



USAMRMC STRATEGIC INFORMATION PAPER

U.S. ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE (USARIEM)

MISSION

The U.S. Army Research Institute of Environmental Medicine provides solutions to enhance Warfighter health and performance through medical research.

BACKGROUND

USARIEM was established in 1961 as a research laboratory under the U.S. Army Medical Research and Development Command (now USAMRMC). USARIEM is internationally recognized as the DoD's premier laboratory for Warfighter health and performance research and focuses on environmental medicine, physiology, physical and cognitive performance, and nutrition research. Military guidance has been published for operations in heat, cold, and high-altitude environments and nutrition for health and performance.

The Institute is organized into five divisions: Biophysics and Biomedical Modeling, Military Nutrition, Military Performance, Thermal and Mountain Medicine, and Research Support. By leveraging its unique capabilities and facilities with industry, academia, and the government, USARIEM produces a variety of important products, including performance optimization doctrine, preventive medicine and planning doctrine, materiel development support, physiological monitoring strategies and predictive algorithms, and Health Hazard Assessments. USARIEM personnel were consultants on the establishment of the Olympic Training Center in Colorado Springs, Colorado.

The U.S. Army Training and Doctrine Command, or TRADOC, has partnered with USARIEM to conduct the Physical Demands Study. The study will be used to determine the physical requirements necessary to perform all combat-type jobs, including infantry, armor, artillery and engineering.

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QUESTIONS & ANSWERS

Q *How do you define environmental and occupational stress?*

A Environmental stress is defined as events or forces in the human or natural environment that lead to a person experiencing stress. Environmental stressors include noise, air pollution, traffic congestion, crowding, natural disasters, terrorism, and extremes of temperature. Environmental stressors can affect a person's mood, behavior, physical health, cognitive function, and/or psychological well-being. Occupational stress is defined as the harmful physical and emotional responses resulting from a poor match between the demands of a job and the needs, capabilities, or resources of a worker. Poor job performance is a typical result of occupational stress. A broad array of stress-related disorders and conditions exist, including psychological and emotional disorders, maladaptive behaviors (including substance abuse), and cognitive impairment. Long-term occupational stress can lead to compromised health, including cardiovascular disease.

Q *What environmental and occupational stressors affect the military and what is USARIEM doing to help?*

A Soldier performance can be adversely affected by numerous occupational and environmental factors, including nutrition, hydration, heat, cold, altitude, fatigue, and combat stress. USARIEM has developed the U.S. Army doctrine for heat, cold, altitude, nutrition, and water consumption and work–rest cycles to help reduce the impact of environmental and occupational stressors under all conditions. Heat acclimation to promote combat effectiveness and reduce casualties has also been studied. Cold research on the management, pathogenesis, and treatment of cold injuries, including trench foot, frostbite, and hypothermia, has been carried out. The Altitude Research Group 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, confined areas of operation, or artificial breathing apparatus).

KEY THEMES AND MESSAGES

USARIEM produces training policy and guidelines that provide recommendations to enhance Warfighter capabilities and reduce health risks.

USARIEM produces preventive medicine guidelines to minimize Warfighter injuries and reduce lost duty time and medical costs.

USARIEM recommends product improvements for clothing, equipment, nutrition, and pharmaceuticals by providing design specifications to improve individual Warfighter equipment and rations.

USARIEM develops strategies for personal physiological status monitoring and a variety of algorithms to prevent and detect Warfighter performance decrements.

USARIEM coordinates Health Hazard Assessments with the U.S. Army Public Health Command for thermal and hypoxic conditions.



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Q *What facilities does USARIEM use to conduct research on extreme environmental conditions?*

A 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 conducts much of its research at the Doriot Climatic Chambers, located on site at the Natick Soldier Systems Center. These chambers can simulate arctic and tropic conditions. These chambers are 60 feet long, 11 feet high, and 15 feet wide. The chambers are large enough to test shelters, parachutes, and other Army equipment. Five-person treadmills are used to assess the effects of ambient heat or cold on the physical performance and physiological responses of Soldiers.

The chambers are among the largest and most sophisticated environmental test chambers in the world. Research conducted in these chambers has contributed to critical operational guidance used by field commanders in Operation Desert 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 14,110 feet. The laboratory has been in almost continuous operation since 1966. It is composed of two laboratory rooms, a medical aid room, dormitory, kitchen, laundry area, and bathroom with showers and can accommodate up to 16 human research volunteers for an indefinite period of time. 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 has environmental chambers used for human studies and biophysical evaluations.

Q *What facilities does USARIEM use to perform cognitive and behavioral research related to various stressors?*

A USARIEM's Psychology and Psychomotor Performance Laboratory provides cognitive and behavioral evaluations of Soldier performance during exposure to operational stressors, including: extended mental alertness, simultaneous and multiple task performance, combat diet regimens, combat-specific medications (e.g., chemical agent antidotes), and



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clothing systems (e.g., chemical protective gear). 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.

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; the Automated Peripheral Vision Device for evaluating reaction time and detection sensitivity over the entire visual field; 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 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.

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

A The Military Nutrition Division at USARIEM defines nutritional standards for operational rations, develops nutritional strategies to support and enhance military performance during sustained operations in all conditions, and evaluates the effects of rations on health, nutritional status, and performance. The Military Nutrition Division has also conducted field trials on a cold-weather ration and a lightweight ration for special operations. Working with Natick's Combat Feeding Directorate, a nutritionally optimized, eat-on-the-move First Strike Ration has been fielded.

Q *What products have been developed by USARIEM?*

A USARIEM has been instrumental in developing numerous products, models, and guidelines for the Soldier, including:

Cold Exposure Guidelines

- Developed to prevent and reduce hypothermia and cold-related injuries to service members.
- Examples include “Sustaining Health and Performance in Cold Weather Operations” and the training aids “Cold Weather Casualties and the Injuries Chart” and “Avoid Cold Casualties.”
- Developed the PSDA for the U.S. Coast Guard Research and Development Center.



DoD Body Fat Assessment Methods and Standards

- Developed to provide consistency among the services when providing physical evaluation of service members.
- The prevention of obesity in the military will lead to the increased combat readiness of service members.

Environmental Strain Prediction Models

- Developed to predict individual and unit-level performance outcomes based on environmental and operational variables.
- Provide mission planners and leaders the ability to simulate missions using accurate predictions regarding service member performance in environmental extremes.

Heat Exposure Guidelines

- Developed to prevent and reduce heat-related injuries to service members.
- Examples include the “Heat Injury Protection Guide,” the “Heat Acclimatization Guide,” and the Technical Bulletin guidance document for health care providers entitled “Heat Stress Control and Heat Casualty Management.”

Performance-Enhancing Ration Components

- Added to rations to increase service member endurance.
- Examples include the First Strike™ Bar and the ERGO Drink, which offset fatigue and stress effects on performance.

Sweat Prediction Models

- Developed to aid in determining the water needs of service members.

Q Does USARIEM track the long-term health of Soldiers?

A USARIEM has developed the Total Army Injury and Health Outcomes Database (TAIHOD), which joins multiple personnel and health data sets from numerous DoD agencies. TAIHOD 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.