US Army Research Institute of Environmental Medicine

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Deputy Director Science & Technology

The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or as reflecting the views of the Army or the Department of Defense.
Why do we exist?
To research and develop solutions to optimize Soldiers’ health and performance in all environments.

What do we do?
Performance physiology, biomedical modeling, environmental stress (altitude/heat/cold), musculoskeletal injury, nutrition, resilience and cognitive performance.

Locations:
- GEN Leonard Wood Building, Natick Soldier Systems Center, Natick, MA.
- Maher Memorial Altitude Laboratory, Pikes Peak, Colorado.
USARIEM is a subordinate command of the U.S. Army Medical Department’s Medical Research and Materiel Command (USAMRMC), Ft. Detrick, MD.

USAMRMC:
Has responsibility for medical research, development, and acquisition and medical logistics development and carries out research in five basic areas (Military Operational Medicine, Combat Casualty Care, Military Infectious Disease, Medical Biological Defense, Medical Chemical Defense).

USAMRIID Ft Detrick, MD
WRAIR Forest Glenn, MD
USAMRICD Aberdeen PG, MD
USAARL Ft Rucker, AL
USAISR Ft Sam Houston, TX

USARIEM Natick, MA
Injury Prevention & Reduction:
- Blast-related injury
- Musculoskeletal injury
- Ocular/facial injury
- Auditory and vestibular injury

Physiological Health & Performance:
- Nutrition

Environmental Health & Protection:
- Real-time physiological status monitoring
- Performance in extreme environments
- Health effects of nanomaterials

*The Human Dimension White Paper, United States Army Combined Arms Center, 9 October 2014
USARIEM Roots In Massachusetts

1853
Pacific Mills, Lawrence, MA: *Wool and Cotton Clothing Design and Manufacturing*

1927
Harvard Fatigue Laboratory, Harvard School of Business: *Human Performance & Environmental Physiology*

1943
Climatic Research Laboratory, Quartermaster General R&D Branch: *Jointly Staffed by Quartermaster & The Surgeon General*

1954
Environmental Protection Research Division (EPRD), Quartermaster Research & Engineering Command, Natick, MA

1961
USARIEM formed from elements of the EPRD and the Armored Medical Research Laboratory (Ft. Knox, KY)

Industry & Academia
USARIEM Organization

Commander
COL Raymond Phua

Deputy Commander
LTC Glen Manglapus

Research Support Division
MAJ Laura McGhee

Deputy Director, Science & Technology
Dr. Stephen Muza

Military Detachment
CPT Jeb Orr

Biophysics & Biomedical Modeling Division
Dr. Reed Hoyt

Military Nutrition Division
Dr. Scott Montain

Thermal & Mountain Medicine Division
Dr. Lisa Leon

Military Performance Division
Dr. Susan Proctor

Federal Civilian Personnel: 95
Military Personnel: 60
Interns, Contractors: 80
Specialized USARIEM Research Facilities

- Hypobaric Chambers
- Biomechanics Lab
- Water Immersion Lab
- Thermal Chambers

Human Performance Laboratories
• Wide ranging environmental conditions
USARIEM research supports Warfighters and Army Medicine…every day

- Physiologically-Based Guidelines for Performance Optimization and Injury Prevention During Training & Operations
- Occupational & Environmental Exposure Limits and Health Risk Prediction & Assessment Models
- Strategies to Enhance Warfighter Readiness & Resilience
- Biomedical Strategies to Sustain Performance in Continuous Operations
- Nutrient Specifications for Rations
- Biomedically-Based Design Criteria for Individual Protection Systems
- Interventions and tools for Soldiers and family members to attain and maintain fitness and healthy weight
- Products and Guidance to the Warfighter
**Major areas of research**

**Biophysics & Biomedical Modeling**
- Biomedical Modeling
- Non-Combat Injury Prevention Modeling
- Physiological Monitoring
- Biomedical Sensors

**Military Nutrition**
- Nutritional Physiology & Metabolism
- Dietary Requirements
- Eating Behavior & Food Choices
- Nutritional Evaluation of Field Rations
- Dietary supplements

**Thermal & Mountain Medicine**
- Heat Stress Physiology
- Cold Stress Physiology
- Altitude and Hypoxia Stress
- Protective Equipment and Microenvironment
- Hydration

**Military Performance**
- Physical Performance Optimization
- Injury Reduction/Bone Health
- Military Biomechanics
- Cognitive Performance
- Injury Epidemiology
- Deployment Health & Protection
BBMD Mission

Develop and use biomedical models, wearable physiological sensors, and field-expedient methods to understand and optimize health, readiness, and performance of Warfighters engaged in demanding training and operations.

Core Capabilities

• Biophysics – assess biophysical properties of CIE
• Predictive biomedical modeling
• Field experimentation
• Wearables – Physiological Status Monitoring
• Field-expedient metabolic monitoring techniques
• Army Requirements for the RT-PSM
  – Open architecture
  – Monitors and records basic vital signs of Soldiers
  – Secure wireless communication with Leaders and Medics
  – Creates actionable information for Leaders to make an informed decision
  – Small, lightweight, and lasts for an extended duration
Improve current commercial technologies to meet Army requirements. Needs include:

- **Improve Actionable Information Provided**
  - *Currently provides heart-rate, respiration rate, and body position*
  - *Must provide core body temperature, skin temperature, hydration status, oxygen levels, and blood loss*

- **Improve Communication Medium for Secure Wireless**
  - *Currently using Bluetooth Low Energy (BTLE)*
  - *Ultra-wide Band and Tunable Narrow Band are more secure*

- **Improve Size, Weight, and Power (SWAP)**
  - *Currently runs continuously for 8 hours*
  - *Must run continuously for 72 hours, requires less power consumption and size reduction*
MND MISSION:

Conduct basic and applied research that provides the biomedical science basis for developing new rations, menus, policies and programs that enable Warfighter health-readiness and optimal performance.

Research Thrusts:

- Recovery Nutrition
- Healthy Eating
- Dietary Supplements
- Physiological Resilience
Current Program Areas

- **Recovery Nutrition** – Develop evidence-based nutritional approaches to promote rapid recovery between missions & restore post-deployment health and fitness
- **Physiological Resilience** – Develop evidence-based nutritional approaches to enhance resilience to operational stress
- **Nutritional Neuroprotection** – Identify and test novel neuroprotective countermeasures in increase tolerance to and improve recovery from mTBI
- **Military Feeding & Combat Ration Support** – Support ration evaluations, continuous ration improvement programs, and nutrition health policy/program development.
- **Dietary Supplement Research** – Surveillance of use patterns, adverse health effects, safety & efficacy evaluations, limited research on selected DSs.
MND S&T Challenges

• Research Methods/Capabilities
  • Gut microbiome sampling
  • Approaches for assessing metabolic state/flux in field situations

• Food Technology
  • Approaches for stabilizing nutrients in complex matrix
**TMMD Mission:**

Conduct research to sustain and enhance performance (physical & cognitive) and minimize medical problems associated with military operations at environmental extremes (heat, cold, & high terrestrial altitude).

**Research Thrusts:**

- Heat Stress
- Cold Stress
- High Terrestrial Altitude & Hypoxia Stress
- Hydration
- Protective Equipment & Microenvironment
S&T Needs for Environmental Stressors

- Individualized risk prediction
- Real-time physiological monitoring
- Whole body hydration monitoring
- Pharmaceuticals / nutraceuticals to prevent or treat environmental injury
- Biomarkers of recovery from heat stroke/injury and altitude sickness
- Portable, low-power microclimate heating or cooling
- Portable, low-power oxygen delivery
MPD MISSION:
Conduct research to **optimize performance** (physical, cognitive, behavioral and psychomotor) of military occupational tasks or **prevent or mitigate performance decrements** due to physical overload, nutritional deprivation, environmental and occupational stresses, or musculoskeletal injury

Research Thrusts:
- Musculoskeletal Injury Reduction
- Physical Performance Optimization and Assessment
- Return to Duty Following Musculoskeletal Injuries
- Military Biomechanics
- Injury and Performance Epidemiology
- Military Cognitive Performance and Readiness
Musculoskeletal Injury Questions:

- Injury mechanisms
- Injury “biomarkers”
- Anti-inflammatory strategies
- Mechanical forces
- Biomechanics - gait patterns
- Computer Modeling - Injury prediction
- Stress fracture – quantification
- Bone health – exercise training programs

- Bone health – interventions
  - Mechanical loading
  - Vibration
- Bone assessment: structure
- Quantification of injuries
- Risk factors (acute injury)
- Evaluation of interventions (PAB)
- Disability (musculoskeletal) risk factors

Needed R&D Capability: Free ranging ambulatory biomechanics data collection
We Partner
With Massachusetts

CONTRACTS
for services and products

EQUIPMENT LOANS
Local universities

COMMERICAL TEST AGREEMENTS
Altitude Chamber use by small businesses

US Army Patent LICENSEE
Exclusive worldwide license to DESIGN TURN of Wellesley, MA

RESEARCH PARTNERS
- MGH (bone health)
- BWH (biomarkers distinguishing mTBI and PTSD)
- WPI, GORDON COLLEGE (biomechanics running injuries)
- MASSACHUSETTS REHABILITATION COMMISSION AND BU (persistent post-concussive syndrome)
- TUFTS (healthy eating)
- Boston Athletic Assoc. (microclimates)

INTERNSHIPS
UMASS Amherst, Lowell & Boston; WPI, BC, Stonehill, Holy Cross, Tufts, NEU and BU

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Select **PARTNERING** link to learn more about Working With Us (http://www.usariem.army.mil)

Submit -- New Product or Idea, Research Proposal and Find Licensing opportunities for Technology Transfer
Extramural Research Funding

The U.S. Army Medical Research and Materiel Command funds a broad range of extramural research programs. Awards are contracts, grants, or cooperative agreements. The USAMRMC BAA FY17 (Funding Opportunity Announcement Number W81XWH-17-R-BAA1) is continuously open, or through special USAMRMC BAA Announcements, which are open for limited timeframes.
Opportunities for Small Business Innovation Research (SBIR) allow small U.S. businesses (less than 500 employees) an opening to provide innovative research and development solutions in response to critical Army needs. On the MRMC Small Business website, you’ll find links to SBIRs and to submit new product ideas: 

http://www.mrmc.smallbusopps.army.mil
Other Product/Services Entry Points with the U.S. Army

• Government Point of Entry
  ✔ For Commercial Off the Shelf products, unique service or capability for sale. Single point where Government business opportunities > $25,000, including synopses of proposed contract actions, solicitations & associated information can be accessed electronically by the public.

• The Army Single Face to Industry (ASFI)
  ✔ U.S. Army’s designated site to host all Army contracting opportunities. Army contracting personnel use the application to post procurement notices. Vendors (also referred to as ‘industry’) use the application to locate and respond to Army solicitations for goods and services.
  Note – not all award postings are available on the ASFI.

www.fbo.gov

https://acquisition.army.mil
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USARIEM R&D FY16 Funding

USAMRMC Military Operational Medicine Research Program ($16.4M)

- DoD Defense Health Agency ($8.8M)
- Army, Navy, Marines, Air Force, Special Operations, Federal Agencies ($0.5M)
- Industry ($0.4M)