# Perceptions of Secondary School Athletic Trainers in the Diagnosis of Exertional Heat Stroke

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**Context:** Health care providers, including athletic trainers (ATs), may not be using the best practices for diagnosing exertional heat stroke (EHS), including rectal thermometry. Therefore, patients continue to be susceptible to death from EHS.

**Objective:** To examine the health belief model and its association with using rectal thermometry as the best practice for diagnosing EHS.

- Design: Cross-sectional study.
- Setting: Web-based survey.

**Patients or Other Participants:** A total of 208 secondary school ATs completed an online survey, and the data of 159 were included in the analysis.

**Main Outcome Measure(s):** The survey contained 2 primary sections: AT characteristics and health belief model structured questions assessing perceptions and techniques used to diagnose EHS. Answers to the latter questions were rated on a 5-point Likert scale. We performed a binary logistic regression to ascertain the effects of the health belief model constants (eg, perceived susceptibility, barriers), age, sex, and the type of school at which

the AT worked on the likelihood that participants would use best practice for diagnosing patients with EHS.

**Results:** Only 33.3% (n = 53) of the participating ATs reported they used best practice, including rectal thermometers to obtain core body temperature. The binary logistic regression was different for the 5 constructs: perceived susceptibility ( $\chi_6^2$  = 22.30, *P* = .001), perceived benefits ( $\chi_6^2$  = 71.79, *P* < .001), perceived barriers ( $\chi_6^2$  = 111.22, *P* < .001), perceived severity ( $\chi_6^2$  = 56.27, *P* < .001), and self-efficacy ( $\chi_6^2$  = 64.84, *P* < .001). Analysis of these data showed that older ATs were at greater odds (*P* ≤ .02) of performing best practice.

**Conclusions:** These data suggested that the health belief model constructs were associated with the performance of best practice, including using rectal thermometry to diagnose EHS. Researchers should aim to create tailored interventions based on health behavior to improve the adoption of best practice.

Key Words: health belief model, rectal thermometry, heat illnesses, high school

#### **Key Points**

- Given that exertional heat stroke is one of the leading causes of death in athletes, clinicians in all settings must follow best practice for recognizing and treating this potentially fatal condition.
- The health belief model proposes a new intervention strategy targeting an individual's health behavior for improved adoption of best practice.
- Perceived barriers, perceived benefits, self-efficacy, and demographics can strongly affect whether athletic trainers follow best practice.
- Researchers should use health behavior as a guide for developing tailored interventions to improve best-practice adoption in order to decrease the risk of death associated with exertional heat stroke.

**E** xertional heat stroke (EHS) is one of the leading causes of death in high school athletes.<sup>1,2</sup> In the sports setting, athletic trainers (ATs) are typically the first providers to identify, evaluate, and diagnose potential EHS in an athlete. Best practice for the prehospital recognition and treatment of EHS consists of core body temperature assessment using rectal thermometry and aggressive cooling via cold-water immersion.<sup>1,3</sup> The criterion standards of rectal thermometry for diagnosis and cold-water immersion for treatment were first published in 2002 and have been established as the best practice for health care professionals in several position and consensus statements, including the National Athletic Trainers' Association (NATA) position statements on

exertional heat illnesses.<sup>1,3–6</sup> Rectal thermometry was included as an educational competency in athletic training education in 2011.<sup>7</sup> However, despite the numerous publications and documentation of hundreds of patients with EHS who had positive outcomes<sup>2,8</sup> confirming this criterion standard of care, researchers<sup>3,9–15</sup> have suggested that ATs are not following this recommendation.

Many barriers have been identified to explain why ATs are not using rectal thermometry to recognize EHS. These include a perceived lack of education about and comfort using rectal thermometers, fear of liability, administrations that do not allow them to use rectal thermometers, and lack of access to rectal thermometers at their secondary schools.<sup>10,11,13–15</sup> Athletic trainers working in secondary

schools have reported that only 9.6% would use rectal thermometry to diagnose EHS, whereas only 0.9% of those who actually did treat a patient with EHS used rectal thermometry. Most recently, in their 2019 study of ATs in the secondary school setting, Scarneo et al<sup>10</sup> found that only 15.9% (n = 202) had access to rectal thermometers at their schools. Athletic training educators have also described not being comfortable or not believing they were prepared to teach students about rectal thermometry because of their own lack of training and experience in using rectal thermometers.<sup>13,14</sup> These findings foreshadow the possibility that health behavior may play a large role in the likelihood that an AT will adopt the best practice of using rectal thermometry for diagnosing suspected EHS.

The health belief model is a framework for evaluating health behavior that focuses on behavioral change at the individual level.<sup>16</sup> This model suggests that individuals may assess the expected net benefits of changing certain behaviors to decide whether they will make a specific change.<sup>16</sup> This internal assessment includes *perceived susceptibility* (the perceived risk of contracting the health condition), *perceived benefits* (perception of the positive results of adopting specific behaviors), *perceived barriers* (perception of the challenges and costs of performing such behaviors), *perceived severity* (perception of the consequences if the health condition is contracted), *cues to action* (exposure to factors that prompt action), and *self-efficacy* (the confidence in oneself with respect to the ability to perform the action).<sup>16-18</sup>

The health belief model has often been used to modify behavior, as described in the traditional public health literature.<sup>19,20</sup> For example, Solhi et al<sup>19</sup> found that, after educating adolescents about the perceived benefits of brushing their teeth and using dental floss, they were more likely to adopt these hygiene practices into their daily routines. Similarly, Moodi et al<sup>20</sup> observed that female students were more likely to perform breast self-examinations after they were educated on breast cancer and the benefits of performing self-examinations.

Barriers related to EHS diagnosis that ATs have reported were closely associated with different constructs of the health belief model. For instance, not being comfortable using rectal thermometry fits in the self-efficacy construct, and not being knowledgeable in the skill falls in the cuesto-action construct. The model is often used in public health, and its application in the athletic training setting may provide insight into potential explanations for why ATs decide to not implement best practice (ie, rectal thermometry) in the diagnosis of EHS.

A rectal thermometer is the only valid temperature device that should be used when diagnosing and treating EHS.<sup>21–23</sup> Despite the fact that it is considered the criterion standard by the NATA and other medical organizations, many ATs have not adopted it into their clinical practice.<sup>3,9–15</sup> To develop interventions that increase the use of this necessary practice, we must become better at addressing the factors affecting ATs' likelihood of adoption. Although the health belief model has been used in sports medicine research, the literature is lacking regarding its application in delineating health behavioral differences in EHS evaluation.<sup>24</sup> Therefore, the purpose of our study was to examine the health belief model and its association with secondary school ATs' use of rectal thermometry as best practice for



Figure 1. Sampling distribution.

diagnosing EHS. Obtaining this information will allow us to create strategies for improving ATs' adoption of rectal thermometry when diagnosing and treating EHS in the secondary school setting.

### METHODS

#### **Research Design and Participants**

We used a cross-sectional research design. A series of email notifications was sent to a sample of ATs across the United States. To increase our sample size, we also posted a link to the survey on social media platforms (eg, Facebook, Twitter). The sample distribution is outlined in Figure 1. Volunteers were included in the study if they worked as ATs in a secondary school, regardless of whether they had treated a patient with EHS. All participants indicated informed consent by continuing to the survey after reading the description and informed consent statement. This study was classified as exempt by the University of South Florida Institutional Review Board.

#### Instrument

The survey was a 1-time, self-administered online survey delivered using Qualtrics (Provo, UT). It had 2 primary sections: (1) characteristics of the ATs and health belief model questions regarding their perceptions and the techniques used to assess and treat patients with EHS (Appendix) and (2) questions for assessing the ATs' current perceptions and the techniques they used to diagnose EHS. The questions were based on the 6 categories of the health belief model and were answered using a 5-point Likert scale, with 1 indicating *strongly disagree*, 3 indicating *neither agree nor disagree*, and 5 indicating *strongly agree*. The health belief model questions were not presented in the 6 health belief model categories and were instead randomized (Table 1).

#### Table 1. Health Belief Model Construct Questions<sup>a</sup>

	Frequency, No.(%) <sup>b</sup>				
Health Belief Model Construct and Question (Respondents)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Perceived susceptibility					
<ol> <li>I do not think the risk of EHS occurring at my school is very likely because it does not get that hot here. (n = 159)</li> <li>Taking property for EUC will prove the EUC form</li> </ol>	102 (64.2)	42 (26.4)	8 (5.0)	4 (2.5)	3 (1.9)
<ol> <li>a king preventative measures for EHS will prevent EHS from occurring. (n = 159)</li> <li>I have not had an athlete experience EHS in my career, so it is not</li> </ol>	3 (1.9)	10 (6.3)	24 (15.1)	66 (41.5)	56 (35.2)
likely that I will ever have to manage this condition. ( $n = 158$ )	82 (51.9)	56 (35.4)	16 (10.1)	4 (2.5)	0 (0)
Perceived benefits					
<ol> <li>Correctly diagnosing EHS utilizing rectal thermometry is very important to me. (n = 159)</li> <li>Obtaining a patient's core body temperature with rectal</li> </ol>	9 (5.7)	31 (19.5)	32 (20.1)	44 (27.7)	43 (27.0)
thermometry is vital to accurately diagnosing EHS. ( $n = 159$ ) 6. By having a rectal temperature, I am able to accurately decide how	2 (1.3)	18 (11.3)	23 (14.5)	45 (28.3)	71 (44.7)
to treat a hyperthermic patient. ( $n = 159$ )	6 (3.8)	17 (10.7)	30 (18.9)	48 (30.2)	58 (36.5)
Perceived barriers					
<ul> <li>7. I believe rectal thermometry is an invasion of privacy and thus, I will not do it at my high school. (n = 159)</li> <li>8. Other temperature assessment devices are accurate at obtaining</li> </ul>	45 (28.3)	51 (32.1)	35 (22.0)	21 (13.2)	7 (4.4)
<ul> <li>core body temperature. (n = 159)</li> <li>9. My school's administration will not allow me to use rectal</li> </ul>	55 (34.6)	66 (41.5)	22 (13.8)	11 (6.9)	5 (3.1)
thermometry. $(n = 159)$	27 (17.0)	23 (14.5)	48 (30.2)	30 (18.9)	31 (19.5)
Perceived severity					
<ul> <li>10. I do not need a rectal temperature in order to diagnose someone with EHS. (n = 159)</li> <li>11. Obtaining a patient's temperature is not as important as scaling.</li> </ul>	34 (21.4)	40 (25.2)	39 (24.5)	41 (25.8)	5 (3.1)
<ul> <li>them as fast as possible. (n = 158)</li> <li>Morbidity and mortality will decrease with proper diagnosis via</li> </ul>	12 (7.6)	42 (26.6)	35 (22.2)	51 (32.3)	18 (11.4)
rectal thermometry. (n = 159)	3 (1.9)	13 (8.2)	39 (24.5)	47 (29.6)	57 (35.8)
Cues to action					
13. I have treated a patient with EHS in the past. ( $n = 159$ )	33 (20.8)	42 (26.4)	9 (5.7)	44 (27.7)	31 (19.5)
Exertional Heat Illnesses (2015). ( $n = 159$ )	3 (1.9)	1 (0.6)	4 (2.5)	80 (50.3)	71 (44.7)
thermometry. ( $n = 159$ )	19 (11.9)	21 (13.2)	14 (8.8)	51 (32.1)	54 (34.0)
Self-efficacy					
16. I have learned how to take rectal temperature. ( $n = 158$ ) 17. I am comfortable in using a rectal thermometer to diagnose and	22 (13.9)	23 (14.6)	10 (6.3)	58 (36.7)	45 (28.5)
treat EHS. (n = 159) 18. I feel it is not my duty to diagnose EHS, that is up to emergency	22 (13.8)	42 (26.4)	25 (15.7)	47 (29.6)	23 (14.5)
medical services.° (n = 159)	90 (56.6)	54 (34.0)	7 (4.4)	7 (4.4)	1 (0.6)

Abbreviations: EHS, exertional heat stroke; NATA, National Athletic Trainers' Association.

<sup>a</sup> Instrument is reproduced in its original format.

<sup>b</sup> Percentages were rounded and therefore may not equal 100%.

° This question was not included in the analysis.

#### **Reliability and Validity of the Survey**

Face and content validity were established by 3 ATs with expertise in EHS and sport safety. The ATs evaluated the survey throughout the development of the study to determine if the questions were clear, important, and properly administered. We revised the survey based on the panel's feedback. A pilot study was conducted with a sample of 14 ATs working in the secondary school setting. Feedback from the participants in the pilot study and additional suggestions from the panel were used to make further modifications to the survey. A reliability analysis (construct validity) of each of the 6 constructs of the health belief model was conducted. The Cronbach  $\alpha$  for each construct is provided in the Data Analysis subsection.

#### Procedures

We used a multimodal recruitment approach (Figure 1). First, the NATA sent the survey invitation via email to 1000 random potential participants who fit the inclusion criteria. The survey remained open for 6 weeks. During that time, those who had not completed the survey received 3 reminder emails asking them to do so before the deadline. Second, a convenience sample of 51 ATs was sent 1 email invitation each to participate in the survey after the closing of the initial distribution. Also, we invited ATs with whom we had relationships to participate in the convenience sample. Third, a link to the survey was posted on social media websites (eg, Facebook, Twitter) to solicit responses. Respondents were instructed to not complete the survey if they had already done so. The Web-based survey took 6.57  $\pm$  2.96 minutes to complete. Responses were removed if the participant was ineligible for the study (eg, did not work in the secondary school setting) or did not answer  $\geq$ 80% of the health belief model questions (2 participants included in the analysis answered 98% of the health belief model questions, whereas 157 participants answered 100% of the health belief model questions). The completion rate for the survey was 76.4%.

Participants were not required to answer all the questions and could exit the survey at any time. They also had the option of returning to the survey at any time. Therefore, the response rate varied by question. The 3 questions with the lowest response rate were "I have not had an athlete experience EHS in my career, so it is not likely I will ever have to manage this condition," "Obtaining a patient's temperature is not as important as cooling them as fast as possible," and, "I have learned how to take a rectal temperature" (for each question, n = 158/159; response rate = 99.4%).

#### **Data Analysis**

Reliability Analysis. A reliability analysis was carried out on the 6 constructs of the health belief model. Each construct consisted of 3 questions that were added into the reliability analysis using a Cronbach  $\alpha$ . A Cronbach  $\alpha$ between 0.64 and 0.70 was considered *adequate* and >0.70 was considered *acceptable*.<sup>25,26</sup> The Cronbach  $\alpha$  showed that the questionnaire achieved adequate or acceptable reliability for 4 of the 6 constructs (perceived benefits,  $\alpha =$ .85; perceived barriers,  $\alpha = .67$ ; perceived severity,  $\alpha = .71$ ; self-efficacy,  $\alpha = .71$ ). Most items appeared to be worthy of retention because  $\alpha$  decreased when they were deleted. However, the perceived susceptibility  $\alpha$  increased when the question "Taking preventative measures for EHS will prevent EHS from occurring" was removed. Therefore, we deleted the question, and the resulting  $\alpha = .57$  was retained (Table 1). Additionally, the perceived self-efficacy  $\alpha$ increased if the question "I feel it is not my duty to diagnose EHS, that is up to emergency medical services," was removed. Therefore, this question was also deleted, and the resulting  $\alpha = .84$  was retained. Furthermore, for cues to action, we identified a wide variety of responses, suggesting an invalid questioning structure ( $\alpha = .33$ ). Given this, we analyzed each question separately and calculated individual binary regression models for the individual questions within the construct rather than use a composite score with associated medians. Constructs with adequate and acceptable reliability were established as median values of the questions included. The Likert scores for each question were averaged to provide a median score for that construct, as this is a common method in questionnaires and the health belief model analysis specifically.<sup>27</sup> Questions that were removed from the construct (eg, "Taking preventative measures for EHS will prevent EHS from occurring") were not included in the binary logistic regression or the Kruskal-Wallis H test. However, they were retained in Table 1 to depict the responses across the Likert scale.

**Statistical Analysis.** We performed a binary logistic regression to ascertain the effects of the health belief model constants (perceived susceptibility, perceived barriers, etc), age, sex, region, and the type of school at which the AT worked on the likelihood that participants would perform best practice for diagnosing EHS. *Best practice* was defined as participants using central nervous system (CNS) dysfunction and core body temperature measured via rectal thermometry as their diagnostic criteria. The health belief model constructs established as a median score, as described in the "Reliability Analysis" subsection, were included in the model.

A secondary analysis was conducted to evaluate if heatsafety region was associated with the health belief model constructs. Respondents provided their zip codes, which we used to determine their heat-safety region as defined by Grundstein et al.<sup>28</sup> Each health belief model construct consisted of 3 questions. A median value for the Likert scale was calculated for each participant and for each construct (see "Reliability Analysis" subsection). Given that the data were not normally distributed and were nonparametric, we performed the Kruskal-Wallis *H* test with post hoc Dunn-Bonferroni analysis to compare the dependent measure (health belief model construct) and the 3 regions.

All data analysis was conducted in SPSS (version 26; IBM Corp, Armonk, NY). Results were considered different if  $P \leq .05$ .

#### RESULTS

#### Characteristics

A total of 208 individuals responded to the survey. Only respondents meeting all study criteria (secondary school ATs who completed the survey) were included in the analysis (n = 159). Participants were mostly female (63.5%; n = 101), were aged 37.95  $\pm$  10.92 years, worked at high schools with an average of 1332  $\pm$  852 students and 526  $\pm$  353 athletes, had  $\geq$ 15 years of experience (25.2%, n = 40), and had earned a master's degree (68.6%; n = 109). The highest percentage of respondents was from NATA District 9 (Table 2).

#### **Exertional Heat-Stroke Evaluation**

Approximately 61.6% (n = 98) of participants were not following the best-practice recommendations for the diagnosis of EHS. When instructed to choose the criteria they used to diagnose EHS, ATs most often reported using CNS dysfunction (82.4%, n = 131) and obtaining temperature (66.7%, n = 106; Figure 2). Of those who reported measuring temperature as a criterion for diagnosing EHS, 57.5% (n = 61) stated they only used a rectal thermometer to obtain core body temperature (Figure 3).

#### **Health Belief Model Constructs**

**Perceived Susceptibility.** On a 5-point Likert scale, 4.4% (n = 7) of the respondents indicated they agreed or strongly agreed with the statement, "I do not think the risk of EHS occurring at my school is very likely because it does not get that hot here" (Table 1). The binary logistic regression was different ( $\chi_6^2 = 22.30$ , P = .001). The model explained 19.2% (Nagelkere  $R^2$ ) of the variance in

Table 2.	Participants'	Characteristics
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Characteristic	Frequency, No. (%) <sup>a</sup>
Sex (n = 159)	
Male	55 (34.6)
Female	101 (63.5)
	3 (1.9)
Highest level of education (n = 159)	
Bachelor's degree	45 (28.3)
Doctorate	5 (3.1)
Experience as an athletic trainer, y (n = 159)	
<1	6 (3.8)
1–5	41 (25.8)
6–10	22 (13.8)
11–15	17 (10.7)
≥15	73 (45.9)
Time in current position, y (n $=$ 155)	
<1	24 (15.5)
1–5	57 (36.8)
6–10	25 (16.1)
11–15 >15	9 (5.8) 40 (25.8)
$\geq$ 10	40 (20.0)
Type of secondary school ( $n = 159$ )	22 (20 8)
Public	33 (20.8) 123 (77 4)
Charter	1 (0 6)
Magnet	2 (1.3)
National Athletic Trainers' Association District (	n = 157)
1	10 (6.4)
2	30 (19.1)
3	19 (12.1)
4	22 (14.0)
5	8 (5.1)
6	11 (7.0)
/	5 (3.2)
0 Q	13 (0.3) 32 (20 4)
10	7 (4.5)
Heat-safety region (n = 155)	. ,
1	31 (19.9)
2	46 (30.3)
3	75 (49.3)

<sup>a</sup> Percentages were rounded and may not equal 100%.

performing best practice and correctly classified 70.0% of cases. Athletic trainers who perceived the susceptibility to sustaining EHS to be lower were at lesser odds of performing best practice (P = .02,  $\beta = -0.47$ , standard error [SE] = 0.18). Furthermore, they were also at lesser odds (odds ratio [OR] = 0.67) of using best practice for diagnosing EHS than ATs who perceived the susceptibility to EHS to be higher. Increased age was associated with 1.05 greater odds (P = .02,  $\beta = .05$ , SE = 0.02) of performing best practice. The Kruskal-Wallis H test showed a difference among regions (P < .001). The post hoc Dunn-Bonferroni test showed that the median perceived susceptibility was lower in heat-safety regions 2 (3.09 ± 1.18; P < .001) and 3 (2.69 ± 0.96; P < .001) than in region 1 (4.26 ± 1.75).

**Perceived Benefits.** In response to the statement, "Correctly diagnosing EHS utilizing rectal thermometry is very important to me [sic]," 25.2% (n = 40) of the



Figure 2. Methods used to diagnose exertional heat stroke (N = 159). Participants were instructed to select all the criteria they used to diagnose exertional heat stroke.

respondents commented that they disagreed or strongly disagreed (Table 1). The binary logistic regression result was different ( $\chi_6^2 = 71.79, P < .001$ ). The model explained 52.6% (Nagelkere  $R^2$ ) of the variance in performing best practice and correctly classified 82.8% of cases. The ATs who indicated greater agreement with the perceived benefits of using rectal thermometry were at greater odds of performing best practice (P < .001,  $\beta = 2.05$ , SE = 0.400). Furthermore, those who endorsed greater agreement with the perceived benefits of using rectal thermometry were at 7.79 greater odds of using best practice than ATs who perceived the benefits to be less. Increased age was associated with a greater likelihood of using best practice  $(P = .02, \beta = .54, SE = 0.023, OR = 1.06)$ , but sex and the type of school where the AT worked were not associated. The Kruskal-Wallis H test revealed a difference among heat-safety regions and perceived benefits (P = .02). The Dunn-Bonferroni post hoc test revealed that the median perceived benefits were higher in heat-safety region 3 (3.63  $\pm$  1.26) than in region 2 (2.84  $\pm$  1.26; P = .01).

**Perceived Barriers.** Only 34.6% (n = 55) of respondents expressed strong disagreement with the statement, "Other temperature assessment devices are accurate at obtaining



Figure 3. Types of thermometers used to diagnose exertional heat stroke (n = 106). Participants who reported obtaining a temperature as a diagnostic criterion for exertional heat stroke were instructed to indicate the type of thermometer used. They were allowed to select >1 type of thermometer. A total of 33 individuals did not answer this question because they did not use a thermometer to diagnose exertional heat stroke.

core body temperature," compared with rectal thermometry (Table 1). The binary logistic regression finding was different ( $\chi_6^2 = 111.22$ , P < .001). The model explained 72.5% (Nagelkere  $R^2$ ) of the variance in performing best practice and correctly classified 87.4% of cases. Athletic trainers who indicated more disagreement with the perceived barriers to using rectal thermometry were at greater odds of performing best practice (P < .001,  $\beta = -3.86$ , SE = 0.70). When ATs perceived more barriers to rectal thermometry, their odds of obtaining rectal temperatures in patients with suspected EHS were 21% less. No associations were noted among age, sex, region, and type of high school where the AT worked. We did not identify differences between heat-safety region and perceived barriers using the Kruskal-Wallis H test (P > .05).

**Perceived Severity.** When instructed to respond to the statement, "I do not need a rectal temperature in order to diagnose someone with EHS," only 21.4% (n = 34) of the respondents strongly disagreed, suggesting they believed a rectal temperature was needed to aid in the diagnosis of EHS (Table 1). The binary logistic regression result was different ( $\chi_6^2 = 56.27$ , P < .001). The model explained 43.3% (Nagelkere  $R^2$ ) of the variance in performing best practice and correctly classified 83.4% of cases. Athletic trainers who indicated less agreement with the perceived severity of EHS were at greater odds of not performing best practice (P < .001,  $\beta = -1.63$ , SE = 0.31). We did not observe differences between perceived severity of EHS across heat-safety regions using the Kruskal-Wallis *H* test (P > .05).

Cues to Action. Most participants had some type of educational experience with rectal thermometry (66.0%; n = 105; Table 1). Given the variance in the responses, we decided to analyze the questions separately rather than analyze a median value for a true construct. The binary logistic regression finding was different for questions 14 ("I have read and understand the NATA Position Statement on Exertional Heat Illnesses [2015]";  $\chi_4^2 = 13.49$ , P = .009) and 15 ("I have had some type of educational experience with rectal thermometry";  $\chi_4^2 = 41.11$ , P < .001) but not for question 13 ("I have treated a patient with EHS in the past";  $\chi_4^2 = 7.58$ , P = .12). Having had some type of educational experience with rectal thermometry was associated with performing the skill (P < .001). The model explained 31.9% (Nagelkere  $R^2$ ) of the variance in performing best practice and correctly classified 77.2% of cases. Additionally, reporting having read and understood the NATA position statement was associated with using rectal thermometry (P = .01). The model explained 11.4% (Nagelkere  $R^2$ ) of the variance in performing best practice and correctly classified 70.3% of cases.

We observed no associations between heat-safety region and questions 13 ("I have treated a patient with EHS in the past") and 14 ("I have read and understand the NATA Position Statement on Exertional Heat Illnesses [2015]"; P > .05). The Kruskal-Wallis H test identified a difference between region and question 15, "I have had some type of educational experience with rectal thermometry" (P = .02). The post hoc Dunn-Bonferroni test demonstrated that more ATs in heat-safety region 3 had educational experience than ATs in region 2 ( $4 \pm 1$  versus  $3 \pm 1$ ; P = .02).

**Self-Efficacy.** Only 44.0% (n = 70) of participants agreed or strongly agreed with the statement, "I am comfortable in

using a rectal thermometer to diagnose and treat EHS" (Table 1). The binary logistic regression was different ( $\chi_6^2 = 64.84$ , P < .001). The model explained 48.5% (Nagelkere  $R^2$ ) of the variance in performing best practice and correctly classified 78.1% of cases. Greater self-efficacy (P < .001,  $\beta = 1.46$ , SE = 0.28, OR = 4.31) for performing best practice and older age (P < .004,  $\beta = .70$ , SE = 0.02, OR = 1.07) were associated with performing best practice. The Kruskal-Wallis *H* test revealed a difference between heat-safety regions and self-efficacy (P = .002). The post hoc Dunn-Bonferroni test showed that the median perceived self-efficacy was higher in heat-safety region 3 (3.63 ± 1.26) than in region 2 (2.84 ± 1.26; P = .001).

#### DISCUSSION

#### **Exertional Heat-Stroke Diagnosis**

Researchers<sup>11–15,29,30</sup> have determined that many ATs were not using rectal thermometry in their clinical practice to diagnosing EHS. However, increases in evidence and published papers and focus on educational competencies have clearly defined rectal thermometry as best practice for recognizing and diagnosing EHS.<sup>1,3,5–7,21–23,31</sup> The 2 main diagnostic criteria for EHS are a rectal temperature >105°F (40.5°C) and CNS dysfunction.<sup>1,3</sup> Our findings suggested that, despite the evidence and educational efforts, many ATs were still not following best practice for recognizing patients with EHS in the secondary school setting. Surprisingly, nearly 65% (n = 103) of the participants would incorrectly use the presence of hot, dry skin to diagnose EHS. An individual who collapses because of EHS during exercise in the heat will likely still be sweating; for this reason, the presence or absence of sweat should not be used to rule EHS in or out.

We also noted that half of the respondents who indicated they would obtain a temperature in an athlete with possible EHS reported they would not use a rectal thermometer. Almost one-third (28.9%; n = 46) agreed or strongly agreed with the statement, "I do not need a rectal temperature in order to diagnose someone with EHS." Although these numbers have improved considerably over the years compared with those reported by previous authors,<sup>11</sup> it is important to understand why many ATs were still not following best practice. Our results on EHS and ATs' knowledge and perceptions regarding best practice can provide support for future interventions and educational efforts directed at ATs and guided by the health belief model.

#### Applying the Health Belief Model to EHS Diagnosis

To our knowledge, we are the first to use the health belief model to determine the association among the constructs (eg, perceived benefits, perceived barriers, perceived severity) and ATs' decision making related to recognizing a patient with EHS in an emergency situation. As mentioned, the health belief model has been used frequently in the public health literature.<sup>19,20</sup> This model includes constructs, such as perceived susceptibility, perceived benefits, perceived barriers, perceived severity, cues to action, and self-efficacy.<sup>16–18</sup> By using the health belief model, we may be able to better identify certain health behaviors that affect ATs' willingness to perform or perceptions about performing best practice, such as obtaining a rectal temperature to diagnose EHS.

In our study, these data suggested that greater agreement with the perceived benefits of obtaining rectal temperature was associated with performing the skill. This finding indicated that, when ATs had a more positive perception of the benefits of rectal temperature, they were more likely to follow best practice of using rectal thermometry. Interestingly, participants living in heat-safety region 3 (southern part of the United States, including the entire Southeast and mid-Atlantic regions, parts of Texas, and various parts of California)<sup>28</sup> expressed greater agreement with the perceived benefits of following best practice than those in region 2 (portions of the Midwest, Ohio Valley, Northeast, and interior Northwest through Nevada).

Similarly, when our ATs identified little or no agreement with previously identified barriers (ie, if they did not perceive barriers to performing the skill), they were more likely to perform it. Also, ATs who perceived more barriers to obtaining a rectal temperature in the secondary school setting were less likely to follow best practice. This finding concurs with that of Saunders et al,<sup>32</sup> who reported that individuals who perceived more barriers to acquiring hearing aids were less likely to obtain them. They concluded that individuals who had low perceived susceptibility and severity, meaning that they did not think they could experience hearing loss and that it would not affect them if it did, were less likely to seek medical attention for their impairment.<sup>32</sup> Our use of the health belief model in this study coincided with these results on hearing aids: ATs who reported they had less agreement with the perceived susceptibility and severity of EHS were less likely to use best practice of rectal thermometry. We observed no differences regarding severity across the 3 heat-safety regions of the United States, although interestingly, we did find less perceived susceptibility in regions 2 and 3 than in region 1.

Previous investigators<sup>11</sup> observed that lack of training was cited as a potential barrier to ATs' use of rectal thermometry in a patient with suspected EHS. In our study using the health belief model, the same was true of ATs who were trained in this skill. Our results suggested a relationship between an ATs past educational opportunities to use rectal thermometry and whether they would apply this evidence to clinical practice. We also determined that older ATs appeared to display greater agreement with perceived susceptibility, perceived benefits, and selfefficacy. Whereas the ORs for age and the associated constructs were not high, it is interesting that this finding was different. The educational competency for obtaining a rectal temperature was not added until 2011; therefore, it is notable that the older participants had higher perceived susceptibility, perceived benefits, and self-efficacy, as they were likely not taught this skill during their undergraduate education. Anecdotally, we would presume that increased age would include an "old-school mentality" and the refusal to use best practice, but these findings demonstrated this was not the case. It is plausible that older ATs with more educational opportunities regarding rectal thermometry (via continuing education) were more likely to incorporate this skill into their clinical practices.

Although we did not detect an association between heatsafety region and having treated a patient with EHS or having read the NATA position statements on exertional heat illnesses, ATs in region 3 reported more educational experiences with rectal thermometry than those in region 2. Similarly, participants in region 3 had greater self-efficacy than those in region 2. Thus, reporting greater agreement with cues to perform rectal thermometry was associated with performing the skill. This finding is extremely encouraging because, if Commission on Accreditation of Athletic Training Education-accredited education programs, AT staff, and continuing education providers provide more hands-on educational opportunities, the number of ATs who are following best practice in recognizing EHS may increase. About 66% (n = 105) of the respondents described having some type of educational opportunity with rectal thermometry, but only 44% (n = 70) felt comfortable measuring a rectal temperature (Table 1). These results were similar to those from another health care study<sup>20</sup> using the health belief model in which education and perceived benefits produced cues to action. These data support the need for increased education on rectal thermometry, as ATs who said they had some type of educational experience with rectal thermometry were more likely to perform the skill.

Education needs to include not only clinicians but also educators, administrators, and other stakeholders (ie, school board members, superintendents). According to our results, 38% (n = 61) of participants indicated that their administrations would not allow them to obtain a rectal temperature (Table 1). Fear of liability has often been cited<sup>11,13,14,30</sup> as a reason for not using best practice to recognize EHS. Therefore, educating administrators on the necessity of this skill from a liability perspective can lead to more support for the clinician. All stakeholders should be instructed in the detrimental effects of not correctly diagnosing and treating a patient with EHS and the liability for not following best practice. Providing examples of EHS patients whose clinicians did or did not follow best practice, along with the associated outcome, can facilitate adding rectal thermometry to the AT's heat-illness protocol.

These data offer preliminary insights into the application of the health belief model to sports medicine domains to guide future efforts aimed at improving best-practice adoption through tailored interventions (ie, continuing education opportunities that include training and further explanations of the benefits of obtaining a rectal temperature in patients with suspected EHS; Table 3). Specifically, by identifying ATs' health belief model perceptions, we can tailor interventions to address the specific constructs identified in this study and improve best-practice adoption. For example, when ATs reported more barriers to performing rectal temperature, they were less likely to perform the skill. Researchers have identified liability concerns, lack of education, and lack of awareness of the necessary equipment as among the barriers that ATs described. Therefore, future interventions should address these barriers, using such methods as increased educational opportunities, more dissemination of position statements, and additional opportunities for ATs to practice the skill. The strategies listed in Table 3 include action items for both clinicians and experts in EHS or those leading educational efforts in this area. We believe we are the first to investigate the relationship between the health belief model and the performance of best practice for the diagnosis of EHS using

Table 3.	Intervention Strategies for Best Practice in the Diagnosis
and Mana	agement of Patients With Exertional Heat Stroke in the
Seconda	ry School Setting

Health Belief Model Construct	Strategies
Perceived susceptibility	Increase the dissemination of information from the National Center for Catastrophic Sport Injury Research on deaths from exertional heat stroke around the nation (not just in the Southeast).
Perceived benefits	Clinicians should increase their knowledge about the need to obtain rectal temperature in order to accurately diagnose and treat a patient with exertional heat stroke.
Perceived barriers	Fear of liability: Clinicians should work with supervising physicians and administrators to incorporate best-practice recognition and treatment of exertional heat stroke into standing orders, heat policy, and emergency action plans.
Perceived severity	Organizations should create educational resources based on the most recent published literature and position statements to enhance knowledge about the catastrophic nature of exertional heat stroke.
Self-efficacy	Clinicians should seek educational opportunities, either online or in person via the nearest Commission on Accreditation of Athletic Training Education–accredited athletic training programs.
Cues to action	Clinicians should stay up to date on position statements, consensus statements, and original research regarding the prehospital care of patients with exertional heat stroke.

rectal thermometry. This information will allow for a better understanding of the health behaviors that clinicians experience when diagnosing and managing a patient with suspected EHS. Moreover, these data will aid in creating tailored strategies to improve best-practice adoption by using public health approaches based on health behaviors.

#### LIMITATIONS

Our study had limitations. First, we were unable to calculate a valid response rate due to the social media distribution of the survey link. Second, the small sample size (n = 159) may restrict the ability to generalize these findings to a national pool of ATs. Third, we found a lower Cronbach  $\alpha$  value in the perceived susceptibility construct; therefore, caution is needed when interpreting the results for that construct. Although several reasons could explain the lower Cronbach  $\alpha$  value in this construct, one possibility was the lower response rate. We also noted a low Cronbach  $\alpha$  for the cues to action. Given the exceptionally low Cronbach  $\alpha$  (.33), we believe this reflected the question structure (ie, how the questions were phrased).

Another limitation of this investigation was the decision to use convenience sampling. As such, it is possible that the convenience sample was biased toward performing best practice. This sampling process may have also led to the interesting result that older participants were more likely to perform rectal thermometry. Our primary purpose was to identify associations between the health belief model and performing best practice for EHS diagnosis. Therefore, we believe the biased sample further supports the relationship between the model and the effect it may have on following best practice. For example, if a participant followed best practice and realized a greater benefit from doing so, these data are valuable in showing that a greater perceived benefit was related to performing best practice. However, if a participant did not perceive any benefit to performing rectal thermometry, he or she may choose to not perform the skill. Our results depicted a higher percentage of respondents who performed rectal thermometry and overall best practice for the diagnosis of EHS compared with previous literature. However, readers should exercise caution when generalizing these findings to the general population. Although 32.7% (n = 52) of participants stated they were using rectal thermometry in their practice, other authors have shown a lower percentage of clinicians following best practice. Thus, convenience sampling may have influenced this percentage.

### CONCLUSIONS

Our findings suggested that many ATs in the secondary school setting were still not performing the best-practice recommendation for diagnosing EHS. Given that EHS is one of the leading causes of death in sport,<sup>3,5,6,22</sup> clinicians must follow best practice in all settings to recognize and treat patients with this potentially fatal condition. The health belief model construct proposes a new intervention strategy when targeting an individual's health behavior for improved adoption. Perceived barriers, perceived benefits, and self-efficacy, as well as other characteristics (ie, age, heat-safety region), can strongly affect whether ATs follow best practice. We provided preliminary data on the applicability of the health belief model in the realm of EHS and potentially other areas of athletic training. Researchers should aim to use health behavior as a guide for tailored interventions to improve best-practice adoption in order to decrease the risk of preventable deaths from EHS.

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#### Appendix. Current Perceptions and Techniques for Diagnosing Exertional Heat Stroke Questionnaire<sup>a</sup> Continued on Next Page

, , , , ,
Yes
No * China tao and a farman if Damas any anti-mark in the accordance
school setting? = No
General Information
What is your school's five digit zip code?
Sex
Male Female
Prefer not to disclose
Age
What is your ethnicity? (Select all that apply)
Caucasian Black or African American
American Indian or Alaskan
Asian
Native Hawaiian or Pacific Islander
Hispanic/Latino
Prefer not to disclose
Other
What type of school do you work at?
Public
Private
Magnet
Other
How many athletes does your school have?
How many students are enrolled at your high school?
Less than 1 year
1–5 years
6–10 years
11–15 years
15 or more years How long have you been at your current position?
Less than 1 year
1–5 years
6–10 years
11–15 years
What district of the NATA do you work in?
What is your highest level of education?
Bachelor's degree
Master's degree
Doctorate
Please select the method(s) you utilize to diagnose exertional heat
stroke (EHS):
Hot/dry skin
Hot/moist skin
Obtain temperature
Other: please write in
I do not diagnose EHS
*Skip To: End of Block if: Please select the method(s) you utilize to
lf you obtain temperature, what method do you use?
Oral
Rectal
Aural
Esophageal
Forehead
Temporal

Survey Questions

- Appendix. Continued From Previous Page Please answer the questions below based on your agreement with the statement. Exertional heat stroke = EHS Central nervous system = CNS I do not think the risk of EHS occurring at my school is very likely because it does not get that hot here. 1 = strongly disagree 2 = disagree 3 = neither agree nor disagree 4 = agree5 = strongly agreeTaking preventative measures for EHS will prevent EHS from occurring. 1 = strongly disagree 2 = disagree3 = neither agree nor disagree 4 = agree5 = strongly agreeI have not had an athlete experience EHS in my career, so it is not likely that I will ever have to manage this condition. 1 = strongly disagree 2 = disagree3 = neither agree nor disagree 4 = agree5 = strongly agree
  - Correctly diagnosing EHS utilizing rectal thermometry is very important to me.
    - 1 = strongly disagree
    - 2 = disagree
    - 3 = neither agree nor disagree
    - 4 = agree
    - 5 = strongly agree
  - Obtaining a patient's core body temperature with rectal thermometry is vital to accurately diagnosing EHS.
    - 1 = strongly disagree
    - 2 = disagree
    - 3 = neither agree nor disagree
    - 4 = agree
    - 5 = strongly agree
  - By having a rectal temperature, I am able to accurately decide how to treat a hyperthermic patient.
    - 1 = strongly disagree
    - 2 = disagree
    - 3 = neither agree nor disagree
    - 4 = agree
  - 5 = strongly agree
  - I believe rectal thermometry is an invasion of privacy and thus, I will not do it at my high school.
    - 1 = strongly disagree
    - 2 = disagree
    - 3 = neither agree nor disagree
    - 4 = agree
    - 5 = strongly agree
  - Other temperature assessment devices are accurate at obtaining core body temperature.
    - 1 = strongly disagree
  - 2 = disagree
    - 3 = neither agree nor disagree
    - 4 = agree
    - 5 = strongly agree
  - My school's administration will not allow me to use rectal
    - thermometry.
    - 1 = strongly disagree
    - 2 = disagree
    - 3 = neither agree nor disagree
    - 4 = agree
  - 5 = strongly agree

#### Appendix. Continued From Previous Page

I do not need rectal temperature in order to diagnose someone with EHS. 1 = strongly disagree

- I = strongly disag
- 2 = disagree
- 3 = neither agree nor disagree
- 4 = agree
- 5 = strongly agree
- Obtaining a patient's temperature is not as important as cooling them as fast as possible.
  - 1 = strongly disagree
  - 2 = disagree
  - 3 = neither agree nor disagree
  - 4 = agree
  - 5 = strongly agree
- Morbidity and mortality will decrease with proper diagnosis via rectal thermometry.
  - 1 = strongly disagree
  - 2 = disagree
  - 3 = neither agree nor disagree
  - 4 = agree
  - 5 = strongly agree
- I have treated a patient with EHS in the past.
  - 1 = strongly disagree
  - 2 = disagree
  - 3 = neither agree nor disagree
  - 4 = agree
  - 5 = strongly agree
- I have read and understand the most recent NATA Position Statement on Exertional Illnesses (2015).
  - 1 = strongly disagree
  - 2 = disagree
  - 3 = neither agree nor disagree
  - 4 = agree
  - 5 = strongly agree
- I have had some type of educational experience with rectal thermometry (ie, attended a conference/lab, reviewed procedures via CEUs, professional postprofessional AT program).
  - 1 = strongly disagree
  - $\mathbf{2} = \mathbf{disagree}$
  - 3 = neither agree nor disagree
  - $\mathbf{4} = \mathbf{a} \mathbf{g} \mathbf{r} \mathbf{e} \mathbf{e}$
  - 5 = strongly agree
- I have learned how to take a rectal temperature.
  - 1 = strongly disagree
  - $\mathbf{2} = \mathbf{disagree}$
  - 3 = neither agree nor disagree
  - 4 = agree
  - 5 = strongly agree
- I am comfortable in using a rectal thermometer to diagnose and treat EHS.
  - 1 = strongly disagree
  - 2 = disagree
  - 3 = neither agree nor disagree
  - 4 = agree
  - 5 = strongly agree
- I feel it is not my duty to diagnose EHS, that is up to emergency
  - medical services.
  - 1 = strongly disagree
  - 2 = disagree
- 3 = neither agree nor disagree
- 4 = agree
- 5 = strongly agree

#### Appendix. Continued From Previous Page

- **Open Ended Question** 
  - Is there anything else you would like to tell the research team with regards to your perceptions of the use of rectal thermometry in diagnosing EHS? \_\_\_\_\_

#### \*End of Survey

Abbreviation: CEUs, continuing education units; CNS, central nervous system; EHS, exertional heat stroke; NATA, National Athletic Trainers' Association; lab, laboratory.

<sup>a</sup> Instrument is reproduced in its original format.