USAMRDC USARIEM

U.S. ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE

MISSION

To provide solutions to enhance Warfighter health and performance through biomedical research

BACKGROUND

USARIEM was established in 1961 as a research laboratory under the U.S. Army Medical Research and Development Command. USARIEM, internationally recognized as the DoD's premier laboratory for Warfighter health and performance research, focuses on environmental medicine, physiology, physical and cognitive performance, and nutrition research. The Institutes's research divisions - Biophysics and Biomedical Modeling, Military Nutrition, Military Performance, Thermal and Mountain Medicine - conduct basic and applied biomedical science to sustain the health and operational effectiveness of the Army. USARIEM research supports needed Soldier Readiness to successfully deploy, fight and win any-time, anywhere with optimized performance and fewer injuries. Leveraging its unique capabilities, facilities and partnerships with industry, academia, and the government, USARIEM produces a variety of important solutions for training and operations keeping Soldiers in the fight and requiring fewer Soldiers needed to care for preventable injuries. These solutions include leader decision aids, performance optimization doctrine, preventive medicine and planning doctrine, materiel development support, physiological monitoring strategies and predictive algorithms, and Health Hazard Assessments. USARIEM research also anticipates future demands that will likely require further development of solutions for rapidly changing and com plex conflict environments, such as those experienced by expeditionary forces.

QUESTIONS & ANSWERS

Does USARIEM track the long-term health of Soldiers?

USARIEM has developed the Soldier Performance Health and Readiness Database, or SPHERE, which joins multiple personnel and health data sets from numerous DoD agencies. SPHERE links four general categories of data: demographics, health outcomes (e.g., hospitalizations, outpatient visits, lost-time injuries, permanent disabilities, and fatalities), self-reported health habits and risk-taking behaviors from surveys, and chemical exposures from the Defense Occupational Health Readiness System. Research epidemiologists at USARIEM use the databases to directly link Army personnel records, self-reported health habits, and chemical and noise exposures to specific health outcomes and to trace the interrelationship of these outcomes and exposures over time. Analysis of broad categories of data from multiple sources over time will give researchers an improved understanding of where to optimally focus injury and illness prevention resources.

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KEY THEMES AND MESSAGES

Executes biomedical performance research to develop strategies and solutions that safely enhance Warfighter physical, cognitive, sensory and behavioral performance.

Studies the physiological mechanisms underlying musculoskeletal injuries to identify countermeasures to mitigate injury risk.

Provides practical solutions for Warfighter problems using a collection of unique thermal manikins, comprehensive mathematical modeling, and innovative sensor systems.

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QUESTIONS & ANSWERS

What are the environmental and occupational stressors that affect Warfighter performance?

Environmental stressors are the events or forces in the human or natural environment that lead to a person experiencing stress. Environmental stressors include air pollution, temperature extremes and hypoxia at high altitudes, or in subterranean locations. Environmental stressors affect a person's performance, mood, behavior, physical health, physical and cognitive function, and/or psychological well-being. A broad array of stress-related disorders and conditions exist, including musculoskeletal injuries, psychological and emotional disorders, maladaptive behaviors (including substance abuse), and cognitive impairment. Long-term occupational stress can lead to compromised health, including cardiovascular disease.

How does USARIEM research help with these stressors?

USARIEM developed the U.S. Army doctrine for heat, cold, musculoskeletal overuse, altitude, nutrition, water consumption, and work–rest cycles to help reduce the impact of environmental and occupational stressors under all conditions. USARIEM has carried out research on heat acclimation to promote combat effectiveness and reduce casualties and cold research on the management, pathogenesis, and treatment of cold injuries, including trench foot, frostbite, and hypothermia. Its Thermal Mountain Medicine Division conducts basic and applied research on problems encountered by military personnel exposed to acute and long-term subnormal levels of oxygen (e.g., oxygen levels associated with high terrestrial elevations, subterranean, confined areas of operation, or artificial breathing apparatus). The U.S. Army Training and Doctrine Command, or TRADOC, partnered with USARIEM's Military Performance Division, or MPD, to conduct the Physical Demands Study. The study was used to determine the physical requirements necessary to perform all combat-type jobs, including infantry, armor, artillery and engineering. Based on these findings, the Occupational Physical Assessment Test or OPAT was developed. OPAT is administered to all Army recruits.

What has USARIEM done to support the nutritional needs of Soldiers?

Its Military Nutrition Division, or MND, conducts research that provides the biomedical science basis for developing new rations, menus, policies, and programs that enable Soldier health and performance. MND evaluates Soldier nutritional status and examines interactions between nutrition, health, performance, and the operational environment. The Performance Readiness Bar, or PRB, with supplemental calcium and vitamin D to improve nutritional status and bone health during Initial Military Training, was the result of an MND research collaboration with the Combat Capabilities Development Center Soldier Center, Combat Feeding Directorate, demonstrating that Soldiers needed higher levels of calcium and vitamin D during basic training. The PRB is offered to recruits in all Basic Training Schools beginning in 2018.

What capabilities does USARIEM bring to reducing musculoskeletal injuries and restoring readiness in Warfighters?

Lost duty time and reduction of readiness are the costly results of musculoskeletal injuries. USARIEM's Military Performance Division (MPD) has developed an ecosystem with DOD, international and academic partners to conduct research aimed at reducing injury and other negative health outcomes and improving Soldier Return to Duty. MPD's ARIEM Reduction of Musculoskeletal Injury (ARMI) Study, an extensive field study, also employs advanced, high-resolution bone and muscle imagining to identify the physiological mechanisms underlying MSKIs during basic combat training. This study will produce evidence-based, actionable recommendations to Army leadership to reduce MSKI in recruits without reducing training standards. USARIEM is a founding partner in the new S2PRINT facility to be constructed on the Natick Soldier Systems Center to add to its ability to conduct squad level biomechanics studies.

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KEY THEMES AND MESSAGES

Defines the nutritional requirements of Warfighters coupled with interventions that enable lethality and overmatch.

Studies the impact of environmental stressors of heat, cold, high terrestrial & subterranean environments on medical readiness and perfromance.

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QUESTIONS & ANSWERS

What facilities does USARIEM use to conduct research on extreme environmental conditions?
The U.S. Army's premier hypobaric chamber, located at USARIEM, can simulate heat, cold, and humidity extremes and any terrestrial elevation found in the world, especially in areas of geopolitical importance where troops may be sent. The advantage of a hypobaric chamber is that sophisticated measurements can be made repeatedly on small groups of volunteers that would be impossible in the field. The hypobaric chamber facility is composed of a large chamber and a small chamber both connected to an airlock that allows entry into either chamber when at the same pressure. The facility is complete with a shower, toilet, and running water.

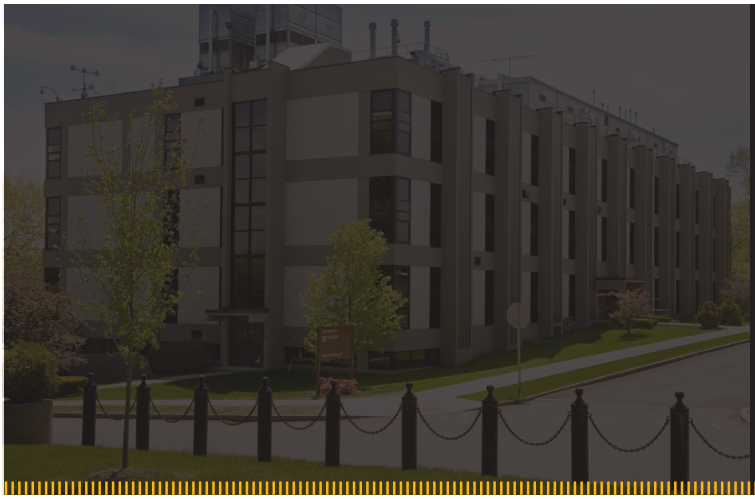
USARIEM also has environmental chambers used for human studies and biophysical evaluations. Research conducted in these chambers has contributed to critical operational guidance used by field commanders in Operation D esert Shield/ Desert Storm, Operation Iraqi Freedom/Operation Enduring Freedom, and other military operations. Research conducted at the Doriot Climatic Chambers has also contributed to the development of Technical Bulletin 507 "Heat Stress and Heat Casualty Management," Technical Bulletin 508 "Prevention and Management of Cold Weather Injuries," and Technical Bulletin 505 "Altitude Acclimatization and Illness Management." These bulletins provide current medical guidance. A Technical Bulletin on injury prevention is expected to be published soon. A variety of publications are available online at www.usariem.army.mil.

For larger studies involving more subjects or longer exposure times, a field environment is ideal. USARIEM has a laboratory on the summit of Pikes Peak at 14,115 feet. The laboratory has been in almost continuous operation since 1969. U.S. Army research studies conducted at the Pikes Peak Laboratory and at other high-altitude sites have provided necessary data for the U.S. Food and Drug Administration to accept Diamox®, the only drug currently approved for the prevention and treatment of Acute Mountain Sickness. USARIEM also conducts field studies at U.S. military posts and training centers.

What capabilities does USARIEM use to perform cognitive and behavioral research related to various stressors?
Using research procedures ranging from questionnaires to mental tests to combat skills performance testing, USARIEM scientists are able to understand and quantify performance changes due to operational stress. This allows the development of unique procedures to sustain and enhance Soldier performance under extreme conditions.

USARIEM uses a wide range of computer-based psychological and cognitive assessments. Assessment techniques developed at USARIEM and routinely used in the laboratory include the Sentry Duty Simulation Model for evaluating vigilance, target detection, and rifle firing accuracy and the Environmental Symptoms Questionnaire, a symptom assessment tool that is used both in the laboratory and the field and has been adopted and translated for use by numerous foreign nations.

USARIEM has expanded its capabilities to conduct cognitive performance research more specific to Soldier related tasks with a new Warfighter Cognitive Performance Laboratory. This 800 square foot facility houses the EST 2000, a widely used weapon engagement simulator that can mimic the ballistic characteristics of 25 different weapons. New marksmanship scenarios can be created. The enhanced capabilities of the EST 2000 make it possible to test several measurement paradigms: marksmanship, shoot—don't shoot, vigilance (or information overload), discrimination of friend versus foe, and motor steadiness under varied situations. These include workload (information or physical), simulated sustained operations, fragmented and inadequate sleep, physiological or metabolic disruption, fatigue (central systemic or localized muscle), and therapeutic strategies.



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QUESTIONS & ANSWERS

How does USARIEM contribute to advancing Physiological Status Monitoring to sustain Readiness?
USARIEM's Biomedical and Biophysical Modeling Division brings extensive expertise in mathematical modeling, deep understanding of human physiology and global research partners to develop the embedded decision aid software in the On Body Area Network Physiological Status Monitoring system (OBAN-PSM). Real time sensors monitoring the status and changes in human performance augment commanders' understanding of their units, inform decisions about the tempo of training and operations. Between 2008 and 2012 there were over 13,000 incidents of heat illness in the U.S. military including 1,867 cases of heat stroke. A real-time PSM system can inform medical personnel about Soldiers who have impending heat injury. USARIEM's Heat Strain Decision Aid (HSDA) allows leaders to adjust factors such as uniform configuration, load carried, coupled with the time of day to gauge how these alterations in training can mitigate heat injury/illness risk.

What products have been developed by USARIEM?
USARIEM has been instrumental in developing numerous products, models, and guidelines for the Soldier, including:

Occupational Physical Assessment Test (OPAT)
- USARIEM research finalized the OPAT for TRADOC with the goals of reducing injuries and attrition in initial military training.
- Rolled out Army-wide in 2017, every recruit who wants to enter Army service must take the OPAT and reach a specific threshold score in order to ship to training.

Altitude Readiness Management System (ARMS)
- Decision aid informs leaders with the probability and severity of high altitude-induced illness or work performance impairment for personnel ascending to altitudes between 2000 – 4500 meters.
- Provides capabilities to better plan training and operational missions at high altitudes and mitigate the impact of altitude on health and performance.

Cold Weather Estimation Decision Aid (CoWEDA)
- Predicts risks of frostbite, hypothermia and excessive sweating
- Scenario specific to include environmental conditions, activity levels, and clothing properties.

Soldier Water Estimation Tool (SWET)
- Decision aid that estimates drinking water requirements from five simple inputs: activity level, military clothing, temperature, relative humidity, and cloud cover.
- Gives leaders a field expedient capability to accurately plan drinking water requirements and thus sustain health and performance.

Heat Strain Decision Aid
- Decision aid tool designed to help determine the risk of heat illness/injury for a given training environment.
- Allows for leaders to adjust training factors such as uniform configuration, load carried, the time of day to assess how these alterations in training can mitigate heat injury/illness risk.

Intelligent Heat Acclimation Training Tool (iHATT)
- Individualized heat training tool jointly developed with UK Ministry of Defense.
- Prevents heat injuries by helping soldiers safely adapt to hot environments as fast as possible.
- Patent pending and available for licensing by commercial partners.

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