

December 6, 2013

NSSC This Week



Natick Soldier Systems Center Public Affairs Office

NSSC

R&D

Top 10 stories of
2013 highlight
NSSC's support for
Warfighters





Publisher's Note

John Harlow
USAG-Natick and NSSC Chief of Public Affairs

Our R&D Top Ten

It's amazing how time flies.

It seems like yesterday that I took over for the retiring Jerry Whitaker as the Chief of Public Affairs at the U.S. Army Garrison-Natick and the Natick Soldier Systems Center. Now, more than four years later, it is hard to believe I have lived here and worked here longer than anywhere other than my hometown of Tyrone, Pa.

The mission of our office is to tell the Natick story accurately to as many people as would listen. While there are many public affairs offices across the Army who have more assets, I will put our small shop up against anyone for quality and quantity of stories told.

This is the third year we have put together our Top 10 stories of the year.

In this edition of NSSC This Week, we look at the Top-10 Research and Development stories of 2013.

There are stories about the research done at the NSRDEC, USARIEM and the PM-FSS. I want to thank the subject matter experts for taking the time, sharing their stories and allowing us to tell the Natick story throughout the Army and through public means.

We hope you look through this issue and learn some of the great things done here at Natick on behalf of our Soldiers.

It has been a tough year with the furlough and government shutdown, but it is a credit to the great people who work here that they are constantly looking for the next great thing to protect our Soldiers on the battlefield.

A special thanks to Bob Reinert, Tazanyia Mouton, Kelly Sullivan, Alexandra Foran, Phil Fujawa and Dave Kamm, who all have a role in telling the Natick story.

Please feel free to provide us your feedback. What you like, don't like or a story you think we should tell. Send e-mails to john.d.harlow.civ@mail.mil.

Next week, the Top-10 people stories of 2013.

Thanks for reading.

John Harlow

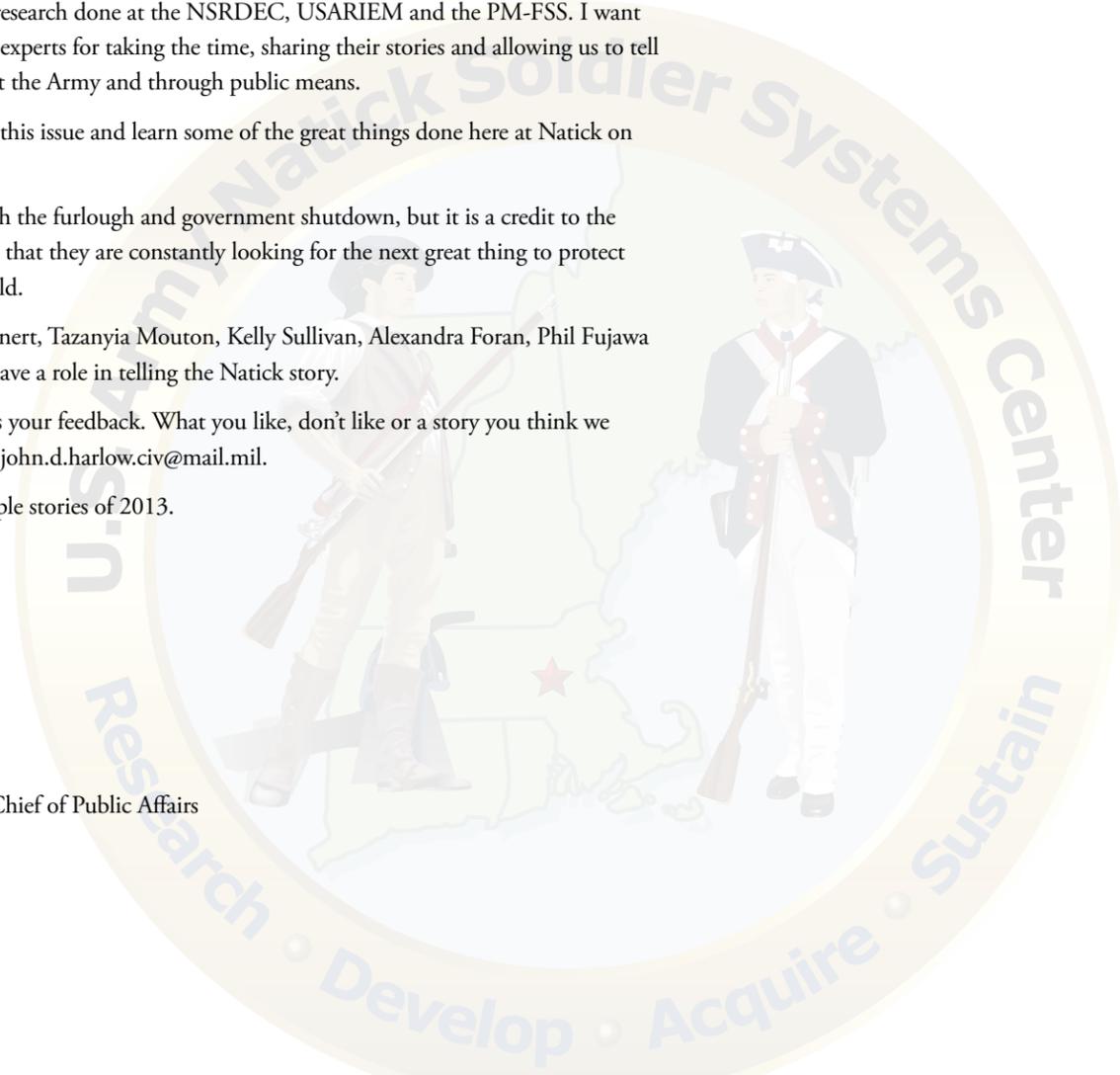
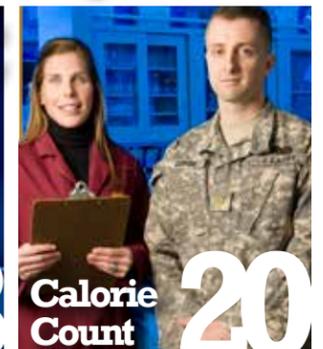
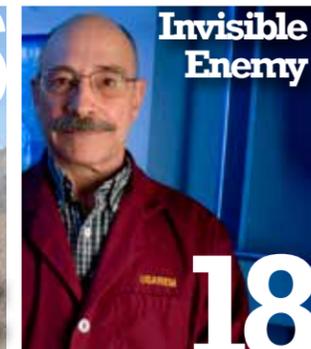
USAG-Natick and NSSC Chief of Public Affairs



Table of Contents

December 6, 2013

NSSC This Week



HEaDS-UP

NSRDEC for better helmets

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (Sept. 6, 2013)

In their quest for better helmet technologies to keep Soldiers and Marines safe on the battlefield, researchers at Natick Soldier Research, Development and Engineering Center are making a “HEaDS-UP” play.

Helmet Electronics and Display System-Upgradeable Protection, or HEaDS-UP, has been a four-year effort at Natick to provide mounted and dismounted troops with more fully integrated headgear system. HEaDS-UP has focused on developing a Technical Data Package of design options and tradeoffs to build a modular, integrated headgear system. Some of these technologies include: improved ballistic materials; non-ballistic impact liner materials and designs; see-through and projected heads-up display technologies; better eye, face and hearing protection; and communications.

Two modular headgear concept designs emerged from the process. They will be officially unveiled in October during a demonstration at Fort Benning’s Maneuver Battle Lab, said Don Lee, project engineer in the Headgear Thrust Area of NSRDEC.

“We’ll have mounted and dismounted Soldiers wear the two different concepts, performing a variety of tasks,” Lee said. “The event will be a VIP demo of Soldiers con-

“Going by a recent (Joint Trauma Analysis and Prevention of Injury in Combat) report, ... of all the injuries to the head, 72 percent are to the face. So that shows a technology gap there.”

Don Lee, project engineer in the Headgear Thrust Area of NSRDEC

ducting training operations at mission speed using the helmet concepts.”

According to Lee, the advances resulted from the collaboration between NSRDEC and the Army Research Laboratory. Quarterly meetings kept dozens of involved personnel on the same page.

“The program was very successful due to the collaborative support from the different agencies,” Lee said. “Without that collaboration and support, it would have made the program more challenging.”

Lee said that the program looked at a variety of technologies.

“It was mostly like an 80-20 split – 80 percent material solution, 20 percent impact on the Soldier,” said Lee, “kind of setting the stage for the next evolution of headgear protection, which will look to swap that, doing more 80 percent impact on the Soldier and 20 percent material solution.”

The modular prototypes were designed to allow warfighters to adapt the headgear to the mission and to work harmoniously “with other existing, fielded technologies – your body armor, your (hydration pack), ... your protective eyewear, and then being able to accomplish common skills and tasks – getting up, getting in a prone positions, entering a vehicle, exiting the vehicle, sighting a weapon, and stuff like that,” Lee said. “We’ve done some cognitive studies, as well, looking at head-mounted displays, see-through displays, the integration factor of the display.”

Mounted and dismounted Soldiers have already worn the prototypes in “human factors evaluations,” from which data were collected, analyzed and applied.

“We were able to integrate the concepts during their normal training scenarios, ...



and then following their training event, get feedback from them,” Lee said. “It was quite overwhelming, the response (we) received that every Soldier that used these systems liked the prototype systems over their currently fielded system. So whether it was an (Army Combat Helmet) or a (Combat Vehicle Crewman helmet), they all like the prototypes over them.”

Lee predicted that Soldiers will embrace the modular platform, from which parts can be added or removed in seconds. “Being able to do that (mandible and visor) protection when needed or being able to remove it when not needed is the big ‘wow’ factor,” he added.

The mandible and visor provide fragmentation protection for the face, Lee said.

“Going by a recent (Joint Trauma Analysis and Prevention of Injury in Combat) report, ... of all the injuries to the head, 72 percent are to the face,” Lee said. “So that shows a technology gap there.”

“Soldiers wear the (ballistic) eyewear, but everything outside the eyewear is open. This will be the biggest advantage to the Soldier.”

Vehicle crew members, in particular, should appreciate the headgear.

“One of the things I hoped to do with this program was reduce the logistic footprint of combat helmets for ground Soldiers,” Lee said. “Right now, mounted Soldiers have two helmets. They have their Combat Vehicle Crewman helmet ... and they have their Advanced Combat Helmet. So, if they dismount from the vehicle, they’re supposed to swap helmets.”

“I think we’ve proven through our program that there can be one helmet for both mounted and dismounted Soldiers, which, I think, is a big deal. I think the program’s proven that a



one-helmet system for ground Soldiers, whether they’re mounted or dismounted, can exist.”

Crew members looking out hatches discovered an unexpected benefit during evaluations.

“When the Soldiers wore the prototype systems with the visor and mandible,” said

Lee, “it was the first time that they weren’t eating sand and dust and rocks going down the road.”

Ultimately, the program data will be transferred to Program Executive Office Soldier and the Marine Corps for decisions about

what technologies should be fielded.

“We’ve come up with tradeoffs, ideas, designs that the Soldier will benefit from in the end,” Lee said. “When these technologies impact the Soldier in a positive way, that’s really the reward at the end of the day.”

Cooler Feet

Putting new boots on the ground

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (June 17, 2013)

What it all comes down to is keeping Soldiers' minds on their missions in Afghanistan, rather than on their feet.

That's how Ben Cooper views the development of the Hot Weather Mountain Combat Boot, or HWMCB, at Natick Soldier Research, Development and Engineering Center, which began in spring 2011. Cooper thought it was so important that he got permission to continue working on the boot after leaving the Footwear Performance Laboratory at NSRDEC to become a senior materials engineer for the Air Force, still situated at Natick.

"Ben was so involved in the early phases of this and had been really running this project superbly, I thought that it was a good idea that he was able to continue on this project," said Bob Hall, the current Army footwear engineer.

"Obviously, in these fiscal times, being able to join together and work toward a common goal for the warfighter and for our country, I think, is the most important thing," Cooper said. "My supervisors have been very supportive about me taking time to help out and support the Army with this effort, and we're all happy to do it."

"The Air Force has been a team player in this," he continued. "It's a sister service — one team, one fight."

Cooper and Hall are working with Program Executive Office Soldier and Product Manager Soldier Clothing and Individual Equipment to unveil phase two of the boot. Phase one — a lighter, more breathable version of the popular Mountain Combat Boot — has been issued to every Soldier deploying to Afghanistan for the past year. As many as 200,000 pairs of the boots have

been fielded with great success.

"(For) the amount of boots that are out there, we've had very, very few complaints," Hall said.

"Soldiers will give you honest feedback," Cooper said. "We haven't heard bad things. In this business, silence is a great thing."

Cooper pointed out that nothing like the HWMCB existed before Soldiers in Afghanistan began asking for it two years ago.

"We were trying to develop and identify the salient characteristics of a Hot Weather Mountain Combat Boot," Cooper said. "Since it was a new item, it's not commercially available. We evaluated three different material solutions at that time from three different manufacturers."

Using Soldier feedback from phase one, which included requests for more breathability, Cooper and Hall confidently strode into phase two.

"We cherry-picked the very best features on each of the boots, and we provided that feedback to industry," Cooper said. "They responded and provided new solutions, updated solutions."

Three new styles are now being evaluated at the National Training Center, Fort Irwin, Calif., by units from the 2nd Brigade Combat Team, 4th Infantry Division, based at Fort Carson, Colo. Each boot is nearly a half-pound lighter than the original mountain boot.

"Due to Afghanistan's unique climate and environment, they needed a boot that not only would provide them ankle stability and traction and durability, but they also needed greater breathability," Cooper said. "It's a

balancing act. We were constantly walking that fine line. I think that we have worked with industry tirelessly on trying to make sure that we accomplish exactly what the warfighter wants and needs."

Industry made the boots more breathable by including moisture-wicking linings, perforating the leather, and inserting textiles wherever possible between the leather and rubber, without compromising stability.

"It took some creative approaches to be able to do that," Cooper said. "If you're kicking rocks, and you're crawling, and you're in the prone position, you need to be able to not have this thing rip."

Cooper will travel to Fort Irwin at the end of June with Chris King, of the Operational Forces Interface Group at Natick, to collect data from Soldiers on the 285 pairs of boots that had been issued to them.

The goal is a technical specification for a boot that could be supplied by any manufacturer. When it's achieved, said Cooper, it will be because of the "collaborative atmosphere" at Natick.

"I think that's just part of the culture that is here, and I'm proud to be a part of that," he continued. "We were able to leverage all the resources that we have available to us."

Ben Cooper (left) and Bob Hall have been working on the development of phase two of the Hot Weather Mountain Combat Boot at Natick Soldier Research, Development and Engineering Center.

'Rock or Something'

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (May 30, 2013)

If you're familiar with the phrase "rock or something," then you've probably used a Flameless Ration Heater to warm up a Meal, Ready-to-Eat.

To this day, the phrase remains part of a pictogram on the package of the heater, known as the FRH, which was developed at Natick Soldier Research, Development and Engineering Center's Department of Defense Combat Feeding Directorate and is celebrating its 20th anniversary in 2013. It refers to directions that advise warfighters to place the FRH at an angle when heating up a Meal, Ready-to-Eat, commonly known as an MRE.

"The term 'rock or something' has now reached cult status," said Lauren Oleksyk, team leader of the Food Processing, Engineering and Technology Team at Combat Feeding. "It's just taken on a life of its own."

Oleksyk was there at the beginning with colleagues Bob Trottier and now-retired Don Pickard when the FRH and that memorable phrase were born in 1993.

"We were designing the FRH directions and wanted to show an object to rest the heater on," Oleksyk recalled. "(Don) said, 'I don't know. Let's make it a rock or something. So we wrote 'rock or something' on the object, kind of as a joke."

The joke has legs. As Oleksyk pointed out, there now are T-shirts and other items for sale that bear those words. "Rock or something" even has its own Facebook page.

Introduced to the heater years ago, famed chef Julia Child insisted on following the package directions and activating it by herself. With no rock handy, she decided to employ a wine glass stem.

"Which is so classic Julia," Oleksyk said, laughing. "So there have been many things other than the rock or something that have been used. There are many, many Soldiers over the years that have their own personal joke about what they might use in place of a rock."

The FRH is no joke, however. Adding an ounce and a half of water to the magnesium-iron alloy and sodium in the heater will raise the temperature of an eight-ounce MRE entrée by 100 degrees in about 10 minutes.

"Some of the challenges were keeping it lightweight and low volume, and not requiring a lot to activate it," Oleksyk said.

"There are many, many Soldiers over the years that have their own personal joke about what they might use in place of a rock."

— Lauren Oleksyk,
Combat Feeding

The heater's arrival gave warfighters the option of a hot meal wherever they went and whenever they wanted.

"I've heard more feedback on this item than any other item I've ever worked on in my career here," said Oleksyk, who has been at Natick nearly 30 years. "They're so grateful to have this heater in the MRE. It's almost always used whenever they have 10 minutes to sit down for lunch."

Prior to the FRH, warfighters used Trioxane fuel bars with canteen cups and cup stands to

heat their MRE entrees. As Oleksyk pointed out, the fuel bars couldn't be packed alongside food in the MRE package.

"So if the fuel bar and the MRE didn't marry up in the field," said Oleksyk, "they really had no way to have a hot meal."

The FRH has remained essentially the same over the past two decades because, as Oleksyk put it, "it's tough to find a better chemistry that's lighter in weight, lower in volume and that heats as well." A larger version has been developed, however.

"We've expanded it to a group ration," Oleksyk said. "So now we have a larger heater that is used to heat the Unitized Group Ration-Express. We call that ration a 'kitchen in a carton.' It serves 18 Soldiers."

The next-generation MRE heater is being tested now, and it will eliminate the need to use one of the most precious commodities in the field.

"The next version of this is a waterless version," Oleksyk said. "It's an air-activated heater, so you wouldn't have to add any water to activate it at all, but that's still in development and will have to perform better than the FRH overall if it's ever to replace it."

Oleksyk remembered sitting on a mountain summit one time during a weekend hike with friends. Suddenly, she heard laughter behind her.

"I hear a guy — sure enough, he says, 'Yeah, I need a rock or something,'" said Oleksyk, who turned to see him wearing fatigues, holding a Flameless Ration Heater, and telling his buddies how great it was.

"So it's far reaching," Oleksyk said. "It really had an impact on the warfighter."



Self-cleaning clothing:

Wear without wear

By Alexandra Foran, NSRDEC Public Affairs / NATICK, Mass. (Feb. 25, 2013)

Imagine a world without dirty clothes. Quoc Truong, physical scientist at Natick Soldier Research, Development and Engineering Center, wants to make that a reality.

“As a single father of four, I fully understand the rationale for self-cleaning clothing, especially when I look back to the time when my children were younger,” Truong said. “So, when former Army General John Caldwell challenged me to come up with clothing that our Soldiers won’t have to wash, I thought that was a great and stimulating challenge.”

Soldiers cannot avoid getting their uniforms dirty while carrying out their missions, especially on the battlefield. Laundering clothes is time-consuming, adds to the logistics burden on the force, and is not always available to forward-deployed Soldiers, who may come into contact with mud, dirt, water, and an assortment of contaminants such as petroleum, oils, and chemicals.

The fabric Truong helped create has a special durable, super-repellent coating with “dual micro- and nano-size architecture.” When this special coating is applied onto clothing, it will give the surface of the clothing a low critical surface energy, or surface tension. When this surface tension is lower than that of the surface tensions of harmful, toxic liquid chemicals, the toxic chemicals would roll off the fabric on contact. Additionally, fabrics that are coated with

this special super-repellent coating showed minimal to no attraction to dust and dirt.

“With minimal or no attractions to dirt and other contaminants, textiles’ frequent launderings will not be necessary, and wash-free clothing could be developed,” Truong said.

Earlier researchers studied microscopic, naturally non-stick surfaces such as the leaves of the lotus and lily flowers, duck feathers, and the feet of a floating water bug, known as the water strider. They found a uniform, repeating “pimples” structure, and they also observed liquid drops’ contact angle as they sit on these micro- and/or nano-structures.

“We go one step further to make our self-cleaning clothing with a special surface coating to resist wetting by oil and dangerous chemicals,” said Truong, who wanted to apply these findings to benefit Soldiers.

Truong submitted a Small Business Innovation Research, or SBIR, topic on Development and Applications of superoleophobic coatings for textile applications in 2007 based on earlier work on self-cleaning, but more importantly, it was based on Massachusetts Institute of Technology’s recent breakthrough discovery about designing superoleophobic surfaces.

By leveraging MIT’s technical findings, Truong believed he could develop self-cleaning clothing for Soldiers.

continued on page 23

Quoc Truong, with Natick Soldier Research, Development and Engineering Center, shows the difference between self-cleaning clothing and regular Army Combat Uniforms when they are exposed to liquids.



Imagine Key lime pie with the consistency of baby food squirting out of a container roughly the size of a toothpaste tube.

The thought of it might make your stomach churn, but one group of high-flying consumers has given two thumbs up to the dessert choice. These discerning diners also think beef stew, truffle macaroni and cheese, chicken a la king, and, especially, home fries and bacon from a tube, are out of this world — or at least in the upper atmosphere.

That's because they fly U-2 reconnaissance aircraft for the Air Force and its NASA research equivalent, the ER-2. Try chowing down while wearing a pressurized suit and helmet at the edge of space, and you'll soon discover why these elite pilots have come to regard the tube foods, produced only by the Department of Defense Combat Feeding Directorate at Natick Soldier Research, Development and Engineering Center, as the very height of culinary achievement.

"We've been making these for years and years," said Dan Nattress, a food technologist with Combat Feeding.

Combat Feeding has been supplying tube foods to U-2 pilots for five decades. For a community of only about 100 pilots, CFD supplies approximately 28,000 tubes annually of the food, which has a shelf life of three years at 80 degrees.

land. Fairly soon before they're landing, they'll open up a caffeinated product."

The tube food menu also needed a boost three years ago, when the Air Force asked CFD to bring its products into the 21st century.

"Things change," Nattress said. "In the 1970s, your expectations were different than what they are in the 2000s. We had no direct communication with the user prior to 2010."

To rectify that, Nattress and Deborah Haley, chef and physical science technician with CFD, visited Beale Air Force Base, Calif., from which the U-2s fly.

"Since then we've had a few pilots who have come here and walked through," said Nattress, "and they are just totally amazed at what we do to make these."

At Beale, Nattress and Haley got a taste of a pilot's life, even trying on the pressurized gear.

"Things are a lot more difficult," Haley said. "Once you're fully suited and under pressure and connected to oxygen, there's no movement inside the helmet, except when you breathe in and breathe out.

"So swallowing is a conscious effort. You have to actually think about that, because there's

you look inside the cockpit — it is just very small," Nattress said. "It really gave us a much better idea of what they go through on a regular basis."

The Air Force asked CFD to produce four products identified by pilots — Peach Melba, Beef Stroganoff, Key lime pie, and a breakfast item, which became bacon with hash browns. They were added to a revamped 15-item menu, all made with fresh ingredients ground to fit in the tubes.

"They didn't want us to completely revise all of the products, but we knew that there were things that we could do to improve them that wouldn't be major," Haley said. "We made some suggestions to develop layers of flavors, and that's my whole thing, is really developing layers of flavors in these tubes.

"So that was the thing just tweaking it and taking it (to) the next level," he continued. "Now the pilots are getting really excited about the food. It's so much better."

Certainly, Nattress and Haley have faced challenges and experienced a failure or two along the way. In the early stages of developing the now successful Peach Melba, Nattress recalled that it had a "dirty sock kind of taste."

Much the same as the pilots they serve, however, the CFD staff continues to push the envelope. In the near future, for example, chicken tortilla soup will find its way onto the menu.

"We're constantly thinking ahead," Haley said. "It takes a while to find just the right balance so that when it comes out of the tube, you've hit just the right flavor profile."

Courtesy photo



Flying High

Natick tube foods keep U-2 pilots fueled

The silver containers attached to feeding probes insert through ports in their helmets and provide nourishment on flights that can last as long as 12 hours. That makes caffeine a popular ingredient among pilots.

"The aircraft itself is every difficult to fly, and it's actually very difficult to land," Nattress said. "They want to be very alert when they

no air movement. It's a lot different sort of feeling to it."

Once pilots are fitted to the four-layer suits by a pair of technicians, they are then shoe-horned into the U-2 cockpits, which actually do have heaters to warm the food.

"I mean, the suit itself is one thing, and

Haley said that she just wants people to know about the science and hard work that go into improving the quality of life for Air Force and NASA U-2 pilots.

"We're such a unique program," Haley said. "There's no one else doing what we're doing."



On Guard

Against Traumatic Brain Injuries

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (May 16, 2013)

They tend to be older, more experienced, and more likely to have families, but deployed members of the National Guard share something in common with their active-duty brothers and sisters — the likelihood of suffering from traumatic brain injuries.

Like other U.S. service members, Guard members take the Automated Neuropsychological Assessment Metrics, or ANAM, test before deployments.

“It provides a baseline of sorts,” said Dr. Kristin Heaton, a neuropsychologist at the U.S. Army Research Institute of Environmental Medicine at the Natick Soldier System Center. “Then if there’s an incident in theater — an injury or a blast exposure or something like that — we can look for changes in these scores as markers of possible injury.”

What’s missing is a reference data set specific to the National Guard so that its members may be compared to their peers. Heaton and other USARIEM researchers aim to correct that by collecting data from a total of 3,000 Guard members from eight states, three different age groups, males and females, in combat support and combat arms units.

“We’ve been in active data collection now for a while,” said Heaton, adding that the process will be complete in December. “We’re aiming for a diverse geographic representation. Having a meaningful, representative data set like this could be really

helpful for interpreting scores, both before and after injuries.”

Why is it important to differentiate the National Guard from other service groups when it comes to traumatic brain injury, known as TBI?

“Being able to better understand [National Guard service members’] unique situation and how deployments have affected them, both in the positive and perhaps not-so-positive ways, is an important area of research that really hasn’t been well developed.”

— Kristin Heaton

“In many respects, they represent a different demographic of Soldier,” Heaton said. “For example, they tend to be older, have families and children, and have dual careers. There is some evidence in the literature that they may respond to deployments, both during and after, somewhat differently than their active-duty counterparts, all of which may impact not just the Soldier, but his or her family, as well.”

Heaton said that in the past, most TBI research had been on active-duty service members. The National Guard recently has become more of a focus.

“Being able to better understand [National Guard service members’] unique situation and how deployments have affected them, both in the positive and perhaps not-so-positive ways, is an important area of research that really hasn’t been well developed,” Heaton explained.

Heaton said she hopes to publish a study containing the results soon after data collection ends. Her team will also provide the resulting data to the National Guard Bureau and the participating states directly.

“They’ve been extremely supportive, and I think they definitely understand the relevance of what we’re doing and why,” Heaton said. “We really do want to be able to get data into their hands that they can use and that would be meaningful and relevant to them, as quickly as we can.”

Just what the data will show, Heaton can’t accurately predict.

“They’re going to perform probably very similar to the rest of the population,” Heaton said. “But we do feel, given that they are a unique cohort within the military, the reference data would reflect their unique demographics.”

Heaton pointed out that National Guard leadership has great interest in the health



and welfare of their personnel.

“They’re very focused on their Soldiers, not just when they have them on drill weekends, but also when they go back home and return to their civilian jobs and re-integrate to their home life situations,” Heaton explained. “They’re extremely interested and eager to know more and to have information that they can then use to help their Soldiers. They have been quite welcoming of this work.”

This is the latest in an impressive number of TBI studies done by Heaton and other USARIEM researchers.

“Much of our work to date has been focused on developing and validating measures of cognitive performance as ways of assessing traumatic brain injury — concussion, in particular,” said Heaton, who added that the goal is “to provide more efficient, more effective and relatively fieldable tools for use by leadership, by medical command, to screen for concussion.”

According to Heaton, TBI research is far ahead of where it stood several years ago. She said she wants to see that momentum continue.

“Traumatic brain injuries don’t go away just because the war ends,” Heaton said. “The effects of these injuries are going to remain with the Soldiers who have sustained them, and a good number of head injuries and concussions occur during training and during off-duty activities. So this is going to be an enduring problem.”



By Bob Reinert, USAG-Natick Public Affairs / FORT DEVENS, Mass. (Nov. 6, 2013)

Innovations meant to improve Soldiers' quality of life during deployments – while saving lives, fuel, water and money – were on display Nov. 5 at the Army Base Camp Integration Laboratory.

The BCIL hosted its second annual "Base Camp Resource and Energy Efficiency Day." Situated on 10 acres at Fort Devens, the laboratory features two "Force Provider" 150-person base camps. One contains standard technologies; the other offers a glimpse into the Army's energy future.

Katherine Hammack, assistant secretary of the Army, Installations, Energy and Environment, and Lt. Gen. Raymond V. Mason, Army deputy chief of staff, Logistics, were among those attending the event. They were briefed about shelters, power management, energy storage, waste disposal and waste-to-energy systems, alternative energy, micro-grids, energy-efficient structures, rigid-wall camps, and fuel-fired kitchens.

"It's just great to see the strides that we're making, the systems that we're testing," Hammack said. "The team here is doing a fantastic job finding ... new technologies, testing them, getting modifications made, and determining the resiliency of the systems prior to deploying them with our Soldiers."

Mason said all the work toward resource and fuel efficiency was done to help Soldiers focus on their missions. He used the hypothetical example of a forward operating base in Afghanistan that has 20 fuel trucks pull up to its front gate.

"Soldiers are put at risk protecting that convoy," Mason said. "Then you've got to get those 20 fuel trucks through your front gate. Every one of those trucks could be a potential bomb."

"Then you've got to store all that fuel somewhere on your forward operating base, which means you've got to build a bigger

(FOB), and that fuel becomes a big target for either indirect or direct fire. Our purpose is to reduce down that risk by reducing down the amount of fuel that's needed to conduct combat operations."

And once it's stored, much of it goes to something other than fueling vehicles or aircraft, Mason noted.

"It's just great to see the strides that we're making, the systems that we're testing. The team here is doing a fantastic job finding ... new technologies, testing them, getting modifications made, and determining the resiliency of the systems prior to deploying them with our Soldiers."

Katherine Hammack, assistant secretary of the Army, Installations, Energy and Environment

"Nearly 50 percent of the fuel that's consumed in Afghanistan on Army operating bases is producing generator power," Mason said.

Hammack pointed out that 70 to 80 percent of all ground convoys in Afghanistan, as measured by weight, consist of fuel and water deliveries.

"And so through better power management, flexible power sources, lightening the energy load on our Soldiers – all combined – we're able to redirect our manpower and our equipment assets back to the mission," said Hammack, "and that increases our agility and it increases our effectiveness overall."

More than 12,000 service members training at Fort Devens rotate annually through the BCIL, providing invaluable user input about systems being developed here, with the ultimate goal of trimming fuel and water usage on base camps by 50 percent. Such innovations as micro-grids, solar shades, shelter

liners and shower water reuse systems have already brought that goal closer to reality.

"When you look at the reductions to date, in a few years, it's remarkable," said Kevin Fahey, Program Executive Officer, Combat Support & Combat Service Support. "And I think a lot of it is our ability to test things and get users on it and get feedback quickly,

and then (be) able to prove that this is the thing we want put in the Soldiers' and the Marines' hands in the field."

This progress has been made despite the budgetary headwinds faced by all Army programs.

"I think this BCIL will survive declining budgets because it's proved the return on investment and the capabilities, and shortened the acquisition process," said Hammack, "and all of those represent costs to the Army and costs to this nation."

Mason said it's critical to maintain funding for such programs as the BCIL.

"If we don't spend appropriately in science and technology, research and development, we're going to find ourselves on the battlefield in a situation where our enemies have a comparative advantage over us, as opposed to the other way around," said Mason, "and our Soldiers are going to be put at more risk."

Energizing Army base camps



“Soldiers have to perform in the mountains. We know lack of oxygen impairs health and performance.”

Dr. Stephen Muza, U.S. Army Research Institute of Environmental Medicine

It’s no secret that Soldiers must prevail in all kinds of terrain and climates to complete missions. Afghanistan, for example, boasts mountains with elevations higher than 24,000 feet.

Many Soldiers who have deployed to high altitudes without the proper time to adjust have learned the hard way that they are probably going to get sick.

“Rapid ascents without sufficient time to adapt to altitude can lead to acute mountain sickness or AMS,” said Dr. Stephen Muza, acting division chief for the U.S. Army Research Institute of Environmental Medicine’s Thermal and Mountain Medicine Division. “This condition, marked by nausea, fatigue, headache and gastrointestinal distress, can really throw a wedge into a mission when not planned for.”

Abrupt exposure to high altitude negatively affects mental and physical performance and overall health because it lowers the oxygen supply to the body’s tissues for a significant

amount of time. This condition, known as hypoxia, is what leads to altitude sickness.

“You also see a performance decrement at altitude,” said Muza. “A Soldier may not be able to carry as heavy a load as they are used to or even march at speed.”

This summer, like many summers before, researchers from USARIEM’s Thermal and Mountain Medicine Division traveled to Pikes Peak in Colorado to study the physiological effects of AMS.

“Soldiers have to perform in the mountains,” Muza said. “We know lack of oxygen impairs health and performance. Currently, we are developing a tool that will give commanders a validated predictive model that accurately tells them at what point a Soldier may feel the effects of AMS and the likely severity of the symptoms.”

Annually, researchers from TMMD make the trek to perform research at Pikes Peak because it allows them to validate the studies they

conduct in the altitude chamber in Natick, Mass., while replicating a forward operating base environment similar to ones in Afghanistan. Also, Pikes Peak has what Muza calls the “ideal research elevation” of 14,000 feet, allowing for significant impairment without making people dangerously sick.

This year’s study concluded a two-year study. Researchers from USARIEM collected data on 70 men and women who were exposed to four different altitudes at different activity levels to validate their previously published predictive model of AMS, which suggested that altitude, time at altitude, gender and physical activity level are significant predictors of AMS.

Peak Performance *continued, page 22*

Peak Performance

Army developing tool to reduce altitude sickness in deployed Soldiers

By Kelly Sullivan, USARIEM Public Affairs / NATICK, Mass. (Sept. 17, 2013)

USARIEM battles Acute Mountain Sickness

The invisible enemy

When they deploy rapidly to the mountainous regions of Afghanistan, U.S. Soldiers confront more than the enemy.

At heights exceeding 8,200 feet, they must worry about the effects of altitude on their mental performance and about their susceptibilities to Acute Mountain Sickness, or AMS. As acting chief of the Thermal and Mountain Medicine Division at the U.S. Army Research Institute of Environmental Medicine, Natick Soldier Systems Center, Stephen R. Muza, Ph.D., devotes a great deal of time to studying those problems.

“We need to know the actual, physiological basis for the development of these altitude illnesses,” said Muza, “and specifically in this case, Acute Mountain Sickness, in order to target new pharmaceutical products.”

Working toward that goal, Muza and his colleagues at USARIEM are collaborating with the Neural Systems Group, Massachusetts General Hospital, Harvard Medical School on “Neuroimaging of Acute Mountain Sickness,” a research study sponsored by the Department of Defense Telemedicine and Advanced Technology Research Center. The study is using near-infrared neuroimaging, or NIN, to non-invasively measure changes in the brains of test subjects at sea level and 14,500 feet while doing cognitive tests and either light or heavy exercise.

Neuroscientist Gary Strangman, Ph.D., of MGH has been bringing his NIN equipment to Natick, where it is used on subjects in USARIEM’s hypobaric chamber, which can simulate altitudes up to 30,000 feet. The NIN is a portable alternative to magnetic

resonance imaging, or MRI.

“He can specifically look at what’s going on in this brain tissue between the transmitter and the receiver,” said Muza of Strangman. “We’re not looking at the whole brain, but we’re looking at the cortex, where most of the neurons are found. That’s where really where all of the action is.”

The collaborative study is focusing on 36 healthy civilian subjects from the Boston metro area, who have baseline measurements done at MGH and then spend two eight-hour sessions each in USARIEM’s chamber. Light is beamed through their brain tissues and then analyzed for changes in blood volume, oxygenation, and fluid distribution.

“He was looking for an opportunity to use his equipment,” said Muza of Strangman.

“I was looking for an opportunity to use cutting-edge (equipment), basically what nobody else has in this world — new portable imaging devices — to study the changes in the brain at altitude in our hypobaric chamber, because you cannot bring an MRI (in there).”

As Muza pointed out, Soldiers’ thought processes slow at altitude. So Strangman designed cognitive tests on a computer screen to measure subjects.

“We want to cause the brain to have to work, and to make the brain work, we do cognitive tasks,” said Muza, “things that are very comparable to what a Soldier does.”

Muza and Strangman also want to know what the brain is doing when a subject is experiencing headaches, lightheadedness,

nausea and other symptoms associated with AMS.

“When you get above 14,000 feet, there’s better than an 80 percent chance that you’ll develop some degree of severity of Acute Mountain Sickness,” Muza said. “We’re interested in knowing what’s going on in the brain in the hours that lead up to the development of Acute Mountain Sickness.”

The study has been ongoing for a year and should be completed in May. The early data are encouraging.

“In the individuals reporting Acute Mountain Sickness versus those who do not report having symptoms of Acute Mountain Sickness, we see that there is a reduction in blood flow to the brain and, therefore, oxygen delivery to the brain in the individuals who are sick versus the individuals who are not sick at altitude,” Muza said. “We do see, with 60 minutes of exercise, more Acute Mountain Sickness than we see with the 10 minutes of exercise. We expected that, and that’s happening.”

The only available pharmaceutical treatment, said Muza, improves breathing, not brain function. This study could help change that one day.

“Finding an alternative drug therapy is a long-term goal of our research program,” said Muza, who added that the collaborative study has offered “the opportunity to bring what I think nobody else has in the world into our hypobaric chamber and use it to study these effects.”



Stephen R. Muza, Ph.D., of the U.S. Army Research Institute of Environmental Medicine’s Thermal and Mountain Medicine Division, is studying the effects of altitude on Soldiers’ mental performance and their susceptibility to Acute Mountain Sickness.

Calorie Count

Army studying special operators' nutritional needs

A typical service member in garrison needs to consume about 3,250 calories a day for sustenance. Maj. Aaron Crombie, Ph.D., is in the process of estimating how much more a special operator should eat.

Crombie, who works for the Military Nutrition Division at the U.S. Army Research Institute of Environmental Medicine, or USARIEM, at Natick Soldier Systems Center, Mass., is leading a team that has been studying special operations forces at training venues around the country to discover that. Results will be used to adjust the Basic Daily Food Allowance, or BDFEA, for dining facilities that serve their meals.

"We know that these guys move a lot," Crombie said. "They train a lot. Some of them are doing two-a-day workouts. They spend a lot of time in the gym, a lot of time at the ranges."

This isn't the first time USARIEM has studied special operators' needs in garrison, said Andrew Young, Ph.D., chief of the Military Nutrition Division.

"The Special Forces have long argued that their people work harder and sustain much higher rates of energy expenditure than the average Soldier when they're training in garrison and subsisting in dining facilities," Young said. "As a result, they argue that their dining facilities should be able to be provided more money per diner to provide more food and extend their operations accordingly to better

meet the nutritional requirements of these more highly active special operations units that are training in garrison."

The current USARIEM study began at the Combat Diver Qualification Course in Key West, Fla. Crombie said preliminary results indicate that service members at that venue needed 4,600 calories a day. Data from Fort Bliss, Texas, and Fort Bragg, N.C., will also be included in the study.

"Dive school is probably going to be the high end of the spectrum," Crombie said. "We should be done collecting data (by the) end of March."

According to Young, nutritional energy requirements are assessed using what's called the "doubly labeled water technique." At the beginning of testing, service members drink water enriched with natural isotopes.

"You can then measure the decline in those isotopes in the body," Young said. "Based on the rate those isotopes decline, we can actually calculate the rate of carbon dioxide loss from the body, which in turn provides an accurate estimate of the rate that the body is burning calories. We compare the caloric burn rate in the Special Forces Soldiers to data we have measured in Soldiers from other types of units.

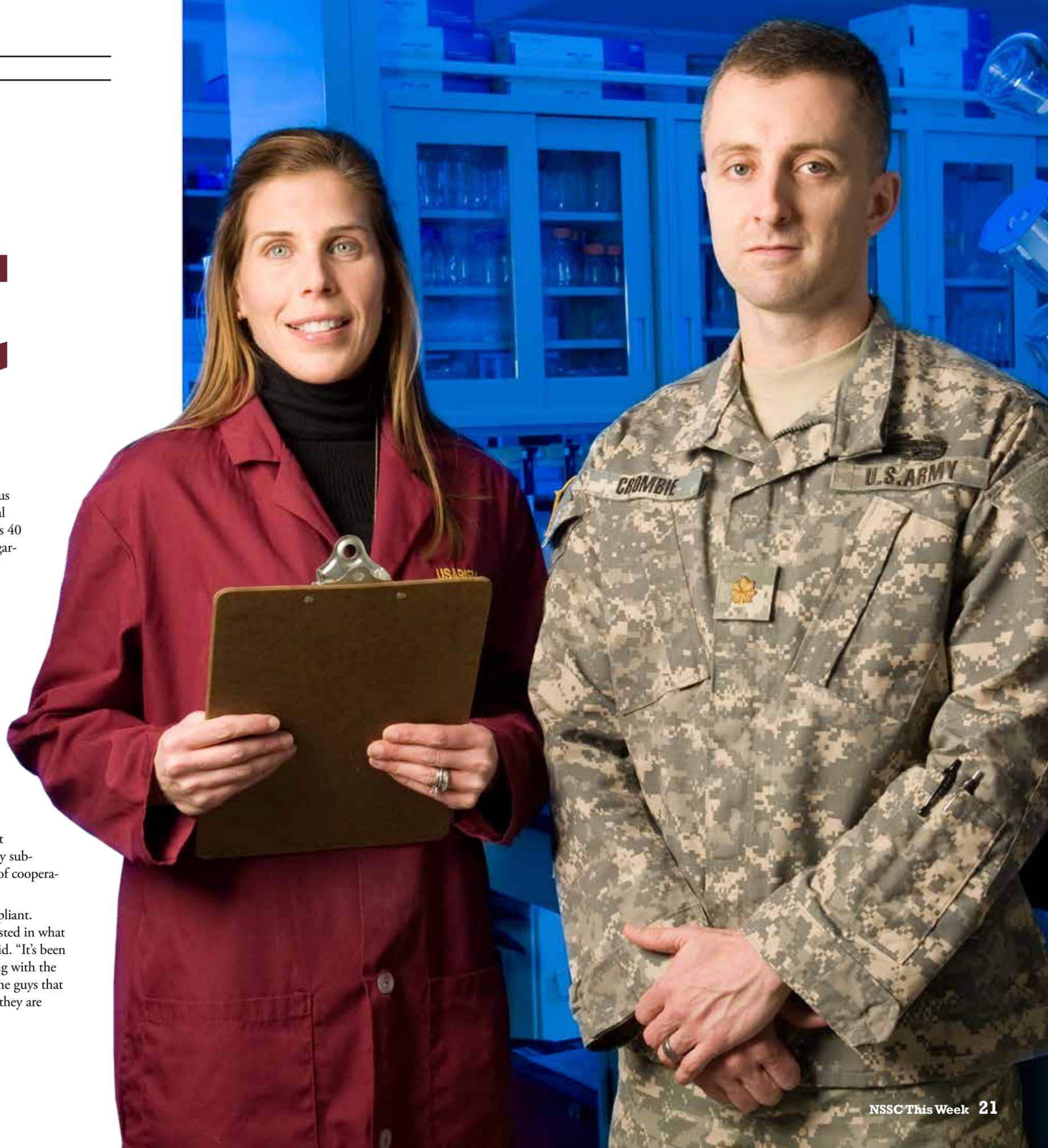
"We get a representative sample of the Special Forces unit members who are engaged in representative activities. We track them during the course of about five to seven days of training."

Crombie said that previous studies have shown special operators burn as many as 40 percent more calories in garrison activities than other service members do. The report from the current USARIEM study should be available sometime this summer, he added.

"They're bigger guys," said Crombie of the special operators. "They have more muscle, so that's more calories they're burning just moving around. They carry a lot of equipment."

Crombie had nothing but compliments for the study subjects and their high level of cooperation with his team.

"They've been really compliant. They've been really interested in what we're doing," Crombie said. "It's been a good experience working with the units and working with the guys that coordinated (it), because they are really on point."



“If a commander has a small unit of 12 Soldiers with specialized skills and potentially two can get sick, that really impacts their mission. With this tool, he or she can think ahead to bring an extra person or allow for more time for Soldiers to acclimatize to the altitude. Essentially, it tells them the risk and also provides them with ways to mitigate that risk.”

Dr. Beth Beidleman,
research physiologist, USARIEM

Peak Performance *continued*

Researchers were also there to collect data to develop an altitude acclimatization model as part of the Altitude Readiness Management System, or ARMS, being developed. This system will contain three models: the validated AMS model, the altitude acclimatization model and a physical performance model.

“USARIEM has the world’s largest mountain medicine database,” said Dr. Beth Beidleman, a research physiologist for TMMD and the primary investigator for this study. “By using the wealth of historical data combined with the studies we have done at Pikes Peak, we have been able to pool information and create this important system.”

Prior to this, there was no test that could predict an individual’s likelihood of getting altitude sickness. So the researchers at TMMD came up with the idea to create a model that would significantly help planners and commanders when they are planning missions.

The ARMS combines population-based data with an individual’s altitude exposure, providing useful information for sustaining health and improving performance. It does this by predicting the prevalence and severity of altitude stress by incorporating altitude acclimatization, acute mountain sickness and physical work performance decrements. Simply put, it predicts the level of AMS a person is likely to experience during a mission and

provides actual ways to reduce the severity and potentially avoid the affects of AMS altogether.

The first AMS model will allow commanders to identify the likely probability and severity of Soldiers experiencing AMS based on the mission requirements. If the risk and severity are too high, the altitude-acclimatization model will then enable commanders to mitigate the risk of AMS by developing an altitude-acclimatization prescription to avoid the harmful effects.

“This model allows commanders to mitigate the impact of altitude exposure,” Beidleman said. “It not only predicts whether a Soldier would get ill at certain altitudes, it gives a prescription for exposure. This tool can prescribe, for example, that if (Soldiers spend) two days at 8,000 feet before they go to their final altitude of 14,000 feet, the likelihood and severity of AMS would be drastically reduced.”

When this patent-pending technology debuts, the goal is to have produced a stand-alone software product coupled with the capability to produce a device version integrated into a wristwatch, GPS or smartphone.

“We are currently collaborating with Massachusetts Institute of Technology’s Lincoln Laboratory to get this technology into a smartphone-based application,” Beidleman said. “It is important for us to provide a really basic planning tool that anyone could easily use while planning missions.”

Putting a good planning tool in the hands of commanders and unit leaders, enabling them to better complete their missions, is the primary planning consideration to Beidleman while perfecting this tool.

“If a commander has a small unit of 12 Soldiers with specialized skills and potentially two can get sick, that really impacts their mission,” Beidleman said. “With this tool, he or she can think ahead to bring an extra person or allow for more time for Soldiers to acclimatize to the altitude. Essentially, it tells them the risk and also provides them with ways to mitigate that risk.”



Dr. Beth Beidleman of USARIEM holds an Android-based smartphone to demonstrate the capability of the altitude-acclimatization model.

Self-cleaning clothing: Wear Without Wear *continued*

“It took me years to realize that I could address our former Army general’s challenge and make his dream come true,” Truong said.

The Army accepted the SBIR topic in 2008 to develop self-cleaning clothing based on the use of superoleophobic coatings, which are coatings that do not allow oils, solvents, or chemicals to wet the surface. Since then, Truong has worked with two leading academic and industry partners — MIT and Luna Innovations, Inc.

During the past four years, many tests were done on omniphobic coated fabrics that were produced by MIT to understand the relationship between omniphobic coated fabric’s texture and design, and its surface chemistry. Luna developed the fabrics using its omniphobic coating chemistry under Truong’s technical guidance.

Currently, the Army Combat Uniform and Joint Service Lightweight Integrated Suit Technology chemical protective overgarment have a durable water repellent, or DWR, treatment to repel rain. However, this DWR-treated clothing would lose its water repellency after wear, repeated washing, and coming into contact with petroleum, oils, and lubricants.

Performance goals were set to improve the fabric development of self-cleaning clothing.

“In making sure that our self-cleaning clothing does not attract dust, dirt, or get wet, is comfortable and durable to wear, and requires minimal or no laundering to stay clean, we have used many standard tests and also came up with many special non-standard tests and demonstrations,” Truong said. “This is because in certain scenarios such as testing with mud and dirt, there are no test standards out there for us to use.”

Some specific tests that Truong has conducted to create and improve self-cleaning clothing include contact angle measurement, liquid drop roll-off testing, spray testing, abrasion testing, durability testing, and low pressure hydrostatic resistance testing. These tests and others were designed to develop effective, durable omniphobic fabrics.

In 2011 the Luna self-cleaning clothing was produced using a commercial scale coating process, where 25 sets of clothing were subsequently fabricated using a 60-inch-wide omniphobic coated fabric. Twenty self-cleaning garments were field tested in June 2011



for 10 days; Soldiers wore their clothing for up to almost 15 hours each day.

“The results were very promising,” said Truong.

All of the 20 participating Soldiers said their

“Someday, we will not have to clean our clothing as often or not at all, and our clothing will remain clean, odor-free, and keep us safe.”

garments shed water well to very well when assessing liquid repellency performance. Sixty-seven percent of the Soldiers said their garments shed oil well to very well. Sixty-nine percent said their Luna omniphobic treated ACU had improved their missions, and 73 percent said their suits should be adopted for use.”

Luna’s omniphobic treated ACU fabric met all of Natick’s performance goals for having high contact angle, moisture vapor permeability, laundering, wash durability, abrasion

resistance, tensile strength, air permeability, and flexibility. After the field testing, the omniphobic coating technology was given Air Force Research Laboratory’s only Outstanding Warfighting Transition Award.

NSRDEC is now working with Luna to develop self-cleaning, water and liquid chemical super-shedding clothing that is also multifunctional. A field test of this special multifunctional omniphobic protective clothing will take place in fall 2013.

“In the next few years, you can expect to see self-cleaning clothing that will also be flame resistant and odor free,” Truong said. “These clothes will contain antimicrobial additives, which do not allow microbes to grow on the fabric.”

“Someday, we will not have to clean our clothing as often or not at all, and our clothing will remain clean, odor-free, and keep us safe.”

The development, test, evaluation, and limited field demonstration of omniphobic coating technology have shown promise for its potential use as self-cleaning and enhanced chemical-biological protective clothing.

“If we don’t spend appropriately in science and technology, research and development, we’re going to find ourselves on the battlefield in a situation where our enemies have a comparative advantage over us, as opposed to the other way around, and our Soldiers are going to be put at more risk.”

Lt. Gen. Raymond V. Mason, during a visit to the Base Camp Integration Laboratory at Fort Devens

“When you get above 14,000 feet, there’s better than an 80 percent chance that you’ll develop some degree of severity of Acute Mountain Sickness. We’re interested in knowing what’s going on in the brain in the hours that lead up to the development of Acute Mountain Sickness.”

Dr. Stephen R. Muza, USARIEM

“Someday, we will not have to clean our clothing as often or not at all, and our clothing will remain clean, odor-free, and keep us safe.”

Quoc Truong of NSRDEC, on the development of self-cleaning clothing

“We’ve come up with tradeoffs, ideas, designs that the Soldier will benefit from in the end. When these technologies impact the Soldier in a positive way, that’s really the reward at the end of the day.”

Don Lee, NSRDEC, on new helmet designs

“Soldiers will give you honest feedback. We haven’t heard bad things. In this business, silence is a great thing.”

Ben Cooper, on the new hot-weather mountain combat boot

“We’re constantly thinking ahead. It takes a while to find just the right balance so that when it comes out of the tube, you’ve hit just the right flavor profile.”

Deborah Haley of Combat Feeding, discussing tube foods for NASA U-2 pilots

“The term ‘rock or something’ has now reached cult status. It’s just taken on a life of its own.”

Lauren Oleksyk of Combat Feeding, talking about wording on the Flameless Ration Heater package

“If a commander has a small unit of 12 Soldiers with specialized skills, and potentially two can get sick, that really impacts their mission. With this tool, he or she can think ahead to bring an extra person or allow for more time for Soldiers to acclimatize to the altitude. Essentially, it tells them the risk and also provides them with ways to mitigate that risk.”

Dr. Beth Beidleman of USARIEM, about a tool to predict altitude sickness

“They’re bigger guys. They have more muscle, so that’s more calories they’re burning just moving around. They carry a lot of equipment.”

Maj. Aaron Crombie of USARIEM, speaking about the nutritional needs of Special Operators

“Traumatic brain injuries don’t go away just because the war ends. The effects of these injuries are going to remain with the Soldiers who have sustained them, and a good number of head injuries and concussions occur during training and during off-duty activities. So this is going to be an enduring problem.”

Kristin Heaton of USARIEM, on her TBI research

Favorite Quotes of 2013

