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Technology Monitors Warfighter Welfare

By Maryann Lawlor, SIGNAL Magazine
February 2011

Headbands and handhelds facilitate the care of troops.

Master Sgt. Robert Bean, USAF, inspects the wireless pulse oximetry sensor, which is part of the Battlefield Automatic Life Status Monitor (BALSM) headband in his helmet. In addition to measuring the amount of oxygen in the blood, the BALSM headband estimates heart rate and respiration.

To improve access to warfighters' well-being, the military and industry are developing innovative ways to assess and treat them both inside the battlespace and when they return home. Sensors and communication technologies are evolving into capabilities that are as much about saving individual lives as they are about maintaining situational awareness for entire squads. And, in a world booming with social media, help coping with the physical and psychological effects of war now is literally at a warfighter's fingertips.

Although not as devastating as the Vietnam War, in which more than 58,000 lives were lost and approximately 153,303 troops came home wounded, the Global War on Terrorism has taken its toll in affected lives. According to the U.S. Defense Department, by the first week of December 2010, the number of warfighters killed in operation Iraqi Freedom was 4,408; the number of wounded in action totaled 31,935. Between October 2001 and December 2010, more than 1,400 warfighters had died in operation Enduring Freedom; 9,675 troops had been wounded. But while it is possible for the Defense Department to get a handle on the number of physically wounded warriors, it is impossible to calculate the number of walking wounded who have brought disturbing memories home with them.

Advanced technologies have been credited with the reduction in the number of killed and wounded in wars that took place nearly three decades apart. Current communication capabilities enable warfighters to call for assistance faster, and medical advances have saved lives that 30 years ago would have been lost. But recognizing that more can be done, the military and industry are introducing technologies that are likely to save even more lives and help those without outward injuries better cope.

The Battlefield Automatic Life Status Monitor (BALSM) is one example of how the military is working with industry to save lives on the battlefield. The Air Force Research Laboratory, 711th Human Performance Wing, Human Effectiveness Directorate, Wright-Patterson Air Force Base, Ohio, and QinetiQ North America's Technology Solutions Group, Waltham, Massachusetts, have developed a capability that enables medics to determine a warfighters physical status on the battlefield from a distance. Using sensors that are worn and ingested, BALSM monitors physiologic life status signs for triage, rescue or recovery. It also provides a health status history for each person monitored.

According to Dr. Dianne Popik, doctor of audiology and research audiologist, battlespace acoustics branch, 711th Human Performance Wing, Human Effectiveness Directorate, BALSM is being developed for pararescue jumpers so that their health status can be obtained easily and

accurately without introducing additional risk. Wireless sensors measure life signs, and a pararescue team member or medic can obtain the information via radio receiver and then process it using computer software.

“Physiological monitoring technology is well-established; however, miniature remote sensors that are wearable for long periods of time and robust in all environments are a new application for this technology. Research and development was needed to determine methods of remotely and accurately measuring core body temperature, pulse ox [blood oxygen levels] and respiration rates, then have this data transmitted among members of Special Forces teams in extreme situations and environments,” Popik explains.

BALSM has not yet been fielded; however, Popik says the prototypes that have been developed also could be used in situations that do not specifically involve pararescue personnel. “The prototypes developed are promising and have potential for multiple purposes in military environments including Special Forces team member health status monitoring, triaging patients in field evacuation situations, as well as monitoring patient status during transport to combat hospitals,” she relates. “Not only is BALSM useful when team members are not in line of sight, but it is ideal for situations when it is not possible for the medic to have complete focus on one patient, but is instead caring for multiple patients in various states of medical distress. When a patient’s health status changes, the medic is alerted and can triage and attend that patient as needed.”

Scott Shaw, director, soldier systems, Technology Solutions Group, QinetiQ NA, explains that his company has conducted physiological status monitoring research for the U.S. Army in the past. As a result, the Air Force chose to work with the company to create a prototype system that met the unique needs of airmen on the battlefield.

“Under the BALSM project, we rapidly designed and produced prototypes of a new wearable physiological status monitoring system that was built to be Air Force Special Forces-unique and [to meet] user specifications. To build BALSM, we integrated proprietary infrared-based pulse oximetry sensor technology from Worcester Polytechnic Institute with the FDA [Food and Drug Administration] and off-the-shelf temperature measurement technology from Respironics,” Shaw explains.

The system consists of a wireless headband sensor unit, an indigestible temperature capsule and a USB-based receiving unit. The sensor unit contains the pulse oximeter and a three-axis accelerometer. It continuously measures blood oxygen level, heart rate, respiration rate, body position and activity level; the indigestible temperature capsule measures core body temperature. The receiver unit continuously monitors the wireless sensor data and interfaces to a ruggedized laptop so monitoring data can be relayed in real time over military radios.

A wireless sensor is the second part of the BALSM system. When the warfighter ingests the capsule, the sensor within measures core body temperature.

“The system is important as it allows continuous monitoring of the status of an entire team even when the team members are separated by a distance or out of line of sight from each other. It could also be used for monitoring pilots or for monitoring a group of injured airmen in a mass casualty or a medical evacuation situation,” Shaw relates.

His company continues to explore the use of BALSM by airmen in the battlefield as well as other military and commercial applications. Discussion has taken place about utilizing the system to monitor pilots

in flight to measure blood oxygen levels and core body temperatures in high-G and heat-stress environments, he adds.

QinetiQ has some experience with this type of technology. According to Shaw, the company worked with the Army's Medical Research and Materiel Command and Natick Soldier Systems Center when they were conducting research and development of wearable physiological status monitoring systems. The company developed a T-shirt that includes multiple sensors in an electronic-textile bus embedded into a garment. Called TrainTrak, the fully integrated system monitors heart rate, respiration, posture, activity and location via the Global Positioning System and then wirelessly transmits this data to a display unit in a different location.

But monitoring warfighters' health status on the battlefield is only one way the Defense Department and innovative industry teams are helping the troops. Well aware that the wounds of warfare can go deep and stay entrenched, new apps for mobile devices are appearing on handheld devices, making it easier for warfighters and veterans to seek treatment.

For example, the Army created the mCare telehealth outreach program for troops who are recovering from mild traumatic brain injuries and other wounds. mCare includes a mobile app that complies with the Health Insurance Portability and Accountability Act and enables patients and Army health care professionals to communicate securely. Users also can store their essential health care information on their cell phones.

According to Mark Trigsted, executive vice president of health care, Diversinet Corporation, Toronto, the project began when the Army requested a way to communicate with warfighters in a case-management manner that went beyond telephone calls. The goal was to ensure extended care because wounded warriors were missing an average of 10,000 medical appointments per month. Missed appointments occurred for several reasons, including warfighters who already had returned to their units or were lost in the Department of Veterans Affairs system. Trigsted points out that in many cases, missing medical appointments is simply a matter of re-entering the flow of home life, which includes time-eaters such as financial paperwork as well as welcome activities such as time with family.

Working with the Army, Diversinet determined that what was needed was a non-obtrusive approach to communicate in a secure manner, he explains. One challenge was the different types of cell phones service members use. While 60 percent owned smart phones, approximately 30 percent used clam-shell phones. To determine which type of phone a warfighter owns, the case manager inputs the telephone number, and when the soldier responds, the Diversinet's auto detection and provisioning technology identifies the individual's smart phone type and cell phone service.

In the two-way communication process, a medical care team member writes a message to the warfighter. The message is encrypted and sent to the warfighter's telephone. To respond to the message, a soldier inputs a unique username and employs the bilateral security feature: a personal identification number and an authentication password. "Every time a message is generated, a one-time authentication password is sent to the soldier to verify identification," Trigsted explains.

"The results have been astonishing. We have gone from a two-digit suicide rate to almost nothing. The number of missed appointments is down by 80 to 90 percent," he states.

At the completion of the pilot program, the company moved into full production so that the Army now can track the progress of as many as 10,000 wounded warriors who have returned home or to community-based transition units following their initial recuperation in military medical facilities.

Trigsted relates that in the future the service will go beyond telephone messaging and take the smart phone to the next level. Diversinet plans to enter the world of social networking by enabling messaging in a secure structure. This capability would allow warfighters to work peer-to-peer. In addition, the company is working on a remote detection patch that would monitor a body's enzymes, blood glucose and blood pressure. This information would be sent via smart phone to the case manager.

Physical well-being is not the only aspect of the troops that the military leadership is interested in monitoring and supporting both during and after service. The Defense Department's National Center for Telehealth and Technology, Joint Base Lewis-McCord, Washington, has created the T2 Mood Tracker. The smart phone app makes it easier for users to monitor trends in their emotions and behaviors in response to therapy, medication, daily experiences and changes in their work and home environments.

Dr. Robert Ciulla, chief of the population and prevention programs division at the center, explains that the mobile app was designed for the Android platform as an alternative to paper and pencil. When patients are asked to keep track of their moods using the traditional method, they often forget to write down how they feel at specific times or when crises occur. The touchscreen technology makes this job both easy and intriguing. "Too often, the medical service provider will ask, 'How was your mood over the past week?' The patient responds with retrospective reporting, which is not always specific," Ciulla explains.

To track their moods in different circumstances, users rate how they are feeling on a scale that ranges from one extreme to another. This information is then saved so that it can be shared with medical personnel at their next appointment.

Other features of the T2 Mood Tracker include an audio signal that prompts the user to respond at certain intervals and the ability to jot down notes with the mood rating.

Not only does this ensure that accurate information is recorded, Ciulla says that self-monitoring also engages the user, resulting in a personal awareness of changes. "Research shows that focusing on yourself helps create changes within," he adds. He emphasizes, however, that the T2 Mood Tracker is not a diagnostic tool.

The app is available for downloading not only for military personnel but also by anyone who owns a smart phone. The tracker can function as a stand-alone tool or used in tandem with a provider. Currently, the information that is on the user's smart phone cannot be sent to the medical service provider; however, this is a capability that the center is examining. In addition, the app initially was available only on the Android platform, but it is scheduled to be available on the iPhone early this year.

Although the center has not been analyzing usage data, as of the beginning of last September, more than 8,000 people downloaded the app; their names are not recorded. Center personnel also know that 18,000 mood-tracking sessions had occurred.

The T2 Mood Tracker came in first place in the General Wellness category in the Apps for the Army application development challenge that took place late last year. The center is in the process of developing similar apps for medical service providers and the Department of Veterans Affairs' National Center for Posttraumatic Stress Disorder.

WEB RESOURCES
Air Force Research Laboratory, 711th Human Performance Wing, Human Effectiveness Directorate: ***www.wpafb.af.mil/afrl/711HPW***
Diversinet Corporation: ***www.diversinet.com***

mCare: ***www.tatrc.org/?p=locs/south/events***
T2 Mood Tracker: ***http://t2health.org/apps/t2-mood-tracker***