

## U.S. Warfighters' Mental Health and Readiness

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### **ABSTRACT**

*Today's warfighter like all his predecessors is exposed to an inordinate amount of stressors on the battlefield. A few examples include, sleep deprivation because of the high operational tempo, information overload due to the complex network-centric environment of modern warfare, emotional strain brought about by surrounding violent acts, and anxiety for the welfare of their family members left behind. The Military Operational Medicine Research Program (MOMRP), nested in the U.S. Army Medical Research and Materiel Command, is a multi-laboratory program that studies the warfighter as a biomedical system in an effort to maintain his/her health and combat readiness. This paper presents MOMRP's research efforts that focus upon a few of the tools developed to assess mental health and cognitive functioning and the employment of those tools to evaluate our troops.*

*One of the tools is the "Automated Neuropsychological Assessment Metrics" which consists of a library of computerized tests to measure cognitive processing efficiency to include attention, memory, problem solving, process efficiency, and performance consistency. Several research groups have successfully employed this tool in a variety of studies to include the effects of concussion from sport injuries and military operations. The tool is being validated and developed for commercial production.*

*The "Actigraph" is a wristwatch-like device that measures movement which enables determination of an individual's sleep/wake cycle, and consequently can estimate mental fatigue resulting from sleep loss. Sleep is being recognized as a commodity requiring replenishment for proper mental function and the actigraph can serve as a meter of sleep deprivation. The flight simulator at the U.S. Army Aeromedical Research Laboratory has been used to study the effects of sleep loss. Using the simulator, the investigators found that pilots flying over-night missions had significant visual perceptual impairment and complex motor performance impairment, beginning 19 hours after continuous wakefulness.*

*Another tool that MOMRP scientists developed to further study warfighters' mental health and readiness during deployment is a survey instrument. COL Charles Hoge and coworkers at the Walter Reed Institute of Army Research developed surveys to identify the mental health problems in our warfighters who have deployed in the current war. They found that warfighters who deployed to Iraq were exposed to more frequent and intense combat than those deployed to Afghanistan. Not surprisingly, a greater percentage of those returning from Iraq screened positive for major depression, generalized anxiety or Post Traumatic Stress Disorder (17%) compared to those returning from Afghanistan (11%) or compared to those who had*

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*not deployed (9%) found that post-deployment surveys were more effectively utilized 60-90 after returning rather than immediately upon return. LTC Paul Bliese and coworkers found that post-deployment surveys were not as effective in detecting mental health problems in the warfighters immediately after returning home as they were 60-90 days afterwards, resulting in a policy change in post-deployment surveying.*

*With a focus upon the future warfighter, CDR Margaret Ryan and her Naval Health Research Center coworkers in San Diego have been conducting the "The Millennium Cohort Study." This is a longitudinal, prospective epidemiological study which uses surveys to evaluate the health of nearly 140,000 warfighters at periodic intervals over a 20-year follow-up.*

*In conclusion, these MOMRP laboratories have developed key assessment tools and have implemented them to help identify potential cognitive functioning mental health problems and provided commanders with the appropriate intervention actions to improve the warfighters' psychological well-being and readiness.*

### 1.0 INTRODUCTION

The present global war on terrorism has resulted in over 300,000 U.S. warfighters being deployed to nearly 120 countries around the world (1,2,3). In this war, the enemy blends into the civilian population and employs non-standard terror tactics. This type of unconventional warfare can compromise the psychological resilience of even the most conditioned warfighters. Additionally, numerous other war-zone stressors exist that compromise the warfighter's mental health. For example, in a typical mission, the warfighter may experience information overload due to the complex network-centric environment of modern warfare, sleep deprivation because of the high tempo of our operations, emotional strain brought about by surrounding violent acts and by separation from family members left behind. These stressors negatively affect the warfighter's immediate performance and potentially long-term mental and physical health.

At the United States Army Medical Research and Materiel Command, the Military Operational Medicine Research Program (MOMRP) has been studying the warfighter as biomedical systems in an effort to maintain warfighter's health and combat readiness. The purpose of this paper is to present some of MOMRP's research efforts on developing tools to assess mental health and employing those tools to evaluate and treat our troops.

Continued operations in harsh environments can create psychophysiological demands that tax the soldiers cognitive function. Additionally, typical mental health problems on any battlefield may range from sub-clinical mental distress that can affect cognition to psychiatric illnesses (e.g., schizophrenia, bipolar disorder, obsessive-compulsive disorder, panic disorder, and depression). Consequently, a mental health assessment tool should be sensitive enough to quickly diagnosis problems and the electronic platform hardened to withstand the harsh battlefield environment. Some important criteria for development of an ideal neuropsychological monitor include: (1) no or minimal added weight; (2) no or minimal added power requirement; (3) affordable and cost-effective; (4) unobtrusive and non-invasive; (5) existence of device undetectable; (6) transparent in that the monitored individual and does nothing to initiate/sustain frequent measurements; (7) resistant to environmental and physiological artifact, or amenable to real-time artifact removal; (8) relevant feedback provided to monitored individual through workload control feedback or automation; (9) information secure from unauthorized individuals; (10) critical information remotely transmitted to key personnel; and, most importantly (11) precise and accurate measurements of the parameter of interest. Although all the conditions above would be extremely difficult to meet for a given assessment tool, military research scientists in MOMRP have been developing several tools that meet many of the criteria.

## **2.0 ASSESSMENT TOOLS**

One of the tools developed by the MOMRP in 1995 is the Automated Neuropsychological Assessment Metrics, (ANAM), the brainchild of the late Dr. Fredrick Hegge, former Director of MOMRP. The ANAM consists of a library of over 30 computerized tests organized into specific batteries to be useful over a broad range of cognitive, psychological and neurological applications. The instrument permits efficient and precise assessment in areas including performance consistency, cognitive processing, vigilance, problem solving, neuropsychology, fitness for duty, exposure to neurotoxins, pharmacologic assessment, aerospace and undersea medicine, sleep and fatigue cognitive alteration, sports medicine, traumatic head injury and chronic neurological conditions. Both civilian and military research and clinical groups employ the instrument, or derived batteries, for these purposes and new applications are under development. A version has been developed on a hand-held personal digital assistant for field use and is being transitioned to commercial development (Figure 1).

Two items of particular interest are: 1) the development of a parsimonious battery that quickly assesses basic cognitive and neurological domains and provides additional domain tests when indicated by reference to normative values; and 2) use of the instrument in an on-going perspective study of cognitive function of service members returning from deployment to Operation Iraqi Freedom/Operation Enduring Freedom.

ANAM has been successfully used to determine that parachuting appears to be a risk factor for mild traumatic brain injury in the U.S. Army. Moreover, paratroopers with a history of traumatic brain injury before joining the Army might be at a somewhat increased risk of sustaining additional traumatic brain injury while serving in the Army (4). Also, in a group of West Point Academy boxers who received a significant hit to the head, ANAM measured cognitive impairment that was apparent on the day of injury and at 1 to 2 days post-injury with recovery 3- to 7-days later (5). ANAM was used to measure more subtle cognitive performance decrements in a Navy Experimental Diving Unit that traditional tests have not been sensitive enough to detect. The results ensured proper documentation of the divers' neuropsychological condition before and after warm water exposure, and identified any residual effects from exposure to warm water (6).

Another assessment tool being developed is the Sleep Watch Actigraph (Figure 2). The "Actigraph" is a wristwatch-like device that measures movement which enables determination of an individual's sleep pattern, and consequently can estimate mental fatigue resulting from sleep loss. COL Dan Redmond, (ret) U.S. Army, first wrote the specifications for the prototype in the 1970s and it has been developed and improved for dual military/civilian use today. This wear-and-forget watch is a digital signal-processing device that measures wrist movement through actigraphy. Incorporated into the hardware is software that translates the movement into sleep/wake status. Based upon sleep/wake history and the time of the day, the software predicts cognitive capabilities for each warfighter. The estimates can be telemetered to commanders for purposes of mission planning. Leaders or pertinent individuals could then employ pharmacological countermeasures (such as the caffeinated gum) or provide the required rest to achieve appropriate alertness, based upon mission requirements.

Actigraphy has now been well validated as a measure of sleep and is used in both clinical (7) and research settings (8). Future iterations will have the appearance and all the functions of a sports watch (thus, will replace the watch the soldier currently wears—adding no additional burden to the soldier).

A third, laboratory-based, assessment tool is the helicopter flight simulator (Figure 3) located at the U.S. Army Aeromedical Research Laboratory, Fort Rucker, Alabama. This research device simulates the UH-60, being fully instrumented with six degrees of freedom in motion and fully visual display adjustable to day or

night missions. The software itself can be modified to specifically test certain stressors such as visual display delays or information overload. The cockpit has an environmental control unit to regulate internal temperature between 20 and 41 degrees Celsius and relative humidity between 50% and 90%. Subject pilots can fly precision maneuvers such as straight-and-level, climbs, descents, and turns typical of real UH-60 missions. The simulator has allowed us to evaluate the effects of several stressors and countermeasures on pilots. For example, one study found most aviators could not fly a single standard mission (one fuel load or 2 hours) in 105 degree Fahrenheit (41 C) with U.S.- issued chemical protective ensemble without some type of cooling equipment (9). Another study found that pilots deprived of sleep performed equally well with oral administration of modafinil or dextroamphetamine, both significantly above placebo (10).

Several MOMRP researchers have used custom-designed surveys as assessment tools. For example, COL Charles Hoge and associates from the Walter Reed Army Institute of Research developed surveys that provide effective methods of conducting psychological health screening in deployed troops and methods for units to assess the behavioral health status. They use these tools to identify needed interventions that prevent stress- and psychiatric-related casualties and performance degradation.

One of the surveys they developed identified the mental health issues in our warfighters who have deployed in the current war (Operation Enduring Freedom and Operation Iraqi Freedom). They found that warfighters deployed to Iraq were exposure to more frequent and intense combat than those deployed to Afghanistan. Not surprisingly, a greater percentage of those returning from Iraq screened positive for major depression, generalized anxiety or Post Traumatic Stress Disorder (17%) than those from Afghanistan (11%) or those who had not deployed (9%) (11).

Also, LTC Paul Bleise and coworkers found that Soldiers deployed to Iraq reported an increase in psychological symptoms at 120 days after reintegration, relative to immediate reintegration (12). As a result, a 90-120 day post-deployment survey is now being planned for all returning American troops.

The Office of Naval Research the Naval Medical Center in San Diego, California, has initiated an effort, under CDR Russell Shilling, to use virtual reality and videogame technologies to help treat acute PTSD in returning warfighters (Figure 4). The main aim of this study is to compare the effect of virtual-reality exposure to having people revisit traumatic events by imagining scenarios. Based on the video game "Full Spectrum Warrior", these virtual-reality treatment scenarios gradually expose the patient from being in the middle of a city to more radical situations (e.g., full-blown ambush) (13). These tools will hopefully provide therapists a means to guide a patient through a highly immersive virtual environment which triggers the intense sights, sounds and other sensory stimuli experienced in the original conflict.

CDR Margaret Ryan from the Naval Health Research Center and coworkers are executing the largest longitudinal, prospective epidemiological study in military history. The "Millennium Cohort Study" has been using detailed surveys to follow 140,000 military personnel over a 20-year period. The primary objective has been to assess the adjusted risk for the development of common chronic diseases of concern (e.g., asthma, diabetes, and hypertension) within the cohort. They also aim to evaluate subjective health and functional status through standard survey instruments. Preliminary analyses have demonstrated differences in participants who responded before and after the terrorist attacks of September 11th, 2001 (14). Ongoing analyses will demonstrate health effects associated with deployments to OEF and OIF. This critical study's ability to prospectively evaluate both objective and subjective health status, in relation to deployments and other occupational exposures will be of high interest to both military and civilian public health professionals.

### **3.0 CONCLUSION**

The scientists in the Military Operational Medicine Research Program have developed several key cognitive functioning and mental health assessment tools, several of which are discussed above. These tools have been used to help evaluate neuropsychological functioning and mental health status. Use of these tools may enable commanders to take appropriate actions to improve warfighters' psychological well-being. These assessment tools also enable evaluation of preventive or therapeutic psychological countermeasures. The ultimate objective would be to develop psychological resilience in our warfighters to prevent mental health issues and to quickly identify potential problems for rapid and effective treatment.

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### **5.0 DISCLAIMER**

The views, opinions and/or findings contained in this article are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

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**Figure 1: The Automated Neuropsychological Assessment Metrics (ANAM), consists of a library of over 30 computerized tests organized into specific batteries to be useful over a broad range of cognitive, psychological and neurological applications.**



**Figure 2: The Actigraph is a wristwatch-like device that measure wrist movement which enables determination of an individual's sleep/wake cycle and consequently estimates fatigue level.**



**Figure 3: The helicopter flight simulator simulates the UH-60, being fully instrumented with six degrees of freedom in motion and fully visual display adjustable to day or night missions.**



**Figure 4: Virtual reality and videogame technologies are being developed help treat acute PTSD in returning Warfighters by guiding them through a highly immersive virtual environment which triggers the intense sights, sounds and other sensory stimuli experienced in the original conflict.**