



*U.S. Army Medical Research and Materiel Command  
Walter Reed Army Institute of Research*

# Physiological Monitoring for Life Signs Detection and Remote Triage for the Objective Force Medic

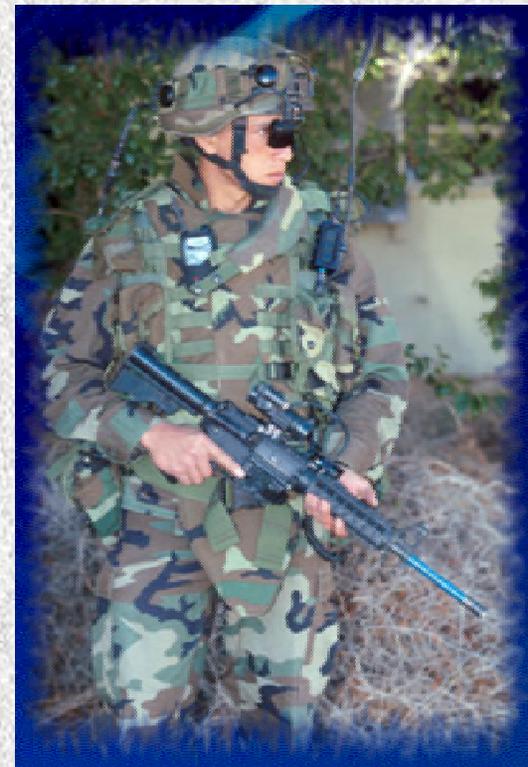
Frederick J. Pearce, Ph.D.

Chief, Department of Resuscitative Medicine

Walter Reed Army Institute of Research

Phone: 301-319-9761      FAX: 301-319-9839

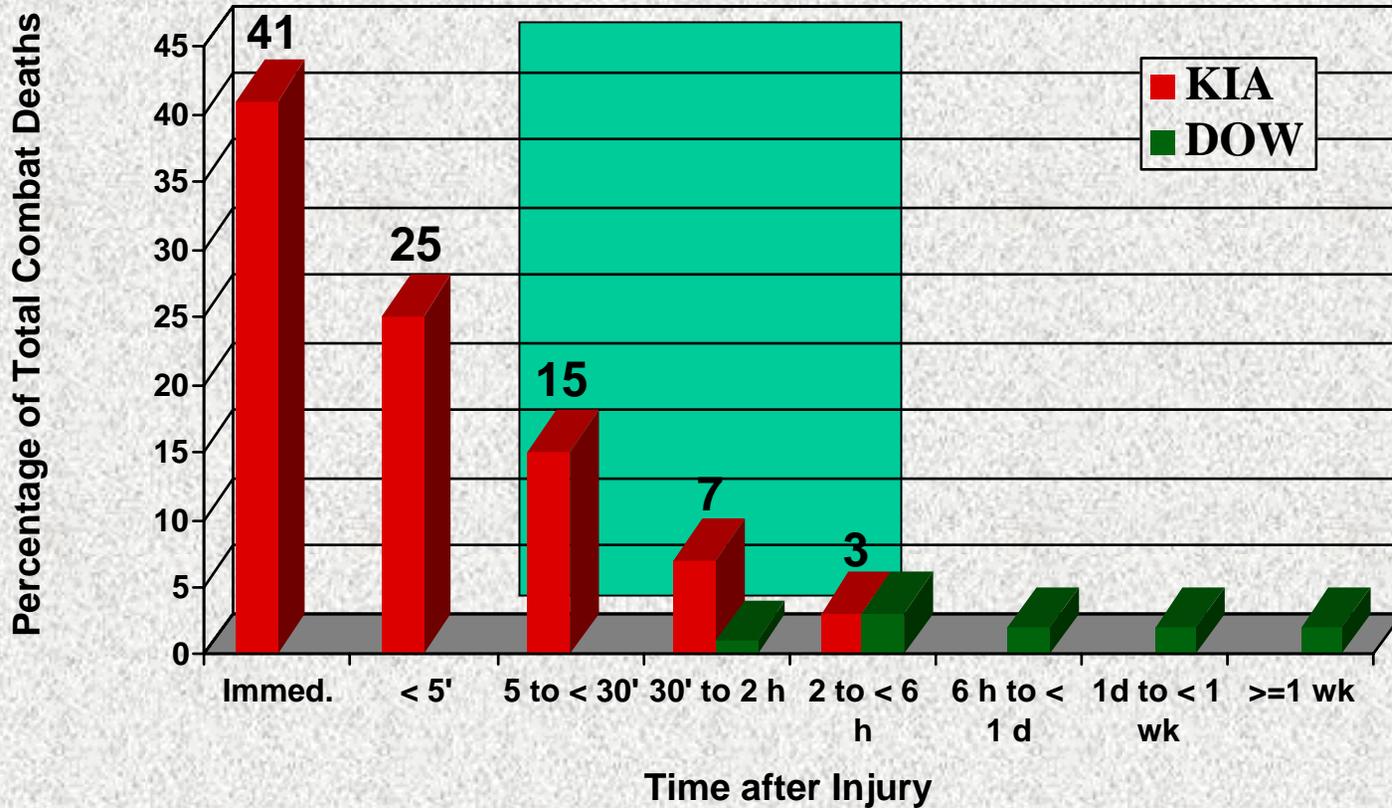
Email: [frederick.pearce@na.amedd.army.mil](mailto:frederick.pearce@na.amedd.army.mil)





*U.S. Army Medical Research and Materiel Command  
Walter Reed Army Institute of Research*

# Window of Therapeutic Opportunity



**CURRENT**

**SENSORS/ MEASUREMENTS**

- 1 Headband EEG and Oximetry
- 2 Acoustic  
(Voice Stress and Content Analysis)
- 3 Dead Reckoning Module  
(3-Axis Accelerometer, GPS,  
Magnetometer, Altimeter)
- 4 EKG, EMG, and  
Thoracic Impedance Cardiography
- 5 Body Core and Skin Temperature
- 6 Near-Infrared (or Other) Technology\*  
Tissue pH, Glucose, and Lactate
- 7 Wrist-Worn Actigraph
- 8 Boot-to-Boot Impedance\*
- 9 Foot Contact (Weight/Locomotion)
- 10 Wireless Inter-Module Communication



**PHYSIOLOGICAL  
CONSEQUENCES OF CONCERN**

- Hypothermia
- Hyperthermia
- Hypoxia
- Metabolic Fatigue
- Vigilance Lapses
- Dehydration
- Psychological Stress
- Inadequate Restorative Sleep
- Desynchronization of  
Circadian Functions
- Jolt, Blast, and Repeated  
Impact Exposure
- Toxic Substance Exposure

Predict  
Significant  
Performance  
Degradation  
and  
Impending  
Casualty

**FUTURE**

*Specifications for Minimal Sensor Set  
to Predict Warfighter Physiology*

\* Concept

Figure 1. Warfighter Physiological Status Monitoring (WPSM)

USAMRMC/Military Operational Medicine Research Program/Ft. Detrick, MD  
POC: COL John P. Obusek (508)233-4811/LTC Karl E. Friedl (301)619-7301  
Graphics: Janet G. Reese



*U.S. Army Medical Research and Materiel Command  
Walter Reed Army Institute of Research*

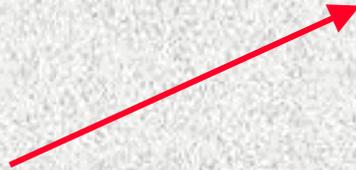
## Sequence of Medic Action

### Conventional

- Detect wounding
- Locate
- Acquire
- Assess
- **Triage**
- Treat
- Evacuate

### Objective Force Medic

- Detect wounding
- Locate
- **Triage**
  - Dead, Alive, Severity
- Acquire
- Assess
- Treat
- Evacuate



Direct the medic to the casualty for which he can make a **LIFE-SAVING** difference



*U.S. Army Medical Research and Materiel Command  
Walter Reed Army Institute of Research*

## Remote Triage Concept

- Triage algorithm to be dynamic with assessment on a minute to minute basis
  - Stable vs unstable
- Algorithm on LW computer will integrate sensor data locally and send ONLY:
  - Help call, Soldier ID, Location, time of injury, breathing, cardiac electrical activity, motion, body position
  - Injury Severity Score
- LW medic computer will sort on presence of vital signs



*U.S. Army Medical Research and Materiel Command  
Walter Reed Army Institute of Research*

## *Technical Targets*

- Minimal sensor configuration (motion, respiration, pulse)
- Minimal weight (< 1 lb.)
- Self-contained power supply (< 1 watt)
- Maximal comfort ( $\geq$  72 hr operation)
- High reliability (with system integrity checking)
- FDA compliant
- Incremental (P<sup>3</sup>I) development strategy
- Design to cost goal of under \$1,000 each

# Life Sign Detection System

Accelerometry

Motion

Body Position

Inductance pneumography

Respiration

ECG

Heart Rate

Thermister

Skin Temperature

Ambient Temperature

## Through Clothing Sensors



Micro-impulse Radar  
Capacitively Coupled ECG

## Chest Belt



## Pacing Technologies:

- Developmental sensor technologies (TRL 3-4)
- Unmodified COTS physiological sensors (TRL 5)
- Modified COTS with LSD algorithm in hand-held (TRL 6)

LifeShirt

