



Naval Medical Research Unit Dayton
Wright-Patterson AFB, Ohio



Science Update

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MISSION

To maximize warfighter performance and survivability through premier aeromedical and environmental health research-delivering solutions to the field, the Fleet, and for the future.

VISION

NAMRU-D is Navy Medicine's world class, global aeromedical and toxicology research leader. Our efforts and innovative products are aligned with operational requirements to solve the naval and joint warfighter challenges of the future.

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Joint Efforts Emphasis during Air Force DHA and Navy R&D Visit NAMRU-D



Dr. Wong demonstrates how NAMRU-D's unique nose-only inhalation towers operate during RADM Doll (left) and Lt Gen Robb (middle) visit.

NAMRU-D Public Affairs

On April 10 and 11, 2014, Defense Health Agency Director Lieutenant General Douglas Robb and DHA Research Development & Acquisition (RD&A) Director, Rear Admiral Bruce Doll, visited Dayton's local Air Force and Navy research facilities at Wright-Patterson Air Force Base (WPAFB). The two day visit included a tour with each of Naval Medical Research Unit Dayton's unique science laboratories. Captain Andrews, Commanding Officer, NAMRU-D and Brigadier General Timothy Jex, Commander USAF 711th Human Performance Wing accompanied them on the duration of their briefs and tours while at WPAFB.

Dr. Richard Arnold, Director of Aeromedical Research Directorate, NAMRU-D led a tour on April 10 thru many of the world-class Navy Medicine research laboratories. One of the highlighted stops was NAMRU-D's Disorientation Research Device (DRD), a platform created to evaluate unique aviation and other dynamic operational environments.

CDR Richard Folga, Acceleration and Sensory Sciences Department Head, NAMRU-D explained capabilities of the DRD to the distinguished visitors. The device system's objective is to simultaneously perform research addressing leading aeromedical mishap causal factors including spatial disorientation, fatigue, motion sickness and hypoxia. Other stops on the tour were the fatigue, spatial disorientation simulation, motion sickness countermeasures, vision sciences, and hypoxia laboratories.

Day two incorporated a visit to NAMRU-D's Environmental Health Effects Research Directorate. Mr. Tim Sakulich, Vice Director of the 711th HPW, and Dr. Garrett Polhamus, Acting Director, Human Effectiveness Directorate of the 711th HPW joined NAMRU-D tours on April 11. Dr. Karen Mumy, Deputy Director Environmental Health Effects, NAMRU-D led a tour through two of Navy Medicine's world-class toxicology laboratories at WPAFB.

Story continues on top of page 3.

NAMRU-D Participates in the 53rd Annual Meeting for the Society of Toxicology

NAMRU-D Public Affairs

Scientists from Naval Medical Research Unit Dayton's (NAMRU-D) Environmental Health Effects Directorate attended and presented research during the 53rd Annual Meeting for the Society of Toxicology (SOT) held in Phoenix, Arizona March 23 to 27, 2014. This meeting brings together approximately 6,500 toxicologists from over 50 countries to discuss recent advances and technologies in toxicological research. Dr. Karen Mumy, Dr. Lisa Sweeney, Dr. Brian Wong and Mr. Arden James were all co-authors on a combined total of five posters presented at the meeting, all of which were in collaboration with the U.S. Air Force or Army. Dr. Sweeney co-chaired a platform session on risk assessment of toxic metals. Research from the two department in the Environmental Health Effects Directorate, Inhalation Toxicology and Environmental Toxicology, were well represented during this SOT meeting.

NAMRU-D scientists teamed up with 711th Human Performance Wing/RHDJ U.S. Air

Force scientists for a study to simulate conditions of high altitude and exposure to a known volatile organic compound. The goal of this effort is to determine what effect, if any, a stressor like altitude might have on the toxicity of an unlabeled compound under condition associated with the operation of high performance combat aircraft. Dr. Wong and Mr. James of NAMRU-D presented this work during a poster session entitled, "Enhancing Strategies for Risk Assessment."

In collaboration with U.S. Army, Dr. Sweeney presented research that generated data to test the validity of the toxic load model for extrapolation from constant exposures to time-varying exposures. The traditional laboratory data approach returns values that are similar to those obtained from an exposure scenario that is more realistic for an environmental release. Investigators hypothesized that time-varying concentrations of HCN exposures would yield the same cumulative exposure, as determined by the toxic load model.

The Department of Defense uses the toxic

load model in military operational risk management, therefore establishing the applicable range for its validity is critical to ensuring the well-being of our warfighters.

Additionally, NAMRU-D scientists contributed their research efforts to the following three collaborative poster presentations at SOT: Mitochondrial respiratory impact of acute toluene exposure after rapid altitude adjustment; human health hazard assessment of hydroprocessed esters and fatty acids (HEFA) bio-based jet fuels; and The effect of altitude on tissue distribution of toluene.

SOT is geared to provide innovative perspectives, in-depth analysis, countless networking opportunities for a global audience. The value for NAMRU-D scientists to present research does not stop there. With every knowledge-exchange platform the stronger our primary mission is supported; "To maximize warfighter performance and survivability through world-class aeromedical and environmental health research by delivering solutions to the field, the Fleet and for the future."

Physical Properties of Nanomaterials in the Atmosphere

J. Mueller

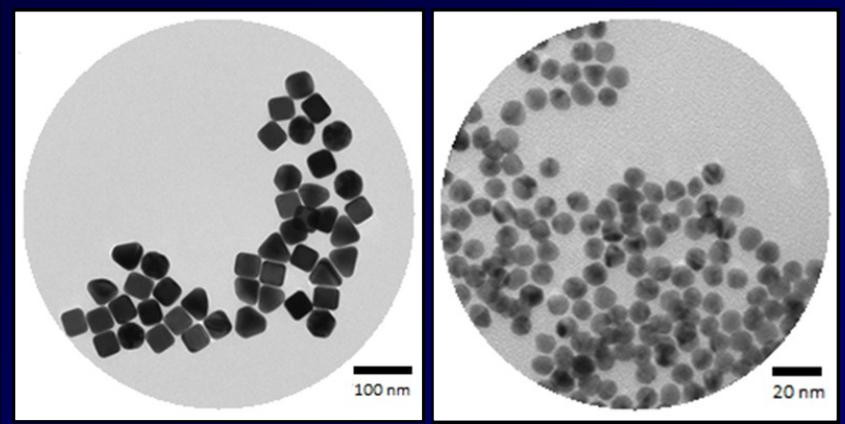
There is intense interest in nanomaterials in the scientific community because their physical and chemical properties are often different than those of their bulk counterparts. There has been a great deal of effort over the past few years to design, produce, and characterize nanomaterials. A "nanomaterial" is defined as a material with one external dimension in the size range of 1-100 nanometer (nm). A nanometer is one billionth of a meter. The relative difference between a nanometer and a meter is comparable to the difference between a millimeter and the distance from

Wright-Patterson Air Force Base, Ohio to the tip of Long Island, New York.

A nanomaterial may be a sheet of atoms, like the thin graphene sheets that earned the Nobel Prize in Physics in 2010, it may be a rod with circumference on the nano-scale, or it may have all three dimensions on the nano-scale. With the advent of engineering nanomaterials, there has also been an effort to identify environmental and incidental nanomaterials (INM). INM have been found in specialized work such as grinding and arc

welding and from common sources such as engine exhaust.

For INM and possible environmental contamination by ENM, it is important to understand physical properties and the likelihood of exposure. In the Fall 2013 Science Update, a proof-of-principle nanoparticle generation system for future in vivo inhalation experiments was presented. NAMRU-D is now designing a collaborative project with Dr. Saber Hussein of the USAF 711 HPW Molecular Bioeffects Branch/RHDJ to study the physical properties of three nanoparticles in a test atmosphere. The goal of the work is to determine the persistence of nanomaterials that have been lofted into the atmosphere. Do nanomaterials stay in the air for an indeterminate period of time? Do they settle to the floor or cling to vertical surfaces? Are they easily re-introduced from a surface to the atmosphere? This work, in conjunction with future in vivo studies, will help to assess both the likelihood of inhalational exposure to nanomaterials and the effects to personnel.



Left: 50 nm nanoparticles.

Right: 10 nm nanoparticles. Transmission electron microscopy (TEM) images courtesy of Dr. Saber Hussein.

Joint Efforts Emphasis (cont.)

A major tour stop was the animal inhalation research facility, the largest within the DoD. Dr. Brian Wong (NAMRU-D) described the unique aspects of the inhalation facility, including the nose-only inhalation towers. NAMRU-D's inhalation systems are equipped with a diverse suite of analytical instrumentation capable of monitoring precise exposures to gases, vapors, aerosols and particulates, and environmental conditions. In addition, Dr. Joyce Rohan (NAMRU-D) discussed the research conducted in NAMRU-D's electrophysiology laboratories.

Research briefings focused largely on joint efforts across the services, including multiple collaborative projects between NAMRU-D and 711th HPW/RHDJ. The visit to NAMRU-D laboratories and the project described jointness and our support of our nation's war fighters.



RADM Doll discusses the hypoxia research NAMRU-D principal investigators Dr. Jeffrey Phillips and Dr. Bill Becker are currently investigating.

NAMRU-D Staff Recognized at the 85th Annual AsMA Meeting

Dr. Richard Arnold and
NAMRU-D Public Affairs

The 85th annual scientific meeting of the Aerospace Medical Association (AsMA) was held 11-15 May 2014 in San Diego, California. Several members of the scientific staff highlighted recent Naval Medical Research Unit Dayton (NAMRU-D) aeromedical research through a variety of workshops, scientific presentations, and posters. Dr. Lynn Caldwell co-lead a workshop with Dr. John Caldwell on "Aircrew Fatigue; Causes, consequences, and countermeasures". This fatigue workshop has been presented at 12 successive meetings of AsMA. This year 54 conferees attended the workshop.

Several presentations and posters covering recent research on pilot spatial disorientation were presented by NAMRU-D staff, including: CDR Rich Folga, Dr. Cristina Kirkendall, Dr. Hank Williams, and Dr. Rick Arnold. Motion sickness countermeasures research was presented by CDR Rich Folga, Ms. Jacqueline Gomez, and Mr. Dan Geyer. CDR Mike Reddix



The 2014 Fellows of the Aerospace Medical Association were acknowledged during the Honors Night Banquet. Recently elected, Dr. Lynn Caldwell of NAMRU-D is second from the left in the front row.

presented his US Navy Bureau of Medicine and Surgery (BUMED) Advance Medical Development program-sponsored research to assess new computerized color vision tests for potential application in aviation medical screening. And, Dr. Jeff Phillips, Mr. Eric Robinson, and Mrs. Stephanie Warner presented lectures and posters describing recent NAMRU-D research on effects of hypoxia on pilot performance and research to assess the efficacy of various sensors for in-flight hypoxia detection.

Two NAMRU-D staff were recognized by

their professional colleagues at the 2014 meeting. CDR Rich Folga assumed his elected duties as incoming President of the Aerospace Physiology Society, a constituent organization of AsMA. Dr. Lynn Caldwell was recognized for her many years of outstanding research on fatigue mechanisms and countermeasures by her election as a Fellow of the Aerospace Medical Association. She was recognized along with the others in her Fellows class of 2014 during the AsMA Honors Night Banquet.

The annual meeting of AsMA provided NAMRU-D scientists a unique opportunity to interact with their peers in aeromedical research from the sister services and from across the national and international aerospace communities. They also were able to interact with fleet stakeholders and research sponsors, ensuring the laboratory's research remains relevant to fleet requirements and, just as critically, supported by funding sponsors. Next year's meeting will be held 10-14 May 2015 in Orlando, Florida.

Retirement Ceremony for CDR Michael D. Reddix Chock-full of Navy Tradition

NAMRU-D Public Affairs

On June 19, 2014, family, friends, and command members attended a retirement ceremony steeped in Navy tradition for CDR Michael D. Reddix, previous Executive Officer at Naval Medical Research Unit Dayton (NAMRU-D). The bell ringer sounded four bells as the boatswain mate piped the official party in for the ceremony and the sideboys stood at attention. The honor guard posted the colors and the band played the National Anthem.

Reddix graduated from the University of Illinois at Urbana-Champaign with a Ph.D. in Educational Psychology with an emphasis in cognitive psychophysiology. Over a 22-year active-duty career Reddix has executed meaningful aspects of the Navy mission. His first assignment was Chief-Vision Science, Naval Aerospace Medical Research Laboratory, Pensacola, FL. The next four years he spent at Brooks AFB, TX as the Head-Laser Department. Following that, Reddix was in Norfolk, VA as Branch Head, Aviation Human Factors, Naval Safety Center (1999-2003) and Head, Force-Human Factors, Commander Naval Air Force U.S. Atlantic Fleet (2003-2006). He returned to San Antonio, TX as Officer in Charge, Naval Health Research Center Detachment, Directed Energy Bioeffects Laboratory, Brooks City-Base, (2006-2009) and reported as Executive Officer, Naval Medical Research Unit San Antonio (2009). Relocated to his state of birth, Reddix was Associate Professor at the United States Air Force (USAF) Academy in Colorado Springs, CO for the next three years.

Reddix has received several personal military awards throughout his career and during his retirement ceremony another was added – the Meritorious Service Medal. Master of Ceremonies, LCDR Tuberson read the award citation from Vice Admiral Nathan, Chief, Bureau of Medicine and Surgery,

“...CDR Reddix was hand selected to take on the elevated level of responsibility and successfully provided his talents by managing two key command positions as NAMRU-D’s Executive Officer as well as the duties of a technical advisor scientist for the Aeromedical directorate, executing the command’s 9.5 million dollar Environmental Health and Aeromedical mission through an unprecedented government shutdown.”



A shadowbox that signifies CDR Reddix’s 22 years of Naval service was presented by CAPT Andrews on behalf of the NAMRU-D command.



Above: CDR Reddix with his two children Emily and Jonathan

Left: CDR Reddix recognized his wife, Nancy’s selfless devotion to service during his Naval career.

Reddix’s wife, Nancy, and two children, Emily and Jonathan, were presented with a spouse appreciation plaque and Navy dog tags, respectfully. Reddix said, “But, ... at the end of the day, if I’ve accomplished anything worthwhile, it was because I had the complete support of my family, and many of you my extended family.”

A family friend and former Brooks AFB, TX associate, Mr. Randal LeBlanc, CDR (retired) shared sea stories from their time working together. Reddix’s response was “...so be it, they’re all true.”

In addition to his family, Reddix recognized three WWII veterans and a Korean War veteran as a group he joined and calls “the cluckers”. Reddix acknowledged their valuable service by presenting them with a special cover, representing their respective warfare designators.

CAPT Jeffrey M. Andrews, Commanding Officer, NAMRU-D was the presiding officer and guest speaker at the ceremony. Reddix requested permission to go ashore for the last time, “Permission granted,” said CAPT Andrews. As the four bells rang, “Navy family, retired, departing,” was stated and Anchors Aweigh concluded the retirement ceremony.

Commanding Officer's Corner

CAPT Jeffrey Andrews

Spring at NAMRU Dayton is filled with *change*. I would like to express my sincere appreciation to two of our key command players who have retired. CDR Mike Reddix was highlighted in this edition, congratulations and BZ to "Bat" on a very successful 22 year career in our Navy and an unprecedented final tour as the NAMRU-D Executive Officer. Also, farewell to our USAF Liaison, Col Glen Hover, who retired from the USAF after an epic 30 years. He is a true ambassador for jointness and paved the future for many significant collaborative R&D efforts throughout DoD. The summer turnover is here as the command gains six personnel and will lose four stellar military officers; CDR William Howard, LCDR Wilfred Wells, LCDR Hong Gao, and LCDR James Tuberson. All will be greatly missed, thanks for your dedication, lasting contributions, and making a difference.

As personnel changes so does the work. Our Aeromedical Research Directorate projects continue to progress with a myriad of several active projects. Subject testing and recruiting continues with our pharmaceutical fatigue countermeasures study conducted for Air Force Special Operations Command (AFSOC) and sponsored by USAF Surgeon General. Subject recruitment and data collection has begun for the latest motion sickness study using intranasal scopolamine. Principal Investigators for Spatial Disorientation mitigation training successfully completed three operational simulator based illusions and our scientists are currently engaged in the production of three more different illusion scenarios. The hypoxia sensors work is complete with testing of mask integration and now moving into the next phase of research of sensors with simulated breathing at altitude. The joint project of F-22 oxygen delivery is testing different oxygen concentration at different altitudes to determine cognitive and physical performance effects. The United States Coast Guard recently requested assistance from NAMRU -D to develop a Laser Eye Protection solution in response to nuisance laser glare incidents that jeopardize homeland security and search and rescue missions. The current focus of our Environmental Health Effects Research Directorate is on the recently awarded Defense Medical Research and Development Program (DMRDP), Military Operational Medicine Joint Program Committee 5 (MOMJPC5) projects assessing the toxicity of burn pit emission (with and without sand pre-exposures) and neurological effects of jet fuel exposure. Both projects will be done in collaboration with the USAF 711th Human Performance Wing/Behavioral Systems (HPW/RHDJ) experts and are projected to mitigate health risks and improve operational risk management and medical treatments.

During this time of change, the pursuit of jointness remains constant and has expanded with our triservice partners and the Federal Aviation Administration (FAA). High level working meetings were established and will continue on a regular basis to coordinate efforts and concerns in the future. NAMRU-D continues to CLIMB, ROLL, and BOOM as a global research leader delivering solutions for our joint warfighters.



Captain Jeffrey M. Andrews,
MSC, USN
Commanding Officer

Biomarker Assessment for Resilience Prediction

LCDR Wilfred Wells

Researchers from Naval Medical Research Unit Dayton (NAMRU-D) and San Antonio (NAMRU-SA) are collaborating with the Air Force 342nd Training Squadron (TRS), U.S. Air Force School of Aerospace Medicine, Neurostat, and the 711th Human Performance Wing Applied Neuroscience Branch on a study to investigate the appearance of biomarkers of stress resilience and performance during the Pararescue Indoctrination Course.

The Air Force led project commenced data collection on May 16 at Lackland Air Force Base in San Antonio, Texas and will continue on alternating weeks for 9-weeks. The information collected will serve as the building blocks for developing a real-time biomarker detection tool and future

human performance augmentation.

Warfighter resilience is immensely important within the military due to the uncontrollable stressors that many of our warfighters face today. Stressors such as psychological consequences of improvised explosive device (IED) exposure are categorized as uncontrollable stressors. Understanding how resilience can be enhanced on an individual basis will improve operational performance and reduce attrition rates in training. Observing biomarkers like neuropeptide Y (NPY) and dehydroepiandrosterone (DHEA) in an Air Force training environment may provide insight into the coping mechanisms available for our warfighters. The research team will try to determine if NPY or DHEA play a role in

the control of cortisol and/or norepinephrine levels during high stress.

The identification of these relationships can lead to the development of assays that can be used by medical communities to identify warfighters who are under high levels of stress. Once identified, these individuals could use supplementation, for example to mitigate high stress. Overall, this study has developed a partnership between the Air Force and the Navy to advance knowledge to improve the health and readiness of our active duty service members.

NAMRU-D Products & Presentations

- Caldwell, J.A. and Caldwell, J.L. (2014). Understanding and managing fatigue in aviation. *Workshop at 84th Annual Aerospace Medicine Association Conference.*
- Folga, R. Eggan, S. & Kirkendall, C. (2014). U.S. Navy and Marine Corps spatial disorientation incidents as reported in the Naval Aviation Safety Awareness Program. *Poster presented at 84th Annual Aerospace Medicine Association Conference.*
- Folga, R., Patterson, R., Williams, H. (2014). Assessing where pilots are looking: Eye tracking during episodes of pilot spatial disorientation and control reversal errors. *Presentation presented at 84th Annual Aerospace Medicine Association Conference.*
- Geyer, D., Littman, E., Gomez, J., Becker, W. (2014). An updated review of scopolamine's mechanism of action. *Poster presented at 84th Annual Aerospace Medicine Association Conference.*
- Guznov, S., Caldwell, J.L., Ogle, Young. (2014). Combined over-the-counter and prescription stimulant use in U.S. Air Force special tactics operations. *Poster presented at 84th Annual Aerospace Medicine Association Conference.*
- James, R.A., Mahle, D.A., Mattie, D.R., Howard, W.R., Wong, B.A., Eden, P.R. (2014). Use of a single pass, nose only exposure system to simulate high altitudes. *Poster presented at Society of Toxicology 53rd Annual Meeting, 23-27 2014.*
- Lawson, Arnold, R., Newman, Rupert, McGrath, Milam, Thompson. (2014). Quantitative Modeling and Simulation of Spatial Disorientation (SD) Events *Presentation presented at 84th Annual Aerospace Medicine Association Conference.*
- Littman, E. & Folga, R. (2014). Motion sickness in the naval aviation fleet as reported in the naval aviation safety awareness program. *Poster presented at 84th Annual Aerospace Medicine Association Conference.*
- Mahle, D.A., Eden, P.R., Shyyanov, P.A., Hack, C.E., Qi, L., James, R.A. (2014). Effect of altitude on tissue distribution of toluene in S-D rats. *Poster presentation at Society of Toxicology 53rd Annual Meeting. 23-27 March 2014.*
- Makley, M.K., Chapleau, R.R., Ntamack A.G., James, R.A., Gearhart, J.M., Mahle, D.A. (2014). Mitochondrial respiratory impact of acute toluene exposure after rapid altitude adjustment. *Poster presented at the Society of Toxicology 53rd Annual Meeting. 23-27 March 2014.*
- Mattie, D., Sweeney, L.M., Mummy, K.L., Wong, B.A., Sterner, T. (2014). Human health assessment of hydroprocessed esters and fatty acids (HEFA) bio-based jet fuels. *Poster presented at Society of Toxicology 53rd Annual Meeting, 23-27 March, 2014.*
- Phillips, J., Wright, Folga, R., Horning, D., Powell, C., O'Hara. (2014). Comparing physiological responses to normobaric and hypobaric environments. *Presentation presented at 84th Annual Aerospace Medicine Association Conference.*
- Reddix, M., Kirkendall, C., Gao, H., O'Donnell, Williams, H., Eggan, S., Wells, W. (2014). Assessment of color vision screening tests for U.S. Navy special duty occupations. *Presentation presented at 84th Annual Aerospace Medicine Association Conference.*
- Robinson, F.E., Phillips, J., Warner, S., Drummond, L., & Funke, M. (2014). The performance effects of hypoxia: An additive factors approach. *Presentation presented at 84th Annual Aerospace Medicine Association Conference.*
- Sweeney, L.M., Sommerville, D.R., Channel, S.R., Gargas, N.M., Sharits, B.C. (2014). Impact of non-constant concentration exposure on lethality of inhaled hydrogen cyanide in the rat: A case study for assessing the validity of toxic load models. *Poster presentation at Society of Toxicology 53rd Annual Meeting. 23-27 March 2014.*
- Warner, S., Phillips, J., Lee, M., Funke, M., Robinson, F.E., Drummond, L. (2014). Hypoxia detection through in-mask sensors in platforms equipped with OBOGS. *Poster presented at 84th Annual Aerospace Medicine Association Conference.*
- Williams, H. Folga, R., Patterson, F., Arnold, R., Horning, D. (2014). U.S. Navy and Marine Corps spatial disorientation countermeasures training: Flight simulation for black hole illusion recognition and avoidance. *Presentation presented at 84th Annual Aerospace Medicine Association Conference.*

Taking the Helm of Navy Medicine's Aeromedical & Environmental Health Research

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