ONR 34: Warfighter Performance
Sustaining the Edge
Serving the Next Generation Warfighter ... Now

Expeditionary Warfare Conference
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CDR, MSC, USN
26 October 2011

DISTRIBUTION STATEMENT: A
Approved for public release; distribution is unlimited.
Human Systems Integration
- Manpower Modeling
- Personnel Selection & Assignment
- Training
- User-Centered Design
- C2 Decision Support
- Safety

Bio-Engineered Systems
- Marine Mammal Health
- Bio-based Sensors
- Microbial Fuel Cells
- Bio Robotics
- Human-Autonomy Systems

Undersea & Expeditionary Medicine
- Undersea Medicine
- Point of Injury Care
  - Extend “Golden Hour”
  - Treat hemorrhagic shock
- Automated Medical Monitoring /Care / CASEVAC
- Traumatic Brain Injury
HISTORY OF SUCCESS

Pharmaceuticals

Blood

Devices

Discoveries

2005 QuikClot FDA approved

2006 Combat Trauma Registry

2007 Combat Gauze FDA approved

2007 OSD Joint Trauma Registry

2008: USMC adopted Combat Gauze as 1° and QuikClot as 2° hemostatic agent

2008 Shipboard Disease Decision Tool

2009 Casualty Warming Device

2009 PHEL Curve Update

2009 Medical Planning Tool

2009 Modeling for Improved PPE

2010: Wireless Vital Signs Monitor

2010: Fibrin Gauze

FY92-FY05

FY06

FY07

FY08

FY09
WIRELESS VITAL SIGNS MONITOR

- Small, lightweight, highly-mobile, patient-worn medical monitoring system
- WiFi technology to collect and display a patient’s vital signs.
- Enables medical personnel to be in touch with remote or on-site monitoring
- Connects wirelessly to Smart Phones, PDAs and multiple PCs.

- ONR Force Health Protection FNC Product demo in 2007, FDA-approved in 2010
- Integrates standard medical technologies, e.g., blood oxygenation sensor (SPO$_2$), non-invasive blood pressure (NIBP) monitor, Heart rate, and electrocardiograph (ECG), already on the market – thereby minimizing product acquisition and support costs
- Attaches to the standard blood pressure arm cuff for sedentary & mobile patients
- Development / evaluation by SOCOM (mini-Medic), NECC for Expeditionary Resuscitative Surgical Suite (ERSS), Army & civilian MEDEVAC helicopters

ONR PI, Dr. Peter Rhee, used WVSM to track vital signs of Congresswoman Giffords. Dr. Rhee was key to ONR’s development of QuikClot, now in wide use across DOD.
FORCE HEALTH PROTECTION (FHP)
FUTURE NAVAL CAPABILITY (FNC) PROGRAM

FY08
Casualty Prevention
- Treatment for Decompression Sickness
- Models of Head and Cervical Spine

FY08
Advanced Forward Care
- Closed Loop Fluid Delivery
- Closed Loop Ventilation
- Oxygen Generation

FY08
Warfighter Restoration
- Hearing Loss Prevention and Treatment
- Post-Traumatic Stress Mitigation
- Repetitive Neurotrauma Mitigation
- Wound Repair Wound Healing

Dr. Tim Bentley, FHP FNC Deputy

FY10
Human Injury Treatment Models

FY08
Rapid Blood Treatment
- Hemostatic Agents FY13
- Pharmacologic Resuscitation FY13
- Transfusion Safety FY13

FY11
Multi-Functional Blood Substitute
FHP-FY12-01: Automated Critical Care System

En Route Care - efficient and lighter with integrated physiological systems

Provides:
- Physiological Monitoring
- Mechanical Ventilation
- Supplemental Oxygen Therapy
- Analgesia/Anesthesia
- Fluid & Drug Therapy
- Casualty & Fluid Warming
- Patient data storage and transmission

Exploring Joint Acquisition Strategy

Dr. Michael Given EC Manager
FHP-FY12-02: Saving Lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi)

- Local drug delivery for altitude sickness
- Nitrogen gas sponge for Decompression Sickness
- Hypothermia for TBI
- Mechanoprotection and anti-inflammatory agent for blast lung & bowel

Drug: PFC Nanocrystal

CDR Sheri Parker EC Manager
Decompression Illness

Gas transport through channels
Allometric Scaling of DCS
Biochemical Markers of DCS
Neutrophils in DCS

Oxygen Toxicity

Cellular Mechanisms
Hyperoxemia-induced Stress in CNS Cells
CNS-Pulmonary Interaction in OxTox
Ca2+-mediated impairment of CNS
Neutrophil Adherence

Fatigue & Exercise Intolerance
Biosensor for Electrophysiology
Vigabatrin Treatment

Submarine / Diver Health and Performance

Epidemiology: Medical Events
Ultrasonic Hearing
Women in Subs: Reproductive Toxicity

Respiratory Work at Depth
Inert Gas & Hyperbaric Pressure in the Hippocampus
Bone Health
Scalable Hyperbaric Patch Clamp

CDR Matthew Swiergosz Ph.D.
NOISE INDUCED HEARING LOSS PROGRAM

Mr. Kurt Yankaskas & CDR Matthew Swiergosz Ph.D.

Reduce Noise at the Source

- Shipboard noise assessment
- Jet noise measurement standards
- Laboratory scale tests of jet noise reduction

Personal Protective Equipment (PPE)

- Shipboard PPE
- 3D Digitization for “Prescription” Ear Plugs
- In-Ear Dosimetry
- Underwater comm’s & hearing protection

Medical Prevention & Treatment

- Cell regeneration
- Pharmacologic interventions
- Blast interventions
- Pulmonary and nasal drug delivery

Incidence, Susceptibility & Evaluation

- Assessment tools
- Hearing loss simulator
- Modeling Tools
**Basic Biomedical Program**

**Sleep / Fatigue**
- Phenotypic and Genotypic Markers of Performance Vulnerability to Sleep Loss
- Work-related Fatigue on Deadly Force Decision Making

**Blast**
- SEMPPer Fi Continuation (support of EC) PFC-TBI Funding
- Management of acute and sub-acute traumatic brain injury: Can hyperbaric oxygen therapy improve outcome?

**Environment**
- Exertional Heat Illness Biomarkers for Prediction and Return to Duty
- In Vivo Animal Model (and Biomarkers) of Environmental Heat Stress
- Identification of Markers of Endothelial Permeability in High Altitude

*CDR Sheri Parker, Ph.D.*
CAPABLE MANPOWER (CMP)
FUTURE NAVAL CAPABILITY (FNC) PROGRAM

CMP-FY08-01
Game-Based Training
- Advanced Technologies for Automated Performance Assessment in Games FY11
- Automated Performance Assess & After-Action Review FY11
- Integrated System for Language Education and Training (ISLET) FY11
- Tools for Game-based Training and Assessment of Human Performance FY11

Deployed training games Ship and shore

CMP-FY08-03
Human Systems Integration
- Exceptional Expertise for Submarine Command Team Decision Making FY11
- HSI Design Environment FY12
- State of the Art, Multimodal Tools for Increased Situational Awareness in Sonar FY10
- Unmanned Vehicle Control & Monitoring HCI for Amphibious Operations FY11

Exceptional Expertise for Submarine Command Team

Kip Krebs, Ph.D.

CMP-FY08-05
Strategy for Our People
- Navy Manpower and Personnel Modeling, Simulation, and Optimization Tools FY12

Navy manpower and personnel

CMP-FY10-01
Information Architecture for Improved Decision Making
- Data Triage FY14
- Display Information with Uncertainty FY14

Information Architecture for

CMP-FY10-02
Adaptive Training to Enhance Individual and Team Learning and Performance
- For Combat Information Center Teams FY14
- For Submarine Navigation & Piloting Teams FY14

Adaptive Training to Enhance

CMP-FY10-03
Human Systems Integration
- Exceptional Expertise for Submarine Command Team Decision Making FY11
- HSI Design Environment FY12
- State of the Art, Multimodal Tools for Increased Situational Awareness in Sonar FY10
- Unmanned Vehicle Control & Monitoring HCI for Amphibious Operations FY11

Exceptional Expertise for Submarine Command Team

Kip Krebs, Ph.D.

CMP-FY11-01
Naval Next-Generation Immersive Technology
- Augmented Immersive Team Trng: FY15
- Percept Trng Systems & Tools: FY15

Naval Next-Generation Immersive Technology

CMP-FY11-02
Performance Shaping Functions for Environmental Stressors
- Performance Shaping Functions FY15

Performance Shaping Functions

CMP-FY12-01
Live, Virtual, and Constructive Trng Fidelity
- Tactics & Speech Capable Semi-Auto Forces: FY16
- Cognitive Fidelity Synthetic Environment FY16
- Virtual/Constructive Reps on Live Avionics Displays: FY16

Live, Virtual, and Constructive Trng Fidelity
### ONR34 : WARFIGHTER PERFORMANCE Science & Technology Department

**Dr. Terry Allard, Department Head / CAPT David Neri PhD, Deputy**

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BACK-UP
Hemorrhage and Resuscitation

Hemorrhage is the #1 cause of preventable death on the battlefield

- FHP-FY08-13 Rapid Blood Treatment
  - Spray Dried Plasma
  - Fibrin Gauze

- Pharmacologic Resuscitation
- Transfusion Safety

Dr. Michael Given EC Manager
Proposed FHP-FY13-01: Sound Diagnostics

Enhancements for Hand-Held Ultrasound

Non-expeditionary

Expeditionary

4D-Imaging capability (HW/SW)

Computerized training modules

SPIO-platelets for detection of internal bleeding

Pulmonary and transcranial imaging

Dr. Michael Given EC Manager
ONR Strategy for Force Health Protection

A Continuum of Care

Pre-Deployment Care & Prevention

• Hearing Loss Prevention & Treatment
• PTSD Prevention & Mitigation
• Modeling & Simulation for Improved PPE
• Submariner Health

Advanced Forward (Point-of-Injury) Care

• Hemostatic Agents
• Pharmacologic Resuscitation
• Rapid Blood Typing & Pathogen Detection
• TBI detection

En Route and Automated Care

• Closed Loop Fluid & Ventilation System
• Oxygen Generation, Patient Warming

Post-Deployment Care, Treatment, and Restoration

• Wound Healing
• Wound repair
• AFIRM: Armed Forces Institute of Regenerative Medicine
Advanced Forward Care

FHP-FY08-02 Advanced Forward Care

Closed Loop Fluid Delivery

Closed Loop Ventilation

Oxygen Generation Without Power

Better Care / Force Multiplier for Seabasing and Distributed Operations

ACCS

Dr. Michael Given EC Manager
Casualty Warming Device (CWD)

**Description:** Hypothermia prevention product

**Naval Need:** Solution that is...
- Lightweight & disposable
- Compact & shelf-stable
- Low-cost
- Has no power generation requirement

**Discovery and Invention Efforts Leveraged:**
In clinical studies, Infoscitex demonstrated CWD maintained skin interface temperature at 40°C (104°F) for 8 hr, greatly surpassing stability of other devices

**Impact:** Hypothermia prevention that...
- Requires no external power
- Achieves self-regulation achieved by unique dual layer technology
- Enables safe, unattended operation
- Provides stable temperature up to 8 hr

*FY10: Transitioned to MCSC for evaluation with other casualty warming technologies. NECC will accept MCSC recommendation.*
Description: Nanofiber bandage with desired properties of blood absorbability and biodegradability over period of days

Naval Need:
• Reducing hemorrhage -- leading cause of death on battlefield
• A solution with point-of-injury use, adequate resorption (so can be left in wound), and capability of internal use

Impact:
• Improved hemorrhage control
• Will reduce killed-in-action rate
• Will reduce requirement for blood / resuscitation fluids on the battlefield

Dr. Michael Given
20-27 October 2011
ONR 34 - Expeditionary Warfare Conference

FY10: External use submitted to FDA for approval; internal use submission to follow

Cleared for Public Release ONR Case Number 43-617-11
Description: Closed-Loop-Control (CLC) system for fluid resuscitation

Naval Need:
• Continuous patient monitoring
• Less outside intervention
• Improved patient care for better outcomes

Impact:
• 24/7 patient monitoring
• Reduced risk of over/under fluid resuscitation and subsequent med issues
• Decision-Assist provides recommendations for acceptance or rejection
• Fully autonomous-care-capable
• Reduced logistics: 80% reduction in fluid required to maintain target blood pressure

FY10: Decision-Assist component submitted to FDA for approval
**Died-of-Wounds Projection**

**Description:** Dynamic Military Treatment Facility (MTF) planning tool and decision aid for medical combat developers

**Naval Need:**
- In-theater decision aid to redeploy medical assets to meet changing operational conditions
- Objectively model the effects of treatment delays on mortality

**Warfighting Payoff:**
- Quickly examine reasonable Courses of Action (CoA) for an MTF network in dynamic situations
- Supports USMC “Distributed Operations” concept
- Medical planner can select best CoA based on associated field operational and medical system constraints

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**A Medical Planning Tool to Optimize Deployment of Limited Medical Assets**

*FY10: Transitioned to Marine Corps Combat Dev Command; Used in OIF and OEF Theater*

Dr. Michael Given
**Description:** High fidelity computational model of human head and ears to simulate blast/noise energy transfer from air to inner ear. Model is being validated in Marine Corps Breachers study.

**Naval Need:**
- Modeling and simulation of blast injuries
- Protection for head, neck and spine
- Accurate enhancement of specs for Personal Protective Equipment (PPE)
- Fewer injuries associated with blast effects on the head and neck.

**Warfighting Payoff:**
Accurate pressure profiles to enhance protection against:
- IEDs (ground)
- Rapid ascent from depth (diving)
- Flight ops acceleration (altitude)
- Ejection G stress (flight ops)
- Noise (everywhere)

**Addresses occupational head, neck and spine injuries from blast, noise, pressure and acceleration forces**

**Project Funded by ONR Force Health Protection, Undersea Medicine & Noise Induced Hearing Loss**

**Represents collaboration between government labs, academia and industry**

**CDR Sheri Parker PhD**
Approved FHP-FY13-03: Extreme Operations

- Hypoxia Alert and Monitoring System
- High Altitude & Gz Induced Hypoxia
- Oxygen Imbalance
- DCS & OxTox: New indications for already FDA-approved treatments
- Reduce Class A Aviation Mishaps
- Gas measures & vibratory alert
- NIRS; pulse ox
- Controller in pocket or on wrist
- Flow
- Chest sensor option

Expansion Diver Range / Improve DISSUB rescue

CDR Sheri Park EC Manager
24-27 October 2011
ONR 34 - Expeditionary Warfare Conference
Neurotrauma
Blast Sensing and TBI Detection

Tissue Regeneration

Resuscitation

ACCSIL
Tissue Preservation & Limb Sparing

I PREDICT
Computational Tool for PPE Improvement
Navy Medical Research

Coordinated strategy

**CNO Special Interest**

*Noise-Induced Hearing Loss*
- Comprehensive S&T program approved by ASN
- ONR’s cross-component leadership
- Linkage to VA, Army, Defense Health Program
- Coordination with BUMED Audiology

*Women in Submarine Force*
- RDT&E program includes S&T, Advanced Development, O&M,N funding
- BUMED programmatic leadership (Prusaczyk)
- Builds on ONR Health Surveillance Undersea Medicine leadership

**CMC Special Interest**

*Combat Casualty Care*
- Point of Injury Care
- Casualty Evacuation Technologies
- TBI / PTSD
- AFIRM
- Warfighter Resilience
- Dismounted Complex Battle Injury*

* New working group by direction of ACMC. Report by ~Thanksgiving 2011

**ASD (Health Affairs) Defense Health Program**
- Cross-component transition strategy
- Navy in Joint Program Committees
- Cross-component reviews (ASBREM)
- Coordinated AFIRM funding strategy

**Unified DoN RDTE investment plan**
- Strong ONR / BUMED cooperation with Navy Advanced Development program (CAPT Montcalm-Smith / Dr. Prusaczyk)

**NASA Human Health & Performance Ctr**
- Coordination, Collaboration, Leverage
- Industry, Academia, Gov’t