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Investigation of Emergency Medical Technicians Practice and Beliefs Regarding the Recognition and Treatment of Exertional Heat Stroke

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INVESTIGATION OF EMERGENCY MEDICAL TECHNICIANS PRACTICE AND
BELIEFS REGARDING THE RECOGNITION AND TREATMENT OF EXERTIONAL
HEAT STROKE

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APPROVAL PAGE

Master of Arts Thesis

Investigation of Emergency Medical Technicians Practice Beliefs Regarding the Recognition and Treatment of Exertional Heat Stroke

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I entered into the sports medicine program as a freshman at Merrimack College interested in two things: sports and medicine. Knowing very little about the profession, I was encouraged by my advisor and faculty members to apply for the athletic training program. Being surrounded by sports my entire life, athletic training was the perfect fit. This medical-based career has allowed me to combine something I enjoy being part of in addition to helping others. After 4 years at Merrimack College and 2 years at the University of Connecticut, I feel as though I have gained invaluable knowledge, experiences, and relationships that I will take with me into my future. I want to thank many different people including professors, classmates, athletic training staff, friends, and family for their support and encouragement over the past 6 years. I would never be where I am today without them.

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Dr. Casa provided me with the opportunity to further my education by receiving a master's degree in exercise science at the University of Connecticut. His enthusiasm toward athletic training and good spirited attitude has provided me with exactly what I needed

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ABSTRACT

Utilization of Evidence-Based Practice by Emergency Medical Service Professionals Regarding the Recognition and Treatment of Exertional Heat Stroke

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Context: Current Evidence Based Practice (EBP) supports the use of rectal thermometry (T_{re}) for an accurate diagnosis and cold water-immersion (CWI) for the treatment of Exertional Heat Stroke (EHS) for an optimal outcome. Emergency Medical Services (EMS) play a critical role for the diagnosis and treatment of EHS as they may be the first to arrive on scene, however there is limited data regarding their implementation of EBP. **Objective:** Investigate current practice regarding EHS by EMS professionals and explore the relationship that exists between EMS and Athletic Trainers (ATs). **Design:** A basic qualitative design using in-person focus groups.

Setting: Regionally biased EMS companies. **Participants:** A total of 17 (3 females and 14 males) EMS professionals including Emergency Medical Technicians (EMTs) (n=11) and Paramedics (n=6), age 28 ± 8 years participated in the study. EMS professionals averaged 6.3 ± 5.3 years of experience. **Data Collection and Analysis:** Interviews were transcribed verbatim and data was analyzed using open coding procedures. Peer review and multiple analyst data triangulation were conducted to establish trustworthiness. **Results:** Educational preparation emerged as the predominate explanation for the lack of EBP regarding EHS. Three sub-themes help illustrate educational preparation including *temperature assessment* (educational training and knowledge), *rapid cooling* (educational training, knowledge, and logistics), and the *role of the AT/Healthcare professional*. Educational training and knowledge provided for the EMS professional, regarding temperature assessment was limited, in some cases inaccurate as compared to the most current EBP, and highlighted a disparity in the EMS professional's ability to accurately diagnosis EHS. Because the education EMS professionals receive is limited partly

due to scope of practice, the knowledge they bring to clinical practice reflects this disconnect. *Rapid cooling* educational training and knowledge illustrates the use of and belief in alternative methods other than CWI such as ice bags, air conditioning, and shaded areas. *Logistics played a* limiting role for the use of CWI as immediate transport is considered more important than immediate rapid cooling as well as impossible in an ambulance. The true *role of the AT/Health care professional* was unknown to many EMS professionals, which created confusion between two separate medical professionals. **Conclusion:** Findings from this research are consistent with previous literature regarding EBP among medical professionals; a failure to utilize best practices. Unlike the AT, cool first transport second is not considered standard practice for EMS, due to protocol procedures, therefore alternative, but effective methods must be investigated. Proper education consistent with the most current literature regarding EHS must be taught within EMS certification preparation to ensure the most efficient recognition and treatment of EHS. A relationship among EMS professionals and ATs should be formed to create familiarity among the professions and establish emergency treatment protocols ensuring consistent EBP and optimal care. **Word Count:** 449

REVIEW OF THE LITERATURE

HEAT STROKE

Exertional Heat Stroke (EHS) has received a great amount of public attention in the United States considering the recent deaths of collegiate and professional athletes. EHS is currently the third leading cause of death in athletes behind cardiac disorders and head and neck trauma. Heat stroke is one type of heat illness that has shown to cause detrimental effects to not only athletes, but the general public as well causing unnecessary deaths each and every year. Approximately 400 deaths can be attributed to all types of heat related illness in the United States annually.¹ Heat related deaths and illnesses are preventable however, according to the CDC, between 1979-2003 excessive heat exposure caused 8,015 deaths in the United States. During this time span, more people in the United States died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.² An EHS presents when the temperature of the body's internal organs rise above a critical threshold (40°C) and usually leads to cell death and organ failure if not treated properly.³ There are two different types of heat stroke that should be differentiated which are classical heat stroke and EHS. The reaction of the body to both types of heat strokes is similar and can prove to be fatal if not treated properly. The National Athletic Trainer's Association (NATA) as well as the American College of Sports Medicine (ACSM) have both promoted proper prevention, recognition, and treatment of EHS to educate sports medicine professionals as well as the general public in attempt to decrease the likelihood of fatality.

Classical Heat Stroke

Classical heat stroke is not common in athletics, however it is important to distinguish between the two different types of heat stroke. Classical heat stroke, where the environment plays a major role in an individual's ability to dissipate heat, occurs more often with prolonged heat exposure to populations such as the elderly, infants, or unhealthy sedentary adults when the temperature rises much higher than average.^{1,4} Classical heat stroke have been shown to happen most often during extreme heat waves and occur when there is a dysfunction of the thermoregulatory system causing the prevention of heat dissipation of heat that is created by or absorbed by the body.¹

Exertional Heat stroke

Exertional heat stroke is much more common in the athletic population where exercise intensity has a direct relation to elevated core body temperature. EHS is an elevated core body temperature (usually $>40^{\circ}\text{C}$) that is associated with signs of organ system failure due to hyperthermia.^{1,3,4,5} EHS occurs when the temperature regulation system is completely overwhelmed by excessive endogenous environmental conditions and can progress to complete thermoregulatory system failure.⁴ Unlike classical heat stroke, EHS occurs during physical activity causing overheating of organ tissues that may induce malfunction of the temperature control center in the brain, circulatory failure, or endotoxemia.⁴ Although EHS can occur in many different environments, football has been shown to have the greatest number of heat stroke fatalities in athletics that we know of. The National Center for Catastrophic Sport Injury Research noted that there were 26 deaths in high school, collegiate, and professional football from 1995-2005.¹

THERMOREGULATION

Thermoregulation is the process in which the body balances and maintains a consistent internal temperature. This process is a complex interaction that takes place in the hypothalamus and is among the central nervous system, cardiovascular system, and the skin to maintain a body-core temperature of 37°C.⁴ The hypothalamus has a core temperature set-point that is specific to each individual person. Core body temperature is determined by metabolic heat production and the transfer of body heat to and from the environment calculated by this equation:

$$S = M \pm R \pm K \pm C_v - E$$

- S- the amount of stored heat
- M- the metabolic heat production
- R- the heat gained or lost by radiation
- K- the conductive heat lost or gained
- C_v- the convective heat lost or gained
- E- the evaporative heat lost⁴

As core body temperature increases during exercise, the thermoregulatory response increases peripheral vasodilation and blood flow to the surrounding vasculature to promote cooling.³ Heat can be gained or lost from the body through conduction, convection, radiation, or evaporation. Conduction is the direct transfer from warmer to cooler objects through physical contact. Convection is the heat transfer to or from the body to surrounding moving fluid or air. Radiation is energy that is transferred to or from an object from electromagnetic radiation. Evaporation usually occurs with the body's ability to sweat, which vaporizes into the air as a cooling mechanism. If the body is not able to release heat through any of these mechanisms, heat illness may result.

PREVENTION

Prevention of EHS should be implemented in levels of all athletics. A thorough pre-participation examination (PPE) prior to the start of athletic competition identifies athletes predisposed to heat illness as well as those who have a prior history of EHS. Establishing a team of appropriate medical staff on-site including certified athletic trainers that are familiar with EHS will ensure that proper prevention, recognition, and treatment will be carried out. It should be a requirement that all athletic trainers and other health care providers attending athletic events are allowed to evaluate any athlete showing signs or symptoms of heat illness. Based on these signs and symptoms, they should be granted the authority to restrict athletic participation if he or she is experiencing a heat illness. Providing education to athletes and coaches regarding the prevention, recognition, and treatment of heat illnesses is important to ensure that prevention is implemented. Education should include proper hydration guidelines focusing on balancing sweat and urine losses to fluid intake to maintain adequate hydration status which may include weighing athletes before and after practice^{1,3,4}. Environmental conditions should be considered when schedule practice times, work intensities, water breaks, rest breaks, and equipment worn as shown in Figure . An organized and well-practiced emergency action plan (EAP) should be established to avoid confusion in the event of an emergency situation.

Emergency Action Plan (EAP)

Emergency planning in athletics is critical to preventing sudden death in sport. Preparation for responding to an emergency includes education and training, maintenance of emergency equipment and supplies, appropriate use of personnel, and the development and actual implementation of an emergency plan. The National Athletic Trainers' Association

(NATA) recommends that each institution or organization that sponsors athletic activities must have a written emergency plan which should be comprehensive and practical, but flexible enough to adapt to any situation.⁶ These documents must be written and should be distributed to all pertinent personnel including staff as well as local emergency medical services personnel. Sports medicine professionals, officials, and coaches should be trained in automatic external defibrillation, cardiopulmonary resuscitation, first aid, and prevention of disease transmission⁶⁻⁸. Equipment should be specified including locations. The EAP should specify the necessary documentation for implementation and evaluation of the EAP during and following an emergency situation. The EAP should be reviewed and rehearsed annually and documented. All personnel involved with the organization share a professional and legal duty to develop, implement, and evaluate an EAP for all activities. The EAP should be reviewed by administration of the sponsoring organization or institution. Preparedness in regard to preventing sudden death not only involves an appropriate EAP, but also education and awareness of risk factors for each individual athlete. Risk factors including intrinsic and extrinsic for heat illness should be taken into consideration as shown in Table 1.

Table 1. Predisposing Risk Factors for EHS³

Internal Factors	External Factors
Age (<15 years or >65 years)	Activity level
Alcohol consumption	Excessive clothing
Medical conditions- respiratory, cardiovascular, hematologic	Lack of water or sufficient shade
Dehydration	Temperature (ambient)
History of heat-related illness	Humidity
Medications or supplements	Wet bulb globe temperature (WBGT)
Obesity	
Overmotivation	
Poor acclimatization	
Poor cardiovascular fitness	
Recent febrile illness	
Sickle cell trait	
Lack of appropriate sleep	

Intrinsic Risk Factors

Exertional heat stroke can generally be caused either by internal or external factors.

Internal or intrinsic risk factors for EHS are predisposing factors that present within the athlete.

Acclimatization

Acclimatization should include modifying the time and length of practices beginning with shorter durations and gradually increasing to longer practices as well as avoiding practicing during the hottest and most humid times of the day. Heart rate, plasma volume, and perceived exertion changes are usually completed by 3-6 days, while rectal temperature and electrolyte concentration changes may take several additional days. Increased sweating rate is usually the last adaption often taking up to 2 weeks.⁹ Gradually increasing intensity and progressively introducing athletic equipment are also major components of acclimatizing athletes. By gradually increasing these factors, the athlete can adapt to the demands of stress being placed in them by both the environment and physical exertion. Adapting athletes to exercise in the heat

usually takes about 10 to 14 days through progressively increasing the intensity and duration of work in the heat with a combination of strenuous interval training and continuous exercise.⁴ According to the National Collegiate Athletic Association (NCAA) Sports Medicine Handbook, student-athletes should gradually increase exposure to hot and/or humid environmental conditions over a period of 7-10 days to achieve heat acclimatization. Each exposure should involve a gradual increase in the intensity and duration of exercise until the exercise is comparable to that likely to occur in competition. They also recommend that frequent rest periods are advised as well as preventing excessive tape and outer clothing that would restrict sweat evaporation.¹⁰ According to Casa et al, there is a 14-day heat-acclimatization period that should be implemented for the secondary school athlete. This should include a gradual introduction including an increase in time, intensity, and equipment to safely acclimate an athlete to the conditions presented to them.¹¹ Modifications through acclimatization to the renal and cardiovascular systems include improved sodium retention, increased renal glomerular filtration rate, and enhanced cardiovascular performance. Most cells in the body have the ability to make heat shock proteins, which serve to assist the cells in the body to tolerate heat in a more efficient manner.¹

Rest and Nutrition

Maintaining proper health through sleep and nutrition is another important risk factor to consider. Athletes should sleep at least six to eight hours of sleep in a cool environment each night.^{12,13} If this is not accomplished and an athlete begins exercising with an already increased body temperature, it will take them less time to reach a hyperthermic state.¹⁴⁻¹⁶ Athletes should also sustain a well balanced diet that follows the Food Guide Pyramid and United States Dietary

Guidelines.^{17,18} Encouraging proper eating will enforce the replacement of calories burned during exercise as well as fluids and electrolytes sodium and potassium lost through sweat. Athletes need to consume adequate energy during periods of high-intensity and/or long duration exercise to maintain body weight and health and maximize training performance. Low energy intakes can result in loss of muscle mass, menstrual dysfunction, decreased bone density, and an increase in fatigue, injury, illness, and potentially a prolonged overall recovery process.¹⁹ Athletes exercising in hot conditions especially more than once a day may require extra sodium from their diet and/or rehydration beverages to make certain that the athlete's hydration status is properly maintained.

Hydration

Hydration is a critical component for optimal athletic performance and in the prevention of heat illness.²⁰ Not only does dehydration impair physiologic function and performance,^{5,21,22} but it also increases the risk for heat exhaustion and is an obvious risk factor for EHS.²³ Dehydration, which can be caused from exercising at increased intensities and/or in a hot and humid environment without properly rehydrating, can also decrease the body's thermoregulatory function.^{3,5} Evidence for a greater physiologic strain and resultant compromised performance includes increased HR, decreased stroke volume, thermoregulatory strain (or the physiologic response to excessive heat production and storage in the absence of heat dissipation), stress response, perception of effort and anticipatory regulation of pace, hypovolemia, hyperosmolality, and a decrease in percentage of total work completed, among other factors.²² Athletes should be encouraged to match fluid intake with sweat and urine loss. This can be monitored through mandatory body weight measurements before and after each practice by a certified athletic

trainer. By obtaining this objective data, the athletic trainer can calculate the percent of water lost in a specific practice session in each athlete. This can be addressed to the athlete to motivate them to consume fluids to match this loss as well as potential disqualification until they are able to reach their starting body weight again. Athletes should be instructed to drink sodium containing fluids to keep their urine clear to light yellow to improve hydration. If an athlete had one or more practices in a day, it is recommended to replace fluids between practices to maintain less than an overall 2% body weight change.²⁰ These hydration tips will lessen the risk of acute and chronic dehydration and decrease the overall risk of heat-related illness.⁴

Extrinsic Factors

External or extrinsic risk factors associated with EHS are predisposing factors that present outside of the athlete.

Environmental Conditions

Environmental conditions have shown to be one of the most significant factors in predicting an EHS because of the inability of the body to efficiently dissipate heat through sweat and thermoregulate to adjust to extremely high temperature. Wet-bulb globe temperature (WBGT) factors in the heat and humidity as measured by a sling psychrometer and is displayed in Figure 1. This figure demonstrates the relationship between dry bulb temperature (ambient temperature) and relative humidity in conjunction with equipment added. This figure shows the relationship between temperature and relative humidity as it relates to the use of equipment. The ACSM recommends that if the WBGT is greater than 82°F, an athletic event should be delayed, rescheduled or moved into an air-conditioned facility, if possible.⁴ These guidelines are based on

an athlete that is wearing shorts and a t-shirt. Exercising in the heat compared to a neutral environment causes many physiologic changes in the dynamics of the human body including changes in circulatory, thermoregulatory, and endocrine system functions. In a hot environment, the body attempts to balance internal temperature by dissipating heat via conduction, convection, evaporation, and radiation. As ambient temperature increases, radiation and convection decrease and heat loss by conduction is usually insignificant regardless. Heat loss via evaporation becomes the predominant heat loss mechanism. Adding humidity decreases the ability for the body to dissipate heat via evaporation and when heat dissipation fails to equal heat acquisition, hyperthermia may result.²⁴

Equipment

Different clothing that is commonly worn to practice is displayed as shorts, light pads, and full pads to show the difference in heat tolerance based on equipment. Using these instruments as tools to assess the safety of competition based on environmental heat conditions provide guidelines to limit intensity and duration of activity, increase the quantity and length of breaks, limit the amount of clothing and equipment being worn by athletes, and to encourage proper hydration when rest breaks are given.

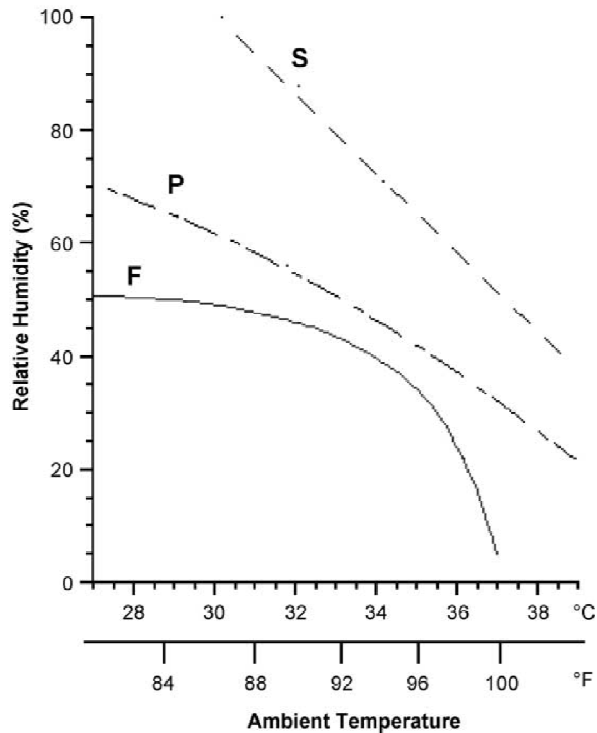


Figure 1. WBGT: Relative Humidity Versus Dry Bulb Temperature, S- clothing including shorts, socks, and sneakers; P- helmet, undershirt, shoulder pads, jersey, shorts, socks, and sneakers; F- helmet, undershirt, shoulder, pads, jersey, shorts, socks, sneakers, game pants, thigh pads, and knee pads. The zone above and to the right of each clothing ensemble (F,P,S) represents uncompensable heat stress with rising core temperature during exercise. The zone below and to the left of lines F, P, and S represents compensable heat stress with heat balance possible.³

RECOGNITION

Recognizing EHS quickly and accurately is highly important in preventing fatality. Recognition takes place during the initial evaluation of a suspected victim. It is critical to first assess airway, breathing, and circulation and to address these first if any are compromised. The

signs and symptoms of EHS including disorientation, confusion, dizziness, irrational or unusual behavior, inappropriate comments, irritability, headache, inability to walk, loss of balance and muscle function, collapse, intense fatigue, hyperventilation, vomiting, diarrhea, delirium, seizures, or coma.³ According to a study done regarding the field and clinical observations of EHS patients by Shapiro and Seidman, the following symptoms were shown to occur: coma 100%, convulsions 72%, confusion and/or agitation 100%, hypotension (systolic below 90) 35%, dry skin 26%, rectal temperature at 41 °C 55%, vomiting 71%, and diarrhea 44%.²⁵ If any of these are observed and EHS is suspected it is important to assess both temperature and cognitive function.

Temperature Assessment

The most accurate and reliable measurements of core body temperature are obtained through rectal, esophageal, and intestinal temperature readings for athletes exercising in the heat.^{26,27} This has been established as the gold standard of temperature assessment compared to aural or tympanic, oral, temporal, and axillary temperature assessments which tend to give slightly lower temperature readings regarding core body temperature. Ganio et al and Casa et al both showed that the validity of temperature assessment devices both indoors and outdoors show that compared with rectal temperature, gastrointestinal temperature was the only measurement that accurately assessed core body temperature. Oral, axillary, aural, temporal, and field forehead temperatures were significantly different from rectal temperature and therefore should not be used when assessing hyperthermia in individuals exercising both indoors and outdoors.^{28,29} Despite the fact that esophageal and intestinal temperature assessments have been shown to show no statistical difference to rectal temperature assessment, it is clear that rectal

temperature assessment is more practical for the environment in which athletes participate.³⁰ Rectal core temperature (T_{re}) should be obtained in any athlete who collapses or exhibits signs or symptoms of EHS.^{3,5,26,28,29} Although the assessment of rectal temperature can be controversial because of its obvious invasiveness, it has been shown to be the most accurate among others and should be used in conjunction with cognitive function assessment to recognize an EHS. After an EHS is suspected by a medical professional, it is important to utilize the most accurate and effective mechanisms of recognition and treatment to prevent fatality. Although rectal thermometry may be invasive for the athlete, the medical professional at the scene should be most concerned with preventing death from EHS and not the controversial aspects of T_{re} assessment. Another reason T_{re} may not be assessed is the lack of comfort and hands-on experience of the medical profession on scene. This should not be an excuse considering the proven accuracy of T_{re} in a hyperthermic person as shown in the current literature. Cost effectiveness may also be an argument against rectal thermometry however it is a one-time cost that can be reused after cleaned properly.

Cognitive Function

In conjunction with increased core body temperature, signs of central nervous system (CNS) dysfunction is another sign that an athlete is suffering from EHS. CNS functions decrease when the temperature of the brain rises. Signs and symptoms associated with this can include irritability, ataxia, confusion, dizziness, altered consciousness, convulsions, decreased mental acuity, emotional instability, hysteria, apathy, behavior changes, coordination difficulties, decreased physical performance, collapse, and coma. An athlete suspected of EHS may also be suffering from nausea, vomiting, diarrhea, headaches, weakness, hot and wet or dry skin,

increased heart rate, decreased blood pressure, increased respiratory rate, dehydration, and combativeness.^{1,4,5} It is critical that the evaluator who responds to the athlete does not overlook the fact that there may be a period of time where core body temperature is increased yet CNS dysfunction does not seem apparent yet which is known as a lucid period.²⁶ Because these symptoms are relatively subjective, it is extremely important that either the medical professional on scene or a bystander that knows the athlete can assist in determining if any of these exist within the athlete. Considering the difficulties with subjective measurements while assessing cognitive function is important to consider both cognitive function and core body temperature assessment not as two separate entities, but as one used in conjunction to each other.

TREATMENT

When an EHS is suspected, it is critical that Emergency Medical Services (EMS) is activated immediately and cooling is initiated. Although there has been discrepancy whether to cool prior to transport or transport first, it has been shown that to minimize cell damage the athlete should be cooled prior to transportation provided by EMS.^{5,31} The longer a person's temperature is above the critical level of 40°C, the more cell damage occurs within the body. As time increases with a person's temperature elevated, the percent of survival decreases dramatically as shown in Figure 2. For this reason it is important that immediate cooling is initiated when an EHS is suspected. The amount of time it takes to transport an athlete can vary depending on the location of the venue and nearest medical facility. Because of this variable, transporting an athlete prior to cooling becomes even more of an issue that cannot be relied heavily on. The common first thought in any medical emergency for most medical professionals may be to activate EMS and transport the athlete to a medical facility for advanced care,

however, the athlete should be cooled to 39°C prior to transportation to a medical facility. As long as immediate and efficient cooling is initiated in the first twenty minutes, the cell and organ damage will be minimal when reaching the advanced medical facility.³¹ Severe organ damage can occur if proper cooling techniques are not initiated immediately. Table 3 It is important to obviously first take into consideration vital signs and in particular airway, breathing, and circulation and if any of these are compromised in anyway, to transport the athlete immediately to advanced medical care.

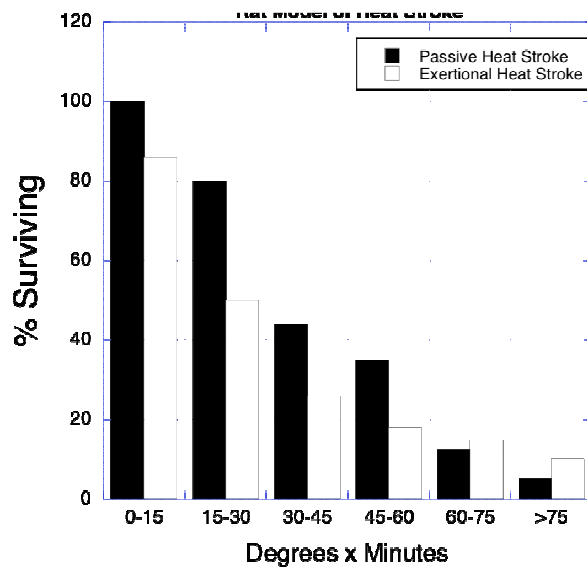


Figure 2. Survival as it Related to Severity and Duration of Hyperthermia in a Rat Model of Heat Stroke³²

Cold Water Immersion

There are several cooling modalities that are promoted to use for the treatment of an EHS including ice bags, ice packs, fans, water dousing, shade, hand cooling units, water mist, hand and feet water immersion, ice towels, ice vests, ice hoods, and cold water immersion (CWI).³¹

Although there are a number of different cooling modalities available, the cooling rates of each modality are significantly different and should be considered when choosing which should be used in treating EHS. A comparison of several cooling rates by each modality is shown by Casa et al. in Figure 3. This table shows that cold water immersion and ice water immersion are far superior to other modalities of cooling. The National Athletic Trainers' Association (NATA) promotes that the fastest way to decrease body-core temperature is CWI of the trunk and extremities into a pool or tub.⁴ A systematic review was completed by McDermott et al. showing that the available research on whole-body cooling for the treatment of exertional hyperthermia concludes that ice-water immersion provides the most efficient cooling. If ice water immersion is not possible, continual water dousing combined with fanning, cold shower, or rotating ice towels are alternative methods until advanced cooling can be done. Until further studies are done identifying whole-body cooling techniques for exercise-induced hyperthermia, ice-water immersion and cold-water immersion are the most efficient cooling methods showing the fastest cooling rates.^{33,34}

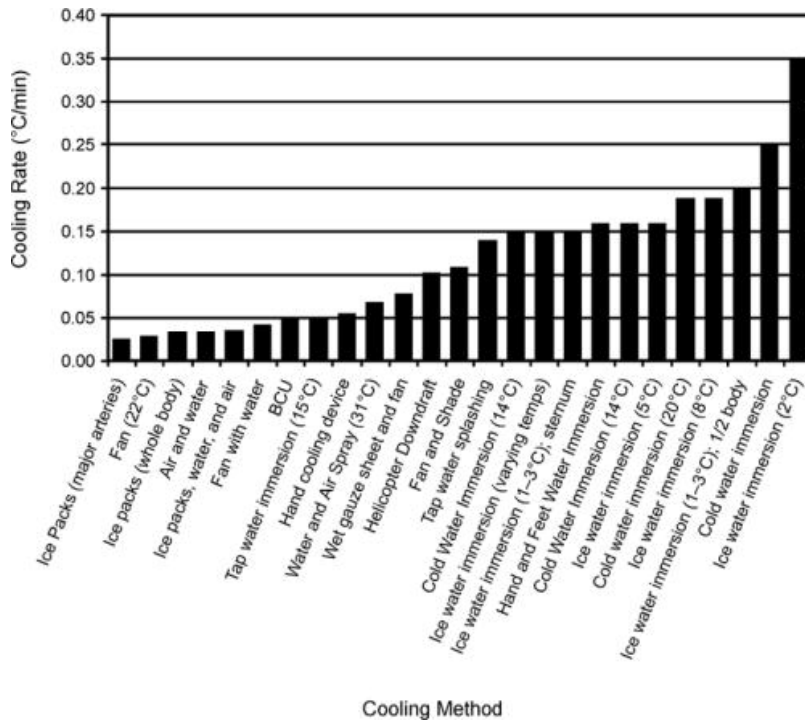


Figure 3. Comparison of Various Cooling Methods³⁵

Cold water immersion has been shown to be the gold standard for treatment of an EHS. Water has different physical characteristics that differentiate it from air such as higher thermal conductivity, higher specific heat, and a higher density. Based on this information, a person cools four times faster in water than in air of the same temperature.³¹ A study done by Proulx et al. looking at the effect of water temperature on cooling efficiency during hyperthermia in humans showed results suggesting that 2°C water is the most effective immersion treatment for exercise-induced hyperthermia demonstrating a 0.25°C/min cooling rate.³⁶ Clements et al showed that cooling rates were nearly identical between ice-water immersion and cold-water immersion concluding that given the similarities in cooling rates and rectal temperatures between ice-water immersion and cold-water immersion, either mode of cooling is recommended for treating a hyperthermic individual.³³ Similar to obtaining a T_{re} , there has been some concerns

regarding the use of CWI for treatment of an EHS as well. CWI has been criticized for several reasons including the potential for peripheral vasoconstriction, shivering, preventing advanced medical treatment, discomfort of athlete and medical staff members, and the risk of drowning if not properly monitored. Although these concerns exist, it has not been shown that any of these are valid and should prevent CWI from being used in the case of an EHS. Table 2 shows the common misconceptions of CWI and how they can be controlled. The idea that peripheral vasoconstriction delays cooling may be considered due to the initial rise in temperature while cooling, followed by a rapid decrease in temperature. The initial rise is not great enough to outweigh the rapid decrease in core temperature that is achieved through CWI. The actual procedure of CWI is argued to be uncomfortable, unsanitary, and unfeasible. Comfort and hygiene of the athlete and staff should be inferior to the act of saving an athlete's life from EHS. Immediate cooling of an athlete suffering EHS via CWI is the most effective way to decrease an athlete's core temperature rapidly. If an athlete was suffering from a life threatening cardiac condition, CPR would be initiated although clearly uncomfortable for the staff to perform and athlete to withstand. The goal for medical staff in a life-threatening situation is to save the athlete's life, no matter what.

Table 2. Common Misconceptions of CWI³⁵

Misconception	Explanation to Perpetuate Misconception
Peripheral vasoconstriction delays cooling	<ul style="list-style-type: none"> • Cold-induced dermal vasoconstriction may impede heat dissipation, even to the extent of effectively insulating the body core from its surrounding environment • Intense peripheral vasoconstriction shunting blood away from the skin and perhaps causing a paradoxical increase in core temperature • The rapid cooling of the skin from immersion in ice water induces shivering and causes intense vasoconstriction of the cutaneous vessels, which impedes the transfer of heat from the body core to the surface, which is an important process in eliminating the heat load • Common sense dictates that an overheated athlete should be placed in a cool environment, such as an air-conditioned room or even an ice bath. However, this can be counterproductive and even dangerous. The cold stimulus on the skin causes blood vessels in the skin to constrict, preventing heat dissipation from the body core. • It is necessary to emphasize the elementary fact that the evaporation of fluid from the body surface is quantitatively the most important avenue of heat dissipation. All primary efforts should therefore be directed towards achieving this goal, e.g., by means of compressed air, fans, and concurrent maintenance of a wetted body surface. The use of ice packs, chilled water, or ice-baths if contraindicated for the simple reason that they are more likely to induce dermal vasoconstriction, an event tantamount to insulating the body core from its environment, than to achieve heat dissipation through conduction
Shivering delays cooling	<ul style="list-style-type: none"> • Cold water immersion and cooling blankets can also induce shivering and cutaneous vasoconstriction, which may lead to an undesirable increase in core body temperature • Early immersion in ice water, though frequently recommended, is not without hazard, for it causes a sudden drop in temperature, and the resultant vasoconstriction and shivering impede further heat loss
Immersion is uncomfortable for patient/staff	<ul style="list-style-type: none"> • Cold water immersion is uncomfortable for both patient and staff and can interfere with the resuscitation measures that are often necessary in this setting • In contrast to the severe discomfort, including shivering, observed by whole body immersion in an ice water bath, the patient is comfortable and at ease
Difficult to apply supplemental treatments (AED, intravenous fluid, oxygen, etc.)	<ul style="list-style-type: none"> • Although thermal vasoconstriction may be countered through whole-body immersion in lukewarm water, immersion techniques have other disadvantages, e.g., they are impractical if administration of oxygen and IV fluids is necessary • Immersion cooling also may make it difficult to access a patient- a concern if the patient experiences cardiac arrest
Immersion may be unsanitary	<ul style="list-style-type: none"> • Immersion in ice water is uncomfortable, unpleasant, and unclean for comatose or restless patients who may vomit or urinate during cooling • While a tub of water mixed with vomitus and diarrhea of comatose patients is unhygienic to both the patient and his attendants
Hypothermic afterdrop	<ul style="list-style-type: none"> • The method is nevertheless contraindicated, apart from the difficulty of patient management and discomfort, simply on the basis of the danger of a hypothermic overshoot • The results reported here suggest that evaporative cooling (tap water splashing with wind) is the preferred procedure on several counts
Immersion is not the most effective or recommended cooling modality	<p>(Also refute immersion simply on the basis of the danger of a hypothermic overshoot)</p> <ul style="list-style-type: none"> • The device can extract heat 3-5 times faster than any other technique that is available today for extracting heat. This is believed to be better than cooling off with a bucket of ice
Immersion is unfeasible and requires staffing numbers	<ul style="list-style-type: none"> • How can one medical professional safely immerse an individual in a tub of water?

While using CWI, the medical staff can continue to monitor vitals such as monitoring airway, breathing, circulation, T_{re} assessment, and even administering intravenous fluids if necessary. After CWI is initiated, T_{re} should be assessed every 10 minutes and should be continued until the patient's temperature reaches 101°-102°F. Only when this temperature is reached should the athlete be transported to an advanced medical facility for further follow up. Table 3 and Table 4 show the comparison between an athlete being immediately cooled once an EHS is suspected versus an athlete receiving cooling after a delay due to transporting based on CWI, Wet towels, and ice bag cooling rates. Cold water immersion was based on using water with a temperature of 20°C. Wet towels and Ice bags are based on rotating either modality on areas including the groin, neck, and armpits. It is clear with this comparison that delaying cooling keeps an athlete's temperature at a critically high level for a longer amount of time causing more damage. For example, even if an athlete is properly cooled via CWI but the treatment is delayed, the patient will still be above 105.5°F for 35 minutes compared to only 7 minutes if immediate cooling is initiated. It is critical to decreasing cell damage and potential fatality that the athlete is cooled first and transported second for the best chance of survival.³⁵

Table 3. Time to Recognition and Cooling: Immediate ATC Response to EHS³⁷

	Cold-Water Immersion 20°C Cooling Rate .2°C/min	Wet Towels Cooling Rate .11°C/min	Ice Bags Cooling Rate .05°C/min	Nothing Cooling Rate .025°C/min
4:30 - Athlete Collapses / EHS Determined / Cooling Started	42.22°C (108°F)	42.22°C (108°F)	42.22°C (108°F)	42.22°C (108°F)
4:32 - Call 911	41.82°C (107.28°F)	42.0°C (107.6°F)	42.12°C (107.82°F)	42.17°C (107.91°F)
4:34 - Ambulance Dispatched	41.42°C (106.56°F)	41.7°C (107.2°F)	42.02°C (107.64°F)	42.12°C (107.82°F)
4:37 - Ambulance Leaves Center	40.82°C (105.48°F)	41.45°C (106.61°F)	41.87°C (107.37°F)	42.045°C (107.68°F)
4:52 - Ambulance On- Site	38.82°C (101.88°F) Cooling Stopped at 4:47	39.8°C (103.64°F)	41.12°C (106.02°F)	41.67°C (107.1°F)
4:55 - EMS at Patient		39.47°C (103.05°F)	40.97°C (105.75°F)	41.595°C (106.87°F)
5:10 - EMS leaves Scene		38.92°C (102.06°F) Cooling Stopped at 5:00	40.22°C (104.4°F)	41.22°C (106.2°F)
5:25 - Ambulance Arrives at Hospital			39.97°C (103.95°F)	41.095°C (105.97°F)
5:28 - Care Begins			39.82°C (103.68°F)	41.02°C (105.84°F)
5:40 - Cooling Begins			39.22°C (102.6°F)	40.72°C (105.3°F)
			Cooling Continues until 5:50 (38.944°C/102 .1°F)	Cooling Continues w/ Ice Bags until 6:16 (38.889°C/102° F)
Minutes Above 104°F	7 minutes	13 minutes	28 minutes	70 minutes

Table 4. Time to Recognition and Cooling: Delayed Response to EHS³⁷

	Cold-Water Immersion 20°C Cooling Rate .2°C/min	Wet Towels Cooling Rate .11°C/min	Ice Bags Cooling Rate .05°C/min	Nothing Cooling Rate .025°C/min
4:30 - Athlete Collapses 1st Time	41.667°C (107.0°F)	41.667°C (107.0°F)	41.667°C (107.0°F)	41.667°C (107.0°F)
4:45 - Athlete Collapses 2nd Time	41.994°C (107.5°F)	41.994°C (107.5°F)	41.994°C (107.5°F)	41.994°C (107.5°F)
4:50 - Athlete is moved to Shade / Cooling Begins	42.22°C (108°F)	42.22°C (108°F)	42.22°C (108°F)	42.22°C (108°F)
5:00 - Call 911	41.82°C (107.28°F)	42.0°C (107.6°F)	42.12°C (107.82°F)	42.17°C (107.91°F)
5:02 - Ambulance Dispatched	41.42°C (106.56°F)	41.78°C (107.2°F)	42.02°C (107.64°F)	42.12°C (107.82°F)
5:05 - Ambulance Leaves Center	40.82°C (105.48°F)	41.45°C (106.61°F)	41.87°C (107.37°F)	42.045°C (107.68°F)
5:20 - Ambulance On- Site	38.82°C (101.88°F) Cooling Stopped at 5:15	39.8°C (103.64°F)	41.12°C (106.02°F)	41.67°C (107.1°F)
5:23 - EMS at Patient		39.47°C (103.05°F)	40.97°C (105.75°F)	41.595°C (106.87°F)
5:38 - EMS Leaves Scene		38.92°C (102.06°F) Cooling Stopped at 5:28	40.22°C (104.4°F)	41.22°C (106.2°F)
5:53 - Ambulance Arrives at Hospital			39.97°C (103.95°F)	41.095°C (105.97°F)
5:56 - Care Begins			39.82°C (103.68°F)	41.02°C (105.84°F)
6:08 - Cooling Begins			39.22°C (102.6°F)	40.72°C (105.3°F)
			Cooling Continues until 6:18 (38.944°C/102.1°F)	Cooling Continues w/ Ice Bags until 6:44 (38.889°C/102°F)
Minutes Above 104°F	35 minutes	40 minutes	56 minutes	98 minutes

RETURN TO PLAY

After an EHS, an athlete may experience impaired thermoregulation, persistent CNS dysfunction, hepatic insufficiency, and renal insufficiency which may last up to more than 1 year depending on the individual.⁴ Exertional Heat Stroke can affect internal organs including the brain, liver, heart, and kidneys, so return to play following an EHS is crucial to recovery.³⁸ However, a patient that has suffered an EHS and was treated rapidly show no damage caused. The severity of an EHS plays a large role in the amount of damage to the body and should be highly taken into consideration when determining when an athlete should return to play. The current military guidelines for the U.S. Army and Air Force include first being referred to a Medical Review Board (MEB) to determine when and if they can return to full duty based on a series of lab tests, mental, and physical status followed by a gradual return to activity including 3 months with no heat intolerance. Similarly the U.S. Navy and Marine Corps required to see the Physical Evaluation Board (PEB) where a physician will determine the physical status of the patient and grant up to 90 days of light/limited duty. The Israeli Defense Forces (IDF) has had a heat tolerance test (HTT) for many years to determine when soldiers are able to return to duty. This HTT requires a soldier to walk on a treadmill at a speed of 5 km/hr on a 2% grade for two hours under a high heat load while rectal temperature, heart rate, and sweat rate are measured to determine if the patient is ready to return to full duty.³⁹ This HTT is something that has been considered for the athletic population, however, has never become required. It is recommended by the NATA that an athlete is cleared by a physician before returning to activity in athletics. The athlete's return to full participation should be gradual and monitored by medical staff.⁴ The progression to return to athlete to play should be dependent on the severity of the EHS and damage caused. It is recommended, however, that an athlete should avoid all exercise for a

minimum of 1 week after release from medical care. Generally, the gradual return to play should begin with light exercise indoors in a climate-controlled facility progressing to intense exercise in a climate-controlled facility. Light exercise in heat should occur next followed by strenuous exercise in the heat. If applicable, light exercise with equipment in the heat followed by strenuous exercise in the heat with equipment should follow. It is important for an athlete to be monitored and proceed through a gradual progression back into full participation considering they may be at a higher risk of suffering another exertion heat illness with past history.^{5,26}

EMERGENCY MEDICAL TECHNICIAN (EMT)

EHS is a serious medical emergency in athletics that is usually first recognized by a medical staff member on site such as an athletic trainer (AT). Because EHS is a potentially life threatening situation, the activation of EMS is crucial to later advanced medical services. At this point there may be more than one medical professional on site working together to treat this condition. It is important that both the medical staff on site and the medical staff arriving on the scene are on the same page to treat the athlete in the most efficient and effective manner. The NATA position statement on EHS states that an athlete should be immediately cooled when an EHS is suspected and transported second, however EMTs do not receive the same education on this treatment protocol.⁴ A policy should be in place at each venue in conjunction with EMTs to cool onsite. This conflict of knowledge may cause confusion and improper treatment of an EHS. While an AT is taught to cool first, and transport second, an EMT commonly wants to transport first to get the athlete to advanced medical care as soon as possible. The delay from transporting an athlete from being immediately cooled may lead to more serious damage and potentially may

deem fatal. This confusion could be avoided if all medical professionals were provided the same knowledge regarding the recognition and treatment of EHS.

Certification and Licensure

The National EMS Scope of Practice Model states that there are four levels of EMS personnel licensure including Emergency Medical Responder, Emergency Medical Technician, Advanced Emergency Medical Technician (Intermediate), and Paramedic. The primary focus of an Emergency Medical Responder is to initiate immediate lifesaving care of critical patients who activate EMS under direct supervision. This individual possesses basic knowledge and skills necessary to provide lifesaving interventions while waiting for additional EMS with higher qualifications to arrive at the scene to assist in transport as shown in Table 5. The primary focus for the Emergency Medical Technician is to provide basic emergency medical care and transportation for critical and emergent patients who activate EMS. This individual has the basic knowledge and skills necessary to provide patient care and transportation and is also under direct medical oversight. EMTs perform interventions with basic equipment found on an ambulance and serve as a link from the scene to the advanced medical site. Advanced Emergency Medical Technicians (Intermediate) provide basic and limited advanced emergency medical care and transportation for critical and emergent patients who activate EMS. These individuals also possess basic knowledge and skills necessary to provide patient care and transportation under medical oversight. These individuals can perform interventions with basic and advanced equipment on an ambulance and also serve as a link from the scene to the emergency health care system. The paramedic is an allied health professional whose primary focus is to provide advanced emergency medical care for critical and emergency patients activating EMS. This

individual possesses complex knowledge and skills necessary to provide patient care and transportation. Paramedics also function as part of the comprehensive EMS response under medical oversight utilizing basic and advanced equipment available.⁴⁰

The National Registry of Emergency Medical Technicians (NREMT) currently certifies five levels of Emergency Medical Professionals: First Responder, Basic, Intermediate/85, Intermediate/99, and Paramedic. The NREMT is accredited by the National Commission for certifying Agencies (NCCA), the accreditation body of the National Organization for Competency Assurance (NOCA) as well as the Commission on the Accreditation of Allied Health Educational Programs (CAAHEP). The certification examination questions are written by national experts including state officials, educators, employers, and EMS physicians. The NREMT defines entry level competency through committees of providers, regulators, and medical directors. The examination is directly related to practice through data obtained from the NREMT Practice Analysis. A minimum score of 70% obtained on the certification examination is required for a passing grade. Certification through the NREMT indicates that a standard level of competency has been met demonstrating entry level competency, however it does not authorize a person to work. Emergency medical professionals are required to obtain a state license to work. In conjunction with a written examination, a psychomotor competency (practical exam) must be taken as well. Forty-six states currently use the NREMT for certification for one or more EMS levels. States that do not use the NREMT must develop their own standards which tends to lead to inconsistency among the country. Recertification is required nationally through continuing education and competency verification every two years to ensure continued competency.⁴¹

Table 5. EMS Scope of Practice⁴²

Level of Certification	Scope of Practice
Emergency Medical Responder	Initiate immediate lifesaving care to critical patients who access EMS. Provide lifesaving interventions while awaiting additional EMS response to assist higher level personnel. Serve as a part of the comprehensive EMS response, under medical oversight. Perform basic interventions with minimal equipment.
Emergency Medical Technician	Provide basic emergency medical care and transportation for critical and emergent patients who access EMS. Provide patient care and transportation under medical oversight. Perform interventions with basic equipment found on an ambulance. Serve as a link from scene to emergency health care system.
Advanced Emergency Medical Technician	Provide basic and limited advanced medical care and transportation for critical and emergent patients who access EMS. Provide patient care and transportation. Serve as part of comprehensive EMS response, under medical oversight. Perform interventions with basic and advanced equipment found on an ambulance. Serve as link from scene to emergency health care system.
Paramedic	Allied health professional whose primary focus is to provide advanced emergency medical care for critical and emergent patients who access EMS. Provide patient care and transportation. Serve as part of comprehensive EMS response, under medical oversight. Perform interventions with the basic and advanced equipment found on an ambulance. Serve as link from scene to health care system.

Education Requirements

The education requirements for each type of EMS member vary based on the level of certification. Each level increases in curriculum rigor including First Responder, EMT-Basic, Intermediate/85, Intermediate/99, and Paramedic respectively. Table 6 displays the 5 different levels of EMS comparing several variables including age, previous certifications and education required, CPR requirements, cognitive testing curriculum, cognitive examination contents, and psychomotor examination.⁴¹ The National EMS Scope of Practice Model identifies the psychomotor skills and knowledge necessary for the minimum competence of each nationally identified level of EMS provider. This model is used to develop National EMS education

Standards, national EMS certification exams, and national EMS educational program accreditation. In order to be eligible for state licensure, under this model, EMS personnel must be competent in the minimum knowledge and skills needed to ensure safe and effective practice at that specific level in which they are certified. Scope of practice is a legal description of the distinction between licensed health care personnel and the common person and among different licensed health care professionals. Table 6 displays the relationship between education, certification, licensure, and credentialing among EMS medical staff.⁴²

Table 6. Emergency Medical Services: Education and Credentials⁴⁰

	Age	Req. Hours	Education	CPR	Cognitive Curriculum	Cognitive Exam	Psychomotor Examination
First Responder	-	48-60	state approved First Responder Course	X	airway, breathing, cardiology, trauma, medical, obstetrics, pediatrics, EMS operations.	computer adaptive test (CAT), 80-110 questions, 1h 45m 0s	state-approved exam
EMT-Basic 18	18	150-190	state approved EMT-Basic Course	X	airway, breathing, cardiology, trauma, medical, obstetrics, pediatrics, EMS operations	CAT, 70-120 questions, 2h 0m 0s	patient assessment of a trauma patient, cardiac arrest/AED, bag-valve mask, spinal immobilization, fracture immobilization, joint dislocation immobilization, traction splinting, bleeding control/shock management, upper airway adjuncts and suction, mouth-to-mouth ventilation, and supplemental oxygen
185	18	150-250	state approved Intermediate/85 Course	X	airway, breathing, cardiology, trauma, medical, obstetrics, pediatrics, EMS operations	CAT, 85-135 questions, 2h 15m 0s	patient assessment/management, ventilatory management, intravenous therapy, spinal immobilization, bleeding control/shock management
199	18	150-250	state approved Intermediate/99 Course	X	airway, breathing, cardiology, trauma, medical, obstetrics, pediatrics, EMS operations	computer based test (CBT), 150 questions, 2h 30m 0s	patient assessment-trauma, patient assessment- medical, ventilatory management, cardiac management, IV and medication, pediatric, spinal immobilization, bleeding control/shock mngmt.
Paramedic 18	18		state approved Paramedic Course	X	airway, breathing, cardiology, trauma, medical, obstetrics, pediatrics, EMS operations	CAT, 80-150 questions, 2h 30m 0s	patient assessment-trauma, ventilatory management, cardiac, IV and Medication, Oral communications, pediatric, spinal immobilization, bleeding control/shock mngmt.

Specifically, the EMT-Basic Course, which is the course all EMTs must take in order to become an EMT-Basic or higher, requires a minimum of 110 hours modeled by the National Standard Curriculum given by the national highway Traffic Safety Administration (NHTSA). Most state requirements exceed the 110 hours minimum and the average EMT-basic course now

runs between 130-150 hours and includes modules such as preparatory for anatomy and physiology, airway, patient assessment, medical emergencies, trauma emergencies, pediatrics, and ambulance operations. The NREMT certification examination is not utilized by all states, and the states that do not utilize their own exams. With this in mind, the advantage of the NREMT certification is that it facilitates the movement of one's license from one state to another.⁴³

Curriculum

An EHS is considered a medical emergency and more likely than not the patient is unresponsive. In a current EMT curriculum textbook titled *Emergency Care* written by Limmer et al., treating an unresponsive patient is discussed. It states that when approaching an unresponsive patient, a rapid physical exam should be performed first including assessing the head, neck, chest, abdomen, pelvis, extremities, and posterior. Assessing each area should include looking for signs of injury such as deformities, contusions, abrasions, penetrations, burns, tenderness, lacerations, and swelling. Vital signs should then be obtained including respiration, pulse, skin color, temperature, condition, pupils, blood pressure, and oxygen saturation. A sample history should then be taken by interviewing family and bystanders for information about the present illness. Such information asked should include the patient's signs and symptoms, allergies, medications, pertinent past history, last oral intake, and events leading to illness. Lastly, online medical direction should be contacted and interventions should be performed as needed followed by transporting the patient.⁴⁴ An EMT following this sequence of assessments when arriving on the scene of an unresponsive patient will not seek information from bystanders only after obtaining an overall assessment of the patient including vital signs.

An important bystander to consult at an athletic event may be an AT who witnessed the event and has been providing care until the EMT arrived. Not obtaining information from an AT until after performing these assessments may be the difference in saving a life. An athlete may be unresponsive for a number of different reasons and differential diagnosis may be difficult if the mechanism is unknown. It is important to understand the mechanism of injury to help determine what treatment to initiate.

EMT curriculum covers several different areas pertaining to EHS including body temperature, temperature regulation, effects of heat on the body, heat production and loss, hyperthermia, and heat-related illnesses as shown in Table 7. Body temperature is described as the balance between the heat produced by the body and the heat lost from the body. Rectal temperature is considered a measurement of the body's core temperature. The temperature measured in the armpit (the axillary temperature) or orally is about 1°F less than the rectal (core) temperature. Although this information is provided, the current EMT literature does not specify which mode of temperature should be performed for the most accurate core body temperature assessment. The body regulates core temperature through vasodilation, vasoconstriction, sweating (through evaporation), shivering, increasing or decreasing activity, and behavioral responses.⁴⁵ Hyperthermia is defined as an increase in body temperature above normal caused when heat gained exceeds heat lost.⁴³⁻⁴⁵ Heat is lost through conduction, convection, radiation, and evaporation, however, in a hot and/or humid environment the skin may absorb more heat than it loses potentially leading to heat-illness. Predisposing factors for heat-illness include dehydration, diabetes, fever, fatigue, high blood pressure, heart disease, lung problems, obesity, drug use, medications, fever, thyroid disorder, Parkinson's disease, previous history, and lack of acclimatization.^{44,45}

Table 7. EMT Curriculum Regarding EHS⁴³⁻⁴⁵

	Lapierre	Limmer et al	Aehlert
Hyperthermia definition	An Increase in body temperature above normal when heat gained exceeds heat lost	An Increase in body temperature above normal when heat gained exceeds heat lost	An Increase in body temperature above normal when heat gained exceeds heat lost
Predisposing Risk Factors	None	Dehydration, diabetes, fever, fatigue, high BP, heart disease, lung problems, obesity, drug use, age, existing injuries	High ambient temp, dehydration, lack of acclimatization/physical fitness, medications, lack of mobility, impaired thermoregulation, impaired sense of thirst, age, medications, drug use, heart disease, obesity, fever, fatigue, diabetes, thyroid disorder, Parkinson's disease
Preferred temperature assessment	None	None	None
Symptoms	skin	rapid, shallow breathing, generalized weakness, little or no perspiration, loss of consciousness or altered mental status, dilated pupils, seizures	dry, hot, flushed skin, high body temperature (higher than 103F orally), fast heart rate followed by slow heart rate, deep breathing followed by shallow breathing, headache, dizziness, nausea, vision disturbances, muscle twitching, seizures, unresponsiveness
Treatment	Basic life support, aggressive cooling with cool wet towels to groin, axillary, cervical regions, cooling should be done en route to emergency room and should not delay transport	Remove patient from hot environment and move to cool spot, remove clothing, apply cool packs to neck, groin, and armpits, keep skin wet with sponge or towels, fan aggressively, administer oxygen, transport immediately, if transport is delayed find a tub and immerse patient up to neck in cooled water and monitor vital signs.	Call for advanced life support and transport immediately, give oxygen, start cooling patient with cool packs to neck, armpits, and groin, fan aggressively, never cool in ice bath, monitor vitals

Heat stroke is recognized as the least common heat-illness but as a serious medical emergency. It occurs when the body can no longer regulate its temperature. Current EMT curriculum does not differentiate between a classical heat stroke, which is commonly experienced by infants or elderly in hot and humid environments and EHS which is commonly experienced by athletes undergoing intense exercise in a hot and humid environment. It suggests that the signs and symptoms of heat stroke include altered mental status or loss of consciousness, rapid pulse, hot skin, high body temperature (higher than 103°F or 39.4°C), deep breathing, headache, dizziness, nausea, vision disturbances, muscle twitching, and seizures. One sign of heat stroke shows to be different among the current EMT literature. Aehlert et al. states that a sign of heat stroke is dry, hot, flushed skin,^{43,45} while Limmer et al. states that the skin may be hot and dry or moist.⁴⁴ This creates major confusion when determining whether an athlete is experiencing a heat stroke or not. If an EMT is taught that if an athlete is still sweating then they are not experiencing a heat stroke, this is a problem! It is important that the literature is consistent among the current literature to be taught in an effective manner. Although a patient may not be able to release heat through evaporation (sweating), sweat may still be present on the skin from previous exercise and heat loss mechanisms. The NATA Position Statement on EHS states that an athlete may still be sweating when experiencing an EHS,⁴ so it is crucial that a medical staff member arriving on scene does not believe that if the patient is still sweating, it cannot be a heat stroke.

Emergency care of a heat stroke is described as a procedural list of events to immediately initiate treatment. Current literature agrees that is important for an EMT to immediately initiate a mechanism of cooling to decrease the patient's core body temperature. Dated back to 1895, Wilson et al⁴⁶ showed the importance of rapid cooling by being the first to

state that you should cool first and transport second. They prescribed the use of ice or cold water and measuring of temperatures in the rectum stating “From the experience of several physicians it must be remarked that for the treatment of insolation (thermic fever) every ambulance should carry ice, sprinkler, and pail, and the patient should be treated on the spot until the ambulance surgeon feels it is safe to move him. It is essential to have the patient’s clothing removed, and it is best to take thermometric observations with the thermometer in the rectum.” First, the EMT is instructed to remove the patient from the hot environment and place him in a cool environment (in an ambulance with air conditioner running on high). Remove clothing and apply cool packs to neck, groin, and armpits. Keep the skin wet by applying water by sponge or wet towels and fan aggressively.⁴³⁻⁴⁵ Aehlert et al. suggests to never try to cool a patient by placing him in an ice water bath. Also advocated is to never cool the patient to the point of shivering because shivering generates more heat. And, transport should never be delayed to cool the patient.⁴⁵ Oxygen should be administered by a nonrebreather mask at 15 liters per minute and the athlete should be transported immediately.⁴³⁻⁴⁵ However, if transport is delayed for some reason, the patient should be immersed in a tub up to the neck in cooled water while vital signs are monitored. A pediatric note is given stating that for infants or young children, cooling should be started using tepid (lukewarm) water progressing to cooler water at the recommendation of medical direction.⁴⁴ It is important to recognize that the current literature among EMTs alone is not consistent, recommending contradicting recognition and treatment strategies. Also the current literature as a whole among EMTs is not consistent with the current body of knowledge provided to athletic trainers. Specifically, EMT literature suggests to transport prior to cooling is initiated which is inconsistent with the AT literature suggesting to always cool first and transport second. Because an AT may be the first medical professional to the scene, they will initiate

treatment based on what they have been educated on. Soon later to the scene may be an EMT, with a different set of knowledge and beliefs on what they believe to be the proper treatment for an EHS. These contradicting beliefs can cause major confusion at the site of a medical emergency! If all medical professionals are not on the same page, it may be a life-threatening situation for the patient. Optimal treatment in an emergency situation requires quick and efficient protocols which cannot be achieved if the medical professionals at the scene are not working together toward the same goal based on the current literature available regarding evidence based medicine.

EVIDENCE BASED PRACTICE

Evidence based practice (EBP) follows the concept of evidence based medicine (EBM) which is practicing based on the current literature that is represented in a given field of knowledge. Studies are constantly being conducted in the medical field, which updates and improves the current recommendations for the care of patients. New research is constantly being published proving and disproving medical theories that are currently being practiced. It is important for a professional working in the medical field to follow the current literature available within their scope of practice to ensure that proper recognition and treatment of patients is carried out. This can be done in many ways including obtaining continuing education units (CEUs), workshops, pertinent courses, and keeping up with current literature within your field. Not only is it important for each individual to keep up to date with the current evidence based medicine, but also for authors and educators who are instructing the up and coming generation of medical professionals. Contradictory educational tools in the field of medicine will only result to conflicting beliefs of attitudes among medical professionals. This shows to be true among the

literature given to EMTs versus ATs in regards to the recognition and treatment of EHS. This inconsistency will lead to poor patient treatment and potentially cause more harm than good to patients being treated for any medical emergency.

A study by De Smedt⁴⁷ et al investigated primary care professionals' self reported attitudes towards EBP, attention to information sources, perceptions of the barriers to EBP, and strategies to improve insight in EBP and patient care. EMTs, firemen, and medical volunteers were found to be supportive to of EBP and agreed that this concept improves patient care, however, they claimed that only 54% of their practice is evidence-based. All subjects strongly relied on experimental knowledge gained through interaction with colleagues, although the majority reported that colleagues are often not supportive of EBP. Lack of time, the overwhelming mass of literature, difficulties with implementation of evidence in to practice are the most common barriers to EBP. These barriers prevent medical professionals from providing optimal patient care utilizing EBM and essentially cause an inconsistency among medical professionals.

QUALITATIVE RESEARCH

Qualitative and quantitative are two separate types of research. A comparison of the two methodologies is illustrated in Table 8. Quantitative research focuses on specific variables usually in a laboratory setting. It is based on statistical significance to prove or disprove a predicted hypothesis and is objective in nature. Qualitative research, on the other hand, uses an open-ended approach exploring data using observation, focus groups, and interviews etc. to observe aspects that occur in real life situations.^{48,49} These subjective observations are used to formulate a hypothesis based on the findings. Strategies such as interviews, conversations, focus

groups, and field notes are used to examine a person's beliefs or views on a specific area to examine human behavior. Because there is an existing gap in the relationship of ideas regarding the recognition and treatment of EHS between sports medicine professionals and EMS, it is important that this is addressed. Using a qualitative approach to study the rationale among EMTs as to why they practice specific EHS treatment protocols over others may explain how to close the gap among different medical professionals. If there is common reasoning among EMTs why certain treatment protocols for EHS are practiced over others, it will be easier to determine how to create consistency among medical professionals that arrive at the scene of an emergency situation.

Interviews are utilized when a researcher needs to understand factors that cannot be observed such as a subject's thoughts, feelings, and perceptions. They are also conducted when information regarding past experience needs to be obtained. An interview can take several different forms including unstructured, semistructured, or structured formats. Most commonly a semistructured format is used directed by an interview guide, which contains a list of questions. The interview is recorded and transcribed at which point the data are considered textual and written words can be analyzed.⁴⁸ Qualitative research data collection methods include focus groups, phone interviews, and surveys. Focus groups in particular involve a guided interview with a small group of subjects. This method not only allows the interviewer to observe the subject's thoughts, feelings, and perceptions on a topic, but also facilitates more conversation among not only one person, but a group of people with similar backgrounds.

Table 8. Qualitative Versus Quantitative Research^{50,51}

Criteria	Qualitative Research	Quantitative Research
Purpose	To understand and interpret social interactions	To test hypotheses, cause and effect, make predictions
Group Studied	Smaller and not randomly selected	Larger and randomly selected
Variables	Study of the whole, not variables	Specific variables studied
Type of Data Collected	Words, images, or objects	Numbers and statistics
Form of Data Collected	Open-ended responses, interviews, field notes, reflections	Precise measurements with structured and validated means
Type of Data Analysis	Identify patterns, features, themes	Identify statistical relationships
Objectivity and Subjectivity	Subjective	Objective
Role of Researcher	Biases may be known to participant and vice versa	Double blind studies
Results	Specific findings that is less generalizable	Generalizable findings applied to other populations
Scientific Method	Exploratory, hypothesis generated from data collected	Hypothesis tested
Most Common Research Objectives	Explore, discover, construct	Describe, explain, predict
Nature of Observation	Behavior studied in natural environment	Under controlled conditions, isolate causal effects
Final Report	Narrative, contextual, direct quotations from participants	Correlations, comparisons, and statistical significance

The purpose of this investigation is to gain a better understanding of the Emergency Medical Technician (EMT) understanding of best practices as it relates to the recognition and treatment of EHS. Additionally, we hope to gain more insights into the working relationship between the EMT and the Certified Athletic Trainer (AT) and the influence it may have on the recognition and treatment of an athlete with EHS. The study will be guided by the following questions: 1) what do EMTs know about the recognition, diagnosis, and treatment of EHS, 2) do they implement best practices regarding EHS, and 3) what influences their decisions regarding those practices?

PRACTICAL IMPLICATION

Although emergency situations do not occur every day in the world of sports, it is important that when they do everything run smoothly. If an appropriate EAP is not properly written and rehearsed by all pertinent sports medicine professionals and EMS, the risk for confusion in an emergency is extremely high. Because an AT is usually one of the first individuals to reach an athlete in an emergency and also usually one of the individuals who witnessed the incident, it is important that they establish a solid relationship with EMS. Once EMS is activated by an AT, they become an integral part of the initial treatment and transport of the athlete. If there are existing conflicting views regarding the treatment and transportation of an athlete in an emergency, confusion may arise and the athlete could be put at an increased risk for harm. Because the views among ATs and EMTs regarding the recognition and treatment of EHS are inconsistent, it is important that this be addressed so that it can be resolved to provide efficient and adequate care for an athlete. Investigating the working relationship between ATs and EMTs will provide information to better the medical profession to assure that proper patient care is consistent and efficient. Exploring not only what EMTs know about the EHS but also what practices are implemented and why will provide data to compare to what ATs know and practice. Closing the gap between the two medical professions will ensure proper recognition, diagnosis, and treatment of EHS based on the current evidence based medicine provided in the literature.

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INTRODUCTION

Exertional Heat Stroke (EHS) is a major concern in both high school and collegiate athletics, particularly due to the fact that it is consistently one of the top three causes of sudden death in sport.¹⁻⁵ EHS, as compared to a classical heat stroke usually affects healthy active people during intense exertion. Over the past 10 years, at the high school and collegiate levels, there have been 27 EHS deaths in football alone, and the past five year period has seen the highest five-year death rate over the past 35 years.^{6,7} The increasing number of deaths caused from EHS are troublesome considering they are entirely preventable and treatable once accurately diagnosed (and the condition can be prevented in the first place in numerous circumstances).

The National Athletic Trainers' Association (NATA)¹ and American College of Sports Medicine (ACSM)² recognize the severity of the condition releasing position statements outlining the proper steps for prevention, recognition, and treatment of EHS. These guidelines, which are based upon the most current evidence, recommend the use of rectal temperature assessment (T_{re}) for diagnosis and cold water immersion (CWI) for treatment of EHS. Evaluation of a suspected EHS should include a measurement of core body temperature via T_{re} as well as an assessment of CNS dysfunction along with other common symptoms associated with the condition.^{1,2,8,9} Upon diagnosis of EHS, whole body cooling should take place via CWI. The evidence demonstrates that CWI has the fastest cooling rates among other cooling methods, such as ice bags, and cool mist.^{1,5,10} Rectal temperature assessment and the use of CWI are practiced in collaboration, at the Falmouth Road Race and Marine Corps Marathon among other prominent road races and military bases. Over the last 40 years, the two have demonstrated 100% effectiveness as death has not resulted when using the two methods at Falmouth Road Race. Also, illustrating the importance of utilizing the two methods jointly is the evidence

demonstrating that death from EHS has been shown to be 100% preventable if treated via CWI within the first 10 minutes after collapse.⁷⁻¹¹

Body temperature assessment can be determined by a variety of devices including oral, axillary, tympanic, and temporal.^{8,9} Although medical care professionals use these easily accessible techniques routinely, current research has shown that these devices provide inaccurate measurements of core body temperature while exercising due to a variety of internal and external variables. Environmental conditions while exercising such as wind, rain, direct sunlight, and sweat can all influence the accuracy of temperature assessment if rectal temperature is not used. Internal core body temperature increases differently than oral, axillary, or skin temperatures.^{8,11} Because of these variables, gastrointestinal (GI) and T_{re} are the most accurate. Because GI temperature assessment is sometimes not practical, it is important to use T_{re} when assessing temperature in an exercising athlete. It may be argued that temperature assessment is not necessary, however many conditions such as cardiac, head injury, exertional sickling, or other heat related conditions including heat exhaustion may present with similar signs and symptoms.¹² Recognizing the complexity in diagnosis, it is imperative for an accurate diagnosis to obtain an accurate core body temperature to rule these other conditions out as well as to navigate the most appropriate care.

Athletic Trainers (ATs) are often the first medical professionals arriving at the scene. Athletic trainers are unique health care providers who specialize in the prevention, assessment, treatment, and rehabilitation of injuries and illnesses. Previous research reveals that ATs despite having knowledge of the NATA position statement on heat illness and having reviewed it (77.1%), less than 20% of them use T_{re} to assess core body temperature to recognize EHS, and less than half used cold-water immersion to treat EHS.¹³ The literature reveals several barriers to

using T_{re} including the invasiveness of the device, lack of training related to the use of the device, and a lack of equipment to carry out a rectal temperature assessment.¹³ Barriers to the implementation of CWI or ice water immersion included limited resources, location of practice/game facilities, and shock and safety of the athlete once emerged into the immersion tub.¹³

Although ATs usually are the first medical providers to respond to an EHS, they are not the only medical providers that can be involved in the immediate treatment of the potential case. In some cases such as a secondary school setting, an AT may not be present to diagnosis or care for the athlete suffering from a possible case of EHS. The Inter-Association Task Force on Exertional Heat Illnesses Consensus Statement recommends to cool first via CWI, then transport second.¹⁴ Because an EHS is a life threatening condition, which requires immediate cooling and then transportation, Emergency Medical Services (EMS) will be activated and Emergency Medical Technicians (EMTs) and/or paramedics will arrive on the scene. The NATA position statement on emergency planning recommends that the emergency action plan (EAP) at an institution should be developed, reviewed, and rehearsed in conjunction with EMS.¹⁵ This rehearsal is crucial as both the AT and EMS professional as they have differing roles in the healthcare system as well as receive differing information regarding their educational preparation; this may cause conflicting viewpoints regarding the recognition and treatment of EHS. Decoster *et al*¹⁶ investigated anecdotal reports describing disagreements between ATs and EMS professionals particularly concerning head and neck injuries. Athletic Trainers were shown to meet with EMS prior to preseason only 57.6% of the time and 42% of ATs reported at least one on-field disagreement with EMS during a football-related emergency. It is important that all medical professionals on the scene of an emergency use the most current evidence based practice

(EBP) and are working together so no time is wasted from conflicting beliefs. A study by De Smedt *et al*¹⁷ investigated primary care professionals' self reported attitudes towards EBP, attention to information sources, perceptions of the barriers to EBP, and strategies to improve insight in EBP and patient care. EMTs, firemen, and medical volunteers were found to be supportive of EBP and agreed that this concept improves patient care, however, they claimed that only 54% of their practice is evidence-based.

The purpose of this investigation is to gain a better understanding of the EMS professional's practices as it relates to the recognition and treatment of EHS. Additionally, we hope to gain more insights into the working relationship between the EMS professional and the AT as well as the influence it may have on the recognition and treatment of an athlete with EHS. The study will be guided by the following questions: 1) what do EMTs and paramedics know about the recognition, diagnosis, and treatment of EHS, 2) are EMTs and paramedics utilizing EBP regarding recognition and treatment of EHS, and 3) what influences their decisions regarding those practices.

METHODS

This exploratory study used qualitative methods to address the purpose and research questions posed.¹⁸⁻²⁰ We opted for qualitative methods for several reasons including complex nature of behaviors, use of interpersonal focus groups, and exploration because it allowed us to dialogue with EMTs to get their perspective on EHS. Utilizing qualitative methods allowed us to study human behavior in each focus group session examining the participants' beliefs to formulate theories regarding the recognition and treatment of EHS in the EMS population. In the focus group sessions we hoped to draw upon similar or shared experiences of participants

allowing each participant to build upon each others thoughts. We chose a small size focus group with co-workers to ensure participant comfort and promote dialogue among the group. Limited information on this topic exists so we hoped to gather data and utilize inductive reasoning to generate theories regarding the recognition and treatment of EHS provided by EMS.²⁰

Participants

The researchers utilized a purposeful, criterion sampling technique for subject recruitment,²¹ which included EMTs or paramedics with a minimum of 3 years of certification/licensure. A minimum of 3 years of certification/licensure was chosen to ensure that the participants included had an adequate amount of work experience to reflect upon as well as a recollection of educational training. Basic EMTs usually receive 120-150 hours of training including classroom and ride time, while paramedics are required to receive between 1,200-1,800 hours of training through a two-year degree program. Although EMTs are often the first responder on the scene and require less training for certification than a paramedic, both parties play a role in emergency care and were therefore were included in study. Table 1 shows the differences in scope of practice for each level of EMS. Participant recruitment was also guided by recruiting from EMS companies with an affiliation with a college or high school clinical setting. Table 2 highlights individual participant demographic data.

Table 1. EMS Scope of Practice²²

Level of Certification	Scope of Practice
Emergency Medical Responder	Initiate immediate lifesaving care to critical patients who access EMS. Provide lifesaving interventions while awaiting additional EMS response to assist higher level personnel. Serve as a part of the comprehensive EMS response, under medical oversight. Perform basic interventions with minimal equipment.
Emergency Medical Technician	Provide basic emergency medical care and transportation for critical and emergent patients who access EMS. Provide patient care and transportation under medical oversight. Perform interventions with basic equipment found on an ambulance. Serve as a link from scene to emergency health care system.
Advanced Emergency Medical Technician	Provide basic and limited advanced medical care and transportation for critical and emergent patients who access EMS. Provide patient care and transportation. Serve as part of comprehensive EMS response, under medical oversight. Perform interventions with basic and advanced equipment found on an ambulance. Serve as link from scene to emergency health care system.
Paramedic	Allied health professional whose primary focus is to provide advanced emergency medical care for critical and emergent patients who access EMS. Provide patient care and transportation. Serve as part of comprehensive EMS response, under medical oversight. Perform interventions with the basic and advanced equipment found on an ambulance. Serve as link from scene to health care system.

Seventeen emergency response personnel participated in the study, which included 11 EMTs and 6 paramedics. There were 14 male and 3 female participants, with a mean age of 28 ± 8 years and average experience of 6.3 ± 5.3 years.

Table 2. Participant Demographics

	AGE	GENDER	EXPERIENCE	CREDENTIAL	LOCATION	EDUCATION
EMT1	19	M	2 years	EMT-B	CITY1	HS
EMT2	22	F	4 years	EMT-B	CITY1	HS
EMT3	23	M	3 years	EMT-B	CITY2	Bachelor's
EMT4	21	M	2 years	EMT-B	CITY2	Bachelor's
EMT5	23	M	2 years	EMT-B	CITY2	HS
EMT6	22	M	5 years	EMT-B	CITY3	HS
EMT7	46	M	20 years	EMT-B	CITY3	HS
EMT8	39	M	18 years	EMT-B	CITY3	HS
EMT9	29	M	5 years	EMT-B	CITY4	Bachelor's
EMT10	23	M	3 years	EMT-B	CITY4	Bachelor's
EMT11	25	M	3 years	EMT-B	CITY4	Bachelor's
MEDIC1	30	M	7 years	Paramedic	CITY1	HS
MEDIC2	25	M	4 years	Paramedic	CITY1	Bachelor's
MEDIC3	31	M	9 years	Paramedic	CITY2	Bachelor's
MEDIC4	27	M	5 years	Paramedic	CITY2	HS
MEDIC5	32	F	5 years	Paramedic	CITY3	HS
MEDIC6	41	F	10 years	Paramedic	CITY3	HS
Mean	28.1	14 M	6.3	11 EMT-B		10 HS
SD	7.6	3 F	5.3	6 Paramedics		7
Bachelor's						

Data Collection Procedures

The in-person focus group interview sessions were separated into 2 sections: (1) knowledge and understanding of the role of the AT and/or previous professional relationships with an AT and the profession of athletic training, and their understanding of the AT's role in emergency care, specifically related to EHS and (2) knowledge and application of T_{re} and CWI in the recognition and treatment of EHS, previous experiences, and current practice beliefs and implementation of assessment and treatment modalities related to EHS.

Table 3. Interview Guide

Part I

1. Can you describe your understanding of the field of sports medicine, in particular the role of the AT?
 - a. What do you feel is the ATs role in treating an athlete with an EHS?
2. Does your EMS Company provide services for any local school settings?
 - a. If so, have you ever discussed an emergency action plan with the AT, sports medicine staff, or nursing staff at that/those schools?
 - b. Have you ever experienced a conflict in an emergency situation with an AT regarding the care and treatment of an athlete (particularly with EHS)? If yes, please elaborate on the situation.

Part II

3. Currently, as outlined in your protocol manual, what is the course for diagnosis and care for a suspected EHS?
 - a. Who develops this manual?
 - b. How often is it updated?
4. Do you agree with the criteria outlined in your manual? Please explain your rationale.
5. The evidence supports the use of Rectal Temperature Assessment for the accurate diagnosis of an EHS, can you explain if this is part of your protocol and whether you feel comfortable using this skill?
 - a. Have you ever been taught or practiced this method?
6. At the present time, the recommendation is to “cool first, transport second,” is this practiced with your company? Can you explain why or why not?
 - a. If cooling is part of the treatment plan, please describe what methods and why this is the case.
7. What could be done to encourage the use of rectal temperature measurements when it comes to the diagnosis of an EHS?
 - a. What can be done to encourage its use and spread awareness to the general public of its effectiveness/importance?
8. What might be done to encourage the use of cold water immersion or the motto, “cool first, transport second”?
 - a. What can be done to encourage its use and spread awareness to the general public of its effectiveness/importance?

A semi-structured format of open-ended questions were employed to allow the researcher to prompt the participants to elaborate on their response as well as to ask follow up questions that may add further insights not initially established at the outset of the study (Table 3). 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.²³ This data collection procedure was also selected to help enhance the

richness of the data generated, as an inherent design of a focus group is to stimulate further discussion among the participants, which ultimately highlight and confirm the study's overall findings.²⁰ The semi-structured interview guide, as described above, was developed by a group of researchers including AT educators, graduate students in athletic training (n=2), and several ATs (n=3). Additionally, once a final draft of the interview guide was reached one EMT reviewed it for clarity, interpretability, and flow. All focus groups were recorded digitally and with videotapes and were transcribed verbatim for subsequent data analysis. All participants names are pseudonyms. 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 was an experienced qualitative researcher and an AT. The inclusion of field notes was purposeful and aided in capturing the interview environment,²¹ commonalities that arised during the discussions, as well as add rigor to the data analysis, by confirming or refuting emergent themes.^{20,21} Prior to all focus group sessions, all participants gave consent as well as complete a background questionnaire.

A total of 4 focus group sessions were conducted with 4 different emergency response companies located in the Northeast. Each lasted approximately 30-45 minutes and contained between 4 to 5 EMTs or paramedics. EMTs and paramedics were interviewed together to stimulate conversation because this mimics their relationship in the field setting working together as a unit on a day-to-day basis. Although we interviewed EMTs and paramedics employed at the same company, they had received training and professional work experiences at different locations and programs, offering additional insights/opinions. Moreover, if participants in the focus groups share a previous relationship, they may tend to be more comfortable, and willing to share their thoughts and opinions more freely.²⁰

Establishing Credibility

Several strategies were utilized to establish credibility and dependability of the findings of the study. Participant checks were the most important step in this process to reduce the possibility of misinterpretation of the findings and the meanings derived from the participants experiences and thoughts.^{20,23} All participants, after transcription, had the opportunity to review the interview transcripts taken during the focus group sessions 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.²⁰ Finally, multiple-analyst triangulation,^{20,25} 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 three-member research team (two researchers and a peer debriefer), independently evaluating the data, utilizing open coding and content analysis procedures. Once emerging themes were ascertained, the researchers compared findings and when necessary negotiated the findings until agreement is reached.

Data Analysis

Interview transcripts were analyzed inductively, borrowing from a grounded theory model, as described by Strauss and Corbin^{26,27} as well as other researchers.^{21,25} Three

researchers, independently to ensure rigor and trustworthiness of the data, performed this analysis. 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.

RESULTS

One central theme emerged to explain EMTs and paramedics practices as it relates to the recognition and treatment of EHS: *Educational Preparation*. The assessment and treatment methods utilized for a case of EHS are based completely on the educational training the emergency medical care provider receives prior to licensure/certification. Three lower level themes support the central theme of *Educational Preparation* and include: 1) *Temperature Assessment*, 2) *Rapid Cooling*, and 3) *Role of the Athletic Trainer*. *Temperature Assessment* and *Rapid Cooling* were further detailed by two and three lower order theme, respectively. EMTs and paramedics were lacking a complete appreciation for EHS along with the proper tools to diagnose and treat the condition. Figure 1 provides a visual illustration of the findings of the study. Each of these themes is explained below and supported with participants' quotes.

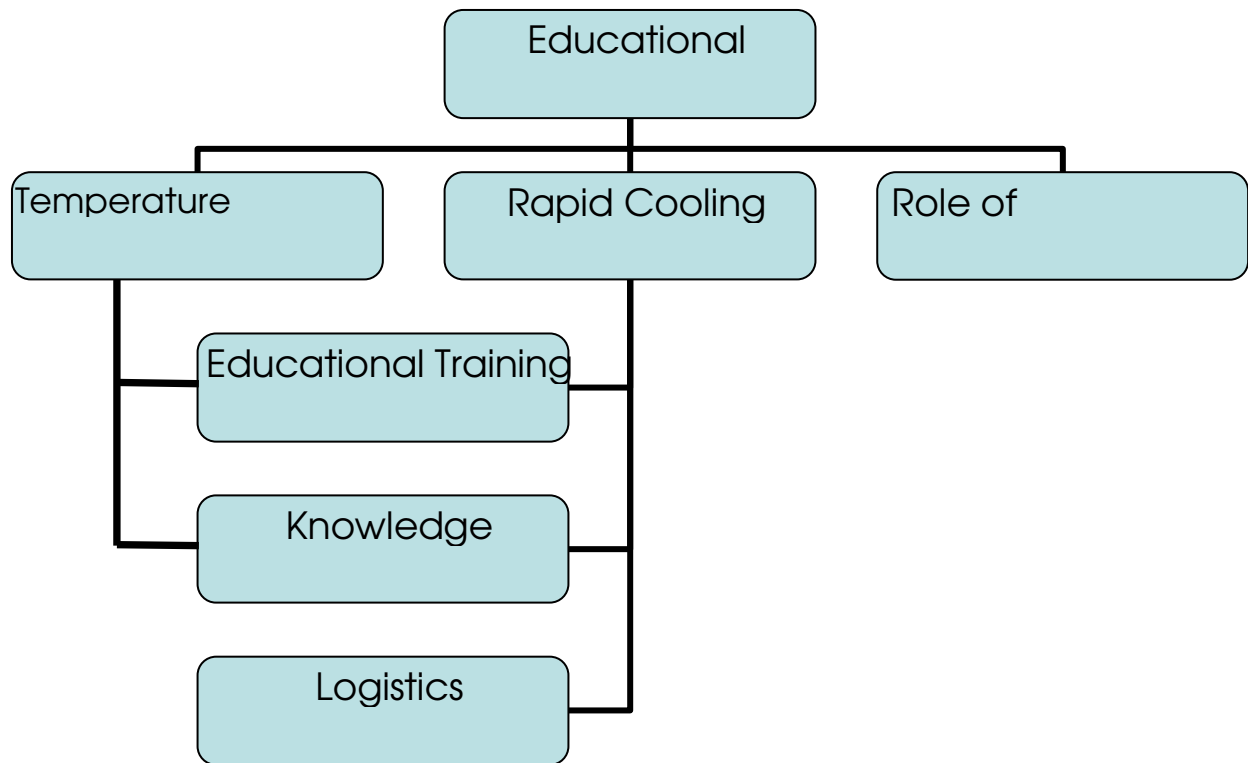


Figure 1. EMT Preparedness for EHS

Educational Preparation: Temperature Assessment

The higher order theme, *temperature assessment* highlights the lack of EMTs and paramedics to utilize any method of temperature assessment as a means to differentiate EHS.

The theme of *Temperature Assessment* was defined by two lower order themes including *educational training* and *knowledge*. EMTs do not assess temperature via oral, tympanic, rectal, or any other method as they do not assess core body temperature as part of their on-scene evaluation. *Educational training* and *knowledge* provide the rationalization for why temperature assessment is not a constituent in the evaluation of a potential case of EHS.

Educational Training

The theme of *educational training* summarizes the limited time spent gaining hands on training regarding temperature assessment as well as the scope of practice for the

EMT/paramedic. There was a consensus among the four focus group sessions, which highlighted the paucity of information provided during their professional training. EMT3 stated, ‘there wasn’t too much at the EMT [education] level. I do remember [reading] a chapter in the [EMT] book and there had to be a couple hours of lecture [regarding heat illnesses].’ A similar comment was shared in a separate focus group by MEDIC6 who was discussing protocols for recognition and treatment of EHS. She said, ‘that [EHS] is discussed in your [classroom] training, active versus passive cooling. As far as actually taking a body temperature it’s just not [in our protocols].’ When asked if anyone ever covered rectal temperature when they were in school EMT2 replied, ‘not in EMT [schooling].’ Another reason for the omission of temperature assessment training for the EMT and paramedic was related to the equipment available to them. EMT6 declared,

We don’t have the equipment in the field to do that [temperature assessment]. We don’t carry it [rectal temperature devices], we don’t have any sort of thermometer at all on the bus. We absolutely don’t, once they get to the hospital they’ll do that there [get a temperature reading].

Other discussions by the emergency response personnel revealed that temperature assessment was not outlined within the scope of practice. The participants explained that EMS providers, especially an EMT, act as first responders to an emergency situation. Their primary goal is to get the patient to a higher-level medical care unit, and are not to spend time evaluating the patient for a complete diagnosis. MEDIC5 said,

Honestly taking a temperature would probably fall to the last thing [I would do] and even if I had time to get to it [a temperature], I’m going to treat [the patient]. We treat how our patient is presenting, [their] signs and symptoms, ABC’s (airway, breathing, circulation).

MEDIC5 continued by saying,

It’s not within our scope (rectal temperature assessment) and that is a national [standard]. It is not within the national scope of an EMT or paramedic to take any temperature.

The previous quotes speak to the professional training the emergency medical personnel receives, which is deficient in the knowledge of temperature assessment devices as well as hands on training with the skills associated with the diagnostic tools. This may be facilitated by the scope of practice outlined for the EMT/paramedic, which is void of any temperature assessment measurement for any condition.

Knowledge

The theme *knowledge* was operationalized as the level of understanding possessed by the EMT/paramedic regarding evidence based practice and EHS. It was evident that EMTs and paramedics are completely unaware of some of the most current information regarding EHS. Many participants agreed that hot and dry skin was one of the primary criteria used to diagnosis EHS. Although it was agreed that EMTs do not engage in temperature assessment, MEDIC1 explains their general knowledge of EHS; “when it comes to heat stroke, that is the progression of heat exhaustion and when you see them with cherry red and dry skin and temperature is over 40.6C.” A participant from another EMS company, MEDIC6 was in agreement saying, “dry [skin]. If they have dry it is heat stroke.” When asked how he would recognize an EHS during a separate focus group session EMT10 said,

Well to probably identify [EHS] you’re going to want to see that the skin is flushed, they have not been hydrating as well, probably have stopped sweating by the time the heat stroke has been occurring.

Some participants also recognized symptoms of CNS impairment, such as dizziness and lightheadedness, as other indicators for EHS, in addition to skin temperature and appearance.

MEDIC2 said, “I would look for altered mental status, skin that is dry hot, red or pink.”

As illustrated by the preceding quotes, cessation of sweating and/or dry skin was used as a key distinguishing factor for EHS over many others. The preceding quotes highlight a dichotomy between the knowledge gained by EMS personnel through educational preparation and the current literature and educational standard. The participants were focused on inaccurate diagnostic signs regarding EHS.

Educational Preparation: Rapid Cooling

Rapid cooling for the purpose of this study is defined by an immediate aggressive cooling using CWI. Similar to the theme of temperature assessment, rapid cooling, was defined by *educational training and knowledge*, but was also supported by logistics. EMS is not utilizing this method of cooling as an immediate treatment for EHS. Each is presented in the following sections.

Educational Training

The *Educational training* theme for rapid cooling illustrates the absence of educational training received by the participants in this study regarding the most effective treatment for EHS: immediate and rapid cooling of the body. This finding was consistent among all participants in the study, regardless of employment location. Participants mentioned alternative methods of cooling such as an air-conditioned environment, and cold packs, among other methods, but they never discussed the use of cold-water immersion as a means to treat the condition. When asked what the immediate treatment of EHS would be EMT11 replied, “I probably would kick the AC on, start putting some cold packs under their armpits trying to get the main arteries cooled off.” The use of AC was a constant means to cool an athlete with EHS, as most indicated this as a first step in the treatment of the condition. EMT11 replied “cold packs, and the AC in the ambulance.” Cooling, via the major arteries (femoral and carotid) with ice bags/packs was also

discussed by many as another method to help cool an EHS patient. MEDIC2 responded to the question about treatment by saying,

We also use ice packs in the groin area under the armpits, to kind of do some cooling that way but not cooling them too fast because we don't want them to start shivering and reverse everything.

Also supporting the use of cold packs, EMT10 said,

You get them out of the environment cool them off...even if just a little bit of shade, provide some active cooling, packs [just like my partner said] in the groin and armpits.

Very little information was provided to the EMTs and paramedics who participated in this study regarding the most accurate methods for cooling a case of EHS. No mention was ever given to them regarding rapid cooling of an athlete with the condition. In fact, a suspected case of EHS was considered life threatening and therefore warranted immediate transport to the hospital, with only previously mentioned cooling methods.

Knowledge

The *knowledge* theme represented the misgivings and/or the lack of understanding regarding the need to rapidly cool a patient with EHS prior to transportation as well as the most appropriate means to promote rapid cooling. EMT9 had this to say regarding the treatment of an EHS,

You want to be on scene [of an EHS case] for no longer than 10 minutes, if that. You want to take the patient to a higher level of care immediately; that is what I would say. So waiting would be one thing, if you had a doctor on scene, but I would rather get that patient to a higher level of care as soon as possible [for treatment].

MEDIC6 highlighted the focus group members' limited understanding of the need for active, immediate cooling, while discussing the treatment protocol for an EHS. They stated,

When we are transporting someone that is either heat stroke or heat exhaustion someone that is obviously overheated to some degree your going to put them in [the ambulance], put the AC on, probably going to give them fluids anyway because the fluids are cold. So

you are going to be doing some things to help cool them, you're not going to actively cool them but your going to do some things that can help cool them.

Other discussions by the members of the 4 focus groups revealed a disconnect between what is currently understood about the condition, particularly for the athletic population and what is documented in the textbooks utilized within the EMT/medic curriculums. This information is what is used to determine treatment protocols. As presented earlier, the knowledge level did not match current evidence-based practice for example, MEDIC4 said, "well first, you would want to get them out of the environment, into a cooler environment, and then remove any clothing, any insulators that are keeping heat in." This paramedic understood the initial steps of treatment, however, there was no mention of rapid cooling which is critical in lowering core body temperature. MEDIC2 commented, "if we are suspecting that (EHS), our treatment plan is using IV fluids to cool the patient and replace any electrolytes that were lost." Although these protocols may offer some benefit in treating a patient with EHS, nothing was mentioned regarding an active, aggressive cooling procedure to rapidly decrease core body temperature. Another participant, EMT9, was adamant about getting the patient in the ambulance as quickly as possible. When asked by the interviewer, "so you would hope to get them in the ambulance within 3 minutes to transport them?"

Yeah, especially if you had someone on scene like an AT to provide you, give you a little bit of a background.

In addition to never being taught that rapid cooling is the most effective way to lower a person's core body temperature suffering from EHS, some information was given to participants against this method of cooling. MEDIC4 stated, "I have been taught that cooling too rapidly causes seizures." As previously discussed, MEDIC2 states,

We also use ice packs in the groin area under the armpits, to kind of do some cooling that way but not cooling them too fast because we don't want them to start shivering and reverse everything.

The knowledge derived from educational preparation regarding the treatment of EHS and specifically CWI was consistently not practiced by EMS professionals. Alternative, but less effective means of cooling were used such as ice packs, air conditioning, shaded areas, and fluids. Misinformation regarding CWI also lead EMS professionals to believe it was not an appropriate means of cooling for a patient suffering from EHS.

Logistics

Logistics reflects the responsibility of the EMTs and paramedics to immediately transport a patient to a location of higher medical care as well as the limitations posed by the size of the ambulance; all which reduce the feasibility of cold water immersion. EMT6 simply said, "we don't really have the means to do active cooling." When asked why ice bags were not an option of cooling, MEDIC3 at a different location stated, "there is really nowhere to store ice bags."

MEDIC 3 added,

You are going to get someone coming back to you saying look we do maybe five of these calls a year, is it really effective to be putting extra equipment on there for that when an AT will already have them when you get on scene?

The overall goal of an EMT or paramedic is to transport the injured/sick individual to a higher level of care in the shortest amount of time and treat that same patient with those modalities available to them in the ambulance. These quotes highlight the issue between best practices and scope of practice.

Educational Preparation: Role of the Athletic Trainer in Emergency Procedures

Another dynamic that emerged within the data were the dichotomy between the EMT and paramedics understanding of those potentially involved with the emergency care of an injured

patient/athlete. Several of the participants explained a very limited understanding of the role of the AT within the healthcare system, but especially regarding on the field care emergency procedures. The education that an AT receives and their subsequent scope of practice is not well known among EMS professionals. MEDIC3 commented on an ATs general scope of practice and said,

I think it is confusing because I think there is a hole that we don't really know. [We don't know] what their protocols and practices are, so a lot of people are under the impression that an AT just trains the athletes and is not really responsible for any sort of care for them.

When asked what the role of an AT is, EMT 9 replied,

I think, ah, I'm not too familiar with it but sort of my guess would be, obviously athletes put a lot of strain on their body and with AT the trainers are more apt to know what's going on with say an athlete compared to someone on the street that we're not as familiar with.

In addition to the confusion regarding the role of the AT, the education that is required of ATs was also inaccurate. When asked what education is required for an AT, EMT1 responded,

I'm pretty sure it is a general requirement for a sports trainer to have an EMT certification anyways and typically they are trained and know what is going on.

During later discussion, participants were questioned whether they had ever experienced any sort of conflict with an AT, especially with the initial recognition and treatment at the scene of an emergency. MEDIC3 had this to say,

There was confusion. The AT was saying "no you're not going to transport the patient" and we're like we have to [transport them]. At the same time, I didn't know at the time that they were qualified to handle that injury and assess that injury and decide whether or not they needed hospitalization or required a doctor. So there was some confusion on that part, and it wasn't an unpleasant experience, it was just...we didn't understand what he [the AT] was saying so after the fact I had to do a little research.

Discussion revealed that the confusion and unfamiliarity existing between EMS and an AT could potentially lead to an undesirable situation. The overall consensus among EMS professionals was that they received little information on the roles and responsibilities of other emergency healthcare providers, which if done so could improve patient care.

DISCUSSION

It is crucial that all emergency medical professionals including EMTs and paramedics utilize EBP in the clinical setting to ensure quality medical care. The current evidence recommends the use of T_{re} and CWI in the diagnosis and treatment of EHS. The current literature identifies that ATs in most cases are not using EBP regarding EHS, even if they have the knowledge of those best practice.²⁸⁻³⁰ The purpose of this investigation was to gain a better understanding of EMTs' and paramedics' practices as it relates to the recognition and treatment of EHS. An additional aim was to gain more insights into the working relationship between the EMT/paramedic and the AT and the influences it may have on the recognition and treatment of an athlete with EHS. Our data suggests that the education being provided to EMS professionals does not follow the most current EBP regarding the recognition and treatment of EHS and the education regarding the AT profession. Our findings were somewhat consistent with De Smedt *et al.* which found that EMTs, firemen, and medical volunteers were found to be supportive of EBP and agreed that this concept improves patient care, however, they claimed that only 54% of their practice is evidence-based.¹⁷

Temperature Assessment

Not only was T_{re} not used, but there was a failure of EMTs and paramedics to utilize any method of temperature assessment in the recognition and diagnosis of EHS. This may be attributed to the fact that most EMS professionals agreed that temperature assessment was not even within their scope of practice. The National EMS Model does not specifically state that temperature is within the scope of practice of an EMT, which causes confusion for the practicing EMS professional in the clinical setting. The educational training in temperature assessment was limited or absent in most cases as well including an insufficient amount of hands on experience. Table 4 displays the preferred temperature assessment to use in three commonly used EMT educational textbooks. In Lapierre, Limmer *et al*, and Aehlert³¹⁻³³ no preferred temperature was discussed. An absence of available equipment on the ambulance was also another topic of concern for EMS. Because temperature assessment is not within the scope of practice of an EMT and subsequently not a component of educational training, it is not available on ambulances for EMS to utilize. The participants agreed that the knowledge obtained from the EMS curriculum was inconsistent with the most current evidence in the literature. Most commonly, the participants agreed that the two signs most indicative of an EHS were hot and dry skin. This information gathered from the participants is consistent with the education that they have received as indicated in Table 4. However according to a study done regarding the field and clinical observations of EHS patients by Shapiro and Seidman, only 26% of EHS patients presented with dry skin.³⁴ Emergency Medical Services' curriculum is not the only to lag behind regarding the most current recommendations for EHS as several athletic training textbooks being used in classrooms also contain information not consistent with the most current evidence. It has been shown that ATs understand the correct techniques for the diagnosis and treatment of EHS

but do not practice them, most often due to a lack of formalized training.^{13,28-30} EMS, on the other hand, is not being given the correct information from the curriculum.

The absence of the utilization of T_{re} in the clinical setting may prevent an accurate diagnosis of EHS. The most accurate and reliable measurements of core body temperature are obtained through rectal, esophageal, and intestinal temperature readings for athletes exercising in the heat.^{4,35} This has been established as the gold standard of temperature assessment compared to aural or tympanic, oral, temporal, and axillary temperature assessments which tend to give slightly lower temperature readings regarding core body temperature. Ganio *et al.* and Casa *et al* showed that the validity of temperature assessment devices both indoors and outdoors show that gastrointestinal temperature was the only measurement that accurately assessed core body temperature besides T_{re} .^{8,9} Oral, axillary, aural, temporal, and field forehead temperatures were significantly different from T_{re} and therefore should not be used when assessing hyperthermia in individuals exercising both indoors and outdoors.^{8,9} Because T_{re} is the most accurate core temperature assessment, it should be utilized to diagnosis EHS.

Table 4. EMT Curriculum Regarding EHS³¹⁻³³

	Lapierre³¹	Limmer et al³²	Aehlert³³
Hyperthermia definition	An Increase in body temperature above normal when heat gained exceeds heat lost	An Increase in body temperature above normal when heat gained exceeds heat lost	An Increase in body temperature above normal when heat gained exceeds heat lost
Predisposing Risk Factors	None	Dehydration, diabetes, fever, fatigue, high BP, heart disease, lung problems, obesity, drug use, age, existing injuries	High ambient temp, dehydration, lack of acclimatization/physical fitness, medications, lack of mobility, impaired thermoregulation, impaired sense of thirst, age, medications, drug use, heart disease, obesity, fever, fatigue, diabetes, thyroid disorder, Parkinson's disease,
Preferred temperature assessment	None	None	None
Symptoms	dry skin	rapid, shallow breathing, generalized weakness, little or no perspiration, loss of consciousness or altered mental status, dilated pupils, seizures	dry, hot, flushed skin, high body temperature (higher than 103F orally), fast heart rate followed by slow heart rate, deep breathing followed by shallow breathing, headache, dizziness, nausea, vision disturbances, muscle twitching, seizures, unresponsiveness
Treatment	Basic life support, aggressive cooling with cool wet towels to groin, axillary, cervical regions, cooling should be done en route to emergency room and should not delay transport	Remove patient from hot environment and move to cool spot, remove clothing, apply cool packs to neck, groin, and armpits, keep skin wet with sponge or towels, fan aggressively, administer oxygen, transport immediately, if transport is delayed find a tub and immerse patient up to neck in cooled water and monitor vital signs.	Call for advanced life support and transport immediately, give oxygen, start cooling patient with cool packs to neck, armpits, and groin, fan aggressively, never cool in ice bath, monitor vitals

Rapid Cooling

The current evidence in the literature suggests that aggressive CWI is the most efficient cooling modality for the treatment of EHS.^{1,36} Despite this, EMS professionals do not use this method as immediate treatment for this condition in part because of their educational training, but also due to logistics related to their role as a first responder and transportation. Educational training for EMS professionals does not include the use of CWI, but instead teaches more passive cooling techniques such as air conditioning units, cold packs, among others. Table 4 displays the treatment techniques for EHS, which are inconsistent depending on the book that is used within each of the curriculums offered by each service provider. Current literature documents that medical healthcare professionals rely heavily on previous formal training when implementing clinical practices.³⁷ This is evident among EMS professionals who are not being taught based on the most current evidence in the literature.

Based on the participants' feedback it was apparent that the ultimate goal of EMS was to transport a patient that is a life-threatening situation to a higher level of medical care as soon as possible, regardless of the diagnosis. Table 5 and Table 6 show the comparison between an athlete being immediately cooled once an EHS is suspected versus an athlete receiving cooling after a delay due to transporting based on CWI, wet towels, and ice bag cooling rates. Cold water immersion was based on using water with a temperature of 20°C. Wet towels and ice bags are based on rotating either modality on areas including the groin, neck, and armpits. It is clear with this comparison that delaying cooling keeps an athlete's temperature at a critically high level for a longer amount of time causing more damage. For example, even if an athlete is properly cooled via CWI but the treatment is delayed, the patient will still be above 105.5°F for

35 minutes compared to only 7 minutes if immediate cooling is initiated. Using alternative methods of cooling or not cooling at all poses a serious risk for increase hyperthermia and eventually death.

Table 5. Time to Recognition and Cooling: Immediate ATC Response to EHS³⁸

	Cold-Water Immersion 20°C Cooling Rate .2°C/min	Wet Towels Cooling Rate .11°C/min	Ice Bags Cooling Rate .05°C/min	Nothing Cooling Rate .025°C/min
4:30 - Athlete Collapses / EHS Determined / Cooling Started	42.2°C (108°F)	42.2°C (108°F)	42.2°C (108°F)	42.2°C (108°F)
4:32 - Call 911	41.8°C (107.3°F)	42.0°C (107.6°F)	42.1°C (107.8°F)	42.2°C (107.9°F)
4:34 - Ambulance Dispatched	41.4°C (106.6°F)	41.7°C (107.2°F)	42.0°C (107.6°F)	42.1°C (107.8°F)
4:37 - Ambulance Leaves Center	40.8°C (105.5°F)	41.45°C (106.6°F)	41.9°C (107.4°F)	42.045°C (107.7°F)
4:52 - Ambulance On- Site	38.8°C (101.9°F) Cooling Stopped at 4:47	39.8°C (103.6°F)	41.1°C (106.0°F)	41.7°C (107.1°F)
4:55 - EMS at Patient		39.47°C (103.1°F)	40.97°C (105.8°F)	41.595°C (106.9°F)
5:10 - EMS leaves Scene		38.9°C (102.1°F) Cooling Stopped at 5:00	40.22°C (104.4°F)	41.22°C (106.2°F)
5:25 - Ambulance Arrives at Hospital			40.0°C (104.0°F)	41.1°C (106.0°F)
5:28 - Care Begins			39.8°C (103.7°F)	41.0°C (105.8°F)
5:40 - Cooling Begins			39.2°C (102.6°F)	40.7°C (105.3°F)
			Cooling Continues until 5:50 (38.9°C/102.1° F)	Cooling Continues w/ Ice Bags until 6:16 (38.9°C/102°F)
Minutes Above 104°F	7 minutes	13 minutes	28 minutes	70 minutes

Table 6. Time to Recognition and Cooling: Delayed Response to EHS³⁸

	Cold-Water Immersion 20°C Cooling Rate .2°C/min	Wet Towels Cooling Rate .11°C/min	Ice Bags Cooling Rate .05°C/min	Nothing Cooling Rate .025°C/min
4:30 - Athlete Collapses 1st Time	41.7°C (107.0°F)	41.7°C (107.0°F)	41.7°C (107.0°F)	41.7°C (107.0°F)
4:45 - Athlete Collapses 2nd Time	42.0°C (107.5°F)	42.0°C (107.5°F)	42.0°C (107.5°F)	42.0°C (107.5°F)
4:50 - Athlete is moved to Shade / Cooling Begins	42.2°C (108°F)	42.2°C (108°F)	42.2°C (108°F)	42.2°C (108°F)
5:00 - Call 911	41.8°C (107.28°F)	42.0°C (107.6°F)	42.1°C (107.82°F)	42.2°C (107.91°F)
5:02 - Ambulance Dispatched	41.4°C (106.56°F)	41.8°C (107.2°F)	42.0°C (107.64°F)	42.1°C (107.82°F)
5:05 - Ambulance Leaves Center	40.8°C (105.5°F)	41.45°C (106.61°F)	41.9°C (107.4°F)	42.0°C (107.7°F)
5:20 - Ambulance On- Site	38.8°C (101.9°F) Cooling Stopped at 5:15	39.8°C (103.6°F)	41.12°C (106.0°F)	41.7°C (107.1°F)
5:23 - EMS at Patient		39.5°C (103.05°F)	41.0°C (105.75°F)	41.6°C (106.87°F)
5:38 - EMS Leaves Scene		38.9°C (102.1°F) Cooling Stopped at 5:28	40.2°C (104.4°F)	41.2°C (106.2°F)
5:53 - Ambulance Arrives at Hospital			40.0°C (103.95°F)	41.1°C (105.97°F)
5:56 - Care Begins			39.8°C (103.7°F)	41.0°C (105.8°F)
6:08 - Cooling Begins			39.2°C (102.6°F)	40.7°C (105.3°F)
			Cooling Continues until 6:18 (38.9°C/102.1°F)	Cooling Continues w/ Ice Bags until 6:44 (38.9°C/102°F)
Minutes Above 104°F	35 minutes	40 minutes	56 minutes	98 minutes

In addition to CWI being excluded from most EMS professionals' curriculums based on the data, it was also clear that some EMTs and paramedics were distinctly against using CWI. Some reasons for this were the beliefs that CWI causes side effects such as seizure or shivering that may reverse everything. Logistically, participants argued that they do not have the means to do active cooling in the ambulance. This was a barrier to using CWI among ATs mostly at the high school setting as well where budget was an issue of concern.²⁸ EMS participants also made a point that EHS is not prevalent enough especially in this region of the country to consider making changes to their protocol. Although EHS may not be as prevalent in the northeast, it is still an issue of concern. EHS do not only happen in hot weather but instead can happen in low temperatures as well.

At an athletic venue ATs are most commonly the first medical professional on the scene of an emergency. It is important that when an EMS professional arrives on scene, both the AT and EMS professional work in conjunction to treat the patient. Cooling should be initiated immediately on site utilizing the cool first, transport second method. Transportation can be delayed once cooling has been started considering lowering the patient's core temperature is the most important goal for treatment. Because of the equipment and space restraints in the ambulance, it is most efficient to use this method to cool the patient before transportation to a higher level of medical care. If for some reason the patient is being transported via ambulance, rotating cold towels are the most efficient way to decrease core body temperature other than CWI.^{1,10}

Role of AT/Healthcare

The role of the AT and the relationship between the two professions was not well understood by EMS professionals within this study. There was a limited understanding of the role of the AT within the health care system especially regarding field emergency care procedures. In most cases at an athletic venue, the AT is the first to be present on a scene to a life-threatening situation. According to a venue's Emergency Action Plan (EAP), the AT would subsequently activate EMS to come to the scene. The NATA recommends that each organization or institution that sponsors athletic activities or events develop and implement a written EAP.¹⁵ This plan should be developed by organizational or institutional personnel in consultation with the local EMS. Components include identification of the personnel involved, specification of the equipment needed to respond to the emergency, and establishment of a communication system to summon emergency care. Additional components of the emergency plan are identification of the mode of emergency transport, specification of the venue or activity location, and incorporation of emergency service personnel into the development and implementation process. Emergency plans should be reviewed and rehearsed annually, with written documentation of any modifications.¹⁵ Despite these recommendations by the NATA, Decoster *et al*¹⁶ showed that ATs met with EMS prior to preseason only 57.6% of the time and 42% of ATs reported at least one on-field disagreement with EMS during a football-related emergency. For this reason it is important that both EMS professionals and ATs know about the other profession including scope of practice, education, etc. The education that an AT is required to receive prior to certification was also unknown to participants. Not only should the professions be educated regarding the others credentials, but a relationship should also be formed. Both the AT and EMS professional should go over emergency action procedures so in the event of a life threatening condition, there is no confusion what each person's responsibilities

are. ATs and EMS professionals should work synchronously together to provide the most efficient patient care possible.

Implications

Medical professionals including EMTs, paramedics, and ATs have a responsibility to continue their education past their original certification. It is important that these professionals follow the most current literature and subsequently use EBP in their clinical setting. Table 8 illustrates possible solutions to the confusion that is experienced when dealing with an EHS. The current literature supports the use of T_{re} and CWI in the recognition, diagnosis, and treatment of EHS so this should be followed. Furthermore, it is critical that EMS professionals and ATs form a strong relationship built upon communication and working together as a unit. Failure to use proper diagnostic tools severely impairs the EMS professionals' ability to accurately diagnose EHS which alters treatment and in turn become a life threatening situation.

Table 8. Solutions

1. EMS educational training should include most current evidence-based medicine regarding the recognition, diagnosis, and treatment of EHS.
2. Direct physician involvement should be implemented overseeing the communication between AT and EMS
3. Temperature assessment should be included within the scope of practice of an EMT.
4. RT should be used as the gold standard temperature assessment when dealing with an EHS.
5. Aggressive cooling with CWI should be the gold standard for treatment for an EHS.
6. Hands on training for temperature assessment and aggressive cooling should be implemented within the EMS curriculum.
7. Add to educational training module on professional roles of medical personnel.
8. ATs, especially at the secondary school setting need to include EMT with planning and development of the EAP.

Limitations

The EMS professionals who participated in this study were chosen based on availability and willingness to participate, therefore the data may not entirely represent the educational training, clinical practice, and experiences of all EMS professionals. All participants were employed in the northeast, which creates a regional bias, especially when it comes to likelihood. Exertional heat stroke is more prevalent in warmer climates, therefore it is possible that many of the participants have not regularly experienced diagnosis and managing the condition. We recognize that the sample size was relatively small, however the purpose of this exploratory study was to discover barrier to the use of evidence based medicine regarding the recognition, diagnosis, and treatment of EHS. The utilization of focus groups as the method of data collection has its own set of limitations including that participants may have felt pressured to provide similar responses as their co-workers. Also some participants may have not contributed as much if others were more outspoken.

Future Research

Future research should include surveys and interviews of different healthcare professionals that are involved in the recognition, diagnosis, and treatment of EHS. Those that have not been investigated yet include coaches, parents, emergency room physicians and physicians who oversee standing orders for EMS. It is important that all the individuals that could potentially be involved with this condition are investigated to eliminate the disconnect that may come forth in an emergency situation. This investigation could be broadened to all regions of the country to eliminate regional bias and provide a larger sample size. The data collection for this study could be collected via individual interviews so there is no pressure from peers to

conform to what each co-worker has to say. This would also allow all individuals to speak equally which does not always occur in a focus group with varying personalities.

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APPENDIX A

Background Questionnaire-Emergency Medical Technician (EMT)

1. Gender M___ F___

2. Age ___

VII. Years as an EMT ___

VIII. How long have you been employed at your current location? _____

5. What state are you currently working in? _____

6. Indicate your highest level of education:

___ High School ___ Bachelor's Degree ___ Master's Degree ___ PhD ___ EdD
___ Other, please specify _____

7. Where did you complete your EMT Training? _____

8. What examination did you take to become a certified EMT? _____

9. What certifications do you hold? _____

10. What is your current position?

___ EMT-Basic
___ EMT-Intermediate
___ Paramedic
___ Other, please specify _____

11. How much time dedicated to EHS was required of:

Lecture: ___ hours

Observation: ___ hours

Clinical Practice: ___ hours

Total: ___ hours

12. Do you cover any athletic events at either high schools or colleges/universities in your area?

YES NO

If so, where?

13. Have you ever been involved with the treatment of an EHS? YES NO

14. What clinical findings do you rely on to determine whether an athlete/patient is suffering from an EHS?

Why are those factors so important? _____

15. On average, how many exertional heat strokes has your department seen in the last 5 years?

In athletics? _____

How many of these resulted in a fatality? _____

9. Please describe the treatment protocol for an athlete/patient suffering from an exertional heat stroke? _____

Is cooling, part of the treatment? YES NO

If so, how is the athlete/patient cooled? _____

17. What are some concerns that you have with cooling an athlete?

18. Is exertional heat stroke discussed in your protocol manual? YES or NO

If so, what is your department's policy on heat stroke?

19. In regards to your EMT education and training, please describe what information was provided regarding EHS diagnoses and treatment.

20. How comfortable are you with dealing with an exertional heat stroke?

Not Familiar 1 2 3 4 5 6 7 8 9 10 Very Familiar

21. How familiar are you with obtaining a rectal temperature?

Not Familiar 1 2 3 4 5 6 7 8 9 10 Very Familiar

22. How familiar are you with using cold water immersion as a cooling technique?

Not Familiar 1 2 3 4 5 6 7 8 9 10 Very Familiar

23. How comfortable are you with using cold water immersion as a cooling technique?

Not Familiar 1 2 3 4 5 6 7 8 9 10 Very Familiar

Please add any additional comments below:

Thank you for your participation.

APPENDIX B

**Interview Guide
Emergency Medical Technician (EMT)**

Part I

- IX. Can you describe your understanding of the field of sports medicine, in particular the role of the AT?
- a. What do you feel is the AT's role in treating an athlete with an EHS?
10. Does your EMS Company provide services for any local school settings?
- a. If so, have you ever discussed an emergency action plan with the athletic trainer, sports medicine staff, or nursing staff at that/those schools?
 - b. Have you ever experienced a conflict in an emergency situation with an athletic trainer regarding the care and treatment of an athlete (particularly with EHS)? If yes, please elaborate on the situation.

Part II

3. Currently, as outlined in your protocol manual, what is the course for diagnosis and care for a suspected EHS?
 - a. Who develops this manual?
 - b. How often is it updated?
4. Do you agree with the criteria outlined in your manual? Please explain your rationale.
5. The evidence supports the use of Rectal Temperature assessment for the accurate diagnosis of a EHS, can you explain if this is part of your protocol and whether you feel comfortable using this skill?
 - a. Have you ever been taught or practiced using this method?
6. At the present time, the recommendation is to “cool first, transport second,” is this practiced with your company? Can you explain why or why not?
 - a. If cooling is part of the treatment plan, please describe what methods and why this is the case?
7. What could be done to encourage the use of rectal temperature measures when it comes to the diagnosis of an EHS?
 - a. What can be done to encourage its use and spread awareness to the general public of its effectiveness/importance?
8. What might be done to encourage the use of cold water immersion or the motto, “cool first, transport second”?
 - a. What can be done to encourage its use and spread awareness to the general public of its effectiveness/importance?

APPENDIX C

RECRUITMENT PHONE SCRIPT TO [Emergency Medical Technicians]

RECRUITMENT PHONE SCRIPT TO [Emergency Medical Technicians]

Hello _____ [subgroup] _____,

My name is Stephanie Mazerolle and I am a professor at the University of Connecticut. My fellow colleague, Douglas Casa and I are in the initial stages of recruiting potential participants for a study investigating an EMT's knowledge, attitudes, and clinical practice choices regarding key issues surrounding the recognition and treatment of exertional heat stroke. Additionally, we hope to gain more insights into the working relationship between the EMT and the Certified Athletic Trainer and the influence it may have on the recognition and treatment of an athlete with EHS.

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 an EMT's practice choices it can help us as a profession as we move towards a more evidence based approach to consistent and effective medicine/care.

This study, which has been approved by the University of Connecticut IRB, is a focus group design that will be held at your EMS location. It will last approximately 30 to 45 minutes and will be conducted with about 3 to 4 EMTs.

We are looking for EMTs with a certification of EMT-Basic or higher with a minimum 3 years of certification and licensure. If you are willing to participate or know anyone that may be interested in participating, please let me know as soon as possible. If you need some time to think it over, you can contact me at 860-486-4536 at your earliest convenience. Thank you.

APPENDIX D

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 your home base.

The purpose of this study is to gain a better understanding of an EMT'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 specifically. 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. EMTs play a critical role in the recognition and treatment of EHS, particularly at the high school level and gaining more insight into their educational preparation and practice beliefs may help improve the care provided to an athlete suffering from the condition.

This study will last approximately 30-45 minutes. It will be conducted at your specific work site. The focus group discussions will be video and audio taped. The session will include 3-4 other EMTs from your site who are participating in the focus group. Along with those involved with the focus group, 3 researchers will be present including the facilitator and two note-takers. 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, if you wish the transcription can be mailed to you), to be sure the information is accurate. Once the study is completed all tapes will be destroyed. This informed consent for 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 or Kristin Applegate, ATC, Graduate Student at 860-617-7639 . 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___