Naval Medical Research Unit Dayton
Wright-Patterson AFB, Ohio

Science Update

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NAMRU-D 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.

Inside this issue:

Excellence Award Presented to NAMRU-D from Brig. Gen. Jex

Brig. Gen. Timothy Jex, Director USAF 711th HPW (left) presents the Excellence Award to CAPT Doug Forcino, Commanding Officer of NAMRU-D.

NAMRU-D & 711th HPW

On 25 January 2013 the Naval Medical Research Unit Dayton (NAMRU-D) received an Excellence Award from Brigadier General Timothy Jex, Director USAF 711th Human Performance Wing. The award reflects how the NAMRU-D command demonstrated exceptional partnership with the 711 HPW in the accomplishment of mutual missions. Most notably, NAMRU-D contributed critical leadership and expertise as part of a comprehensive scientific, medical, and technical response to Air Force concerns about the F-22 on-board oxygen generation system. The teamwork between NAMRU-D and 711 HPW at every level was instrumental to the success of that response, and has earned rave reviews from AF and Office of Secretary of Defense senior leaders. Under the leadership of NAMRU-D's commanding officer, CAPT Doug Forcino, partnership with the 711 HPW rose to new heights over the past year, underscoring the wisdom of the original 2005 Defense Base Realignment and Closure (BRAC) Commission's vision and enabling new synergies for delivering world-class human performance solutions to the joint warfighter.

NAMRU-D and the 711th HPW/RHDJ Host Tri-Service Toxicology Consortium

Dr. Michael L. Gargas

NAMRU-D and the Air Force 711th Human Performance Wing (HPW) hosted a gathering of the Tri-Service Toxicology Consortium (TSTC) on 15-16 January 2013 in our Building 851 at Wright-Patterson AFB.

There were 43 scientists in attendance on-site or via the DCO line during this recent update. Toxicology research organizations representing the Army, Navy and Air Force were present, with additional representatives from the Veteran's Administration and the Deputy Under Secretary of Defense for Installation & Environment. Each organization provided updates to on-going projects and programs as well as future endeavors, with valuable input and insights provided by those in attendance. One topic of Tri-Service interest was the lead (Pb) contamination issue at DoD firing ranges. The TSTC has been tasked by the OSD-I&E to evaluate a recent report by the NAS that indicated the existing OSHA acceptable blood lead level is no longer health protective. The TSTC members will determine a more suitable acceptable blood lead level and explore ways to derive and recommend an appropriate air lead standard and action level for DoD personnel at firing ranges. The three officers that coordinate TSTC activities are: Chair, Dr. Mark Johnson of USAPHC, Co-Chair, Dr. Michael Gargas of NAMRU-D and Secretary, Dr. Dave Mattie of 711 HPW/RHDJ.

Dr. Brian Wong of NAMRU Dayton discussed a new joint project with Air Force on the toxicities of cockpit contaminants in the F-22 at altitude.

TSTC Charter

"The DoD has a high priority goal to preserve the health and well-being of its force to enhance the security of the nation and as a moral obligation to our Service members. In order to accomplish this goal, supporting research, testing, and training operations must be maintained and in some cases enhanced. Supporting toxicology data on chemicals that may be encountered are critical to ensure the fitness, health, and safety of our Service members and civilian employees, and to provide important data to the Acquisition Community for weapon system decisions and to platform developers to ensure the sustainability of our installations and OCONUS operations. The Tri-Service Toxicology Consortium is being organized to coordinate, optimize, and communicate recent toxicology information and data to protect human health and the environment. Through close interaction with participating agencies, the TSTC will optimize the conduct of research, the derivation of toxicology data, the application of world-class tools, and communicate the development of recent data where the DoD has interest. The TSTC will participate in technical reviews, interagency organizations, and evaluate various techniques and methodologies for toxicological assessments, with the goal of focusing the science of toxicology towards the pressing needs of the DoD; to minimize duplication and enhance mission capabilities."

Dr. Saber Hussein of the 711th HPW/RHDJ provided a briefing on his nanomaterials research.

Building a Foundation for Collaborative Research Efforts

Dr. Michael L. Gargas

On 24 January 2013 NAMRU-D held a meeting with the 711th Human Performance Wing/Behavioral Systems (RHDJ) at Wright-Patterson AFB to discuss building future foundation for collaborative efforts. The meeting objectives were to have Principal Investigators (PIs) and management from each organization present key research areas and projects as a means of developing a better understanding of the capabilities of each group. Overviews of the scientific programs were presented by Dr. Schlager, Branch Chief of RHDJ; CAPT Forcino, NAMRU-D Commanding Officer; Dr. Arnold, NAMRU-D Aeromedical Director; and Dr. Gargas, NAMRU-D Toxicology Director. Presentations from various PIs from each organization regarding specific studies and/or programs followed the overviews. Throughout this day long function, tours of the Air Force laboratories, the NAMRU-D Toxicology facilities and the Aeromedical laboratories were also conducted.

International Flight Surgeons Tour Aeromedical Directorate at NAMRU-D

Dr. Richard Arnold

Since its 2010 establishment as part of the Maj Gen Harry G. Armstrong Center for Aerospace Medicine at Wright-Patterson AFB, OH, NAMRU-Dayton researchers have established close partnerships with their local Air Force counterparts. A recent example was provided when NAMRU-D hosted a visit by a group of international flight surgeons who are aboard Wright-Patt attending the Advanced Aerospace Medicine for International Medical Officers (AAMIMO) course at USAF School of Aerospace Medicine. Tours of NAMRU-D aeromedical facilities were provided to USAF and AAMIMO students on 6 February 2013.

(A) Flight Surgeon from Egypt with Dr. Hank Williams in the Spatial Disorientation Training Research Program.

(B) Dr. Joseph Chandler explains Motion Sickness Countermeasures Program.

Among the tour stops: Dr. Henry Williams demonstrated a prototype simulation-based trainer to provide spatial disorientation familiarization to pilots (A); Dr. Joseph Chandler discussed recent research on the efficacy of intranasally delivered scopolamine as a motion sickness countermeasure (B) Dr. Jeff Phillips discussed his research on physiologic sensor technologies for in-cockpit hypoxia detection (C); and LCDR Will Wells demonstrated the capabilities of the NAMRU Dayton Vertical Linear Accelerator (VLA) for conducting research on rotary wing vibration effects (D).

(C) Dr. Jeffrey Phillips explains NAMRU-D Hypoxia Research Program.

(D) LCDR Wells discusses the Vertical Linear Accelerator.

NAMRU-D Doubles Capability to Perform Fuel Inhalation Studies

Mr. Arden James and Dr. Karen Mumy

In order to keep pace with the rapidly advancing field of alternative and bio-based fuels, the Naval Medical Research Unit Dayton Environmental Health Effects Research Directorate has recently doubled its capability for performing fuel inhalation studies. NAMRU-D has historically been a "go-to" laboratory for many of the Department of Defense fuel needs for evaluating inhalation health risks associated with fuel exposure. More recently, with the Navy, Air Force and Army looking to transition to renewable fuels, NAMRU-D was faced with the need to evaluate multiple fuels within overlapping timeframes. In order to meet DOD needs, and in collaboration with the 711th HPW USAF, NAMRU-D increased its number of fuel inhalation chambers from four to eight to accommodate testing two fuels at the same time.

Typically, animals are exposed to three concentrations of jet fuel test atmospheres (with one room air control) via whole body exposure to evaluate the toxicity and health effects associated with respiratory exposure. Inhalation test atmospheres are created to simulate in-theatre conditions that military personnel experience. These systems are automated to control the test atmospheres to within 5% of test article target concentration. In addition, specialized equipment is used to verify that the test atmospheres are stable for the length of the exposures.

Modified H1000 whole body inhalation system at NAMRU-D to accommodate additional jet fuel studies in support of DOD transition to renewable fuels.

The new inhalation chambers are currently being prepped to begin a 90-day inhalation study of an Alcohol-To-Jet (ATJ) fuel under consideration for use by the Navy, Air Force and Army. This 90-day study, due to start late-spring 2013, is a Tri-Service effort and will be closely monitored by the Tri-Service Alternative Fuels Team.

Evaluations of In-Mask Hypoxia Mitigation Sensors at NAMRU-D

Dr. Jeffrey Phillips & Dr. Bill Becker

Flight safety is a top research priority in the NAMRU-D Aeromedical Directorate. Hypoxia still represents a significant hazard in military and civil aviation. Since 2001 there have been over 100 hypoxia related hazard reports and three Class-A mishaps in Naval Aviation attributed to hypoxia. Scientists and engineers at NAMRU-D have been testing in-cockpit hypoxia detection methods for the past seven years. Experiments conducted to date have focused on a myriad of physiological sensors including pulse oximetry, reflectance oximetry, and near-infrared spectroscopy for in-cockpit hypoxia detection. Although each of these techniques is capable of detecting a hypoxic event, their functionality is often compromised by environmental factors encountered in aviation and they require the operator to experience a significant degree of blood oxygen desaturation before hypoxia is detected. Unfortunately, there are many cases in which operator performance is significantly affected by hypoxia before it is detected. These key limitations led NAMRU-D investigators to seek hypoxia detection methods that would alert the operator rapidly to the onset of a hypoxic event. One promising approach uses gas sensors to monitor the volume and quality of air provided to pilots and crew through their life support systems. Dr. Jeffrey Phillips and his team determined that in the event of a hypoxic episode an oxygen sensor in the mask would detect hypoxia as long as six minutes before any of the measures of blood oxygen saturation would.

Figure 1: The Orbital hypoxia mitigation sensor suite mounted to a standard aviation mask.

Promising results associated with detecting hypoxia at the mask has led to collaboration between the Navy, the Air Force, and private industry. Orbital Research, based in Cleveland, OH, has developed a sensor suite to detect any disruption in the quantity or quality of the breathing air supplied to the pilot before operator performance is affected. The Orbital suite is composed of an oxygen and flow sensor to test air before it reaches the operator as well as a carbon dioxide sensor to check for anomalies in expired air to suggest a disruption to normal respiratory metabolism. NAMRU-D researchers are currently executing a project, funded through the Air Force Surgeon General's Office, to characterize the effect of normal aerospace environmental factors on sensor performance and accuracy. Many aspects of the aviation environment such as fluctuating barometric pressures and humidity levels, and temperature extremes can negatively influence sensor performance in operational settings. In tests currently being conducted at NAMRU-D sensors are evaluated inside a hypobaric chamber while temperature, pressure, flow and humidity are manipulated. The information acquired through these tests will be used to establish algorithms to correct for the negative effects of aviation specific environmental issues that influence sensor performance. Additionally, NAMRU-D researchers are working closely with Air Force colleagues to identify methods to detect the presence of contaminants in air delivered to pilots. Similar methods will be used to characterize the effects of the same environmental issues on contaminant sensors identified by Air Force researchers.

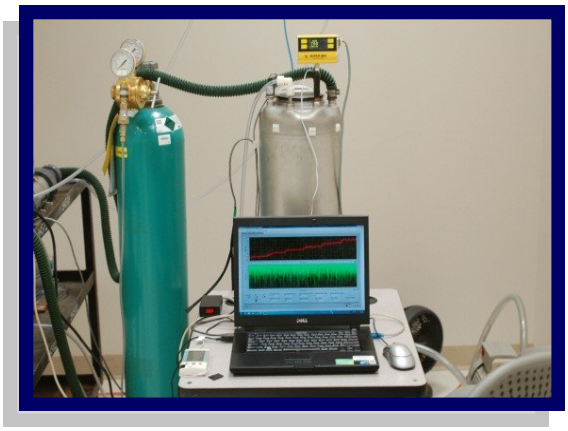


Figure 2: NAMRU-D's small hypobaric testing chamber.

The development of in-mask sensors to detect disruptions in air supplied to flight crew appears for now to be the most promising approach to this insidious threat. NAMRU-D researchers and their research collaborators will continue investigating this and other potential mitigations, with the constant goal to improve safety of flight for our warfighters.

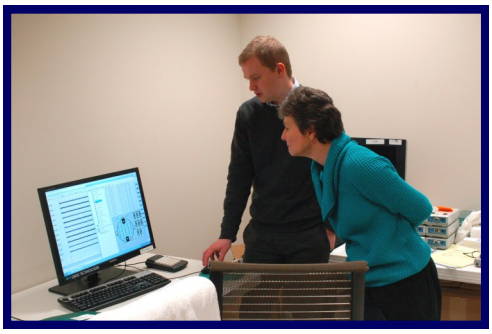
NAMRU-D Expands Collaborations and Capabilities for Fatigue

Dr. Lynn Caldwell

One of the major goals of BRAC in moving the Navy's aeromedical research function from Pensacola to Wright-Patterson AFB was to allow opportunities for growth and collaboration with other research laboratories. This goal is coming closer to achievement with the Air Force-funded study to investigate the combined effects of caffeine and modafinil, the military's prescription alertness-enhancing medication. Scientists from NAMRU-D, the U.S. Air Force School of Aerospace Medicine (USAF SAM), and the Christchurch Neurotechnology Research Programme (*NeuroTech*Ô), based in the New Zealand Brain Research Institute, have come together to explore the effects of combining multiple alertness aids on various measures of physical and cognitive performance. As the lead in this research effort, NAMRU-D's contribution includes performance of various cognitive tests as well as measurement of brain activity using a newly-acquired polysomnographic system. Recording of the sleep electroencephalographic (EEG) will allow scientists to determine stages of sleep during overnight sleep recordings and thus document the quality of sleep research participants obtain. This system also has the capability of recording wake EEG activity and processing the data through spectral analysis. The outcome of this EEG analysis during a cognitive task permits scientists to correlate performance with brain activity and eventually predict when a person is too sleepy to perform a task successfully. Dr. Richard Jones from the New Zealand Brain Research Institute is contributing a task which measures behavioral lapses in attention. Combining performance on a tracking task with eye movement and EEG activity provides data which reliably detect lapses in attention, and thereby signaling when a person is no longer able to stay awake and perform the task on hand. Dr. James Gaska from USAF SAM and LCDR Hong Gao of NAMRU-D are contributing to the effort by measuring changes in depth perception as a person becomes sleepy. Through this joint research effort, questions concerning the safety and efficacy of combining prescribed and over-the-counter stimulants can be documented, leading to informed policies concerning the use of stimulants.

Dr. Beth Hartzler measures and positions the EEG sensors on the research volunteer's head before he performs the tacking task.

Ms. Chelsea Sill (right) prepares the tracking task. EEG activity is recorded during the task and processed through spectral analysis which can detect the research volunteer's lapses in attention.



Dr. Slaval Guznov (left) and Dr. Lynn Caldwell (right) analyze the measures of physical and cognitive performance of the research volunteer's wake EEG activity on the polysomnographic system.

NAMRU-D Products & Presentations

Brown, D.L., Caldwell, J.L., & Chandler, JF. (2013, January). At war with fatigue: Weave sleep into your ops plan or give the enemy an advantage. *Armed Forces Journal*, 12-15, 31.

Hardt, D. (2012). *Health Risk Assessment of Women in Submarines (Phase III): Two Generation Developmental and Reproductive Safety Evaluation of Major Submarine Atmosphere Components (CO, CO2 and O2) in Rats (Rattus norvegicus).* (Report No. 159260).

Mumy, K.L., Howard, W., Wong, B., & Mattie, D. (2013, March). *90-Day toxicity study with hydroprocessed esters and fatty acids jet fuel from camelina (HEFA-C) in rats.* Presentation given at the 52nd Annual Society of Toxicology Meeting and ToxExpo, San Antonio, TX.

William, H., Robinson, E., & Kirkendall, C. (2013, March). *Development of a subjective evaluation tool for assessing marksmanship training effectiveness.* (Report No. 166448).

Wong, B., James, R.A., Sharits, B., & Sweeney, L. (2013, March). *Development of an inhalation exposure system to control concentration and time profile of a test gas to evaluate the predictivity of "toxic load" models.* Presentation given at the 52nd Annual Society of Toxicology Meeting and ToxExpo, San Antonio, TX.

Commanding Officer's Corner

CAPT C. Douglas Forcino

Captain C. Douglas Forcino, MSC, USN
Commanding Officer

As I write the CO's Corner for this edition of the newsletter, there is still quite a bit of uncertainty regarding the federal budget, due largely to the components of the fiscal "perfect storm" in which we find ourselves: sequester, the possibility of another continuing resolution, and the federal debt ceiling. These are certainly times unlike any that we've ever experienced – including those of us who have been around for quite a while. Many others have written or spoken about the deleterious effects of this situation, and certainly, the possibility of a 20% pay reduction for our civil service employees is not to be taken lightly; however, I'd like to focus this article on why I think NAMRU-D will survive this storm and will remain an organization of which our employees can be proud and on which our sponsors may rely.

I've learned in the nine months I've had this job that the character of our employees will keep NAMRU-D from failure, regardless of the situation or conditions placed upon us. There is an indomitable spirit here that has swept over the whole command. Certainly, people are concerned about the fiscal situation, but aside from a bit of gallows humor (which is probably healthy) there has been no discernible change in peoples' attitudes toward their work. Research protocols continue to be executed for our sponsors and for the benefit of warfighters across DoD. Investigators are responding to calls for pre-proposals and proposals with high quality, focused, mission-centric responses. The science directorates are supporting one another in an unprecedented way by co-authoring numerous project proposals and by offering assistance in other ways to one another. I have always looked at NAMRU-D as a family and I think that the present hardships have brought us closer together.

To those of our customers and sponsors who are reading this, let me say that you may continue to depend upon us in these difficult times to deliver products that are on budget and of high quality. We are structuring our approach to the furlough period to ensure that we have coverage of projects 100% of the time by using a floating furlough schedule for our civil service personnel and by fully utilizing our military population and our highly talented and capable contract workforce.

It is possible that between the time I write this and the time you read it the issues of sequester and CR will be solved and everyone will stay at work. But whether that happens or not, we'll be here for our customers when they need us, just as the members of the NAMRU-D family have been here for one another all along.

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

NAMRU - Dayton

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