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**TECHNICAL INFORMATION BULLETIN No. 18**

**To: Members, Arizona School Risk Retention Trust, Inc.**

**Re: Hot Weather, Heat Stress, and School Safety**

**Introduction**

Each year, Arizona students compete in strenuous outdoor sports such as cross-country, soccer, softball, and football. Younger students, too, play outside in the heat of the day. And school staff must sometimes work outdoors, or perform tasks in facilities that lack climate control (in a warehouse or a large storage unit, for example), or that otherwise experience temperature extremes (e.g., near ovens and stoves in food service areas).

The combination of warm temperatures and physical exertion can create the potential for heat-related problems. Accordingly, great care must be taken to protect students and staff from the effects of heat illnesses. This Technical Information Bulletin provides information regarding the causes, prevention, and treatment of such illnesses.

**Heat Illness: Types, Causes, and Symptoms**

Heat illness occurs when the body's core temperature rises to a dangerous level for a sustained period. This is particularly likely to occur when: (1) temperatures exceed 86 degrees Fahrenheit or humidity is greater than 80 percent; and (2) no special precautions have been taken.

Heat illness can include a variety of symptoms and can take on a number of forms. Important terms for understanding heat illness include:

- heat-induced dehydration,
- heat cramps,
- heat exhaustion, and
- heat stroke.

### Heat-induced dehydration

Heat-induced dehydration occurs when the body's water content falls to a dangerously low level. Early signs of dehydration are dry lips, dizziness, and lethargy. Treatment includes resting and increased fluid intake.

### Heat cramps

Heat cramps take the form of involuntary, painful cramping of the muscles, usually in the calves or abdomen. Treatment includes resting and cooling down; drinking clear juice or a sports drink with electrolytes; and practicing gentle range-of-motion stretching and massage on the affected muscle group. Medical assistance should be sought if the cramps do not subside in approximately one hour.

### Heat exhaustion

Heat exhaustion is the most common heat illness. It is characterized by headache, dizziness, shortness of breath, goosebumps, nausea, and, potentially, vomiting. An individual may also experience heat cramps; heavy sweating; rapid, weak heartbeat; low blood pressure; low-grade fever; fatigue; and dark-colored urine.

Individuals suffering from heat exhaustion should: (1) be moved to a shady or air-conditioned location; (2) be placed lying down with feet and legs elevated slightly; and (3) be provided with cool water to drink. The heat exhaustion victim should also have any excess clothing loosened or removed, should be sprayed or sponged with cool water, and should be fanned so as to accelerate cooling. Finally, victims of heat exhaustion should be carefully monitored, as heat exhaustion can quickly become heat stroke.

### Heat stroke

Heat stroke is the least common but most serious (sometimes fatal) form of heat illness. Because of this, if heat stroke is suspected, 9-1-1 should be called immediately so that professional medical treatment and hospital transport can be arranged.

Heat stroke is characterized by disorientation, dizziness, convulsions, confusion, and/or loss of consciousness. Other signs of heat stroke include irritability, hot/dry skin, increased body temperature, elevated or lowered blood pressure, rapid and shallow breathing, and rapid/strong pulse.

Treatment of heat stroke requires rapid cooling. While awaiting emergency responders, therefore, the individual suffering from heat stroke should be moved to a shaded and/or cooled environment, and should be covered with damp sheets or other dampened light cloth/fabric, or sprayed with cool water.

## Statutory Requirements

While being aware of and learning to deal with heat-related illnesses is good practice, it is also the law. A.R.S. §15-341 (A)(24) requires the district governing board to “prescribe and enforce policies and procedures relating to the health and safety of all pupils participating in district sponsored practice sessions, games or other interscholastic athletic activities, including...the provision of water.”

For many years, it was argued that student-athletes understood, and therefore assumed (in a legal sense), the risk of injury associated with participation in athletic events. Court cases throughout the United States, however, have eroded the concept of assumption of risk as it relates to athletic injuries and illnesses.

This means that coaches, like teachers, are responsible for the welfare of students and must take appropriate measures to prevent harm. This includes promoting awareness of potential heat-related illnesses, and implementing plans for their prevention and treatment. Specifically, coaches need to inform student-athletes and parents regarding:

- the requirements of their sport(s),
- the risks of heat illness, and
- the proper steps to prevent heat illness.

Coaches also need to:

- provide for the health and safety of the athlete, and
- enforce established rules related to the prevention of heat-related illness and injury.

## Prevention

There are a variety of precautions that can help prevent heat-related illness. The most important ones are described below.

### Monitor heat conditions

For purposes of monitoring outdoor conditions and assessing heat-related risks, the use of the Wet Bulb Globe Temperature (WBGT) is considered the “gold standard.” This measure accounts for the combined effects of temperature, humidity, and the impact of direct sunlight.

However, obtaining the WBGT requires the use of a wet bulb globe thermometer, which schools may not have.

An alternative to the WBGT is the heat index (HI), the temperature the body feels when heat and humidity are combined. The higher the heat index, the greater the possibility

that prolonged exposure or strenuous activity will lead to heat illness. With high heat index temperatures, students should balance practice or play with rest and hydration to minimize their risk.

The heat index temperature is calculated using air temperature and: (a) relative humidity; or (b) dew point. These three elements can be obtained by checking local weather at <http://weather.yahoo.com>. An HI calculator can also be found online at [http://www.srh.noaa.gov/epz/?n=wxcalc\\_heatindex](http://www.srh.noaa.gov/epz/?n=wxcalc_heatindex).

The table on the following page displays the HI for different combinations of air temperature and humidity. To illustrate, with an air temperature of 106 degrees Fahrenheit and a relative humidity of 40 percent, the heat index would be 124 degrees. The table legend indicates that individuals engaged in outdoor activities at this heat index temperature are at risk of a heat-related illness.

Table 1. Heat index values, with legend

HEAT INDEX °F (°C)													
Temp.	RELATIVE HUMIDITY (%)												
	40	45	50	55	60	65	70	75	80	85	90	95	100
110 (47)	136 (58)												
108 (43)	130 (54)	137 (58)											
106 (41)	124 (51)	130 (54)	137 (58)										
104 (40)	119 (48)	124 (51)	131 (55)	137 (58)									
102 (39)	114 (46)	119 (48)	124 (51)	130 (54)	137 (58)								
100 (38)	109 (43)	114 (46)	118 (48)	124 (51)	129 (54)	136 (58)							
98 (37)	105 (41)	109 (43)	113 (45)	117 (47)	123 (51)	128 (53)	134 (57)						
96 (36)	101 (38)	104 (40)	108 (42)	112 (44)	116 (47)	121 (49)	126 (52)	132 (56)					
94 (34)	97 (36)	100 (38)	103 (39)	106 (41)	110 (43)	114 (46)	119 (48)	124 (51)	129 (54)	135 (57)			
92 (33)	94 (34)	96 (36)	99 (37)	101 (38)	105 (41)	108 (42)	112 (44)	116 (47)	121 (49)	126 (52)	131 (55)		
90 (32)	91 (33)	93 (34)	95 (35)	97 (36)	100 (38)	103 (39)	106 (41)	109 (43)	113 (45)	117 (47)	122 (50)	127 (53)	132 (56)
88 (31)	88 (31)	89 (32)	91 (33)	93 (34)	95 (35)	98 (37)	100 (38)	103 (39)	106 (41)	110 (43)	113 (45)	117 (47)	121 (49)
86 (30)	85 (29)	87 (31)	88 (31)	89 (32)	91 (33)	93 (34)	95 (35)	97 (36)	100 (38)	102 (39)	105 (41)	108 (42)	112 (44)
84 (29)	83 (28)	84 (29)	85 (29)	86 (30)	88 (31)	89 (32)	90 (32)	92 (33)	94 (34)	96 (36)	98 (37)	100 (38)	103 (39)
82 (28)	81 (27)	82 (28)	83 (28)	84 (29)	84 (29)	85 (29)	86 (30)	88 (31)	89 (32)	90 (32)	91 (33)	93 (34)	95 (35)
80 (27)	80 (27)	80 (27)	81 (27)	81 (27)	82 (28)	82 (28)	83 (28)	84 (29)	84 (29)	85 (29)	86 (30)	86 (30)	87 (31)

Category	Heat Index	Possible heat disorders for people in high risk groups
Extreme Danger	130°F or higher (54°C or higher)	Heat stroke or sunstroke likely.
Danger	105 - 129°F (41 - 54°C)	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
Extreme Caution	90 - 105°F (32 - 41°C)	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	80 - 90°F (27 - 32°C)	Fatigue possible with prolonged exposure and/or physical activity.

It should be noted that the temperatures in heat index tables, including the one above, generally assume shady conditions and a light wind. Exposure to direct sunlight can increase the heat index up to 15 degrees Fahrenheit. In addition, the heat index is only an informational tool; it cannot substitute for experience and professional judgment.

### Avoid excessive physical exertion

The best way to prevent heat injuries is to avoid excessive (or excessively vigorous) outdoor activities during times of high heat and/or humidity.

### Remain in air-conditioned facilities

According to the Centers for Disease Control and Prevention (CDC), air conditioning is the number one protective factor against heat-related illness and heat-related deaths.<sup>1</sup> Accordingly, coaches, teachers, staff, and students should remain indoors during extreme heat and/or humidity. (If this is impossible, or impractical, the precautions discussed in the remainder of this document should be followed.)

The Arizona Administrative Code requires that classrooms be equipped with an HVAC system capable of maintaining temperatures in the range of 68 to 82 degrees Fahrenheit.<sup>2</sup> If HVAC systems fail or are ineffective in maintaining temperatures in this range, schools should use temporary air conditioning or evaporative cooler units in each occupied area until the HVAC units are repaired. (It should be noted that evaporative coolers are less effective during the monsoon season due to the increase in humidity. Also, though electric fans may provide comfort, they will not prevent heat-related illness when the temperature is in the high 90s or above.)

### Promote acclimation

If outdoor activity cannot be avoided, acclimation is the recommended method for reducing risk. In general terms, acclimation means adapting oneself gradually to a change in environment. In the context of outdoor activities, it means moderating activity to mitigate the risk of illness due to heat and/or humidity.

Acclimation is achieved most effectively by exercising, working, or playing moderately during repeated heat exposures. Proper acclimation usually takes 10 to 14 days. If individuals miss training sessions or other scheduled activities outdoors, the acclimation process must be extended. For example, if an athlete is absent for two days of pre-season training, those two days must be added to his/her acclimation period prior to the athlete participating at the same level as others.

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<sup>1</sup> See "Keep Your Cool in Hot Weather," Centers for Disease Control and Prevention, available online at <http://www.cdc.gov/Features/ExtremeHeat/>.

<sup>2</sup> See Arizona Administrative Code, Title 7, Chapter 6, R7-6-213.

### Regulate and monitor athletic training

During pre-season practices and training, many athletes will not be conditioned for or acclimated to the heat. To minimize heat stress, there should be a gradual transition to full-intensity practice, including full gear. All practices should be modified, as necessary, based on the risk of heat-related illnesses.

Another risk factor for athletes involves individuals who attempt to perform feats of extreme exertion in the heat—perhaps beyond their capabilities or training level—in order to surpass previous performance. Coaches and physical education staff should closely monitor student-athletes to limit their activity to an acceptable level.

### Take other preventive measures

The following measures can also be taken to help prevent heat illness:

- Recommend that students and staff increase fluid intake in warmer weather. (See further discussion of this topic in the next sub-section.)
- Educate students and staff on the signs and symptoms of heat-related illness.
- Vary the duration and intensity of activity during high heat periods.
- Provide breaks from outdoor practice, play, and work (in shaded or cooled areas, if possible) to help the body regulate internal temperature and minimize the adverse effects of cumulative heat exposure.
- Check on students and staff periodically when they are playing, practicing, or working outdoors, or in non-climate controlled environments.
- Encourage the buddy system during outdoor activities.
- Never leave students, staff, or visitors in a closed, parked bus or other vehicle.
- Recommend the following steps for students and staff who will be engaging in outdoor or high-heat activities:
  - ◆ Drink extra fluids before (throughout the day), during, and after such activities.
  - ◆ Wear lightweight, light-colored, and loose-fitting clothing.
  - ◆ Maintain adequate rest and proper nutrition.
  - ◆ Monitor body weight daily. (Acute losses—greater than 3 percent of body weight—are usually water losses.)
  - ◆ Eat a balanced diet with adequate potassium; this provides for electrolyte replacement.
  - ◆ Replace lost salt by adding table salt to food (subject to physician approval; avoid using salt tablets and potassium supplements, as they can cause undesirable side effects; focus instead on proper hydration and nutrition).

### Special note: maintaining proper hydration

Historically, the Trust's sister pool, the Arizona School Alliance for Workers' Compensation, Inc. (the Alliance), has received a number of dehydration-related claims

from workers not typically thought to be at high risk for such problems (bus drivers and indoor workers, for example). These claims illustrate an important point: Many different types of workers—not simply those working outdoors in direct sunlight—are at risk for heat-related illness. Districts should bear in mind, therefore, that when temperatures increase, indoor workers who work in high-heat settings, in situations with poor or non-existent air conditioning, or who perform particularly vigorous tasks, may also suffer from dehydration and its consequences.

Recognizing this, staff members working in warmer-than-average settings or performing work tasks that are more vigorous than average need to monitor their fluid intake—even if not working outdoors. How much fluid is enough? Though there are no firm answers to this question, as a guideline, the National Institute for Occupational Safety and Health recommends that workers engaged in moderate activity in moderate conditions drink a cup of water every 15 to 20 minutes.<sup>3</sup> This is 24 to 32 ounces of water per hour. Workers may adjust this number upward or downward, depending on their individual circumstances. However, they should be encouraged to drink fluids *before* they become thirsty. This is a good strategy for preventing dehydration.

### Treatment

Heat-related injuries may be 100% reversible if immediate and proper treatment is given. (Depending on the severity of the illness or injury, it may require attention from emergency medical professionals, transport to a medical facility, etc.) The following treatment steps should be applied to individuals who exhibit signs of heat illness:

1. Move to a shaded area immediately (or to an air conditioned area, if available).
2. Begin cooling as soon as possible.
3. Loosen or remove excess clothing.<sup>4</sup>
4. Position on back with feet elevated above the level of the heart.
5. Provide cool fluids to sip (if individual is conscious and not nauseated or vomiting).

Though not part of the medical treatment protocol, an individual's emergency contact(s) should also be notified when he or she exhibits signs of heat-related illness.

Cooling (item #2 above) can include:

- covering the individual with damp sheets or other damp, light fabric;
- liberally sprinkling the individual with water;

<sup>3</sup> See “Keeping Workers Hydrated and Cool Despite Heat,” available online at: <http://goo.gl/Rx8gK>. Examples of moderate work include picking fruits and vegetables (bending and squatting), painting a structure with a brush, pushing or pulling lightweight carts or wheelbarrows, and weeding or hoeing. (Source for moderate work examples: <http://goo.gl/nRmXg>.) Moderate conditions are, roughly, when heat index values are in the range of 91° to 103°. (Source: <http://goo.gl/JVWfx>.)

<sup>4</sup> In order to reduce potential district liability, if clothing is to be loosened or removed, this should be done on a same-gender basis (males removing or loosening the clothing of males, females removing or loosening the clothing of females)—unless doing so will compromise the efficacy of treatment.



- fanning to increase evaporative cooling; and
- rubbing ice packs over major blood vessels in the armpits, groin, and neck.<sup>5</sup>

In many instances, the presence or absence of ice will be decisive in facilitating a full recovery from heat injury. Recognizing this, large quantities of ice should be kept available in school buildings, at training sessions, and at athletic events during high heat periods. As an alternative, an inflatable swimming pool placed in a shaded area and filled with water and ice can be an effective tool for cooling.

## Conclusion

Heat-related injuries are common but preventable. It is important to consider outdoor weather conditions (temperature, relative humidity, and direct sunlight exposure); duration of heat exposure (practice/play time or work time); and available controls (air conditioning, cooling packs, shaded areas, drinking water, and appropriate rest periods) prior to planning physical activities outdoors or in high-heat locations. If outdoor activities have been deemed appropriate, supervision of students playing outdoors is especially important; heat-related injuries can occur quickly, and risk factors may combine to cause an otherwise healthy student to become overwhelmed by heat exposure.

If you have questions regarding heat-related illness, please contact Member Services at (800) 266-4911 or (602) 266-4911, or via email at [the-trust@the-trust.org](mailto:the-trust@the-trust.org).

## References and Resources

*National Athletic Trainers' Association Offers Tips for Exercising Safely in the Heat*, National Association of Athletic Trainers, available online at <http://goo.gl/3kjUI>.

*Beat the Heat: AMAA Warns About Dangers of Heat Illness*, Kari Volyn, American Medical Athletic Association (2002), available online at <http://goo.gl/0fY60>.

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*Courts and Sports: A Current Update*, Nick C. Nichols (undated), available online at <http://goo.gl/loIEL>.

*Dehydration and youth sports: Curb the risk*, MayoClinic.com (2008), available online at <http://www.mayoclinic.com/health/dehydration/SM00037>.

*Heat exhaustion*, MayoClinic.com (2007), available online at <http://goo.gl/QM4fD>.

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<sup>5</sup> In order to reduce potential district liability, if ice is to be applied to the groin, this should be done on a same-gender basis (males applying ice to males, females applying ice to females)—unless doing so will compromise the efficacy of treatment.

*Heat Illness Prevention etool*, California Department of Industrial Relations, available online at <http://www.dir.ca.gov/dosh/etools/08-006/WhatCauses.htm>.

*Heat stroke: First aid*, MayoClinic.com (2007), available online at <http://goo.gl/r8VHa>.

“Legal Duties of Coaches,” David La Vetter, *Arkansas Journal* (April 2009), Vol. 44, No. 1, pp. 6–12, available online at <http://goo.gl/Gz9wA>.

*Youth football: Heat stress and injury risk*, American College of Sports Medicine, Special Communications Roundtable Consensus Statement (2005), available online at <http://goo.gl/CpMgX>.

## **APPENDICES**

## **APPENDIX A. DEALING WITH HEAT-RELATED ILLNESSES: SAMPLE SITUATIONS**

### **Emergency Situation #1: Too Much Sun**

A fourth-grade student is found sitting under a tree, dizzy, disoriented, and complaining of nausea and a headache. The playground monitor notices that the child's skin is flushed and dry to the touch.

The monitor sends an adult or trusted student to the school office or health services office to call an ambulance. The monitor, with help, immediately moves the student indoors into an air conditioned space, removes excess clothing, and applies cool water to the skin. Health services staff attends to the student while awaiting emergency personnel. Staff notifies the student's parents of the heat stress event. Emergency personnel arrive and treat the child for heat stroke.

### **Emergency Situation #2: Too Much Play**

During physical education class, a student complains of nausea and a headache. The teacher tells the student to get a drink and sit in the shade until she feels better. The student feels considerably worse after a few minutes and vomits.

The teacher escorts the student to the health services office, which is located in an air-conditioned space. Health services staff provides care for heat stress (water, cooling, lying down with feet elevated) and notifies the student's parents of the heat stress event.

### **Emergency Situation #3: Heat Stroke**

During a track meet, a student experiences shortness of breath and becomes convulsive and delirious. The coach immediately calls "9-1-1," and an ambulance is dispatched. The coach and trainer place the student in a cool and shady area, remove excess clothing, and sponge the skin with cool water. The school notifies the student's parents of the event.

### **Emergency Situation #4: Mechanical Breakdown**

Maintenance staff receives a call at 1:00 p.m. indicating that the air conditioning units in three classrooms are not functioning. Classroom temperatures are above 82 degrees Fahrenheit already, and will continue to increase as outdoor temperatures rise during the afternoon. Additionally, after-school meetings are scheduled in the classrooms. The maintenance staff calls the HVAC maintenance contractor, who indicates that he can be at the school at 4:00 p.m. It is further determined that it will take at least an hour to rent, pick up, and deliver a portable air conditioning unit. The facilities director calls the school office and learns that there are two vacant classrooms. The maintenance director and the school principal decide to move two of the classes to the empty rooms and one class to the library while repairs are undertaken. After-school meetings are rescheduled.

**APPENDIX B. DEALING WITH HEAT-RELATED ILLNESSES: QUIZ**

1. At what temperature does the risk of heat illness become a major concern? (Circle one.)
  - A. 86° F
  - B. 72° F
  - C. 60° F
  - D. 100° F
  
2. What are three major symptoms of heat stroke?
  1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
  
3. List three major steps that can help prevent heat illness.
  1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
  
4. What is the most effective method of cooling someone who is suffering from a heat illness?
  
5. How long should a student-athlete acclimate prior to competing? (Circle one.)
  - A. 7 days
  - B. 10 to 14 days
  - C. 3 days
  
6. Can a school district expect to use “assumption of risk” as a defense for an athlete suffering injury or illness due to heat? (Circle one.)

Yes                      No
  
7. What information should a coach provide to a student-athlete and parents concerning heat illness? (Circle one.)
  - A. No information
  - B. Only enough information to scare the athlete
  - C. Full disclosure regarding the risk, prevention, and treatment of heat illness
  
8. The least common but most serious form of heat illness is: (Circle one.)
  - A. Heat exhaustion
  - B. Heat cramps
  - C. Dehydration
  - D. Heat stroke
  
9. The most common form of heat illness is: (Circle one.)
  - A. Dehydration
  - B. Heat exhaustion
  - C. Heat cramps

**APPENDIX B. DEALING WITH HEAT-RELATED ILLNESSES:  
QUIZ ANSWERS**

1. **A.** When temperatures exceed 86° Fahrenheit, serious heat illness may occur if adequate precautions are not taken.
2. Heat stroke is characterized by disorientation, dizziness, convulsions, confusion, and/or loss of consciousness.
3. Steps that can be taken to prevent heat illness include:
  - monitoring heat conditions;
  - avoiding excessive physical exertion in conditions of high heat/humidity;
  - remaining in air conditioned facilities;
  - encouraging acclimation to heat and humidity;
  - regulating and monitoring athletic training schedules;
  - practicing and/or playing during cooler parts of the day;
  - increasing fluid intake during periods of warmer temperatures or increased exertion, and drinking fluids before, during, and after outdoor activities;
  - taking water and rest breaks;
  - wearing lightweight, light-colored, and loose-fitting clothing; and
  - getting adequate rest and maintaining proper nutrition.
4. The most effective method of cooling persons suffering from heat illness is to move them to an air-conditioned area, if available, or to a shaded area if not; loosen or remove excess clothing; and begin immediate cooling with fans, water, and ice.
5. **B.** Typically, 10 to 14 days of exercising or playing in the heat are required for acclimation.
6. **No.** Court cases throughout the United States have eroded the concept of assumption of risk in athletic injuries. This means that coaches, like teachers, are responsible for the welfare of student-athletes and must take appropriate measures to prevent harm.
7. **C.** Coaches should provide full disclosure to student-athletes and parents regarding the risk, prevention, and treatment of heat illness.
8. **D.** The least common but most serious form of heat illness is heat stroke.
9. **B.** The most common form of heat illness is heat exhaustion.