

Management of the Seriously Ill or Injured Ultramarathon Runner

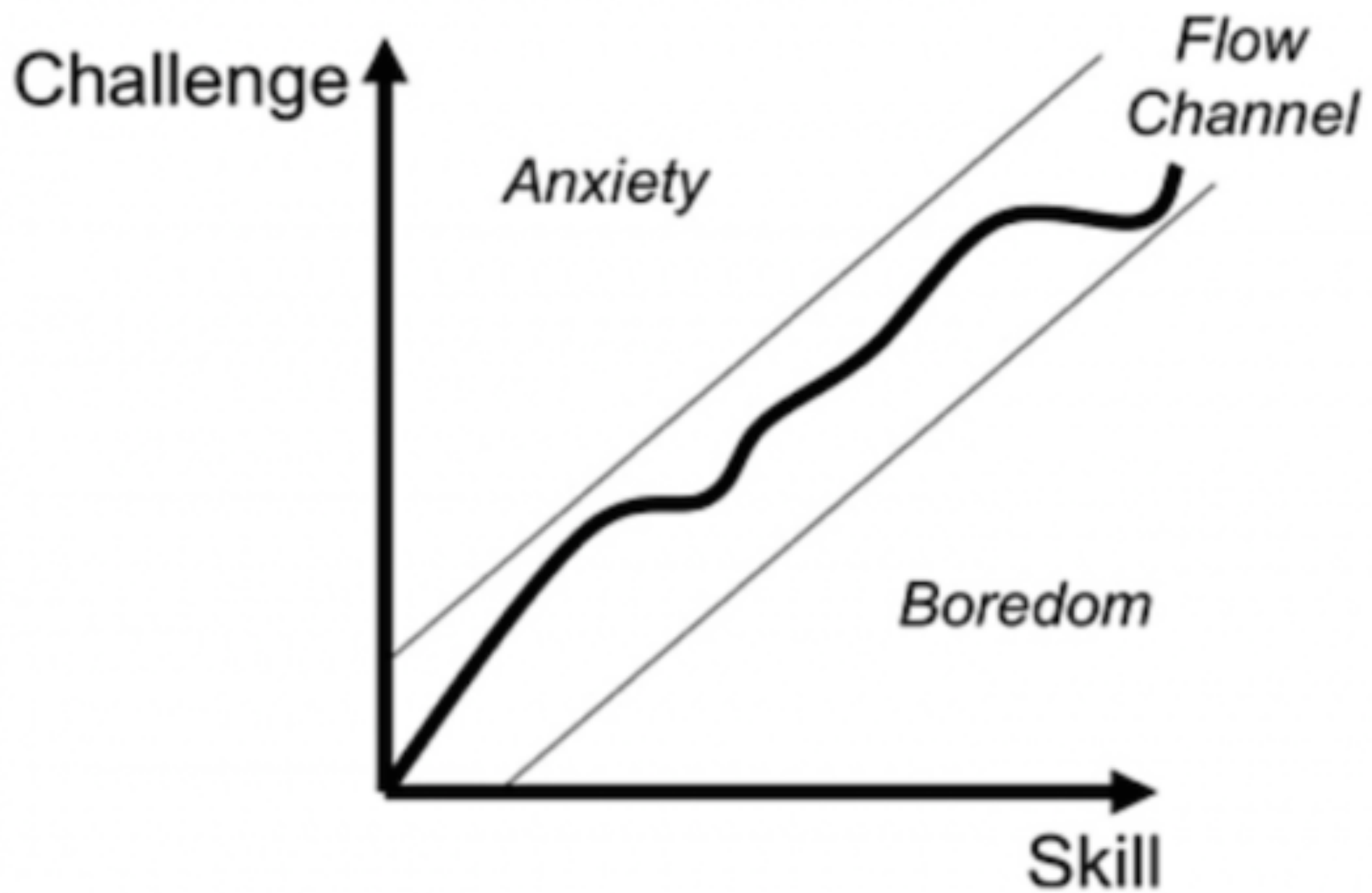
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- Grand to Grand Ultra (MDSU)
Utah/Arizona
- Desert RATS (MDSU)
Colorado/Utah
- Jungle Marathon (MDSU)
Brazil
- Ancient Khmer Path (MDSU)
Cambodia
- Wild Elephant Trail (MDSU)
Sri Lanka
- The Last Secret (MDSU)
Bhutan
- Ironman 70.3 Syracuse
- Empire State Marathon
- Miscellaneous fun runs and other
races

Wilderness & Expedition Medicine





"Flow" concept by Mihaly Csikszentmihalyi. Drawn by Senia Maymin.

Supplies & Equipment

- Epidemiology
- Budget
- Purchasing vs Leasing
- Camp stock vs ALS bags
- AED
- Foot & skin care limitations





Potentially
Serious
Medical Issues
vs.
Common
Ones



Major Trauma

- Immobilization & evacuation
- Should always have plan in back of mind
 - “what if.....
 - slide off mountain
 - attack by large animal
 - hit by car

Exercise-associated collapse

- Athlete crosses finish, stops, bends forward to receive medal around neck, collapses at finish line.... chaos ensues.



EAC (EAPH)

- Multifactorial
 - Athletic training causes decreased vasoconstriction with postural hypotension
 - Decrease Preload (pump stopped)
 - Dehydration???
 - Barcroft/Edholm Reflex

Barcroft/Edholm Reflex

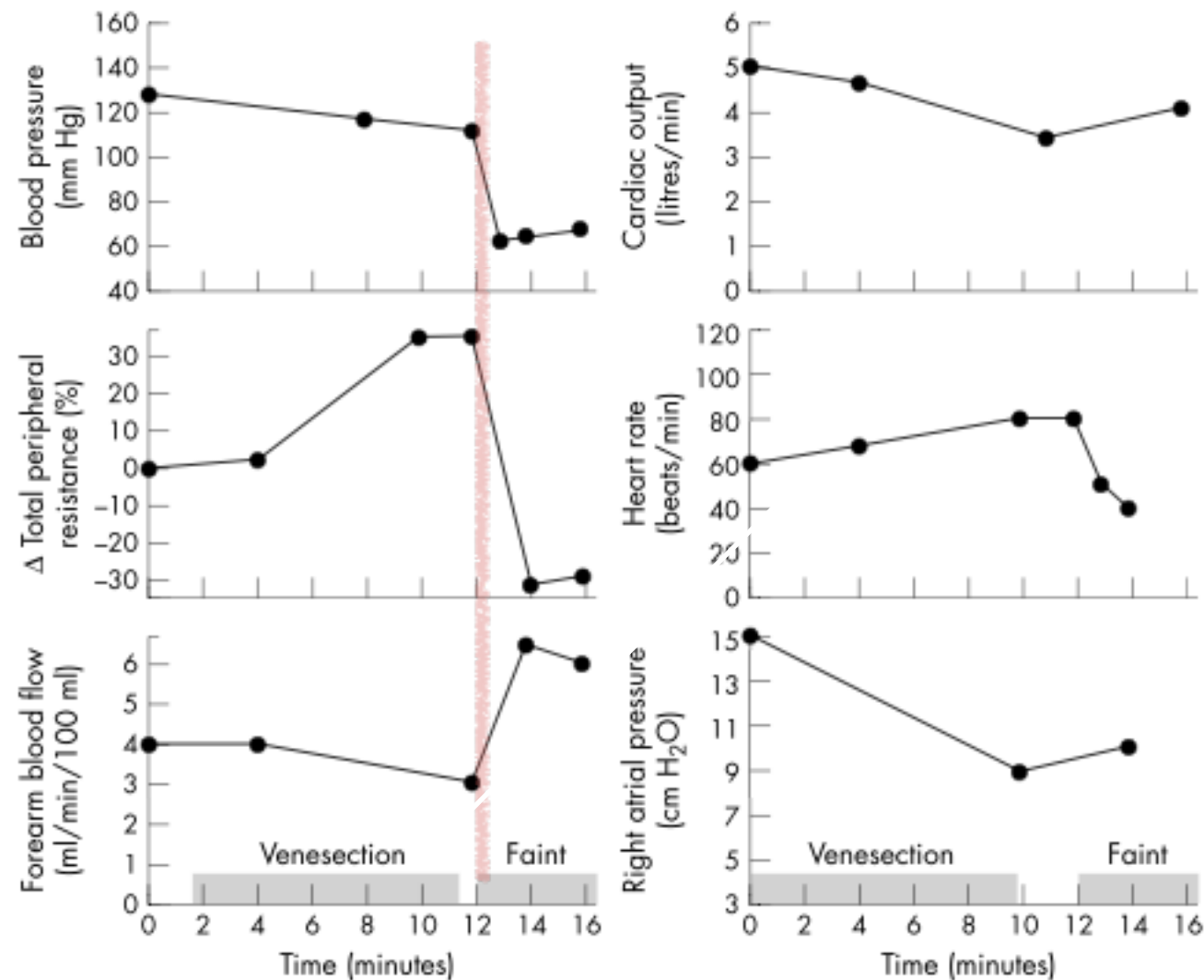


Figure 1 Changes in blood pressure, total peripheral resistance, forearm blood flow, cardiac output, heart rate, and right atrial pressure in subjects who underwent rapid venesection of about 1 litre of blood in 12 minutes. Note that fainting is caused by a sudden reduction in peripheral vascular resistance resulting from an increase in forearm blood flow as right atrial pressure falls, the Barcroft/Edholm reflex. Redrawn from data in Barcroft *et al.*⁵

Collapse

Table 1

Causes of collapsed runner

Mental status changes absent

Exercise-associated collapse (misnomers include heat syncope or heat exhaustion)

Hyponatremia

Cardiac arrest

Severe muscle cramps

Asthma

Anaphylaxis (hymenoptera sting)

Fractures, and pain-associated collapse

Mental Status changes present

Heat stroke

Hypoglycemia

Hypothermia

Hyponatremia

Cardiac arrest

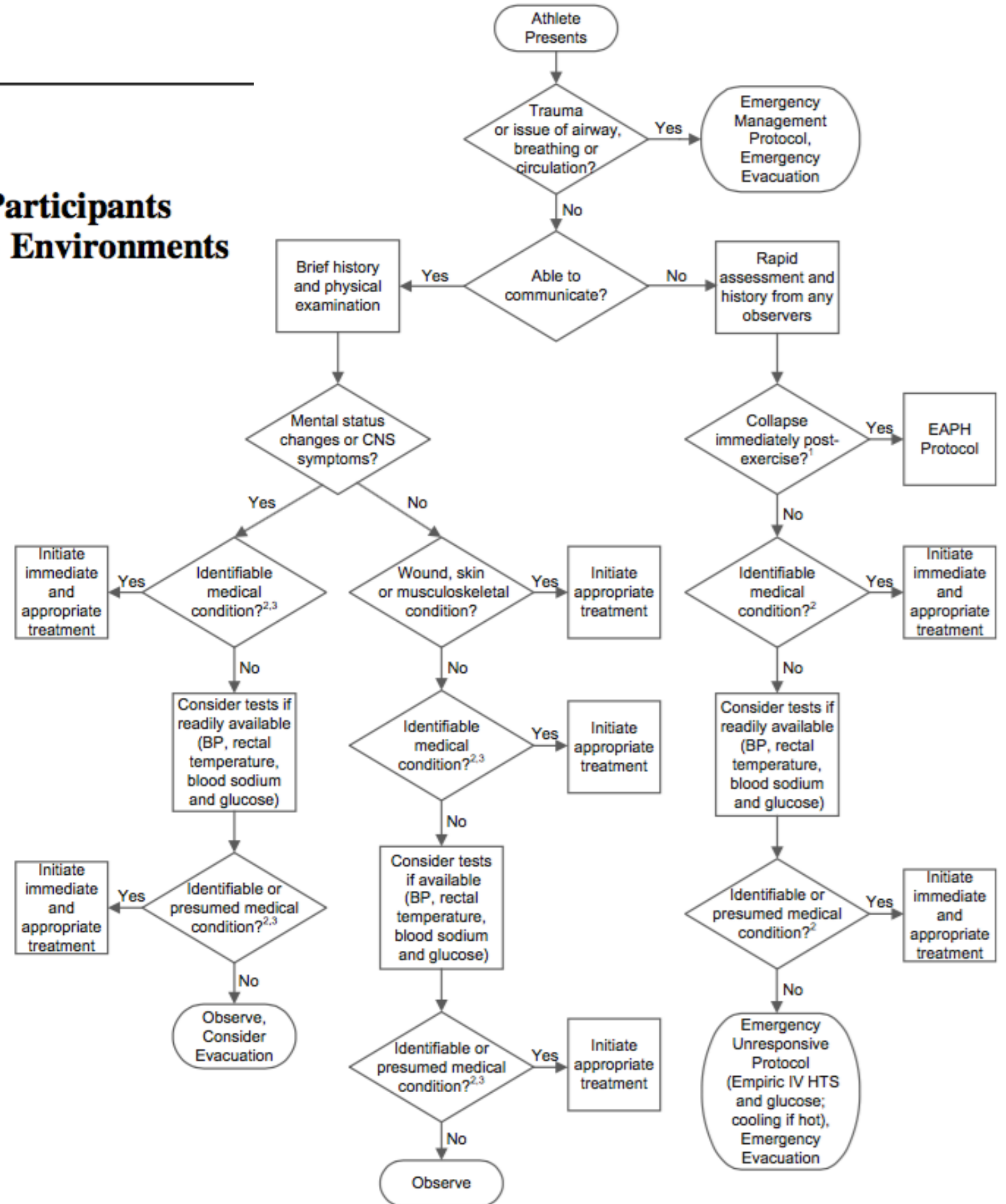
Anaphylaxis

Head injury

Asthma

Managing Collapsed or Seriously Ill Participants of Ultra-Endurance Events in Remote Environments

Martin D. Hoffman · Ian R. Rogers ·
Jeremy Joslin · Chad A. Asplund ·
William O. Roberts · Benjamin D. Levine



¹Collapse during exercise substantially increases the chance of a serious diagnosis, and possible etiologies should be carefully sought.

²Considerations include EHS, hypothermia, diabetic hypoglycemia, EAHE, severe dehydration, ACS, HAPE, HACE, envenomation, anaphylaxis and bronchospasm.

³An additional consideration includes AMS.

Collapse

- Trendelenburg
- Fluids??
- Noakes, et al.... No difference in level of dehydration of those with EAC vs Not

Position Statement

Clinical Journal of
SPORT
MEDICINE

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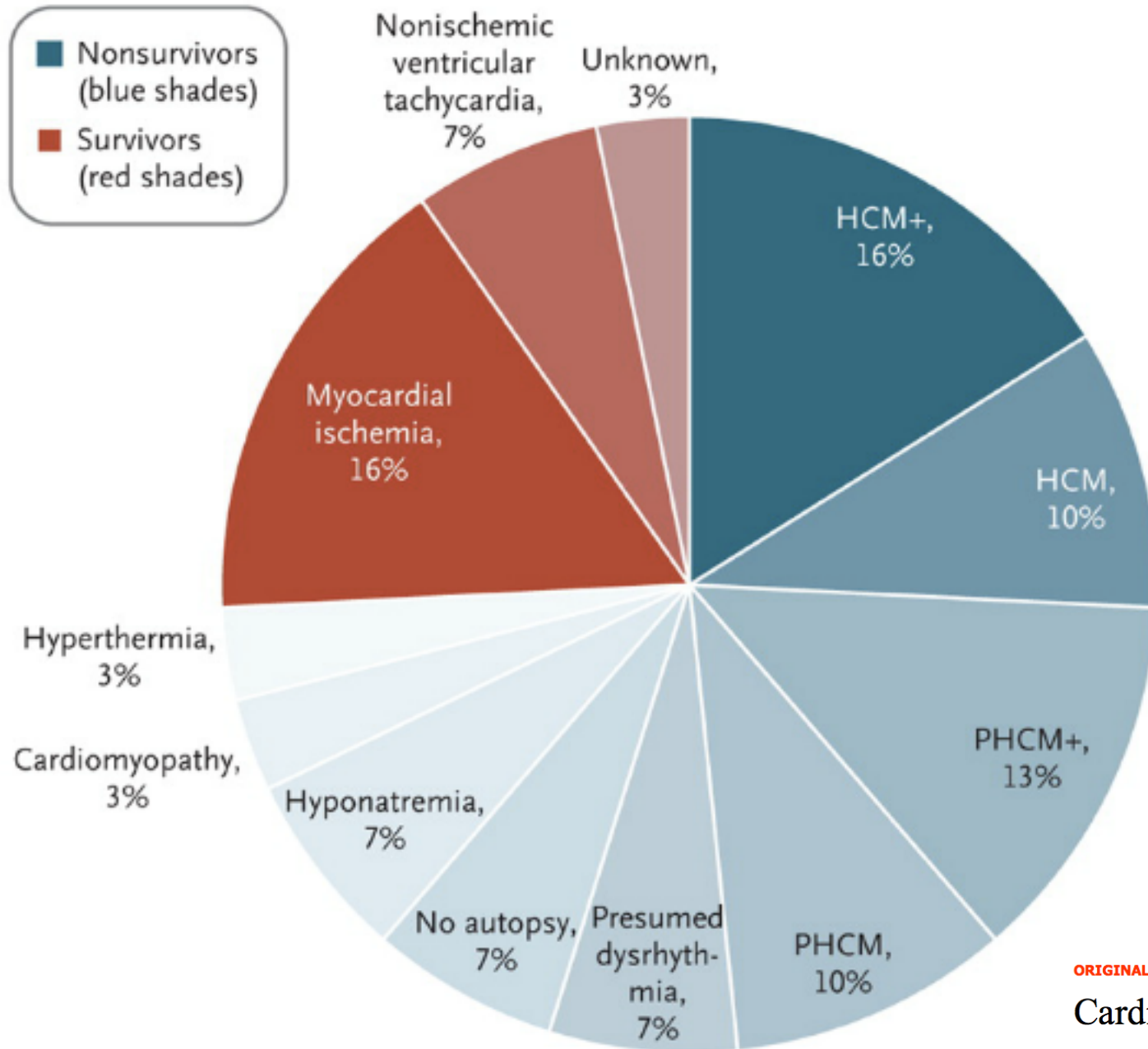
EAC in South Africa

- Noakes, et al
 - “NO IVF in the last 4 years” (2003)
 - Two Oceans Marathon... 20k+/yr
 - Cape Town Ironman Triathlon... 1k/yr

Cardiac Sub-Set of Collapse

- The collapsed runner on the course
(vs. at finish line)
- Arrhythmia
 - Hypertrophic cardiomyopathy
 - Channel-opathy
- Ischemic event

NEJM



10,900,000
Runners

10 Years

59 cardiac deaths
71% fatality rate

ORIGINAL ARTICLE

Cardiac Arrest during Long-Distance Running Races

Jonathan H. Kim, M.D., Rajeev Malhotra, M.D., George Chiampas, D.O., Pierre d'Hemecourt, M.D., Chris Troyanos, A.T.C., John Cianca, M.D., Rex N. Smith, M.D., Thomas J. Wang, M.D., William O. Roberts, M.D., Paul D. Thompson, M.D., and Aaron L. Baggish, M.D. for the Race Associated Cardiac Arrest Event Registry (RACER) Study Group
N Engl J Med 2012; 366:130-140 | January 12, 2012 | DOI: 10.1056/NEJMoa1106468

Severe Dehydration

- Intellectually dishonest to attribute blame for collapse unless circumstances allow for the ddx
- Beware the AVP stimulation

Exercise-associated hyponatremia

- AVP hypersecretion after physiologic stress
- Be prepared with 3% saline in ALS bag
- Treat empirically if symptoms
- 100mL IV bolus - may repeat as needed

	NaHCO₃	3% Saline	0.9% Saline
Ampule (50mL)	50 mEq		
Mini Bag (100mL)		50 mEq	15.4 mEq



Letter to the Editor

Novel Method for Reducing Temperature of i-STAT1 Analyzer in Extreme Environments

To the Editor:

The use of the i-STAT1 Analyzer (Abbott Point of Care Inc., Abbott Park, IL) in wilderness settings has become more common over the last few years. Uses include health and safety monitoring¹ as well as data collection for endurance-related research.² Because it was designed for use in the hospital setting, it is not surprising that its use in the wilderness is fraught with problems. Personal communications with other research teams, as well as the anecdotes of our own team, relate difficulty with keeping the unit within the required temperature range of 61°F to 86°F (16°–30°C). Outside this strict window of temperatures, the unit ceases to operate, and displays a message indicating the unit's temperature is out of range.

We have heard tales of researchers sheltering underneath cars and other objects capable of creating shade, and we would like to describe 2 methods we use for keeping the i-STAT1 Analyzer within range while using it in high temperature environments. One we adopted from the long experience of the military and of desert dwellers. The other is a modification of the method by Backer et al,¹ who utilized an insulating pack with an enclosed cold pack from a freezer to keep both the machine and the cartridges cool.

During a recent event in the arid, hot environment of northern Arizona (78°F [25.6°C], average humidity 29%) we experienced difficulty using the device within our medical tent (99°F [37.2°C]). To bring the unit into range, we used the low relative humidity and endothermic properties of evaporation to lower the machine's temperature by 10°F (5.5°C) within 5 minutes. To



Figure 1. The device being wrapped in a damp bandana.

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Letter to the Editor



Figure 2. The device cradled in 2 chemical cold packs. During our event, we used a single larger cold pack.

accomplish this, we used a thin cotton handkerchief or bandana that had been soaked with room temperature water and wrung out once. We then wrapped the machine like a burrito and set it on the ground within the tent. After 5 minutes, we turned on the device and found it to be within range. This technique worked several times as needed (Figure 1).

During another recent event in the humid, hot environment of the Brazilian jungle (95°F [35°C], average humidity 83%), we similarly experienced difficulty with using the device owing to temperature out of range. To bring the unit into range, we utilized the endothermic properties of a chemical cold pack and simple conduction to lower the machine's temperature 6°F (3.3°C) within 5 minutes. To accomplish this, we activated the chemical cold pack and nestled the machine on top of it. After 5 minutes of thermal conduction, the machine's temperature was found to be within range. This technique also worked several times as needed (Figure 2).

Evaporative cooling, used in swamp coolers or desert coolers, works because water has a large heat of vaporization. The heat of vaporization is "the quantity of heat that must be absorbed if a certain quantity of

liquid is vaporized at a constant temperature."³ In our use of evaporative cooling, heat energy from the i-STAT1 Analyzer was absorbed by the water molecules on the damp cloth and used to transform those water molecules from the liquid phase to the gas phase. The evaporation caused a net cooling effect as heat energy was pulled away.

Harnessing the thermodynamic properties of the environment, we were able to successfully use the i-STAT1 Analyzer within both a desert and a jungle environment to accomplish our needs of checking event participant's serum electrolytes for educational purposes. Backer et al¹ caution that the cartridge electrodes are sensitive to temperature as well. We kept cartridges out of direct sun and heat, and would like to reinforce with readers the need to protect the integrity of the cartridge temperature as well. Although not novel technology, we believe this to be the first report of utilizing these techniques for maintaining i-STAT1 Analyzer functionality, and humbly wish to share them with the wilderness medicine community. Further testing and review by the manufacturer are required, and we do not specifically endorse the use of these techniques for critical clinical applications.

Acknowledgement

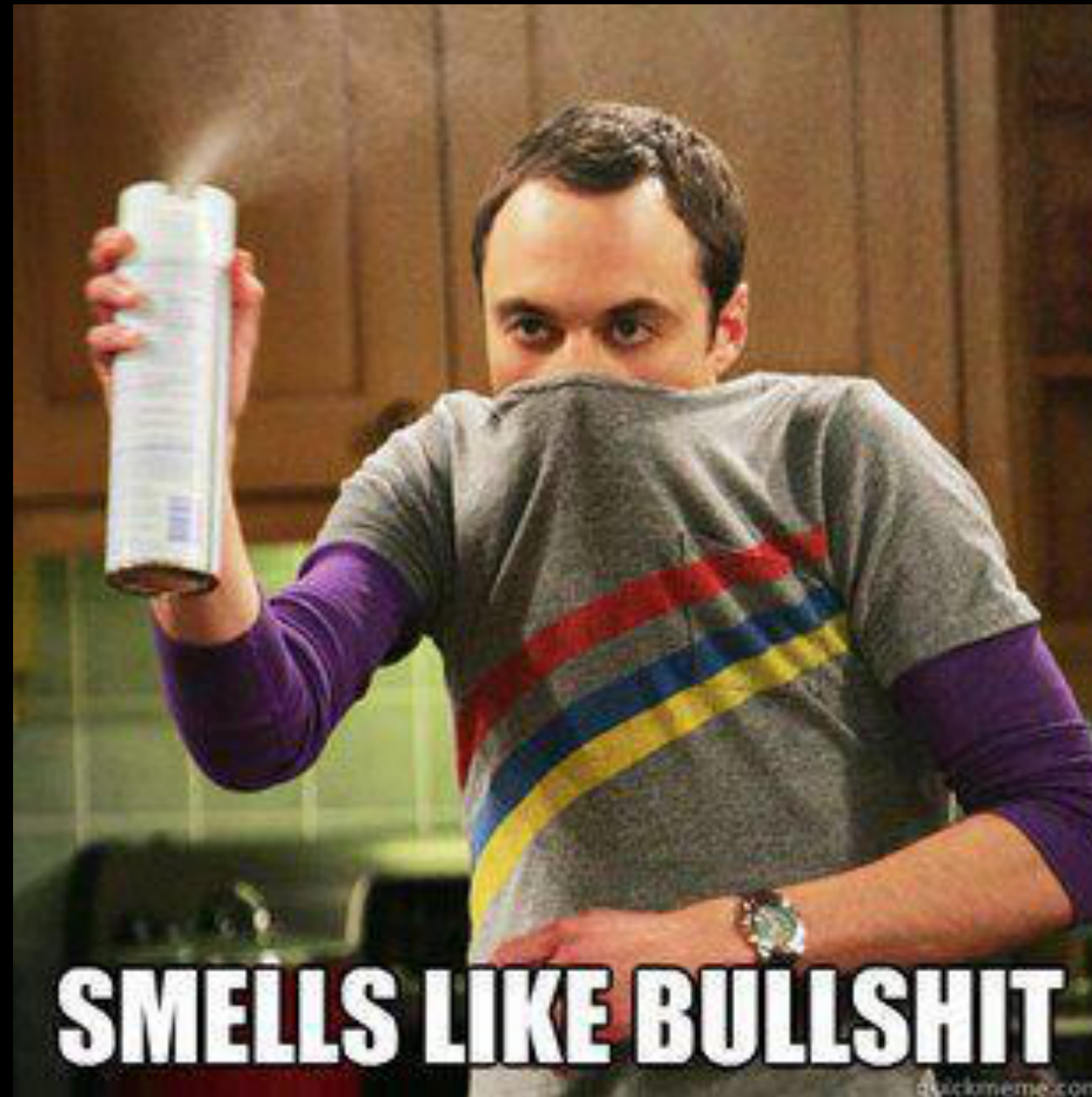
We thank Abbott for lending us an i-STAT1 analyzer unit. No funding was received, and this letter was not solicited by, or discussed with, them.

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References

1. Backer HD, Collins S. Use of a handheld, battery-operated chemistry analyzer for evaluation of heat-related symptoms in the backcountry of Grand Canyon National Park: a brief report. *Ann Emerg Med.* 1999;33:418–422.
2. Lipman GS, Krabak B, Waite B. A prospective cohort study of acute kidney injury in multi-day ultramarathon runners. *Wilderness Environ Med.* 2011;22:358.
3. Nandini Bapat. Heat of vaporization. UC Davis ChemWiki. Available at: http://chemwiki.ucdavis.edu/physical_chemistry/thermodynamics/state_functions/enthalpy/enthalpy_of_vaporization. Accessed December 12, 2013.

Heat Illness



Heat Stroke

- Uncommon but represents life threat
 - End organ injury in setting of heat stress
 - Beware of using temperature alone
 - Brain boils first
- Have a cooling plan for every race and every part of each race
- Utilize environmental heat sinks (rivers/streams, heat of vaporization)
- Should be evacuated/transported (cool before when possible)

32 yo male collapsed



Hypothermia

- Have plan in place for identification and treatment
- Passive treatment with warm PO fluids and blanket
- Beware warming skin only --> impairs shivering reflex

Altitude Illness

- Know runners who may be at risk for your race's profile
- Prevention better than treatment
- Caution use of diuretics or steroids in the endurance athlete - acclimatization best

Anaphylaxis

- Should be part of screening process
- Required personal gear
- Should have epinephrine, diphenhydramine, albuterol, and steroid in ALS bag

Anaphylaxis



Common Medical Issues

Blisters & Skin Problems

- Blister prevention
- Supply vs Demand of supplies
- Managing expectations
- Teach a man to fish approach...



Gastrointestinal Issues

Table 2. Final Exercise-Associated Gastroparesis Severity Score

Symptom	None	Mild	Moderate	Severe	Very Severe	Unbearable
Nausea	0	1	2	3	4	5
Vomiting	0	1	2	3	4	5
Loss of Appetite	0	1	2	3	4	5
Loss of Desire to Drink	0	1	2	3	4	5
Abdominal Sloshing	0	1	2	3	4	5
Abdominal Pain	0	1	2	3	4	5

Gastroparesis Severity Score (GSS) = ____ (add total from all rows)

- Exercise-associated gastroparesis (common ailment with potential for race interruption)
- Occult bleeding common (25-30%)

Hydration Issues

- At MDSU's use evening rest time to hydrate
- Education of runners on drinking to thirst
- Personally used only 4 liters of IVF for hydration



Musculoskeletal injuries

- Splints
- Wraps
- Bandages
- Beware wet courses and pseudomonas



Vision Issues

- Not completely understood
- Impacted race performance = 3%
- Reported cloudiness of vision
- Association with previous refractive surgery

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