Challenges in Undersea Medicine

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April 2016
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Panel Members

- CAPT Fred Yeo, MD, Commanding Officer, Naval Submarine Medical Research Laboratory
- William D'Angelo, PhD, Program Officer, Undersea Medicine Program, Office of Naval Research
- David Southerland, MD, Acting Program Manager, Deep Submergence Biomedical Development Program, Office of Supervisor of Salvage and Diving, Naval Sea Systems Command
- CDR Hugh Dainer, MD, PhD, Department Head, Undersea Medicine Department, Naval Medical Research Center

Office of Naval Research Undersea Medicine Program

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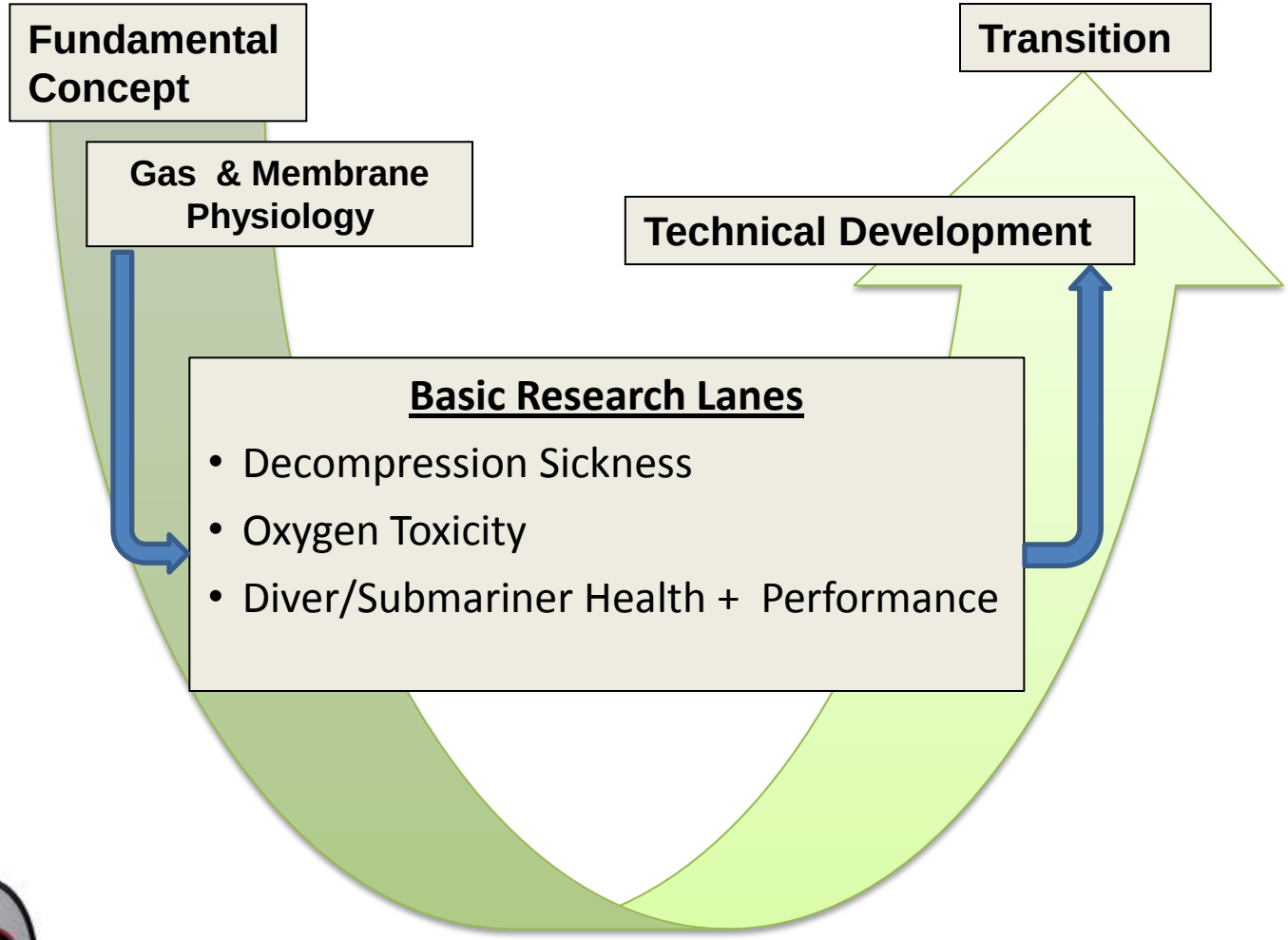
Purpose

To compensate for human shortfalls in operating under water.

- **Approach: Enhance human physiology, provide technology to do so or set appropriate operational limits**
- **An ONR National Naval Responsibility**
  - ***Sustain robust international research capability and Navy labs***
  - ***Cultivate pipeline of scientists and engineers***
  - ***Provide S&T products that ensure future superiority in the undersea domain***
- **Direct and immediate warfighter application**
  - ***Diving and Salvage: hull repair, recovery, rescue***
  - ***Special Warfare (SEAL & EOD): stealthy ingress, route clearance***
  - ***Submarine Force: long missions, confined space, limited senses***

UMed Focus and Pathway



Funding Opportunities

- **ONR is the Basic (6.1) and Applied (6.2) research agency**
- **General submission information for academia and industry**
  - Fiscal Year Broad Agency Announcement (BAA)
    - http://www.onr.navy.mil/en/Contracts-Grants.aspx
  - Rolling submission throughout fiscal year
- **Strong UMed small business program (SBIR/STTR)**
  - Human factors of technology for divers
  - Development of research tools
- **Other ONR Funding Opportunities**
  - Basic and Applied Research Challenge (BRC & ARC)
  - Multidisciplinary Research Program of the University Research Initiative (MURI)
  - Defense University Research Instrumentation Program (DURIP)
  - Young Investigator Program (YIP)
  - ONR Global
    - http://www.onr.navy.mil/en/Science-Technology/ONR-Global.aspx

Deep Submergence Biomedical Development Program

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Apr 2016
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Opinions expressed are my own and are not necessarily those of the Naval Sea Systems Command.

DSBD in a Nutshell

Deep Submergence Biomedical Development (DSBD) Program

An integrated biomedical/bioengineering advanced development (6.4) R&D effort to enhance U. S. Navy capability in:

- Enhancement of Survival of Submariners in a Disabled Submarine (DISSUB) scenario
- Diver Health and Safety
- Biomedical Criteria for Diver Equipment/Procedures

Sponsor:	CNO-97 Undersea Warfare
Manager:	NAVSEA 00CM
Products:	90% Guidance and Procedures
Current projects:	14 (Each runs ~1-3 years)

Current Researchers

- Navy Experimental Diving Unit, Panama City, FL (NEDU)
- Naval Submarine Medical Research Laboratory, Groton, CT (NSMRL)
- Naval Medical Research Center, Silver Spring, MD (NMRC)
- Duke University
- State University of New York at Buffalo
- University of Wisconsin

“Researchees”

- Human
  - Nonclinical
  - Greater than minimal risk (usually)
- Animal
  - Swine
  - Sheep

Award Process

- Solicitation - Broad Agency Announcement
  - http://www.supsalv.org
    --> 00C3 Diving --> Diving R&D BAA
- Pre-Proposal
- Invited Proposal
- Technical Advisory Board (TAB)
  - Membership: Operational and technical personnel
  - Review and Rank Proposals
- Awards based on ranking and funding available

Biomedical Diving Gaps/Deficiencies

Biased toward problems I see

(Formal Gap Analyses for Submarine and Diving medicine are currently in progress.)

- DISSUB Submariner Survival
  - Shallow air saturation decompression procedures after escape
  - Thermal model for dry, humid hyperbaric exposures with no fluid replacement.
- Diver Health and Safety
  - Integrated diving and altitude decompression model
  - Helium-Oxygen decompression table update
  - Robust CNS oxygen toxicity model
- Biomedical Criteria for Diver Equipment/Procedures
  - Tolerable Work of Breathing limits for dry, pressurized exposures

Biomedical Research in the Navy Laboratories: Animal Models and Advanced Development

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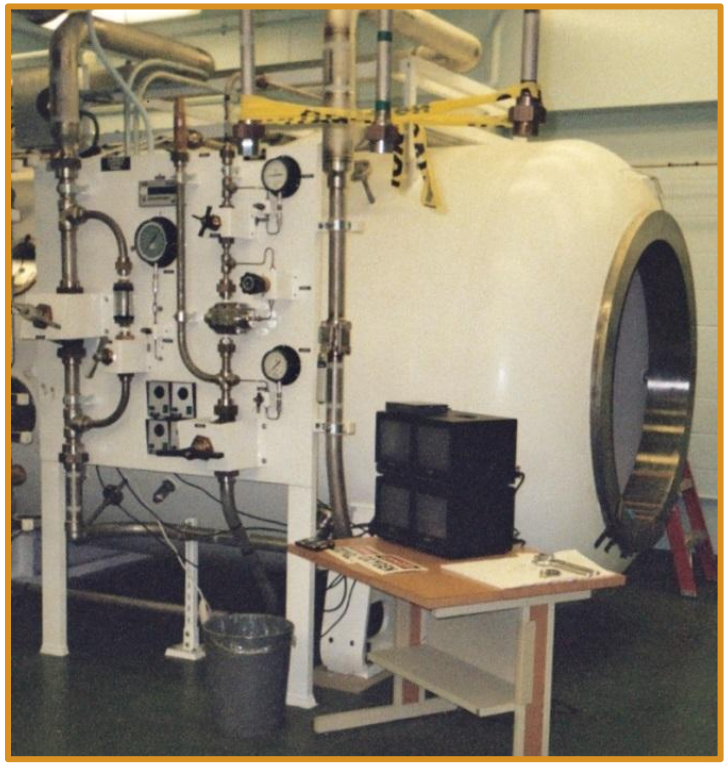
Areas of Active Research

- Decompression Sickness
  - Disabled Submarines
  - Working Divers
- Oxygen Toxicity
  - Special Forces
  - Chamber Personnel
- Extreme Environments
  - En Route Care
  - Hypobaria
  - Hypoxia



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Active Undersea Medicine Projects	Area of Research	Funding
Tiotropium and Pulmonary Oxygen Toxicity	Oxygen Toxicity	NAVSEA
Channels in High Altitude Cerebral Edema	Extreme Environs	ILIR
MSK Damage and TBI	Extreme Environs	ILIR
Model for Drowning Research	Extreme Environ	ONR
Oxygen Microbubbles	Decompression	ONR
ARDS and Volatile Organic Compounds	Oxygen Toxicity	JPC-5
VOC's in Military Divers	Oxygen Toxicity	ONR
Heliox Diving – Uncontrolled Ascent	Decompression	NAVSEA
Pharmacology Altitude Acclimatization	Extreme Environs	JPC-5

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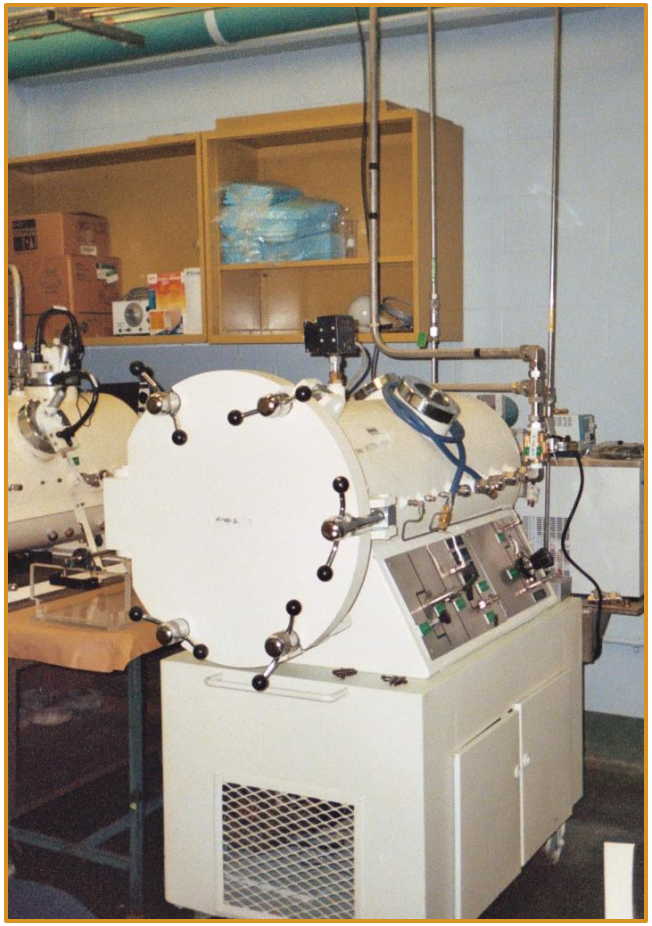

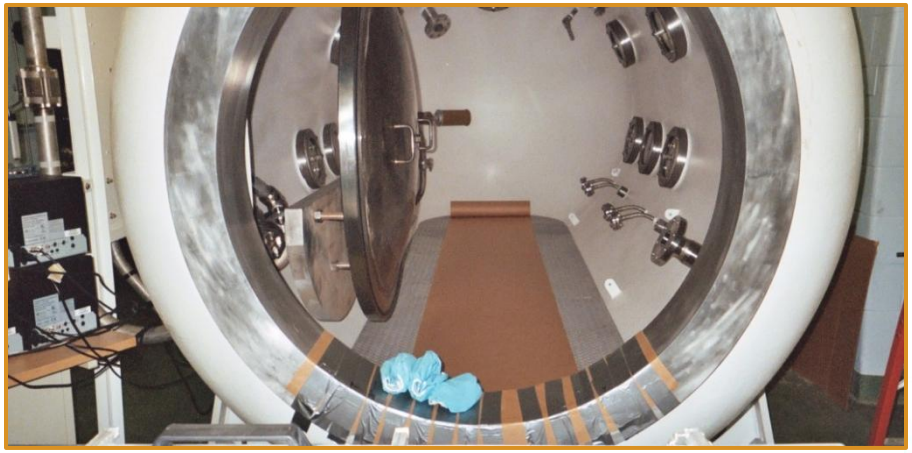

Submarine Medicine

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NSMRL

- Naval Submarine Medical Research Laboratory, Groton CT
- Co-located on the largest submarine base in the US
- Echelon 4 to Bureau of Medicine and Surgery (BUMED)
- NSMRL Mission: Provide innovative human-centric research solutions aligned with the Submarine Force strategic direction, to sustain superiority in the undersea domain
- Conduct research across 6.1 to 6.7 domain
- 100% reimbursable lab, $ 9-11 M/year
- Transition products directly to the submarine force
- Sponsors: ONR, NAVSEA, BUMED, NASA, SUBFOR, NUWC, USARIEM, VA, others

NSMRL: areas of research focus

- Submariner health: medical and psychologic
- Aligning submariner medical standards to evidence
- Submarine escape and rescue procedures
- Submariner microbiome
- Hearing conservation efforts
- Resiliency, performance, team resiliency
- Cognitive performance
- Screening and selection of submariners
- Submarine atmosphere and environment
- Submariner epidemiology

Questions?

For additional questions after the conclusion of the conference, send an email message to usarmy.detrick.medcom-usamrmc.mbx.mmpd@mail.mil