walk-through, conditioning, and weight room activities are a part of the practice time

Athletic trainer on site before, during, and after all practices

•Key Definitions

- *heat acclimatization period*: the initial 14 consecutive days of preseason practice for all student athletes
- *practice*: period of time a participant engages in coach-supervised, school-approved, sport or conditioning-related physical activity
- *walk-through*: teaching opportunity with the athletes not wearing any protective equipment or using any other sport-related equipment
- *recovery period*: time between the end of 1 practice or walk-through and the the beginning of the next practice or walk-through

Exertional Heat Stroke - Diagnosis

Exertional heat stroke (EHS) is a highly recognizable and treatable medical condition suffered by athletes and soldiers all over the world. Sports medicine organizations such as the National Athletic Trainers' Association (NATA) and the American College of Sports Medicine (ACSM) have composed position statements with

specific recommendations as to how to properly recognize, treat, and prevent exertional heat stroke death in athletes. These documents provide excellent guidelines to the sports medicine team and are widely recognized within the medical community. Athletic trainers work under the care of a physician and must implement an emergency action plan (EAP). Physicians are involved in the process of making sure the EAP thoroughly details what actions should be taken in the event of a specific emergency. The AT and the physician can use the two documents from the NATA and ACSM to complete their EAP regarding exertional heat illnesses.

The two cardinal signs of EHS include high body temperature ($>40^{\circ}\text{C}$, 104°F) with central nervous system (CNS) disturbances (ex. altered consciousness) and multiple organ system failure.^{4,11,17} Additional signs and symptoms of EHS may include dehydration, weakness, profuse sweating, tachycardia, hypotension, vomiting, diarrhea, and coma.^{4,11,17}

Temperature Assessment A key component of diagnosing exertional heat stroke is assessing core body temperature. Exertional heat stroke can often be confused with exertional heat exhaustion, which presents with body temperatures less than 40°C ($<104^{\circ}\text{F}$) and without CNS disturbances. It is especially important to obtain the correct diagnosis to ensure that the athlete is properly treated quickly. There is much controversy when it comes to recognizing exertional heat stroke. The gold standard to assess core body temperature is the use of rectal thermometry if it is available.^{4,11,17} Other methods of body temperature assessment often provide inaccurate temperature readings. Casa et al. tested various methods of temperature assessment such as oral, axillary, aural, gastrointestinal, forehead, temporal, and compared these methods to rectal temperature

measurements. It was discovered that the oral, aural, axillary, temporal, and forehead temperature assessments were greatly different from the rectal temperature readings. The authors deemed the five assessment tools as inaccurate and therefore recommended not to use in the clinical setting to assess core body temperature in athletes who exercise in the heat.⁶ The only device that accurately measured core body temperature was the gastrointestinal thermistor.⁶ Ganio et al. also performed a similar study except the subjects performed exercise in a controlled laboratory environment. Forehead, temporal, oral, aural, and axillary temperature site did not provide valid estimates of rectal temperature.¹⁸ Other temperature assessment devices can be influenced by other factors such as air, skin, and liquids that touch the mouth and skin.¹⁷ Oral temperature is influenced by respiratory rate, temperature of rehydrating solutions, and temperature of the saliva.^{19,20} Other research has been completed that assess the validity of body temperature devices including a study by Knight et al. who observed a difference of 2°C (4°F) lower in tympanic temperature than readings given from a rectal thermometer.²¹ Ronneberg et al. completed a study to determine the accuracy of temporal artery temperature assessment compared to rectal temperature assessment in marathon runners and other athletes. As a result, the authors concluded that temporal artery temperature assessment will not identify hyperthermic runners/athletes.²² Rectal temperature assessment clearly provides the clinician with the most accurate core body temperature and is necessary to provide quick and optimal care to those athletes suspected of EHS. Tables 3 and 4 show various temperature device and their accuracies.

Central Nervous System Disruption to the central nervous system is a cardinal sign of EHS. Changes such as dizziness, irrational behavior, confusion, disorientation, and

agitation indicate a mild EHS. Hysterical behavior, memory loss, seizures, loss of consciousness, and coma indicate a severe EHS. Central nervous system symptoms will often get worse if cooling is delayed.²³

Other Signs and Symptoms Clinicians may also report other signs and symptoms with an EHS patient. Symptoms that may be reported include a feeling of excessive warmth, increasing dehydration, nausea, profuse sweating, decrease of performance or weakness, low blood pressure, and increased respiratory rate.¹¹

Table 3. Measurements of body temperature at various sites during rest and exercise.

*Adapted from Casa et al. 2005.¹³

Measurement site	Research conducted at rest	Results	Research conducted with athletes exercising in the heat	Results
Rectal	Yes	Valid [15-18]	Yes	Valid [16]
Esophageal	Yes	Valid [16,17]	Yes	Valid [16]
Intestinal (via ingestible thermistor)	Limited	Valid [16,28••]	Limited	Likely valid [16,19•,28••]
Aural	Yes	Mixed [18,20•21]	Yes	Not valid [20•,22•,23••]
Oral	Yes	Mixed [15,18]	Yes	Not valid◇
Axillary	Yes	Mixed [15,17,18,24]	Yes	Not valid◇
Forehead (sticker)	Limited	Mixed [21,24]	Yes	Not valid◇
Temporal artery	Limited	Mixed [25,26]	Yes	Not valid◇

Although medical staffs assess core temperature at a variety of sites, there are few original investigations from peer-reviewed journals (ie, not claims) that validate the use of sites other than esophageal, rectal, and ingestible thermistors for the measurements of core temperature of athletes exercising in the heat. Mixed results are a result of different populations and methodologies used and conclusions made by the authors. Articles referenced are representative of the literature and are not an exhaustive review. Some of these have been addressed since publication.

◇ = Research conducted by Casa et al. 2007 after original publication.

Table 4. Measures of validity using rectal temperature as the reference.* Used from Casa et al. 2007.⁶**Measures of Validity Using Rectal Temperature as the Reference**

Temperature Measurement	Bias	r	Intraclass Correlation Coefficient	SEM	Limits of Agreement	Coefficient of Variation (%) ^a
Oral temperature						
Inexpensive device	-1.87°C -3.00°F	0.16	0.19	0.48°C 0.87°F	±1.88°C ±3.03°F	1.46 (C) 0.98 (F)
Expensive device	-1.20°C -2.17°F	0.13	0.09	0.48°C 0.87°F	±1.71°C ±3.07°F	1.36 (C) 0.92 (F)
Axillary temperature						
Inexpensive device	-2.07°C -3.73°F	0.45	0.59	0.40°C 0.73°F	±1.44°C ±2.60°F	1.74 (C) 1.17 (F)
Expensive device	-2.58°C -4.65°F	0.24	0.41	0.54°C 0.97°F	±1.71°C ±3.08°F	1.95 (C) 1.30 (F)
Aural temperature						
	-1.00°C -1.80°F	0.70	0.70	0.24°C 0.43°F	±1.14°C ±2.05°F	1.16 (C) 0.79 (F)
Intestinal temperature						
	-0.19°C -0.34°F	0.86	0.87	0.27°C 0.49°F	±0.99°C ±1.78°F	1.99 (C) 1.38 (F)
Forehead temperature						
In the pavillion	-0.14°C -0.25°F	0.87	0.73	0.48°C 0.83°F	±1.48°C ±2.68°F	2.34 (C) 1.60 (F)
On the field	0.60°C 1.08°F	0.12	0.37	0.67°C 1.21°F	±1.70°C ±3.06°F	2.13 (C) 1.47 (F)
Temporal measurement						
Per instruction manual	-1.46°C -2.64°F	0.30	-0.56	0.85°C 1.52°F	±2.16°C ±3.89°F	1.84 (C) 1.24 (F)
Modified method	-1.36°C -2.44°F	0.34	-0.64	0.75°C 1.35°F	±2.05°C ±3.69°F	1.58 (C) 1.07 (F)

^aValue (C) = coefficient of variation when using °C; value (F) = coefficient of variation when using °F. See text for further descriptions.

Exertional Heat Stroke - Treatment

Proper and swift treatment of EHS is imperative to the outcome of the athlete.

Various methods of cooling can be used but the best and most effective way to cool the athlete is by removing their clothing and immersing the whole body in ice or cold water.^{4,11,17} Cold water immersion is considered the gold standard for heat stroke treatment. Circulation of the water can also enhance cooling.⁴ Ice water (0°C, 32°F) and cold water (13-19°C, 55-60°F) immersion have similar cooling rates.²⁴ Ice water immersion has a reported 0.15-0.20°C per minute cooling rate.²⁵ Cold water immersion has a zero percent fatality rate in 252 cases of EHS in the military.²⁶ McDermott et al. 2009 compiled a systematic review of the literature regarding whole body cooling.²⁷ If CWI is not available, there are other methods of cooling the medical staff should employ until the patient can be brought to a better cooling facility.

Ice Packs Ice bags can be placed in the neck, armpits, groin, and behind the knees. The goal of this treatment is to cool the blood as it is pumped through the carotid, axillary, femoral, and popliteal arteries.²⁷ In a recent systematic review, McDermott et al. rated various forms of cooling modalities based on their cooling rate. Ice packs were classified as being in the worst groups of cooling modalities due to the high cooling rate. Results show that ice packs would cool a person over a longer period of time compared to cold water immersion. The authors discourage the use of ice packs as they are ineffective in treating exertional heat stroke in a quick amount of time.²⁷

Wet Towels Only one study has researched the effect of placing cold, wet towels on hyperthermic athletes. Armstrong et al. treated one group of more hyperthermic (rectal temperature $41.7^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$) runners with ice water immersion.²⁷ The authors also cooled a group of less hyperthermic runners (rectal temperature $40.4^{\circ}\text{C} \pm 0.3^{\circ}\text{C}$) with ice wet towels around the thorax and abdomen. Although this difference in group treatment may have affected the results of the study, McDermott et al. 2009 suggested that this cooling modality may be researched more often in the future due to its cooling rate and relatively ease of use.²⁷

Evaporative Methods There have been some reports of using evaporative methods in order to cool those who suffer from EHS. Devices have been invented that promote evaporative cooling but do not exhibit optimal cooling rates such as the Body Cooling Unit (BCU). Israeli Defense Forces have used the evaporative cooling technique for decades. Treatment at collapse included moving the patient to a shady area, removing clothing, and splashing the patient's skin with cold water while fanning. The patient is then quickly transported to an emergency medical facility.²⁸ Poulton and Walter

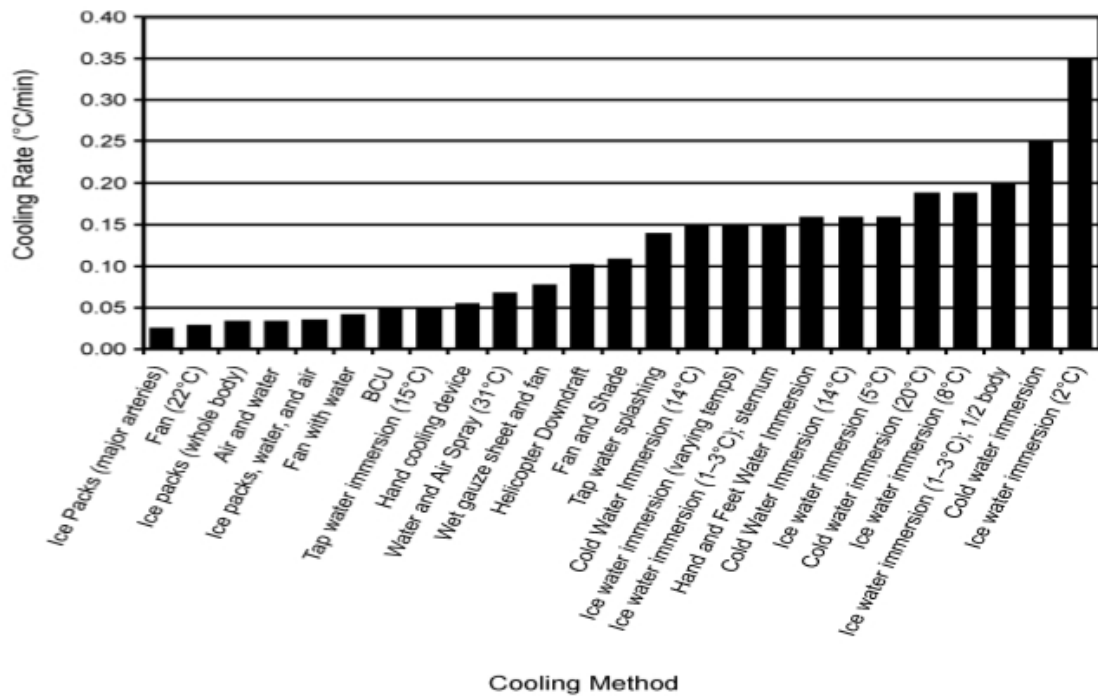
demonstrated successful cooling by using a small helicopter as a large powerful fan to increase cooling and enhance evaporation of water sprayed over the patient. An average cooling rate of 0.1°C/min was reported. However, this method is very impractical for the clinical setting, not to mention very dangerous for the patient and the medical staff.^{28,29}

Figure 1 shows cooling rates for various cooling methods.

There has been much controversy regarding ice/cold water treatment due to the belief that hypothermic overshoot, peripheral vasoconstriction, shivering, and cardiogenic shock will occur.⁴ It has also been hypothesized that heat loss is halted while the patient is immersed in cold water. However, research has been completed to refute this thought and the current literature does not support the theory.⁵ Proulx et al. conducted a study to evaluate the cooling rate of hyperthermic subjects when immersed in a range cold water temperatures. The results of this study prove that heat loss is not impeded during immersion in ice water as a result of vasoconstriction and shivering.³⁰ Medical staff should not be discouraged from using ice/cold water immersion in the clinical setting.

Figure 1. Cooling Rates for various cooling methods

*Used from Casa et al. 2007.⁵



Exertional Heat Stroke – Return to Play

There is limited information regarding the return to play protocol after incurring EHS and there are no formal guidelines or recommendations.¹¹ A proper return to play protocol must address the factor(s) that caused the initial EHS. The factor(s) are likely still present when the athlete returns to sport. The EHS may have also caused damage to function that allow an athlete to optimally thermoregulate.³¹ The absence of current recommendations may be due to liability concerns and lack of scientific research.³² Some sports medicine professionals allow patients to return to play without considering the following: exercise heat tolerance deficits, neuropsychologic impairments, or altered and reduced fitness status/acclimatization as compared to their teammates due to recovering from EHS. It is important to carefully plan and progressively increase exercise while

being supervised by a certified athletic trainer or team physician as part of the return to play implementation.^{4,13} Figure 2 outlines recommendations made by Casa et al. in response to return to play after EHS. Other groups including the U.S. Army and Air Force and the Israeli Defense Force also have their own recommendations relating to return to activity after EHS. The U.S. Army and Air Force recommend three months of restricted activity lasting no longer than 15 minutes. If there are no heat intolerance episodes, normal work-load is permitted. If there is no heat intolerance episodes through the next summer, full return to activities is allowed.^{32,33} Figure 3 outlines US Army protocol for return to duty after EHS.³⁴ More research is needed in this area.

Figure 2. Return to play protocol – post-exertional heat stroke.
*Adapted from Casa et al. 2005.¹³

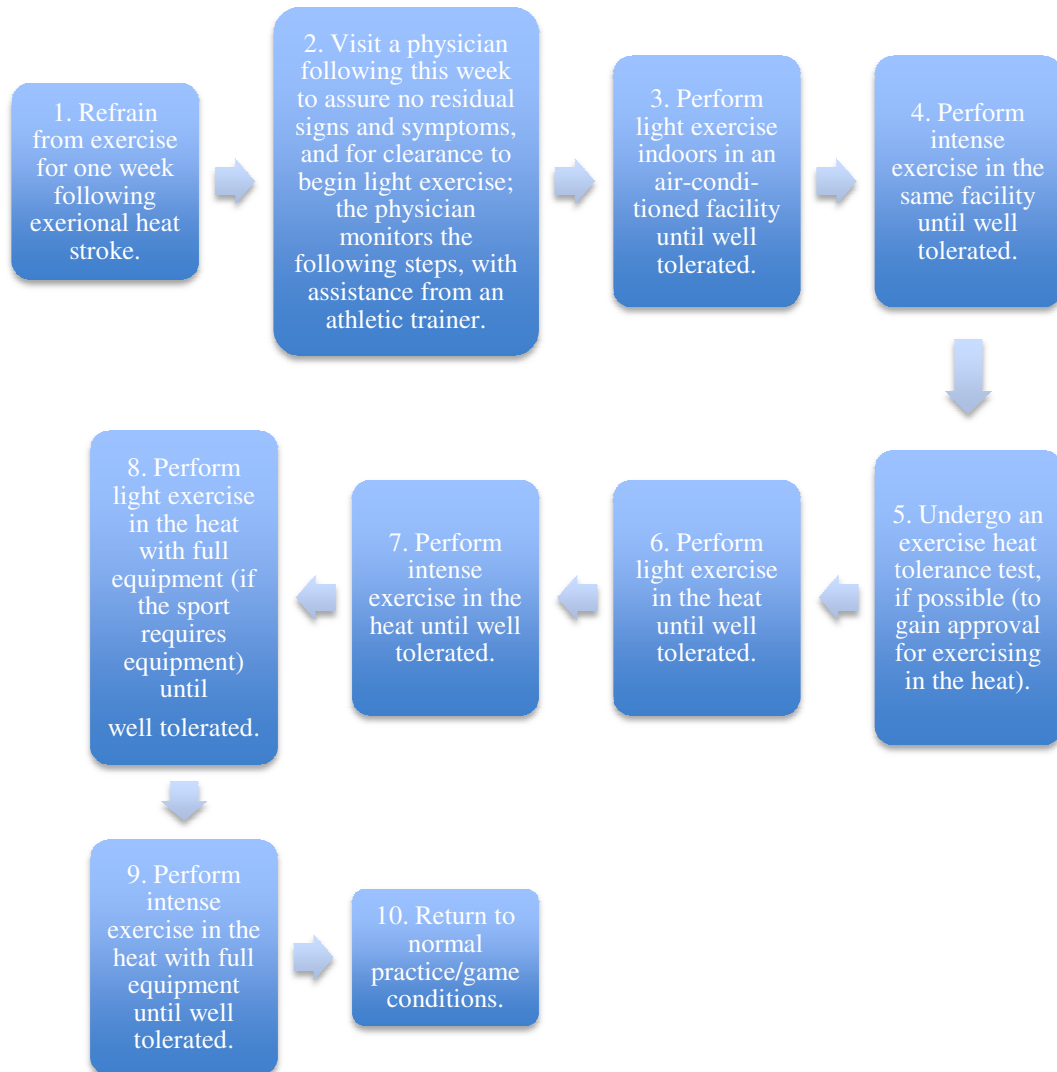


Figure 3. Profile progression recommendations for the soldier with heat stroke (HS) without or with sequelae, or complex HS or heat exhaustion (HE), heat injury (HI) pending an MEB.

*Used from Heat Illness Military Evaluation Board (MEB) and Profile Policy - US Department of the Army, 2009.³⁴

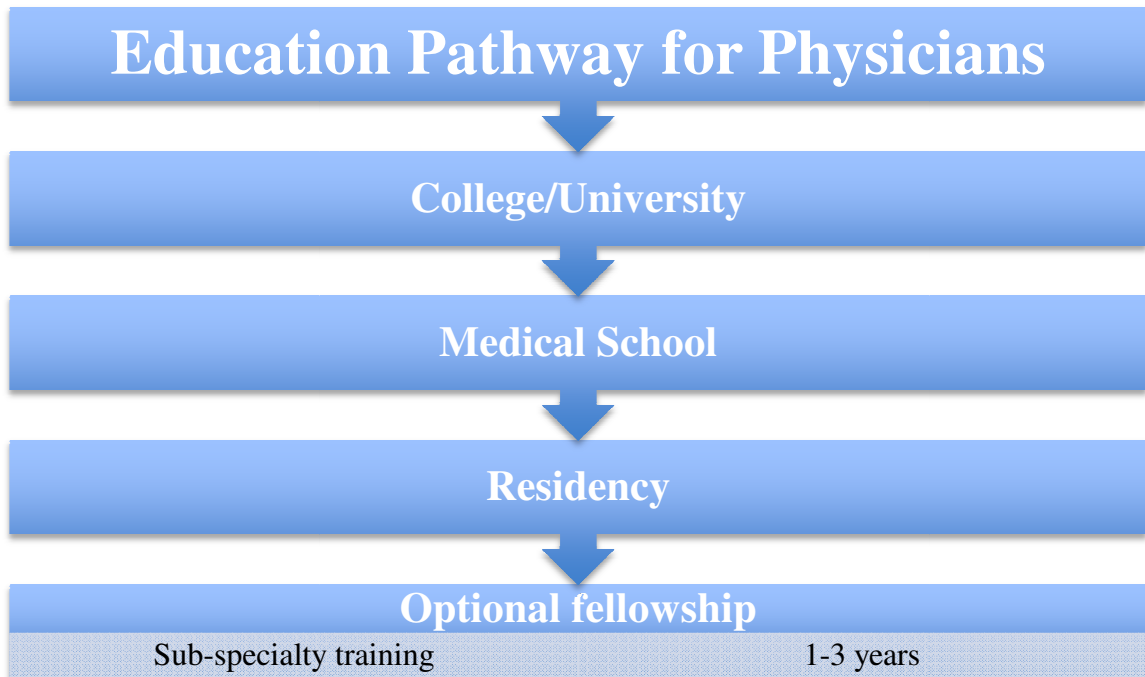
Profile Code*	Restrictions**	HS without Sequelae	HS with Sequelae	Complex HS or HE/HI Pending MEB
T-4 (P)	Complete duty restrictions.	2 weeks	2 week minimum; advance when clinically resolved.	2 week minimum; advance when clinically resolved.
T-3 (P)	Physical Training and running/walking/swimming/bicycling at own pace and distance not to exceed 60 min per day. No maximal effort; no APFT; no wear of IBA; no MOPP gear; no ruck marching. No airborne operations (AO).	1 month minimum	2 months minimum	Pending MEB
T-3 (P)	Gradual acclimatization according to TB Med 507. No maximal effort; no APFT; no MOPP IV gear. IBA limited to static range participation. May march with a ruck sack at own pace/distance with no more than 30 lbs. Non-tactical Operational Environment (OE) permitted.	1 month minimum	2 months minimum***	N/A
T-2 (P)	Continue gradual acclimatization. May participate in unit PT; CBRN training with MOPP gear for up to 30 min; IBA on static and dynamic ranges for up to 45 min; no record APFT. Ruck march at own pace/distance with no more than 30 lbs up to 2 hrs. Non-tactical OE permitted.	N/A	Pending completion of 30 day heat exposure requirement, if not accomplished during prior profile***	N/A
<p>*Temporary Profile; Physical Category P (PULHES). **Soldiers manifesting no heat illness symptomatology or work intolerance after completion of profile restrictions can advance and return to duty without an MEB. Any evidence/manifestation of heat illness symptomatology during the period of the profile requires an MEB referral. ***HS with Sequelae return to full duty requires a minimum period of heat exposure during environmental stress (Heat Category 2 during the majority of included days).</p>				

Education

The education of a medical student is a lengthy one. Figure 4 outlines the medical school education. Students generally begin their medical schooling at a 4-year college or university. Students must complete a rigorous course schedule that includes such courses as English, Biology, Organic Chemistry, Inorganic Chemistry, Physics, and Calculus. Pre-med majors will obtain a Bachelors of Arts or Bachelors of Science.

Students then take the MCAT exam and applying to medical schools. Medical school precedes a residency in a certain specialty. There is not currently a specialization in sports medicine. According to the American Osteopathic Academy of Sports Medicine (AOASM), a medical doctor can achieve the sports medicine qualification after completing a residency in another specialty.³⁵

Figure 4.



Throughout medical school, medical students must prepare to take the United States Medical Licensing Examination (USMLE) which is composed of three examinations (Exam 2 has two parts: Knowledge and Skills).³⁶ Each test is unique and evaluates the student on different aspects of medical science.³⁷⁻⁴⁰ Table 5 effectively describes each test including when during a student's education the test is administered and when the subjects of each test are. A popular examination study tool includes the First Aid® series of examination preparation books. Each book is specifically geared towards test preparation for each individual exam. Table 6 outlines how each examination preparation book prepares the student for any questions that test the students' knowledge of EHS diagnosis and treatment.

Table 5. United States Licensing Examinations.

*Adapted from the United States Medical Licensing Examination web site.²⁸

Examination	Period of schooling exam is typically taken	Content that the exam evaluates
Step 1	End of 2 nd year of medical school	Tests students' mastery of the sciences as they apply to the practice of medicine
Step 2 Clinical Knowledge (CK)	4 th year	Organization of clinical science material along two dimensions: physician task and disease category
Step 2 Clinical Skills (CS)	4 th year	Standardized patients (people trained to portray real patients) simulate important situations that a physician is apt to encounter during his/her career
Step 3	1 st or 2 nd year of residency program	Final assessment of physicians assuming independent responsibility for delivering general medical care

Table 6. Common exam preparation books used by medical students in training for the USMLE.

Title	Editor	Year of Publication	Recommended Method of Temperature Assessment	Recommended Method of Cooling	Other Information
First Aid for the USMLE Step 1	Tao Le MD MHS, Vikas Bhushan MD, et al.	2009	Not mentioned.	Not mentioned.	Not mentioned.
First Aid for the USMLE Step 2 (CK)	Tao Le, MD MHS, Vikas Bhushan MD, et al.	2007	Not mentioned.	Not mentioned.	Not mentioned.
First Aid for the USMLE Step 2 Clinical Skills (CS)	Tao Le MD MHS, Vikas Bhushan MD, et al.	2010	Not mentioned.	Not mentioned.	Not mentioned.
First Aid for the USMLE Step 3	Jonathan P. Van Kleunen MD	2009	No mention of device recommendation. Defines heat stroke temperature to be “frequently above 106°F.”	Recommends “aggressive cooling measures” such as evaporative cooling, ice baths, cooled fluids.	Very limited information regarding EHS. Discusses cause, S/S, temp., tests, treatment, and complications.

As part of the medical school education, there are several textbooks that are commonly used by students. Table 7 outlines each textbook and what information is provided specifically regarding EHS. Cecil Medicine, 23rd edition and Conn's Current Therapy provided the greatest amount of information about EHS however Conn's was more specific about EHS compared to classical heat stroke and included the athletic population. The textbooks gave varying information regarding the core body temperature. Cecil mentioned that EHS is commonly seen with core body temperatures greater but not always higher than 40°C (104°F). The suggested temperature reported by Conn's was 40.6°C (105°F). Both publications were consistent with recommending that cold or ice water immersion was the ideal form of treatment for an athlete who suffers the condition.^{41,42} The method of surrounding the body with ice packs was also mentioned as another form of treatment, however Conn's was specific in recommending exactly where upon the body the packs should be placed.^{41,42} They were also both consistent with recommending a rectal temperature assessment as the most accurate device to evaluate core body temperature. Conn's even mentioned that obtaining an axillary or aural temperature assessment may be inaccurate as those readings are often misleadingly low.⁴² Harrison's Principles of Internal Medicine, 17th edition provided the least information about EHS. Discussion of core temperature measurements was present but method of treatment was omitted from the text. It was reported that rectal temperature assessments tend to be 0.4°C (0.7°F) higher than oral temperature measurements. Although oral and tympanic temperature measurements are convenient and easy to use, they will provide inaccurate measurements. Exertional heat stroke is a condition that warrants quick recognition and treatment in order to avoid dire results. Harrison's also mentioned how

Table 7. Common textbooks used during medical school education for physicians.

Title	Editor	Year of Publication	Recommended Method of Temperature Assessment	Recommended Method of Cooling	Other Information
<i>ACSM Recommendation</i>	<i>Lawrence E. Armstrong, Douglas J. Casa, Mindy Millard-Stafford, et al.</i>	2007	<i>Rectal temperature (>40 °C [104 °F])</i>	<i>Most rapid whole body cooling rates with cold/ice water immersion.</i>	**LATEST MEDICAL RECOMMENDATIONS**
<i>NATA Recommendation</i>	<i>Helen M. Binkley, Joseph Beckett, Douglas J. Casa, et al.</i>	2002	<i>Rectal temperature (>40 °C [104 °F])</i>	<i>Immerse the body into a pool or tub of cold water.</i>	**LATEST MEDICAL RECOMMENDATIONS**
ACSM's Handbook for the Team Physician	W. Ben Kibler, MD	1996	Rectal temperature >40°C, usually >42°C	Immediate cooling is the definitive treatment for EHS.	Mentions the importance of cool first, transport second.
Cecil Medicine, 23 rd edition	Lee Goldman MD, Dennis Ausiello MD	2008	Rectal temperature (>40°C [104°F])	Immersion in cool or iced water with skin massage is most effective. Ice sheets and ice packs are also effective in dissipating the heat.	Characterized by central nervous system dysfunction with high body temperatures usually but not always greater than 40°C (104°F).
Conn's Current Therapy	Robert E. Rakel MD, Edward T. Bope MD	2009	Rectal temperature (40.6°C [105°F])	Ideal treatment includes cold-water immersion. Also mentions constant flowing cold water over patient. Ice packs to groin, axillae, trunk, and other skin surfaces also described as less effective.	States axillary and aural temps. May be misleadingly low. Separated EHS and classical heat stroke information. Provided information specific to the athletic population.
Current Medical Diagnosis and Treatment 2010	Stephen J. McPhee, Maxine A. Papadakis	2010	Rectal temperature over 40°C	Evaporative cooling is easy, non-invasive, effective and quick. Ice-water bath immersion is impractical in the clinical setting.	Separates heat illness. Mentions absence of sweating in patients. Avoid shivering since this inhibits cooling.
Harrison's Principles of Internal Medicine, 17 th edition	Anthony S. Fauci MD Eugene Braunwald, MD, et al.	2008	Rectal temperatures are generally 0.4°C (0.7°F) higher than oral temperature measurements. Lower esophageal temperatures closely reflect core temp. Oral and tympanic temp. readings are convenient but may be more variable than rectal.	Not mentioned.	Very limited information regarding EHS. No specific information to guide diagnosis and treatment. Mentions occurrence in those who exercise in elevated ambient temps. and increased humidity. Dehydration and certain medications may be at risk for EHS.

lower esophageal temperature measurements closely resemble rectal temperature assessment.⁴³

Current Medical Diagnosis and Treatment, 2010 advocates acclimatization and monitoring of the weather in order to prevent EHS. The section includes the fact that EHS is recognized due to an elevated core body temperature greater than 40°C and the authors mention rectal temperature in their description. They advise to cool until rectal temperature reaches 39°C. The “Treatment” section of the article mentions that shivering should be avoided due to the increased internal heat production and inhibited cooling that will result which Binkley et al. determined was a misconception attributed to cooling methods. Evaporative cooling is the first method of treatment advocated by the authors such as cold wet sheets and fanning. The authors mention that immersion is effective but impractical due to its “physical requirements to patient access and monitoring.”⁴⁴ This recommendation contradicts the NATA and ACSM position statements.

Another book that may be commonly used by team physicians, athletic trainers, and other healthcare providers that work exclusively with the athletic population, includes the Team Physician’s Handbook, 3rd edition. This book provides immediate access to practical information, particularly sports and exercise physiology, treatment of general medical problems, specific injury prevention, diagnosis and treatment, and sports medicine issues of particular concern to sports medicine physicians in the United States. The book includes a chapter on heat injuries that discusses major topics such as heat transfer/dissipation, exertional heat illnesses, and prevention of heat illness. Exertional heat stroke is defined as a medical emergency with a core body temperature >105°F but can often be as high as 107-108°F. Rectal temperature is listed as the most accurate core

body temperature value when compared to other devices. Immersion in an ice water bath is recommended as the best option for immediate external cooling but “may not always be possible in field.” Wetting the patient with tepid or cold spray with the addition of a fan, as well as packing the patient with ice packs are additional methods of treatment recommended.²³ Although published in 1996, the ACSM Handbook for the Team Physician provided very accurate information and guidelines for the diagnosis and treatment of EHS. The section clearly recommends quick recognition and treatment of the condition and how imperative it is. Rectal temperatures will be $>40^{\circ}\text{C}$, usually $>42^{\circ}\text{C}$. Although ice packs, evaporation methods, wet towels and fans are listed as possible treatments, immediate cooling is recommended as the definitive treatment method.⁴⁵

The American College of Sports Medicine (ACSM) developed a series of consensus statements in relation to care and treatment for athletes. In 2004 and 2007, consensus statements titled, “Mass Participation Event Management for the Team Physician: A Consensus Statement” and “Selected Issues in Injury and Illness Prevention and the Team Physician: A Consensus Statement” were published. The “Mass Participation...” article discusses many facets in which a team physician should be prepared while providing medical services at a large-scale event. Site preparation, staffing, and medical supplies are discussed. Among those supplies mentioned as “highly desirable” by the statement include rectal thermometers and immersion tubs. No other information is provided regarding the diagnosis and treatment of EHS.⁴⁶ The consensus statement titled “Selected Issues...” was more specific regarding treatment for heat illness. The statement discussed selected issues in athletes and gave necessary

recommendations for prevention only. Topics covered include physiology/pathophysiology, risk factors, evaluation, and intervention. Unfortunately, this consensus statement is not very specific in making recommendations related to diagnosis and treatment of exertional heat stroke like the ACSM position statement on exertional heat illnesses. The document is very vague and only recommends “implementing a mechanism for rapid cooling.” No mention is made regarding rectal thermometry measures and the optimal method of cooling, cold/ice water immersion.⁴⁷

There are two types of sports medicine doctors: non-surgical or primary care sports medicine and orthopedic surgeons. Most primary care sports medicine physicians choose to train in family medicine for the first three years after medical school before undergoing specialized training in sports medicine. Family medicine is the most common training these physicians specialize in for their first residency but other specializations are common as well. Specializations can also include internal medicine, pediatrics, emergency medicine, and rehabilitation medicine. These specialties are non-surgical but orthopedic surgeons must complete a surgical residency.³⁵

Following the initial residency, the physician will apply for a 1-2 year sports medicine fellowship. During the fellowship, an emphasis is made upon learning more about various sports injuries. Although the primary care sports medicine physicians will not become surgeons, they often complete their fellowship at an orthopedic surgeon’s office. They will also assist the orthopedic surgeons with various surgical procedures. It is important for primary care physicians to experience surgical procedures in order to educate their future patients about possible procedures they may need. Fellowships can also take place at high schools and colleges/universities. Fellows may have the role of

being team physicians in these settings.³⁵ Orthopedic medicine residents may also apply for a surgical sports medicine fellowship. The fellowship can last 12-24 months and will give the physician education and experience in performing sports injury surgical procedures, however many physicians choose to complete fellowships that specialize in a specific joint of the body such as the shoulder or knee.

Primary care sports medicine physicians must pass an exam that tests medical and musculoskeletal aspects of sports medicine. This certification exam is called Certificate of Added Qualifications (CAQ) in sports medicine. Only those physicians who complete the fellowship are permitted to take the exam. The American Board of Family Medicine provides an outline to exam candidates in order to review the exam content.⁴⁸ Exam content is included in Table 8.

Table 8. CAQ in sports medicine exam content.

*Adapted from the American Board of Family Medicine web site.⁴⁸

Content Area	Percentage of Exam	Other Information
Role of the team physician	1%	Ethics, legalities, administration
Basic science of sports	16%	Exercise physiology, anatomy, biomechanics, pharmacology, growth/development/aging
Health promotion /Preventive aspects of sports medicine	20%	PPE, conditioning and training techniques, nutrition, exercise prescription, epidemiology, event administration
Emergency assessment and care	8%	Abdominal/pelvic/groin trauma, airway compromise, anaphylaxis, cardiac arrest, c-spine injury, chest trauma/disorders, environmental illness (incl. hyperthermia), EAC, eye trauma, head injury, metabolic disease, musculoskeletal trauma/disorders, vascular trauma/disorders
Dx, Mx, Rx of sports-related injuries and conditions	50%	HEENT, neck, chest, abdomen, back, shoulder, elbow/forearm, hand/wrist, pelvis/hip/thigh, knee, lower leg/ankle/foot, pediatric musculoskeletal injury, neurologic, cardiovascular, pulmonary, GI, genitourinary/renal, dermatologic, hematologic, endocrine, infectious disease, GYN/OB, allergy/immunology, environmental (incl. heat illness), psychiatric, rheumatologic, special demographic groups,
Musculoskeletal rehabilitation	3%	Shoulder, back, knee, ankle, techniques, sports-specific rehab leading to RTP
Procedures	2%	Casting/splinting/bracing, joint and soft tissue injection/aspiration, reduction of joint dislocation/fractures, exercise testing

Evidence based medicine – Physicians

Medical professionals such as athletic trainers and physicians are formally taught throughout their education, current methods to treat illness and injury. As more research is conducted and the body of literature expands, so do methods of treatment. Athletic trainers are required to keep their certification current by acquiring continuing education units (CEUs). Every three years, athletic trainers must report how they have maintained their responsibility to keep their certification current. Continuing education units can be gained by attending school, symposiums, conferences, and workshops.

Halpern et al. have determined that medical education and training programs are generally slow to introduce changes into the school curriculum that reflects important changes in practice organization and health services delivery.⁴⁹ However, there is motivation for reform that is gaining momentum since graduates of medical school are ill-prepared for changes that occur within the practice environment. Since 1995, many prominent national medical organizations and professional societies have published reports including recommendation for curricular reform. These recommendations address the education and preparation of physicians as they prepare for the evolving practice environment of medicine. A major theme from these reports include the influx of knowledge in biomedical sciences, epidemiology, and health services research and how information technology will be a major tool to progress and improvement in medical school education. Medical education within the United States has developed a commitment to lifelong learning with the medical profession. Physicians must adapt to changes in medical knowledge in order to be as effective as possible.⁴⁹ Cruess et al. believes that there is a need for practice to be based on proper evidence and that it is the duty of the physician to maintain their competence in medical knowledge throughout

their careers. Physicians share in the obligation to expand the knowledge base and maintain it's integrity by supporting the scientific research and identifying scientific fraud. Medical associations must also support the expanding medical research and affectively distribute the current knowledge to its members.⁵⁰

Swanson and Anderson conducted a survey of 84 medical schools in North America (US and Canada). The authors compiled their survey based upon recommendations that had been made by three major reports conducted in the 1980s. The results of the survey revealed several indications as to why change in medical knowledge is not being implemented into medical school education programs.⁵¹ In regards to faculty development, the study revealed that more time must be devoted to the students' education and that more time and resources must be given to educators in order to improve their own teaching and clinical skills. However, there was a reported unwillingness to recognize the need to improve clinical skill among educators. Clinical skills workshops are often available however, are rarely attended by clinical instructors. Simply, educators do not make the time to attend. Oftentimes, educators also run their own practices and/or conduct research therefore limiting their time. Demands to provide revenue from patient care often takes priority over the improvement of clinical instruction. Nine schools in the survey reported an attitude amongst the faculty at their institutions that putting a large emphasis on teaching would weaken the scholarly research being conducted, since the primary focus would no longer be on research. There is a common belief that research accomplishment must be the primary reason for advancement. Method of teaching was also questioned. Lecturing is the predominant form of education, even though it has been suggested that lectures may not necessarily be

the most effective way to teach preclinical skills. Although schools recognize this fact, there is much resistance from faculty for change because they believe that lecturing is the most effective and efficient.⁵¹ Towle gave a presentation questioning why the culture of medical education is shifting and why this subject so controversial. Towle states that physicians rarely use evidence-based medicine in their clinical practice or search for evidence based practice methods using literature searches or evaluating the methodology of conducted research studies. Also, a small percentage of examinations assess students' skills in evidence-based practice.⁵²

Physicians are also required to acquire continuing medical education (CME) to keep up to date with the most current methods of treatment. The CME is also required for licensure re-registration. Requirements for each state vary and can be found on the American Medical Associations web site. Table 9 includes CME requirements for states in the northeast region of the United States.⁵³ The purpose of the CME is to remain current with the latest advances in patient care, accept new more-beneficial care, and discontinue use of existing low-benefit diagnostic and therapeutic interventions.⁵⁴ Halpern et al. suggested that CME will be a key resource for learning new content and skills that physicians will need to provide optimal care to patients.⁴⁹ However, CME education and training programs must develop and revise their current curricula in order to help physicians better understand their current practice environment and to acquire new competencies to help provide and manage high quality and cost-effective care to patients.⁴⁹

Table 9. Continuing medical education requirements for licensure reregistration.

*Adapted from the American Medical Association.⁵³

State	Required Number of CME credits per Year(s)	Average Credits per Year
Connecticut	50 credits every 2 years	25 credits
Maine	100 credits every 2 years	50 credits
<i>Maine DO</i>	<i>100 credits every 2 years</i>	<i>50 credits</i>
Massachusetts	100 credits every 2 years	50 credits
New Hampshire	100 credits every 2 years	50 credits
Rhode Island	40 credits every 2 years	20 credits
Vermont	None	None
<i>Vermont DO</i>	<i>30 credits every 2 years</i>	<i>15 credits</i>

**DO = Diploma in Osteopathy*

There is much controversy in the medical field when it comes to patient treatment. It is often asked why are medical professionals slow to adapt to changing medical recommendations? Bloom conducted a systematic review of the literature to discover why there is such a disparity in the available information for effective care and what is actually practiced in the medical setting. As mentioned before, there is a disparity in the way EHS in athletes and soldiers is treated and what is actually taught as part of a student's education.⁵⁴ If physicians know that rectal temperature assessment is the most accurate device to assess core body temperature and cold/ice water immersion are the most effective methods used to treat EHS, then why such a deviance in what is practiced?

One hypothesis Bloom acquired in his assessment of the literature was the way in which physicians are taught. It was discovered that relatively ineffective continuing medical education tools and techniques are used to promote the latest and most current information. Bloom found that didactic techniques and printed materials have little to no effect on effectively educating physicians. Didactic techniques include lectures and presentations that often include a question and answer session. In contrast, interactive

programs resulted in moderate to high effects. Interactive programs include role-playing, case discussion, and honing newly acquired practice skills, as well as interactive education, audit and feedback, reminders, academic detailing. The most common techniques used were found to have the least effect.⁵⁴

Other meta-analyses regarding continuing medical education were also completed that found similar results to Bloom. Thomson O'Brien et al. found a moderate to high effect of interactive programs in changing physician care and low or no effect of didactic programs. Davis et al. estimated a nonsignificant standardized effect size of 0.34 (95 percent confidence interval [CI], -0.27-0.97) for didactic programs and a significant standardized effect for interactive and mixed education programs of 0.67 (95 percent CI, 0.01-1.45).⁵⁵⁻⁵⁷ Table 10 outlines potential causes of disparity in medical education.

Bloom also discusses implementation through educators, funders, and physicians. Policies must be implemented to ensure the smooth transition and integration of current recommendations. Organization, delivery, and financing of these endeavors will also play a crucial role in the implementation of current patient care within a country. A suggestion is made for countries who use fee-for-service payments. A physician could be potentially paid more when they use the best evidence recommended for patient care. Physicians would then be encouraged to use the best care as to not lose patients due to competition and to increase their salary.⁵⁴

Table 10. Possible causes of disparity in medical education.

- Medical education and training programs are slow to introduce changes to the school curriculum.
- Educators must hone their own teaching and clinical skills.
- Minimal usage of evidence-based medicine in the clinical setting.
- Lack of policies to implement current patient care.
- Ineffective continuing education tools and techniques
 - Didactic techniques (lectures and presentations) and printed materials have little to no effect.
 - Interactive programs (role-playing, case discussion, practicing skills, etc.) resulted in moderate to high effects.

Although EHS is an entirely preventable and treatable condition, this heat illness still continues to occur in athletes all over the country. In recent years, there has been a large amount of research completed in regards to the illness and the best way to prevent, recognize/diagnose, and treat the condition. Addressing predisposing factors (such as those reviewed by Rav Acha et al.), being properly acclimatized, as well as other factors, will help decrease the likelihood of exertional heat illness from occurring. Currently, the literature and research recommend using rectal temperature assessment of $>104^{\circ}\text{F}$ to recognize EHS will ultimately lead to swift and successful treatment of cold/ice water immersion. Rectal temperature assessment will garner the best results for core body temperature assessment. Also, cold/ice water immersion has the fastest cooling rate compared to all other modalities. Since EHS is a medical emergency, it is imperative that treatment and cooling begins as soon as possible.

Sports medicine or team physicians play a large role as part of the sports medicine team. Physicians have an extensive educational background that includes schooling at an undergraduate institution, medical school, and a sports medicine fellowship. Sports medicine physicians must take a certification exam to be certified in the specialty of sports medicine called the CAQ. Reasoning for why physicians may fail to use the most

effective and current knowledge is still being understood. Some suggestions include slow integration of new medical concepts, ineffective education tools, and refusal to change teaching methods. All of these reasons further slow the integration and adaptations in evidence-based medicine that are required to treat patients effectively. As a result, athletes continue to succumb to EHS which a highly preventable and treatable condition if diagnosed appropriately.

Exertional heat stroke is a highly preventable and treatable condition that athletes continue to be victim of. Unfortunately, accurate methods of diagnosis and treatment are not being implemented in the clinical setting. It is imperative that researchers and educators learn why there is a disconnect between what is taught and what is practiced in the clinical setting by physicians. Until the disconnect is found, athletes will continue to needlessly suffer from this treatable illness.

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INTRODUCTION

There has been an influx of literature, anecdotally and empirically, over the last decade regarding sudden death in sport. One such condition, exertional heat stroke (EHS), has garnered both media and research attention as many high school and collegiate football players continue to die.^{1,2} The National Center for Catastrophic Injury Research (NCCIR) estimates that EHS is the leading cause of death during the hot and humid preseason months of July and August, as well as the second leading cause of death in athletics, regardless of the time of year. The NCCIR only retains records regarding high school and collegiate sport deaths so the data has the potential to be higher when other organized sporting events are considered. Moreover, the most recent 5 years has shown to be the most deadly within the last 35 years, despite its strong prognosis if proper measures are taken regarding diagnosis and treatment.¹

Securing an accurate core body temperature assessment has been proven to be a key component of preventing death from EHS as it allows for an accurate diagnosis. This diagnosis then helps navigate proper management (immediate and aggressive cooling) as well as to manage care following the illnesses, including return to sport.^{3,4} The National Athletic Trainers' Association (NATA) in 2002 released a position statement of Exertional Heat Illnesses, which outlines proper assessment and treatment methods. The document strongly recommends assessing core body temperature via rectal thermometry (T_{re}) and rapid cooling by cold water immersion (CWI) for the assessment and treatment of EHS.³ The American College of Sports Medicine (ACSM) has also produced a similar document that also supports the use of T_{re} and CWI for the diagnosis and treatment for EHS, respectively.⁴ The recommendations of both the NATA and ACSM are well

supported in the literature as multiple studies and systematic reviews have supported their use and efficacy.^{5,6}

Although these recommendations have been made and are endorsed by the NATA and ACSM, death in the realm of athletics due to EHS is still occurring, as previously presented. Many plausible explanations exist as to why these deaths continue to plague the high school and collegiate athlete include a failure to recognize the signs and symptoms of the condition, a failure to provide immediate and rapid cooling, or the failure to have appropriate medical care on site. This may occur especially in the case where a high school does not employ an athletic trainer, leaving the care of the athlete to the coach or parent in the case of an emergency.² Take for instance the controversial case of Kentucky High School football player Max Gilpin, who died from an EHS; as his death may have been attributed in part to his coach as well as failure to provide adequate medical coverage.⁷ Many high schools, despite the recommendations of the NATA on appropriate medical coverage,⁸ fail to employ an athletic trainer, thus leaving the care of the athlete in the hands of the coach.⁹ A lack of medical coverage may only be part of the problem regarding sudden death and EHS as in some cases the emergency care provider, usually the athletic trainer, may not be prepared to appropriately handle a case of EHS. It has been shown that less than 20% of athletic trainers utilize T_{re} assessment as a means to assess core body temperature, and only half utilize CWI as a means to treat the condition once a case is suspected.¹⁰ This disconnect between recommended practices and actual clinical practice has been associated with educational training. Based upon the existing literature, athletic trainers report having limited exposure to the recommended practices, and if any formalized training in the skill sets. Oftentimes athletic trainers are only

verbally instructed to use T_{re} assessment for diagnosis and to rapidly cool the athlete via CWI, but were never afforded the opportunity to utilize those skills.¹¹⁻¹³ Along with formalized training, it appears that some athletic trainers also have many misconceptions regarding the effectiveness and cost to both methods. The factors previously discussed in combination result in the athletic trainer not implementing the recommended practices set forth by the current evidence-based medicine.¹⁰

As previously stated, the athletic trainer is often responsible for implementing the proper methods to diagnose and treat an EHS. The athletic trainer may be the first medical professional to assess an athlete with an EHS. The athletic trainer is an integral component to the sports medicine team and works under the supervision of a licensed physician. The athletic trainer and the team physician must work cooperatively in order to successfully manage and provide optimal care for athletes as well as other physically active adults. The team physician must be an MD or a DO as well as possess a special proficiency in the care of musculoskeletal injuries and medical conditions encountered in sports. State license acts require the athletic trainer to work under the direction of a physician. It is ultimately the team physician's responsibility to make medical decisions that affect the athlete's safe participation. It has been suggested that an athletic trainer's decision to use the skills of T_{re} and CWI are related to their emergency action plans and standing orders, which are developed with a licensed physician.¹⁰ Hypothetically, the practice beliefs of the physician can influence the athletic trainer's use of these practices clinically. Previous research revealed that physicians strongly support the use of rectal thermometry and CWI for the diagnosis and treatment of EHS and encourage the athletic

trainers as part of their sports medicine team to use the most current evidence based medicine.¹⁰

There is currently a disconnect between evidence-based medicine that is taught and what is actually practiced clinically within the medical field for athletic trainers and this study aimed to help bridge this gap. The purpose of our research study is to investigate team physicians' practice beliefs regarding the recognition and immediate treatment of EHS and the ways to increase and promote the use of best practices within the athletic training profession. Specifically, the following questions guided our investigation: 1) what criteria do sports medicine physicians use as their diagnostic criteria for EHS, 2) what do they perceive as the most effective treatment of the condition, and 3) what influences their decisions regarding the proper recognition and treatment of EHS.

METHODS

In this exploratory study, we sought to better understand the team physician's practice beliefs regarding temperature assessment and rapid cooling as it pertains to EHS and the athletic trainer. Qualitative methods, in this case, provided the best means to address our purpose and research questions, as it is best in situations when the intended purpose is to build a holistic picture¹⁴ as well as gain insight into a specific phenomenon.¹⁵

Participants

Participants were recruited purposefully; using first a criterion sampling which was followed up by convenience and snowball sampling techniques.^{14,15} At the onset, we established criteria for inclusion,¹⁴ based upon the purpose and research questions. The specific criterion included team physicians who were currently working with athletes serving in the capacity of the "team physician" for a college, university, or secondary school. All participants needed to have at least 3 years of full-time work experience beyond their medical residency and possessed a family medicine or internal medicine specialization. In total, thirteen physicians (10 male, 3 female) with a mean age of 44.2 ± 3.8 with 10.2 ± 7.1 years of sports medicine specific experience. Participants represented 11 states, 6 NATA districts. Table 1 summarizes the individual data using participant pseudonyms.

Table 1. Participant Background Information.

Pseudonym	M/F	Age	State	Yrs. Board Certified	Yrs. Specializing in Sports Medicine	Setting	Credentials
Nick	M	38	TN	10 yrs.	10 yrs.	College D1	CAQ Sports Med.
Derek	M	52	AL	22 yrs.	21 yrs.	College, high school, recreational	N/A
Bud	M	46	MI	12 yrs	12 yrs.	College, high school, professional	ATC, CAQ Sports Med.
Colby	M	39	PA	7 yrs.	6 yrs.	High school	N/A
Keri	F	35	MA	7 yrs.	6 yrs.	College D1	CAQ Sports Med.
Kane	M	46	NC	10 yrs.	6 yrs.	Military	CAQ Sports Med.
Tate	M	41	IN	13 yrs.	12 yrs.	College, Olympic, high school	CSCS, FACSM
Clark	M	44	TX	3.5 yrs.	3 yrs.	NASA astronauts, marathon participants	N/A
Andrew	M	63	MN	33 yrs.	23 yrs.	College, high school	CAQ Sports Med.
Will	M	50	NC	20 yrs.	15 yrs.	College	CAQ Sports Med.
Danny	M	43	MD	15 yrs.	11 yrs.	College, military	N/A
Brooke	F	37	WI	7 yrs.	2 yrs.	College, high school	MPH
Ceci	F	37	MA	4 yrs.	2 yrs.	College	CAQ Sports Med.

Procedures

Two weeks prior to the 57th Annual ACSM Meeting in 2010, a recruitment letter was posted on the American Medical Society of Sports Medicine (AMSSM) list serve, (the national organization body for team physicians). Individuals interested emailed the

primary researcher to acknowledge participation and to coordinate a focus group time, which fit best with their conference schedule. To increase participation, individuals were also recruited through referrals and recommendations from participants and team physicians acquainted with the researchers. All participants completed a demographic sheet, informed consent form, and a brief survey prior to data collection sessions.

Instrument

We developed a brief background questionnaire and interview guide (Appendix C & D) to investigate the current behaviors of team physicians with regard to the recognition and treatment of EHS. The background questionnaire included sixteen open-ended questions that sought to gain information regarding the educational background of the physician and their prior experiences with EHS. The interview guide, which was semi-structured in nature, included ten open-ended questions to gain understanding of the physician's clinical practices of EHS and reasoning for such practices. We developed both documents with a group of researchers including AT educators (n=2) with previous research experience with qualitative methods and EHS and graduate students (n=3) in athletic training. Prior to data collection both the background questionnaire and interview guide was reviewed by two team physicians with 15 years of clinical practice experience for clarity, interpretability, and flow. Only minor grammatical changes were made to the document based upon the physician's review.

Data Collection

The interview sessions, both focus group and phone, followed a semi-structured format to allow us to ask follow up questions to the participants for a more elaborate response or to ask follow up questions, that may add further insights not initially

established at the outset of the study. The use of semi-structured format is considered a form of naturalistic inquiry, which is necessary when the researchers are not seeking normative responses, but rather the participant's honest opinion and experiences.¹⁶ The researchers purposefully selected two separate methods for data collection: focus group sessions and phone interviews. This was done for multiple reasons including to help secure the credibility of the findings (multiple analyst triangulation) as well as to take advantage of each methods strengths as a form of data collection. Focus group sessions have been shown to enhance the richness of the data generated, as an inherent design of focus group sessions is to stimulate further discussion among the participants, which ultimately can highlight and confirm the study's overall findings.¹⁵ Despite the advantages related to the interactions amongst the participants, some members can dominate the discussion or persuade other members to conform to the thoughts generated, therefore we also utilized phone interviews. The individual phone interviews, followed the same format, but only involved the participant and the researchers. As previously mentioned, the phone interviews allowed us to triangulate the data collected in the focus group session, avoiding the influence of a group. All interview sessions were recorded digitally and were transcribed verbatim for subsequent data analysis.

During each interview session, a two-member research team was used during data collection; with one member serving as the moderator and the other as a field note taker. The moderator in this case is an experienced qualitative researcher with more than 7 years of experience with qualitative methodology and an athletic trainer. The inclusion of field notes purposefully aided in capturing the interview environment¹⁴, commonalities

that arose during the discussions, as well as added rigor to the data analysis, by confirming or refuting emergent themes.^{14,15}

A total of 3 focus groups were conducted first (n=7). Each session had at least 2 members. A small number was preselected as the researchers felt as though it would be manageable, allow the participants to feel at ease and increase the likelihood of discussion, and retain their interest. Prior to data collection, the researchers hoped to have between 3-4 in each session, however due to scheduling conflicts and previous engagements, some of the interested participants were not available to attend. Each focus group lasted approximately 45 minutes. To confirm the study's findings and to add to the data collected, an additional set of phone interviews were conducted. A total of 6 individual phone interviews lasted about 30 minutes. These individuals were interested in the study, but as previously mentioned, were unable to attend the in-person focus group sessions.

Establishing Credibility

Several strategies were utilized to establish credibility and dependability of the findings, which included participant checks, peer review, multiple analyst triangulation, and methodological triangulation. Participant checks is an important step in this process to reduce the possibility of misinterpretation of the findings and the meanings derived from the participants experiences and thoughts.^{15,17} All participants, after transcription, had the opportunity to review the interview transcripts taken during the focus group or phone interview they participated in, and make any changes, if necessary, to ensure accuracy in the transcription process. A second method was the use of a peer debriefer, a researcher with previous experience in both the content of the research project and focus

group methodology. This person reviewed data collection procedures, data management, as well as the data analysis process to ensure a systematic approach was maintained throughout the process.¹⁵ Multiple-analyst triangulation^{15,18} was used during the data analysis process to add rigor to the research and enhance the trustworthiness of the emergent themes. Multiple-analyst triangulation included a four-member research team (three researchers and a peer debriefer), independently evaluating the data, utilizing open coding and content analysis procedures. Once emerging themes were ascertained, the three researchers compared findings and when necessary negotiated the findings until agreement is reached. They then shared the agreed upon findings with the peer debriefer to finalize data analysis. Finally, methodological triangulation was used to establish credibility as was explained in detail previously.

Data Analysis

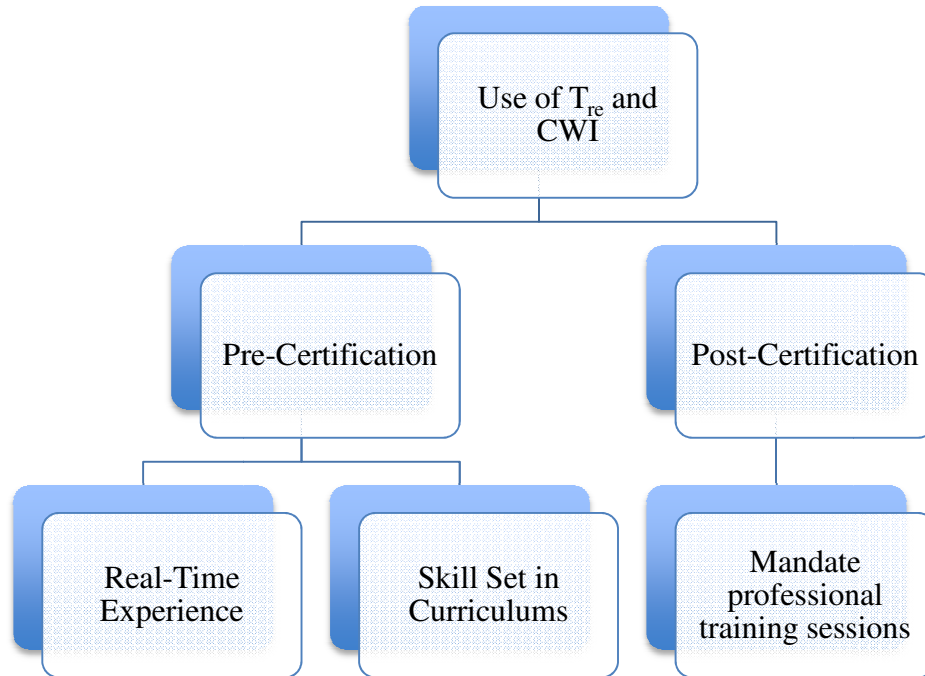
Interview transcripts were analyzed inductively, borrowing from a ground theory model, as described by Strauss and Corbin^{19,20}, as well as other researchers.^{14,18} Three researchers, including a graduate student in athletic training and two AT educators, independently performed this analysis to ensure rigor and trustworthiness of the data. Initial analysis involved open coding, where single sentences or thoughts, as related to the research purpose, were identified. These conceptual categories were placed throughout the transcripts, and were continually updated and organized, and eventually combined when necessary (axial coding). The categories, which were continually updated and evaluated, were examined to better understand the key emerging themes (selective coding). Upon completion of these steps, the three researchers compared notes and negotiated findings to have agreement upon the final results. In the end, only the use of terminology to describe the final themes were negotiated, not the data contained within

them. The final step as previously mentioned, was sharing the results with the peer. All members were in agreement of the final theme presentation.

RESULTS

This study proposed two major questions regarding EHS and best practices from the perspective of the sports medicine physician. Data analysis was guided by the two questions, identified previously. Two main themes emerged to explain the viewpoint of the physician on best practices and EHS, which included: 1) *supervisory role of the physician*, and 2) *core body temperature*. Two major themes materialized from the data to respond to the second research question: 1) *Pre-certification* and 2) *Post-Certification*. The pre-certification was supported by two lower level themes including: 1) *Skill set mandate*, and 2) *Real-time experience*, while the second theme was illustrated by one lower theme: *professional development*. Figure 1 provides an illustration of the findings related to the second research question. Each theme is presented below and supported with participants' quotes. Pseudonyms are used to protect the participants' identities.

Figure 1. Methods to Increase Use of Rectal Temperature Assessment and Cold-Water Immersion: Sports Medicine Physician Perspective



Supervisory Role of the Physician

The theme, *supervisory role of the physician*, is a reflection of the relationship between the team physicians, and the athletic trainers they work with regularly. The relationship, as described by this cohort of participants, was very amicable, goal-orientated, and professional. When describing the relationship of the physician and athletic trainer, Will stated,

The team physicians are usually the directors or the people who are mostly involved with policy development and implementing policies [say for EHS]. So we work closely with our athletic trainers to ensure what we think is the best management and treatment program...It's a group effort [between both healthcare providers].

Many of the participants recognized their role as a team physician, in which they were responsible for promoting best practices, but they did not feel it was their personal or

professional responsibility to provide educational training for T_{re} and CWI. Bud and Colby, members of the same focus group agreed that it was the team physician's role to require the use of both as part of the standing orders or emergency action plan procedures, but it was not their role to teach the athletic trainer proper use of the devices as it should be part of their previous educational experiences. Bud stated,

We're in charge of the protocol...but if they're [athletic trainers] still not comfortable doing that, I don't see that as a responsibility of the team physician. That should be their undergraduate training.

Ceci, in an individual interview, agreed that it is important for the sports medicine professional to implement what is considered the standard of care or recommended practices. She stated,

That's the standard of care [T_{re}] for diagnosis of EHS. I think whoever is supervising a certified athletic trainer or physician is responsible for sticking to the standards of care. It is the recommendation [for a reason].

Will, in an individual interview, had a similar opinion stating,

I think the ultimate management of these patients, of a heat stroke victim, is going to fall to the physician and the athletic trainers. [The athletic trainers] are obviously the first line of defense oftentimes with the management. [Exertional] heat stroke should be managed by a physician and I think because of that, we have an obligation to help and train our athletic trainers in how to recognize it and how to properly initiate treatment.

The role of the team physician was to uphold the standard care as recommended by the governing sports medicine agencies (ACSM, NATA, etc.) by those healthcare professionals that they directly supervised. Some physicians did recognize that although initial educational training was not in their scope of practice, review of policies and procedures were critical. Several mentioned conducting a formal review meeting to discuss the policies and procedures of the institution prior to the start of the season for all

employed athletic trainers, physicians, and staff. The purpose of these sessions was to ensure all members of the sports medicine staff are educated on proper procedures as to ensure optimal care for the injured athlete in a timely manner. Nick discussed educational sessions held at the beginning of each pre-season for his staff and students with the use of T_{re} and CWI, among other school policies for emergency care. He said, “We have a didactic day set up for our certified staff, graduate assistants, and then with our students.” The implementation has allowed for all members of the team to be aware of the policies, comfortable with their responsibilities and roles, as well as provide continuing education with the skill sets to help improve competence.

Core Body Temperature

The theme *core body temperature* illustrates the sports medicine physician’s belief that an accurate measurement of core body temperature is necessary for diagnosis, as well as the first step for implementation of proper treatment. The discussions, both in the focus groups and phone interviews, revealed similar responses which included the use of T_{re} for an accurate measurement. Physicians agreed that although invasive, T_{re} will provide the most accurate body temperature and needs to be implemented into clinical practice by the athletic trainer.

Ceci agreed that the use of T_{re} needs to be encouraged within the athletic training profession. She stated,

I think you have to remind them [athletic trainers] of the standard of care. Oftentimes, the athletic trainer is the first contact as far as the medical professional with the athlete and so it’s necessary to do it [T_{re}]. It’s the standard of care so it’s part of the job description. If that’s what you suspect, then T_{re} needs to be done and then a cold-water tub needs to be readily available to cool them. You

have to push the fact that it's standard of care across the board. And the athletic trainer, as the first medical professional there [on scene] is responsible for carrying that out.

Brooke also agreed with Ceci during a separate individual interview,

I certainly feel that we as a sports medicine staff should make it happen [facilitating use of T_{re} and CWI]. If we sat down with our athletic training staff and said we feel that this is important, that this should be a well-defined policy, that this is what we do... There's no reason why we couldn't do that with a heat related illness.

Danny went on to discuss the knowledge of the athletic trainers he interacts with and the importance of getting a body temperature,

I tell them that it's [T_{re}] the easiest and most accurate way we can get a core temperature. They [athletic trainers] already knew that oral temperature and temporal temperatures... were not accurate... One of our obligations is to try and make the diagnosis and T_{re} is a pretty important piece of information that can help you make a diagnosis especially when collapse can be related to other things [conditions].

Consistently, the group discussed the importance of securing a core body temperature assessment in the management of EHS. Moreover, they felt the athletic trainer, who is often the first to respond and care for the potential case, must have training in those skills.

Pre-Certification

The central theme of *pre-certification* references the physicians' opinion that those who are currently enrolled in degree programs for athletic training need to receive formal training regarding the best practices for EHS, which in their mind as previously presented was T_{re} and CWI. The participants unanimously believed that the governing bodies, particularly the educational aspect of athletic training need to mandate the training with T_{re} and CWI. Danny stated, "right now it is the best professional practice out there and to not teach people, that is not right [in my opinion]." Brooke's comments

were comparable to Danny, saying, “I’d say they [T_{re} and CWI] should be mandated if there’s compelling evidence known that that should be the standard of care.” Andrew explained that the training of an athletic trainer needs to parallel the training of a physician. He stated,

Mandate this [T_{re}, CWI] as part of their training. They work some event where it happens so they can observe a physician doing this. If you observe someone do it, then it’s not that difficult to see one and do one, would be my opinion at least on T_{re} because that’s how we did it in residency or as medical students.

Ceci agreed with the need to mandate T_{re} and CWI in athletic training education,

Yes I think it should be part of the clinical education that everyone knows how to take the T_{re} and that is the standard of care. It should be implemented that that is the standard of care and you should have that available onsite in case of an [exertional] heat stroke.

The physicians were in agreement that to encourage the use of these tactics that their educational training needed to incorporate the skill sets into the curriculum as well as provide an authentic experience to make the condition seem real.

Pre-Certification: Skill set mandate

The participants all expressed their belief that athletic trainers should be educated on the skill sets of T_{re} and CWI within the athletic training curriculum. The physicians discussed the importance of gaining educational training with the skill sets of T_{re} and CWI, as they are the best practices for diagnosis and treatment of EHS. The participants described their training in the skill during medical school and stated that the preparation of an athletic training student could be similar. Keri stated, “You could describe it [T_{re} assessment] and they could see me do it twice. With a little bit of instruction and observation, it’s done.”

Tate stated,

I would mandate it, in a perfect world, if we could make a policy right now, right here. You need to incorporate into the curriculum [for the athletic trainer]. Make it part of the certification process.

Danny, in a separate individual interview, echoed Tate's thoughts, "I think education is the first thing." Rob, in the same focus group as Tate, offered this thought, "Mandate it part of their training, by having them observe a physician completing the task." Kane mentioned,

To me, that's the only way you're going to get it [mandate being trained in the skills] because everybody has to do it. You need to do it [learn the skills] in a safe environment, and I would recommend it for the athletic training school. Be more like the medical school set-up. You start off on a model [anatomical replica], get some confidence, and then you go onto a real patient with confidence... You're getting comfortable with practice.'

Tate had similar sentiments as Kane saying,

You incorporate it into the athletic training curriculum. Mandatory on assessment which includes, how to insert their own rectal thermometer device into a patient, by using a fake butt [anatomical replica].

Tate went on to discuss the importance of accountability for the student or future medical provider,

Make it part of when they take the certification exam. Make it part of their practicum [on the exam]. If they know they have to possibly put it in, they're probably going to practice if they know its part of their test.

Pre-Certification: Real-time experience

Throughout the interviews, it was clear that participants firmly believed that real-time experience should be required as part of an athletic trainer's education. Many discussed the importance of observing the use of T_{re} and CWI as a means to promote use and comfort with the devices.

Andrew suggested,

If you observe someone do it, it's not that difficult to see one [being performed]. My opinion would be, in at least in regards to T_{re}, would be to have everyone observe how it is done. That is how we did it in residency and as medical students.

Many suggested an event like a marathon where the student can observe a physician physically performing the skill accurately. The participants paralleled the experiences during their sports medicine fellowship training to that of what should be required of an athletic training professional, which included clinical hours working triage at a mass medical event. Brooke reflected, "as part of our fellowship, we are required to cover several mass medical tents." Keri, also recounted her fellowship experiences, "I did some marathon coverage, which was when the implementation of T_{re} and CWI were most applicable." Observation of these practices being implemented in real-time, appeared to be the most effective means for understanding their ease of use and effectiveness.

Most physicians agreed that athletic trainers need to be educated in the use of T_{re} and CWI in order to encourage the use of accurate practices. Unawareness or lack of exposure was also discussed by many participants as reasons why they felt their staff athletic trainers were apprehensive to utilize T_{re} and CWI to recognize and treat EHS when faced with a possible case. Clark explained,

I get the feeling that my athletic trainers haven't been prepared for dealing with this [EHS and T_{re} and CWI] and they're not ready to throw people in the tub and take responsibility [for using T_{re}]. [To me] it is a lack of exposure and lack of the experience [with the condition].

Tate agreed with a lack of exposure as precipitating the avoidance of the use of T_{re} and CWI by athletic trainers and added on the thoughts of Clark during the focus group by saying,

Show them [the student or athletic trainer] what someone dying with heat stroke looks like. Show them a rectal thermometer [assessment], teach them how to do it, and if all else fails, [educate them to] throw them [a person with EHS] in a tub of water.

Keri, too, believed the only way to increase adherence to best practices regarding EHS and T_{re} was to provide exposure to real-life implementation of those skills sets. She stated, “Doing a mass medical tent [the athletic training member]. Because, basically, they could see me do it.”

Real-life experiences appeared to be a common thread to provide the sports medicine physician with the competence and confidence to utilize T_{re} and CWI when appropriate in the case of EHS and in their opinion can be paralleled in the athletic training preparation.

Post-Certification

Post-certification illustrates the dynamic nature of medicine and best practices. The physicians were acutely aware that current athletic training professionals might have not received the training necessary to implement best practices or feel comfortable with the practices T_{re} or CWI. A common point of discussion among the participants included the unease that the athletic trainers have in using T_{re} , which was rooted in a lack of educational training. The physicians recognize that the athletic trainers at their universities, despite knowledge of best practices, are uncomfortable with performing the

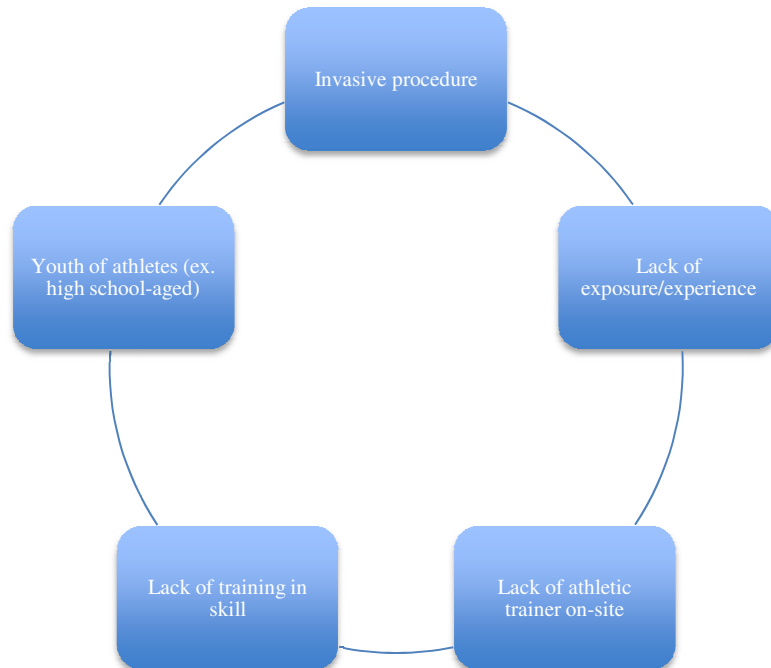
skill, particularly with T_{re}. Figure 2 identifies factors that physicians identify as impedances to the use of T_{re} and CWI among athletic trainers.

Keri stated,

People are ‘squirrely’ about using T_{re}...I can tell you at my institution, they know they are supposed to use T_{re} but they don’t want to [for comfort reasons].

Despite the lacking of formal training in the preparation phase, the physicians’ felt it was important for the clinician to receive formal training in order to implement these tactics, which they felt could be viable through professional development courses and continuing education units.

Figure 2. Factors Physicians Identify that Impede Use of T_{re} and CWI by Athletic Trainers.



Post-Certification: Professional development

Following athletic trainer certification, the participants of the study expressed the need for athletic trainers to continue their education of exertional heat injuries like heat stroke and the need for mandated Continuing Education Unit (CEU) training and to show evidence that they are proficient in the proposed skill.

Bud said,

As physicians, we have ongoing education...It's updating and you show evidence that you are proficient in what you need to do. I think that's probably the only way you're going to catch those individuals up with what's new in the field.

Examples of ways athletic trainers could be educated in what is currently evidence based regarding heat stroke through NATA (National Athletic Trainers' Association) workshops and annual review and practice of protocols. Bud said that although it is important to go conferences, there needs to be a way to recertify online post-conference.

He stated,

You have to do some sort of CME [CEU] type activity that updates you on whatever area that that's most pertinent in your area...Documentation that you're keeping up to date with those skills that you don't use very often.

Many of the participants recommended using the "heads of leadership" such as the NATA, state legislation, school board, etc. to implement and mandate an organized system to ensure proficiency and knowledge of current evidence based evaluation tools and treatment protocols.

DISCUSSION

Death from EHS is still being reported within the media and medical literature, despite the overwhelming evidence that positive outcome can be obtained if accurately diagnosed and properly treated. Existing literature identifies a strong knowledge base of those medical care providers, particularly the athletic trainer, who is often the first to respond to a case of EHS in regards to the best practices.¹¹ Unfortunately, knowledge of best practices does not always equate to implementation in the clinical practice, predominately due to a lack of training^{10,11} and preconceived myths.¹² The goal of this study was to gain a better understanding of the role the team physician could play in implementation of EBP, especially with EHS. Our results indicate that although team physicians are in support of the use of T_{re} and CWI by emergency care professionals including the athletic trainer, they do not believe they should have to provide the necessary medical training to ensure use by those who they supervise. The results also illustrated the physicians' recognition that strategies must be in place to promote the use of best practices, especially in the case of EHS, which is a life-threatening condition. The strategies discussed were rooted in educational preparation something previously identified as a roadblock to implementation of EBP for the athletic trainer regarding EHS.^{10,12-13}

Supervisory Role of the Physician

The team physician and the athletic trainer are integral parts of the sports medicine team and must work closely together to provide optimal treatment for their athletes. This relationship is regardless of the clinical setting and critical when it comes to

emergency preparedness and development of policies and procedures related to emergency care. In collaboration, the NATA, ACSM, and the AMSSM urge the team physician to establish a chain of command, which defines the roles and responsibilities of those involved with emergency response as well as establish policies, including the care for the athlete/patient suffering from a potential condition including EHS. The results from this study demonstrated that although the team physician identifies it to be their responsibility to enforce accurate protocols, which includes EBP for EHS, they do not feel that it is their responsibility to educate the athletic trainer on how to properly perform T_{re} and CWI. The team physician believes these skills are fundamental to gaining an accurate diagnosis and corresponding treatment, which is dictated by best practices, and therefore should be taught during the educational preparation of the athletic trainer.

As identified by the AMSSM, the sports medicine physician is the leader of the sports medicine team, who must promote collaboration between group members as well as establish policies to advocate optimal care for their athlete.²² The data generated from this study illustrates this mentality, as previously mentioned, of the team physician, who believes they must work together with the athletic trainer, but in the end are responsible to establish and enforce the policies related to patient care. The relationship between the team physician and the athletic trainer is the critical link in providing optimal care for the student-athlete, as the athletic trainer is often the healthcare provider coordinating care on a daily basis as well as implementing the protocols established by the team physician.²³ The team physician is also responsible for establishing policies and procedures regarding on-site medical care as it pertains to sports medicine emergencies,^{22,24} which includes environmental conditions such as EHS. The team physician, when developing these

policies and procedures, should involve the athletic trainer and be receptive to their thoughts and input regarding protocol development as in the end, it takes a team effort to implement the emergency action plan.²⁵ Although the team physician does not feel it is his or her responsibility nor is it their responsibility to teach the athletic trainer proper skill techniques, they should review policies on an annual basis, as well as rehearse the plan with all members of the sports medicine staff.²⁵ The policies and procedures should also reflect the most recent evidence-based medicine recommendations to ensure optimal care is provided to the student-athlete as well as to meet the legal obligations of the health and medical care provider.²⁵ As suggested by several of the participants, yearly staff meetings to discuss policies and procedures may be implemented for review. Both healthcare professionals are responsible for providing the standard of care to the patient and providing this communication if crucial to maintain that responsibility.

Core Body Temperature

The results of this study corroborate previous research, which demonstrates that medical care providers like the athletic trainer¹² and the team physician recognize T_{re} provides the most accurate assessment of core body temperature for a correct diagnosis of EHS. In contrast however, is the team physician's recognition that they currently implement and support the use of T_{re} , whereas the athletic trainer most often avoids use for diagnosis.¹² The team physicians in this study also strongly believed that the athletic trainer, due to their role in emergency care procedures needed to be prepared to utilize the skill set of T_{re} in order to make a correct diagnosis to ensure optimal care. Moreover, many of the team physicians acknowledged that it was a team effort, and that both the athletic trainer and the team physician need to work together to develop policies and

procedures which ensure quality care for the student-athlete: a previously identified key to a successful relationship and standard of care of the student-athlete.^{23,24} When more athletic trainers start using the gold standards of T_{re} and CWI and more team physicians encourage its use, there is a strong likelihood there can be a decrease in athletic death due to EHS (in addition to the obvious and most critical need to have athletic trainers at all high school settings).

Pre-certification

Several of the team physicians acknowledged, which has previously been reported in the literature,^{12,13} that many of the athletic trainers they work with are ill-prepared to use T_{re} due to a lack of formalized training and real-time exposure to the condition. All of the team physicians unanimously agreed that athletic trainers, like themselves during their medical school training, must receive formal instruction on T_{re} in order to be prepared to utilize best practices as it is part of their ethical and legal duty.^{26,27} The most logical step is to implement the skill sets of T_{re} and CWI into the educational competencies, which is the standard to which all athletic trainers will be held responsible. The team physicians believed athletic trainer leaders and educators should lobby to move the educational template to mirror those of medical school training. A recommendation, which helps support the claims of a previous research study that found the lack of specific documentation of T_{re} and CWI as a barrier to providing the proper instruction regarding the skills.^{10,11} Many of the team physicians also felt real-time exposure, something which was required for completion of their sports medicine fellowships, is vital to the development of confidence and competence with those skills. Authentic experiences have been fundamental to the athletic training student's professional

development, thus is a reasonable requirement for the clinical education component of the curriculum.²⁸ Interactive learning has also been supported within the medical literature, which has demonstrated to have a positive influence on educating physicians in comparison to more traditional modes of delivery, such as lectures and presentations.²⁹

In the near future, the NATA will issue the 5th edition of its Educational Competencies, and for the first time, as indentified by this group of team physicians, the skills of T_{re} and CWI will be required skills. As this lack of documentation had been previously indentified by athletic training educators¹⁰ as a major roadblock to providing adequate instruction, this change will hopefully increase use by athletic trainer when faced with the condition. It has been suggested by this group of team physicians as well as in anecdotal reports that athletic training education curriculums follow the medical school model and capitalize of the instructional methods of problem-based learning (PBL). Medical schools have been using the PBL approach for 40 years to promote knowledge application and provide realism to skill acquisition. In several published reports, PBL has proven to be a more advanced method of instruction allowing the medical student to demonstrate knowledge application and perform better in the clinical environment when compared to other traditional modes of learning.^{10,11,13} Like the profession of athletic training, medical schools have been slow to implement changes as reflective of dynamic nature of medicine. Many prominent national medical organizations and professional societies continue to encourage educators to utilize evidence-based medicine as the foundation to curriculum development. Particularly in the case of EHS, a life-threatening condition, all emergency care providers need to be aware of the recommended practices and trained accordingly.

Post-Certification: Professional Development

As discovered by Mazerolle *et al.*¹⁰, athletic trainers have a sound knowledge base when it comes to appropriate diagnosis and treatment methods regarding EHS. Athletic trainers recognize T_{re} and CWI as the most accurate tools to be used when an EHS is suspected, however they were found to still hesitate to use these methods. The major barrier stems from a lack of professional training with the skill sets as many athletic trainers have only heard through professional development that T_{re} and CWI are the best practice.^{10,11,13} In support of the claims made by several previous studies,^{10,13} the team physicians in this study agreed that athletic trainers are not confident or proficient with the skills. To address the dynamic nature of medicine many of the team physicians suggested using the professional development criteria as a forum to properly train athletic trainers, such as the continuing education training necessary for first aid and CPR. As part of the continuing education (CE) training, athletic trainers would have the opportunity, through a workshop type learning environment, gain proficiency with those skill sets. There is also the possibility that like the professional rescuer and first aid certification, the skill of T_{re} be mandated as part of the CE requirement for the athletic trainer. Although formal and informal types of CE activities can both greatly improve professional practice, informal events are usually attended more frequently by the athletic trainer despite the fact that CE credit is not awarded.³⁰ It is also important to note that for the athletic trainer informal CE opportunities such as workshops and learning labs are more important and interesting as they are perceived to improve clinical skills and abilities for patient care.³⁰

Most successful CE activities, especially for the medical care provider, include live presentations and workshops, personalized practice audits, and interactive computer programs.³¹ Cole and Glass noted that CE activities are not always meant to change behavior but to reinforce correct practice methods that are already present.³² This is an important finding as it relates to T_{re} and CWI. Perhaps, the team physician can help improve the athletic trainers confidence levels by hosting impromptu training sessions or utilize the annual rehearsal of the EAP as a means to practice those skills sets on a more informal, but regular basis. Laurent and Weidner reported that behaviors and practices modeled by clinical instructors, is the most beneficial strategy to promote learning for athletic training students;³³ therefore it is plausible to assume that if the team physician models this behavior as well as provides informal learning opportunities for the athletic trainer that the skills will be implemented appropriately and more often.

Conclusions

Together the team physician and the athletic training staff must work together to develop appropriate emergency care procedures to ensure an optimal outcome for the student-athlete. Exertional heat stroke, despite it's strong prognosis, continues to be ranked among the top 5 reasons for sudden death in sport. Critical to changing this statistic is the proper education of the athletic trainer as well as the development of emergency care procedures that recognize T_{re} and CWI as the gold standards. While it is important for the team physician to uphold and implement the standard of care of using T_{re} and CWI, the physician does hold the responsibility for teaching the athletic trainer proper utilization techniques. Until the educational preparation of the athletic trainer meets the standard as outlined within the NATA and ACSM position statements, the team

physician needs to continue to support those recommendations as well as advocate for the sports medicine team and athletic trainer to receive proper training in order to feel confident enough to utilize those skills clinically.

Limitations and Future Research

The participants of this study were board certified family physicians who also completed a sports medicine fellowship. All physicians were currently serving in the role as the team physician for within the military, the secondary school, or collegiate setting, therefore the results of the study can only be generalized to the team physician with the sports medicine credential. Physicians serving in the capacity of team physician at the secondary level may not have the sports medicine credential, consequently future studies should examine the practice beliefs of those individuals serving in the capacity as a team physician but do not hold the credential of a sports medicine physician. The sample size was purposefully small, but future studies should look to gain a large perspective from team physicians as well as compare the responses provided based upon employment setting. Another important cohort is that of the emergency room physician as they play an integral part in the initial or continuation of treatment of an EHS victim and gaining their perspectives can help us gain a holistic perspective of the care provided to an EHS patient.

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APPENDIX A - INSTITUTIONAL REVIEW BOARD Approval Letter



University of Connecticut
Office of Research Compliance

DATE: March 25, 2010

TO: Stephanie Mazerolle, Ph.D.
Kristin Applegate and Lindsey McDowell, Student Investigators
Kinesiology, Unit 1110

FROM: Jaci L. VanHeest, Ph.D. *JLVH/w*
Vice-Chair, Institutional Review Board
FWA# 00007125

RE: Protocol #H10-061: "Investigation of Emergency Medical Technicians' and Team Physicians' Practice Beliefs Regarding the Recognition and Treatment of Exertional Heat Stroke (EHS)"
Please refer to the Protocol# in all future correspondence with the IRB.
Funding Source: Unfunded
Approval Period: From: March 25, 2010 Valid Through: March 25, 2011
"Expiration Date"

On March 18, 2010, the Institutional Review Board (IRB) reviewed the above-referenced research study by expedited review, and determined that modifications were required to secure approval. Those requirements have been met, and the IRB granted approval of the study on March 25, 2010. The research presents no more than minimal risk to human subjects and qualifies for expedited approval under category #7: Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. Enclosed are the validated consent forms, which are valid through March 25, 2011. A copy of the approved, validated consent form (with the IRB's stamp) must be used to consent each subject.

All investigators at the University of Connecticut are responsible for complying with the attached IRB "Responsibilities of Research Investigators."

Re-approval: It is the investigator's responsibility to apply for re-approval of ongoing research at **least once yearly**, or more often if specified by the IRB. The Re-approval/Completion Form (IRB-2) and other applicable re-approval materials must be submitted **one month** prior to the expiration date noted above.

Modifications: If you wish to change any aspect of this study, such as the procedures, the consent forms, the investigators, or funding source, please submit the changes in writing to the IRB using the Amendment Review Form (IRB-3). All modifications must be reviewed and approved by the IRB **prior to** initiation.

Audit: All protocols approved by the IRB may be audited by the Research Compliance Monitor.

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438 Whitney Road Extension, Unit 1246
Storrs, Connecticut 06269-1246

Telephone: (860) 486-8802
Facsimile: (860) 486-1044
web: compliance.uconn.edu

APPENDIX B - Letter of Informed Consent

INFORMED CONSENT FORM

You are invited to participate in a research study examining current clinical practices regarding exertional heat stroke. You were selected to participate because you currently are a certified EMT with a minimum 3 years of certification/licensure. This study, which was approved by the UCONN Institutional Review Board (IRB) is a qualitative study involving a focus group discussion lead by myself, Stephanie Mazerolle PhD, ATC and Douglas Casa PhD, ATC. Your participation in this study is completely voluntary and involved one, 30-45 minute long focus group discussion to be conducted in a small conference room at the SpringHill Suites by Marriott Hotel in Baltimore, MD.

The purpose of this study is to gain a better understanding of a team physician's knowledge, attitude, and clinical practice choices regarding key issues surrounding exertional heat stroke (recognition and prevention) as well as the beliefs of the field of sports medicine and athletic trainers in specific. This study serves as a follow-up study to previously conducted studies involving high school and college athletic training clinicians, athletic training students, and athletic training program directors investigating the same topic. This qualitative inquiry is designed to compare the findings of the previous study focusing on athletic training to team physicians.

This study will last approximately 30-45 minutes. It will be conducted at the SpringHill Suites by Marriott Hotel. The focus group discussions will be video and audio taped. The session will include 3-4 other team physicians who are participating in the focus group. Along with those involved with the focus group, 3 researchers will be present including the facilitator, note-taker, and video-taper. Once the video tapes are transcribed, the researchers will send you a copy of the transcript, modifications to the transcripts will be made based upon your comments, and use only an assigned pseudonym to secure the data (your name will not appear in any official transcript or publication, you will only be referred to by your pseudonym). You will be sent the completed transcription, via email (email is not a secure method of transmission), to be sure the information is accurate. Once the study is completed all tapes will be destroyed. This informed consent form will be kept in a locked cabinet. In addition to the researchers listed above, one other graduate student will have access to the transcripts; they will aid in the data collection and analysis process to ensure accuracy and consistency.

There are no perceived anticipated emotional, social, or psychological risks. All data will be kept confidential in that your name will not be divulged in a verbal or written manner, except by the researchers to organize and arrange interviews. The researchers hope to gain valuable information in regards to recognition and treatment of exertional heat stroke. This information can then hopefully be utilized to reduce the number of deaths associated with the condition.

Please read the following carefully as these are your rights as a participant in this study:

If I am quoted in any way in a research report, I will be referred to by the pseudonym I pre-selected. The same is true of any other individuals and institutions or organizations that I

mention in the interview. If by request, the researchers will not include any specific information in a research report. I can answer any and only the questions I feel comfortable answering and I can choose to drop out of the study at any point.

I understand that participation is voluntary and that I will not be penalized if I choose not to participate. I also understand that I am free to withdraw at any time without any penalty. The general purposes, the particulars of involvement and possible hazards and inconveniences have been explained to my satisfaction. My signature also indicates that I have received a copy of this signed consent form. If I have any questions regarding the research study I can contact Dr. Stephanie Mazerolle, Assistant Professor, University of Connecticut, at 860-486-4536 or Stephanie.mazerolle@uconn.edu or Dr. Douglas Casa, Associate Professor, University of Connecticut, at 860-486-3624 or Douglas.casa@uconn.edu. If I have any questions about my right as a research participant I can contact: University of Connecticut Institutional Review Board (IRB) at 860-486-8802.

Signature of participant: _____ Date: ___/___/20___

Name of participant: _____

Witness: _____ Date: ___/___/20___

APPENDIX C - Email Recruitment, Team Physician

RECRUITMENT EMAIL TO [Team Physicians]

Dear _____ [subgroup] _____,

My name is Lindsey McDowell, ATC and I am a graduate student at the University of Connecticut. My professors, Dr. Douglas Casa and Dr. Stephanie Mazerolle, and I are in the initial stages of recruiting potential participants for a study investigating a team physician's knowledge, attitudes, and clinical practice choices regarding key issues surrounding exertional heat stroke (recognition and prevention).

This study serves as a follow-up study to a previously conducted survey investigating the same topic. This qualitative inquiry is designed to expand upon the initial findings yielded by the survey and to allow athletic training professionals to elaborate on their clinical practices and beliefs. Recent studies have shown a majority of professionals, due to a variety of reasons, are not utilizing rectal thermometry and cold water immersion. Gathering information regarding a team physician's practice choices it can help us as a profession as we move towards a more evidence based approach to medicine/care.

This study, which has been approved by the University of Connecticut IRB, is a focus group design that will be held at the ACSM Annual Meeting in Baltimore, Maryland June 3-4, 2010. You will be in a room with 4 additional members of the focus group along with 3 researchers, including myself, Dr. Stephanie Mazerolle, and Dr. Douglas Casa. We recognize that this requires that you be present for that date, however if you are planning to attend to the symposia, the time commitment for this focus-group study will be approximately 30-45 minutes which will benefit the entire field of Athletic Training and those we care for.

We are looking for team physicians who are employed at the collegiate level and must have more than 3 years of full-time working experience beyond their residency with a family medicine or internal medicine specialization. If you are willing to participate or know anyone that may be interested in participating, please forward their contact information (including email) to me at Lindsey.mcdowell@uconn.edu.

Respectfully,
Lindsey McDowell, ATC

APPENDIX D - BACKGROUND QUESTIONNAIRE

1. Male or Female
2. Current Age
3. What medical school did you attend?
 - a. Years attended?
 - b. What type of Medicine did you concentrate?
4. What state do you currently practice in?
5. How long have you been board certified?
 - a. What year were you certified?
6. Do you have any other credentials or specialties? (i.e. ATC, etc.)
7. How many years have you been specializing in sports medicine?
 - a. How many years have you worked at your current setting?
 - b. What sports do you have background in?
8. What population do you predominately work with? (Ex. Professional, college, high school, military, etc.)
 - a. What is the age range of your patients?
 - b. What sports do you directly work with?
 - c. Approximately, how many patients are under your care?
9. How often do you attend conferences that include lectures or workshops dedicated to recognition and treatment of EHS? (circle one)

Not often	Somewhat often	Very often
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10. What is your professional opinion regarding the use of rectal thermometry for the recognition of EHS?
 - a. Is rectal temperature available in your clinical setting to evaluate the patient of a suspected EHS?
11. What is your professional opinion regarding the use of cold water immersion for the recognition of EHS?
 - a. Is CWI available in your clinical setting to cool the patient of a suspected EHS?
12. Approximately how many exertional heat strokes occur annually at your clinical setting?
 - a. Approximately how many (if any) have resulted in fatality?
13. Approximately how many exertional heat strokes have you personally recognized and treated?
 - a. Approximately how many (if any) have resulted in fatality?
14. Have you worked other events (ex. marathons, triathalons, etc.) where protocol for EHS recognition and treatment was outlined in detail?
 - a. Which events are they?
 - b. Give location and date
14. What group(s) recommendations do you most likely adhere to, regarding the latest information of EHS recognition and treatment? (Ex. NATA, ACSM, AMA, other)
15. Did you have any specific training with the skills of rectal thermometry during your medical training? YES NO

- a. If so, please describe your educational experiences. Brief response.
 - b. If no, do you feel as though it should have been a part of your training?
Please explain your response.
16. Did you have any specific training with the skills of cold water immersion during your medical training? YES NO
- a. If so, please describe your educational experiences. Brief response.
 - b. If no, do you feel as though it should have been a part of your training?
Please explain your response.

Additional comments:

APPENDIX E - INTERVIEW GUIDE

1. Can you discuss your educational background as it pertains to the recognition and treatment of exertional heat stroke (EHS)?
 - a. How has the literature evolved since your training?
 2. Discuss, what you have found to be most helpful in keeping up to date with the latest recommendations regarding EHS?
 - a. Approximately when was the last time you read the latest recommendations?
 - b. How often?
 3. What steps are necessary to take to encourage the use of RT/CWI among physicians, EMTs, and ATs?
 4. As outlined in your policy and procedures manual, how do you and your sports medicine team recognize a suspected EHS? (what factors, clinical findings are used to diagnose the condition?)
 5. What is your professional opinion of using rectal temperature assessment during an EHS evaluation?
 6. What is your professional opinion of using cold-water immersion (CWI) as treatment for EHS?
 7. What factors influence the decision to use rectal thermometry (RT)?
 - a. Why do physicians, ATs, EMTs, etc. skip RT and cool immediately?
 - b. How can we encourage the use of RT?
 8. What factors influence the decision to use CWI?
 - a. What do physicians, ATs, EMTs, etc. use to cool instead of CWI?
 - b. How can we encourage the use of CWI?
 9. Do the ATs you supervise utilize RT in their diagnosis of an EHS?
 - a. Do you find that ATs are not comfortable using this skill?
 - b. If they are not comfortable with this skill, what do you do?
 10. Currently, once an EHS is diagnosed/suspected, how do you and your sports medicine team treat the condition?
- Please describe any personal experiences with treating exertional heat stroke cases.