Return to Play Decisions

Leigh Romero, MD, CAQSM

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ACSM TPCC Update 2002

The Team Physician and Return-To-Play Issues: A Consensus Statement

DEFINITION

Return-To-Play is the process of deciding when an injured or ill athlete may safely return to practice or competition.

GOAL

The goal is to return an injured or ill athlete to practice or competition without putting the individual or others at undue risk for injury or illness.

To accomplish this goal, the team physician should have knowledge of and be involved with:

- Establishing a Return-To-Play process
- Evaluating injured or ill athletes
- Treating injured or ill athletes
- Rehabilitating injured or ill athletes
- Returning an injured or ill athlete to play

SUMMARY

The objective of this consensus statement is to provide physicians who are responsible for the healthcare of teams with a decision process for determining when to return an injured or ill athlete to practice or competition. This statement is not intended as a standard of care, and should not be interpreted as such. This statement is only a guide, and as such is of a general nature consistent with the reasonable and objective practice of the healthcare professional. Individual decisions regarding the return of an injured or ill athlete to play will depend on the specific facts and circumstances presented to the physician.

Adequate insurance should be in place to help protect the athlete, the sponsoring organization, and the physician.

This statement was developed by the collaborative effort of six major professional associations concerned with clinical sports medicine issues; they have committed to forming an ongoing project-based alliance to "bring together sports medicine organizations to best serve active people and athletes." The organizations are: American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and the American Osteopathic Academy of Sports Medicine.

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EXPERT PANEL

Stanley A. Herring, M.D., Chair, Seattle, Washington
John A. Bergfeld, M.D., Cleveland, Ohio
Joel Boyd, M.D., Edina, Minnesota
Timothy Duffey, D.O., Columbus, Ohio
Karl B. Fields, M.D., Greensboro, North Carolina
William A. Grana, M.D., Tucson, Arizona
Peter Indelicato, M.D., Gainesville, Florida
W. Ben Kibler, M.D., Lexington, Kentucky
Robert Pallay, M.D., Hillsborough, New Jersey
Margot Putukian, M.D., University Park, Pennsylvania
Robert E. Sallis, M.D., Alta Loma, California

ESTABLISHING A RETURN-TO-PLAY PROCESS

Establishing a process for returning an athlete to play is an essential first step in deciding when an injured or ill athlete may safely return to practice or competition.

It is essential for the team physician to coordinate:

- Establishing a chain of command regarding decisions to return an injured or ill athlete to practice or competition
- Communicating the Return-To-Play process to players, families, certified athletic trainers, coaches, administrators, and other healthcare providers
- Establishing a system for documentation
- Establishing protocols to release information regarding an athlete's ability to return to practice or competition after an injury or illness

It is essential that the Return-To-Play process address the:

- Safety of the athlete
- Potential risk to the safety of other participants
- Functional capabilities of the athlete
- Functional requirements of the athlete's sport
- Federal, state, local, school and governing body regulations related to returning an injured or ill athlete to practice or competition

EVALUATING INJURED OR ILL ATHLETES

Evaluation of an injured or ill athlete establishes a diagnosis, directs treatment, and is the basis for deciding when an athlete may safely return to practice or competition. Re-

It is essential for Return-To-Play that the team physician confirm the following criteria:

- The status of anatomical and functional healing
- The status of recovery from acute illness and associated sequelae
- The status of chronic injury or illness
- That the athlete pose no undue risk to the safety of other participants
- Restoration of sport-specific skills
- Psychosocial readiness
- Ability to perform safely with equipment modification, bracing, and orthoses
- Compliance with applicable federal, state, local, school, and governing body regulations

ACSM TPCC Update 2012

SPECIAL COMMUNICATIONS

Team Physician Consensus Statement

The Team Physician and the Return-to-Play Decision: A Consensus Statement—2012 Update

DEFINITION

Return-to-play (RTP) is the decision-making process of returning an injured or ill athlete to practice or competition. This ultimately leads to medical clearance of an athlete for full participation in sport. This consensus statement will focus on the process that addresses non–game-day RTP decisions.

GOAL

The goal is to return an injured or ill athlete to practice or competition without putting the individual at undue risk for injury or illness. The team physician's duty is to protect the health and welfare of the athlete. To accomplish this goal, the team physician should have knowledge of and be involved with:

- Establishing an RTP process.
- Evaluating injured or ill athletes.
- Treatment and rehabilitation of injured or ill athletes.
- Returning an injured or ill athlete to play.

INTRODUCTION

The objective of this consensus statement is to provide physicians who are responsible for the health care of teams with a decision process for determining when to return an injured or ill athlete to practice or competition. This statement is not intended as a standard of care and should not be interpreted as such. This statement is only a guide and as such is of a general nature consistent with the reasonable and objective practice of the health care professional. Individual decisions regarding the return of an injured or ill athlete to play will depend on the specific facts and circumstances presented to the physician. Adequate insurance should be in place to help protect the athlete, the sponsoring organization, and the physician. This statement was developed by the collaborative effort of six major professional associations: American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and the American Osteopathic Academy of Sports Medicine.

PRIMARY AUTHORS

Stanley A. Herring, M.D., Chair, Seattle, WA
W. Ben Kibler, M.D., Lexington, KY
Margot Putukian, M.D., Princeton, NJ

EXPERT PANEL

John A. Bergfeld, M.D., Cleveland, OH
Lori Boyajian-O'Neill, D.O., Overland Park, KS
Rob Franks, D.O., Marlton, NJ
Peter Indelicato, M.D., Gainesville, FL
Rebecca Jaffe, M.D., Wilmington, DE
Walter Lowe, M.D., Houston, TX
Craig C. Young, M.D., Milwaukee, WI

ESTABLISHING AN RTP PROCESS

Establishing a process for returning an athlete to play is the essential first step in deciding when an injured or ill athlete may safely return to practice or competition. This process should include evaluation of the athlete's health status, participation risk, and extrinsic factors (3). The final RTP decision is made by the team physician.

It is essential the team physician:

- Understand the RTP process should be established during the off season.
- Coordinate a chain of command regarding decisions to return an injured or ill athlete to practice or competition.
- Evaluate the athlete's health status.
  - Medical factors including history, symptoms, signs, and additional tests.
  - Psychological factors, including readiness and coping mechanisms (5).
  - Functional testing to evaluate readiness to RTP.
  - Nature of the illness/injury including mechanism of injury, natural history, and known risks of participating after illness/injury.

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It is essential the team physician confirm:

- Restoration of sport-specific function to the injured part.
- Restoration of musculoskeletal, cardiopulmonary, and psychological function, as well as overall health of the injured or ill athlete.
- Restoration of sport-specific skills.
- Ability to perform safely with equipment modification, bracing, and orthoses.
- The status of recovery from acute or chronic illness and associated sequelae.
- Psychosocial readiness.
- The athlete poses no undue risk to themselves or the safety of other participants.
- Compliance with federal, state, local, and governing body regulations and legislation.

Sports PT Consensus Statement 2016

Consensus statement

2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern

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Clare L Ardern,[1,2,3] Philip Glasgow,[4,5] Anthony Schneiders,[6] Erik Witvrouw,[1,7] Benjamin Clarsen,[8,9] Ann Cools,[7] Boris Gojanovic,[10,11] Steffan Griffin,[12] Karim M Khan,[13] Håvard Moksnes,[8,9] Stephen A Mutch,[14,15] Nicola Phillips,[16] Gustaaf Reurink,[17] Robin Sadler,[18] Karin Grävare Silbernagel,[19] Kristian Thorborg,[20,21] Arnlaug Wangensteen,[1,8] Kevin E Wilk,[22] Mario Bizzini[23]

For numbered affiliations see end of article.

Correspondence to
Dr Clare Ardern, Aspetar Orthopaedic & Sports Medicine Hospital, P.O. Box 29222, Doha, Qatar; c.ardern@latrobe.edu.au

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ABSTRACT
Deciding when to return to sport after injury is complex and multifactorial—an exercise in risk management. Return to sport decisions are made every day by clinicians, athletes and coaches, ideally in a collaborative way. The purpose of this consensus statement was to present and synthesise current evidence to make recommendations for return to sport decision-making, clinical practice and future research directions related to returning athletes to sport. A half day meeting was held in Bern, Switzerland, after the First World Congress in Sports Physical Therapy. 17 expert clinicians participated. 4 main sections were initially agreed upon, then participants elected to join 1 of the 4 groups—each group focused on 1 section of the consensus statement. Participants in each group discussed and summarised the key issues for their section before the 17-member group met again for discussion to reach consensus on the content of the 4 sections. Return to sport is not a decision taken in isolation at the end of the recovery and rehabilitation process. Instead, return to sport should be viewed as a continuum, paralleled with recovery and rehabilitation. Biopsychosocial models may help the clinician make sense of individual factors that may influence the athlete's return to sport, and the Strategic Assessment of Risk and Risk Tolerance framework may help decision-makers synthesise information to make an optimal return to sport decision. Research evidence to support return to sport decisions in clinical practice is scarce. Future research should focus on a standardised approach to defining, measuring and reporting return to sport outcomes, and identifying valuable prognostic factors for returning to sport.

BACKGROUND
After a sports injury, the first question asked by most athletes (and coaches) is: 'When will I (the athlete) be able to compete again?' The answer to this question is rarely straightforward and is influenced by many factors. However, in most cases the goals of the injured athlete and the treating clinician (plus other stakeholders in the decision-making team, such as coaches, parents and managers) are the same—to facilitate a timely and safe return to sport (RTS).

The *Swiss Sport Physiotherapy Association* along with the *International Federation of Sports Physical Therapy* and the *BJSM* hosted the first international RTS congress in Bern, Switzerland (20–21 November 2015). The aim of the congress was to present current evidence and guidelines in areas where sports medicine clinicians (particularly physiotherapists and physicians) play a major role in helping athletes to RTS after injury or surgery. The congress also acknowledged the important role of practitioners including orthopaedic surgeons, physiologists, coaches, and strength and conditioning professionals in helping athletes RTS.

Consensus process
A half day consensus meeting was held following the congress (22 November), and 17 members of the consensus group participated. Prior to the congress, members of the consensus group were invited to write a narrative review on their topic area. Authors were asked to focus on summarising what is currently known and what are the future advances needed to advance knowledge in RTS. This information was disseminated to the group and used as a basis for the first round-table discussion, facilitated by two researchers (CLA and KMK), where the four sections of this statement were initially agreed on. Participants then elected to join one of the four groups, and each group focused on a different section of the statement. A section leader was nominated by the members of each group, and participants in each group discussed and summarised the key issues for their section. Each of the groups then presented their summary, and the 17-member group discussed the key issues to refine each section.

Objective
This consensus builds on important formative work published over a decade ago, regarding the team physician's role in the athlete's RTS. In 2002, an expert panel representing the most prominent American orthopaedic, sports and family medicine member societies placed the team physician prominently as the gatekeeper of the RTS decision.[1] The field of sport and exercise medicine has progressed considerably since then.[2] Now, more than ever, decision-making models and ways of practising that are athlete-centred are advocated, placing the athlete in the position of an active decision-maker

CrossMark

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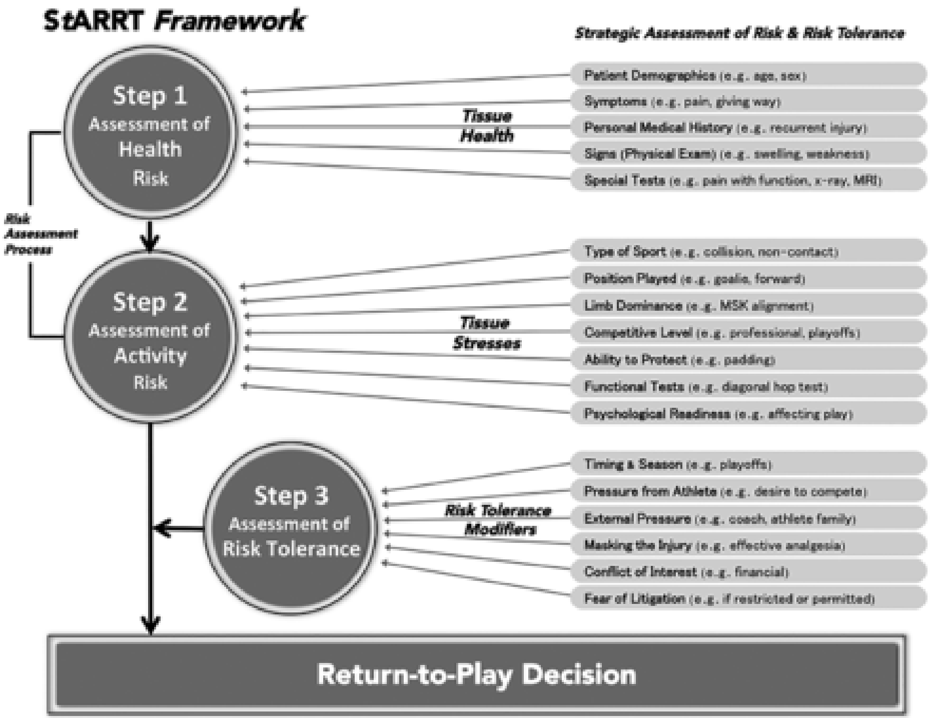
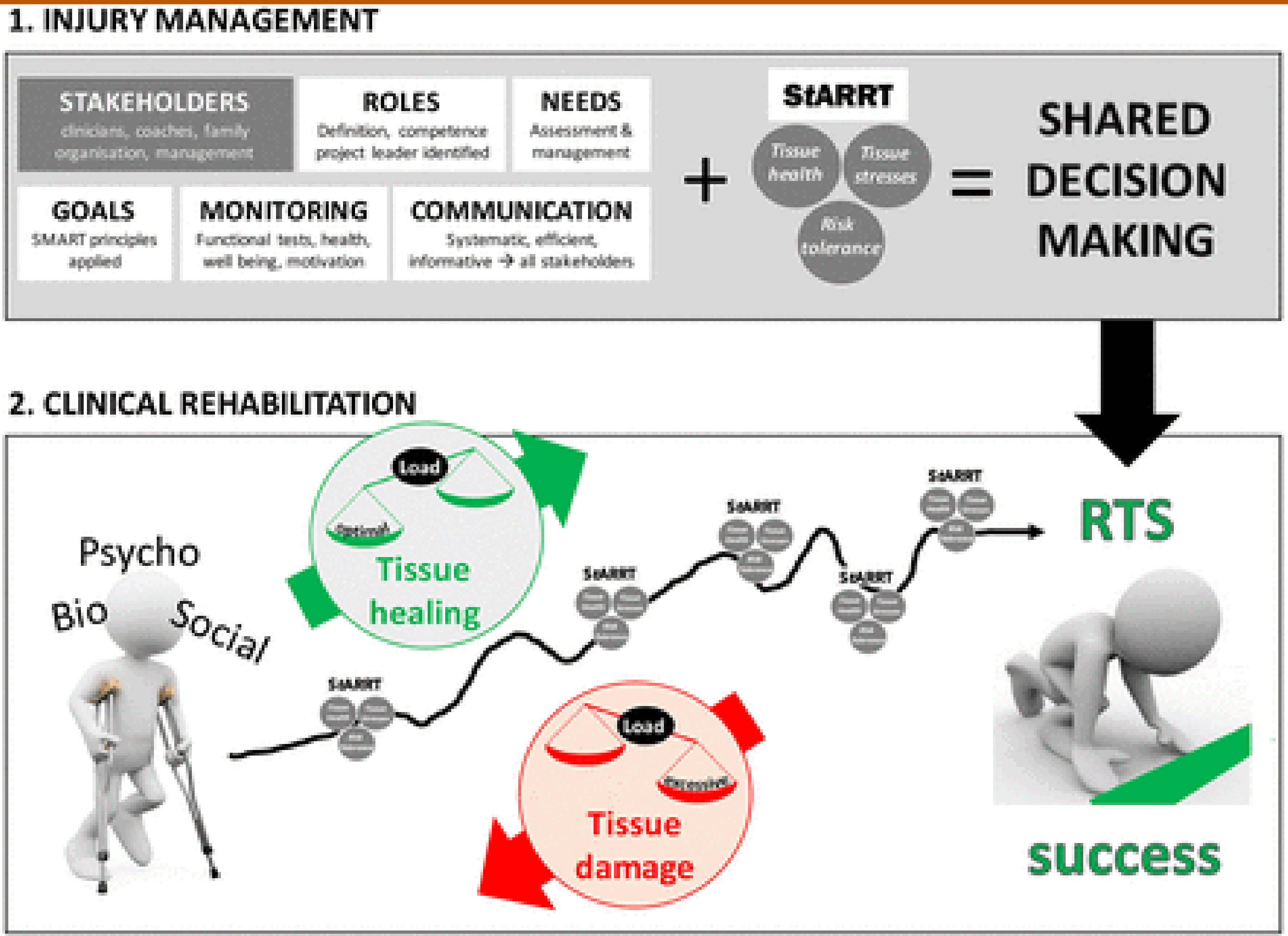
Box 1: Key take home messages regarding definitions for return to sport (RTS)

- The minimum information required to define RTS is: the sport and the level of participation the athlete aims to return to.
- RTS is a continuum comprising three elements: return to participation, return to sport and return to performance.
- In certain situations, the RTS decision may be reversed to a removal from sport decision.
- The RTS decision should be shared among all stakeholders (except in the case of health risk to the athlete).

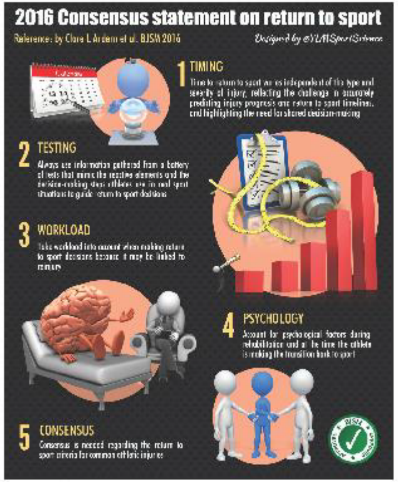
StARRT Framework for RTP Decisions




1. INJURY MANAGEMENT
STAKEHOLDERS
clinicians, coaches, family organisation, management
ROLES
Definition, competence project leader identified
NEEDS
Assessment & management
GOALS
SMART principles applied
MONITORING
Functional tests, health, well being, motivation
COMMUNICATION
Systematic, efficient, informative → all stakeholders
StARRT
Tissue health
Tissue stresses
Risk tolerance
SHARED DECISION MAKING
2. CLINICAL REHABILITATION
Psycho
Bio
Social
Load
Optimal
Tissue healing
Load
Excessive
Tissue damage
StARRT
RTS
success

Infographic: 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern

Clare L Ardern,[1,2] Philip Glasgow,[3] Anthony G Schneiders,[4] Erik Witvrouw,[5] Benjamin Clarsen,[6] Ann MJ Cools,[5] Boris Gojanovic,[7,8] Steffan Griffin,[9] Karim Khan,[10,11] Håvard Moksnes,[6] Stephen Mutch,[12,13] Nicola Phillips,[14] Guus Reurink,[15] Robin Sadler,[16,17] Karin Gravare Silbernagel,[18] Kristian Thorborg,[19,20] Arnlaug Wangensteen,[6,21] Kevin Wilk,[22] Mario Bizzini[23]



[1]La Trobe University, Melbourne, Australia
[2]Department of Medicine and Health Sciences, Division of Physiotherapy, Linköping, Sweden
[3]Sports Medicine, Sports Institute of Northern Ireland, Newtownabbey, UK
[4]School of Human, Health and Social Sciences, Central Queensland University, Branyan, Australia
[5]Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium
[6]Oslo Sports Trauma Research Center, Oslo, Norway
[7]Swiss Olympic Medical Center, Hopital de la Tour, Meyrin, Switzerland
[8]Sports Medicine, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland
[9]College of Medical and Dental Sciences, University of Birmingham, Birmingham, UK
[10]Department of Family Practice, The University of British Columbia, Vancouver, Canada
[11]Centre for Hip Health and Mobility, University of British Columbia, Vancouver, Canada
[12]SPACE Clinics, Edinburgh, UK
[13]Scottish Rugby, Edinburgh, UK
[14]Postgraduate Healthcare Studies, Cardiff University, Cardiff, UK
[15]Sports Medicine, Sports Physicians Group, Amsterdam, The Netherlands
[16]Sports Medicine, Manchester City Football Club Ltd, Manchester, UK
[17]Derby County FC, Derby, UK
[18]Department of Physical Therapy, University of Delaware, Newark, USA
[19]Sports Orthopaedic Research Center Copenhagen (SORC-C), Amager-Hvidovre Hospital, Copenhagen, Denmark
[20]Department of Orthopaedic Surgery and Physical Therapy, Amager-Hvidovre Hospital, Copenhagen, Denmark
[21]Aspetar Orthopaedic & Sports Medicine Hospital, Doha, Qatar
[22]Champion Sports Medicine, Birmingham, USA
[23]Schulthess Clinic, Zürich, Switzerland

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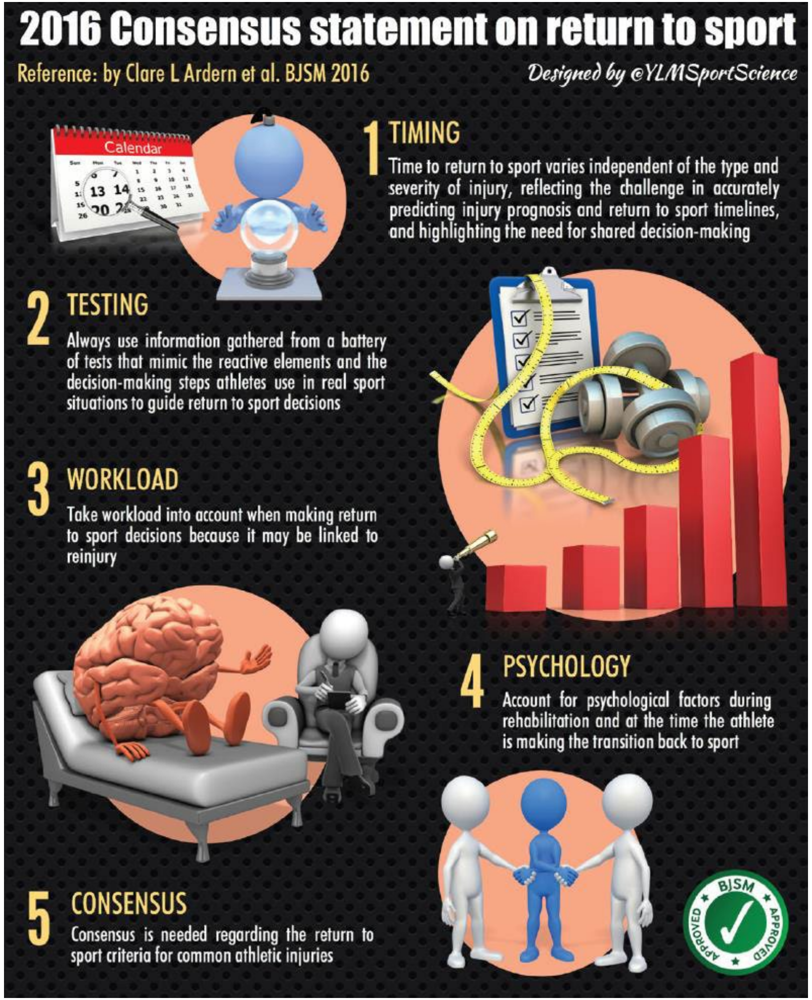

RTP Decisions: EHS, ER, ECAST

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[Primary Care]

Challenging Return to Play Decisions: Heat Stroke, Exertional Rhabdomyolysis, and Exertional Collapse Associated With Sickle Cell Trait

Chad A. Asplund, MD, MPH, FACSM,*† and Francis G. O'Connor, MD, MPH, FACSM‡

Context: Sports medicine providers frequently return athletes to play after sports-related injuries and conditions. Many of these conditions have guidelines or medical evidence to guide the decision-making process. Occasionally, however, sports medicine providers are challenged with complex medical conditions for which there is little evidence-based guidance and physicians are instructed to individualize treatment; included in this group of conditions are exertional heat stroke (EHS), exertional rhabdomyolysis (ER), and exertional collapse associated with sickle cell trait (ECAST).

Evidence Acquisition: The MEDLINE (2000-2015) database was searched using the following search terms: *exertional heat stroke*, *exertional rhabdomyolysis*, and *exertional collapse associated with sickle cell trait*. References from consensus statements, review articles, and book chapters were also utilized.

Study Design: Clinical review.

Level of Evidence: Level 4.

Results: These entities are unique in that they may cause organ system damage capable of leading to short- or long-term detriments to physical activity and may not lend to complete recovery, potentially putting the athlete at risk with premature return to play.

Conclusion: With a better understanding of the pathophysiology of EHS, ER, and ECAST and the factors associated with recovery, better decisions regarding return to play may be made.

Keywords: return to play; heat illness; rhabdomyolysis; sickle cell trait

Sports medicine physicians are frequently relied on to make return-to-play (RTP) decisions for sports-related conditions and injuries. Many of these are musculoskeletal injuries that sports clinicians are well trained for, regularly encounter, are not life threatening, and feel comfortable managing. In addition, many orthopaedic as well as medical conditions have identifiable resources, such as the American College of Sports Medicine Team Physician Consensus Statement series, the Preparticipation 4th Edition Monograph, and the Bethesda Conference Guidelines,[28] to assist the sports medicine provider with prudent RTP decisions. Occasionally, however, sports medicine clinicians are challenged with complex medical conditions for which there is little evidence-based guidance, and physicians are instructed to individualize treatment; included in this group of conditions are exertional heat stroke (EHS), exertional rhabdomyolysis (ER), and exertional collapse associated with sickle cell trait (ECAST). These entities are unique in that they may cause organ system damage capable of leading to short- or long-term detriments to physical activity and may not lend to complete recovery, potentially putting the athlete at risk with premature RTP.

From †Athletic Medicine, Division of Health Services, Health and Kinesiology, Georgia Southern University, Statesboro, Georgia, and ‡Military and Emergency Medicine, Consortium for Health and Military Performance, Uniformed Services University of the Health Sciences, Bethesda, Maryland
*Address correspondence to Chad A. Asplund, MD, MPH, FACSM, Athletic Medicine, Division of Health Services, Health and Kinesiology, Georgia Southern University, Statesboro, GA 30458 (email: casplund@georgiasouthern.edu).
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Dr O'Connor works for the United States Army and Department of Defense. The views and opinions expressed herein are the private views of the authors and do not reflect the views of the US Army or the Department of Defense.
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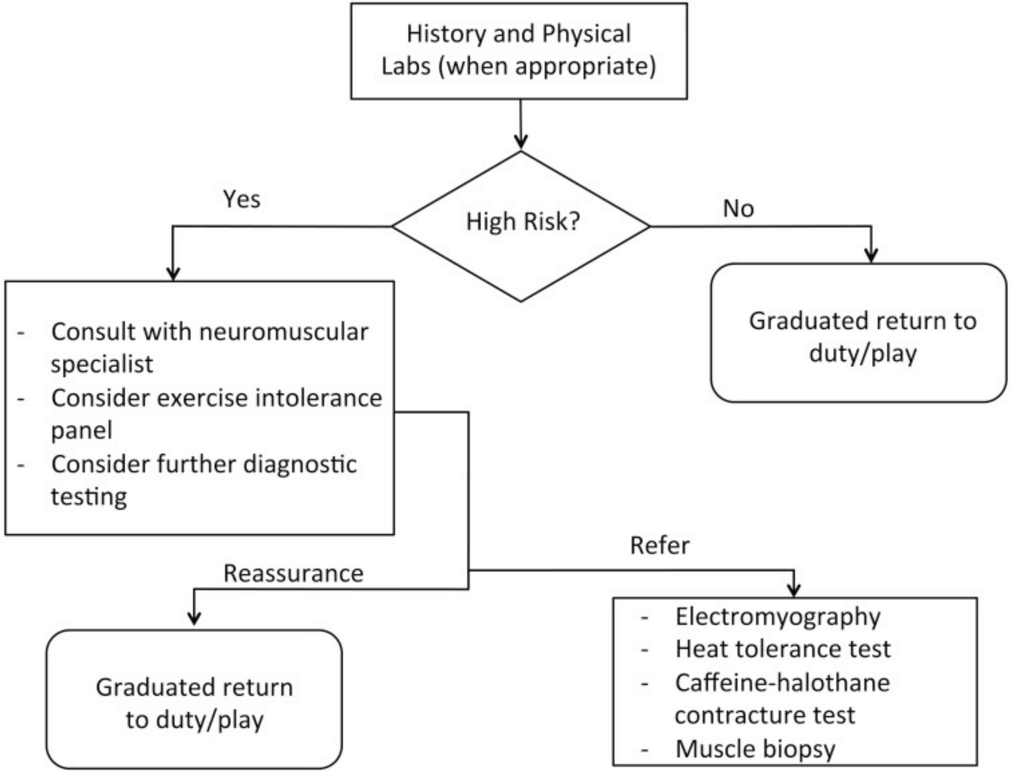
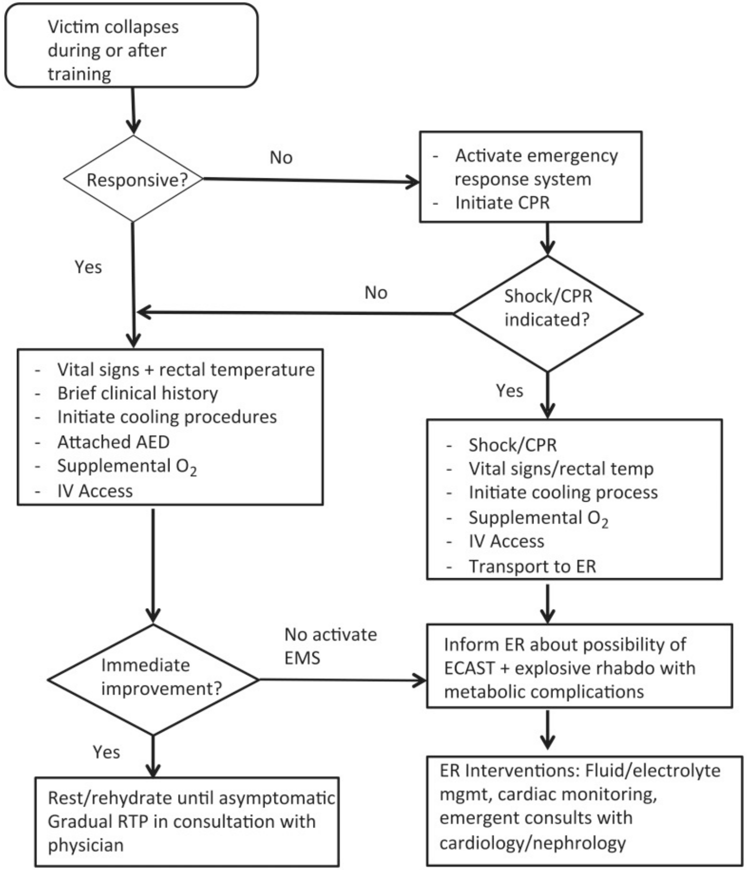
- Prevalence is low
- RTP decisions challenged by a relative lack of evidence regarding natural course of disease, risk of recurrence, and guidance for return


History and Physical
Labs (when appropriate)
High Risk?
Yes
No
Graduated return to duty/play
- Consult with neuromuscular specialist
- Consider exercise intolerance panel
- Consider further diagnostic testing
Reassurance
Refer
Graduated return to duty/play
- Electromyography
- Heat tolerance test
- Caffeine-halothane contracture test
- Muscle biopsy


Victim collapses during or after training
Responsive?
No
- Activate emergency response system
- Initiate CPR
Yes
No
Shock/CPR indicated?
- Vital signs + rectal temperature
- Brief clinical history
- Initiate cooling procedures
- Attached AED
- Supplemental O_2
- IV Access
Yes
- Shock/CPR
- Vital signs/rectal temp
- Initiate cooling process
- Supplemental O_2
- IV Access
- Transport to ER
Immediate improvement?
No activate EMS
Inform ER about possibility of ECAST + explosive rhabdo with metabolic complications
Yes
Rest/rehydrate until asymptomatic
Gradual RTP in consultation with physician
ER Interventions: Fluid/electrolyte mgmt, cardiac monitoring, emergent consults with cardiology/nephrology

Heat Illness Epidemiology

- 9,000 EHIs treated annually in US HS sports
- American football has the highest overall EHI rate
- Girls' cross country highest competition EHI rate
- EHI rates were highest in the southern US region

Kerr ZY, Yeargin SW, Hosokawa Y, Hirschhorn RM, Pierpoint LA, Casa DJ. The Epidemiology and Management of Exertional Heat Illnesses in High School Sports During the 2012/2013–2016/2017 Academic Years. J Sport Rehabil. 2020 Mar 1;29(3):332-338. doi: 10.1123/jsr.2018-0364. Epub 2019 Jun 6. PMID: 30747580.

Heat Illness Epidemiology

- American football deaths due to EHS
  - Since 1996, 68 preventable deaths
    - 50 HS, 13 college, 2 professional, 1 MS, 2 youth
  - HS/MS/youth have risen throughout the years
  - 2010-2014: highest 5 year block in 35 years
  - Most occurred in August (60.3%)
  - 1/3 occurred >2 hours into the practice session

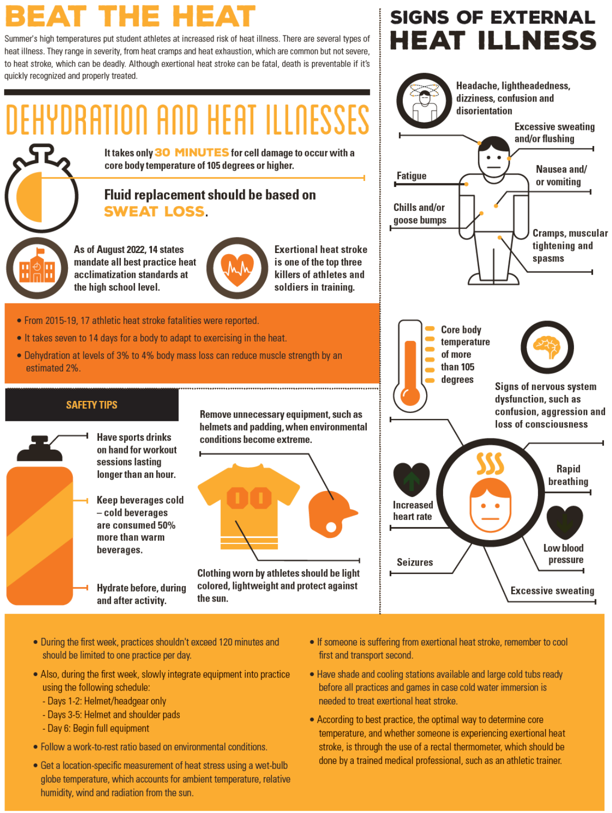
Kucera KL, Klossner D, Colgate B, Cantu RC. Annual Survey of Football Injury Research 1931–2019. 2020 [cited 2020 Dec 24].

Kerr, Z. Y., Marshall, S. W., Comstock, R. D., & Casa, D. J. (2014). Implementing exertional heat illness prevention strategies in US high school football. *Medicine and science in sports and exercise*, *46*(1), 124-130.

Kerr, Z. Y., Casa, D. J., Marshall, S. W., & Comstock, R. D. (2013). Epidemiology of exertional heat illness among US high

Defining Heat Stroke

- Severe Hyperthermia (>104.5F)
  - Typically warm environments
  - Can occur in cooler climates
    - Impaired heat dissipation
    - High exertional strain
- End Organ Dysfunction
  - Typically CNS dysfunction
- Types of Heat Stroke
  - Classic: resulting from environmental heat
  - Exertional: resulting from strenuous exercise



Infographic courtesy of the National Athletic Trainers' Association (Updated 2023)

Sources: Korey Stringer Institute, American Medical Society for Sports Medicine, NATA, National Center for Catastrophic Sport Injury Research, University of North Carolina

4 Key Aspects to Surviving Heat Stroke

- 1. Immediate recognition
- 2. Accurate core body temperature with rectal thermometer
- 3. Utilizing the best cooling modality available (preferably cold-water immersion)
- 4. Cool first, transport second

- 100% survival if core body temperature is brought down to <104F within 30 minutes
- Increased organ damage, morbidity, and mortality after 30 minutes of extreme hyperthermia.
- The key determinant for EHS outcome is the time above a critical temperature, not the maximum temperature obtained.

Exertional Heat Stroke: New Concepts Regarding Cause and Care

Douglas J. Casa, PhD, ATC, FACSM, FNATA[1,2]; Lawrence E. Armstrong, PhD, FACSM[1,2]; Glen P. Kenny, PhD[2,3]; Francis G. O'Connor, MD, MPH, FACSM[2,4]; and Robert A. Huggins, MEd, ATC[1,2]

Abstract
When athletes, warfighters, and laborers perform intense exercise in the heat, the risk of exertional heat stroke (EHS) is ever present. The recent data regarding the fatalities due to EHS within the confines of organized American sport are not promising: during the past 35 years, the highest number of deaths in a 5-year period occurred from 2005 to 2009. This reminds us that, regardless of the advancements of knowledge in the area of EHS prevention, recognition, and treatment, knowledge has not been translated into practice. This article addresses important issues related to EHS cause and care. We focus on the predisposing factors, errors in care, physiology of cold water immersion, and return-to-play or duty considerations.

Introduction

Throughout the sports and military medicine literature, much evidence indicates that the common signs and symptoms of exertional heat stroke (EHS) include a core temperature usually >40°C (104°F) coupled with central nervous system alteration (3,13,17,49). Furthermore, much evidence indicates that death related to EHS is preventable through immediate recognition using a rectal thermometer and rapid treatment via cold water immersion (CWI). Even with this knowledge, the prevalence of EHS in competitive sport, military, and industrial population continues to increase (3,9,13,17,49). Within the last 5 years, the incidence of EHS deaths in American sports remains high when compared to the last 35 years, with the incidence from 2005 to 2009 being the highest ever recorded (49). This indicates that recent findings are not being applied in clinical practice and that a renewed emphasis is needed across the sports medicine community. It is the purpose of this article to review the predisposing factors, errors in care, physiology of CWI, and return-to-play or duty considerations as they relate to EHS.

Predisposing Factors

The discipline of labor, physical training, or sporting events may thrust military personnel and athletes into tasks that exceed exercise capacity or heat acclimatization status. These individuals have an increased risk in the presence of environmental, organizational, and individual factors that predispose humans to EHS (Table 1). Rav-Acha *et al.* (40) made some important observations of 130 EHS cases, of which 6 were fatal. Predisposing factors included low level of physical fitness, sleep deprivation, high ambient temperature, intense solar radiation, exercise intensity not matched with physical fitness, ineffective or absent medical triage, and disregard for organizational safety regulations. Clearly, the primary predisposing factor of EHS is complex and may vary from case to case, but hyperthermia is always the common denominator.

New concepts currently being investigated in the realm EHS, found prominently in recent literature, are worthy of further research:

1. Advancements in the use of gene chip technology have enabled the identification of approximately 700 genes that are activated or suppressed by exercise heat stress in patients who had prior EHS (47). It is not known whether there is an upward or downward regulation in response to exercise heat stress, but perhaps if warfighters or athletes undergo genome screening, the predisposing factors for EHS may be identified by comparing normal individuals to patients who had prior EHS.
2. Various medications negatively affect heat dissipation and exercise performance by reducing sweat production (*e.g.*, antihistamines, anticholinergics), altering

[1]Department of Kinesiology, University of Connecticut, Storrs, CT; [2]Korey Stringer Institute, Neag School of Education, University of Connecticut, Storrs, CT; [3]School of Human Kinetics, University of Ottawa, Ottawa, Ontario, Canada; and [4]Military and Emergency Medicine, Uniformed Services University, Bethesda, MD

Address for correspondence: Douglas J. Casa, PhD, ATC, FACSM, FNATA, Korey Stringer Institute, Department of Kinesiology, University of Connecticut, 2095 Hillside Road, U-1110, Storrs, CT 06269-1110; E-mail: douglas.casa@uconn.edu

1537-890x/1103/115–123
Current Sports Medicine Reports

- Inaccurate temperature assessment or misdiagnosis
- No care or treatment delayed
- Inefficient cooling modality
- Immediate transport (and/or waiting for transport)

Journal of Athletic Training 2012;47(4):477–480
doi: 10.4085/1062-6050-47.4.08

www.nata.org/journal-of-athletic-training

consensus statement

The Inter-Association Task Force for Preventing Sudden Death in Collegiate Conditioning Sessions: Best Practices Recommendations

Douglas J. Casa, PhD, ATC, FNATA, FACSM (Chair)*; Scott A. Anderson, ATC*; Lindsay Baker, PhD†; Scott Bennett, MS, MSCC, SCCC, CSCS*D‡; Michael F. Bergeron, PhD, FACSM§; Declan Connolly, PhD, FACSM, CSCS*D‡; Ron Courson, PT, ATC, NREMT-I, CSCS*; Jonathan A. Drezner, MD||; E. Randy Eichner, MD¶; Boyd Epley, MEd, RSCC*E, FNSCA#; Steve Fleck, PhD, CSCS, FNSCA, FACSM#; Rob Franks, DO, FAOASM; Kevin M. Guskiewicz, PhD, ATC, FNATA, FACSM*; Kimberly G. Harmon, MD||; Jay Hoffman, PhD, RSCC*D, FNSCA, FACSM#; Jolie C. Holschen, MD, FACEP††; Jon Jost, MS, RSCC*E#; Alan Kinniburgh, PhD#; David Klossner, PhD, ATC‡‡, Rebecca M. Lopez, PhD, ATC, CSCS*; Gerard Martin, MS, RSCC*D#; Brendon P. McDermott, PhD, ATC*; Jason P. Mihalik, PhD, CAT(C), ATC§§; Tom Myslinski, MS, RSCC#; Kelly Pagnotta, MA, ATC, PES||||; Sourav Poddar, MD‡‡; George Rodgers, MD, PhD‡; Alan Russell, MS, ATC, PES, CES¶¶; Latrice Sales‡‡; David Sandler, RSCC*D#; Rebecca L. Stearns, PhD, ATC||||; Chuck Stiggins, EdD‡; Charlie Thompson, MS, ATC***

*National Athletic Trainers' Association; †Gatorade Sports Science Institute; ‡Collegiate Strength and Conditioning Coaches association; §American College of Sports Medicine; ||American Medical Society for Sports Medicine; ¶University of Oklahoma, Retired; #National Strength and Conditioning Association; **American Osteopathic Academy of Sports Medicine; ††American College of Emergency Physicians; ‡‡National Collegiate Athletic Association; §§Canadian Athletic Therapists' Association; ||||Korey Stringer Institute; ¶¶National Academy of Sports Medicine

In January 2012, the National Athletic Trainers' Association, along with the National Strength and Conditioning Association, convened a meeting in Colorado Springs, Colorado. Its purpose was to hold an interdisciplinary forum and gather input to address sudden death in collegiate conditioning sessions. Based on these discussions, a writing group drafted the following recommendations. To date, these best practices have been endorsed by the American College of Emergency Physicians, American College of Sports Medicine, American Medical Society for Sports Medicine, American Osteopathic Academy of Sports Medicine, Canadian Athletic Therapists' Association, Collegiate Strength and Conditioning Coaches association, Gatorade Sports Science Institute, Korey Stringer Institute, National Academy of Sports Medicine, National Athletic Trainers' Association, and National Strength and Conditioning Association. Other reviewers and meeting participants are listed with the professional organizations they represent at the end of this article.

Maximizing strength and conditioning sessions has become fundamental to sport. The right combination of strength, speed, cardiorespiratory fitness, and other components of athletic capacity can complement skill and enhance performance for all athletes. A sound and effective training program that relies on scientific principles of exercise physiology and biomechanics intended to produce outcomes that are sensitive and specific to the sport should be the goals. Unfortunately, the athlete's development, health, and safety are sometimes overshadowed by a culture that values making athletes tough, instilling discipline, and focusing on success at all costs.

This ill-conceived philosophy has been a contributor to the alarming increase in collegiate athlete deaths and serious injuries during conditioning sessions. A total of 21 National Collegiate Athletic Association (NCAA) football players have died during conditioning workouts since 2000.[1] The 3 most common causes of the fatalities were (in order) exercise-related sudden death associated with sickle cell trait (SCT), exertional heat stroke, and cardiac

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The Inter-Association Task Force for Preventing Sudden Death in Secondary School Athletics Programs: Best-Practices Recommendations

Douglas J. Casa, PhD, ATC, FNATA, FACSM (Chair)*†; Jon Almquist, VATL, ATC*; Scott A. Anderson, ATC*; Lindsay Baker, PhD‡; Michael F. Bergeron, PhD, FACSM§; Brian Biagioli, EdD||; Barry Boden, MD¶; Joel S. Brenner, MD, MPH, FAAP#; Michael Carroll, MEd, LAT, ATC*; Bob Colgate; Larry Cooper, MS, LAT, ATC*; Ron Courson, PT, ATC, NREMT-I, CSCS*; David Csillan, MS, LAT, ATC*; Julie K. DeMartini, MA, ATC†; Jonathan A. Drezner, MD††; Tim Erickson, CAA‡‡; Michael S. Ferrara, PhD, ATC, FNATA*; Steven J. Fleck, PhD, CSCS, FNSCA, FACSM§§; Rob Franks, DO, FAOASM||||; Kevin M. Guskiewicz, PhD, ATC, FNATA, FACSM*; William R. Holcomb, PhD, LAT, ATC, CSCS*D, FNATA, FNSCA§§; Robert A. Huggins, MEd, ATC†; Rebecca M. Lopez, PhD, ATC, CSCS†; Thom Mayer, MD, FACEP¶¶; Patrick McHenry, MA, CSCS*D, RSCC§§; Jason P. Mihalik, PhD, CAT(C), ATC##; Francis G. O'Connor, MD, MPH, FACSM††; Kelly D. Pagnotta, MA, ATC, PES†; Riana R. Pryor, MS, ATC†; John Reynolds, MS, VATL, ATC*; Rebecca L. Stearns, PhD, ATC†; Verle Valentine, MD††**

*National Athletic Trainers' Association; †Korey Stringer Institute; ‡Gatorade Sports Science Institute; §American College of Sports Medicine; ||National Council on Strength and Fitness; ¶American Orthopaedic Society for Sports Medicine; #American Academy of Pediatrics; **National Federation of State High School Associations; ††American Medical Society for Sports Medicine; ‡‡National Interscholastic Athletic Administrators Association; §§National Strength and Conditioning Association; ||||American Osteopathic Academy of Sports Medicine; ¶¶American College of Emergency Physicians; ##Canadian Athletic Therapists Association

The secondary school athletic population leads the nation in athletic-related deaths.[1–6] Given that many such deaths are avoidable through proper prevention, recognition, and treatment protocols, those involved with secondary school athletics can benefit from policy considerations regarding health and safety for participation in sport. The health and safety of secondary school athletes is paramount, but barriers that jeopardize the delivery of optimal safety and preventive measures remain prevalent across the secondary school athletic landscape. To date, these "best-practices" recommendations have been endorsed by the American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, American Osteopathic Academy of Sports Medicine, Canadian Athletic Therapists Association, Gatorade Sports Science Institute, Korey Stringer Institute, Matthew A. Gfeller Sport-Related Traumatic Brain Injury Researcher Center, National Athletic Trainers' Association, National Center for Catastrophic Sport Injury Research, National Council on Strength and Fitness, National Federation of State High School Associations, National Interscholastic Athletic Administrators Association, and National Strength and Conditioning Association.

This document provides a roadmap for policy considerations regarding health and safety concerns for secondary school athletes. Although these guidelines are not exhaustive for all conditions, these best practices address the leading causes of sudden death in this population (head and neck injuries, exertional heat stroke [EHS], sudden cardiac arrest [SCA], and exertional sickling). Further, we present information to address the infrastructure conditions and barriers that can introduce the most risk to athletes (lack of emergency action plans [EAPs], lack of medical staff, lack of emergency equipment [eg, defibrillators], poor heat acclimatization policies, and improper conditioning sessions).

The advent of increasing policy mandates and legislative efforts has resulted in a greater need to have a medical gatekeeper who can properly supervise the sports health of

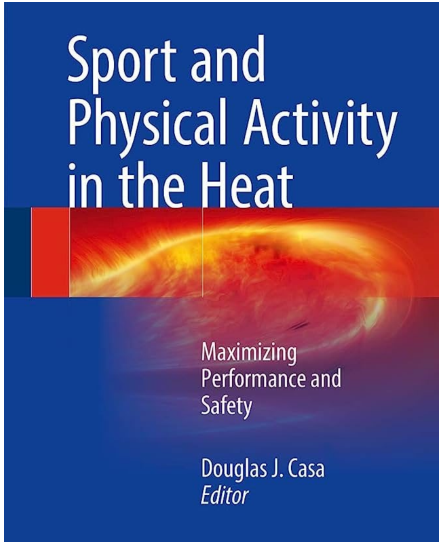
Pillars of EHS Prevention

- Heat acclimatization
- Body Cooling
- Work-to-rest Ratios & Environmental Considerations
- Hydration
- Sleep
- Education

Preseason Heat-Acclimatization Guidelines for Secondary School Athletics

Douglas J. Casa, PhD, ATC, FNATA, FACSM*; David Csillan, MS, LAT, ATC*

*Inter-Association Task Force for Preseason Secondary School Athletics Participants: Lawrence E. Armstrong, PhD, FACSM†; Lindsay B. Baker, PhD‡; Michael F. Bergeron, PhD, FACSM§; Virginia M. Buchanan, JD†; Michael J. Carroll, MEd, LAT, ATC||; Michelle A. Cleary, PhD, LAT, ATC||; Edward R. Eichner, MD, FACSM†; Michael S. Ferrara, PhD, ATC, FNATA||; Tony D. Fitzpatrick, MA, LAT, ATC||; Jay R. Hoffman, PhD, FACSM, FNSCA¶; Robert W. Kenefick, PhD, FACSM#; David A. Klossner, PhD, ATC||; J. Chad Knight, MSHA, MESS, ATC, OTC||; Stephanie A. Lennon, MS, NBCT, LAT, ATC||; Rebecca M. Lopez, MS, ATC||; Matthew J. Matava, MD**; Francis G. O'Connor, MD, FACSM††; Bart C. Peterson, MSS, ATC||; Stephen G. Rice, MD, PhD, FACSM, FAAP‡‡; Brian K. Robinson, MS, LAT, ATC||; Robert J. Shriner, MS, LAT, ATC||; Michael S. West, MS, ATC||; Susan W. Yeargin, PhD, ATC||*



KSI 77
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Preventing sudden death in sport

Comparison of NCAA and High School Heat Acclimatization Policies

	NCAA	High School
Length of Acclimatization Period	• 5 day acclimatization period	• 14 day acclimatization period
Equipment allowed during Acclimatization	• Days 1 & 2 only helmets • Days 3 & 4 only helmets and shoulder pads • Days 5+ All equipment	• Days 1 & 2 only helmets • Days 3-5 only helmets and shoulder pads • Days 6+ All equipment
Single-practice days	• Practice time should not exceed 3 hours	• Practice time should not exceed 3 hours • A 1-hour walkthrough is allowed if practice is separated by at least 3 hours
Double-practice days	• May have a 1 hour testing session and a 2 hour practice on one of the 5 days • 3 hours of recovery must seperate the 2 sessions	• Only on days 6+ • Must be followed by a single-practice day • Must be separated by 3 hours of rest • Neither practice should be longer than 3 hours • Total practice time should not be longer than 5 hours • Double-practice days
Missed day policy	• All athletes must complete the heat acclimatization period regardless of arrival to preseason practice	• Days which athletes do not practice, either individually or team-wide, do not count to the 14 days
Drills allowed during practice		• Football may use tackling dummies and blocking sleds on days 3+ • Live contact drills may begin on days 6+
Medical Coverage		• Athletic Trainer recommended to be on site

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Consensus Statement

Consensus Statement- Prehospital Care of Exertional Heat Stroke

Luke N. Belval, MS, ATC, Douglas J. Casa, PhD, ATC, William M. Adams, PhD, ATC, George T. Chiampas, DO, Jolie C. Holschen, MD, Yuri Hosokawa, PhD, ATC, John Jardine, MD, Shawn F. Kane, MD, Michele Labotz, MD, Renée S. Lemieux, BS, Kyle B. McClaine, MD, Nathaniel S. Nye, MD, Francis G. O'Connor, MD, MPH, Bryan Prine, MD, Neha P. Raukar, MD, Michael S. Smith, MD, PharmD, Rebecca L. Stearns, PhD, ATC

Abstract

Exertional heat stroke (EHS) is one of the most common causes of sudden death in athletes. It also represents a unique medical challenge to the prehospital healthcare provider due to the time sensitive nature of treatment. In cases of EHS, when cooling is delayed, there is a significant increase in organ damage, morbidity, and mortality after 30 minutes, faster than the average EMS transport and ED evaluation window. The purpose of this document is to present a paradigm for prehospital healthcare systems to minimize the risk of morbidity and mortality for EHS patients. With proper planning, EHS can be managed successfully by the prehospital healthcare provider. **Keywords:** heat stroke; heat stress disorders; hyperthermia; sports; exercise

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Douglas Casa has served as an expert witness.

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Address correspondence to Luke Belval, MS, ATC Korey Stringer Institute, Department of Kinesiology, University of Connecticut, 2095 Hillside Rd, U-1110, Storrs, CT 06269, USA. E-mail: Luke.belval@uconn.edu

Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/ipec.

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Introduction

Exertional heat stroke (EHS) is an emergent hyperthermic condition that occurs in individuals performing physical activity, typically in warm environments (1, 2), but can also occur with exertion or impaired heat dissipation in cool environments (3). This is contrasted by classic heat stroke, which occurs more commonly in those lacking normal thermoregulation, such as the elderly and infants during heat waves. EHS is characterized by severe hyperthermia (>40.5°C) and end organ dysfunction, which typically manifests as central nervous system (CNS) dysfunction (4). Optimal outcomes from EHS requires rapid reversal of hyperthermia through whole body cooling (5, 6). Evidence has shown that immediate and aggressive cooling after collapse ensures survivals with limited sequelae (6–10), highlighting the need for appropriate prehospital care.

Cold water immersion (CWI) is considered to be the gold standard treatment for EHS (11), but unfortunately, there are many situations in which CWI is not available. In the current practices of Emergency Medicine, Prehospital Medicine, and Sports Medicine, there is wide variability in practices for EHS despite published evidence for optimal EHS care. Efforts are required to standardize treatment by these providers and coordinate efforts toward providing optimal EHS care in the prehospital setting.

- This document helped bridge the gap from sideline care to ER care
- EMS cannot transport until appropriate temp
- Maryland and ? Maine

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Preventing Catastrophic Injury and Death in Collegiate Athletes: Interassociation Recommendations Endorsed by 13 Medical and Sports Medicine Organisations

John T. Parsons, PhD, ATC*; Scott A. Anderson, ATC†; Douglas J. Casa, PhD, ATC, FNATA, FACSM‡; Brian Hainline, MD*

*Sport Science Institute, National Collegiate Athletic Association, Indianapolis, IN; †Athletics, University of Oklahoma, Norman; ‡Kinesiology, University of Connecticut, Storrs

The Second Safety in College Football Summit resulted in interassociation consensus recommendations for three paramount safety issues in collegiate athletics: (1) independent medical care for collegiate athletes; (2) diagnosis and management of sport-related concussion; and (3) year-round football practice contact for collegiate athletes. This document, the fourth arising from the 2016 event, addresses the prevention of catastrophic injury, including traumatic and non-traumatic death, in collegiate athletes. The final recommendations in this document are the result of presentations and discussions on key items that occurred at the summit. After those presentations and discussions, endorsing organisation representatives agreed on 18 foundational statements that became the basis for this consensus paper that has been subsequently reviewed by relevant stakeholders and endorsing organisations. This is the final endorsed document for preventing catastrophic injury and death in collegiate athletes. This document is divided into the following components. (1) Background—this section provides an overview of catastrophic injury and death in collegiate athletes. (2) Interassociation recommendations: preventing catastrophic injury and death in collegiate athletes—this section provides the final recommendations of the medical organisations for preventing catastrophic injuries in collegiate athletes. (3) Interassociation recommendations: checklist—this section provides a checklist for each member school. The checklist statements stem from foundational statements voted on by representatives of medical organisations during the summit, and they serve as the primary vehicle for each member school to implement the prevention recommendations. (4) References—this section provides the relevant references for this document. (5) Appendices—this section lists the foundational statements, agenda, summit attendees and medical organisations that endorsed this document.

Key Words: American football, concussion, exertional heat stress, heat acclimatisation, injury prevention

Background

Data about catastrophic injuries and illnesses in collegiate athletes began with intermittent accounts from print media, and more formally in 1931, through the American Football Coaches Association initiation of the Annual Survey of Football Injury Research. Since 1982, the National Center for Catastrophic Sport Injury Research (NCCSIR) at the University of North Carolina, Chapel Hill,[1] has been the nation's premier source of catastrophic injury and death related to participation in organised sports at all levels of competition, including college. The NCCSIR monitors, collects and analyses data on catastrophic injuries, illnesses and death and provides publicly available reports about football and other sports.[1]

In order to create enhanced national surveillance abilities for catastrophic injuries, illness and death, the NCCSIR has partnered with the Consortium for Catastrophic Injury Monitoring in Sport. The consortium includes the division on traumatic injury at the Matthew Gfeller Sport-Related Traumatic Brain Injury Research Center at the University of North Carolina, Chapel Hill; the division on exertional injury at the Korey Stringer Institute at the University of Connecticut; and the division on cardiac injury in sport at the University of Washington.[1] Working through the consortium, the NCCSIR has developed new methods of data collection and analysis, including the use of a public-facing online reporting system.[2]

Researchers who study the epidemiology of catastrophic injury and death in sport identify two mechanisms by which these events occur. *Traumatic* catastrophic injuries, also called direct injuries, are bodily injuries caused directly by participation in a sport activity.[1] An example of a traumatic catastrophic injury is a spinal cord injury caused by tackling in the sport of football. The three leading causes of death from traumatic injury are traumatic brain injuries, spinal cord injuries and internal organ injuries.[1] *Non-traumatic* catastrophic injuries, also known as indirect or exertional injuries, are the 'result of exertion while participating in a sport activity or by a complication that was secondary to a

Consensus statement

Preventing catastrophic injury and death in collegiate athletes: interassociation recommendations endorsed by 13 medical and sports medicine organisations

John T Parsons,[1] Scott A Anderson,[2] Douglas J Casa,[3] Brian Hainline [1]

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[1]Sport Science Institute, National Collegiate Athletic Association (NCAA), Indianapolis, Indiana, USA
[2]Athletics, University of Oklahoma, Norman, Oklahoma, USA
[3]Kinesiology, University of Connecticut, Storrs, Connecticut, USA

Correspondence to
Dr Brian Hainline, National Collegiate Athletic Association (NCAA), Indianapolis, IN 46206, USA; bhainline@ncaa.org

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The following organisations endorsed this document: American Association of Neurological Surgeons, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, American Osteopathic Academy of Sports Medicine, College Athletic Trainers' Society, Collegiate Strength and Conditioning Coaches Association, Congress of Neurological Surgeons, Korey Stringer Institute, National Athletic Trainers' Association, National Strength and Conditioning Association, National Operating Committee for Standards on Athletic Equipment, Sports Neuropsychology Society. The following organisation has affirmed the value of this document: American Academy of Neurology.

ABSTRACT

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CLINICAL SCIENCES

Effectiveness of Cold Water Immersion in the Treatment of Exertional Heat Stroke at the Falmouth Road Race

JULIE K. DEMARTINI[1], DOUGLAS J. CASA[1], REBECCA STEARNS[1], LUKE BELVAL[1], ARTHUR CRAGO[2], ROB DAVIS[2], and JOHN JARDINE[2]

[1]*Department of Kinesiology, Korey Stringer Institute, University of Connecticut, Storrs, CT; and* [2]*Falmouth Hospital, Falmouth, MA*

ABSTRACT

DEMARTINI, J. K., D. J. CASA, R. STEARNS, L. BELVAL, A. CRAGO, R. DAVIS, and J. JARDINE. Effectiveness of Cold Water Immersion in the Treatment of Exertional Heat Stroke at the Falmouth Road Race. *Med. Sci. Sports Exerc.*, Vol. 47, No. 2, pp. 240–245, 2015. **Purpose**: This study aimed to investigate the effectiveness (speed of cooling and survival rates) of cold water immersion (CWI) in the treatment of patients with exertional heat stroke (EHS). Secondly, this study aimed to compare cooling rates on the basis of gender, age, and initial rectal temperature (T_r). **Methods**: Eighteen years of finish line medical tent patient records were obtained from the exertional heat illness treatment area at the Falmouth Road Race. Study participants included patients with EHS who were treated with CWI in the medical tent. The number of EHS cases was recorded for each year, and incidence was established on the basis of the number of finishers. Overall cooling rate and differences between initial T_r, age, and sex were evaluated. **Results**: A total of 274 cases of EHS was observed over the 18 yr of collected data. A mean of 15.2 ± 13.0 EHS cases per year was recorded, with an overall incidence of 2.13 ± 1.62 EHS cases per 1000 finishers. The average initial T_r was 41.44°C ± 0.63°C, and the average cooling rate for patients with EHS was 0.22°C·min^{-1} ± 0.11°C·min^{-1}. CWI resulted in a 100% survival rate for all patients with EHS. No significant interactions between cooling rate and initial T_r (P = 0.778), sex (P = 0.89), or age (P = 0.70) were observed. **Conclusions**: CWI was found to effectively treat all cases of EHS observed in this study. CWI provided similar treatment outcomes in all patients, with no significant differences noted on the basis of initial T_r, age, or sex. On the basis of the 100% survival rate from EHS in this large cohort, it is recommended that immediate (on site) CWI be implemented for the treatment of EHS. **Key Words:** HYPERTHERMIA, EXERTIONAL HEAT STROKE, COLD WATER IMMERSION, COOLING RATE

Exertional heat stroke (EHS) is one of the leading causes of death among athletes (5,22,26). Data from the University of North Carolina National Center for Catastrophic Injury have shown drastic increase in the number of deaths from EHS over the last 5-yr reporting period (2004–2009) compared with that in previous reporting periods (26,27,37). Furthermore, during the last 2 yr (2011–2012), these deaths continue to show an increasing trend (23). Many of these deaths occur during organized sport participation, such as high school football practice or collegiate conditioning sessions, when appropriate medical personnel (i.e., certified athletic trainer) are not present. The highest recorded incidence of EHS has been encountered at the Falmouth Road Race, with a reported 1–2 EHS cases for every 1000 entrants (7). However, despite the high occurrence of EHS cases during this event, no deaths have been reported.

Studies and case reports have consistently shown that the time a person's core body temperature is above 40°C predicts the outcome of the EHS case (8,12,20,21,32). Therefore, the primary goal with any patient with EHS is to cool him/her as immediately and rapidly as possible. Substantial evidence has demonstrated (1,4,9,10,14,20,21,29,32,34) or supported (3,4,12,13,25) such use of cold water immersion (CWI) for treatment of EHS. This is largely due to the superior cooling efficacy of CWI established by various research studies (2,10,17,24,25,30,31). CWI is superior to other cooling methods because of its high thermal conductivity and high body surface contact area (38). In addition, various reports have been made on survival from EHS when immediate CWI was used (7,21,38) whereas reports of death have occurred from delayed or inappropriate care (18,21,32,38).

It is suggested that for effective treatment of EHS, a minimum cooling rate of 0.1°C·min^{-1}–0.2°C·min^{-1} (0.18°F·min^{-1}–0.36°F·min^{-1}) should be obtained if cooling occurs immediately or a rate of 0.15°C·min^{-1} (0.27°F·min^{-1}) if cooling is delayed (13,37). With such cooling rates, it is

Address for correspondence: Julie K. DeMartini, Ph.D., A.T.C., L.A.T., Korey Stringer Institute, University of Connecticut, 2095 Hillside Road, Storrs, CT 06269; Email: jdemartini@westfield.ma.edu.
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- Rectal temperature and cold-water immersion occurred within 10 minutes of collapse → 100% survival rate.
- Cold-water immersion tubs cools 30-40% faster than any other method.

Table 2 - This table identifies common onsite whole-body cooling strategies for EHS casualties, with cooling rates as reported in published studies.

Body Cooling Strategies (56, 63, 61, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73)	Treatment Notes	Approximate Cooling Rate (°C·min^{-1}) [a]
Ice water (~2°C) or cold water (~20°C) immersion with stirring	Immerse the full body up to the neck including upper and lower extremities (~90% body surface area) in a tank/tub, circulate the water to increase heat transfer, add ice during cooling to maintain water temperature, support head and airway above water level.	0.13 to 0.35
	Immerse as much of the torso and pelvic region (~65% body surface) following full body treatment notes, extremities not in water should be cooled using other strategies	0.04 to 0.25
Cold water dousing	Free flowing hose or bucket with cool tap water applied to the whole body—extremities, torso, hands, feet, neck, and head (with attention to the airway).	0.04 to 0.20
Tarp-assisted water ice/cold immersion	Providers hold the sides of the tarp with patient, water, and ice in the middle. Ensure as much of the torso, groin, and extremities are immersed as possible. Circulate the water as able.	0.14 to 0.17
Ice/cold water-soaked towels	Towels should be applied to the limbs (including feet and hands), trunk, and head with ice packs placed in the groin, axilla, and neck; include as much of the body as possible (~90% body surface area). Wring towels after soaking in bucket of ice water and change the towels rapidly.	0.11 to 0.16
Ice/cold water-soaked sheets	The whole body (~90% of body surface area) is wrapped in large sheets that are soaked with cold water. Sheets stay in place and are frequently rewetted. A fan directed at the body can be added.	0.05 to 0.06
Cold water immersion in portable water-impermeable bag	Immerse the full body up to the neck including upper and lower extremities (~90% body surface area) in the bag, support head and airway out of the bag.	0.04
Water spray/mister or high powered fan with water spray	Patient should be placed supine on a cot or table. As much of the body surface should be exposed (*i.e.*, remove clothes and shoes) to the fan and mist as possible.	0.03 to 0.17

Original research references provide detailed treatment implementation recommendations. See Table 8 for clinical recommendations.

[a]Cooling rate ranges are affected by body type, initial body temperature (mild exercise-induced hyperthermia or heat stroke), and environmental conditions.

Exertional Heat Stroke

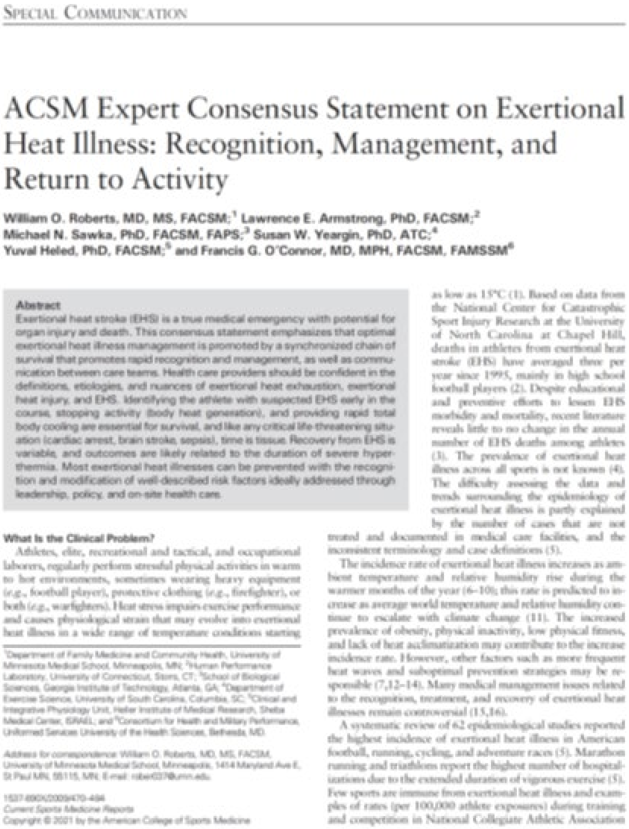
Factors associated with heat intolerance in young active persons

Functional	Low fitness
	Poor acclimatization
	Poor work efficiency
	Decreased skin area to body mass ratio
Acquired	Dysfunctional sweat glands
	Dehydration
	Infection
	History of heat stroke
	Medications/supplements
Congenital	Ectodermal dysplasia
	"Chronic idiopathic anhidrosis"

RTP Protocol After EHS

- No exercise permitted for at least 7 days after release from medical care.
- Follow-up with the medical team approximately 1 week after release for physical examination and any necessary laboratory testing and diagnostic imaging based on the organs affected during the EHS episode.
- Once cleared for a return to activity, the athlete begins exercise in a cool environment and gradually increases the duration, intensity, and heat exposure over 2 weeks to demonstrate heat tolerance and initiate acclimatization.
- Athletes who cannot resume vigorous activity over 4 weeks because of recurrent symptoms (eg, excessive fatigue) should be reevaluated. Laboratory exercise-heat tolerance testing may be useful in this setting.
- The athlete may resume full competition once he or she is able to participate in full training in the heat for 2 to 4 weeks without adverse effects.

ACSM Expert CS on EHI 2023



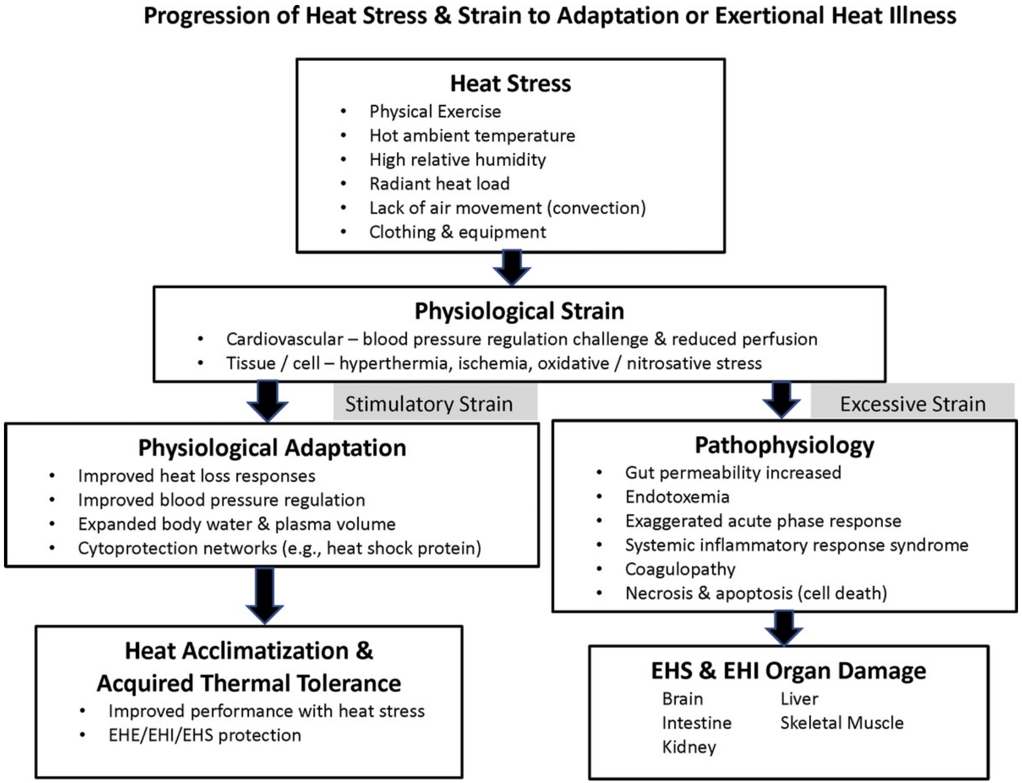
SPECIAL COMMUNICATION

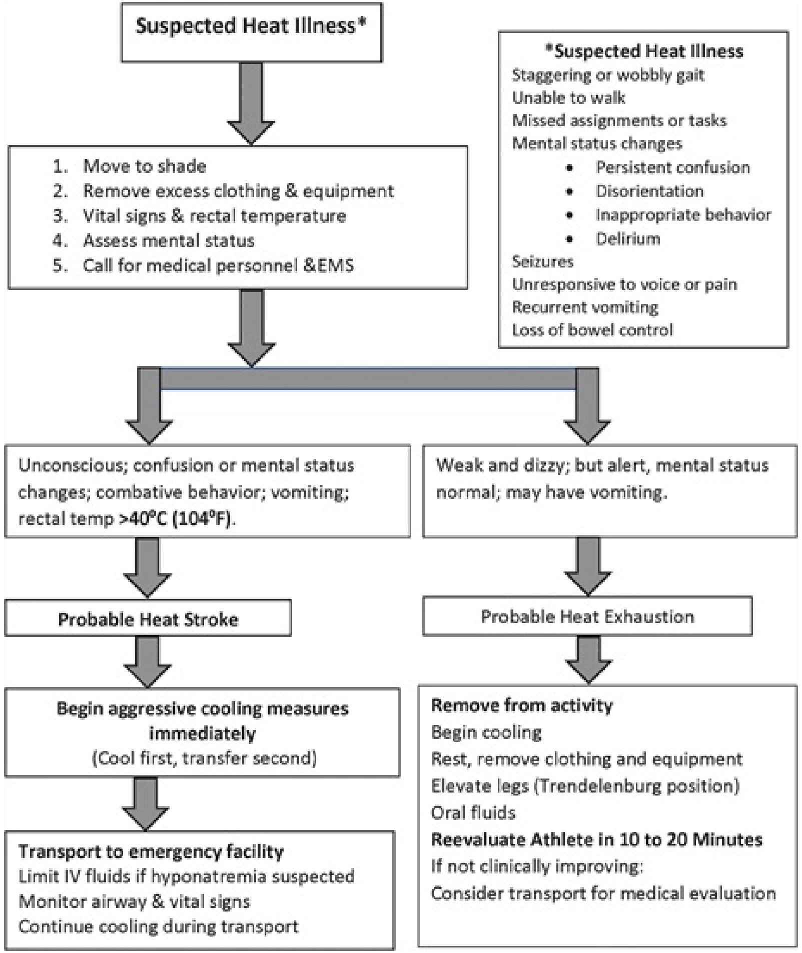
ACSM Expert Consensus Statement on Exertional Heat Illness: Recognition, Management, and Return to Activity

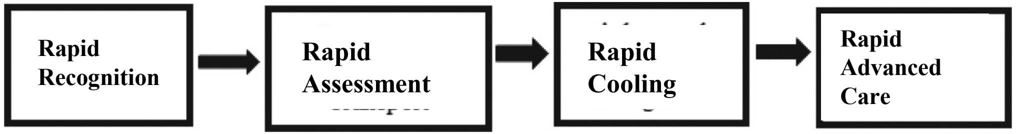
William O. Roberts, MD, MS, FACSM;[1] Lawrence E. Armstrong, PhD, FACSM;[2] Michael N. Sawka, PhD, FACSM, FAPS;[3] Susan W. Yeargin, PhD, ATC;[4] Yuval Heled, PhD, FACSM;[5] and Francis G. O'Connor, MD, MPH, FACSM, FAMSSM[6]

Abstract
Exertional heat stroke (EHS) is a true medical emergency with potential for organ injury and death. This consensus statement emphasizes that optimal exertional heat illness management is promoted by a synchronized chain of survival that promotes rapid recognition and management, as well as communication between care teams. Health care providers should be confident in the definitions, etiologies, and nuances of exertional heat exhaustion, exertional heat injury, and EHS. Identifying the athlete with suspected EHS early in the course, stopping activity (body heat generation), and providing rapid total body cooling are essential for survival, and like any critical life threatening situation (cardiac arrest, brain stroke, sepsis), time is tissue. Recovery from EHS is variable, and outcomes are likely related to the duration of severe hyperthermia. Most exertional heat illnesses can be prevented with the recognition and modification of well-described risk factors ideally addressed through leadership, policy, and on-site health care.

What Is the Clinical Problem?




Suspected Heat Illness*
*Suspected Heat Illness
Staggering or wobbly gait
Unable to walk
Missed assignments or tasks
Mental status changes
• Persistent confusion
• Disorientation
• Inappropriate behavior
• Delirium
Seizures
Unresponsive to voice or pain
Recurrent vomiting
Loss of bowel control
1. Move to shade
2. Remove excess clothing & equipment
3. Vital signs & rectal temperature
4. Assess mental status
5. Call for medical personnel &EMS
Unconscious; confusion or mental status changes; combative behavior; vomiting; rectal temp >40°C (104°F).
Weak and dizzy; but alert, mental status normal; may have vomiting.
Probable Heat Stroke
Probable Heat Exhaustion
Begin aggressive cooling measures immediately
(Cool first, transfer second)
Remove from activity
Begin cooling
Rest, remove clothing and equipment
Elevate legs (Trendelenburg position)
Oral fluids
Reevaluate Athlete in 10 to 20 Minutes
If not clinically improving:
Consider transport for medical evaluation
Transport to emergency facility
Limit IV fluids if hyponatremia suspected
Monitor airway & vital signs
Continue cooling during transport


Rapid Recognition
Rapid Assessment
Rapid Cooling
Rapid Advanced Care

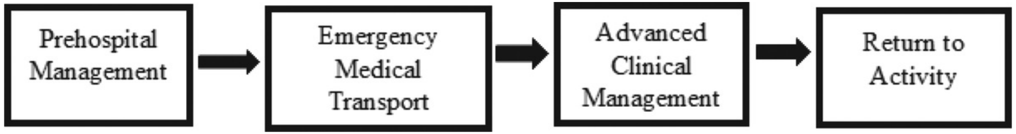

Prehospital Management
Emergency Medical Transport
Advanced Clinical Management
Return to Activity

Table 4 - Staged return to activity or play after a diagnosis of exertional heat stroke.

Stage	Aim/Responsibility/Goal	Activity	Duration/Intensity	Example: HS Cross-Country Runner
1	Medical recovery Physician guided Organ system recovery	Activities of daily living for 1 to 2 wk	Gradual increase in home activities without fatigue	Home rest and return to school
2	Medical Recovery Physician Guided Sustain minimal aerobic fitness and develop confidence	Self-paced comfortable walk in low heat stress conditions (*e.g.*, an air- conditioned gymnasium)	20 to 60 min at Maximal Intensity of HR < 100 or <50% Age Adjusted maximal HR	Return to practice and walk through the warm-up and practice, if the environmental conditions are not stressful. If not, use an air conditioned area of the school
3	Early Exercise Adaptation Athletic trainer guided with physician Gradually improve aerobic exercise capability	Walk at 3.5 mph in low heat stress conditions	60 min at HR < 140 bpm or <70% of age adjusted Maximal HR	Warm up & cool down with team, 1 of 4 reps at half speed
4	Mid Exercise Adaptation Athletic Trainer Guided with Physician Gradually improve aerobic exercise capability & fitness	Walk & run in low heat stress conditions	60 min of progressively increasing run to walk ratio until constant run for 60 min	1 of 3 reps, half speed 1 of 2 reps, ¾ speed
5	Heat Acclimatization Athletic Trainer Guided Gradually improve heat Acclimatization status	Run in ambient warm or hot conditions	60 min of progressively increasing run until constant run for 60 min;	All reps, ¾ speed
6	Sports-specific acclimatization/training Athletic trainer and/or coach guided Improve sport-specific heat acclimatization & fitness	Participate in practice in ambient conditions	Initially participate in sports-specific drills with sports-specific equipment then progress to training and scrimmage.	All reps, full speed
7	Return to Sport Athletic trainer monitors during warm up and game	Normal game or competition participation in ambient conditions		Meet 1—run to finish the race Meet 2 — race to place in the race

Table 5.

ACSM RTA considerations following EHS or EHI.

- A detailed history and physical examination including unique intrinsic and extrinsic risk factors, the timing of treatment, and the rate of cooling must be considered it the RTA decision.
- The athlete should refrain from exercise for at least 7 d after release from initial medical care, at which time the clinician will address the clinical course of the heat stroke incident and carefully assess the status of end-organ function (neurocognitive, renal, hepatic, muscle, hematologic as clinically indicated).
- The clinician should carefully address any intrinsic and extrinsic risk factors associated with the EHS event.
- When medically eligible for RTA/RTP based upon the return of normal end organ function, an individual can begin exercise in a cool environment and gradually increase the duration, intensity, and heat exposure over 2 wk to 4 wk to initiate environmental acclimatization, improve fitness, and demonstrate heat tolerance.
- If return to vigorous activity and evidence of the patient's ability to adapt to exercise-heat stress over several days is not accomplished within 4 to 6 wk, consider referral to a physician with experience in heat-related disorders for further evaluation that may include HTT in a controlled setting.
- The timing for full RTP is highly variable based upon the inter-individual severity and recovery of each EHS event. In general, an athlete may be allowed to resume full competition after demonstrating sports specific exercise acclimatization and heat tolerance with no abnormal symptoms during the re-acclimatization period; this process normally requires a minimum of 2 wk to 4 wk (see Table 4).

WBGT (°C)			Continuous Activity and Competition for Individuals Who Are Highly Fit and Fully Acclimatized to High Heat Conditions[a,b]	Training and Noncontinuous Activity	
Region category[c]					
Category 3	Category 2	Category 1		Nonacclimatized, unfit, high-risk individuals [b]	Acclimatized, fit, low-risk individuals[b,d]
≤ 10.0	<8.7	<6.7	Generally safe; EHS can occur associated with individual factors	Normal activity	Normal activity
10.1 to 18.3	8.8 to 17.0	6.8 to 15.0	Generally safe. EHS can occur in individuals who are not acclimatized or have risk factors	Normal activity	Normal activity
18.4 to 22.2	17.1 to 20.9	15.1 to 18.9	Generally safe. Risk of EHS and other heat illness begins to rise; high-risk individuals should be monitored	Increased risk. Increase the rest/work ratio. Monitor fluid intake.	Normal activity
22.3 to 25.6	21.0 to 24.3	19.0 to 22.3	Risk for all active individuals is increased	Moderate risk. Increase the rest/work ratio and decrease total duration of activity. American rules football restrict equipment to helmet, shoulder pads, and shorts.	Normal activity. Monitor fluid intake. Limit protective equipment.
25.7 to 27.8	24.4 to 26.5	22.4 to 24.5	Risk for unfit, nonacclimatized individuals is high	Moderate high risk. Increase the rest:work ratio; decrease intensity and total duration of activity. No protective equipment during practice and no conditioning activities.	Normal activity. Increase rest breaks. Monitor fluid intake. Consider removing protective equipment. Provide at least three rest breaks per hour with a minimum duration of 4 mi each.
27.9 to 30.0	26.6 to 28.7	24.6 to 26.7	Very high risk[e] Cancel exercise or competition.	Very high risk.[e] Increase the rest:work ratio to 1:1, decrease intensity and total duration of activity. Limit intense exercise. Watch at-risk individuals carefully	Increase the rest:work ratio and decrease total duration of activity (<2 h). Plan intense or prolonged exercise with discretion, watch at-risk individuals carefully. No protectiv equipment during practice and no conditioning activities. Provide at least four rest breaks with a minimum duration o 4 min each.
30.1 to 32.2	28.8 to 30.9	26.8 to 28.9		Very high risk[e] Cancel or stop practice and competition.	Limit exercise time to ≤1 h, no conditioning activities, 20 mi of rest breaks distributed throughout exercise time, no protective equipment, watch for early signs and symptom
> 32.3	> 31.0	> 29.0		Extremely high risk.[e] Cancel exercise.	Extremely high risk.[e] Cancel exercise

Rhabdomyolysis

- Condition or syndrome of skeletal muscle breakdown with release of myocyte contents into the circulation
- Myolysis may arise from a variety of stresses that cause injury to muscle tissue
- Risk of developing metabolic abnormalities and acute renal failure are primary determinants of morbidity and mortality
- Must have severe muscle symptoms (pain, stiffness, and/or weakness) AND laboratory evidence of myonecrosis (CK level >5x ULN) in the setting of recent exercise

Rhabdomyolysis

Risk Factors

- Group Setting
  - Pressure to perform
  - Timed
  - Testing
- Preseason/Offseason
- Individual Factors
  - Training Load
  - Competitive
  - Conditioning Level
  - Supplement use
  - Genetic factors
- Hot, humid climate

High-risk Markers:

- CK >20,000 U/L
- Potential compartment syndrome
- AKI
- Metabolic/electrolyte abnormality
- SCT carrier
- Limited patient f/u

Proposed pathophysiologic sequence of events for ER

Exertional Rhabdomyolysis: Identification and Evaluation of the Athlete at Risk for Recurrence

Michelle E. Szczepanik, MD[1]; Yuval Heled, PhD, FACSM[2]; John Capacchione, MD[3]; William Campbell, MD[4]; Patricia Deuster, PhD, MPH[5]; and Francis G. O'Connor, MD, MPH[5]

Abstract

Exertional rhabdomyolysis (ER) is a common medical condition encountered by primary care and sports medicine providers. Although the majority of individuals with ER follow an expected and unremarkable clinical course without any adverse long-term sequelae or increased risk for recurrence, in others, the condition can serve as an ''unmasker'' of an underlying condition that portends future risk. We present two cases of warfighters with a history of recurrent ER who presented to our facility for further evaluation and a return to duty determination. We describe the definition, pathophysiology, epidemiology, etiology, and clinical course of ER. In addition, we introduce ''high-risk'' criteria for ER to assist in identifying individuals needing further testing and work-up. Finally we present a suggested algorithm that details the work-up of these individuals with high-risk ER to help identify underlying conditions that may lead to recurrence.

Introduction

Exertional rhabdomyolysis (ER) is a common medical condition encountered by primary care and sports medicine providers that results from muscle tissue breaking down with exercise. ER can range in presentation from asymptomatic physiologic elevations of creatine kinase (CK) noted after exercise to severe metabolic complications, which may lead to acute kidney injury (AKI), acute compartment syndrome, and in rare instances, fatal arrhythmias (10,12,15,16,20). Although the majority of individuals with ER follow an unremarkable clinical course without any long-term sequelae or increased risk for recurrence, some may be left with residual morbidity. In addition, in a minority of those who develop ER, exercise may function as an "unmasker" for identifying those with myopathic conditions, which may place the individual at increased risk for future recurrence.

Currently no evidence-based guidelines exist to assist the provider in identifying those who may return safely to play or duty from those who are potentially at higher risk for a repeat event. In this manuscript, we describe two cases involving warfighters who presented to our facility with recurrent ER with need for further evaluation prior to permitting return to duty. We review the definition, epidemiology, etiology, and clinical course of ER and highlight "red flags" in the clinical presentation that may identify those at increased risk for recurrence. Most importantly, we introduce criteria for identifying the high-risk ER patient and a suggested algorithm to assist in evaluating underlying conditions that may lead to recurrence.

Cases

Case 1

A 23-year-old Egyptian American male warfighter developed four episodes of ER, each was associated with decreasing levels of exertion over a 3-year period. He was active and healthy in high school and played soccer, volleyball, and basketball; his first episode of ER occurred after 1 d of intensive training during basic entry level military basic training. The next day, he developed severe muscle pain and limited motion and subsequently presented to the emergency department. He was treated as an outpatient with IV hydration and diagnosed with ER. His CK rose as high as 50,000 $U \cdot L^{-1}$ during his outpatient treatment and follow-up before he had full resolution of his elevated CK and symptoms of muscle pain and limited motion.

After this episode, he went on to complete basic training, including passing a physical fitness test without any further events. Eight months later, he had a second episode of ER with similar symptoms after a routine workout, and this time, he was hospitalized for aggressive fluid hydration. His

[1]Fort Belvoir Community Hospital, Fort Belvoir, VA, [2]The IDF Institute of Military Physiology, Heller Institute of Medical Research, Sheba Medical Center, Tel Hashomer, Israel; [3]Department of Anesthesiology, Uniformed Services University of the Health Sciences, Bethesda, MD; [4]Department of Neurology, Uniformed Services University of the Health Sciences, Bethesda, MD; and [5]Department of Military and Emergency Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD

Address for correspondence: Michelle E. Szczepanik, MD, Sports Medicine Fellow, Fort Belvoir Community Hospital, 9300 DeWitt Loop, Fort Belvoir, VA 22060; E-mail: Michelle.szczepanik@us.army.mil.

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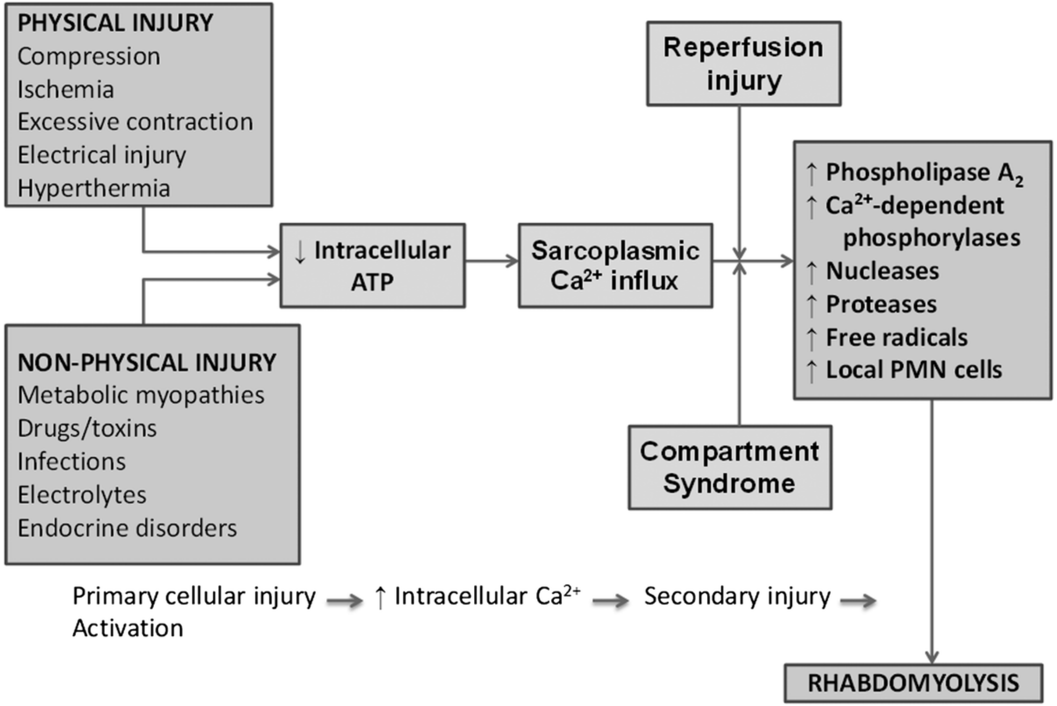
Current Sports Medicine Reports



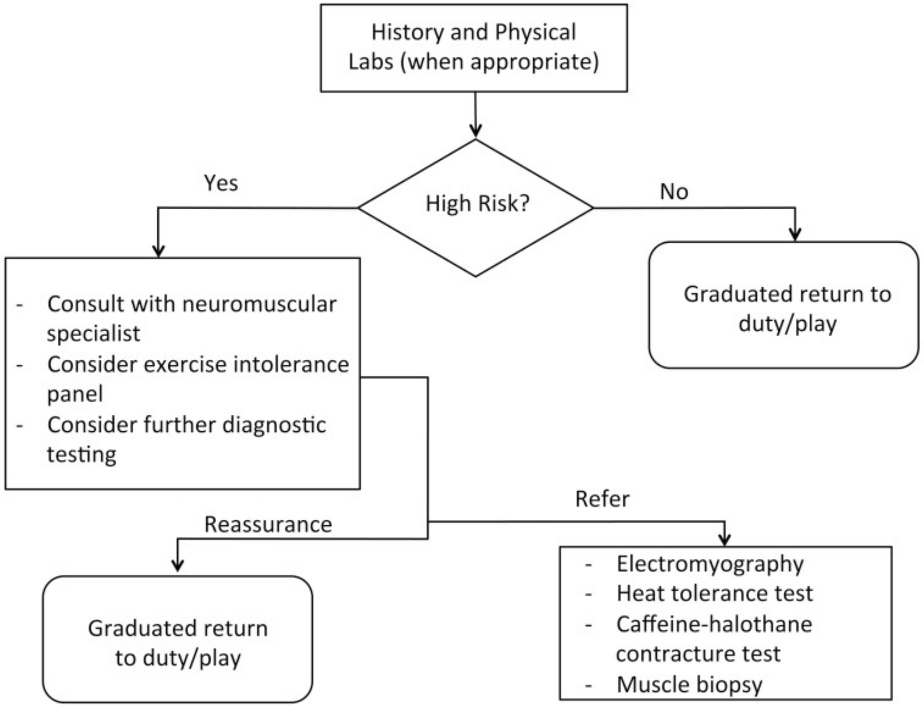
High Risk of Recurrence

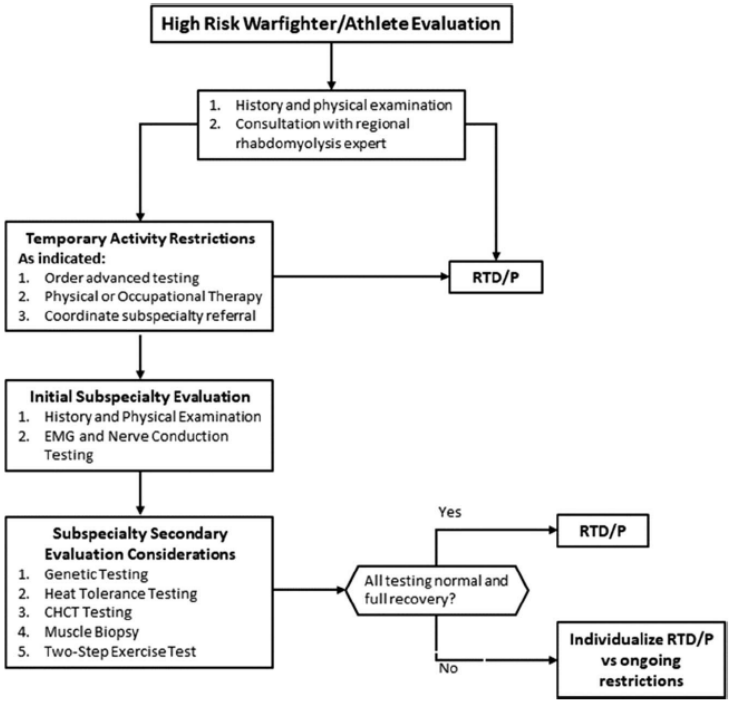
- Delayed clinical recovery, despite >1 week of activity restriction
- Persistent CK elevation >1,000 U/L, despite rest for at least 2 weeks
- ER complicated by AKI that does not return to baseline within 2 weeks
- ER after low to moderate workload
- ER complicated by drug or dietary supplement use
- CK peak >100,000 U/L
- Personal or family history of ER, recurrent muscle cramps or severe muscle pain, significant heat injury, sickle cell trait or disease, malignant hyperthermia, unexplained complications or death following general anesthesia
- Personal history of significant heat injury
- CK peak >100,000 U/L

Low Risk of Recurrence

- None of the high-risk conditions should exist
- A full clinical recovery within 1 week (symptoms and exam findings normalized)
- All laboratory values normalized within 2 weeks with exercise restriction
- **At least one** of the following conditions must also exist:
  - Physically trained warfighter with a history of very intense training;
  - Known participation in extreme conditioning program prior to event
  - No personal and family history of ER or previous reporting of exercise-induced severe muscle pain, muscle cramps, or heat injury;
  - Existence of other ER cases in the same training unit;
  - Identifiable period of sleep and/or nutrition deficit;
  - Concomitant viral illness or other infectious disease.

RTP Based on Risk of Recurrence





Return to Physical Activity After Exertional Rhabdomyolysis

Francis G. O'Connor,[1] Fred H. Brennan, Jr.,[2] William Campbell,[3] Yuval Heled,[4] and Patricia Deuster[5]

[1]Consortium for Health and Military Performance (CHAMP), Uniformed Services University of the Health Sciences, Bethesda, MD; [2]Seacoast Center for Athletes, Somersworth, NH; [3]Department of Neurology, Uniformed Services University of the Health Sciences, Bethesda, MD; [4]Heller Institute of Medical Research, Sheba Medical Center, Israel; [5]Consortium for Health and Military Performance (CHAMP), Uniformed Services University of the Health Sciences, Bethesda, MD

TABLE. Exertional rhabdomyolysis: return to play guidelines for the low risk athlete.

Phase One:

- Rest for 72 h and encourage oral hydration.
- Sleep 8 h consecutively, nightly.
- Remain in thermally controlled environment if ER occurred in association with a heat injury.
- Follow up in 72 h for repeat CK and UA.
- When the CK value is less than five times the upper limit of the lab normal range and the UA has returned to normal, begin Phase Two. Otherwise remain in Phase One, and return every 72 h and repeat until CK is less than five times the upper limit of the lab normal range and the UA has returned to normal.
- If CK remains greater than or equal to five times the lab upper limit of normal and/or the UA is persistently abnormal for 2 wk, refer for expert consultation.

Phase Two:

- Begin light activities, no strenuous physical activities.
- Physical activity at own pace and distance.
- Follow up with care provider in 1 wk.
- If no return of clinical symptoms, then begin Phase Three; otherwise remain in Phase Two and return at 1-wk intervals. May progress to Phase Three when there is no significant muscle weakness, swelling, pain, or soreness. If muscle pain persists without objective findings beyond 4 wk, consider specialty evaluation to include psychiatry.

Phase Three:

- Gradually return to regular sporting activities and physical training.
- Follow up with care provider as needed.

Return to Play After Exertional Rhabdomyolysis

Kevin Schleich, PharmD*; Tyler Slayman, BS*; Douglas West, PhD, ATC*; Kyle Smoot, MD†

*The University of Iowa, Iowa City; †University of Kentucky, Lexington

Table 1. Overview of Phased Return

Phase	Activities
I	Return to activities of daily living for 2 wk Regular monitoring by athletic training staff Screening for symptoms consistent with exertional rhabdomyolysis, sleep patterns, hydration, urine color, and class attendance Monitoring of creatinine kinase and serum creatinine by primary care physician
II	Daily monitoring of hydration status, muscle soreness, and swelling Initiation of physical activity: foam rolling, dynamic warm-up, aquatic jogging, and stretching
III	Daily monitoring of hydration status, muscle soreness, and swelling Progression of physical activity: body-weight resistance movements, resistance training with elastic band, core training, stationary bicycling, and stretching
IV	Daily monitoring of hydration status, muscle soreness, and swelling Initiation of resistance training at 20%–25% of estimated 1-repetition maximum, agility exercises, and running

Sickle Cell Trait

- SCT is found in ~300 million people
- Highest prevalence in sub-Saharan Africa (~30-40%)
- Concentrations also in Arabian Peninsula, India, Mediterranean, and southern US
- Can be associated with significant morbidity and mortality
- Average life span is similar to that of the general population

Tsaras, Geoffrey et al. "Complications Associated with Sickle Cell Trait: a Brief Narrative Review." The American journal of medicine. 122.6 (2009): 507–512.

SCT Screening

- Newborn screening for SCD adopted as a public health imperative in the US in 2008
- NCAA testing requirement implemented in 2010 – athlete can opt out
- Genetic testing is currently exploratory

Prevention of Sickling

- Knowledge of SCT status
- Education about what exertional sickling is
- Modification and Recognition

Sickle Cell Considerations in Athletes

- Many of the deaths have occurred after strenuous exercise in unconditioned military recruits or deconditioned athletes in the pre-season.
- Increased risk related to repeated intense exercise bouts with limited recovery over a short period of time.

Eichner, E Randy. “Sickle Cell Considerations in Athletes.” Clinics in sports medicine. 30.3 (2011): 537–549.

Exercise Collapse Associated with SCT

- ECAST – coined by SCT summit in 2011
- 2019 summit goals
  - Review current service policies on SCT screening
  - Develop draft procedural instructions for executing current policy on SCT within the Department of Defense
  - Develop draft clinical practice guidelines for management of ECAST
  - Establish a framework for education on SCT and ECAST
  - Prepare a research agenda to address identified gaps

O'Connor, Francis G et al. "Summit on Exercise Collapse Associated with Sickle Cell Trait: Finding the 'Way Ahead'." Current sports medicine reports. 20.1 (2021): 47–56.

Recognition

- Conscious, Cramp-like, Collapse
  - Severe pain, out of proportion to exam
  - Muscles painful to move but flaccid, not cramping
- Sickling worsens in:
  - Hypoxemia, H ions (acidosis), Hyperthermia, deHydration
- Theory: High intensity, maximal effort with minimal recovery?
- Terrible T's (too fast, too much, too soon timed test, tyrannical trainer)
  - Preseason, offseason, too little recovery, timed testing

Precautions on RTP

- Exercise Acclimatization
- Environmental Acclimatization
  - Heat and Altitude
- Attention to Hydration
- Careful Assessment of Medications and Supplements
  - Optimize Medical Management of Asthma
- Athlete and Staff Education
  - Work/Rest Attention
- Emergency Action Plan

Exclusion From Further Participation

- Individualize
- Careful analysis of the event, individual risk factors, ability to mitigate risk, and the inherent demands of the activity.
- Risks of further participation in military service are unique from controlled setting in the sports arena.

Who is at risk for recurrence?

- Unknown at this time – clinical research needed
- Likely comparable to EHS – requires careful analysis of the event and potential contributing factors

Who needs further evaluation?

- Unknown at this time – clinical research needed
- Consider if:
  - History of recurrent events
  - Fulminant collapse
  - Family history
  - Abscence of clear risk factors
- Work-up to consider:
  - Evaluation by hematologist
  - Heat tolerance testing
  - Testing for malignant hyperthermia Susceptibility

	ER	Heat Exhaustion	EHI (Heat Stroke)	ECAST
Presentation	Few days after event	Day of	Day of	Day of
Mental Status	Normal	Normal	Confused	Normal
Core Temp	Normal	<104°F	≥104°F	<104°F
Risk Factors	5 T's	Heat, prior hx	Heat, prior hx	SCT, 4H's & 5 T's
Type of Exercise	5 T's, variable (short or long)	Longer duration	Longer duration	5 T's, short, max intensity
Muscles	Painful, taught	Mild	Mild	Severe weakness/pain, flaccid
Treatment	Oral / IVF, rest	Rest, cooling, shade, oral hydration	Rapid cooling	Rapid recognition and EMS/transport