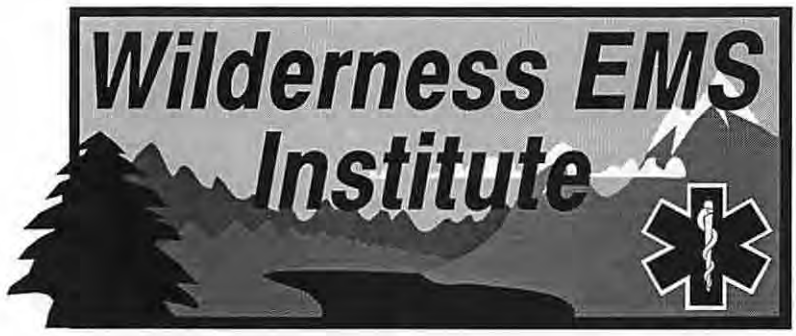

Appalachian Search and Rescue Conference
Center for Emergency Medicine of Western Pennsylvania

Wilderness EMT Lesson Plan

Part VII: Heat-Related Disorders

Draft Version 1.33 September 3, 1993 (reprinted August 1994)
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Verbose Outlines

We develop our WEMT Lesson Plans in a **verbose outline format** (what you see here). Why? Because the material is new to enough reviewers that the usual terse ("telegraphic") lesson plan format might be incomprehensible or misleading.

Our Task Groups use these "verbose" outlines. Each part of the WEMT curriculum (about twenty in all) has a Task Group of five to twenty selected consultants. A Coordinator guides the Task Group in revising the section.

Each Task Group provides references to support its statements and for further reading. They also provide glossary entries for any new terms they introduce. (New, that is, to a reader with basic EMT and SAR training.)

Background material that should appear in the Textbook (see below), but instructors need not present in class, will appear *in a small, italic font.*

Splitting the Outlines

When the outline satisfies the Task Group, it goes to our **Editorial Board**. This Board includes officers of the Appalachian Search and Rescue Conference and Center for Emergency Medicine of Western Pennsylvania, our two sponsors. It also includes experts in emergency medicine, search and rescue, and education. The Editorial Board reviews the verbose outline, and requests any necessary revisions. Once it is acceptable to the Board, we reformat the outline, into two distinct new versions.

We rewrite the material in the standard lesson plan format, which becomes a terse "telegraphic" outline. This version will be briefly reviewed by the Project Coordinator and then released to the public. It is the result of extensive review and testing, and will be used in all our classes. But, we still publish it as a draft, because we expect many good suggestions from the public. We distribute these drafts as widely as possible. After each year of public review, the Task Groups reviews comments, and submits revisions to the Editorial Board. Once all outlines have withstood a year of public scrutiny, we will prepare a single comprehensive curriculum with a Course Guide. We will continue to review and revise the curriculum regularly.

On to a Textbook

As explained above, once the Editorial Board approves the verbose outline, we split it into two versions. Besides the terse teaching outline, it will also become the basis for a textbook chapter. The Project Coordinator is the textbook Editor-in-Chief, and works closely with the Task Groups to consolidate and revise the verbose outlines into a comprehensive textbook. All who have contributed to the curriculum will be acknowledged as contributors. The textbook will be commercially published when completed. Until the textbook is available, we will distribute the verbose outlines or drafts of the textbook at classes.

Notes: *Heat-Related Disorders*

This part of the curriculum reviews pertinent aspects of heat-related disorders in the wilderness context. Burns and lightning are covered in a separate section.

Since the WEMT serves as the field team's medic, we have included a section on the recognition and treatment of mild dehydration, a common summer problem for field team members. We also use the topic of heat syncope to discuss the general management of syncope and near-syncope in wilderness SAR team members.

VII. Heat-Related Disorders

A. Educational Objectives

1. Identify the cause of, seriousness of, and treatment for, heat edema.
2. Describe the diagnosis and management of syncope (fainting) or near-syncope in a hot environment. Specifically,
   a. outline the common causes of syncope;
   b. describe the means of venous return from the legs when standing, and the consequences of being kept in an upright position after fainting;
   c. describe the role of low blood sugar in syncope and near-syncope;
   d. describe the mechanism of psychogenic shock;
   e. describe the mechanisms of and treatment of heat syncope; and
   f. outline a protocol for managing a team member with a syncopal or near-syncopal episode.
3. List the factors that supposedly distinguish heat cramps from "regular" cramps, describe the suspected cause of heat cramps, and describe proper treatment for heat cramps.
4. List the signs and symptoms of dehydration, identify a simple test for dehydration that may be used by field team members, describe the accuracy of thirst for indicating dehydration, and identify the effect of dehydration on core temperature.
5. Describe the causes, diagnosis, and wilderness treatment for heat illness. Specifically:
   a. define and describe the clinical features of dehydration, heat illness, heat exhaustion, and heatstroke;
   b. list predisposing factors for heat illness;
   c. describe two distinct populations at risk for heat illness; and
   d. describe the signs, complications, immediate treatment, and extended prehospital treatment of severe heat illness (heatstroke).
6. Explain important factors in the choice of oral fluid and electrolyte replacement, including
   a. the best concentration of salt for oral rehydration fluids for hot weather use; and
   b. the dangers of using salt tablets.

B. Heat Edema

1. Pedal edema (swelling of the legs) may come from many diseases, including:
   a. loss of blood protein through the kidneys, buildup of water from kidney failure;
   b. a decreased production of blood proteins and other problems caused by liver failure;
   c. abnormal retention of water by the kidneys due to the effects of congestive heart failure; or
   d. deep venous thrombosis (clots in the deep veins of the legs).
2. Some people, especially sedentary older people, may develop leg swelling when exposed to a hot environment. This may occur with no other underlying diseases. It usually goes away in a few days, as the person acclimatizes to the heat. Elevating the legs and elastic bandages or support stockings may provide some relief until the edema resolves. No other treatment is needed.
3. You don't make the diagnosis of heat edema in the field. If you find a field team member with sudden onset of significant pedal edema, you should

check for pulmonary edema, and evacuate promptly. The team member should be evaluated by a physician to rule out the other possible causes of pedal edema listed above.

C. Heat Syncope

1. A person may faint for many reasons.
   a. Fainting (or syncope, to use the medical term) may be a sign of serious medical problems, such as a seizure disorder, a heart valve problem or arrhythmia, or a stroke.
   b. On the other hand, fainting may be due to minor problems, such as dehydration, a sudden psychological shock, prolonged standing, or forgetting to eat breakfast.
2. Blood is returned from the legs by a pumping system built into the leg veins.
   a. Every few inches, each vein has a small one-way valve (similar to, but much smaller than, the heart valves). Muscular contraction in the legs alternately squeezes one section, then squeezes another. The combination of alternate squeezing along with one-way valves acts to pump the venous blood back up to the heart.
   b. If you stand for a long time without moving your legs, the blood pools in your legs, creating a relative hypovolemia in the rest of your body. If this is bad enough, you faint; luckily, this brings you to a horizontal position, allows blood from the legs to return to the upper body, and terminates the cause of the problem. For those standing at attention, especially in hot weather (e.g., Civil Air Patrol and military personnel in formation), pooling of blood in the legs may be prevented, to a degree, by alternately bending and tightening one leg at a time, even if doing it so slightly as not to be perceptible.
   c. If a person who faints is kept in a sitting or upright position, the lack of brain perfusion often leads to small seizure movements, and may eventually lead to irreversible brain damage.
3. A low blood sugar seems to make you more likely to feel effects from a lack of blood to your brain. (This makes sense when you remember that the brain can only do without glucose for a few seconds before becoming unconscious).*
4. "Psychogenic shock" (fainting from a psychological shock) is probably caused mostly by sudden vasodilation of the blood vessels in the legs. Placing

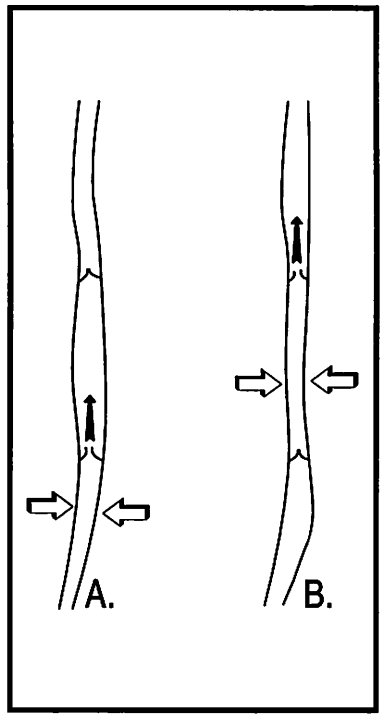

Figure 1. Venous valves + muscle contractions pump blood.

* In experiments, you can see changes in the brain's EEG (electroencephalograph) tracings as the blood sugar gets down to 36. A normal blood sugar is roughly around 100.

the person supine or with the head slightly down is generally curative.

5. Syncope from a cardiac arrhythmia (also knows as a Stokes-Adams attack, or a "drop attack") often happens without warning. There is no lightheadedness, tunnel vision, or nausea, as is seen with many other kinds of syncope.

6. Heat syncope probably results from a combination of volume depletion with vasodilation from sudden exposure to heat. No treatment is needed for heat syncope, provided you are sure it was heat syncope, except for better hydration, and more gradual acclimatization.

7. If you are on a wilderness SAR task and find yourself confronted with a team member who has had a syncopal or near-syncopal episode in a hot environment, you face a difficult decision.

   a. Though no treatment or further investigation is needed for simple heat syncope, determining that the episode was, in fact, heat syncope is hard to diagnose in the field (though it's not necessarily that much easier in the Emergency Department).

   b. Establishing a protocol for syncope and near-syncope management is the prerogative of your physician medical director. (And, deferring the decision to a Wilderness Command Physician after ascertaining the following items is best, if you can communicate with Command.) A team member who meets the following criteria might be allowed to resume duties after a few minutes' rest and some rehydration and sugar replenishment:

      (1) the team member had some lightheadedness or nausea prior to the episode;

      (2) the team member was unconscious for only a few seconds;

      (3) the team member has no history of heart problems, and had no chest pain or chest pressure associated with the episode;

      (4) the team member had no specific neurological symptoms;

      (5) no seizure activity was noted, nor anything to suggest a seizure (no tongue biting, no urinary or fecal incontinence);

      (6) no significant injury occurred to the team member from falling; and

      (7) on exam, you can hear no heart murmur, you find a regular pulse, and you find a normal neurological exam.

   c. You should use the above protocol with caution; anything about the episode that makes you suspicious that it was not heat syncope, even if the team member meets all the above criteria, should be cause to terminate the task and head back to base.

   d. You should carefully check the team member for orthostatic changes in blood pressure (or pulse, if you do not have a blood pressure cuff), and should continue rehydration and sugar replenishment until the person is no longer orthostatic. (Orthostasis is discussed in the section on *Patient Assessment.*)

   e. Any team member with syncope should be examined by a physician when the team returns to base, even if you have cleared the team member to continue with the task.

D.Heat Cramps

1. Cramps are common in hot weather. We think that dehydration contributes to the tendency of muscles to cramp, as do low body or blood levels of salt (hyponatremia) or potassium (hypokalemia). There may be direct effects of overheating on muscles, too. There seems to be some anecdotal and other evidence that replacement of water without replacement of salt leads to

heat cramps. Heat cramps rarely cause any lingering medical problems, and thus are not well-studied. Heat cramps are supposedly different from regular cramps in four ways:

a. heat cramps are often generalized, rather than in a single muscle, and occur during rest after exercise, rather than during exercise, like regular cramps;

b. heat cramps are reputedly more severe than "regular" cramps;

c. heat cramps are common in the abdominal wall muscles; and

d. reputedly, heat cramps do not respond to massage as do "regular" cramps.

2. Regardless, treatment of heat cramps with stretching and adequate fluid and salt replenishment seems to cure them. (See below, under *Oral Fluid and Electrolyte Replacements*, for discussion of how to replenish salt and water).[1]

E. Prickly Heat (Miliaria Rubra)

1. *Prickly heat is a hot-weather problem that results from clogging of the sweat gland pores. Skin that is wet all the time from sweat will swell, and this causes the pores of sweat glands to close. Prickly heat is named for its intense itching; it is often seen in areas with poor air circulation (e.g., on the buttocks after sitting on hot vinyl car seats).*

2. *Since the problem is clogged sweat pores, the treatment is* **not** *to apply thick creams, but to clean the area well with soap and water and perhaps apply a thin coat of a steroid cream to help the itching. Allowing skin to dry for at least a few hours each day is important for prevention.*[2]

F. Dehydration

1. Dehydration may result from many causes: diarrhea and vomiting, slow hemorrhage, burns, or sweating. Here we will concentrate on dehydration from sweating, but the principles apply to most kinds of dehydration. ### add section on symptoms.

2. Dehydration is easy to diagnose in the field: ask team members to urinate. If someone can produce only a small amount of dark urine, he or she has at least mild dehydration. This is mostly useful as a regular check to see that team members are drinking enough fluid on a hot day. Have the team stop to urinate every hour or two, so team members can check the color of their urine, and increase their fluid intake if needed.

3. When confronted by a patient, however, deciding on the extent of dehydration is more complex. Signs of dehydration include:

a. orthostatic changes (orthostatic vital signs are discussed in the section on *Patient Assessment*); if the patient tries to sit or stand and faints, that's also an adequate indication of orthostasis;

b. dry mucous membranes in the nose and mouth (though someone who has been mouth-breathing for a long time may have a dry mouth without dehydration);

c. skin that stays "tented" after pinching it together (but some older people have skin that tents even when not dehydrated);

d. sunken, glassy eyes (seen in more advanced dehydration); and

e. a decreased output of very dark (concentrated) urine.

4. Symptoms of dehydration include lightheadedness, "tunnel" vision (loss of peripheral vision), nausea, mild abdominal pain, vomiting, and headache. Surprisingly, the thirst response varies from person to person, and is not a good indicator of dehydration.[3]

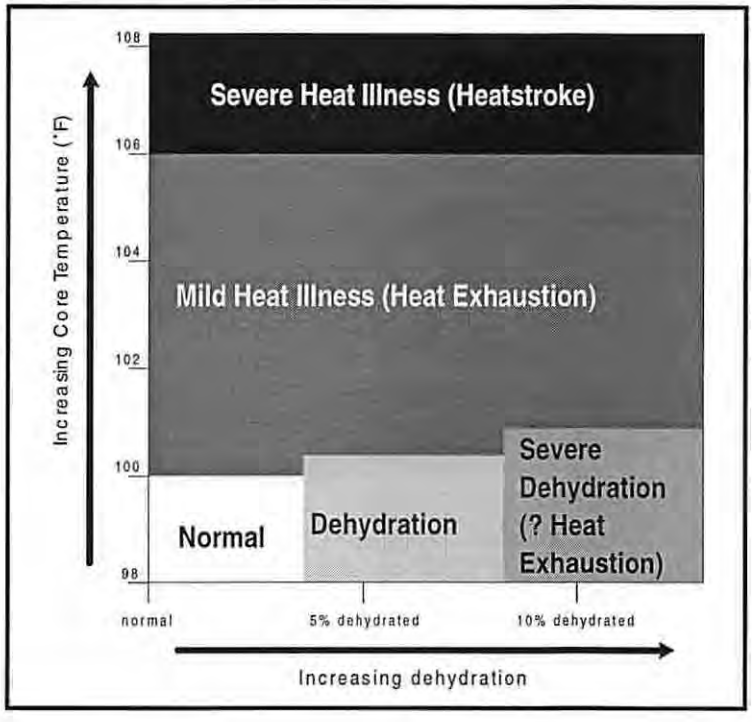

Figure 2. The spectrum of heat-related illness.

5. Thirst is triggered primarily by a low level of water relative to sodium in the blood. (Or, a high level of sodium in the blood, if you insist on looking at it the more common way.) Thirst may be triggered by volume loss without change in the sodium level, but only at when volume is very low. And, sometimes, when volume is low from heat stress, the nausea of dehydration overshadows any thirst sensation.[4]
6. In a hot environment, dehydration combines with vasodilation from the heat to produce a very real form of shock. This is especially so when exertion causes vasodilation of blood vessels in the muscles. This classic type of "heat exhaustion" made the U.S. Army, at one time, promote the classic teaching about heat exhaustion: "if the face is pale, raise the tail."* THIS IS A NORMAL RESPONSE TO OVEREXERTION IN A HOT ENVIRONMENT. If a team member responds quickly to treatment, there is no need for evacuation; merely increase fluid and possibly electrolyte replacement, and decrease exertion for a few hours.
7. An interesting fact about dehydration is that, even with no heat stress, dehydration causes an mildly increased core temperature, but generally not higher than 101°F (38°C).

G.Heat Illness

1. **General:** Heat illness (heat exhaustion and heatstroke) kills more than 4000 people a year in the U.S. Most of those who die are over age 50, but a significant number of young people also succumb to heat illness.

* The parallel teaching for heatstroke was "if the face is red, raise the head."

2. **The Spectrum of Heat Illness:** Heat illness is traditionally divided into heat exhaustion and heatstroke (sunstroke). These terms are well-known, and correspond with two areas of a two-dimensional heat illness spectrum (see Figure 2). And, although heatstroke is fairly well-defined, heat exhaustion is not. Here are some classic sample cases.

   a. Example 1: It is July in the central Appalachians. A field team member has just come back from Antarctica, and is thus not acclimatized to the heat. He is trying to drink plenty of salty fluid as the team climbs up Old Rag Mountain, but halfway up develops nausea and lightheadedness, then vomits. On your exam, his pulse is at first weak, fast, and thready, then slows and becomes more full as he lays down and props his legs up on a rock. Some color comes back into his face, and he says he is feeling better. You measure a rectal temperature and it is 100.3°F (38°C) (a little high, but still within normal limits for a rectal temperature). Some would say that this is a classic case of heat exhaustion, others would class it as simple dehydration. Regardless, it is a case of mild shock from overexertion in a hot environment. Treatment: even more fluids, and a slower pace up the mountain, but no need for any evacuation or other medical treatment.

   b. Example 2: Again, assume a member of the base staff just back from Antarctica, but this time at Base, rather than in the field. It is a summer search in the Allegheny Mountains in July. The temperature in the trailer used for the Operations Center has a temperature of 103°F, (39°C) and it's very humid. This person comes to you, the base Wilderness EMT, complaining of diffuse headache and nausea, and feels flushed. His BP and pulse do not change significantly from lying to standing (i.e., he is not orthostatic), but his rectal temperature is 102.5°F (39°C). Most would agree that this person, if he has no other reason for a fever, has heat exhaustion. (We would prefer the term "mild heat illness" for such a case.)

   c. Example 3: For the next example, let's take our team member from Antarctica and send him up the side of Old Rag Mountain on a scratch search task, again on a July afternoon. Let's further assume that he's in excellent aerobic condition. Halfway up, his partner on the team notes that he's stopped drinking water, is staggering a bit, and when he talks to you, is completely disoriented and confused. His face is still sweaty, somewhat flushed, and very hot. His tympanic (eardrum) temperature is 106.5 degrees F. Most everyone would agree that this is a classic case of heatstroke (severe heat illness). (See the section on *Patient Assessment* for a discussion of how to take temperatures in the wilderness.)

3. **Mild vs. Severe Heat Illness**

   a. There is no clear dividing line between mild heat illness (heat exhaustion) and severe heat illness (heatstroke). In particular, there is confusion over the definition of heat exhaustion.

   (1) Some define heat exhaustion in a way that excludes any neurological symptoms or elevation of temperature (Case 1, above). We prefer to call this simple dehydration. This requires no treatment except for brief rest and rehydration.

   (2) Others reserve the term heat exhaustion for cases such as in case 2, above, with temperatures higher than you would expect from dehydration, and with some neurological symptoms. We agree with this definition. However, if you accept this definition of heat exhaustion, you must accept that heat exhaustion is an

early form of heatstroke, and treat urgently.

(3) Irrespective of which definition of heat exhaustion you prefer, the principles of management are the same, as we will now discuss.

b. Heat illness is a hot core temperature, in a patient who is exposure to heat and who has no reason for fever. Those with mild heat illness (our definition of heat exhaustion) will have only mild symptoms, and those with severe heat illness (heatstroke) will have severe symptoms. Note that **symptoms** distinguish between mild and severe heat illness, not temperature. (A patient who has only a slightly elevated temperature and mild symptoms that respond completely to rest and rehydration has simple dehydration and does not have heat illness.)

c. A high core temperature may cause damage to different organ systems. It's hard to assess damage to the blood, liver, or kidney in the wilderness. However, one of the first things to be affected by heat is the central nervous system. You should have no difficulty evaluating for CNS dysfunction: is the patient stuporous? confused? disoriented? with focal neurological signs?

d. **Temperature**

(1) No one rectal temperature can serve as a marker for severe heat illness (heatstroke). Some well-trained athletes may be able to function at rectal temperatures over 106°F (41°C) without any significant organ damage, yet other people may develop organ damage at temperatures well below this.

(2) This may be due, in part, to variations in individual resistance to the effects of a high core temperature. However, it may also be due to the inaccuracy of rectal temperatures in runners or those involved in other active sports (including wilderness rescue). Warm blood from the legs may warm the rectal temperature far above that of the brain and other vital organs.

(3) Most of the literature about heat illness presumes that rectal temperature is an accurate way to measure core temperature. Once tympanic temperatures become routine in the assessment of heat illness, we may find that tympanic temperature can be used as the primary sign to diagnose severe heat illness. Evidence to date suggests that that tympanic temperature, if measured with a device that is accurate in the field, is the best way to assess core temperature in a patient with suspected heat illness. (See the section on *Patient Assessment* for more on the measurement of temperature in the wilderness.)

(4) If you don't have a tympanic thermometer, and your patient's rectal temperature is 106°F (41°C) or more, it should make you assess carefully for heat illness, even if the patient has been exercising heavily. In a patient with heat exposure, a tympanic temperature this high is a good sign of severe heat illness. When the core gets this hot, the kidney, liver, and brain may suffer irreversible damage. The patient may develop delirium, seizures, focal neurological signs, or coma. The temperature at which damage starts occurring probably depends on individual metabolism. Some factors are probably genetic and others relate to the person's aerobic condition: the high metabolic rate that accompanies a high core temperature demands a lot from the heart, lungs, and blood vessels.

e. Severe heat illness (heatstroke) is not a simple function of temperature. Some athletes can exercise and get their core temperatures over 106°F (41°C) without illness, but some people will develop signs of severe heat

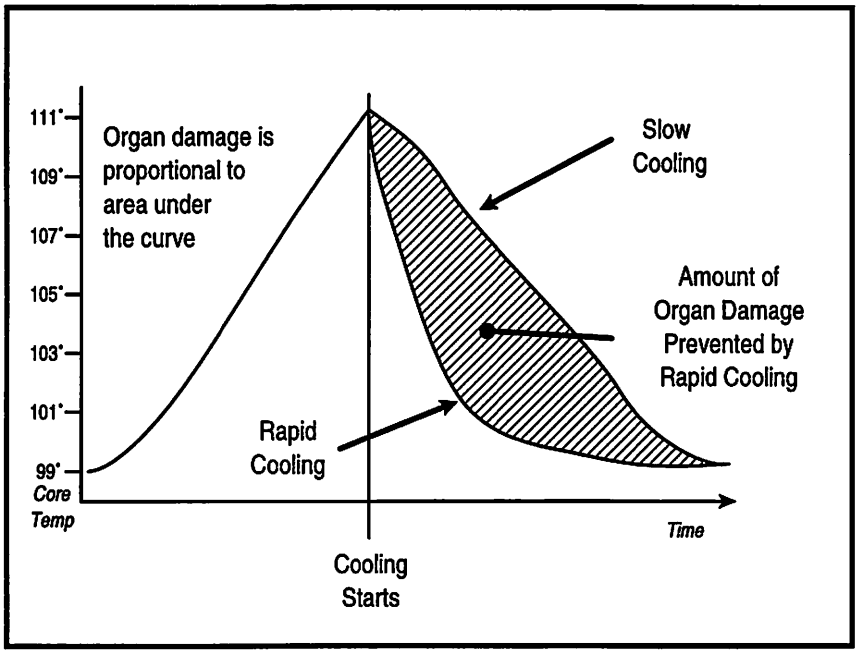

Figure 3. Effect of rapid cooling for heatstroke.

illness (coma, seizures, or other neurological signs) at temperatures well below 106°F (41°C). This may be due to inborn differences in metabolism at the cellular level. A factor in the sudden decompensation associated with some cases of severe heat illness may be decoupling of metabolism. What may happen is that, because of the heat, certain metabolic enzymes malfunction. They then "spin their wheels" and generate lots more heat without much effect, worsening the heat illness.

f. If a team member is working in a hot environment, and develops neurological symptoms and feels hot to you, even if you don't have a thermometer, assume that the team member has heat illness. The only exception would be if you have good reason to suspect meningitis (e.g., if the patient has a stiff neck).

g. If forced to define heat illness, we would say: that it is temperature more than about 101°F, with neurological symptoms, in a proper setting for heat illness, and without history or physical exam evidence to suggest fever. The dividing line between mild heat illness (heat exhaustion) and severe heat illness (heatstroke) lies with the severity of the neurological symptoms, and how quickly they resolve with cooling.

4. **Predisposing Factors**

a. Lack of heat acclimatization is a major factor in many cases of heat illness.

b. Diabetes and certain other diseases may cause a neuropathy (nerve damage) of the autonomic nerves responsible for vasodilation, sweating, and sensing of excessive heat, predisposing to heat illness.

c. Certain psychiatric medications (e.g., Haldol®, Thorazine®, lithium, amphetamines, phenothiazines such as Phenergan® and Vistaril®, and tricyclic antidepressants such as Elavil®) and cocaine interfere with sweating and vasodilation (and possibly of temperature sensing at the hypothalamus). Certain other medications may also cause similar problems, for instance, some rarely used antihyperten-

sive medications: glutethimide and the monoamine oxidase inhibitors.

d. The very young and very old may have poorly functioning responses to heat, as may those with a variety of other chronic diseases (e.g., congestive heart failure).

e. Fatigue and lack of sleep have been associated with heat illness by U.S. Army studies.

f. Some people seem to have a genetic predisposition to heat illness.

g. Fever may cause a person to already have an increased heat burden before heat stress and is thought to predispose to heat illness.

5. **Classic vs. Exertional Heatstroke:** It is useful to divide people who develop severe heat illness into two characteristic groups.

a. First is what we term **exertional heatstroke**. For example, consider a woman, a well-trained runner, who is running on a particularly hot and humid day. She is able to generate heat faster than she can lose it, which gradually makes her core temperature rise until damage starts to occur. Another example would be a young healthy person exposed to high heat and humidity even without exertion (e.g. new military recruit standing at attention, in a wool uniform, on a Georgia parade ground on a summer afternoon). Mortality for these young healthy people is probably much lower than the often quoted figure of 50% heatstroke mortality, given prompt treatment. In particular, the Israeli Army has had virtually no deaths with prompt treatment of heatstroke on the battlefield. Unlike "classic" heatstroke, roughly half of victims of exertional heatstroke are still sweating.

b. The other type of severe heat illness is **classic heatstroke**. This group includes the very young, the very old, and people with diabetes or on predisposing medications. They develop heatstroke generally from long-term exposure to heat and humidity, compared with those with exertional heatstroke. These patients tend to do poorly. This group is probably the source of 50% mortality quoted widely in the older medical literature. Most such victims of heatstroke are no longer sweating.

c. Signs of heat illness, other than neurological signs, and hot skin or a high core temperature, may include:

(1) hot flushed skin that is wet or dry (but skin may be purple and mottled in later stages);

(2) tachycardia;

(3) hypotension;

(4) hyperventilation; or

(5) vomiting and diarrhea.

6. **Complications of Heat Illness:**

a. Complications of severe heat illness include:

(1) shock from pre-existing dehydration;

(2) vasodilation-type shock from heat damage to the brain;

(3) congestive heart failure or cardiogenic shock from increased stress to the heart;

(4) disseminated intravascular coagulation, with subsequent poor clotting of wounds;

(5) pulmonary edema;

(6) kidney failure;

(7) liver failure; and

(8) rhabdomyolysis (breakdown of muscle) leading to myoglobinuria (discussed further under *Wilderness Trauma*).

b. Metabolism increases with temperature. At 105°F, metabolism is half again that at rest. In someone in excellent aerobic condition, this is not a

major problem. But for a person with congestive heart failure or angina, the increased demands on the myocardium may cause pulmonary edema or a MI.

7. **Treatment of Heat Illness:**

a. Treat mild heat illness (heat exhaustion) as follows:

(1) cool immediately (see below);

(2) (aspirin, acetaminophen, and ibuprofen are ineffective in heat illness, and may cause complications, so do not give them);

(3) rehydrate with oral solutions (see below) or IV's if the patient cannot tolerate oral fluids;

(4) monitor the temperature continuously; and

(5) evacuate promptly but not urgently for evaluation for muscle, liver, and kidney damage.

b. Treat severe heat illness (heatstroke) as follows:

(1) Cool immediately to 102°F (39°) by any means handy (e.g., immersion in a nearby lake). Immediate cooling is vital, because the damage to organs is dependent not only the temperature, but also the length of time the organ "cooks."* (See Figure 3.)

(2) Start cardiac monitoring if equipment is available.

(3) Due to the increased metabolic rate with heat illness, you should always administer high-flow oxygen.

(4) An NG tube and Foley catheter would be appropriate in cases of severe heat illness (heatstroke).

(5) Shivering may complicate cooling measures, and may be controlled with small doses (2-5 mg at a time) of Valium® (diazepam). Thorazine® (chlorpromazine) has been recommended for shivering, but is also well-known for causing hypotension, and should be used with caution if at all.

(6) Give routine care if the patient has decreased level of consciousness, or if patient has seizures (e.g., IV diazepam).

(7) Urgently evacuate anyone with severe heat illness (heatstroke).

c. **Cooling Methods**

(a) Use the "**mist treatment.**" Cover the patient with a thin cotton sheet, keep it wet, and fan the patient. If available, use a spray bottle of water to keep sheet damp. Otherwise, dribble water from a water bottle intermittently on the victim. Fan using anything available. (The high-velocity "prop wash" wind of a helicopter's rotor has been used, but exposes the patient and others with the usual hazards of being near an operating helicopter.)

(b) Some authors recommend an ice bath, but a few simple physical calculations show that, unless the humidity is very high, you can cool the patient faster by evaporation. Clinical studies confirm this.

(c) Alcohol evaporates quickly and cools well, but the patient may develop systemic poisoning by absorbing it through the skin. Also, there is a significant fire danger to the patient.

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* A meta-analysis of several studies of classical heatstroke cooling was presented at the 1991 World Congress on Wilderness Medicine. (A meta-analysis is a stastical study looking at data from several smaller studies.) This analysis did show that rapid cooling is associated with a better prognosis. Ramsay CB, et al. University of Missouri Medical Center, Kansas City.

d. Your extended care concerns for the heat illness patient should include the following.

(1) Monitor the patient's temperature. If the patient has sustained hypothalamic damage, he or she may not be able to regulate temperature properly even without any heat stress. You should be ready to readjust cooling and insulation regularly to avoid hyper- or hypo-thermia.

(2) You must think about myoglobin released from heat-damaged muscle possibly causing kidney failure (this problem is discussed further under *Wilderness Trauma*).[5]

H. Oral Fluid and Electrolyte Replacement

1. Inadequate fluid replacement is a common problem for members of SAR teams, as discussed under dehydration, above. While some salts are lost in sweat, the major problem is inadequate water replacement. Enough salts are usually provided by trail foods and meals to make special oral electrolyte solutions unnecessary for most wilderness search and rescue tasks. However, tasks in desert areas or in the hot, humid Southern Appalachians, or even a very difficult rescue task in more favorable conditions, may cause sweating and salt loss beyond the capacity of SAR field rations to supply. Certainly, in cases of clinical dehydration or mild heat illness, electrolyte drinks are indicated, as they are in severe gastroenteritis. However, we must re-emphasize that in most cases **lots of water** is what the team members need, as well as occasional snacks to provide calories as well as salt.

2. The best-absorbed oral electrolyte solutions that are somewhat less salty than blood, are cool, and have a small amount of sugar in them. The patient's kidneys should excrete the proper amount of water to bring the sodium level back to normal, so drinks need not be as salty as blood.

3. Even though a person's problem may be a low concentration of sodium in the blood, you should **not** give any oral solution that has a high salt concentration. First, concentrated salt solutions are noted for their ability to cause vomiting. Second, salt solutions are no longer even recommended to induce vomiting, because they may actually cause hypernatremia and seizures.

4. If you think oral electrolyte replacement is indicated, use a fluid replacement with potassium. Potassium is lost in sweat, vomit, and diarrhea. Give Gatorade™ or an equivalent orally, or some kind of Ringer's solution if the person is unable to take oral fluids.

5. Several types of oral electrolyte fluids are available:

   a. **Salty Lemonade.** To a liter of water and drink mix (lemonade seems to taste best with salt), mix in about half a teaspoon of salt. This makes a cheap and effective, if slightly unusual-tasting, fluid and salt replacement drink.*

   b. **"Athletic" Drinks.** Gatorade™, Squincher™, ERG™, or similar "athletic" or "sports" drinks all contain a dilute (more dilute than blood) solution of sodium and potassium (sometimes with other salts) and varying amounts of sugar and flavoring. The advantage of these drinks over salty lemonade is that they provide the po-

* This provides about 30 mEq of sodium per liter. (Packages of salt from fast-food restaurants are handy to keep in your pack for this purpose.)

tassium that is lacking in table salt. Cool dilute salt solutions with a small bit of sugar are more easily and quickly absorbed than other drinks. These drinks contain 50-90 mEq/L of sodium, and for rehydration during strenuous exercise, are tolerated and absorbed better if diluted half-and-half with plain water. For rehydration from gastroenteritis, use these drinks full-strength.

c. **Concentrated Solutions.** WHO solution*, Gastrolyte™, and the old Red Cross "shock solution" (salt and sodium bicarbonate) contain more salt and less sugar than the "sports" drinks, and were invented to deal with severe loss of fluids and electrolytes such as from severe diarrhea (e.g., cholera) and from blood loss. They taste terrible, because of the high salt concentration, but can be useful in these situations. They are probably inferior to Gatorade™ and its competitors when you have lost more fluid than electrolytes (i.e., in most hot weather situations). They might be somewhat better than "sports" drinks for heat cramps, except for the Red Cross solution, because it contains no potassium.

d. **Salt Tablets.** Don't use salt tablets, and tell team members not to use them. Although they you can take them with large amounts of water, the dissolving tablet may still cause you significant gastric distress. When using salt tablets and water, it is hard to balance the water/salt proportion properly, and salt tablets may cause hypernatremia and even seizures, especially in children.[6]

Glossary

Acclimatize: to become adapted to something, and in particular to become adapted to heat or cold.

Anecdotal: evidence from individual cases, as opposed to more rigorous evidence from planned scientific studies.

Disseminated Intravascular Coagulation: Also known as DIC. Widespread clotting throughout the entire vascular system, causing clots where they're not needed, and causing a decrease in clotting factors for use in areas that actually need a clot.

Drop Attack: Acute syncope from a cardiac arrhythmia.

Exacerbate: to make worse.

Hypokalemia: a low level of potassium in the blood.

Hyponatremia: a low level of sodium in the blood.

Incontinence: loss of control leading to urination or defecation.

mEq: Millequivalent. A measure of concentration for ions. For single-valence ions such as sodium, it is the same as a millimole. For divalent ions such a chloride, which carries two negative charges, it is twice the concentration in millimoles.

Mottled: unevenly colored, blotchy.

Near-syncopal: A near-syncopal episode is when one feels faint or lightheaded but doesn't actually pass out.

Stokes-Adams attack: acute syncope from a cardiac arrhythmia.

Syncopal: relating to syncope (becoming unconscious), usually used as follows: "the patient had a syncopal episode" (i.e., passed out).

Syncope: fainting, passing out, becoming unconscious.

WHO solution: World Health Organization solution. Available in powder form, this is an oral electrolyte replacement solution that has saved thousands from dying from the severe diarrhea of cholera.

References

1. Yarbrough BE, Hubbard RW. Heat-related illness. In: Auerbach PS Geehr EC, eds. *Management of wilderness and environmental emergencies.* Second Edition. St. Louis: C.V. Mosby Co, 1989:119-43.

* Available in powder form, this is an oral electrolyte replacement solution that has saved thousands from dying from the severe diarrhea of cholera. It contains 90 mEq of sodium, 20 mEq of potassium, 80 mEq of chloride, 30 mEq of bicarbonate (now being replaced with trisodium citrate), and 111 mmol (2%) of glucose.

2. Sauer GC. *Manual of Skin Diseases.* Fifth Edition. Philadelphia: J. B. Lippincott Co, 1985.
3. Szlyk PC, Sils IV, Francesconi RP, Hubbard RW, Mathew WT. Variability in intake and dehydration in young men during a simulated desert walk. *Aviat Space Environ Med.* 60:422-7, 1989.
4. Rose BD. *Clinical physiology of acid-base and electrolyte disorders.* Second Edition. New York: McGraw-Hill, 1977:193.
5. Stewart CE, ed. *Environmental Emergencies.* Baltimore: Williams and Wilkins, 1990.
6. Wilderness Medical Society. *Position statement: Oral fluid and electrolyte replacement.* Iserson KV, ed. Point Reyes Station, CA: Wilderness Medical Society, 1989:12-13.