Primary Care Approach to Treating the Injured Athlete




Exertional Heat Illness Prevention: A Military Perspective


Francis G. O'Connor, COL, MC, USA
Medical Director, Consortium for Health and Military Performance (CHAMP)
Professor and Chair, Department of Military and Emergency Medicine
Uniformed Services University of the Health Sciences

DISCLOSURE

- I have no relevant financial disclosures in reference to this lecture.
- That being said, I am a physician in the US Army, and work for the DoD.

My opinions and assertions contained herein are private views and are not to be construed as official or as reflecting the views of the U.S. Army Medical Department , Uniformed Services University or the Department of Defense at large.

Objectives

- **Discuss** the **epidemiology** of exertional heat illness (EHI) in athletes and warriors.
- **Review** the **definition** and **clinical description** of EHI.
- **Identify** strategies utilized to **facilitate acclimatization** and **prevent** EHI.

KOREY STRINGER




Exertional Heat Illness: Epidemiology

Heat Stroke is Common in the Military!

- **MSMR March 2014 21(3)**

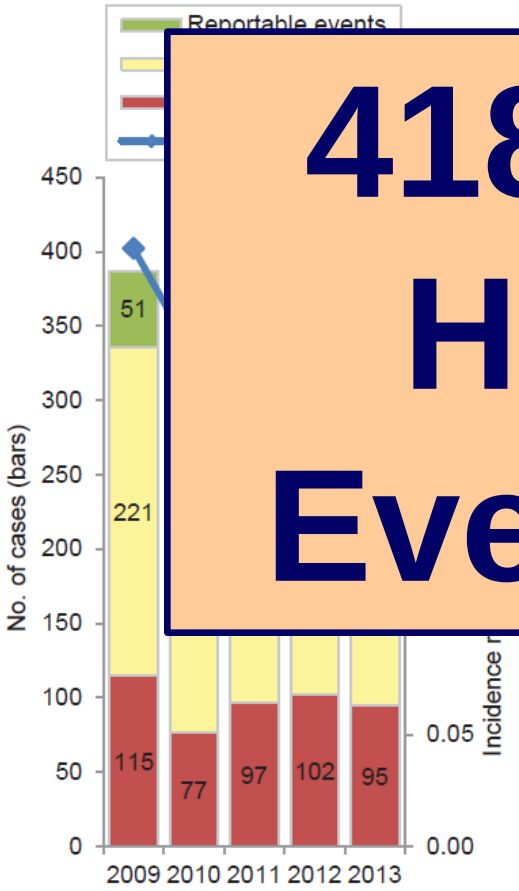


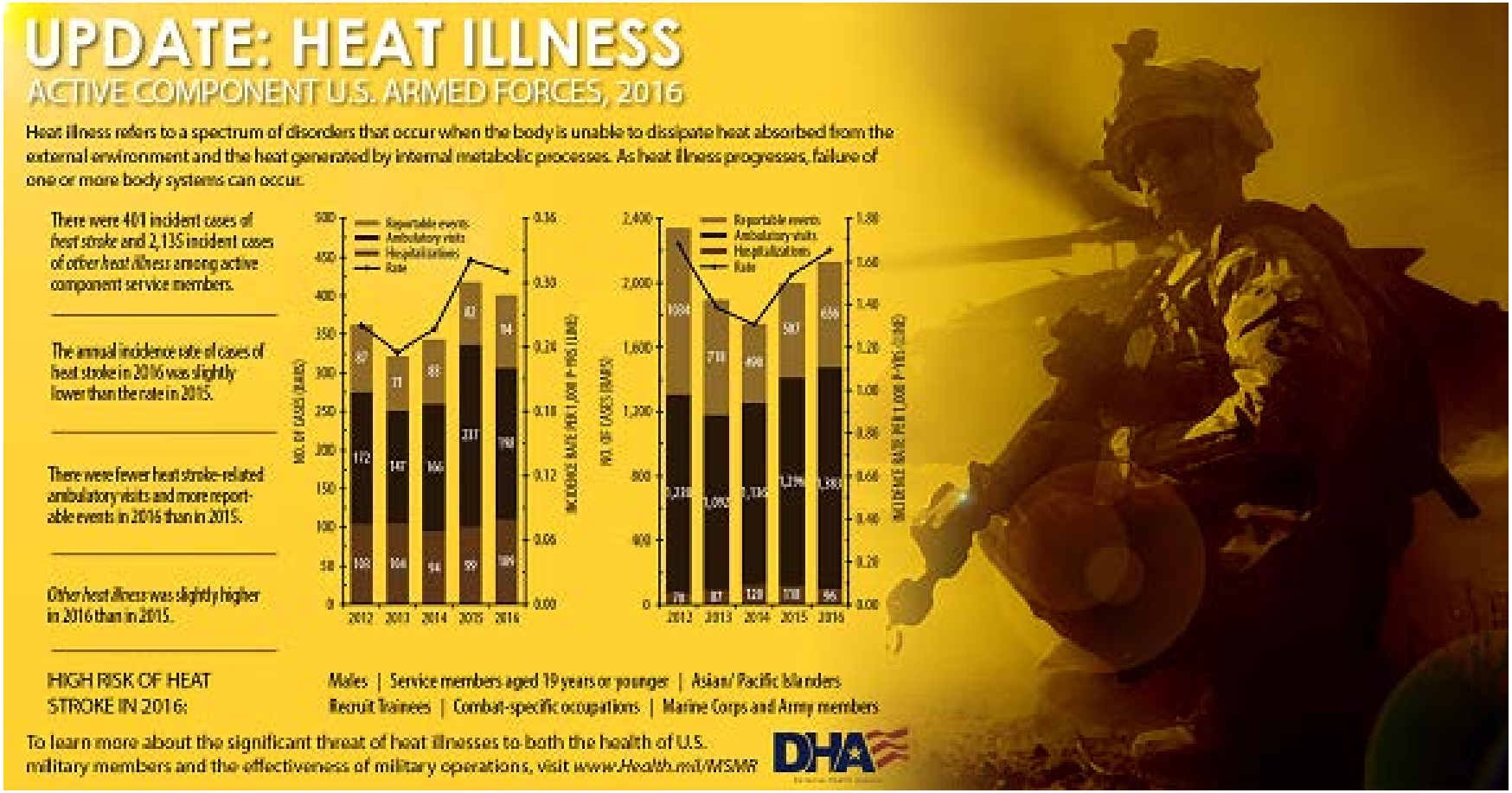
TABLE 1. Incident cases and incidence rates[a] of heat injury, active component, U.S. Armed Forces, 2013

	Heat stroke		Other heat injury		Total heat injury diagnoses	
					No.	Rate[a]
					2,025	1.44
					1,722	1.43
					303	1.45
					373	4.19
					865	1.98
					423	1.23
					183	0.80
					115	0.72
					66	0.43
White, non-Hispanic	200	0.23	1,037	1.19	1,237	1.42
Black, non-Hispanic	51	0.23	321	1.44	372	1.66
Hispanic	36	0.22	179	1.10	215	1.32
Asian/Pacific Islander	25	0.44	86	1.51	111	1.96
Other/unknown	12	0.12	78	0.79	90	0.91

418 Exertional Heat Stroke Events in 2015!

Exertion-Related Injuries despite Prevention!

- **The Medical Surveillance Monthly Report found over 12,700 cases of reported EHI and ER in between 2013 to 2017.**

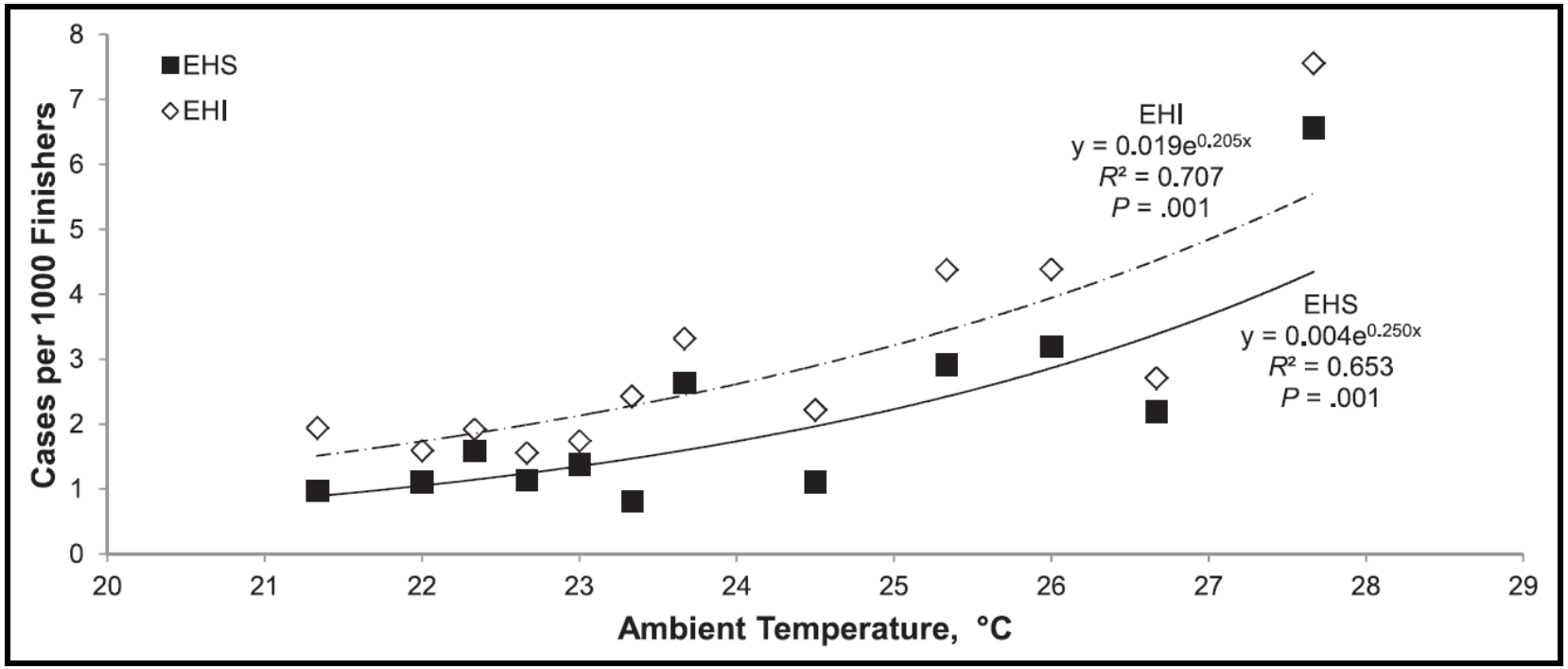


EHI Events Inversely Related to Race Duration

- Marathon (1-2 per 10,000 finishers Twin Cities Marathon)
- Half Marathon (1 per 1,000 finishers Great North Run)
- 7 Miler (2 per 1,000 finishers Falmouth Road Race)

DeMartini JK, Casa DJ, Belval LN, et al: Environmental conditions and the occurrence of exertional heat illnesses and exertional heat stroke at the Falmouth Road Race. J Athl Train. 2014 Jul-Aug;49(4):478-85.

EHI Events Directly Related to Heat Index



DeMartini JK, Casa DJ, Belval LN, et al: Environmental conditions and the occurrence of exertional heat illnesses and exertional heat stroke at the Falmouth Road Race. J Athl Train. 2014 Jul-Aug;49(4):478-85.

Cardiac Arrest or Heat Stroke?

- **METHODS:** retrospective study examined all the long distance popular races that took place in Tel Aviv from March 2007 to November 2013.
- **RESULTS:** Overall, 137,580 runners participated in long distance races during the study period. There were only 2 serious cardiac events (1 myocardial infarction and 1 hypotensive supraventricular tachyarrhythmia); there were 21 serious cases of heat stroke, including 2 that were fatal and 12 that were life threatening. **One of the heat stroke fatalities presented with cardiac arrest**.
- **CONCLUSIONS:** In our cohort of athletes participating in endurance sports, **for every serious cardiac adverse event, there were 10 serious events related to heat stroke.**

Yankelson L, Sadeh B, Gershovitz L, et al: Life-threatening events during endurance sports: is heat stroke more prevalent than arrhythmic death?J Am Coll Cardiol. 2014 Aug 5;64(5):463-9.

Exertional Heat Stroke in Football Players

- Since 1995, **54 reported football player fatalities** from exertional heat stroke (42 high school, 9 college, 2 professional, 1 sandlot)
- **Exertional Heat Stroke is Arguably the Most Common Cause of Preventable Non-traumatic Exertional Sudden Death in American Sports**
- **The EHI rate in football (4.42 per 100,000 AEs) was 11.4 times that in all other sports combined.**

Kerr ZY, Casa DJ, Marshall SW, Comstock RD: Epidemiology of exertional heat illness among U.S. high school athletes. Am J Prev Med. 2013 Jan;44(1):8-14.

Why do Individuals Die from Heat Stoke?

- These **two items** were present in 100% of fatal cases
  - 1) Physical effort unmatched to physical fitness
  - 2) **Absence of proper medical triage**

Rav Acha M: Fatal Exertional Heat Stroke: A Case Series, American Journal of Medical Sciences, 2004;328(2):84-87.

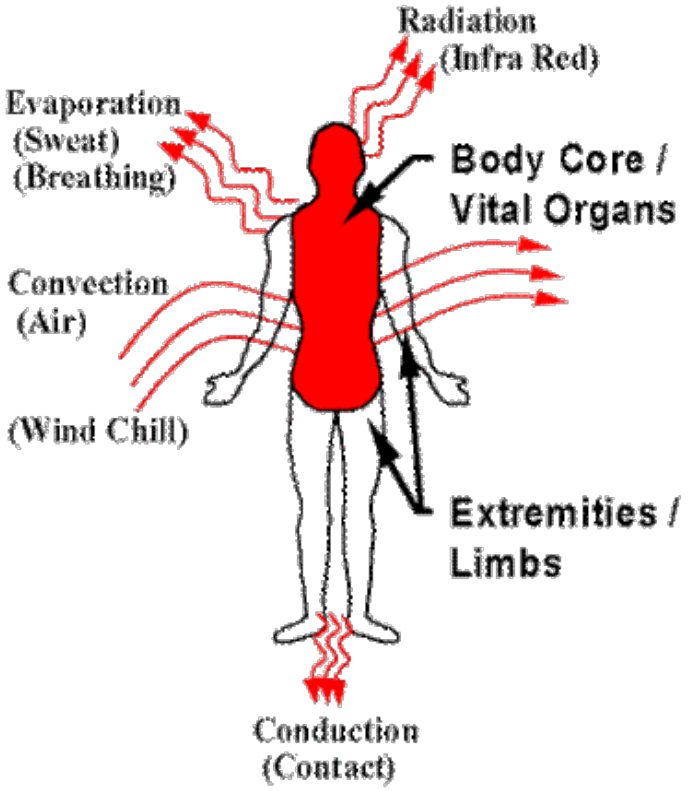
Heat Illness: Definition

Bouchama A, Knochel JP: Heat Stroke.
The New England Journal of Medicine,
Vol 346, No. 25, June 2002.

Terminology

- **Thermoregulation**:

- Body heat is gained from the environment and is produced by metabolism
- Heat dissipation ensues:
  - Vasodilation
  - Thermal sweating
  - Evaporation
  - Convection
  - Conduction
  - Radiation



An intact and functioning Cardiovascular System in Critical!

Terminology

- **Thermotolerance**:

• the ability to compensate to heat stress and sustain work; those individuals who are unable to sustain heat and whose body temperatures rise faster than others in comparable conditions are said to be heat intolerant.

TABLE 2. Classification of factors underlying heat intolerance in the young active population.

Congenital:	ectodermal dysplasia
	"chronic idiopathic anhidrosis"
Functional:	low physical fitness
	lack of acclimatization
	low work efficiency
	reduced skin area to body mass ratio
Acquired:	sweat gland dysfunction
	dehydration
	infectious disease
	x-ray irradiation
	previous heat stroke (?)
	large scarred burns skin area
	drugs

Terminology

- **Acclimatization**:

  - **Takes several weeks to complete:**
    - **Activation of renin-angiotensin- aldosterone system**
    - **Salt conservation**
    - **Expansion of plasma volume**
    - **Increased ability to resist rhabdomyolysis**

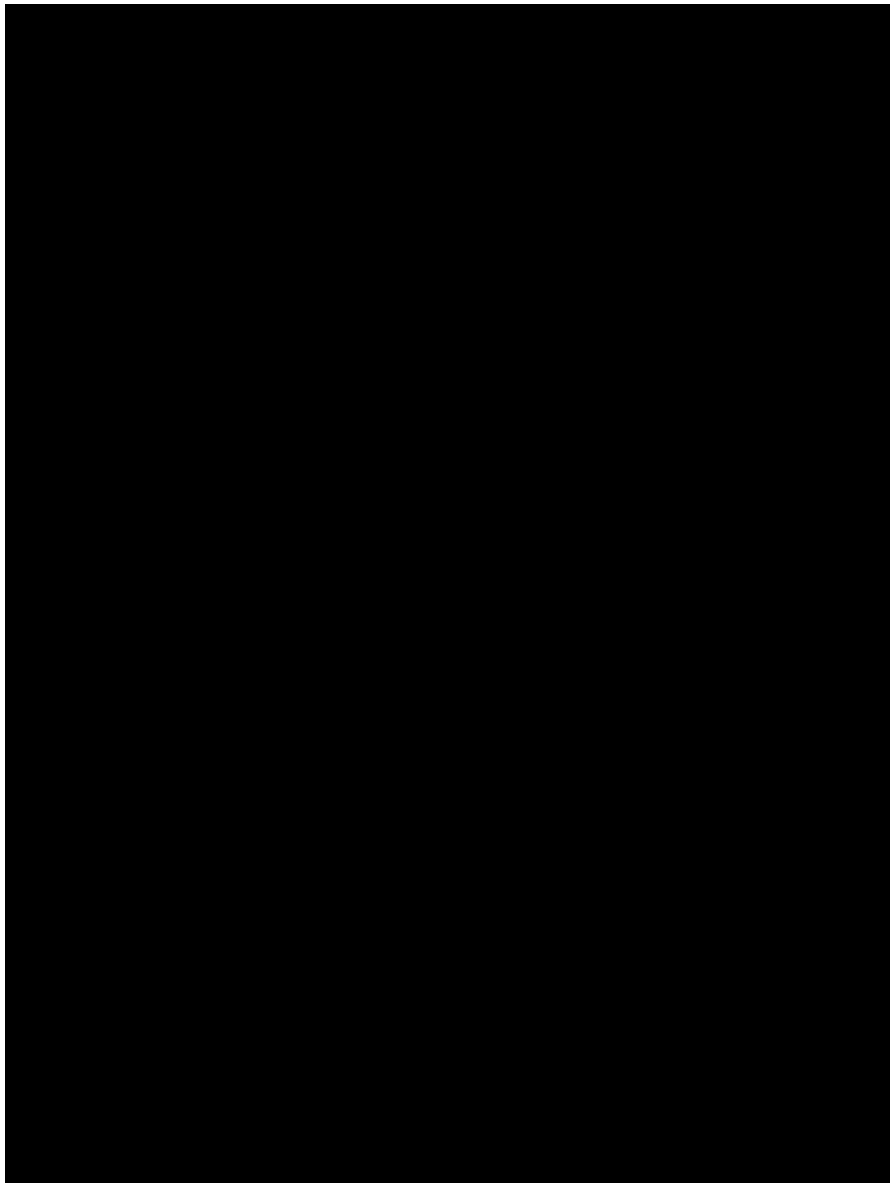
Definition




- **Heat Stroke**: a severe illness characterized by a core temp >40C and CNS abnormalities including delirium, convulsions, or coma.
  - **Classic**: resulting from environmental heat.
  - **Exertional**: resulting from strenuous exercise.

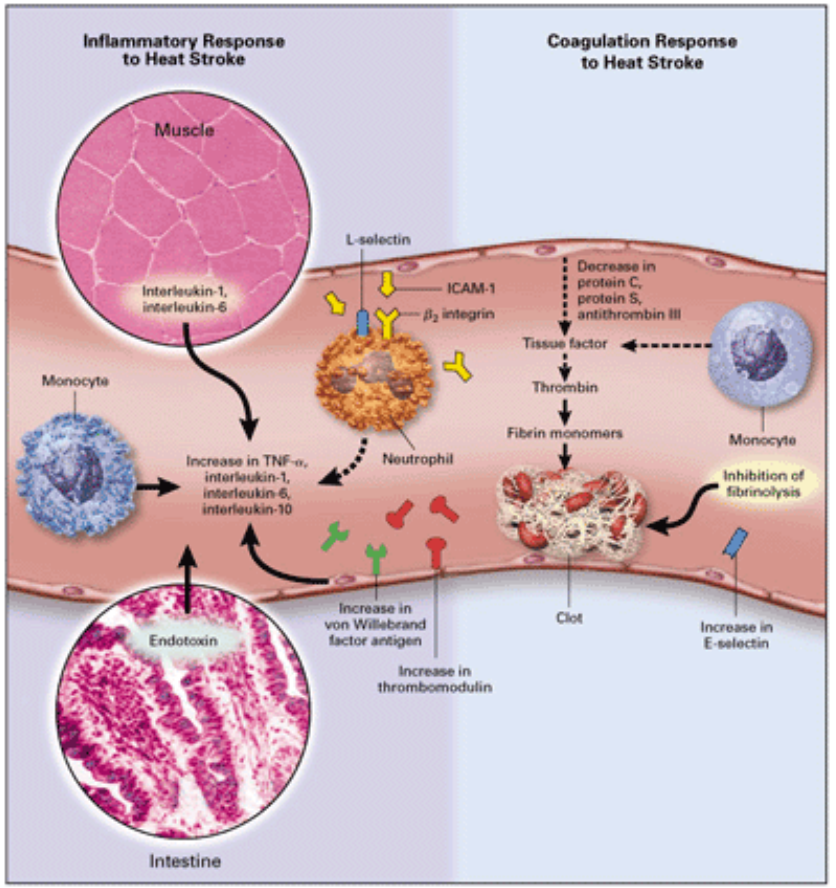
"A form of hyperthermia associated with **a systemic inflammatory response** leading to a syndrome of multiorgan dysfunction in which encephalopathy predominates."

They Can Be Delirious!



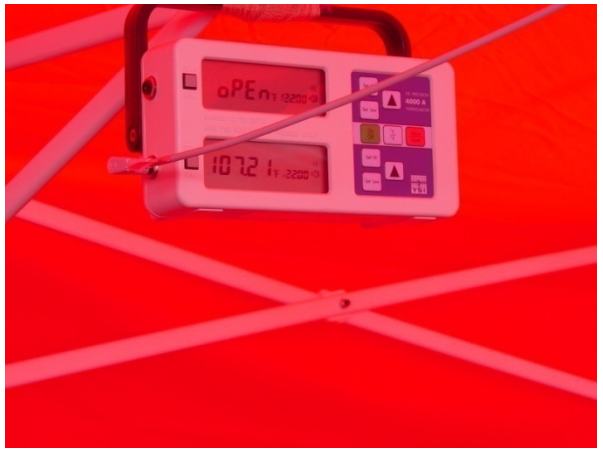
Pathophysiology of Heat Stroke…Still a Mystery!

- **Exaggeration of the Acute-Phase Response**
  - Gastrointestinal tract may fuel inflammatory response
  - Ischemia with hyperpermeability
  - Leakage of endotoxins promotes systemic cytokine response to include pyrogenic cytokines
- **Thermoregulatory Failure**
  - Inadequate cardiac output
- **Alteration of the Heat-Shock Response**
  - Aging
  - Lack of acclimatization
  - Genetic predisposition

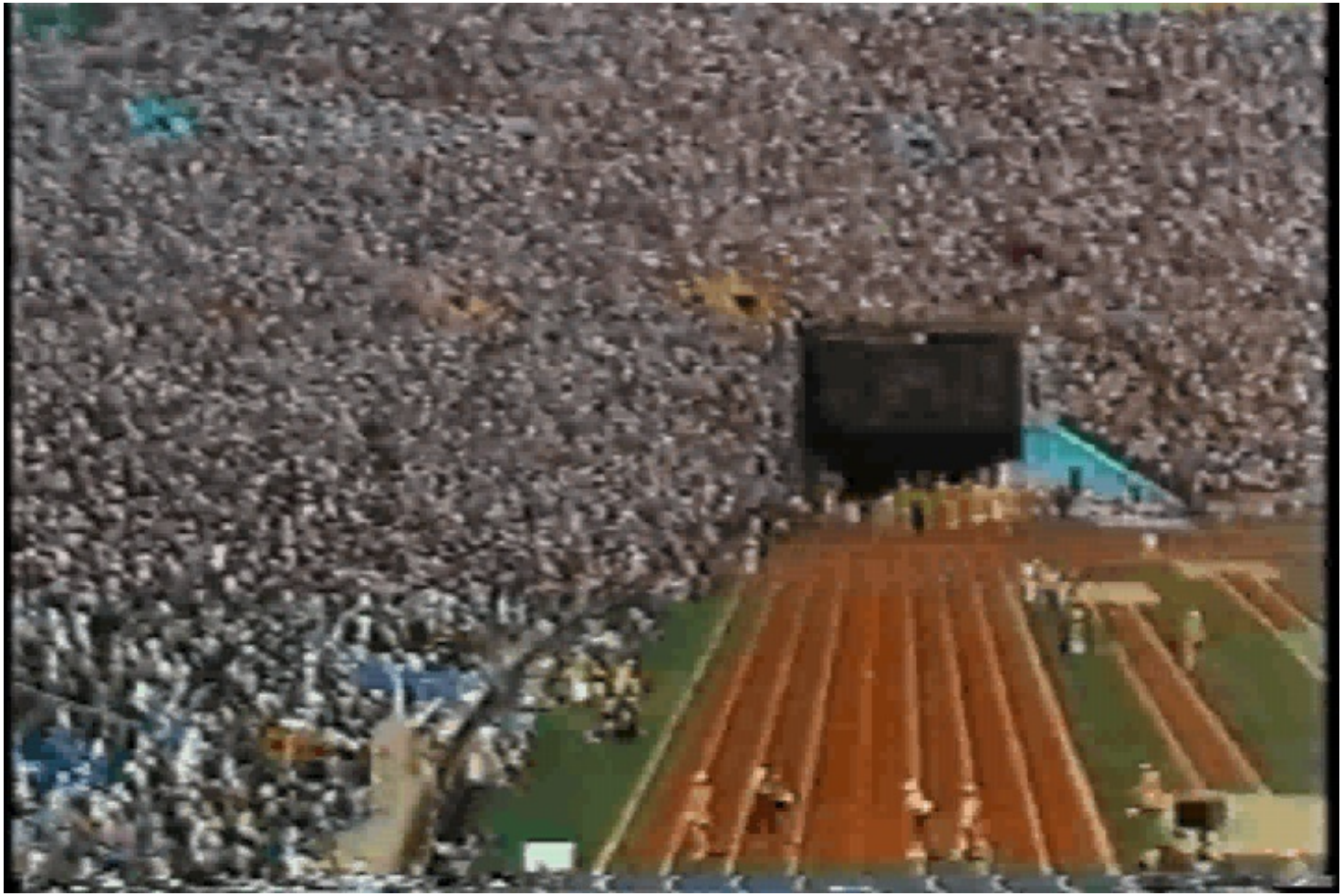


Clinical Manifestations

- **Hyperthermia**
  - 40 to 47C
- **CNS Dysfunction**
  - Inappropriate behavior to coma
  - Cerebellar dysfunction with ataxia
  - Seizures may occur especially during cooling



Gabriella Anderson
1984 Los Angeles Olympics






Exertional Heat Illness: Prevention

Leavell's Prevention Levels

- **Primary**:
  - **Keeps disease process from becoming established** by eliminating causes or increasing resistance.
- **Secondary**:
  - **Interrupts** or detects the disease **before it becomes symptomatic**.
- **Tertiary**:
  - **Limits the consequences** of symptomatic disease.

Risk Factors

- Age
- **Poor physical fitness**
- **Lack of acclimatization**
- **Obesity**
- Prolonged exertion
- Lack of sleep
- **Illness**
- Skin disease
- History of heat injury
- **Drug use e.g. ephedra**
- Use of **heavy equipment or clothing**

Gardner JW, Kark JA, Karnei K, Sanborn JS, et al. Risk factors predicting exertional heat illness in male Marine Corps recruits. Med Sci Sports Exerc. 1996; 28:939-944.

Obesity

- **Obese and overweight men were 3.2 times more likely ($p<0.01$) to sustain any heat illness than non-obese men during the first 90 days of service.**

Bedno SA et al: Exertional heat illness among overweight U.S. Army recruits in basic training. Aviat Space Environ Med. 2010 Feb;81(2):107-11.

Medications that Inhibit Thermoregulation

- Anticholinergics
- Antihistamines
- Tricyclics
- Stimulants
- Diuretics
- Antipsychotics
- ACE inhibitors,
- B-blockers
- **Supplements**

DMAA and Heat Stroke

- **Vasoconstrictor**
  - Inability to properly thermoregulate
- **Strain to Cardiovascular System**
  - Increased BP
- **Increased Metabolic Heat**
  - Increased cellular metabolism
- **Excessive Sense of Energy**
  - Loss of self governor to regulate activity

Heat Stress is Cumulative

- **PURPOSE**: To determine whether cumulative daily average wet-bulb globe temperature (WBGT) index, over one or two preceding days, is a better measure for predicting cases of exertional heat illness (EHI) than current daily average WBGT.
- **METHODS**: A case-crossover study was conducted in male and female Marine Corps recruits in basic training at Marine Corps Recruit Depot, Parris Island, SC
- **RESULTS**: The risk of EHI increased with WBGT (OR = 1.11 degrees F(-1); 95% CI, 1.10-1.13). EHI **risk was associated not only with the WBGT at the time of the event (OR = 1.10 degrees F(-1); 95% CI, 1.08-1.11) but with the previous day's average WBGT** as well (OR = 1.03 degrees F(-1); 95% CI, 1.02-1.05).
- **CONCLUSION: Our results provide evidence for a cumulative effect of PREVIOUS DAY'S HEAT EXPOSURE on EHI risk in these Marine recruits**.

Wallace RF, Kriebel D, Punnett L, Wegman DH, et al. The effects of continuous hot weather training on risk of exertional heat illness. Med Sci Sports Exerc. 2005; 37:84-90.

Primary Prevention

- Air Conditioning
- **Acclimatization**
- Hydration/Exertion Tables
- Modification of uniform/ training sites
  - Remove headgear when not on field
- Increase spacing and positioning resting athletes in shade whenever possible
  - Consider tentage next to training areas
- **Pre/Intra-Cooling**

Work/Rest and Water Consumption Table

Applies to average sized, heat-acclimated soldier wearing BDU, hot weather. (See TB MED 507 for further guidance.)

Easy Work	Moderate Work	Hard Work
• Weapon Maintenance • Walking Hard Surface at 2.5 mph, < 30 lb Load • Marksmanship Training • Drill and Ceremony • Manual of Arms	• Walking Loose Sand at 2.5 mph, No Load • Walking Hard Surface at 3.5 mph, < 40 lb Load • Calisthenics • Patrolling • Individual Movement Techniques, i.e., Low Crawl or High Crawl • Defensive Position Construction	• Walking Hard Surface at 3.5 mph, ≥ 40 lb Load • Walking Loose Sand at 2.5 mph with Load • Field Assaults

Heat Category	WBGT Index, F°	Easy Work		Moderate Work		Hard Work	
		Work/Rest (min)	Water Intake (qt/hr)	Work/Rest (min)	Water Intake (qt/hr)	Work/Rest (min)	Water Intake (qt/hr)
1	78° - 81.9°	NL	½	NL	¾	40/20 min	¾
2 (GREEN)	82° - 84.9°	NL	½	50/10 min	¾	30/30 min	1
3 (YELLOW)	85° - 87.9°	NL	¾	40/20 min	¾	30/30 min	1
4 (RED)	88° - 89.9°	NL	¾	30/30 min	¾	20/40 min	1
5 (BLACK)	> 90°	50/10 min	1	20/40 min	1	10/50 min	1

- The work/rest times and fluid replacement volumes will sustain performance and hydration for at least 4 hrs of work in the specified heat category. Fluid needs can vary based on individual differences (± ¼ qt/hr) and exposure to full sun or full shade (± ¼ qt/hr).
- **NL** = no limit to work time per hr.
- **Rest** = minimal physical activity (sitting or standing) accomplished in shade if possible.
- ***CAUTION: Hourly fluid intake should not exceed 1½ qts.***

  Daily fluid intake should not exceed 12 qts.
- If wearing body armor, add **5°F** to WBGT index in humid climates.
- If doing Easy Work and wearing NBC (MOPP 4) clothing, add **10°F** to WBGT index.
- If doing Moderate or Hard Work and wearing NBC (MOPP 4) clothing, add **20°F** to WBGT index.

For additional copies, contact: U.S. Army Center for Health Promotion and Preventive Medicine Health Information Operations Division at (800) 222-9698 or CHPPM - Health Information Operations@apg.amedd.army. mil.
For electronic versions, see http://chppm-www.apgea.army.mil/heat. Local reproduction is authorized.
June 2004

CP-033-0404

Terminology

- **Acclimatization**:

- **Takes several weeks to complete:**
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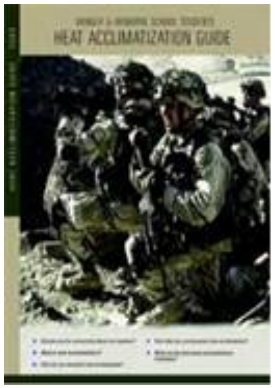
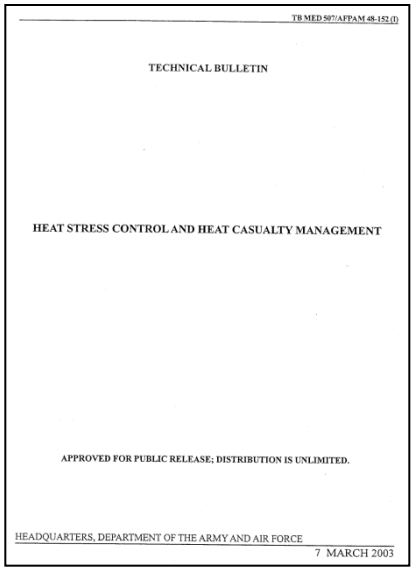
Tyler CJ, Reeve T, Hodges GJ, Cheung SS:The Effects of Heat Adaptation on Physiology, Perception and Exercise Performance in the Heat: A Meta-Analysis. Sports Med. 2016 Apr 22

Primary Prevention

- USARIEM
  - TB MED 507
- http://www.tradoc.army.mil/surgeon/information.htm




TB MED 507/AFPAM 48-152 (I)

TECHNICAL BULLETIN

HEAT STRESS CONTROL AND HEAT CASUALTY MANAGEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.

HEADQUARTERS, DEPARTMENT OF THE ARMY AND AIR FORCE

7 MARCH 2003

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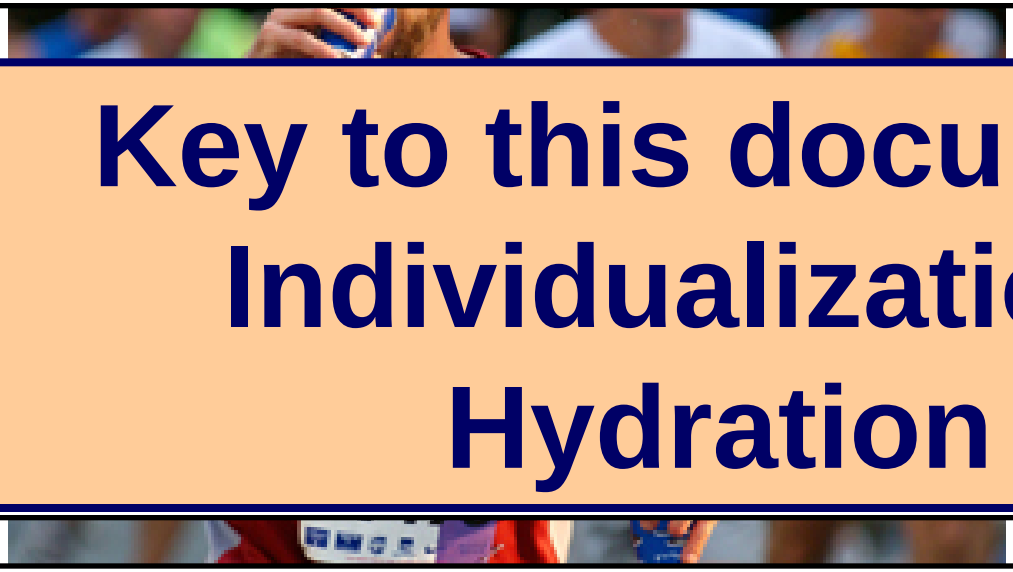
June 2004

CP-033-0404

NATA Hydration Guidelines 2017

Most individuals can avoid fluid-balance problems by drinking when thirsty during and after exercise and eating a healthy diet. In healthy individuals, the thirst mechanism is



National Athletic Trainers'

Key to this document is the Individualization of the Hydration Plan

If athletes do not know their individual sweat rates, drinking to thirst during activity most likely represents a safe strategy to prevent overdrinking. Drinking to thirst

McDermott BP, Anderson SA, Armstrong LE, Casa DJ, Cheuvront SN, Cooper L, Kenney WL, O'Connor FG, Roberts WO. National Athletic Trainers' Association Position Statement: Fluid Replacement for the Physically Active. J Athl Train. 2017 Sep;52(9):877-895.

NATA Guideline on Acclimatization

- **Days 1 through 5** of the heat-acclimatization period consist of the first 5 days of formal practice. During this time, athletes may not participate in more than **1 practice per day.**
- If a practice is interrupted by inclement weather or heat restrictions, the practice should recommence once conditions are deemed safe. Total practice time **should not exceed 3 hours in any 1 day**.
- A 1-hour maximum walk-through is permitted during days 1–5 of the heat-acclimatization period. However, a 3-hour recovery period should be inserted between the practice and walk-through (or vice versa).

Douglas J. Casa, PhD, ATC, FNATA, FACSM et al : Preseason Heat-Acclimatization Guidelines for Secondary School Athletics. Journal of Athletic Training 2009;44(3):332–333.

Consensus Recommendations

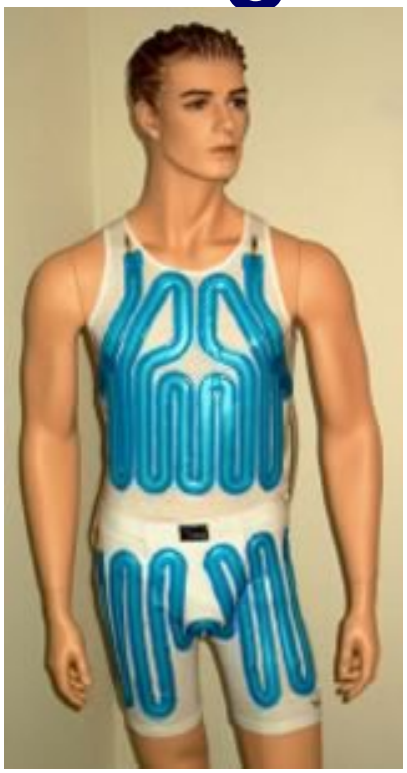
- **Acclimatization**
- Hydration
- Cooling

Table 1. Examples of heat acclimatization strategies

	Objective	Duration	Period	Content	Environment
Pre-/in-season training camp	Enhance/boost the training stimulus	1–2 weeks	Pre-season or in-season	Regular or additional training (75–90 min/day) to increase body temperature and induce profuse sweating	Natural or artificial heat stress
Target competition preparatory camp	Optimize future reacclimatization and evaluate individual responses in the heat	2 weeks	1 month before competing in the heat	Regular or additional training, simulated competition, and heat response test	Equivalent to or more stressful than target competition
Target competition final camp	Optimize performance in the heat	1–2 weeks – depending on results of preparatory camp	Just before the competition	Pre-competition training	Same as competition

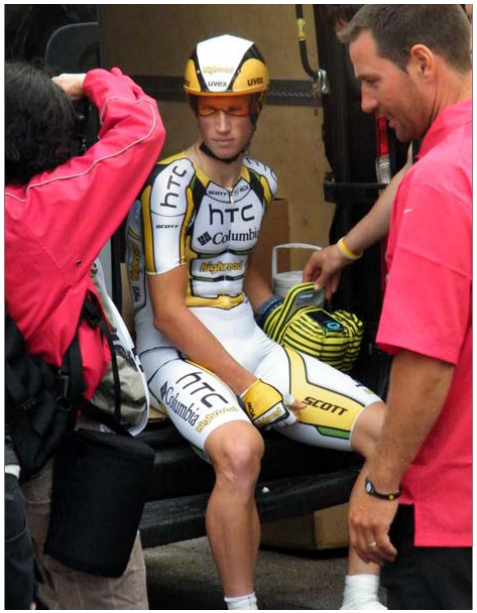
Racinas S et al: Consensus recommendations on training and competing in the heat. Scandinavian Journal of Medicine and Science in Sports 2015: 25(suppl1): 6-19.

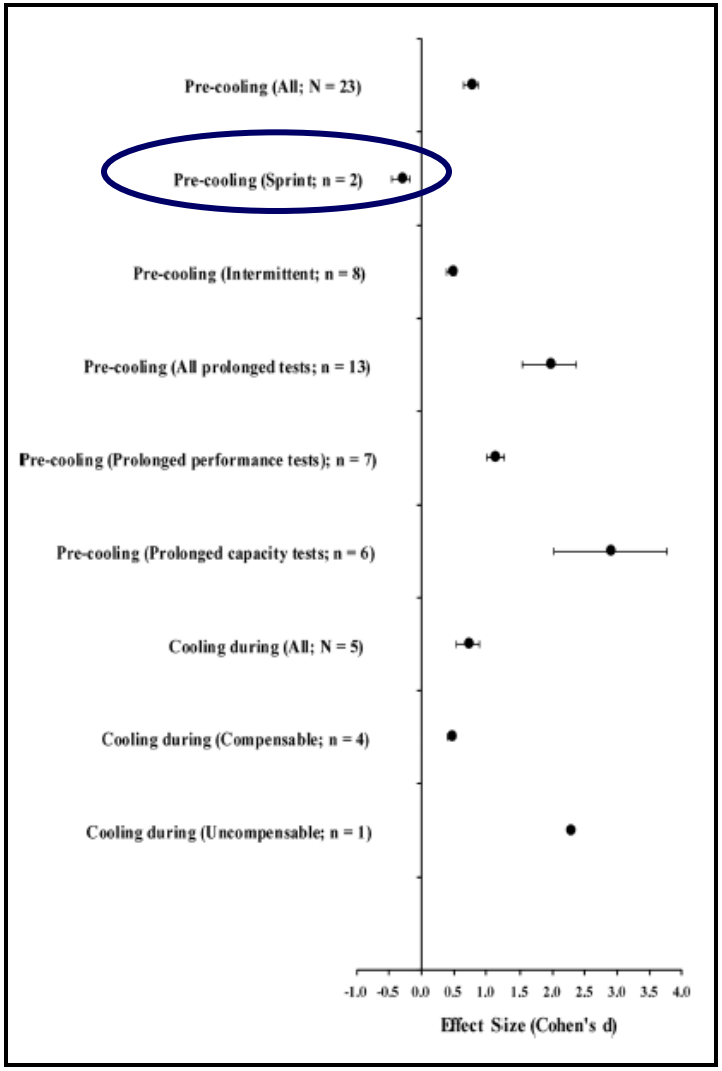
Pre/Intra Event Cooling Strategies



Siegel R Laursen PB: Keeping your cool: possible mechanisms for enhanced exercise performance in the heat with internal cooling methods. Sports Med. 2012 Feb 1;42(2):89-98.

Pre/Intr Event Cooling Strategies May Enhance Performance





Tyler CJ et al: **The effect of cooling prior to and during exercise on exercise performance and capacity in the heat: a meta-analysis.** Br J Sports Med. 2015 49:7-13.

To Start or Not to Start?

CONCLUSIONS:

- Marathons in northern latitudes (>40 degrees) held in "unexpectedly" hot conditions when the participants are not acclimatized and the start WBGT is >21 degrees C often end in either race cancellation or an MCI.
- The rate of unsuccessful marathon starters per 1000 marathon finishers plotted against start WBGT generates a curve that can be used to estimate a do not start level.

Roberts WO.: **Determining a "do not start" temperature for a marathon on the basis of adverse outcomes.** Med Sci Sports Exerc. 2010 Feb;42(2):226-32.

Secondary Prevention

- Detection of milder forms of heat illness
  - **Buddy System**
- Use of those **sentinel cases** to modify training to prevent additional cases
- Screening for poor food and fluid intake
- **Leveraging Heat Dumping**

Michael Macor / The Chronicle

Secondary Prevention

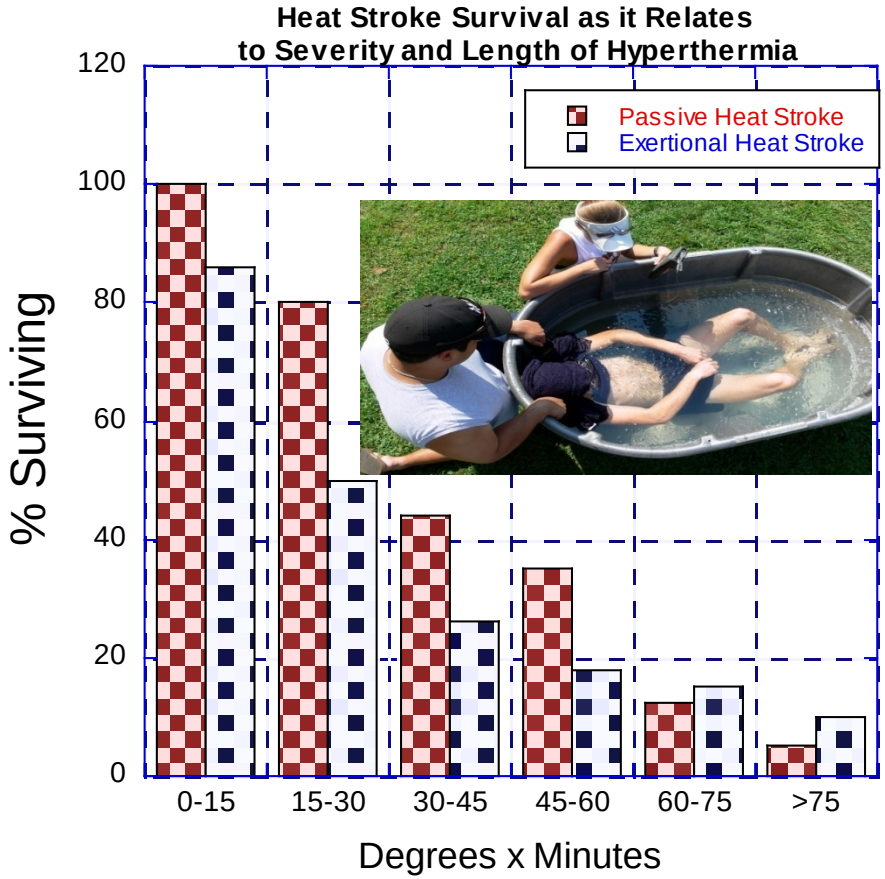
- **Heat Dumping**
  - Encourage cool showers and time in air conditioning between high exertion training
  - If athletes are staying in dorms for summer training- check to ensure air conditioning is functioning

Fort Jackson

Tertiary Prevention

- **Tertiary prevention** efforts focus on people already affected by disease and attempt to reduce resultant disability and restore functionality
- **Rapid cooling intervention** by first responders can reduce organ injury and prevent development of multi-organ dysfunction syndrome

Time is Everything!!



Casa et al. *Medicine and Science in Sports and Exercise*, 2010;42(7):1-7.

(redrawn from Hubbard et al, *J Applied Physiology* 42: 809-816, 1977)

“It’s a Heat Attack”

- **Goals**:
  - Increase the core to skin temperature gradient.
  - More effectively facilitate the transfer of heat from the core to the periphery to the external environment.
  - **Decrease skin blood flow and facilitate an auto transfusion to the central circulation to decrease cardiovascular strain.**

Field Treatment in 2018

- ABCs; rescue position; O2 4L NC
- Measure the patient's core temperature with a **rectal probe**
- Remove clothing and initiate external **cooling**
  - Cold packs to neck, axilla, groin
  - Continuous fanning
  - Ice water immersion
  - **Facilitates an autotransfusion**
- IV NS
- **Treat on Site then Prepare for Transfer**

Casa DJ, Armstrong LE, Kenny GP, O'Connor FG, Huggins RA: Exertional heat stroke: new concepts regarding cause and care.

Curr Sports Med Rep. 2012 May;11(3):115-23

It’s a Heat Attack!

IV. MCM HYPERTHERMIA ALGORITHM

RECTAL TEMP ≥ 104° F // 40° C
LOSS OF THERMOREGULATORY CONTROL
EVIDENCE OF ACUTE ORGAN DYSFUNCTION
(Altered mental status / inappropriate behavior)

↓

- **RAPID EXTERNAL COOLING ❶**
- **IV NS 1-2 LITERS ❷ (OBTAIN BLOOD CHEMISTRY SAMPLES ❸)**
- **CORE TEMPERATURE MONITORING (Q 3 MIN RECTAL TEMPERATURE OR INDWELLING RECTAL THERMISTOR**

↓

- **CONTINUOUS VITAL SIGN REASSESSMENT**
- **CONTINUOUS COOLING INTERVENTIONS**

↓

T ≤ 102° - 102.5°F // 39° C

↓

STOP COOLING TREATMENT
MONITOR FOR TEMPERATURE REBOUND OR HYPOTHERMIC OVERSHOOT

↓

PERSISTENT MENTAL OBTUNDATION — Y → **ASSESS FOR HYPOGLYCEMIA, HYPONATREMIA OR OTHER ETIOLOGY FOR CNS ALTERATION & TREAT ACCORDINGLY ❸**

N ↓

SEVERE RHABDOMYOLYSIS EVIDENT ❹
NEED FOR ONGOING IV HYDRATION ❷ — Y → **TRANSPORT TO ER**

N ↓

RELEASE WITH EXERCISE RESTRICTIONS & PRECAUTIONS REGARDING RHABDOMYOLYSIS

ALL TEMPERATURES ARE RECTAL!

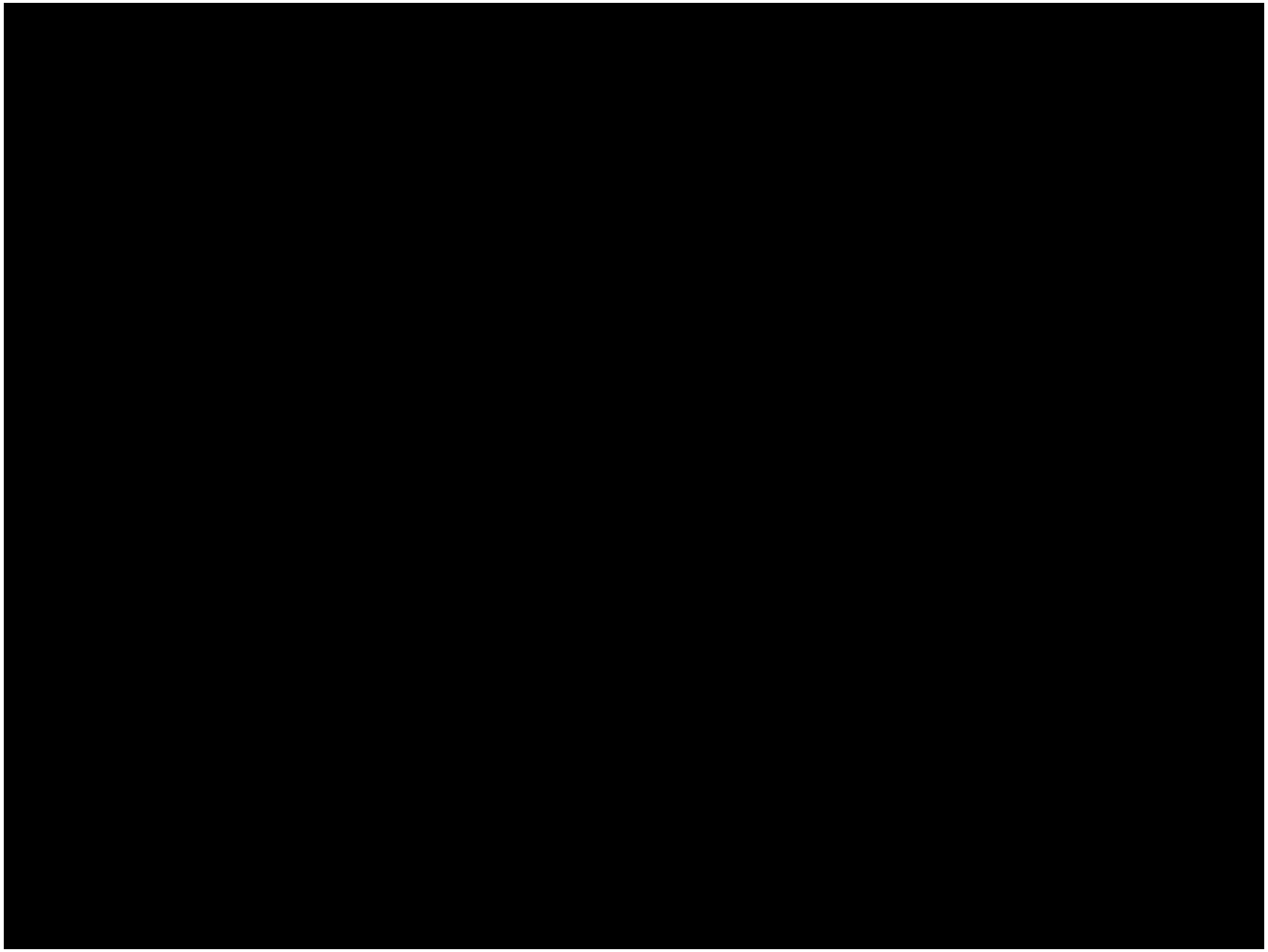
❶ **RAPID COOLING OPTIONS: ICE WATER BATH IMMERSION, WHOLE BODY ICE MASSAGE/PACKING WITH CONTINUOUS ICE WATER DOUSING &/OR ICE WATER-SOAKED SHEETS (REWETTED EVERY 3 MINUTES). FANS IF AVAILABLE. CONSIDER COOLED IV FLUIDS. STOP COOLING WHEN TEMPERATURE DROPS TO 102° F / 39° C OR BELOW.**

❷ **IVF: NS 2L BOLUS UNLESS SIGNS OF OVER-HYDRATION OR CHF (THEN NS @ KVO RATE); REASSESS ON-GOING IVF NEEDS FROM CLINICAL RESPONSE, URINE OUTPUT, AND LABS. COOLED FLUIDS FOR HEAT CASUALTY.**

❸ **IMMEDIATE Na, Gluc, K +/- Cr, BUN, Cl & Hct (e.g. i-Stat®); TREAT HYPOGLYCEMIA AND HYPONATREMIA PER PROTOCOLS.**

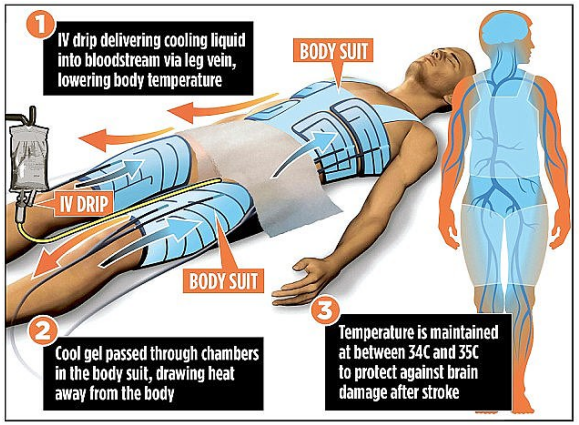
❹ **IF RHABDOMYOLYSIS SUSPECTED, NEED CK, BMP, AST, ALT, LDH, Uric Acid & UA w/ Micro IF AVAILABLE. ADD Ca^{++}, PO_4 & Mg FOR SEVERE RHABDO; IF NOT AVAILABLE, ALERT ER.**

The Military Technique



Adjunctive Therapy

- Intravenous Chilled Saline
- Cold versus luke warm water
- Dantrolene
- Convection



Smith JE: Cooling methods used in the treatment of exertional heat illness. Br J Sports Med. 2005 Aug;39(8):503-7.

Management in 2019

- Cooling
  - I
- Su
  - Support of organ system function.
- Pursuit of therapies directed at causative mechanism of injury.

In 2019, Therapy Remains Largely Supportive!

Casa DJ, Armstrong LE, Kenny GP, O'Connor FG, Huggins RA: Exertional heat stroke: new concepts regarding cause and care. Curr Sports Med Rep. 2012 May;11(3):115-23




Exertional Heat Illness: Prevention of Recurrence

When Can the Heat Stroke Patient Return to Play?

- Status of anatomical and functional healing;
- Whether the athlete poses an undue risk to the safety of other participants;
- Restoration of sport-specific skills;
- Ps
- Ab
  mo
- Compliance with applicable federal, state, local, school, and governing body regulations.

How Long Does it Take the Thermoregulatory System to Recover?

Is there a Risk of Returning an Athlete too Early?

American College of Sports Medicine. The team physician and return-to-play issues: a consensus statement. *Med Sci Sports Exerc* 34: 1212-1214, 2002.

What is the Risk of Recurrence?

- **METHODS:** Marine Corps members who completed at least 6 months of military service and suffered EHI treated as outpatients (N = 872) or inpatients (N = 50) during basic training (BT) in 1979-1991 at the Parris Island Marine Corps Recruit Depot, SC were compared them to 1391 similar members (noncases). Subjects were followed from 6 months after accession into the military through the subsequent 4 yr.
- **RESULTS:** Military retention rates were slightly lower for those who suffered EHI during BT, compared with those who did not (24% vs 30% at 4 yr, respectively). Outpatient EHI cases also had about 40% higher subsequent hospitalization rates in military hospitals than noncases; differences declined over time and diagnoses showed little relationship to EHI. EHI cases had higher rates of hospitalization for EHI, but the number was too small (five hospitalizations) to provide comparisons.
- **CONCLUSION: Hospitalization for EHI is uncommon during service after an initial episode during BT**; occurrence of EHI during BT has only a small impact on subsequent military retention and hospitalization.

Phinney LT, Gardner JW, Kark JA Wenger CB: Long-term follow-up after exertional heat illness during recruit training. Med Sci Sports Exerc.2001 Sep;33(9):1443-8.

SPECIAL COMMUNICATIONS

Exertional Heat Illness during Training and Competition

AMERICAN COLLEGE of SPORTS MEDICINE®

POSITION STAND

This pronouncement was written for the American College of Sports Medicine by Lawrence E. Armstrong, Ph.D., FACSM (Chair); Douglas J. Casa, Ph.D., ATC, FACSM; Mindy Millard-Stafford, Ph.D., FACSM, Daniel S. Moran, Ph.D., FACSM; Scott W. Pyne, M.D., FACSM; and Wiliam O. Roberts, M.D., FACSM.

•**Armstrong LE, Casa DJ, Millard-Stafford D *et al.* Exertional Heat Illnesses During Training and Competition: American College of Sports Medicine Position Stand.**

•***Med Sci Sports Exerc.* 2007;39:556-572.**

Five recommendations have been proposed for the return to training and competition (37).

1. Refrain from exercise for at least 7 d following release from medical care.
2. Follow up in about 1 wk for physical exam and repeat

How Do I really know if an Athlete is Heat Tolerant?

3. When cleared for activity, begin exercise in a cool environment and gradually increase the duration, intensity, and heat exposure for 2 wk to acclimatize

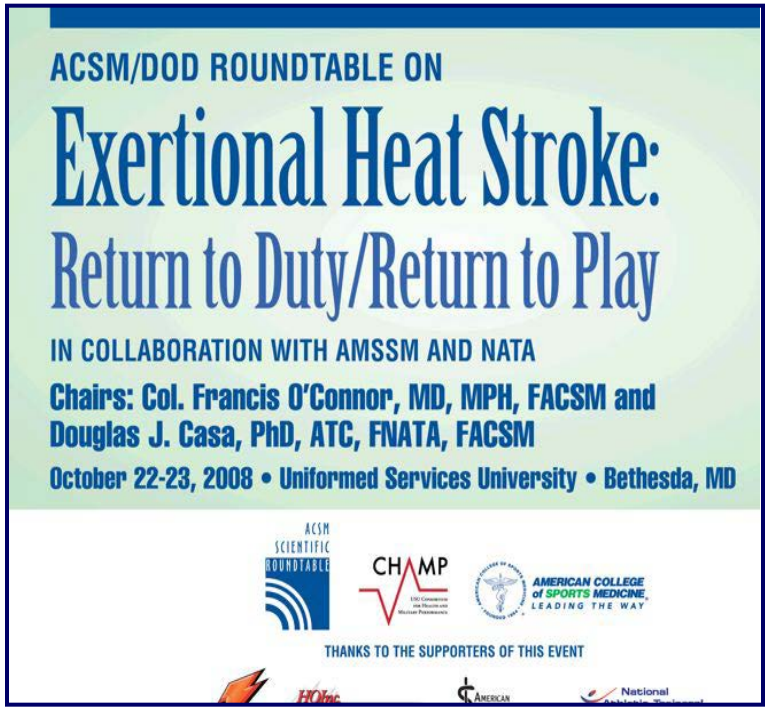
What's a Heat Tolerance Test, and where do I get one ?

4
incident (14,98,103,138).
5. Clear the athlete for full competition if heat tolerance exists after 2–4 wk of training.

Armstrong LE, Casa DJ, *et al.* Exertional Heat Illnesses During Training and Competition: American College of Sports Medicine Position Stand. *Med Sci Sports Exerc.* 2007;39:556-572.

CHAMP Workshop: Heat Illness: Return to Duty

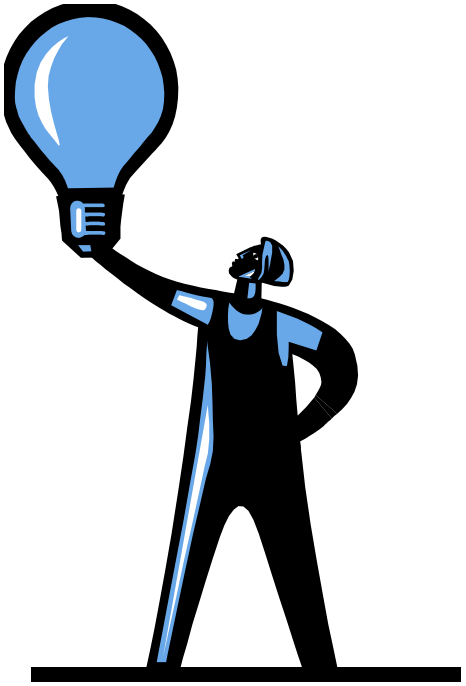
- **Problem:** Line readiness affected by Warfighters on prolonged profile for heat illness; **no consensus and wide variation on return to duty.**
- **Solution:** Conference with DoD (OTSG) and American College of Sports Medicine on 22-23 October 2008 at USUHS to address returning to duty after heat injury
- **Deliverable:** Recommendations for new policy on return to duty for heat injury
- **Potential Outcome: Evidence based return to duty**; decreased health care



O'Connor FG, Casa DJ, et al., American College of Sports Medicine Roundtable on Exertional Heat Stroke - Return to Duty: Conference Proceedings. Curr Sports Med Rep, 2010. 9(5): 314-321.

A Paradigm Shift!

- **Heat Stroke is an Event:**
- **Diagnosis is often Best Made Retrospectively and Individual Morbidity Determines Return!**



Heat Stroke Return to Duty: A Retrospective Assessment

- **Heat Stroke Profile Determination**:
  - Following an episode of HS the affected Soldier(s) will **be placed on a [T4 (P)] profile for a period of two weeks**. For the purpose of further profile and MEB determination, the Soldier will be reassessed weekly for the presence or absence of both complications and contributing risk factor(s). The Soldier will then be classified into one of the following three categories:
    - **HS without sequelae**: all clinical signs and symptoms resolved by two weeks following the event;
    - **HS with sequelae**: any evidence of cognitive or behavioral dysfunction, renal impairment, hepatic dysfunction, rhabdomyolysis, or other related pathology **that does not completely resolve by two weeks** following the event;
    - **Complex HS**: recurrent, or occurring in the presence of a non-modifiable risk factor, either known (e.g. chronic skin condition such as eczema or burn skin graft) or suspected (e.g. sickle cell trait, malignant hyperthermia susceptibility).
  - Profile Disposition of Soldiers with HS. See Table 1

The Heat Tolerance Test

The Heller Institute HTT protocol

Target population	Suspected for heat susceptibility
	Cases of EHS or heat exhaustion (6-8 weeks after recovery)
	The test is limited to the ages 17-30 yrs.
Preliminary investigation	Complete medical history (including family history about heat susceptibility)
	Medical check-up (preclude any illness)
Preliminary instructions (prior to the test)	At least 6 hrs night sleep
	Normal diet
	Euhydration (not over hydrated)
	No physical exercise 48 hrs prior to the test

Journal of Sport Rehabilitation, 2007, **16**, 215-221

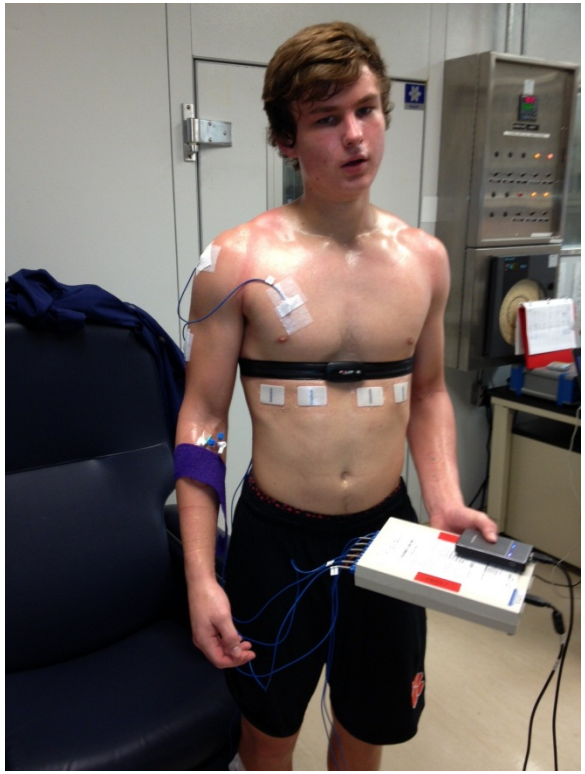
The Heat Tolerance Test: An Efficient Screening Tool for Evaluating Susceptibility to Heat

Daniel S. Moran, Tomer Erlich, and Yoram Epstein

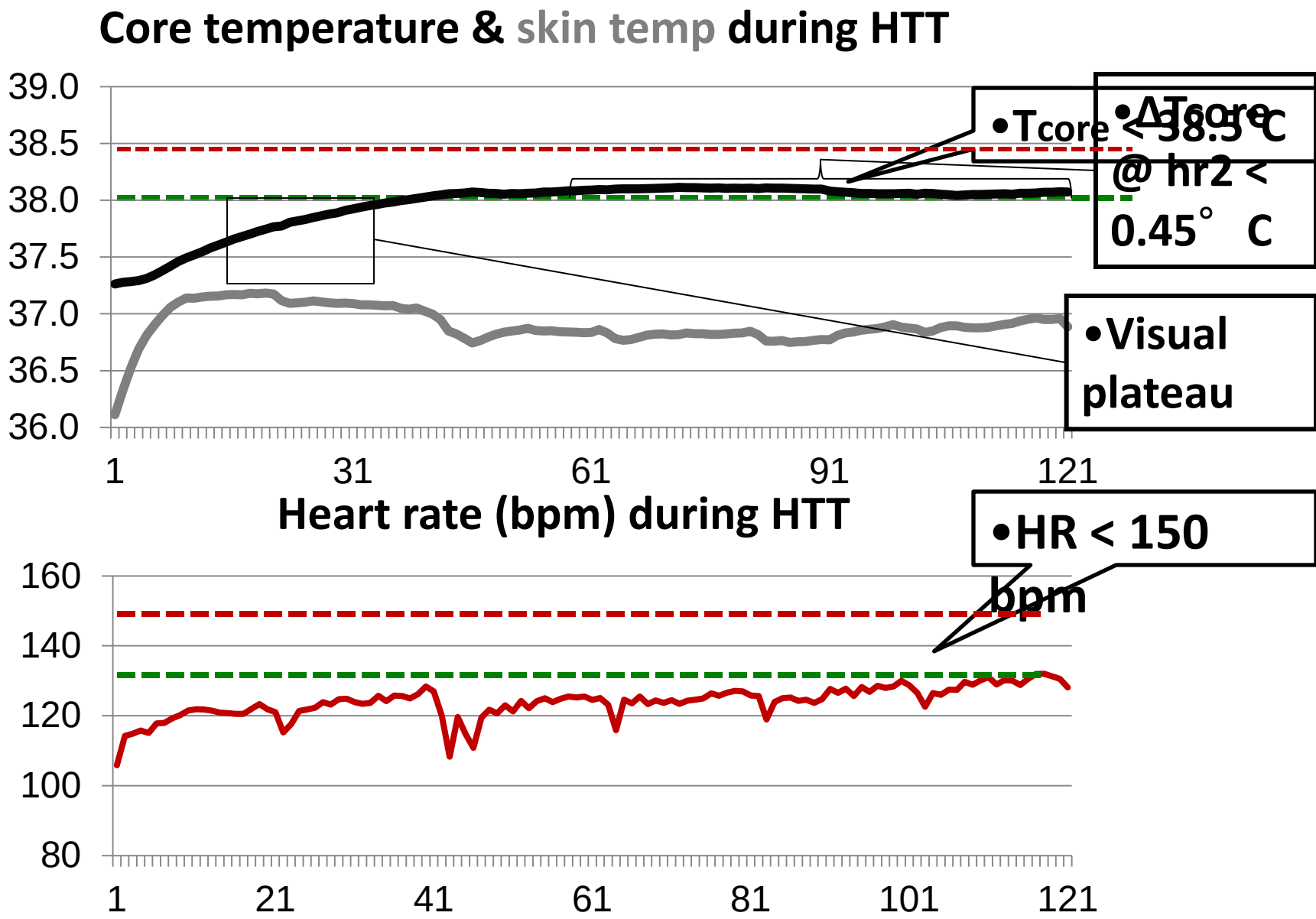
•**Moran et al. Journal of Sport Rehabilitation. 2007, 16;215-221.**

Heat Intolerance Criteria

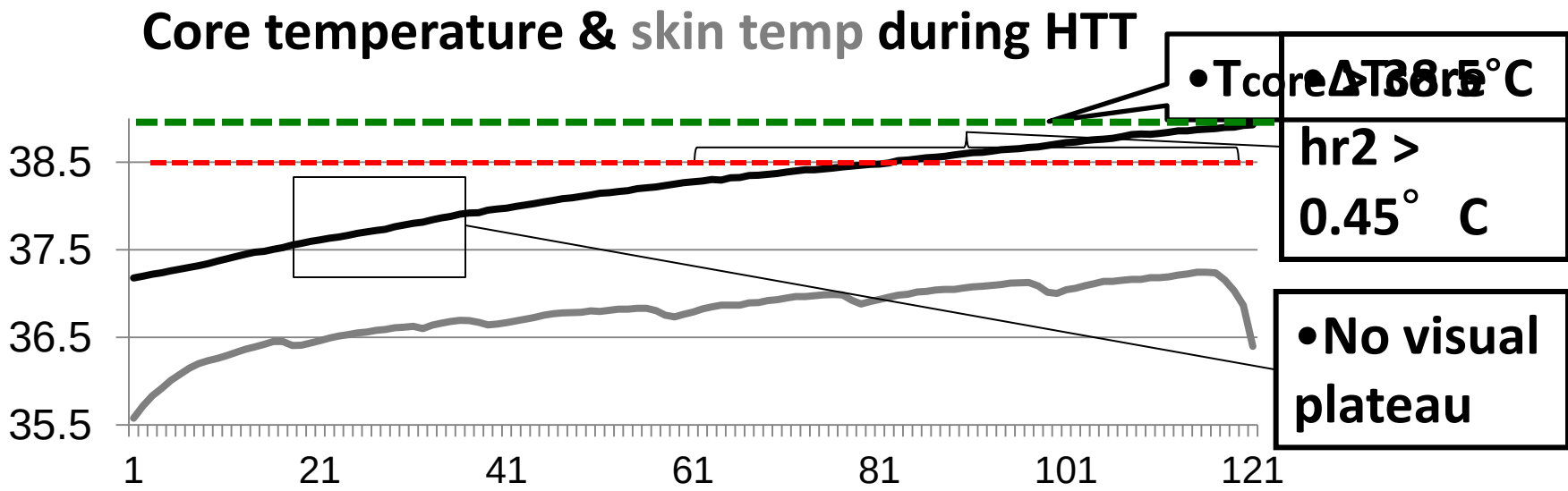
- **Primary measurements**
  - Rectal temperature > 38.5°C
  - **No plateau in the dynamics of rectal temperature**
- **Supportive measurements**
  - HR > 150 bpm
  - Subjective feeling
  - Physiological indexes (Physiological Strain Index -PSI and Cumulative Heat Stress Index - CHSI)

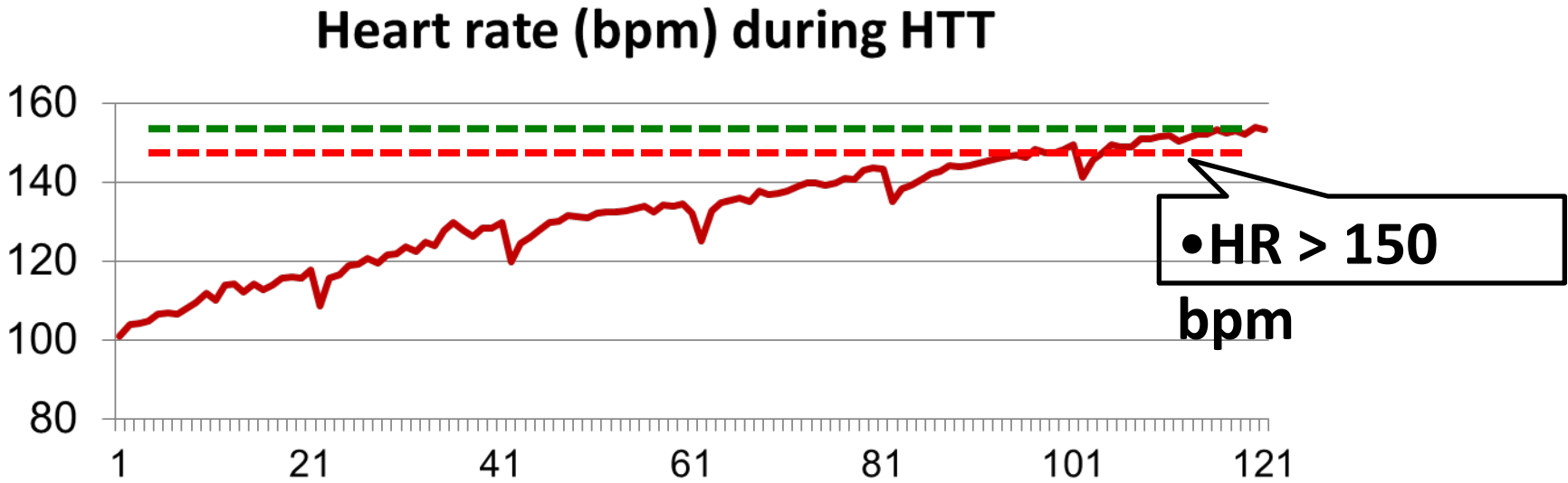


Example: Heat Tolerant



Example: Heat Intolerant





Returning Warfighters to Duty

CHAMP

Francis O'Connor, MD
Consortium for Health and Military Performance
Department of Military and Emergency Medicine
Uniformed Services University

HEAT TOLERANCE TEST RESULTS

Patient Identifiers
Patient Name: [redacted]
Date of Birth: [redacted]
Age: 28

Diagnostic Test and Environment Information
Name of Diagnostic Test: Heat Tolerance Test
Date of Test: 10/01/2009
Time test was taken: 08:00
Location of Test: Environmental Chamber, Building 53, USUHS
Thermal environment (degrees): 40.0 °C
Humidity: 40.0%
Providers/Investigators: COL Francis O'Connor, M.D.; Jennifer Davis, M.S.; Dianna Purvis, M.S.; Stacey Zeno, M.S.
Additional information:

Pre-Test Patient Condition
Hydration (USG): 1.015
Weight: 105.5 kg
Height: 198.2 cm
Body surface area (BSA): 2.4 m^2
Additional information:

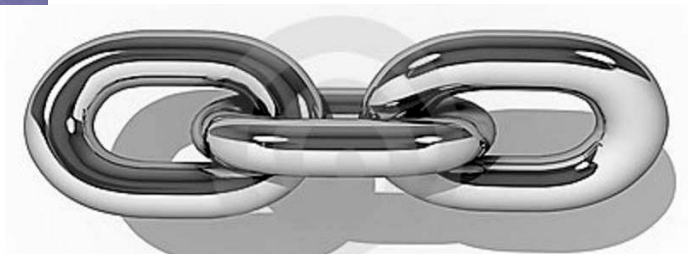
Post Test Patient Condition
Hydration (USG): 1.001
Weight: 105.3 kg
Sweat rate: 0.826 L/hr
Additional information:

Detailed Diagnostic Test Information
Duration of test: 120 min
Type of thermometer: Rectal Thermistor, CoreTemp Pill
Speed: 3.1 mph
Grade: 2.0%
Metabolic work rate: 19.2 ml/kg/min
Fluid intake for entire test: 2956 mL
Additional information:

	HR(bpm)	CORE(°C)	MSKT(°C)	BP(mmhg)
Pre HTT values	90	37.0	33.0	151/93
End of test values	144	38.1	36.1	[redacted]
Peak HTT values	160	38.2	36.9	[redacted]
Post HTT values	85	36.7	33.1	152/79

NOTE: Reference Values for a Negative Test: heart rate < 160, core temperature < 38.6°C, sweat rate 1 Liter per hour, and no other abnormal responses to exercise.

Unexplained Heat Stroke: Is There a Link?



Muldoon S, Deuster PA, Voekel M, Capacchione, Bunger R: Exertional heat illness, exertional rhabdomyolysis, and malignant hyperthermia: is there a link. Current Sports Medicine Reports 2008;7(2):74-80.

What about the Brain?

- **Neurocognitive Testing**
  - Baseline assessments of neurocognitive status may be available
  - ANAM
  - Impact
- Project being developed at Fort Bragg, North Carolina

- **For further information please contact:**

- Dr. Francis G. O'Connor, COL, MC, USA
  Medical Director, Uniformed Services University Consortium for Health and Military Performance
  Professor and Chair
  301 295-2270 francis.oconnor@usuhs.edu
- Dr. Patricia Deuster, Ph.D., M.P.H.
  Scientific Director, Uniformed Services University Consortium for Health and Military Performance
  Professor
  301 295-3020 patricia.deuster@usuhs.edu