US ARMY
MEDICAL DEPARTMENT
JOURNAL

PUBLIC HEALTH AND PREVENTIVE MEDICINE

April – June 2007

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THE UNITED STATES ARMY MEDICAL DEPARTMENT

JOURNAL

A Professional Publication of the AMEDD Community

Online issues of the *AMEDD Journal* are available at https://secure-akm.amedd.army.mil/dasqaDocuments.aspx?type=1

April– June 2007 | **The Army Medical Department Center & School** | **PB 8-07-4/5/6**

MG Gale S. Pollock
Acting The Surgeon General
Commander, US Army Medical Command

MG Russell J. Czerw
Commanding General
US Army Medical Department Center and School

By Order of the Secretary of the Army:
Official:

JOYCE E. MORROW
Administrative Assistant to the Secretary of the Army

GEORGE W. CASEY, JR
General, United States Army
Chief of Staff

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0707809

The *Army Medical Department Journal* [ISSN 1524-0436] is published quarterly for The Surgeon General by the US Army Medical Department Center & School, ATTN: MCCS-DT, 2423 FSH-Hood ST, Fort Sam Houston, TX 78234-5078.

CORRESPONDENCE: Manuscripts, photographs, official unit requests to receive copies, and unit address changes or deletions should be sent to the *Journal* at the above address. Telephone: (210) 221-6301, DSN 471-6301

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OFFICIAL DISTRIBUTION: This publication is targeted to US Army Medical Department units and organizations, and other members of the medical community worldwide.

Perspective

Major General Russell J. Czerw

Since the beginning of warfare, the medical challenges of deployment have remained unchanged. Soldiers still require protection from the natural elements; they still need safe food and water and must deal with diseases and insects. The science and practice of preventive medicine in the military has long been recognized as paramount to the achievement of a relevant and ready force and the sustainment of combat power. This fact is well supported in Field Marshal Viscount Slim's *Defeat Into Victory*. This great account of fighting in the jungles of Burma during WWII provides a superb testimony of the applicability of preventive medicine to warfare, as Field Marshal Slim assesses the deplorable health condition of his forces, derives a plan to fix it, and then, as every great commander does, he enforces it.

To that end, we are indeed fortunate to have our own professional publication, the *AMEDD Journal*, in which to showcase the topical scope and intellectual depth represented by this and the other areas of Army medicine. This issue focuses on that critically important discipline, with an emphasis on the special considerations demanded by the combat environment. For the second year in a row, COL Mustapha Debboun, Chief of Medical Zoology Branch at the AMEDD Center and School, has organized and compiled an outstanding collection of articles from preventive medicine professionals throughout the Army. This issue is just one more example of the level of skill, capability, and dedication of medical professionals who selflessly choose to serve our country with distinction and honor.

BG Michael Cates, the Commanding General of the US Army Center for Health Promotion and Preventive Medicine and the Functional Proponent for Army Preventive Medicine, opens with a superb introduction to the breadth of responsibilities and concerns addressed by those involved in public health and preventive medicine. His observations are sobering, while at the same time challenging and exciting.

Throughout history, the outcomes of wars and military campaigns have often been determined by noncombat factors, especially debilitating diseases, nonbattle injuries, and unhealthy personal habits. Indeed, the fate of the United States as we know it may have hinged on one ambitious, albeit little-known campaign early in the Civil War. Dr Wayne Austerman tells the story of the Confederate attempt to seize the western territories, from Texas to California, early in the war. The effort was hampered from the start by poor planning and leadership, which rendered the force unable to cope with the inevitable onset of disease, injury, hunger, and disability. These circumstances doomed the effort to early failure. Dr Austerman's article is very informative, illuminating, and instructive. The story of such failure in planning and execution underscores the importance of the emphasis the modern Army places on public health and preventive medicine.

Among the various disciplines in medical science, preventive medicine is one that absolutely cannot be practiced in isolation. The next 2 articles clearly illustrate that fact. First, COL (Ret) Daniel Strickman revives and clarifies the concept of integrated disease management, which ties multiple aspects of public health and preventive medicine together in a coordinated, task-oriented fashion to attack all facets of a given public health threat, both clinically and in everyday life. Next, LTC James Sheehan and his coauthors detail an exercise in which a major military facility collaborated with state and local public health, safety, and security agencies in an integrated reaction to a simulated bioterrorism threat. The exercise highlighted the numerous ways in which the military and civilian public health expertise, resources, and requirements are interrelated. Their excellent article illustrates how such cooperative working relationships are essential for the protection and improvement of both individual health and unit readiness.

Although the debilitating affect of the combat environment on mental health has been long recognized, treatment is still problematic. Great progress has been made in training our leaders as to the value of mental health evaluation and treatment for their troubled Soldiers. However, the societal stigma of almost any concerns related to an individual's mental health still persists. Kay Shepard addresses these problems directly and effectively in an important and very timely article about this critical area of public health of our forces. She provides an excellent overview of the problems, and describes the successes of the Schweinfurt medical community, spearheaded by Social Work Services, in providing services to the Soldiers who were rotating into and out of combat operations in the Iraq theater.

LTC Timothy Bosetti contributes an important, informative article clarifying an essential part of preventive medicine planning and operations, the Environmental Health Site Assessment. He presents a well-organized explanation of the requirements, components, and applications for this documentation, with special emphasis on its value to those charged with protecting the health of our deployed Soldiers.

Potable water is essential to the combat effectiveness of any military organization. Dehydration or waterborne disease has resulted in the collapse of many military campaigns. MAJ William Bettin's article looks at the Army's effort to provide individual Soldiers with the best possible capability to generate their own safe water for emergency situations. He describes the Army's detailed, deliberate testing of various individual water purification systems, and the results. An important offshoot of the study was the development of a standardized test protocol for use in evaluating future products, thus eliminating the need to "reinvent the wheel," saving critical time and money.

The last 5 articles provide insights and lessons learned from recent deployments of preventive medicine Soldiers into combat theaters. First, CPT Stephen Lewandowski and CPT Jason Faulkenberry detail the experiences of the first operational deployments of brigade combat teams with organic preventive medicine assets. They cover the growing pains associated with a new organizational structure, as well as the most important aspects of predeployment preparation and operations in the deployment area. The information is timely and important, as the Army rapidly transforms its force structure into the brigade combat team model, and the roles and responsibilities of preventive medicine adapt accordingly.

Those charged with optimizing application of resources must have a method of measuring the effectiveness of those assets. LTC Sonya Schleigh and MAJ Mark Carder detail a spreadsheet based evaluation matrix that was the result of a collaborative effort by the 5 medical detachments deployed with the 61st Multifunctional Medical Battalion to Iraq. The article describes the careful, deliberative process involved in developing and implementing a tool which provides relevant information which is not affected by the character of the detachment or the respective deployment environments.

For over a century, vector control has been a vital element of preventive medicine and public health responsibilities. LTC Jamie Blow and her team of coauthors present a detailed account of the problems and solutions to vector control which are encountered during current operational deployments. Their article provides valuable insights into the myriad situations faced by preventive medicine specialists, including insects, feral animals, birds, and bats. They describe the various attempts at control, some more successful than others. Also, to reemphasize the critical importance of personal protective measures in control of vectorborne illness, the AMEDD Center and School Medical Zoology Branch has provided important information on the DoD Insect Repellent System as an addendum to the article.

Operations in Afghanistan are no less challenging for our preventive medicine specialists. MAJ Christopher Gellasch and CPT Lesly Calix relate their experiences providing support across the widely dispersed forces in an area with considerably less infrastructure than Iraq. Their article describes the challenges encountered in providing all levels of preventive medicine services, especially in the support of the forward operating bases which are located in truly remote locations. Again, this article is a valuable resource for those preparing for deployment into the vitally important operational environment.

Humanitarian missions introduce their own sets of concerns and challenges. CPT Owen Price and his coauthors contribute a detailed, extremely informative account of their rapid deployment into Pakistan (from Afghanistan) to provide relief after the devastating earthquake in October 2005. In addition to the expected public health and preventive medicine responsibilities, their experiences as part of a multinational relief team are a valuable insight into the cultural, political, and functional complexities involved in such nonmilitary environments.

Army Public Health and Preventive Medicine: Proactive Approaches to Readiness

Brigadier General Michael B. Cates

From my perspective as the Functional Proponent of Army Preventive Medicine, military public health includes essential elements that contribute to the overall health and well-being of our Soldiers, civilian employees and Families. Successful prevention leads directly to enhanced readiness through health. All Army leaders, Soldiers, civilian employees, and Families have a role in protecting their own health, and the Army Medical Department (AMEDD) has outstanding military and civilian experts ready and able to assist them.

Army public health encompasses a wide variety of expertise and capabilities, with personnel in over 50 specialties from every corps in the AMEDD. This team includes deployable individuals and units embedded in brigade combat teams up through the combatant commands' headquarters, preventive medicine personnel assigned to Army headquarters, military treatment facilities and installations, Army veterinary personnel, and the professionals assigned to the US Army Center for Health Promotion and Preventive Medicine.

Current public health challenges in our military include injuries, behavioral health issues, infectious diseases, chronic diseases and other conditions related to "lifestyle choices," environmental exposures, occupational hazards, and food and water vulnerabilities. All have various causes and effects, and all require a diverse set of solutions.

Injuries, mostly nonbattle injuries, place the largest burden on our military healthcare system, in garrison and during deployments. Falls, sports injuries, physical training, and private motor vehicle accidents are the major causes of nonbattle injuries in our military, creating significant productivity loss across the entire Department of Defense.

Behavioral health issues are a growing concern, especially among those who have deployed. There is a wide range of diagnoses in this field currently affecting an increasing number of our Soldiers.

BG Cates is the Commanding General, US Army Center for Health Promotion and Preventive Medicine; the Functional Proponent, US Army Preventive Medicine; and Chief, Army Veterinary Corps.

Appropriate and timely identification of those who need mental health care is difficult and, thus, a key piece toward successful resolution. Also, the stigma associated with any type of mental health care creates a disincentive for Soldiers to get the care they need. Education and training efforts are among the most important, proactive tools here, focused on improving behavioral health through early identification and reduced stigma.

Health threats from emerging or reemerging diseases include tuberculosis, malaria, drug-resistant *Acinetobacter* infections, leishmaniasis, and zoonotic diseases associated with indigenous animals. A full understanding of the epidemiology and pathogenesis of many of these is often lacking. So, surveillance, effective prophylaxis, early detection and rapid mitigation are the best approaches to decrease the impact of such health threats.

Recognizing that many of the health threats that Soldiers, civilians, and Family members face are caused by lifestyle choices, the Army public health and preventive medicine programs have embraced the

concept of educating individuals to prevent illness and injury through an aggressive health promotion and well-being campaign. Three continuing problems in Soldier health are tobacco use, weight control, and alcohol abuse. Each poses tremendous short-term and long-term health risks, and recent surveys depict negative trends among our military personnel and their Families that we must continue to address.

Our military has personnel deployed to more than 100 countries in any given week. The infrastructures of many of those countries are poor. Many times, we have very little knowledge of the history of those environments and their associated health risks, and when we do, the information we have may have already changed. Sampling may be slow or difficult as we attempt to learn more about the potential health risks to our military personnel deployed there. Yet, environmental surveillance—monitoring air, water, and soil for indigenous threats to health—is an absolutely necessary piece of the preventive medicine program.

New weapons and new vehicles employed by the military are better, bigger, and bring new health risks, such as acoustic energy, temperature extremes, shock and vibration, and oxygen deficiency. Of these examples, acoustic trauma, with resulting hearing loss or other problems, is the biggest concern.

In the future, food and water have growing potential for health risks. The United States has the best food and water safety program in the world, yet the Centers for Disease Control and Prevention estimate the incidence of foodborne illness at 76 million cases a year. As we deploy personnel into more than 100 countries with public health infrastructures not as robust as ours, the health risks from food and water are much higher. Today, we must also be concerned about intentional contamination of food and water, or the destruction of our water supply systems.

Our Army public health and preventive medicine team, relatively small in size, but broad and deep in expertise, is currently working toward solutions to these current challenges around the world. Team members strive to protect our Soldiers, civilian employees, and Families locally while remaining ready and willing to project globally. They are an amazing group that rarely receives the credit they deserve for ensuring true Force Health Protection and Readiness. I am excited that this edition of the *AMEDD Journal* showcases, for the second straight year, some of their capabilities and contributions.

As we move forward, especially in a time of war, we must continue to improve our military public health efforts. For one, we must place greater emphasis, from all levels, on preventive health, to include more of an investment, looking for the long-term, as well as the short-term benefits of such efforts. Our surveillance must be more synchronized within the Department of Defense and the rest of the US Government, with easy information links between human and animal health, as well as with the environment. We must provide timely, accurate, and actionable data to our commanders in the field to quickly identify and mitigate any significant health risks, and we must have effective ways to change risky behaviors and reduce injuries. Most importantly, partnerships and collaborative efforts should be enhanced among our military public health experts in all of the uniformed services, as well as with outside agencies.

Preventive medicine is crucial in maintaining the readiness of our most important resource—our people. Sustaining, and even improving, a Soldier's health is a much wiser use of resources than waiting until that Soldier becomes sick or injured before attempting to restore health. The better we prevent diseases, conditions and injuries, the more resources will be available to apply to those things we cannot prevent. While there is continuing and growing emphasis on proactive approaches to health in today's society and military, we must all strive toward translating that into real, even greater long-term investments in the future of our personnel. Prevention is the best way to health.

USACHPPM
Readiness thru Health

"Sick, Dead, & Discharged": Disease and the Defeat of the Confederate Campaign into New Mexico, 1862

Wayne R. Austerman, PhD

On May 31, 1861, Henry Hopkins Sibley, an articulate, alcoholic, 45-year-old major in the 2nd US Dragoons who suffered from chronic renal colic, resigned his commission at Fort Union, New Mexico, and traveled eastward to Richmond, Virginia, capital of the newly formed Confederate States of America. There he gained an audience with President Jefferson Davis, winning a commission as a brigadier general and official sanction for his audacious plan to seize modern-day New Mexico and Arizona for the Confederacy as a prelude to launching offensives against the silver mines of Colorado and gold fields of Unionist California. The decision made in Davis' office during the meeting with Sibley sealed the fate of hundreds of young Texans doomed to die in the course of his ill-starred campaign and committed the manpower and materiel-poor Confederacy to an effort whose modest demand on resources promised potentially decisive strategic results. That was before Sibley's alcohol-addled ineptitude as a commander and his force's lack of an adequate field medical support system allowed exposure and disease to sap its strength and dictate defeat in the arid highlands of New Mexico.[1]

When Sibley arrived in San Antonio, Texas, on August 12, 1861, he found that part of his mission had already been accomplished for him. Lieutenant Colonel John R. Baylor of the 2nd Texas Mounted Rifles had taken a battalion of the regiment westward over the 500 miles to El Paso early in June and seized the abandoned post of Fort Bliss early in July. On July 25, the aggressive Baylor took his 350-odd troopers 40 miles up the course of the Rio Grande and fought a pitched battle on the outskirts of Mesilla, New Mexico, with the garrison of nearby Fort Fillmore, subsequently compelling the entire 7th US Infantry regiment to surrender. As a result of Baylor's zeal, the gateway to Unionist New Mexico lay open to invasion by Confederate forces. It remained for Sibley to recruit and equip his new brigade in the San Antonio area before marching westward to resume and expand Baylor's offensive.[1(pp209-221),2,3]

Sibley had begun assembling a staff before he left Richmond with his new commission. He selected Dr Edward N. Covey as his brigade surgeon. A veteran contract surgeon who had earlier served with Sibley in New Mexico, Dr Covey remains an enigmatic figure in the campaign's history. He must have been aware of Sibley's debilitating problem with kidney disease and his advanced alcoholism, yet he seems to have joined the enterprise with little reservation and to have exerted little restraint on Sibley's appetite for the bottle.[1(p219),4,5]

By mid October, Sibley had mustered, organized, and equipped a brigade of 2,500 men consisting of the 4th, 5th, and 7th Regiments of Texas Mounted Volunteers along with 2 batteries of field artillery. Because of an anticipated shortage of water and grazing on the trail to the west, the brigade was broken down into several march increments, the first of which departed for El Paso on November 9 as the cooler autumn weather finally swept over the state.

Contemporary accounts are devoid of any detailed information on the brigade's medical establishment. There are no references to ambulances or enumeration of medical supplies in the record of its organization in San Antonio. Accounts of subsequent combat actions in New Mexico are devoid of any references to the field medical support system and its functional organization. It is known that Sibley took 10 ambulances to El Paso with him, but no documentation survives to detail how they were organized for casualty evacuation or even if they were assigned to that mission or used simply as general utility vehicles. A novice regimental quartermaster sergeant gave Sibley high marks as a logistician when the unit left San Antonio, calling it "the most complete and perfectly equipped brigade sent out by the Confederacy during

the war." When the command departed for El Paso, its supply train consisted of over 300 wagons laden with materiel, while "the quartermaster, brigade and regimental headquarters, and the medical corps also had wagons." Even so, shortages would stalk the wards long before the campaign reached its dismal end by the following spring.[3(p96),6]

The three mounted regiments counted a total of 10 surgeons serving in that official capacity, while numerous other physicians filled the rolls as company commanders and even common riflemen. There was no shortage of medical men in the brigade, but little sign of any united organizational framework capable of exploiting their talents efficiently above the regimental level. There were to be no Lettermans serving with Sibley amid the mesquite and chaparral.

The long march in autumn weather took its toll before the first company reached El Paso. Measles erupted on the trail, afflicting an entire company of the 7th Regiment so badly that the unit was left in quarantine at a post along the way and missed the entire campaign, losing 15 men to the disease during one 3-week period. Young men from rural backgrounds assembled in large groups for the first time typically lacked an immunity to such diseases and thus proved uniquely vulnerable. The command's modern chronicler related:

> Disease plagued the command on its march across Texas and fresh graves marked the brigade's route. Hospitals along the way were filled with patients from Sibley's brigade…. Smallpox, already present in Arizona, posed a threat; regimental surgeons countered by vaccinating most of their men. Other volunteers fell ill on the march, far from even the relative comforts of the crude medical facilities. Routine camp diseases, especially dysentery, affected some troops. Pneumonia also appeared in the command…. Although few of the troops were diagnosed as having pneumonia during the march, many had acquired an unsettling, rattling cough.[4(p 220),6(pp124-125)]

The vanguard of Sibley's brigade reached El Paso in mid-December, but the balance of the unit was not at Fort Bliss until January 19, 1862. Absorbing Baylor's battalion and sundry local volunteer companies into his command, Sibley confronted continuing attrition of his force due to disease. One trooper remarked at the end of December how "our company is in bad health now. There is about half of the company sick…. I think there is poor prospect of our company going out this winter, if the boys keep getting sick." The unit in question, Company A of the 2nd Texas Mounted Rifles, suffered a 50% sickness rate through January 1862, and was forced to remain in the rear throughout the rest of the campaign, rendered fit only for light occupation duties.[3(pp126-136),4(p304),7]

"…sick, dead & discharged…"

In early January, Sibley resumed the offensive initiated by Baylor 5 months earlier by sending units northward to occupy a new forward base of operations at the abandoned prewar post of Fort Thorn, sited on the west bank of the Rio Grande approximately 40 miles upriver from Fort Fillmore. The movement and occupation took place without any interference from the Union forces assembled further upstream at Fort Craig, although Apache raids were a constant nuisance. It was at this post that Sibley's failings as a planner first became manifest to his troops.

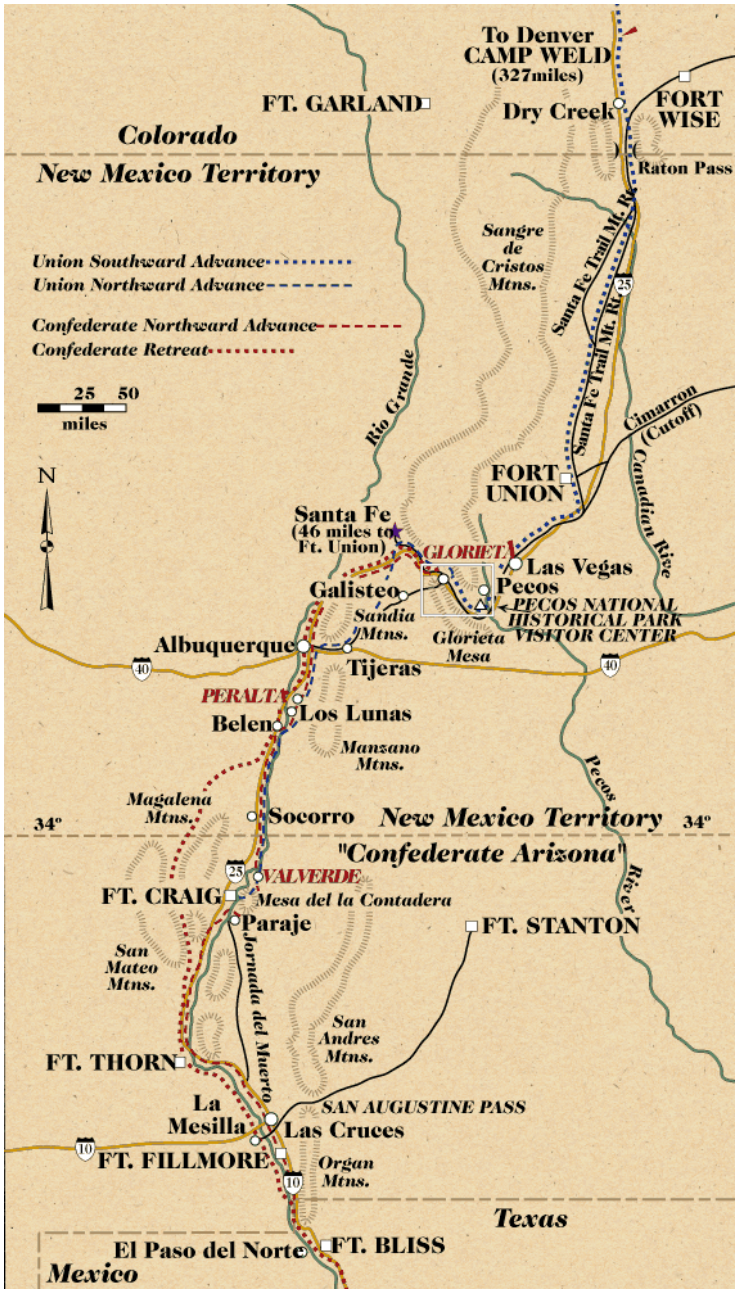
"The arrival of the brigade added more than 2 thousand temporary residents who descended on the area like a human avalanche," noted a recent chronicler of the campaign. "Food, both purchased and stolen, became scarce, and prices rose. Contractors for the army…increased their earnings while poor farmers and their families went hungry…. Baylor's Texans had been a curiosity, Sibley's liberators were a calamity." At Fort Thorn the brigade's supply depot held over a month's rations, and "additional supplies were expected to be taken from the enemy," but the arid countryside and sparse farming population found even in the green, cultivated acreage along the river valley made it clear that New Mexico would offer poor foraging to any army hoping to live off the land. Sibley's antebellum service in the region must have made him aware of the dire logistical problems confronting any sizeable military force seeking to conduct extended operations amid the mountain-hemmed desert country. The forced sale or confiscation of food from the local Hispanic population began the process of alienation from the invaders which would cast most of New Mexico's native population into the Unionist camp as the campaign continued.*

While food was not yet a pressing concern, exposure was already a problem among the Texans, most of

**References 2(pp 55-56), 3(pp 135-138), 6(p 18).*

whom came from the warm latitudes of the Gulf coastal plain. Unaccustomed to the winter chill of the high desert country, they suffered accordingly as up to 4 inches of snow blanketed their new camp. Lacking adequate tentage, the troops slept in the open and soon pneumonia was running through the brigade. The "wheeze and rattle" ravaged Company I of the 5th Texas in particular, killing 3 men within the first week of February, leaving "the most of the men in our company…sick, dead & discharged," lamented a soldier. The harsh weather also made bathing and laundering of clothes difficult. The result was a plague of lice which soon had the entire brigade scratching and searching the seams of its uniforms for deposits of eggs.*

Any veterinary surgeons serving with the brigade also had their hands full, for poor diet, hard usage, and exposure also took a heavy toll among the command's horses and mules, and the mineral-impregnated water of the Upper Rio Grande had given the animals an ailment called "the scours." Even more troubling was the lack of proper feed for the stock, which led to a progressive physical deterioration of the teams. A force of 2,000 troops typically required a train of 350 supply wagons in support. Sibley had barely enough wagons and teams to support his brigade at the start of the campaign in San Antonio. By the time he struck northward into New Mexico, the shortage of teams and scarcity of forage for those remaining dictated that his command would exist on a steadily fraying logistical shoestring unless and until large quantities of supplies could be captured from the enemy early in the campaign. The steady attrition of the animals due to hunger and enemy action would eventually leave most of the proud mounted volunteers afoot and reduce the brigade trains to a few score wagons.[2(pp49-50),3(pp141,149)]



The Confederate Army campaign into the New Mexico territory, January to May, 1862.

On February 7, Sibley resumed his advance upriver with the 5th Texas in the van. The shortage of healthy mules forced the brigade to leave half its wagons behind at Fort Thorn, and priority of space in the remaining ones was given to food and ammunition. The men began the march on half-rations, and although a herd of beef cattle accompanied the column, the steers' condition was so poor that they could barely stagger along, and the men found their meat barely palatable, but it was all to be had amid that desolate country of want.[3(p149)]

By this time, Sibley's kidney disease and alcohol abuse had begun to visibly affect his fitness to command. A surgeon of the 7th Texas had already

References 2(pp 52, 55), 3(pp 137-139, 141-142, 155), 6(pp 16-20, 25-28), 8, 9.

observed that there was "too much drunkenness" among the commander and his staff. His kidney disease had plagued him for years, and while whiskey softened the pain it also exacerbated the severity of his condition. Unable to ride on horseback, he led the advance from an ambulance. "I believe that General Sibley was a brave and gallant man, and a true patriot," wrote one of his officers. "His health was such that he was not fit to command. The mind naturally becomes turned when disease and pain racks the body. (He) ought to have resigned."*

As Sibley's command slogged northward, the enemy awaited his approach behind the network of field fortifications encircling Fort Craig. There, Colonel Edward Canby commanded a force of 3,800 regulars and territorial militia. Sibley's commanding officer at one posting in the old prewar service, Canby was a cautious and prudent commander, who realized that the entire southwestern region of the nation was his to lose in a struggle with the rebels. Reasonably well supplied and commanding an adequate force for defense, he would challenge Sibley but once in the field, then leave him with the options of battering his force bloody in futile assaults against Fort Craig's heavy guns and fieldworks, or risking starvation in attempting to continue his march northward against Santa Fe and the other major bluecoat bastion at Fort Union, northeast of the territorial capital.[2(pp59-82)]

"…a spectacle that was horrible…"

By February 15, Sibley's 2,500 men were deployed for battle roughly 6 miles south of Fort Craig. The still ailing Sibley had temporarily yielded command of the brigade to Colonel Thomas Jefferson Green of the 5th Texas. Green attempted to draw Canby's force out into the open for a battle, but the Union garrison remained safely behind its fieldworks, with heavy cannon which held the Texans at a respectful distance. Green faced a dilemma as the brigade's rations dwindled to a 10-day supply. He elected to cross to the east bank of the Rio Grande, march upstream for 6 miles, and then recross the river at Valverde Ford, hoping that such a move might prod Canby into coming out to fight for fear that the Texans might sever his line of communications northward. Canby divined Green's intentions, however, and when the Confederates reached the ford on the morning of February 21, they found a blocking force occupying the east bank of the crossing site.

A major battle erupted as Sibley sat stuporous with drink in an ambulance in the company of two women of uncertain virtue. Musketry and artillery fire lashed the field until Canby's unsteady militia fled the scene and the Texans overran a battery of Union guns, ending the battle as the defenders escaped across the ford and returned to the sanctuary of Fort Craig. Union losses at Valverde Ford totaled 112 dead and 189 wounded along with 204 missing in action, or nearly 18% of the force engaged. The Texans counted 36 dead, 150 wounded and 1 missing. Forty-three of their wounded subsequently died after reaching the makeshift field hospital erected 2 miles upstream. The Confederates had lost 10% of their force and Canby was still secure in an impregnable position.[†]

A Union officer recalled how "the field was covered with blood, horses, torn and dismembered limbs, and heads separated from their bodies—a spectacle that was horrible." Even the northerners were short of litters and ambulances, for some of their casualties were carried from the site in "barrows." The Confederates borrowed lanterns and shovels from their opponents as darkness fell while both sides combed the battlefield for wounded to retrieve and dead to bury.[10(pp102,159)]

The Confederates had not only failed to win any meaningful sort of victory, they had suffered a severe logistical defeat. Union artillery and small arms had wreaked havoc among the saddle horses and draught animals as they stood tethered in the rear, killing nearly a thousand of them. "The whole seemed to be the abode of death itself," wrote one grieving trooper of the human and equine losses alike. Many of the troops were now put afoot, while much clothing, blankets and other equipment had to be abandoned for lack of transport. As the brigade by necessity continued its advance northward in search of supplies on February 23, 6-man details carried some of the wounded on litters, while others occupied spaces in the remaining wagons. On the 25th, they captured a Union supply depot at Socorro and established a hospital in a church and private home in order to shelter their 200

**References 1(pp 251-252), 3(pp 145, 149), 6(p 42).*

†References 1(pp 252-258), 2(pp 77-103), 3(pp 150-185), 9(118), 10.

sick and wounded, while men were detailed to serve as nurses and stewards. It was the first time any of the brigade's sick or wounded had been under a roof since leaving Fort Thorn, over a month previously. Dr Covey and Dr Samuel B. Maney, a former rifleman, used newly captured medical supplies to ease the men's suffering.[3(pp180-184),10(pp102-103)]

Sibley paused in Socorro long enough to reorganize the brigade and leave his casualties in the hospital under the care of Dr Henry J. Hunter of the 7th Texas. He then resumed the march to Albuquerque, where upon arrival on March 2, the troops found a major enemy supply depot reduced to charred ruins by the departing Union troops. It was a bitter blow, but some of the disappointment receded soon afterward when Dr Finis E. Kavenaugh, a former US Army contract surgeon and Confederate sympathizer, seized an ordnance and quartermaster depot that had been established in the hamlet of Cubero, 65 miles to the west. The coup netted Sibley 25 wagonloads of precious supplies and put the invaders on the best logistical footing they had enjoyed since leaving Fort Thorn. Sibley estimated that he could sustain the brigade for another 3 months on the booty Dr Kavenaugh seized at Cubero. It was the most fateful single act performed by a physician on either side throughout the campaign.*

By March 4, the Union garrison of Santa Fe had torched the supply depot there and abandoned the town. Nine days later a Confederate advance guard entered the capital to sift through the ashes of the charred warehouses. The bulk of Sibley's brigade remained well to the south near Albuquerque for 2 weeks as the onset of severe winter weather forced it to suspend operations for a time. Sibley ordered large portions of the unit to move eastward into the Sandia Mountains in order to block the road linking Fort Craig with Santa Fe and Fort Union, while utilizing the scant shelter afforded by the scattered small villages in the highlands. The hospital established in Albuquerque "was soon filled with dozens of pneumonia cases." The 5th Texas had marked an upsurge in the disease after leaving Socorro. "We buried four men," a despondent soldier wrote. "Pneumonia, measles, small-pox, itch and body lice are getting in their work on us." The deployment to the mountains destroyed the health of many, for a hospital attendant recorded how "a great many more come in from the mountains and report snow all over everything, blankets and all. That foolish move out in those mountains will cause the death of many a poor fellow."[3(pp184-201),8(p138),11]

"…unprotected, with no medicine…"

Sibley continued to ignore Canby as he kept his command massed at Fort Craig. Having taken Santa Fe with a token advance guard, he was poised to renew the advance northward from Albuquerque with the objective of clearing the passes northeast of the capital to seize the major enemy supply depot at Fort Union. If that rich lode of materiel was taken, Canby would be forced to concede his isolation and defeat, while Sibley would then be poised to strike northward into Colorado or conceivably even mount a threat to Union control of California and its Pacific seaports.

At Fort Union, newly arrived Colorado volunteers joined the regulars and militia at the post to spearhead the defenders' riposte to the Texan advance. Colonel John P. Slough led 1,342 men southward from the fort to bar the enemy advance at Glorieta Pass, a 7-mile long notch in the Sangre de Cristo range. Barely a quarter of a mile wide at its midpoint, the pass was key terrain for any force seeking to strike at either Santa Fe or Fort Union. Elements of Sibley's main force were either still encamped or on the march from Albuquerque when Slough's Coloradoans sent an advance guard into the pass from the east on the 25th of March. Shortly before 11 o'clock on the morning of the 28th, Colonel William R. Scurry led a thousand men of Sibley's brigade into action against the Coloradoans near the western end of the long defile. While Scurry fought Slough to a near-defeat, a detachment of Union troops executed an arduous flanking march via a little-known route through the mountains and then made a precipitous descent from a mesa to strike Scurry's baggage camp, burning 80 supply wagons and killing hundreds of horses and mules. A regimental chaplain was also slain when he attempted to halt the small arms fire that raked the nearby Confederate field hospital.[2(pp125-160),3(pp207-230),12]

With the destruction of his supply train, Scurry was forced to concede defeat and begin a withdrawal

**References 2(pp 115-116, 122-123), 3(pp 184-185, 196), 6 (pp 79, 87).*

southward to Santa Fe. It was the first step on the long, punishing road back to San Antonio. Sibley had been unable to bring the bulk of his command to the battlefield at the decisive time and place at Glorieta Pass. Logistical problems and the mounting sickness rate which sapped his manpower and impeded his movements had kept much of his force far southward near Albuquerque while the course of the campaign was being decided in the windswept maw of the Sangre de Cristos. The turning point of the campaign had come, and events conspired against the Confederates, but Scurry was still faced with the issue of burying his 42 dead and evacuating his 203 wounded over the 23 miles westward to Santa Fe. His opponent had his own 47 dead and 78 wounded to bury or bandage, and the Texans faced no immediate threat of pursuit as the combatants mutually agreed upon an 18-hour truce. Once again, the southerners borrowed picks and shovels from their foes in order to bury their dead. With no wagons or ambulances left for transport, nor even animals available to haul travois or slung litters, the Texan wounded faced a slow, painful passage back to shelter at Santa Fe.*

When Scurry's column arrived in Santa Fe on the morning of March 29, they found that none other than Union Colonel Canby's wife had organized the ladies of the town in preparations to receive casualties from the battle. Confronted with the shortage of Texan ambulances, she hit upon the expedient of nailing tent canvas across wagon beds in order to make hammocks, and organized a flow of supplies back to Scurry's camp at the pass in order to help those wounded too badly to be moved. Soon regarded as a heroine by the admiring Texans, Mrs. Canby was still unable to stem the ravages of pneumonia among the wound-weakened men under her care.†

In Albuquerque, Sibley received news of the fights north of Santa Fe on March 30, and he initially thought that Scurry had won a major victory. He and his staff left for Santa Fe soon afterward, and on April 4 they reached town in company with Colonel Green's 4th Texas. Once again, the entire brigade was assembled in one place, its numbers shrunken to approximately 1,700 men by death, wounds, and disease, which had steadily attrited the force from El Paso and Fort Thorn through Albuquerque to Glorieta Pass, reducing it to perhaps two-thirds of its peak strength during the campaign to date.[2(pp163-166)]

Sibley was pondering his next move when word arrived that Canby had departed Fort Craig and marched eastward to combine forces with units from Fort Union. The Texans had no choice but to stage a retreat. The brigade hurriedly countermarched southward, reaching Albuquerque on April 10. Sibley left 250 sick and wounded men behind in Santa Fe, trusting them to the enemy's mercy. Relieved of that burden, the brigade commenced what proved to be a harrowing retreat southward down the corridor of the Rio Grande river valley.[2(pp167-185),3(pp235-245)]

Lashed by wind and rainstorms, the Confederates fought a minor skirmish with Union troops at the village of Peralta on April 16 and 17, suffering only 4 killed and 6 wounded. However, the rapidly deteriorating physical condition of their wagons' teams forced them to leave additional sick and wounded behind in the tiny village, "without attendants or medicines and almost without food." The retreat continued to a point 70 miles north of Fort Craig, where Sibley, fearing being caught between a sortie by the fort's garrison and Canby's pursuing force behind, proposed leaving the west bank of the river and taking a torturous route westward through the mountains to regain the river road below the Union bastion. What followed was a nightmare march of 5 days and 80 miles as the Texans spiked most of their artillery, burned most of their wagons, loaded supplies on pack mules, and began a torturous passage down the western slopes of the Magdalena and San Mateo ranges. All of the remaining sick and wounded who could not ride or walk were abandoned prior to the march on April 17, huddled around a fire beneath a yellow hospital flag. A Union patrol found them a few days later, "unprotected with no medicine, no physician and but few attendants."[2(pp186-191),3(pp246-251)]

"…how general is the debility…"

The rugged country and failing teams soon forced Sibley to abandon the rest of his artillery, burn another 22 wagons and carriages and all 10 ambulances, leaving only 7 wagons to carry the remaining sick. Sibley, "much of the time, unknown to the rank and

**References 2(pp 162-163), 13(pp 101-109), 13.*

†References 2(pp 163-165), 3(pp 231-234), 6(pp99-100), 14.

file, …was drunk." The casualties he abandoned fell into Union hands, as did the ones left in the hospital at Socorro during his earlier march northward. Canby subsequently reported that at the campaign's end he had paroled approximately 240 enemy prisoners of war, while another 240 remained on his hands, of whom "about two-thirds consisted of sick, wounded, and hospital attendants." Canby wisely decided to forego another battle and simply let the starving enemy depart in peace, for he had no desire to assume the burden of feeding hundreds of additional prisoners or caring for their sick and wounded following a final needless clash. As the rest of the ragged, famished brigade stumbled southward for Mesilla and El Paso, muted criticism of Sibley became open contempt among officers and men alike.*

Upon arrival at Fort Bliss, the brigade reassembled for the first time since leaving the river road above Fort Craig and took stock of its remaining strength and condition. The experience of the 4th Texas Mounted Volunteers was perhaps typical. The unit had left San Antonio with 927 officers and men. By campaign's end it mustered 552 present and fit for duty. It had lost 7 dead and 10 medically discharged en route to El Paso. Forty-seven men were killed in action or died of wounds. Another 28 died of disease during the campaign, while 194 were captured, of whom 51 were wounded, 3 of whom subsequently died. At the close of the campaign at Fort Bliss and enroute back to San Antonio another 20 men succumbed to illness. One surgeon and 2 "left behind sick" at Fort Bliss were taken prisoner. By the time of the brigade's Fort Bliss muster, less than 1,800 men remained of the 2,515 who had marched northward with Sibley barely 3 months previously. "All the men are more or less unwell, and it is distressing to notice how general is the debility in camp," recorded a soldier. Measles, smallpox, and pneumonia continued to claim men. Bleeding gums and toothaches were pervasive symptoms of scurvy and vitamin deficiency. One officer lamented that "I have scarcely ten men in my company fit for duty and seven of my best men are dead…. We have many sick…there are many complaining and some just getting over measles, being quite weak."†

**References 2(pp 199-203), 3(pp 235, 252-260).*

†References 3(pp 262, 264), 4(pp 37, 54), 9(132).

The remnants of the brigade made the long march back to San Antonio in June and July 1862. Reconstituted, the unit gave gallant service in Texas and Louisiana through the rest of the war, but Sibley had lost their trust. He spent the autumn of 1862 defending himself against the charges of drunken misconduct brought against him by his own officers. Escaping conviction, he retained command of his disgruntled brigade, but his drunken incompetence during an April 1863 action in Louisiana led to his relief and a second court-martial. Escaping conviction yet a second time, he was left without a command and never led Confederate troops again. After the war he secured a general's rank in the army of the Khedive of Egypt, but his alcoholism led to his loss of that position as well. He died in poverty in Fredericksburg, Virginia in 1886, besotted, diapered, and incontinent.[1(pp301-369),2(pp203-206)]

The Confederate offensive into New Mexico had been doomed from the start due to Sibley's deluded belief that his force could live off the land until it captured sufficient enemy supplies to sustain its drive all the way northward to seize Fort Union. His logistical planning failure was particularly inexcusable in light of his extensive prewar service in the desert Southwest. His opponent's biographer cited several major factors for the defeat of the Confederate offensive. The first lay in the mixed apathy and hostility of the native Hispanic population, who found no reason to ally themselves or their resources with the invaders' cause. More important were the related elements of time and supply. The Texans' fitful rate of movement north from Mesilla gave Canby time to organize the defenses of Unionist New Mexico and summon reinforcements from Colorado. "The demolition, by a number of those troops, of the Confederate supply train at La Glorieta Pass was the immediate cause of the failure of the Southern venture." In addition, the drought which had afflicted the region during the past 2 years resulted in a shortage of local foodstuffs and range forage for the Texans' horses and mules, further complicating the problem of supply.[14(pp180-181)]

Optimistic zeal and personal ambition may have colored Sibley's judgment to a degree, but the suspicion lingers that John Barleycorn occupied as large a role in Sibley's planning processes as did the maxims of Napoleon, Jomini, or Clausewitz. Alcoholism was by no means uncommon among

senior officers on either side in that conflict, but seldom did the liquor-fueled failings of one man have a more profound effect upon the course of an entire campaign. The logistical failure ensured that his troops lacked adequate tentage, winter clothing, medical supplies, and transport for what supplies they did possess. Noted a veteran of the campaign:

> While we had good, kind and able surgeons, who were always willing and anxious to do all in their power to heal the wounded, cure the sick and alleviate their sufferings, yet they were utterly without the medicines and hospital stores to do so. And to such extremities were we reduced, that men would linger and die in their companies, rather than go to the hospitals.[6(pp128-129)]

The brigade's high disease rates and the fate of its sick and wounded, so often abandoned to the enemy, must have sapped the Texans' morale as they fought both the elements and the Yankees in that bleak field of operations. In the end, Sibley could not concentrate adequate combat power at the decisive time and place to destroy the enemy. Measles, pneumonia, dysentery, and malnutrition had beaten his command long before the Coloradoans trekked south from Fort Union to Glorieta Pass. Sibley's personal health problems and his failure to safeguard his men from the ravages of malnutrition and microbes alike doomed one of the most audacious and potentially decisive operations in all of American military history. The student of this tragic episode is left pondering the enigmatic figure of Dr Covey, who gave such able service to the brigade's sick and wounded throughout the campaign, and yet silently acquiesced in the retention of command by an ailing alcoholic who was unfit to oversee a recruiting depot, much less a campaign of potentially strategic importance. In Dr Covey's reticence lay the seeds of disaster for the Confederacy's New Mexico Campaign.

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AUTHOR

Dr Austerman is Command Historian, US Army Medical Department Center and School, Fort Sam Houston, Texas.

Integrated Disease Management: An Old Idea Ready for Our Time

COL (Ret) Daniel Strickman, MS, USA

We human beings are surrounded by systems wherever we go. Those systems might be positive, like the ones that produce clean air through photosynthesis, or they might be negative, such as the ones that result in violent cultural opposition. Disease and health are also the result of systems around us; ones that we very much want to manipulate in order to favor the latter and not the former.

Medical entomologists are used to thinking about the many environmental factors that lead to excessive populations of whatever insect is causing a problem. For example, some of the mosquitoes that transmit *Plasmodium*, and therefore cause malaria, in east Africa develop in weedy, sunlit pools as aquatic larvae. The adults emerge and take blood meals every 2 or 3 days, preferring humans as hosts. Females mate after the first blood meal and lay eggs on the water of those sunlit pools a couple of days later. Females keep feeding on blood and laying eggs for at least 6 weeks or until they meet with an untimely end. Temperatures near the equator in that part of the world hardly vary during the year, but the rainfall is very seasonal. The rhythm of the rainy seasons is the rhythm of the mosquito populations. The mosquito populations multiply when pools are abundant, producing many young females. At the end of the rainy season, the population declines so that the average age of biting mosquitoes gets older and older. It is a dangerous world for the adult mosquitoes, with approximately 20% of them dying each day.

People in that part of the world often live in simple homes that are almost completely open to mosquitoes, so that getting a meal from a sleeping person is no problem. They are also very poor, with sporadic access to health care and difficulty buying household items that we might think of as necessities. The combination of a pathogen that stays in the blood for weeks, a mosquito that bites repeatedly and prefers humans, and a human population that is freely available for bites makes for the explosive malaria situation commonly observed in east Africa and elsewhere.

The challenge for those charged with the alleviation of infectious diseases is to determine how to affect a disease system at exactly those points that will have the biggest negative impact on the pathogen and positive impact on the human population. Prior to the common availability of antibiotics and vaccines, people had to rely on sanitation and avoidance to escape disease. Even before the germ theory of disease, many people seem to have valued clean water, clean habits, and wholesome food, as documented in the scripture of western religions, guides to health, and the wisdom of ancient luminaries such as Aristotle and Galen. Once the nature of pathogens was discovered in the late 19th century, many schemes emerged for disease prevention based on detailed studies of the natural history of the pathogens. The world's various populations desperately, and sometimes successfully, assembled the tools available to mitigate the ravages of malaria, plague, typhus, and other scourges of public health. With the exception of a few vaccines, most of these interventions were outside the human body until the rapid discoveries of effective drugs began in the late 1940s.

We are now in a position to combine the interventions outside the human body with those inside the human body to make dramatic progress against infectious disease. There is much room for improvement, but there are wonderful examples of applying exactly that combination to defeat disease. Certainly tuberculosis and enteric infection would be much worse without the multilayered interventions of sanitation, detection, and treatment that the public has come to expect.

It is possible that the professional communities that deal with arthropod-transmitted (vector-borne) pathogens have been less able to communicate with each other than with communities involved in other aspects of medicine. The reason may lie in the great breadth of medicine, an obviously all-consuming profession, and applied medical entomology, an equally complicated endeavor. Medicine applied in the clinic under the auspices of public health has some

difficulty communicating with vector control that operates in sewers, swamps, and backyards under the auspices of environmental health and public works. The military makes a vigorous attempt to facilitate communication, but in practice, the assessments of one side are not studied consistently by the other, except when energetic and well-intentioned individuals force the process to work.

Integrated disease management is not a new catch phrase, but it is certainly not as commonly practiced as it could be. Entomology has possibly developed a better framework for applying integrated intervention through its own development of integrated pest management in the 1950s through the 1970s. Integrated pest management can be divided into 4 components:

1. Risk assessment (what we find out remotely from existing information)
2. Surveillance (what we find out by measurements on the ground)
3. Control (the full complex of vector control and personal protection)
4. Monitoring (that which is done to detect a resurgence of the problem and to stimulate maintenance of the program)

Integrated disease management extends the range of tools to include those of public health and medicine, with the objective of limiting pathogen transmission by combining all measures that are effective. Risk assessment includes epidemiology as well as entomology. Surveillance includes passive and active human surveillance, as well as vector surveillance. Control includes drug prophylaxis, vaccination, medical treatment of existing disease, and other medical interventions as well as entomological interventions such as community vector control and personal protective measures. Monitoring looks at incidence, damage to human activity and quality of life, and other potential damage from a disease, as well as distribution of the pathogen and vectors.

The term "integration" is often used freely without a great deal of explanation. When thinking about integrated disease management, it is possible to picture the disease as a system. Malaria and dengue have humans as their principle reservoirs, greatly simplifying the situation in comparison to diseases such as West Nile virus fever or Lyme disease, which involve animal reservoirs. It is probably accurate to consider malaria or dengue as 3 part systems consisting of the pathogen, the human, and the vector. Interventions that reduce any of these 3 components are likely to reduce transmission. Experience in operational medical entomology and common sense suggest that using more different methods to attack all three of the components of the system is more likely to succeed than using a single method. For example, imperfect vector control and imperfect case detection and treatment might be combined to achieve regional eradication of malaria, as probably occurred in Thailand. Malaria has been virtually eliminated in most of the country by the systematic application of house spraying for mosquitoes and case detection and treatment for humans. House spraying has been done in response to foci of malaria detected through a network of free clinics dedicated solely to malaria. The simple clinics were carefully placed in locations that could be reached by the majority of rural populations and became the common destination for anyone with fever. Thailand created a specialized corps of malaria workers who could detect malaria with cheap equipment, dispense antimalarial drugs, and follow-up with visits to households where necessary. The success of the program has been the result of thoughtful application of economical methods in response to actual risk.[1]

The usual approach to integration is to combine methods in hopes of achieving the sum of the effect of all the actions. It is unusual to truly integrate the methods into a system that specifically targets vulnerable aspects of the disease system. For example, the distribution of repellents during the West Nile virus outbreak in New York City was done in the hope that enough people would use the repellent to supplement aerial spraying, an additive, rather than integrated, approach. On the other hand, a strategy of vector control and personal protection in primary schools in areas of endemic dengue transmission might limit transmission of the virus in a location where it travels most easily from family to family. The systematic study of susceptible stages of institutional food preparation, and the construction of practical procedures to protect each susceptible stage, is another example of true integration of preventive effort.

If we were able to take integration a step further and apply medical interventions in coordination with

environmental interventions, we would have true integrated disease management. However, such coordination is often made difficult by the lack of an overall authority in a position to direct cooperation of the disparate elements that must work in concert to achieve success. An example of the successful employment of this structure is the modern US military, where hierarchical systems have achieved a large measure of this sort of integration by creating a small group of empowered experts at the highest level of an operational theater. Despite the frustration of relative distribution of resources, imperfect reporting, and limited tools for intervention, the US military has sometimes been able to achieve remarkable levels of health in a deployed theater. One case in point is Operation Enduring Freedom, when, for a few months in 2001 and 2002, military personnel scattered from Uzbekistan to Kenya experienced one of the lowest rates of disease (in military terms, disease nonbattle injury) in military history. As shown in the illustration, the 3rd Medical Command's force health protection experts were colocated with the operations cell, allowing rapid evaluation of situations. The resulting decisions were accomplished in one location, then quickly implemented into the flow of operations.

The group of professionals in the 3rd Medical Command who managed force health protection during Operation Enduring Freedom from December 2001 through May 2002. Working under such confined conditions, a sanitarian, physician, entomologist, veterinarian, and dentist were able to come to decisions quickly with consideration of all aspects of health, a process that approximated a real application of integrated disease management. The military operations (G-3) function is in the background, its proximity allowing health protection decisions to be quickly translated into operational practice under these conditions.

Broader application of the coordination of environmental health and clinical medicine could achieve integrated disease management in more areas and in response to more challenges. In the civilian environment, the structure to drive the necessary coordination would likely be the province of local, regional, and federal governments, as well as private and autonomous entities like hospitals, mosquito abatement districts, and contractors. Most governments already have some responsibilities in many of the disciplines involved in both environmental and health interventions. However, successful integrated disease management will require tact, skillful diplomacy, and a high level of management skills to gain cooperation of various agencies that may already compete among themselves for resources and areas of overlapping authority. In most cases it will not be simple or straightforward, but over the long run the improvements could result in the conquest of persistent infectious diseases, improvements in population-level health, and dramatically reduced costs for society.

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AUTHOR

COL (Ret) Strickman is the National Program Leader, Veterinary, Medical, and Urban Entomology at the US Dept of Agriculture, Agricultural Research Service, Beltsville, Maryland.

Expanding the Role of Preventive Medicine in the United States Army: Integration and Cooperation

LTC James Sheehan, MC, USA
CPT (P) Brent Gibson, MC, USA
MAJ Bryan Sisk, AN, USA

The US Army has a long-standing global public health presence, operating a network of community hospitals and clinics in rural and urban areas around the world. It is from these communities that the Army draws the majority of its civilian work force, and it is these communities that in turn benefit from well-run public health programs. In some instances, the Army may be the most accessible public health presence in these areas, providing services to the populations that have supported and lived in harmony with the military for decades. In addition, many military missions support uniquely hazardous industrial operations, including munitions manufacturing and storage; as well as nuclear, chemical, and biological material storage, research, and destruction. In a deployed or humanitarian setting, the Army may be the only formal public health presence, and is uniquely suited to support infrastructure rebuilding and/or modernization. Military preventive medicine assets, the Army analog of civilian public health departments, are uniquely suited to operate in this environment.

Since September 11, 2001, the public health threat has become more complex, stimulating a rapid change in the practice of public health. Military public health nurses, environmental scientists, sanitary engineers, physicians, veterinarians, physician's assistants, medical entomologists, health physicists, audiologists, medics, preventive medicine specialists, and many others are faced with the monumental task of responding to this ever-changing environment. The most efficient way to fulfill the obligation to protect the public's health is for military and nonmilitary agencies to work together and share resources when dealing with common issues. Collaborative efforts with local, county, and state health departments, as well as with schools of public health, are mutually beneficial and natural. Public health professionals across all disciplines are now under training to be experts in a standard set of proficiencies usually referred to as the Ten Essential Services of Public Health, shown in the table. These common competencies promote partnerships, standardize processes, and streamline communication, thus providing a more robust assessment of a community's health. Overall, partnerships enhance the ability to protect our communities as the demands on public health professionals intensify. An illustrative example of this relationship was evident during a combined training exercise held in Oklahoma during the summer of 2005.

Beginning in late 2004, the State of Oklahoma began planning a statewide mass prophylaxis exercise in

National Public Health Performance Standards Program
Ten Essential Services of Public Health

1. Monitor health status to identify and solve community health problems.
2. Diagnose and investigate health problems and health hazards in the community.
3. Inform, educate, and empower people about health issues.
4. Mobilize community partnerships and action to identify and solve health problems.
5. Develop policies and plans that support individual and community health efforts.
6. Enforce laws and regulations that protect health and ensure safety.
7. Link people to needed personal health services and assure the provision of health care when otherwise unavailable.
8. Assure competent public and personal health care workforce.
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.
10. Research for new insights and innovative solutions to health problems.

Oklahoma State Department of Health News

State Department of Health Bioterrorism Exercise
Scheduled July 12-14

Public Encouraged to Participate

As part of a large-scale effort to test emergency response systems in a public health catastrophic event, the Oklahoma State Department of Health announced today that a bioterrorism exercise simulating a terrorist release of plague will be held in three Oklahoma counties next month. The exercise, called **Operation Firework Fanfare**, is one of the most ambitious and complex exercises of its kind ever held in Oklahoma.

The exercise, scheduled July 12-14, will be a realistic simulation designed to challenge the state's response to a catastrophic health emergency. This simulated event would result in pneumonic plague, a disease that can be transmitted person to person, in addition to those originally exposed. Such an attack would require a massive coordinated response to deliver antibiotics to affected persons in the three counties participating in the exercise: Comanche, Oklahoma, and Tulsa.

A key component of the exercise will be demonstrating the Oklahoma State Department of Health's ability to request, receive and distribute emergency supplies from the Strategic National Stockpile. The Strategic National Stockpile can deliver medicine, vaccine, and antidotes within 12 hours and is maintained by the federal Centers for Disease Control and Prevention in a constant state of readiness to respond to a public health emergency. On July 12 and 13, the exercise will focus on the identification of the biologic agent and emergency procedures necessary to request, receive and distribute supplies from the stockpile to appropriate areas within the state.

On July 14, Oklahoma, Tulsa, and Comanche counties will operate countywide medication dispensing sites to simulate dispensing antibiotics from the stockpile to mass populations who might be at risk of acquiring pneumonic plague.

"Operation Firework Fanfare will demonstrate what we have accomplished in preparing to respond to a serious public health threat as well as identifying areas for future improvement," said State Health Commissioner Dr Mike Crutcher. "In addition, the exercise will demonstrate the close working relationship between branches of federal, state and local governments and local first responders in preparing for a bioterrorist attack."

To help make the exercise more realistic, state health officials are asking Oklahomans to volunteer July 14 as mock "patients" for the exercise by simulating the types of crowds at medication dispensing sites that might occur in a real public health emergency. People interested in participating are encouraged to contact the local health departments in Comanche, Oklahoma, and Tulsa counties.

State partners in the exercise include the Oklahoma Department of Emergency Management, Oklahoma Office of Homeland Security, Oklahoma Department of Public Safety, and the Oklahoma Department of Transportation. County health departments participating include the Comanche County Health Department, the Oklahoma City-County Health Department, and the Tulsa City-County Health Department.

order to upgrade its State Department of Health preparedness status from amber plus to green. The exercise was designed to test the state's response to a bioterrorism attack, particularly its ability to work with the Strategic National Stockpile (SNS) and to ensure the safe, secure, and timely distribution of SNS medications to the general population. Comanche County, Oklahoma, was one of 3 major regions participating in the exercise. This county is home to Lawton, the fourth-largest city in Oklahoma and the community that supports the US Army installation at Fort Sill. The population in the Lawton–Fort Sill area is 100,000, with approximately half of the population having ties to the military installation which includes Soldiers, their Families, and employees working on the installation.

The Fort Sill Commanding General allowed the base to participate in the exercise, a first for any Department of Defense installation. The Fort Sill planning team consisted of the Public Health Emergency Officer (the preventive medicine physician), an Army Public Health Nurse, the Reynolds Army Community Hospital emergency planner, and the preparedness planner from the installation. The team worked closely with the Comanche County Health Department and the Oklahoma State Department of Health planners to

At the military points of dispensing, gates, tables, and high visibility markings were set up to support logical patient flow and decrease the need for verbal instruction. This is an important consideration in fast-paced, tense, noisy environments.

ensure that the installation and the population it supported were accounted for in the final SNS distribution plan. One misconception, identified early, was the belief that the military has its own version of the SNS, when, in fact, military installations are counted as part of the local community by the US Centers for Disease Control and Prevention. The establishment of lines of communication with the surrounding county's officials clarified this issue and ensured that the installation received its allotment of medications and supplies. Ultimately, the installation was incorporated into the county distribution plan.

During the exercise, the installation established a point of dispensing (POD) site which expected to dispense 50,000 doses to individuals. Two additional PODs, established by the county, would dispense to the remaining local population, as well as to residents from rural areas and smaller towns in the county. The expected hourly through-put at each POD site was 750 individuals per hour. The community benefited greatly from the establishment of the third POD by the military, as the county was able to position its dispensing sites further from the center of town. The third, more centrally located, military venue made it easier for those living outside of Lawton to receive their medications from the other 2 PODs. Individuals benefited from decreased travel time to and from the sites, as well as from dilution of the crowds at each site (less wait time, safer environment, and less chance for exposure from proximity to potential carriers). The military benefited from this arrangement as well. Soldiers and their Families did not have to drive through the city to receive their prophylactic doses; they only had to travel to the POD closest to their home.

Despite these benefits, there were several challenges that posed significant barriers to mission success. For example, there was a notable lack of interoperability between communications systems. Military radios could not communicate with civilian radios and, even in the community, fire services could not directly communicate with police agencies. This was not a novel finding in emergency response, but it prompted the installation and community to work on acquiring a single communication system that would allow all agencies to talk directly to each other. This system, once operational, will improve the flow of information, both in a crisis situation and during routine operations.

Force protection status of the installation was another important consideration. The immediate reaction by installation leaders was to significantly restrict access to the installation to only those personnel on active duty and their families. In many emergencies, this may not be necessary. In fact, by the time the installation was effectively sealed off in this scenario, the disease process was already established within the base, and the level of security would undoubtedly delay access to treatment or prophylaxis, and potentially cost more lives.

Soldiers queue at designated stations to be screened for allergies to medication. Local, state, and federal officials observed as 750 Soldiers per hour passed through the point of dispensing site.

Another area of concern that emerged involves the respective lines of authority. While the Army has a well-established command structure that mirrors the Incident Command System used by the civilians, there is some ambiguity surrounding the interplay of federal and state authorities during a domestic emergency. In most scenarios, the governor is the ultimate authority within a state and military participation requires that the installation respond to the instructions and directives issued by state officials. This is in addition to following direction and guidance issued by the military chain-of-command, and the potential therefore exists for conflict between opposing directives.

One final, yet key, element was that control of the POD mission was deferred to the military medical treatment facility (MTF). However, in this scenario, the MTF was overrun with patients. Consequently, physicians, nurses, and medics were not available to staff the POD site. Another perspective, provided by population-oriented preventive medicine experts, was that medication distribution would be just as effectively managed by any number of personnel under the guidance of public health physicians and nurses. This approach preserves remaining clinical providers for those roles which are less easily delegated, such as diagnosis and treatment of affected patients.

The Oklahoma State Department of Health exercise is only one example of military-civilian public health cooperation. Looking beyond this example, there are many other military communities where facilities, supplies, and training of civilian personnel are jointly exercised. The synergy of local healthcare, public health assets, and their military equivalents is essential for successful accomplishment of the overall mission of protecting the public's health. Extending even beyond the boundaries of the United States, these same principles and skill sets are essential to the accomplishment of military missions abroad. The assessment of established public health infrastructure and cooperation with local officials creates a system that ultimately impacts the health of the host nation in a positive manner.

Military preventive medicine assets are uniquely trained to work with local governments in domestic, deployed, and humanitarian settings. They provide training and assistance with assessment of communities, setting goals, and establishment and evaluation of interventions in support of the local governments' objectives. These efforts not only contribute to the host communities, but also build goodwill, permit our forces to gain vital insight into endemic diseases, and prioritize interventions that protect the health of the local population and US forces. Effective oversight of such cooperative efforts depends heavily on preventive medicine and public health's population-based perspective on healthcare. These components are absolutely essential in assuring seamless mutual public health support.

AUTHORS

LTC Sheehan is Chief, Community Health Practices Branch, Army Medical Department (AMEDD) Center and School, Fort Sam Houston, Texas.

CPT (P) Gibson is the Occupational Medicine Instructor/Writer for the Community Health Practices Branch, AMEDD Center and School, Fort Sam Houston, Texas.

MAJ Sisk is the Deputy Chief, Community Health Practices Branch, AMEDD Center and School, Fort Sam Houston, Texas.

HOME OF FIELD ARTILLERY

FORT SILL, OKLAHOMA

How to Stop Fighting Ourselves: Removing the Stigma of Mental Health Treatment for Soldiers

Kay Shepard, MSW

ABSTRACT

Soldiers' fear of stigmatization by peers and superiors is the primary barrier that the US Army must overcome as a prerequisite to providing successful mental health treatment to Soldiers who have been exposed to the combat environment. Untreated mental health conditions can lead to increased severity of symptoms and adversely affect mission readiness. Command leadership must become aware of the effects of combat exposure upon their Soldiers, and refer Soldiers to behavioral health facilities when necessary, so that their Soldiers are peak performers and mission ready.

INTRODUCTION

Soldiers' fear of stigmatization is the primary barrier that the US Army must overcome as a prerequisite to providing successful mental health treatment for combat stress. Soldiers deploy to Operation Enduring Freedom and Operation Iraqi Freedom (OIF) on a rotation basis and are repeatedly exposed to the combat environment. Soldiers are returning from the combat environment with major depression, generalized anxiety, and Post Traumatic Stress Disorder (PTSD). There is a clear correlation "between combat exposure and PTSD, with greater levels of exposure leading to greater prevalence."[1] Individuals need treatment for these mental health conditions in order to be a good spouse and parent in the family environment and a Soldier who is mission ready.

Soldiers express several concerns with seeking mental health treatment. A dominant concern is that they believe it will affect their careers. In 2002, the Epidemiological Consultation team examined the circumstances surrounding 5 murders and 2 related suicides at Fort Bragg. They found that Soldiers resisted seeking mental health services from military resources "for fear of jeopardizing their careers."[2]

PERCEIVED BARRIERS TO SOLDIERS SEEKING MENTAL HEALTH TREATMENT

Soldiers' concern about confidentiality in matters involving mental health is understandable if they are receiving information only from peers who are involuntarily sent to treatment by their commander. Soldiers hear rumors of the separation of Soldiers from the Army after visiting Community Mental Health, and about the chain of command's involvement with a Soldier's attendance for treatment at Social Work Services (SWS). The first situation could occur if the commander deems an individual in need of a duty fitness evaluation. The second situation could occur if a Soldier is directed to the SWS Family Advocacy Program because of a domestic violence incident in the home. Soldiers who voluntarily refer themselves to either SWS or Community Mental Health receive a higher level of confidentiality. These Soldiers typically will not volunteer information to their peers or chain of command that they are participating in mental health treatment. Both the *Health Insurance Portability and Accountability Act of 1996*[3] and Military Rules of Evidence[4] preclude the staff at the behavioral health facility from even acknowledging the individual's attendance at treatment, unless the individual had previously signed a release form permitting the disclosure of such legally privileged information. Furthermore, licensed providers working at SWS are bound to uphold client confidentiality by the codes of ethics of both the National Association of Social Workers[5] and the American Association for Marriage and Family Therapy.[6]

Client confidentiality is not absolute. It becomes limited when someone tells a therapist that they are going to harm themselves, or another person. In such a

case, the therapist is required to report this danger to authorities. A review of the status of the psychological health of Soldiers who are in either the personnel reliability or nuclear surety programs, or have a Top Secret clearance, may be required at any time. The information is disclosed on a need-to-know basis.

According to Hoge,[7] Soldiers who are most in need of treatment are the same ones who are most resistant to seeking help. The respondents in this study thought they would be seen as weak (65%) or be treated differently by unit leaders (63%). Soldiers who visit Schweinfurt SWS repeatedly mention the difficulty they experience in obtaining time off from their duties to attend their appointments. On rare occasions, Soldiers report being humiliated by their superiors after mentioning a personal appointment at SWS. Soldiers do not want to appear weak. This fear was the number one barrier to seeking mental health treatment, according to Hoge's study. It is important that the Soldier be able to receive treatment without pressure from his peers or superiors. At Ledward Barracks in Schweinfurt, Germany, all returning units conducted a 90-day postdeployment screening. During this screening, one Soldier was observed by his peers in the area sitting in the hallway completing the form. The Soldier administering the screening summarized the entire form for the Soldier with words to the effect:

> Are you hitting people? You're okay.
> Just mark the form that you're okay.

The postdeployment screening was poorly administered because it failed to provide confidentiality, permitted the influence of peer pressure, and potentially failed to reach Soldiers that may have needed mental health services.

Part of being a leader in the Army is to be a role model. Positive leadership adopts a holistic view of individuals, and acknowledges the mental and emotional forces acting upon the Soldiers and the leaders themselves. Only rarely do leaders publicly participate in mental health activities. One captain from Schweinfurt boldly did this by attending and participating in a Critical Incident Stress Management Debriefing that he had requested for his Soldiers upon return from OIF. It takes courage for any Soldier in a leadership position to be a role model in the field of mental health treatment. According to COL Thomas Burke, Director of Mental Health Policy for the Department of Defense, the chain of command may elect to remove a Soldier who is receiving treatment for a mental health condition from a leadership position.[8] While some Soldiers get medals after receiving physical injuries in the line of duty, a Soldier whose mental condition is injured and is in need of treatment because of combat exposure receives no medals. Rather, that Soldier may suffer further with diminished promotion opportunities if the perception of instability remains.

EFFECTS OF UNTREATED MENTAL HEALTH CONDITIONS

Untreated combat stress or other mental health conditions can lead to increased symptoms, or an escalation of the severity of their diagnosis. Examples of this are evident when untreated combat stress deteriorates into PTSD, or when substance abuse and marital difficulties lead to irreversible behaviors such as suicides and the murders at Fort Bragg. Untreated mental health conditions affect mission readiness. Following the Vietnam War, PTSD affected 25% to 30% of the returning veterans. Currently, 15% of those veterans still suffer from this disorder. World War II veterans were tested 45 years after returning home. Of that group, Soldiers who had served in combat areas had a 13.3% greater risk of having PTSD symptoms than the Soldiers who had not been in areas involving direct combat.[9]

Another consequence of untreated mental health issues is the prevalence of self-medication. In response to the stress created by these unresolved issues, many Soldiers increase their consumption of alcohol. In reply to the predeployment survey question, "Have you felt you wanted or needed to cut down on your drinking?" 12.5% of the Soldiers answered "yes." After returning from their deployment to Iraq, response to the same question increased to a 20.6% response of "yes."[7] Gerry Warner, Clinical Director of the Schweinfurt Alcohol and Substance Abuse Program, provides anecdotal figures relating to the treatment of individuals referred 90 days after returning from OIF. Ms Warner stated that about "50% of our referrals had been to combat and scored on the moderate to high range on the PTSD questionnaire and 50% of the cases were new Soldiers just getting to Germany on their first enlistment." Captains report that they and their friends are using alcohol to help them sleep at night (G. Warner, e-mail, 22 February 2006). A Soldier with mental health concerns that uses alcohol as a sleep aid is not mission ready. Even

worse, this type of mission impediment does not show up on the radar of their chain of command and is not factored into strategic readiness planning. This blind zone for the chain of command could easily lead to overestimation of force capabilities and fatal results when those unready individuals are relied upon in combat.

TREATMENT OF MENTAL HEALTH

Although known by a variety of names, PTSD has existed as long as war itself. In World War I, the effects were called "shell shock." In World War II and Korea, it was called combat fatigue or battle fatigue. In Vietnam, it came to be known as Post Traumatic Stress Disorder.[4] In 1980, the American Psychiatric Association added PTSD to its publication, *Diagnostic and Statistical Manual of Mental Disorders*.[10]

In World War I, many Soldiers were sent away from the combat area if it was determined that they were suffering from shell shock. This resulted in a shortage of Soldiers. To remedy this, the Army changed procedures and relocated treatment providers near the front lines to treat Soldiers and get them back into combat. The long-term effects of shell shock appeared to be minimal for those Soldiers treated using this method who returned to the battle lines.[1]

Today, the Army has Combat Operational Stress Reaction (COSR) teams that go to the units. To date, the effectiveness of these behavioral health teams is inconclusive. During 2004, SWS conducted mental health screenings of Schweinfurt Soldiers returning from Iraq. These Soldiers confirmed that they were directed to meet with the COSR team after incidents where they had seen people killed or injured. However, the Soldiers also stated that they generally did not report any disturbance to the COSR team because they did not want to be seen as weak. They also questioned how helpful it would be to report any mental health concerns.

During his interview, COL Burke discussed combat stress control units and the Soldiers whose screenings identified symptoms requiring treatment performed near the area of their unit but away from the combat. In about 95% of the cases, their symptoms were addressed and they were returned to their units. According to COL Burke, 70% of the Soldiers sent to a hospital in Iraq returned to duty, 50% of those evacuated to Kuwait returned, 10% of those evacuated to Germany returned, and none of those sent to the United States returned to the theater.[8] The provision of treatment in the Soldiers' own environment where they know they will return to duty, and where they are assured that their feelings are a normal response to an abnormal circumstance, allows Soldiers to avoid the feeling of being adversely labeled with a mental health diagnosis. This level of treatment introduces Soldiers to the concept of caring about mental and emotional health, in addition to their physical health. This method of treatment may also have the unexpected benefit of weakening the structure of the barriers to Soldiers seeking mental health treatment.

Mental health services offered to the Soldier returning from deployment may vary from post to post. In Schweinfurt, Soldiers can receive services from a team of behavioral health professionals including Social Work Services, Community Mental Health, and Division Mental Health. Recent history from the Schweinfurt behavioral health team and collaborating agencies illustrates the positive effects of mental health care for Soldiers and Family members. Prior to the redeployment of Soldiers, SWS, Army Community Service, and the Family Life Center chaplain met with every family readiness group and conducted briefings. Social Work Services (SWS) briefings covered topics such as: combat stress, possible effects of combat exposure, effects upon the family, and services offered by SWS. During reintegration in February 2005, over 18% of approximately 4,900 returning Soldiers were individually screened or assessed by a professional of the Schweinfurt behavioral health team. These Soldiers' responses to the medical questionnaire indicated symptoms related to a combat environment—combat stress, depression, anxiety, or PTSD. SWS also conducted combat stress group briefings with every returning Soldier and with some spouses who joined their husbands during the reintegration process. Ongoing briefings to battalions, commands, and units on combat stress and Critical Incident Stress Management Debriefings continue to be conducted by SWS upon request. Schweinfurt SWS saw an increase in Soldiers self-referring for treatment related to the combat environment. It is typically difficult to link prevention work with results because it requires a comparison of the number of events that did occur with the number of events that would have occurred in the absence of preventive measures. The second component of this equation is always an unknown factor. However, reliable estimates can be obtained by comparing the local rate of domestic

violence incidents after deployment to OIF to those of other military communities with demographically similar populations. In comparison with locations with similarly combat exposed populations but less preventive community outreach, Schweinfurt saw only a small spike during the first 45 days after troops returned from Iraq.

One year after their return from OIF as Soldiers again prepare for deployment, reports of domestic violence remain at all time lows. Schweinfurt reports zero incidents among its 6,000 troops during January and February of 2006. More Schweinfurt Soldiers are mission ready for the upcoming deployment because they have taken care of themselves mentally and emotionally. The many Soldiers who participated in the Combat Operational Stress Group have done the smart thing by proactively dealing with emotional issues while in the safety of the garrison environment, rather than waiting and being distracted by those concerns in life or death situations on the battlefield. They voluntarily attended the Combat Operational Stress Groups where they talked about their thoughts and feelings about what they saw, with other Soldiers who had the same experiences. The Soldiers and their spouses participated in marital therapy, addressing issues that came up both during the last deployment and while the Soldier was home. During an interview, Steve Robinson, the Executive Director of the National Gulf War Resource Center stated, "There's enough evidence to show that if people get help early and often, they can recover and continue to fight."[11]

RECOMMENDATIONS TO DESTROY THE BARRIERS

The military should include outreach, education, and additional easy access to mental health care to address the barriers.[7] Army leaders at all levels should speak out clearly, decisively, and frequently on the importance of mental health as a coequal factor with physical health as a determinant of duty fitness. Leaders must discourage disparaging comments about Soldiers who seek mental health treatment with the same emphasis that they would discourage disparaging sexual or racial remarks about fellow Soldiers, and must recognize these comments as similarly harmful verbal self-attacks upon our own Soldiers.

Information dissemination is a key factor in bulldozing the barriers. Outreach programs of the medical command's behavioral health teams should ensure that briefings reach entire units. Briefings attended by everyone from the unit commander to the most junior Soldier promote development of a cohesive unit attitude of solidarity towards overcoming mental health issues. Additionally, since public briefings about treatment programs do not openly discuss any individual's confidential information, officer attendance can visually demonstrate leadership support of mental health programs to the enlisted Soldiers without raising concerns of diminished perceptions of those officers. Thus, not surprisingly, the first step in removing the barriers begins with Army leader participation in behavioral health briefings, leading their Soldiers by example and participating themselves. An example of the powerful nature of this influence can be seen from the events following an SWS briefing in 2005. At the request of an infantry battalion, Schweinfurt SWS conducted a briefing on combat stress and its effects on the Soldier and Family. The whole battalion, including the commander, attended the briefing. The following day, Schweinfurt SWS began receiving calls from those infantry Soldiers requesting services. The stream of phone calls continued for several weeks following the briefing.

Proactive outreach services such as Critical Incident Stress Management (CISM) Debriefings can forewarn unit personnel of the effects of combat exposure on an individual's mental and emotional states, and lead to early recognition and treatment of these symptoms. CISM debriefings can be flexibly scheduled, both in time and location, for maximum convenience of each unit. The provision of ready access to CISM debriefings from behavioral health providers can be a critical factor in lowering the barriers confronting Soldiers who are deciding whether to seek treatment or ignore their symptoms. The increase of self-referrals for treatment and decreased levels of domestic violence following the implementation of Schweinfurt SWS outreach programs illustrate the tangible benefits to the Army. Fewer Soldiers were embroiled in legal proceedings following domestic violence, and Soldiers were mission ready sooner because they were proactive, rather than reactive, in dealing with their symptoms.

No weapon in the Army's arsenal is accurate or sophisticated enough to recognize and override flawed decisions of an overstressed Soldier. Therefore, our

most sophisticated and advanced technology has human emotion as its weakest link. Reason would then dictate that productive utilization of technological resources will be maximized by reduction of counterproductive influences resulting from emotional distress. To reach this objective, behavioral health professionals must recognize that barriers which prevent Soldiers from reaching out to them currently exist, and compensate with initiatives to reach out to the Soldiers instead. This direct connection with Soldiers is only possible when unit level Army leaders understand the importance of this issue, and take the final step of using the available behavioral health resources.

CONCLUSION

To treat combat stress effectively, the primary barrier that the US Army must overcome is the fear of stigmatization that Soldiers associate with mental health treatment. The Global War on Terrorism has brought to the forefront mental health issues related to combat exposure. Soldiers are returning from combat zones in need of treatment for combat stress, depression, anxiety, and PTSD. Soldiers will continue to avoid voluntary treatment unless they believe that they can avail themselves of mental health services without it affecting their career or causing them to be viewed as weak by their peers and superiors. Army leaders must place increased emphasis on reducing the barrier of that stigma Soldiers fear when seeking mental health treatment. Command leadership must

- Become aware of the effects of combat exposure on their Soldiers.
- Be able and willing to refer Soldiers to behavioral health facilities.
- Invest the duty time necessary to ensure treatment is accomplished so that their Soldiers are peak performers and mission ready.

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AUTHOR

Ms Shepard is Chief, Social Work Services at the US Army Health Clinics in Katterbach and Illesheim, Germany. At the time this article was written, she was Chief, Social Work Services, US Army Health Clinic, Schweinfurt, Ledward Barracks, Schweinfurt, Germany.

Demystifying the Environmental Health Site Assessment

LTC Timothy G. Bosetti, MS, USA

ABSTRACT

At the request of the Multinational Corps-Iraq (MNC-I), the US Army Center for Health Promotion and Preventive Medicine deployed a Special Augmentation Response Team-Preventive Medicine to support MNC-I and preventive medicine assets in Iraq in order to complete environmental health site assessments (EHSAs) for major forward operating bases. Prior to the mission, there was a lot of concern from the field on what constituted an EHSA and how to conduct one. The EHSA is a living document that describes environmental and health conditions on a forward operating base. It identifies, describes, and documents potentially complete and completed exposure pathways. The 90-day mission involved conducting 2 iterations of EHSA training to preventive medicine detachments and brigade combat team Environmental Science and Engineering Officers, conducting site assessments of major forward operating bases in Iraq, and completing over 25 EHSA reports. This article provides an overview of the EHSA process, the site assessment, and the final report in order to demystify the EHSA process and its usefulness to preventive medicine personnel.

WHAT IS AN ENVIRONMENTAL HEALTH SITE ASSESSMENT?

What is an EHSA and why would it be relevant in an expeditionary Army? These are questions many have asked. Unfortunately, few can provide a sound answer to these questions. The answer is not complicated and does not require years of experience and training. Simply, the EHSA is designed to protect our deployed force and document potential exposures resulting from their deployment. The EHSAs are living documents that describe environmental and health conditions at deployed locations. They identify, describe, and document potentially complete and completed exposure pathways. This article provides an overview of the EHSA process, the site assessment, and the final report in order to demystify the EHSA process and its usefulness to preventive medicine personnel.

The objective of the EHSA is to identify complete and potentially complete exposure pathways at deployment sites that may affect the health of deployed personnel. Data generated from the EHSA is used to conduct operational (composite) health risk estimates. The EHSA process consists of 5 components: predeployment activities, site reconnaissance, conceptual site models, environmental sampling, and a report to document findings.

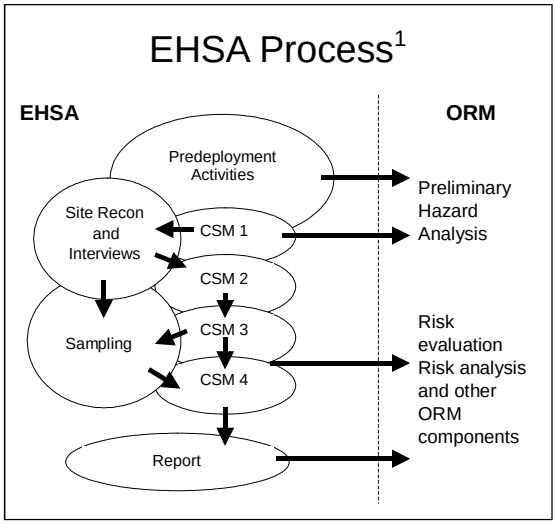
The need for a standard methodology for documenting environmental conditions at deployed locations first became evident after Operations Desert Shield/Storm. However, it was not until the US involvement in the Balkans that the need for a methodology to document environmental conditions that may affect health were required. This documentation had to be separate from the existing environmental baseline survey conducted by the Army Corps of Engineers. The Joint Environmental Surveillance Working Group (JESWG) recognized the need for a standard practice among the military services and the methodology to document environmental health conditions at deployment locations. Although some deployment environmental surveillance was conducted, it was not necessarily a systematic, scientifically based methodology that was recognized by all services. In 2003, the American Society of Testing and Materials (ASTM) International published the *Standard Guide for Environmental Health Site Assessments for Military Deployments*.[1] This was the result of a joint effort championed by the JESWG. The publication of this methodology through the ASTM provided a peer-reviewed, third-party accepted standard that is scientifically defensible.

DoDI 6490.03[2] provides implementation guidance for Environmental Health Site Assessments. Although the 1997 version mentioned the need to document baseline

conditions and conduct environmental baseline studies, specific guidance on the EHSA was not available. As a result, policy guidance from the Joint Staff did not specify the need to conduct an EHSA. The Joint Staff memorandum has been updated to incorporate specific language that requires EHSAs.

As base camps began to appear all over Iraq, the need to document existing environmental conditions arose again. Although some EHSAs were conducted, it was not a standard practice. In 2005, the US Central Command (CENTCOM) Surgeon's staff exerted pressure to have EHSAs conducted at all troop locations within the CENTCOM area of responsibility. This high-level push, quoting nebulous third-party agencies and Department of Defense-level requirements, resulted in the belief that EHSAs were beyond the capabilities of preventive medicine assets in theater. From there, the mystery surrounding the EHSA grew. Concerns were that the EHSA was a burden to theater preventive medicine assets—a boulder in their already full rucksack. However, in reality, the EHSA is nothing more than packaging what is already done by field preventive medicine personnel at all levels of support.

In November 2005, the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) received a mission request from the MNC-I to conduct EHSAs for the major forward operating bases (FOB) in Iraq and to train preventive medicine personnel on the EHSA process. The USACHPPM Special Augmentation Response Team-Preventive Medicine (SMART-PM) consisted of personnel from both USACHPPPM Headquarters and Europe with specialties in environmental engineering, industrial hygiene, public health, and 2 preventive medicine technicians.



In January 2006, the team deployed to Iraq to begin its mission. Two training classes were held at Camp Anaconda, Balad, Iraq. Over 40 preventive medicine personnel from the Army and Air Force were trained. Upon completion of training, the team moved around the theater, visiting the major FOBs, providing additional EHSA training, and completing the EHSAs for each major FOB. Within 60 days, the USACHPPM SMART-PM had completed 25 EHSAs, which included not only the major FOBs but several satellite camps and camps designated for closure. While exiting the theater, the team stopped in Kuwait and provided EHSA training to preventive medicine personnel in Kuwait.

PREDEPLOYMENT ACTIVITIES

Predeployment activities for an EHSA are the same as those for preparing for deployment or mission. In preparation for deployment, preventive medicine personnel identify the medical threats to deployed forces. The threats can be in the form of environmental stressors, endemic diseases, vector-borne diseases, environmental and industrial contamination. The predeployment activities related to the EHSA are not different from those already performed by preventive medicine personnel.

WHERE DOES THE INFORMATION COME FROM?

There are many sources of information. Among the commonly known are the Armed Forces Medical Intelligence Center, the Central Intelligence Agency World Fact Book,[3] and the World Health Organization. These are typically used to develop medical threat briefings and preventive medicine estimates of the situation for a deployment. Most are aware that the USACHPPM Deployment Environmental Surveillance Program is a great resource for gathering health information papers and products, and medical threat briefings. However, the USACHPPM also has a resource that can be used to develop the preventive medicine operational picture for the deployment location. This capability is called the Global Threat Assessment Program (GTAP). The GTAP can provide a Phase I Deployment

Occupational and Environmental Health Risk Summary that includes an overview of the site and geographic location, samples collected, potential hazards in the area, surrounding industries, and potential medical threats.

There are several sources of information for preventive medicine personnel from which to gather data concerning the deployment site. All of these information sources should be used to develop the preventive medicine estimate of the situation to identify the potential medical and health threats. That estimate can then be used to develop the medical threat brief, and serve as the background research for your EHSA and the foundation for the development of the conceptual site models.

CONCEPTUAL SITE MODELS

The conceptual site model (CSM) is a graphical representation of an exposure pathway for a contaminant of concern. It describes how a contaminant of concern moves through the environment (air, soil, and water), identifies the activities that could result in potential exposures, and identifies the potential routes of exposure. Although that process sounds complicated, it is actually quite simple.

Potential Exposure Sources

- ✓ Hazardous material/waste storage areas
- ✓ Motor pools
- ✓ Existing contamination & spills
- ✓ Industry
- ✓ Fuel storage areas
- ✓ Waste disposal areas

First is the identification of the contaminants of concern. This comes from the predeployment activities and the medical and health threats that were identified.

Second is the determination of how the contaminant exists in the environment. This is nothing more than identification of the physical properties of the contaminant of concern and how it exists in the environment: liquid, solid, or gas. The physical properties determine how the contaminant of concern behaves and moves through the environment, and how it enters the human body: dermal contact, ingestion, or inhalation.

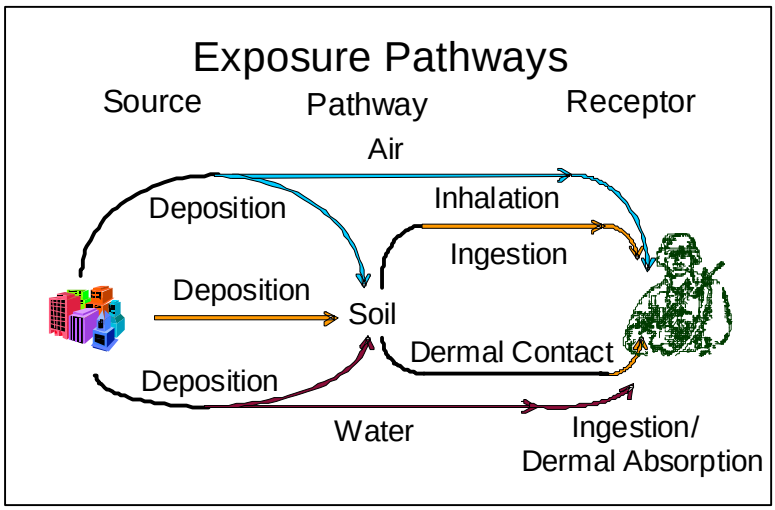
Third is the determination of what, if any, activity will result in an exposure to the contaminant of concern. This is critical, if there is no route of exposure, there is no exposure. Remember that time, distance, and shielding determine the amount of exposure. After the route of exposure has been identified, we need to assess the potential routes of exposure: dermal contact, ingestion, or inhalation.

Finally, in the conceptual site model, we make an assumption as to whether that exposure pathway ends with a human receptor. This model, or conceptual exposure pathway, remains until we can validate, through sampling, whether it exists as a complete exposure pathway, a potentially complete exposure pathway, or an incomplete exposure pathway, ie, no exposure.

The conceptual site model assists in answering the following questions:

- What are the contaminants of concern and what is the source of contamination?
- How does the contaminant exist in the environment?
- How are deployed forces exposed? What is the activity that causes their exposure?
- What is the exposure route: dermal, ingestion, or inhalation?
- Is there a completed exposure pathway?

That last question is key—is there a completed exposure pathway? That is what we as preventive



medicine professionals are attempting to determine, and answer. We answer that by using the CSM developed for a contaminant of concern and developing a sampling program to determine whether that exposure pathway is completed and if there is a human exposure.

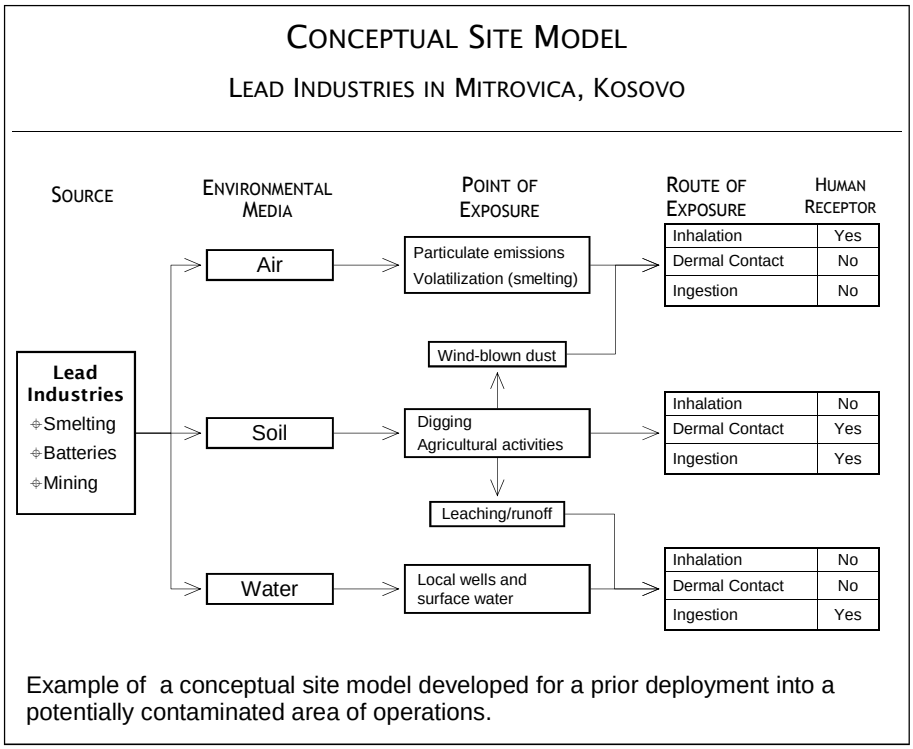
The CSM should be used to develop the sampling and analysis plan (SAP) for the deployed site. The SAP should be discussed in the EHSA report (typically in paragraph 5), or it can be detailed as an appendix to the EHSA. Either way, the SAP should provide a description of the objectives for the sampling and the rationale for conducting the sampling. The purpose of the sampling is to document environmental conditions to validate the CSM and characterize potential exposure pathways. But what does that really mean?

Any sampling done at the site should have a purpose, and that purpose should relate back to the CSM. The CSM shows how a contaminant moves through the environment (air, soil, and water) and to a human receptor through an exposure pathway (ingestion, dermal contact, or inhalation). The sampling to be conducted should focus on those exposure pathways to determine whether they are potentially complete or complete exposure pathways. The goal is to answer the question: does that contaminant exist at a concentration which can pose a health threat to deployed forces? The more detailed the sampling plan, the less opportunity for oversight or misunderstanding during the sampling, analysis, and data management. The confidence in which you can answer that question is related to the detail in the CSM and SAP.

Site Reconnaissance and Interviews

Information from site reconnaissance and interviews is important to verify information collected during the predeployment activities, answer questions about the site, and identify information that was not previously known. In most cases, the ground truth can be very different from what was thought from a thousand miles away. Therefore, it is important to stay objective and make a list of questions that must be addressed once you are on the ground. There are many checklists available from doctrinal manuals, technical guides, and references. Any of these can be used.

However, the best means of both gathering information on the site and conducting the site reconnaissance is through the performance of normal, routine preventive medicine inspections. As preventive medicine professionals, there are a variety of routine inspections and surveys that we conduct that, when evaluated holistically, develop the site picture better than any checklist. Individually, these routine inspections may not seem significant, however, when combined and compared to other inspections, surveys, and reports, the resulting data can be used to identify commonalities between potential exposures. Looking at these inspections across the continuum of preventive medicine support may also help identify what should be accomplished for Deployment Occupational and Environmental Health Surveillance (DOEHS) sampling.



Example of a conceptual site model developed for a prior deployment into a potentially contaminated area of operations.

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL HEALTH SURVEILLANCE SAMPLING

There is a link between the conceptual site model and the sampling and analysis plan. The sampling plan should be based upon the conceptual site model and should support your conclusion. In the conceptual site model, we make an assumption as to whether that exposure pathway ends with a human receptor. This model, or conceptual exposure pathway, remains until we can validate, through sampling, whether it exists as a complete exposure pathway, a potentially complete exposure pathway, or an incomplete exposure pathway— no exposure.

Many of the baseline requirements for DOEHS sampling are identified in policy guidance documents. The minimum requirements for environmental sampling should identify the existing site characteristics and potential areas of contamination. It should be evaluated frequently to ensure that the correct data is collected and adjusted to cover areas that need more attention. The baseline requirements should remain centered on the conceptual site models and potential exposures.

Archiving data collected is important, however, most people only focus on the significant findings or research the data if there is a problem. Although these are important, the most important piece of data and inspection report is the one of negative findings. We often overlook these reports because there was nothing of note, however, these complete the picture of deployment exposures. They are the missing data link. We can identify when there is a problem, but what about the other 99% of the time? Were there any issues? Without the complete picture we will never know. This is why it is important to document your findings, both positive and negative. The EHSA provides a standard format for documenting conditions at a deployment site.

DOCUMENTATION: THE EHSA REPORT

The ASTM standard[1] provides a basic format for the EHSA. This is a suggested format. The conditions on the ground or the nature of the operation may require modifications to the suggested format. Changing the format is acceptable. The emphasis and goal is on documentation of the data; not ensuring that you followed the format. The major components do not necessarily change, however, the details will vary depending on the deployed site.

EHSA Report Format[1]

- Introduction
- Site Description
- Information Sources
- Information from Site Reconnaissance
- Environmental Sampling Data
- Conceptual Site Models
- Conclusion
- Findings and Recommendations
- Technical Assistance
- Appendices
  - References
  - Photographs
  - Site Maps
  - Sample Locations
  - Analytical Data

The EHSA is and must be a living document. Just as we do not conduct an initial inspection and never return to ensure things are still meeting the standard, we should never complete an initial EHSA and file the document away. It should be revisited frequently to ensure that there are no changes and to update findings based upon newly discovered information. The same applies to the conceptual site models and exposure pathways. Are they still valid? Are there changes to the mission or situation that potentially affect the assumptions or route of exposure? Only through routine review can such issues be addressed.

Archiving the EHSA can also provide a later rollup of the preventive medicine activities conducted at a deployed location. It can serve as an historical report and a transition book for the upcoming rotation.

CONCLUSION

The DOEHS sampling should be conducted at all major FOBs and other troop locations. Documentation of baseline conditions and routine surveillance should continue in accordance with current DoD guidelines and policies (eg, *DoDI 6490.03* [2]). The EHSA provides the means and an approved standard for the documentation of baseline conditions and potential exposures to deployed forces. It can also serve as a

tool for preventive medicine units and personnel during their transfer of authority by providing documentation of environmental conditions and potential issues at each base or support area. The EHSA is not a complicated or mystical process that requires an advanced degree. It is designed to be a tool for all preventive medicine personnel, and provide a standard, logical process for our profession to document what we already do to protect the health of deployed Soldiers, Sailors, Airmen, and Marines.

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AUTHOR

LTC Bosetti is Chief, Environmental Engineering Division, US Army Center for Health Promotion and Preventive Medicine-Europe, Landstuhl, Germany.

Archiving Data and Reports

SUBMIT DIRECTLY TO DOEHRS DATA PORTAL
http://doehrswww.apgea.army.mil/doehrs-oehs/
Any user with a military (.mil) domain email address

DOEHS DATA SUBMITTED VIA EMAIL
Data may be submitted to the following address
Unsecured: oehs@apg.amedd.army.mil
or
Secure: oehs@usachppm.army.smil.mil

DOEHS DATA SUBMITTED VIA MAIL
Deployment Data Archiving and Policy Integration Program
USACHPPM ATTN: MCHB-TS-RDD
5158 Blackhawk Road
Building E-1675
Arlington Proving Grounds, MD 21010-5403

FAX: (C) 410-436-2407 DSN 312-584-2407

USACHPPM
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Water Purifiers for the Warfighter

MAJ William J. Bettin, MS, USA

Warfighters need ample supplies of safe, drinkable water to fight and win on the battlefield. In cases where they do not have access to drinking water provided by military sources, they must rely on emergency individual water purifiers (IWP) to meet their drinking water needs. Current military-issued emergency water purifiers work slowly, and may produce microbiologically unsafe water. Commercial vendors have marketed alternate purifiers to the military, but none have been systematically tested by military agencies.

To remedy these shortcomings and to better protect Warfighter health, the US Army Center for Health Promotion and Preventive Medicine's (USACHPPM) Water Supply Management Program recently performed an in-depth performance and health risk assessment of commercial off-the-shelf individual water purifiers in order to develop simple, direct recommendations for the Warfighter. The USACHPPM has presented the results of this study, and created an internet accessible database of commercially available IWPs.*

PROBLEM BACKGROUND

Water supply obviously remains a critical requirement for force sustainment on the battlefield—Warfighters need ample supplies of safe, drinkable water to fight and win. Emergency IWPs are an important component of water supply. Currently fielded individual water purification options for the Warfighter include iodine tablets and chlor-floc tablets. Neither method fully meets the needs of modern Warfighters in terms of ease of use, volume of water produced, or confidence that the final product is microbiologically safe. Many small, hand-operated water purifiers, including both filtration and disinfection-based devices, have been commercially developed in recent years for campers and hikers.

Although military units have used unit funds to purchase commercial purifiers for deployments (in some cases individual Warfighters have even purchased their own purifiers), their selections have been primarily based on packaging and marketing, rather than a science-based, systematic assessment of device performance in a military environment. Lack of such an assessment has placed the Warfighter at risk of contracting waterborne diseases through the ingestion of waterborne pathogens. The USACHPPM recognized this risk through the many requests from deployed units and individuals for recommendations. Its resulting assessment was sponsored by the office of the Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health, and then funded by the Army Study Program.

RESULTS

No matter the methodology employed, ultimately the IWP must provide safe drinking water. In evaluating the safety of IWP-produced drinking water, the USACHPPM study made exposure assumptions regarding population and duration. The study team

*http://usachppm.apgea.army.mil/WPD/

assumed that only the deployable military population would use the IWPs, and that this population would only use them infrequently and for short periods of time. Based on these 2 assumptions, the most significant risk to Warfighter health in using an IWP is the risk from ingesting water-borne microbial pathogens. Thus we evaluated an IWP's ability to provide safe drinking water in terms of its ability to reduce the number of active pathogens in water to a safe (noninfectious) level.

For our test standards we used the test protocol metric widely accepted in drinking water science and in the drinking water industry: a safe level of pathogen removal equates to 6-log (99.9999%) removal of bacteria, 4-log (99.99%) removal of viruses, and 3-log (99.9%) removal of parasitic cysts. Thus a "best" IWP should meet this pathogen removal metric. The study found that few commercially available IWPs could meet this metric. Most commercial IWPs reduce pathogens based on one of two primary mechanisms, either filtration or disinfection. Each has inherent technology limitations to meeting the best pathogen reduction metric.

Filter-based IWPs reduce pathogens in water through size exclusion. They generally do well at reducing the larger pathogens, bacteria and cysts, from water, but do not reduce the smaller viral pathogens to safe levels. Many filter-based IWPs evaluated in this study could successfully remove bacteria and cysts. A small number also showed promise of viral reduction through adsorption on a proprietary filter medium, but require further independent testing to verify the capability. One filter-based IWP was commercially packaged with disinfectant drops as a second purification step, and successfully met the best purifier pathogen reduction metric.

Disinfectant-based IWPs kill or inactivate microbial pathogens in water, thus rendering them noninfectious. Chemical disinfectants generally reduce bacteria and viruses well, but struggle to reduce the tougher, more chemically resistant parasitic cysts to safe levels. Even at high chemical dose and long treatment time, IWPs based on chlorine or iodine could not safely reduce *cryptosporidium*, the toughest of the pathogens. However, at proper dose and treatment time, the chlorine dioxide-based IWPs could kill *cryptosporidium* and meet the best IWP metric for pathogen reduction.

Beyond reducing pathogens, a best IWP also had to be small and lightweight, purify quickly, purify turbid (cloudy) waters, not make the water smell or taste bad, be simple to use, and be durable under field conditions. The study found that choosing a best IWP involves inherent tradeoffs between these characteristics because no single IWP received the highest rating for each. The required tradeoff is usually based on the primary pathogen-reducing technology of the IWP, either filter or disinfectant. For example, disinfectants are inherently small, lightweight, and simple to use, but purify slowly and leave water with an unpleasant chemical smell and taste. Filters purify quickly and can reduce bad tastes, odors and turbidity, but are bigger, heavier, and more complex to use than disinfectants.

Overall, the study team assessed 68 IWPs produced by 27 different manufacturers. Of these, 53 used filtration as the primary means of pathogen reduction while 15 used disinfection. The results were packaged by USACHPPM and made available as a web-based IWP decision tool* to help Warfighters make IWP choices that better protect their health. This decision tool contains a comparative, searchable, relational database of the technical specifications, operating characteristics, and the pathogen removal capabilities of available commercial IWPs as evaluated by USACHPPM.

DATA COLLECTION AND EVALUATION

To identify and collect IWP data, the USACHPPM study team conducted an extensive market survey of commercially available IWPs that could be purchased by units or individual Warfighters. As part of this survey, the team attempted to contact all identified IWP manufacturers to request detailed technical information and performance test data. Manufacturers were informed of the nature of assessment as the basis for the request. Only publicly available product information was collected for the IWPs of those manufacturers that did not respond.

The evaluation of IWP pathogen reduction capability by USACHPPM was a key part in the development of database information. Laboratory testing results were critical to a high-confidence evaluation of this capability. The study team made deliberate and

*http://usachppm.apgea.army.mil/wpd/comparedevices.aspx

exhaustive efforts to locate and review all available laboratory test results showing device efficacy at pathogen reduction. The team evaluated the quality of test data based on these characteristics:

1. How closely the testing followed an applicable test protocol
2. The degree of independent, third-party status of the testing organization
3. The degree to which testing was conducted in accordance with manufacturer-specified device operating conditions
4. The degree to which testing was device-specific, versus based on technology or product family similarities

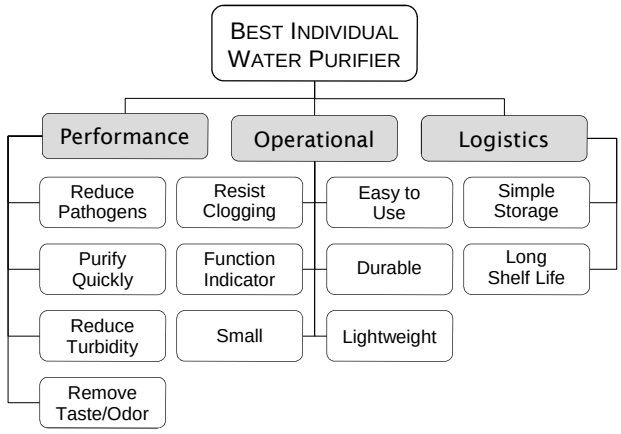
EXPERT PANEL SUPPORT AND MULTIATTRIBUTE ANALYSIS

As part of this study, USACHPPM also developed specific scenario-dependent recommendations for best IWPs. The study team developed these recommendations through an operational analysis, followed by a multiattribute decision model analysis performed by 2 multiservice, interdisciplinary, intradepartmental expert panels. To facilitate the decision analysis, USACHPPM also added decision analysis experts to the study team.

To verify USACHPPM's operational analysis and to develop the decision model, the study team first convened a panel of multiservice combat developers, material developers, and logisticians as user-representative experts. The panel included representatives from the US Army Infantry Center, Directorate of Combat Developments; the Marine Corps Combat Development Command; the Army G4; and the Product Manager, Petroleum and Water Systems. This expert panel developed a decision model, shown in the Figure, that identified, defined, and weighted the 12 most important IWP characteristics required for the best IWP.

Next, the study team convened a panel of multiservice water scientists, engineers, and preventive medicine personnel as technical experts to evaluate IWPs against the decision model. In addition to the USACHPPM in-house experts, this panel included representatives from the US Army Tank and Automotive Research, Development, and Engineering Center; the US Army Natick Soldier Research, Development, and Engineering Center; Naval Sea Systems Command; Naval Facilities Engineering Command; and the Air Force Institute for Operational Health. They developed consensus characteristic scores for each IWP. Because there were incomplete data for some IWPs, the expert panel's knowledge, experience, and professional opinion were critically important in technical evaluation to generate IWP characteristic scores.

DECISION MODEL



The USACHPPM decision model used to identify, define, and weight the 12 most important characteristics required for the best individual water purifier.

Overall scores were then calculated using a linear additive approach, in which the converted score for each characteristic was multiplied by its weight, and then summed for all model characteristics.

TEST PROTOCOL DEVELOPMENT

As part of this study, USACHPPM also developed an IWP test protocol. The study team found that there was no single, accepted performance measure by which to assess and compare IWP pathogen removal performance in military operations. Incorporating lessons learned from its technical expert panel and building on related test protocols, the study team developed a military-oriented IWP test protocol to be that single, comparable measure of IWP performance. The significant and unique military-specific components developed for this protocol included:

1. A list of desirable characteristics and operational capabilities that impact device suitability for use in various emergency military field scenarios.

2. The specification that the IWP manufacturer or vendor, together with the equipment testing organization, produce a written, device-specific test plan and forward it for review to the government review agency before testing.

3. An updated discussion and specification of the selection of microorganisms for performance testing.

The study team then engaged NSF International (Ann Arbor, Michigan 48113, 734-769-8010), a recognized, reputable, third-party entity specializing in standards development, product certification, education, and risk-management for public health and safety, to publish the protocol as "NSF Protocol P248 Emergency Military Operations Microbiological Water Purifiers" (Available at: http://www.nsf.org/business/newsroom/nsfremarks/reMarks-spring06.pdf, page 2).

CONCLUSION

The USACHPPM has successfully performed an in-depth performance and health risk assessment of commercial off-the-shelf individual water purifiers in order to develop simple, direct recommendations for the Warfighter. In meeting this project's objectives, USACHPPM continues to support the Global War on Terror, sustaining a campaign-capable expeditionary Army through providing the means to assess and identify safe, effective commercial water purifiers for emergency individual use. It has also supported Army Transformation by identifying sustainment enablers for the Future Force concept of extended autonomous operations.

AUTHOR

MAJ Bettin is Chief of the Field Water Section, Water Supply Management Program, at the USACHPPM, Aberdeen Proving Ground-Edgewood Area, Maryland.

A Guide to Brigade-Level Preventive Medicine: Stryker Brigade Experience in Operation Iraqi Freedom II & III

CPT Stephen A. Lewandowski, MS, USA
CPT Jason B. Faulkenberry, MS, USA

INTRODUCTION

The transformation of traditional Army brigades into modular brigade combat teams (BCT) brings an environmental science and engineering officer (ESEO) and preventive medicine specialist (military occupational specialty (MOS) 68S) to the brigade level. Prior to 2004, doctrine provided organic preventive medicine capabilities at division level or higher. The formation of Stryker brigade combat teams (SBCT) first tested this change, designed to improve force health protection and make the units more self-sustainable. The 3rd Brigade, 2nd Infantry Division (3/2) SBCT and the 1st Brigade, 25th Infantry Division (1/25) SBCT were the first Stryker brigades to deploy, serving from fall 2003 to fall 2005, primarily in Nineveh province in northern Iraq.

Due to this restructuring, the inexperience of many junior ESEOs and MOS 68S personnel filling these authorizations, the wide scope of defined responsibilities, and limited training time prior to deployment, a potential exists for underutilization or misuse of the BCT preventive medicine section. This article provides a general overview and focus to new preventive medicine personnel and informs commanders and medical planners of their expected roles and value to the organization.

BACKGROUND

The BCT preventive medicine section is authorized 2 entry-level personnel, one each of MOS 72D and a 68S10. It is frequently a first assignment for the Medical Service Corps officer who may be direct commissioned with little experience in the Army. The officer will have a degree in a science-based field and may have attended a 9-week specialty training course, Principles of Military Preventive Medicine, following Officer Basic Leadership Course.

Both the ESEO and the chain of command must have a solid understanding of the expected roles and responsibilities for the position. *Field Manual 3-90.6*,[1] which describes tactics, techniques, and procedures for the tactical employment of the BCT, states simply that the preventive medicine section assists unit commanders through sanitary inspections of food service, latrines, and shower points; medical surveillance of field water supplies; and sample collection for potential toxic industrial materials. *DA Pamphlet 40-11*,[2] used with *Army Regulation 40-5*,[3] states that the section provides level II support by means of basic field sanitation, unit field sanitation team training, field screening and presumptive analysis of water supplies, basic pest management and surveillance, focal application of pesticide, and limited medical surveillance. *Field Manual 4-02.17*[4] lists a similar scope of services (discussed as division preventive medicine since the regulation was written prior to the development of brigade combat teams). Although the listed responsibilities alone account for a full workload for preventive medicine when applied across the brigade operational environment, they are not all-inclusive. Most significantly, the preventive medicine team must consider their role in conducting occupational and environmental health surveillance to characterize long-term health threats. With consideration of this wide range of preventive medicine objectives and the importance of implementation, coordination and communication become critical.

COORDINATION

Coordinating the brigade preventive medicine mission can be a complicated task for the ESEO. The ESEO has to work through proper command and technical chains of multiple levels of support. The SBCT preventive medicine section falls under the brigade support medical company (BSMC) as part of the

brigade support battalion (BSB). The BSMC commander is responsible for operating a level II medical treatment facility and providing health service support to all units in the brigade, while the BSB commander provides the core of sustainment for the brigade. These leaders have many other pressing issues and may have to be convinced of the magnitude of preventive medicine priorities. The level of support of the chain of command has a great impact on the ESEO's ability to execute the mission, especially when it comes to avoiding overstrain of additional duties. The extra assignments will always be present in the BSB, with many company-grade officers already pushed out to combat repair teams and a constant need for bodies in the guard towers and the motor pool. On the technical side, the ESEO's relationship with the brigade surgeon is vital. The brigade surgeon serves as the primary advisor to the brigade commander on the health of the brigade. The BCT surgeon section (BSS) integrates the health service support plan with the brigade maneuver plan. Another important contact for mission planning is the support operations office medical operations officer, also part of the BSB. The support operations office manages support operations and is a key interface with supported units.

COMMUNICATION

The difficulty of communication is compounded while supporting the brigade in a noncontiguous area of operations. With the advanced in-theater mobility of the SBCT, the ESEO may have Soldiers to support at a dozen locations or more at distances of over 250 km away. Furthermore, contact with key leaders may be limited by the separation of forward operating bases (FOBs). In Operations Iraqi Freedom II & III, the SBCT BSB and brigade headquarters were based on opposite sides of the city of Mosul. This separation made communication with the BSS more difficult and was a hindrance to involvement with medical planning for future operations and influence on the command. However, a location in proximity of the BSB provided the advantage of available transportation through logistics packages and a greater ability to monitor the distribution of preventive medicine supplies throughout the brigade. The BSB also contains field feeding teams and water purification units that work closely with preventive medicine personnel.

Communications above the BCT level are necessary for situational awareness and support agreements. For technical preventive medicine support, this included communications with preventive medicine detachments assigned in the region, preventive medicine officers assigned to Multinational Corps-Iraq, and the US Army Center for Health Promotion and Preventive Medicine (USACHPPM). Assets from the 224th and 793rd Medical Detachments, although widely dispersed and limited, conducted valuable base-camp assessments in our sector as part of their mission. An Area Medical Laboratory may also be available for support. The next higher headquarters for our SBCTs in Mosul were Task Forces Olympia and Freedom, consecutively. In our situation, neither Task Force Surgeon had an assigned preventive medicine staff, and consequently worked directly with us on preventive medicine issues.

The method of communication within the brigade can also have a big impact on how the preventive medicine mission is received. It is preferable to transmit necessary preventive medicine measures as part of an operations or fragmentary order than to send memoranda of recommendations. Company commanders and first sergeants will make the effort to comply with the order, whereas a memo with suggestions from a lieutenant in the medical company is more likely to be lost to higher priorities. It is in the ESEO's best interest to keep both the command and technical chains well informed of activities and to provide courtesy copies of reports at multiple levels. It is not easy to respond to so many parties, but, on the other hand, these contacts can provide supplies, transportation, and authority. The level of interaction with the different sections (eg, the support operations office or BSS) will vary with each ESEO and BCT depending on individuals' personalities, backgrounds, abilities, and emphasis on preventive medicine. These relationships are important since they determine how the preventive medicine perspective is accepted, as well as the degree of independence given to the ESEO to set priorities.

While the BCT ESEO's mission is to provide direct support to the brigade as the first line of defense against disease and nonbattle injuries, he or she may also be called upon to provide services to units outside of the BCT task organization. In our case, we conducted routine inspections at a logistics support area with a Corps Support Command Combat Support Hospital, and other joint and combined forces adjacent to our primary FOB. SBCT Soldiers would refuel and eat at this location, so there was still a payoff. This

coverage freed the preventive medicine detachment to cover other bases and minimize risks of travel. We also inspected detention facilities, a Multinational Security Transition Command-Iraq training post, and a rest and recuperation pass site. Such adjustments are in line with the guidance of *DA Pam 40-11*:

> In the theater of operations, preventive medicine support is tailored and phased to enhance mission requirements, counter the medical threat, and provide preventive medicine support as far forward as the tactical situation will permit. Preventive medicine resources providing level II, III, and IV preventive medicine support will be employed on an area basis to provide the utmost benefit to the maximum number of personnel in the area of operations.[2]

However, it is advisable to ensure the chain of command is well aware of the requirements and the reasoning behind the decision before engaging in a mission outside of the direct scope of the BCT.

PREDEPLOYMENT

Preventive medicine efforts prior to deployment substantially reduce dependence once deployed and provide for a more sustainable and healthier force. With preparation and training, the ESEO will have a more attainable mission, allowing focus on areas other than basic sanitation. Given a high operations tempo and full training calendar, it is necessary to take advantage of every opportunity. The preventive medicine section should:

- Train field sanitation team (FST) members.
- Evaluate companies for their preventive medicine readiness.
- Inspect the condition of the brigade's water trailers, water purification and distribution equipment, and field feeding equipment.
- Incorporate preventive medicine into field training exercises as much as possible.
- Obtain and maintain preventive medicine medical equipment sets.
- Train to maintain technical proficiency on mission essential tasks and the sustainment of Soldier readiness and survivability.

Once deployment orders are received, preventive medicine can assist planners in the medical intelligence preparation of the battlefield, conduct information briefs to key leaders and Soldiers on preventive medicine measures to counter the anticipated medical threat, and ensure specific measures such as uniform permetherin treatment are fully accomplished. The ESEO has access to a wealth of medically significant information through the USACHPPM Deployment Environmental Surveillance Program and Global Threat Assessment Program as well as the Armed Forces Medical Intelligence Center to aid in the risk management process.

FIELD SANITATION

Basic field sanitation constitutes the most immediate requirement for BCT preventive medicine to prevent acute outbreaks of disease. Soldiers at all levels are responsible for implementing preventive medicine measures and each company is supplemented by a field sanitation team. On paper, the 2-member FST is certified and equipped to supervise the construction of preventive medicine devices, monitor hand-washing, test the unit water supply, ensure food is stored properly, control arthropods and rodents, ensure the proper disposal of trash, and request preventive medicine support for problems beyond their capabilities.

The authors observed variable FST effectiveness throughout the brigades. Adequate numbers of Soldiers received a 40-hour field sanitation team training course sponsored by the multiple preventive medicine units on Fort Lewis prior to deployment. For the most part, however, these trained Soldiers were not fully utilized for preventive medicine oversight. In

Deep pit latrine, Euphrates River Valley

some cases, when questioned in the field, companies were unable to identify their FST members. Additionally, FST members were not always available when needed due to injuries, leave rotations, or company operations from multiple locations. In place of active FSTs, medics from the battalion aid stations often took initiative and served as points of contact for field sanitation. Another challenge was maintaining accessibility of unit FST supplies which would be stored somewhere in aluminum chests. Accordingly, the preventive medicine section received frequent requests for basic supplies such as fly strips and mouse traps. FST supplies are Class II or Class IX items, and units should be directed to obtain them through company supply chains. The ESEO can provide assistance, but should not be expected to act as a supply officer for FSTs.

The life support services provided by contractors on the major FOBs contributed to a sense of complacency regarding sanitation duties. However, even in such a relatively comfortable FOB environment, FSTs were needed to inspect water tanks, control mice and flies, and ensure Soldiers were using the standard military topical clothing insect repellent, among other duties. The true value of the FST became apparent to units moved to expedient outposts, whether in the open desert or urban slums. With the loss of all external support, essential tasks now included the construction and maintenance of field waste disposal devices and close monitoring personnel hygiene. Most Soldiers had minimal hands-on familiarity with the operation of such devices due to restrictions against digging and burning in training areas. Common mistakes included lack of maintenance or failure to cover waste with dirt, air gaps in latrines that allowed filth flies to breed, lack of hand-washing devices at each site, and the location of garbage burn pits in close proximity to or upwind of living areas.

The collection of OEHS water samples at FOB Marez

Occupational and Environmental Health Surveillance

Level III preventive medicine detachments may take the leading role in collecting occupational and environmental health surveillance (OEHS) samples, but brigade preventive medicine should assume that responsibility when operating in remote locations or when resources are limited. These water, soil, and air samples are needed to fulfill directed requirements to document environmental hazards wherever Soldiers may be exposed. The samples also provide data for detailed long-term health assessments to the command, although results will not be immediately available. The BCT preventive medicine must contend with the difficulties of balancing time to develop and implement comprehensive sampling plans with immediate sanitation concerns, and finding ways to ship samples to Germany or the US in a timely manner. Whereas standard field sanitation and hygiene are tasks common to all Soldiers for which the preventive medicine section provides oversight and recommendations, the OEHS mission requires specific technical skills to leverage the sophisticated laboratories available for valid data collection and analysis.

Base Camp Assessments

The preventive medicine section serves as the eyes of the BCT surgeon and chain of command for disease and nonbattle injury issues across the area of operations. The ESEO functions as a “medical scout” in the sense that he or she is the forward preventive medicine asset and can anticipate, recognize, and prioritize health hazards from multiple locations and battle positions. The base camp assessment is the reporting mechanism for summarizing findings from preventive medicine inspections. The exact formats varied, some were up to a dozen pages long, but the checklists ensured all areas of concern were evaluated. The key areas of focus always included food, water, and pest control.

Food service facilities ranged from large, contracted kitchens to mobile kitchen trailers. The contracted facilities generally maintained good practices once trained to the Army standard, as long as they were regularly inspected. Communication could be difficult with staffs comprised of third-country nationals, but the general managers spoke English. One of the biggest problems encountered was the abundance of foreign vendors selling products from nonapproved food sources to Soldiers on the FOBs. Through insistence by preventive medicine and veterinary personnel, FOB leaders eventually placed these sites off-limits to Soldiers. This change took considerable effort since the vendors had well-established relationships on the bases and enjoyed popularity among Soldiers seeking a change from the mess hall and lacking any familiar fast food sources in the region. In addition to violating theater medical policy for unapproved food sources, the cooks at these food stands and restaurants were unaccustomed to our food handling requirements and required considerable oversight. These establishments increased the vulnerability of our Soldiers due to lack of control over the food supply chain and placed a large demand on preventive medicine.

Bottled water was used for drinking, with bulk treated water used for such purposes as cooking and hygiene. The majority of the treated water came from contracted reverse osmosis water purification units (ROWPUs), however, Army ROWPUs were used on a small scale. The initial setup of the contracted units required heavy preventive medicine oversight. Assigned operators lacked experience, the Italian-designed units were not configured for postchlorination, and water testing supplies were lacking. In addition to routine water quality checks, preventive medicine should monitor how the water is distributed to ensure untreated water is not placed in containers marked *potable*, and ensure that water trucks are secured and only used to transport water. Whether for water or food, the ESEO should maintain contact with the government contracting officer representative to report any failures of contractors to meet Army standards or to recognize positive efforts.

Insects and rodents are ubiquitous in northern Iraq. Different nuisance pests seemed to emerge with each change of season. Filth flies, sand flies, mosquitoes, rats, and feral dogs and cats were all cause for health concerns and required pest control measures. The disease vector potential of these common pests increased due to conditions of poor sanitation and improper waste disposal. Pest control was exceedingly difficult at bases within or on the fringe of urban areas due to nearby open sewage, trash piles, and standing water (see related article, page 46). However, the filth flies even surfaced as “camp followers” at previously uninhabited areas with less than perfect sanitation.

Cutaneous leishmaniasis became the most significant insect-borne disease we faced in terms of prevalence and potential effect on the mission. Where infection rates were high, such as the area around Tal Afar, preventive medicine implemented measures to educate Soldiers on avoiding sand fly bites, reduce the animal reservoirs (intensive rodent destruction), and control the sand fly population in coordination with contracted pest control where available.

CONCLUSION

Preventive medicine personnel in the BCT carry a unique skill set and have many varied responsibilities which may not be widely understood. When properly employed, the preventive medicine section can have a significant impact on the health and readiness of the force, helping to ensure that Soldiers are available when and where they are needed most. Command emphasis enables the ESEO to be effective, giving the preventive medicine section the time it needs to complete its surveys and identify problems before they impact the Soldier. The health hazards and priorities in the combat environment continue to change, requiring a preventive medicine section that is agile and adaptive like the Soldiers it supports. In addition to unit field sanitation and OEHS duties, demand is growing for preventive medicine support of civil affairs and security force training missions. All of these factors dictate that the ESEO must communicate extensively with technical and command chains to ensure provision of the best service to safeguard the health of all Soldiers in contingency operations.

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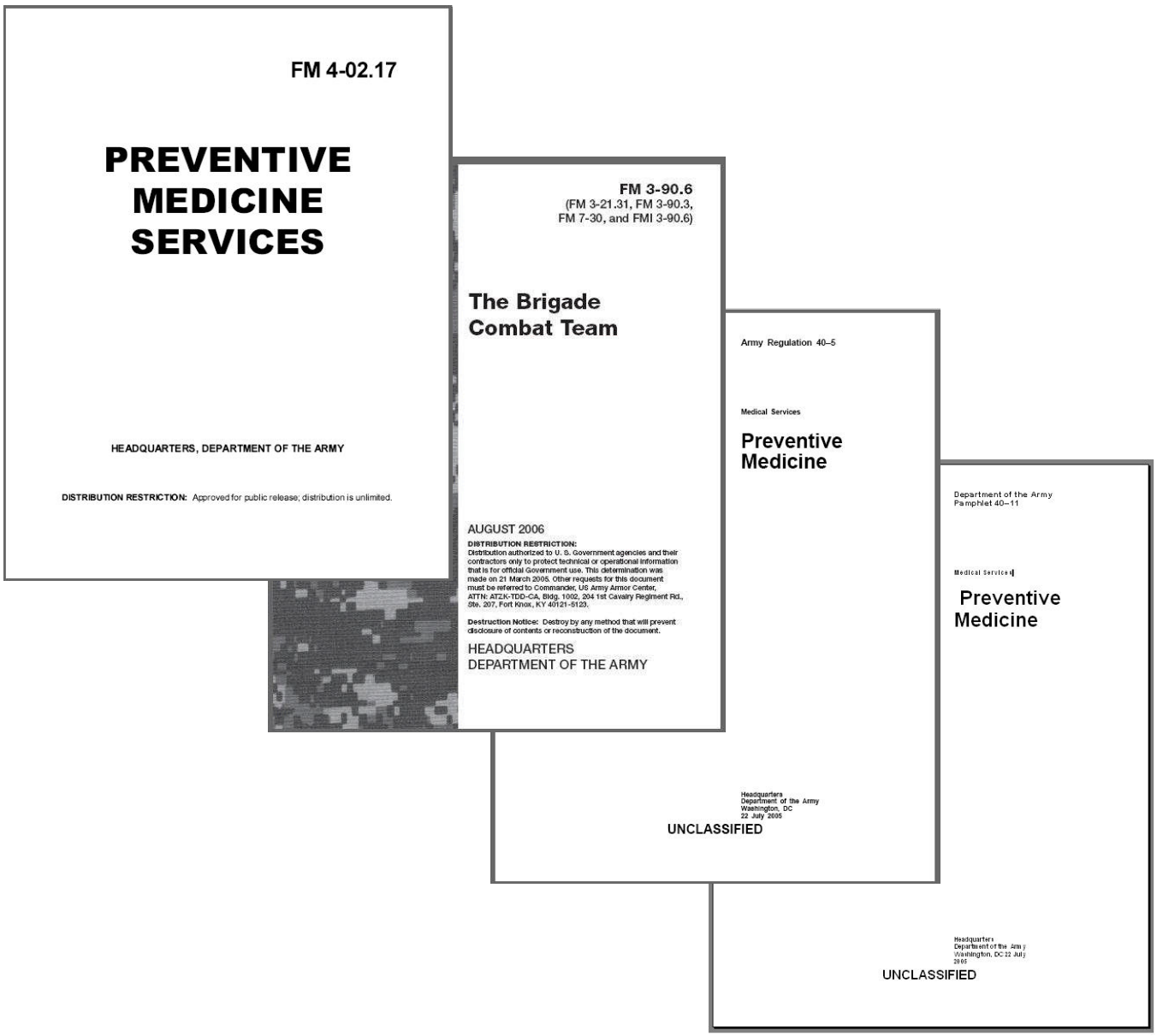
AUTHORS

CPT Lewandowski is Chief, Environmental Health, Dewitt Health Care Network, Fort Belvoir, Virginia. Previously he was Brigade Environmental Science Officer, 1/25 SBCT, Fort Lewis, Washington.

CPT Faulkenberry is Chief, Field Preventive Medicine Division, USACHPPM-West, Fort Lewis, Washington. Previously he was Officer in Charge of Preventive Medicine for the 3/2 SBCT during its inaugural deployment to Iraq.



Measuring Effectiveness of Deployed Medical Detachments

LTC Sonya S. Schleich, MS, USA
MAJ Mark C. Carder, MS, USA

ABSTRACT

The Army Medical Department's (AMEDD) efforts to provide on-target combat health and combat health service support to the Warfighter continue to evolve. Within the framework of modularizing the force, The AMEDD integrated the medical battalion (area support), medical battalion (evacuation), and medical logistics battalion into a single multifunctional medical battalion (MMB), approved by Headquarters, Department of the Army, to support the force commander on the ground.[1] In 2005, the 61st MMB (Provisional), the first of its type, deployed in support of Operation Iraqi Freedom (OIF) 05-07 to provide levels I and II area medical support, ground evacuation, dental, optometry, combat and operational stress control, veterinary services, and preventive medicine.

While deployed during OIF 05-07, the 61st MMB commander employed 5 preventive medicine medical detachments across the entire Iraqi Theater of Operations: the 898th Medical Detachment, 485th Medical Detachment, 255th Medical Detachment, 223rd Medical Detachment, and 903rd Medical Detachment. The number of medical detachments assigned to an MMB is situational and based upon the operational requirements of the combatant commander on the ground. The 61st MMB commander faced a unique challenge in evaluating mission success for the individual medical detachments, as each possessed slightly different capabilities as well as number and diversity of inspections covered within their respective area of responsibility. This article describes an extensive matrix, developed by the medical detachment commanders, to measure mission success and provide a useful tool for the MMB commander.

INTRODUCTION

Currently, 3 types of medical detachment (preventive medicine) Tables of Organization and Equipment exist in the combat health service support force structure. Two types, sanitation and entomology, were developed in support of Medical Force 2000 (MF2K) and consist of 10 personnel and equipment. The third will replace those MF2K types and consists of 13 personnel and equipment under the Medical Reengineering Initiative designed to support combat health service support to the Force XXI Army.[2]

As delineated by the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) *Technical Guide 248*[3] and discussed by Sames et al,[4] the unit responsibilities and scope of essential services required of a preventive medicine medical detachment to maintain and sustain a healthy force include the following:

- Provide assistance in the control of arthropod- and rodent-borne diseases, including technical consultation, entomological surveys and/or investigations, and reinforcement of the unit's organic pest management capabilities.
- Provide assistance in the control of waterborne diseases by monitoring water quality.
- Provide assistance in the control of foodborne diseases by monitoring food service operations and provide guidance to commanders. (The actual function of safety and quality assurance food inspection is a veterinary responsibility.)
- Provide policy guidance and monitoring compliance for immunization, chemoprophylaxis, antidotes, and pretreatment activities and barrier cream use.

- Provide assistance and subject matter expertise in the control of excessive occupational and environmental health (OEH) exposures to such hazards as noise, toxic industrial materials, and climatic extremes.
- Provide assistance to command surgeons in the evaluation of
  - Elements of the medical threat,
  - Risk to the force associated with identified elements of the medical threat, and
  - Integration of the medical threat into planning for and executing force health protection operations.
- Establish a medical and OEH surveillance system which encompasses predeployment medical screening (develop a medical baseline), deployment and surveillance while in the operational area, medical screening prior to redeployment, and follow-up medical assessments upon return to home station.
- Educate troops in disease and nonbattle injury prevention measures, including those measures used to reduce risks from chemical, biological, radiological, and nuclear agents/weapons.
- Train unit field sanitation teams.
- Provide technical consultation on selection and development of bivouac sites, cantonment areas, refugee camps, and enemy prisoner of war/ detainee compounds.
- Conduct field water vulnerability assessments.
- Provide professional and technical advice to commanders at all levels on measures to reduce noneffectiveness from disease and nonbattle injury.
- Report deployment health surveillance and readiness statistics and environmental health data, as required.
- Survey operational environments to detect and identify health hazards and formulate means for minimizing their effects.
- Investigate disease outbreaks and recommend control measures.
- Provide assistance in reducing noise hazards in rest and recuperation areas to nonstressful levels.

The broad scope of responsibilities presented a challenge for each individual medical detachment to measure mission success and prompted the development of the medical detachment preventive medicine matrix.

DEVELOPMENT

The 5 commanders of the 61st MMB preventive medicine medical detachments reviewed several draft matrices. The drafts included lists of all performed inspections and consultations and the assignment of weighted values to specific tasks. The assignment of weighted values and total completed inspections were quickly recognized as inaccurate metrics because of fluctuations in mission set, number of inspections based on the number of facilities, consultations, etc, within each detachment's area of responsibility. A hypothetical example: Detachment A has 20 Army/Air Force Exchange Service food service establishments to inspect within its area of responsibility per month, while Detachment B has 10. A measurement of Detachment A against Detachment B based on the number of inspections performed is not informative. Therefore, the initial preventive medicine weekly report developed by the 30th Medical Brigade Sanitary Engineer was modified and expanded significantly to fully capture and measure weekly mission success and timeliness of completion. The preventive medicine matrix was developed in a spreadsheet format using Microsoft Excel®. The first table in the preventive medicine matrix workbook is a summation spreadsheet that provides an overview specific to the reporting preventive medicine detachment. The first page of the preventive medicine matrix workbook contains unit information: personnel status; logistic status relative to mission essential equipment; a list of supported base camps, forward operating bases, and contingency operating bases; the date last inspected; the number of routine preventive medicine inspections; and occupational and environmental health surveillance (OEHS) and deployed environmental surveillance program (DESP) inspections. The overall preventive medicine risk assessment is based on 6 derivative type inspections which are included within the routine preventive medicine inspections. The overall OEHS risk assessment is based on 2 derivative type inspections which fall under the OEHS and DESP

Base Camp or Forward Operating Base Status (Any Amber or Red Readiness Categories Require Comments)														
Base Camp or FOB	Date of last FOB visit by reporting unit	Echelon II Support Unit	Date of last known FOB visit by Echelon II unit	Routine PVNTMED Inspections							OEHS Incident Response & DESP			
				Food Sanitation	General Sanitation	Field Water Tests	Bottled Water Tests	Waste Disposal	Pest Management Surveillance & Control	Overall PM Risk Assessment	Occupational Health Studies	Environmental or Workplace Noise	DESP	Overall OEHS Risk Assessment
MNF-W*														
Camp 1	6/7/06	BCT-155†	5/27/06	0	0	0	0	2	0		0	0	0	
Camp 2	6/15/06	MAW‡	2/27/06	0	0	0	0	0	0		0	0	0	
Camp 3	6/15/06	MAW‡		0	0	0	0	3	0		0	0	0	

Figure 1. Example of section from Preventive Medicine Matrix Workbook summation sheet showing categories of preventive medicine inspections and risk assessments.

*Multinational Force–West. The summation sheet is for inspections at camps within that area of responsibility. The 485th Medical Detachment was responsible for inspections within MNF-W.

†Brigade Combat Team 155

‡Marine Aircraft Wing.

inspections. The overall risk assessments are ranked based on the number and frequency of satisfactory and unsatisfactory inspections. The resultant action levels are depicted by the colors green, amber, and red, as illustrated in Figure 1. The color green reflects all satisfactory ratings, amber represents minor deficiencies, and red is used for any water sample positive for bacteriological/chemical contaminants, any health/environmental issue that poses an immediate or near-term imminent health threat to personnel, or a failed dining facility at that particular base camp or forward operating base. The remainder of the summation sheet includes information regarding disease outbreak investigations, training provided, and future operations.

The subsequent spreadsheets within the preventive medicine matrix workbook allow the MMB

Forward Operating Base or Camp	Hazardous Material	Hazardous Waste	Regulated Medical Waste	Waste Water	Email Consults	Telephone Consults	Walk-in Consults	Equipment PMCS†	Total Waste Inspections	Total Consults & PMCS†	Grand FOB or Camp Totals
	As Needed	As Needed	As Needed	As Needed	As Needed	As Needed	As Needed	As Needed	Monthly	Monthly	Monthly
MNF-W*											
Camp 1	1		1						2	0	2
Camp 2									0	0	0
Camp 3		1		1		1			2	1	3

Figure 2. Example from Preventive Medicine Matrix Workbook section for the Waste Management category to illustrate derivative inspections that comprise the number reported on the summation sheet.

*Multinational Force–West. The report sheet is for inspections at camps and facilities within that area of responsibility. The 485th Medical Detachment was responsible for inspections within MNF-W.

†Preventive Maintenance Checks and Services.

commander to examine the specific data from the derivative inspections which are presented in the summation spreadsheet. Each of the derivative inspection types are further broken down into several categories, each of which has a column on the spreadsheet. The inspection types and number of categories (in parentheses) include Food (10), General (12), Water (13), Waste Management (8), Vector (21), Epidemiology (8), Industrial Hygiene (8), DESP (10), Consultations (3), Training (10), and Movement (3). Figure 2 is an example of the derivative inspection sheet for waste management.

CAPABILITIES

The medical detachment preventive medicine matrix is a tool for measuring mission success of an individual unit and provides the MMB commander with a snapshot of each unit's workload and accomplishment. In addition, the data contained in each unit's matrix is submitted to the next higher echelon of the preventive medicine support staff within the medical chain of command, oftentimes a medical brigade which will ultimately provide data to the US Army Center for Health Promotion and Preventive Medicine. Members of the brigade preventive medicine staff use the information to identify trends, provide recommendations, and provide information to the theater surgeon as warranted. The benefits of this reporting matrix include:

- Consolidation of reported data.
- Immediate accessibility to detailed information, a numerical presentation of the overall preventive medicine mission set.
- Analysis tool for the MMB commander which can be used on a monthly, quarterly, biannual, or deployed basis to track workload trends.
- Mission success and achieved performance is measured against the individual unit itself with respect to preventive medicine coverage and AOR.

Future improvements to enhance this matrix may include recording the amount of hours/manpower associated with each mission in addition to designing appropriate weighted values that reflect the impact on the at risk population.

Some may argue that this assessment matrix is similar to the "fox guarding the hen house," but disease and nonbattle injuries are a sure indicator of the success, or lack thereof, a unit achieves in its preventive medicine mission.

CONCLUSIONS

The preventive medicine matrix proved to be an excellent tool, not only for the 61st MMB commander to measure mission success, but also for use by each individual medical detachment commander in support of OIF 05-07. With appropriate modifications, the matrix can be tailored to other deployments, contingencies, and garrison environments to reflect the mission set of an individual unit. The preventive medicine reporting matrix is under evaluation for inclusion in the Army's new MMB Field Manual.

ACKNOWLEDGEMENT

We thank the following dedicated professionals for their assistance in the preparation of this article:

- LTC Scott Wright for providing the initial baseline preventive medicine reporting format.
- LTC William B. Grimes, Commander, 61st MMB for critical review and editorial comment.

For assistance with the initial matrix format during the OIF 05-07 rotation:

- MAJ James T. Flanagan, Jr, Commander, 223rd Medical Detachment
- CPT Darryl A. Forest, Commander, 255th Medical Detachment
- CPT Charles B. Raymond, Commander, 903rd Medical Detachment
- MAJ James J. Meckel, Commander, 898th Medical Detachment
- CPT Lewis Long, Executive Officer, 223rd Medical Detachment

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Authors

LTC Schleich is the Executive Officer and Chief, Entomological Sciences Division, USACHPPM-West, Fort Lewis, Washington. Previously, she was the Commander of the 898th Medical Detachment, Baghdad, Iraq.

MAJ Carder is the Commander of the 485th Medical Detachment, Fort Polk, Louisiana. Previously, MAJ Carder simultaneously served as both the 485th Medical Detachment Commander and was the Environmental Science Officer for the 61st MMB, Balad, Iraq.

Crest of the 61st Multifunctional Medical Battalion

Challenges of Effective Vector Control: Operation Iraqi Freedom 05–07

LTC Jamie A. Blow, MS, USA
CPT Darryl A. Forest, MS, USA
CPT Lewis S. Long, MS, USA
MAJ James J. Meckel, MS, USA
CPT Charles B. Raymond, MS, USA
MAJ Mark C. Carder, MS, USA

The primary focus of vector control operations in support of Operation Iraqi Freedom is protection of the Warfighter and government real property and materiel. Vector control responsibilities focus on the search for and suppression of arthropod and rodentborne disease vectors, entomological surveys and investigations, and pesticide application using military and contractor pest management capabilities. To understand the complexity of vector control operations in Iraq, one must understand the levels of Army preventive medicine support. The first level is the company-sized unit's field sanitation team, composed of 2 Soldiers that have attended a 40-hour team training course on all aspects of basic field sanitation. This small team has very limited surveillance and control capabilities, and only provides support within a company's immediate area. The second level is the brigade and division's organic preventive medicine personnel and equipment. Brigade combat teams (BCT) are staffed with an Environmental Science and Engineering Officer (ESEO) and a few Preventive Medicine Specialists. This small team supports the base camps occupied by the BCT's subordinate companies. They have limited vector surveillance and control capabilities, but are able to identify problems and request assistance when necessary. Division level preventive medicine has a senior ESEO who provides assistance to the BCT ESEOs and coordinates with other nondivision preventive medicine assets in theater. The third level is the medical detachments that provide area support within a specified area (eg, northern Iraq) and report to the medical task force. The medical detachments have a military entomologist and more vector surveillance and control capabilities. The entomologist provides advice and recommendations on all aspects of pest surveillance and control measures within their area of responsibility. In addition, there is a senior entomologist located at the medical task force headquarters who provides guidance on vector surveillance and control within the theater, and coordinates efforts when needed.

Adding to the complexity of the situation is the reality that vector control is only one aspect of the overall preventive medicine mission. Preventive medicine personnel at all levels are also responsible for the inspection of food service facilities, including AAFES food concessions, monitoring water supplies, testing bottled water, vector surveillance, noise surveillance, sanitation inspections, investigations of food or water borne illness outbreak, and the provision of other industrial hygiene, occupational, or environmental health surveillance activities as required. Initially, preventive medicine personnel were the only ones conducting both pest surveillance and control measures. A pest control contractor was hired as the theater matured. Pest control activities are now performed at most camps by either a full or part-time DoD or state certified vector control contractor employee. The contractor provides all the pesticides, application equipment, and certified personnel in accordance with the requirements specified in the contract. Their pest controllers work in close coordination with their local preventive medicine personnel to identify problems, conduct surveillance, look for integrated pest management options, and implement appropriate control measures.

As camps have grown, so have vector surveillance and control efforts. In most camps, personnel are now sleeping, eating, and working in climate controlled buildings, thereby reducing the number of arthropod bites. Control efforts have expanded to meet the new demands of the more permanent facility environment,

and the expectations of the deployed personnel. Fly and rodent control and nuisance pest issues (ants, spiders, etc) have become larger issues as the camps have become semipermanent and personnel are less tolerant of pests. Surveillance for mosquitoes and sand flies continues to be an important mission due to the threat of malaria and leishmaniasis transmission. The use of ultra low volume (ULV) applications of pesticides continues to be a primary control method for mosquitoes and sand flies, although mosquito larvacides and application of residual pesticides to resting sites are also used. Also, the efficacy of one type of commercial insect trap was evaluated in some locations. Feral animals are a constant problem in our camps, and control, including bird control, continues to be an ongoing issue. As we use existing structures, the birds resident in them are causing concerns about personnel health.

MOSQUITO AND SAND FLY SURVEILLANCE AT VICTORY BASE COMPLEX

Victory Base Complex (VBC) is composed of several base camps located around the perimeter of the Baghdad International Airport. The 898th Medical Detachment was responsible for devising and sustaining one of the largest and most comprehensive surveillance initiatives to date during a deployment operation. Under the guidance of their commander, the Soldiers of the unit diligently set, maintained, and retrieved 30 Centers for Disease Control and Prevention light traps within the perimeter of the VBC. Over 10,700 specimens were collected, identified, and processed from 1 April through 30 September 2006. All trap catches were sorted, and mosquitoes and sand flies identified to genera. The resulting distribution by genus is illustrated in Figure 1.

Light traps were emplaced in the late afternoon with sensors set to activate at dusk for routine surveillance.

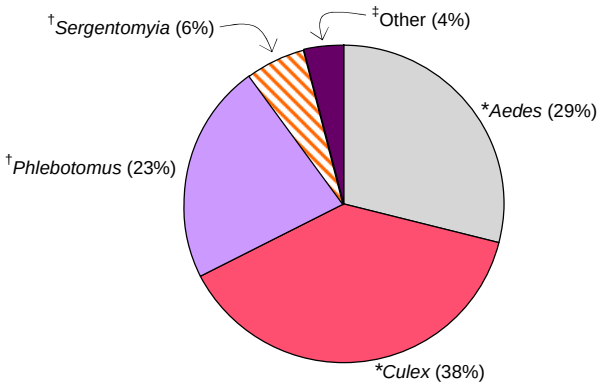


Figure 1. Breakdown of the 10,700+ mosquitoes and sand flies caught in light traps at Victory Base Complex, Iraq between 1 April and 30 September 2006.
*mosquitoes
†sand flies
‡mosquitoes: *Uranotaenia* (4), *Culiseta* (194), *Anopheles* (17)

Each trap catch for a single night was handled as a discrete set throughout the collection, processing, shipment, and pathogen detection process. Each trap catch was sorted into male mosquitoes, female mosquitoes, and sand flies. Sand flies, both male and female, from a single trap catch were sorted into pools of no greater than 100, each of which was then placed in a vial with approximately 1 ml of 100% ethyl alcohol. Female mosquitoes from a single trap catch were sorted to genus (ie, *Anopheles*, *Culex*, *Aedes*) and placed in 2 ml vials with no preservative (no more than 10 specimens per vial). All samples were labeled and processed for pathogen testing in accordance with the US Army Center for Health Promotion and Preventive Medicine (USACHPPM)-North and Multinational Coalition-Iraq established protocols, then shipped to the USACHPPM-North for malaria, leishmaniasis, and West Nile virus pathogen detection. Remarkably, of the 10,700 specimens tested, there were no positive identifications.

The 898th Medical Detachment fostered a close working relationship with the VBC vector control personnel while conducting entomological operations. The initial action threshold was determined to be 25 mosquitoes and/or 15 sand flies in a single light trap in

a single night. This initial action threshold was based on limited historical information and personal knowledge of both the entomologist and vector control personnel. The threshold could be subsequently adjusted higher or lower based on trap collection numbers, collection of sand flies or mosquitoes that tested positive for malaria, leishmaniasis, or West Nile virus, and customer complaints. When the action threshold established for a trap site was reached, a plan was devised in coordination with vector control supervisors involved residual pesticide application to potential resting sites and ULV application to the area of the trap site that required treatment. Typically, after a late night ULV application, the trap numbers were noticeably lower for the next week. As the season progressed, temperatures increased and rain tapered off, with resulting decreases in mosquito trap numbers and increases in sand fly populations, as anticipated. Figure 2 depicts the total numbers of mosquitoes and sand flies, per collection, from traps located around VBC from the start of the mosquito season in early April until the end of the season the end of October.

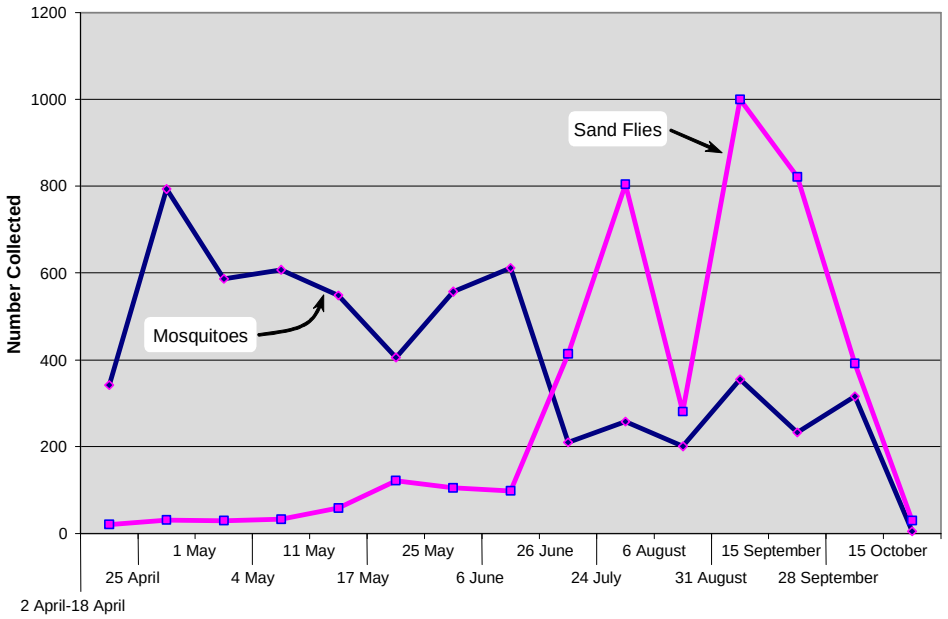


Figure 2. Chronological depiction of the numbers of mosquitoes and sand flies gathered from traps located around the Victory Base Complex, from the start of the mosquito season in early April until the end of the season in late October. (2006 data)

The greatest challenge of operating a comprehensive surveillance system on VBC was balancing the manpower requirements of the daily mission of sanitation, environmental and vector surveillance with the need to respond promptly to emerging situations. The preventive medicine specialists always managed to balance all the missions while providing the best support possible to personnel.

The surveillance data is currently being analyzed by individual light trap location. The data among the light trap locations will be compared in an attempt to determine if there are indicators for specific areas within the VBC which may be prone to harbor arthropods of military importance.

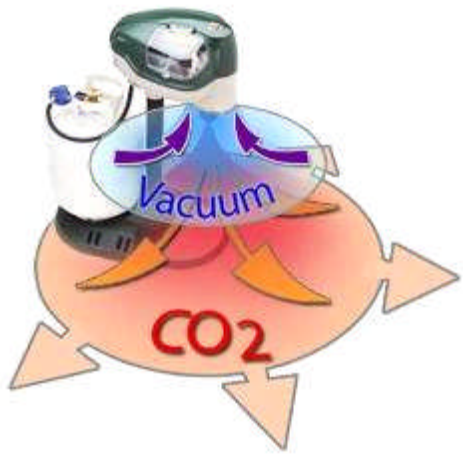
MOSQUITO MAGNETS®

Balad Airbase, also called Logistic Support Area (LSA) Anaconda, is surrounded by an irrigation canal fed by the Tigris River. Although the canal is a steadily flowing body of water, it has many areas of stagnated and/or still pools where many aquatic plants can grow up to 8 feet. This tall dense vegetation along the shores of the canal make an ideal breeding site for many blood-feeding flies and is located in very close proximity to thousands of deployed personnel. The 255th Medical Detachment had the monumental task of protecting the base personnel from this threat and worked closely with the supervisor of the contractor vector control operations on LSA Anaconda.

Due to the extensive breeding grounds just outside the base, the use of ULV pesticides had been substantial in previous years. In an effort to reduce ULV pesticide application, the contractor purchased approximately 50 Mosquito Magnets* in 2003 to use as a control measure. The Mosquito Magnet works by producing the very same characteristics (CO_2, heat, moisture) that a mammalian host would emit. In order to reproduce, female mosquitoes must find a suitable host to obtain a blood meal. They have finely tuned sensors that aid

*American Biophysics Corp, 140 Frenchtown Road, North Kingstown, Rhode Island 02852

them in finding a host by detecting carbon dioxide, warmth, certain plant chemicals, and sometimes even sweat (moisture) chemicals.[1] Using these sensors, mosquitoes found an abundance of prime blood sources among all the personnel located at Balad Airbase.



The Mosquito Magnet® uses propane to produce CO_2 and heat to attract insect vectors which are caught in the vacuum and deposited in the collection bag.

The Mosquito Magnet produces CO_2 by burning propane gas, which contains carbon and hydrogen, producing carbon dioxide and water vapor. However, the newer models of the Mosquito Magnet incorporate an interesting twist on the burning process. Instead of a flame, the propane is burned catalytically, using the same idea as that used in the catalytic converter on a car. The propane flows to the catalyst—a set of ceramic beads or a ceramic grid coated with platinum. The catalyst converts the propane directly to heat, carbon dioxide, and moisture without actually needing a flame. The advantage of this system is that you can catalyze very small quantities of propane over a long period of time without having to worry about the flame ever going out. In addition, there are no worries about other gases, like carbon monoxide or nitrogen oxides, being produced by the flame. The lack of a flame also reduces the risk of fire. By itself, the CO_2 was found to be inadequate, so a cartridge that contains either octenol (a generic molecule that simulates plant chemicals) or Lurex* (a proprietary mixture that simulates sweat chemicals) was added. These chemicals act as strong attractants for different types of mosquitoes. Lurex-type chemicals work best on the Asian tiger mosquitoes, while octenol works best on mosquitoes which are native to the United States. By mixing the chemical attractant with the carbon dioxide and moisture, then emitting the warm mixture into the surrounding air, the trap creates a plume of gas that mosquitoes find irresistible. They will fly upwind to follow the plume to its source. When the mosquitoes get to the mosquito magnet, they encounter a vacuum created by a fan and are sucked into a net bag, where they dehydrate and die.

The contractor had started the Mosquito Magnet control program in 2004 with mixed results. However, in 2005, they increased the number of devices and improved the placement based on 2004 data. The numbers were incredible; over 1.3 million mosquitoes and 600,000 sand flies were caught between April–Nov 2005. In 2006, the contractor and the 255th Medical Detachment continued the mosquito/sand fly control program. First, they initiated an aggressive larval control program on the interior of LSA Anaconda. This was done by using both Altosid† briquets, Altosid liquid, and methoprene mosquito dunks in storm drains, unused sewer lines, and areas of standing water. Additionally, the number of Mosquito Magnets was increased inside the fence line along the perimeter of LSA Anaconda and their spacing was modified so they were approximately one acre apart.

Some of the insects captured by the Mosquito Magnet® traps emplaced around LSA Anaconda.

This was done in an attempt to overlap the magnets' attracting range to ensure maximum coverage. The 2006 results were outstanding, approximately 1.5 million mosquitoes and 800,000 sand flies were

*American Biophysics Corp, 140 Frenchtown Road, North Kingstown, Rhode Island 02852

†Wellmark, International, 1501 E. Woodfield Road, Schaumburg, Illinois 60173

trapped, and complaints were almost nonexistent. Anecdotal evidence* indicated that the strategically placed Mosquito Magnets, in conjunction with an aggressive larvacide program, appeared to significantly reduce the number of blood-feeding diptera on LSA Anaconda.

ULV OPERATIONS

The ULV sprayer is the primary weapon utilized to suppress adult sand fly and mosquito populations in Iraq. However, without the insecticide, the ULV would be useless. Pesticides are hazardous materials (HAZMAT) and shipping them halfway around the world is not an easy endeavor. The first major complication is that special training and certification are required in order to containerize, load, and ship the pesticides. There are specific requirements for documenting the HAZMAT being shipped which include material safety data sheets, declaration documentation, spill response and contingency plans, safety requirements, and load plans. The documentation is complicated and the volume is staggering. Units are required to have HAZMAT handlers and certified personnel in order to expedite the material transport process. However, the process is worth the effort once the insecticide arrives and vector suppression operations begin.

The second major complication is the sheer volume of pesticides required and the different restrictions of shipping classes. As a basic planning factor, preventive medicine personnel should plan for 8 weeks of sustained operations before resupply. This is the factor recommended if the theater of operations is not developed logistically. Obviously, less may be required based upon the intelligence gathering from the battle space prior to deployment. It should also be noted that certain classes of insecticides cannot be shipped in the same container due to reactivity. Another factor to consider is that clothing, tools, and field gear should not be shipped with insecticides. These factors will increase container requirements, as well as tracking considerations for those containers.

A third complicating factor is that the lead acid batteries required to run the ULV sprayer most commonly used in Iraq by US forces, the Beecomist 15MP[†] are considered HAZMAT.

Once in theater, ULV sprayer maintenance is required on regular intervals and will require more vigilance and extensive attention to detail. Two areas of particular concern are static build up and battery charging. In hot dry climates where electrical devices are used, static electricity can become an issue if equipment is not properly grounded. This is especially true for ULV sprayers mounted in trailers which are subsequently towed by HMMWVs[‡] during pest control operations. Attention must also be given to battery maintenance and charging. Regular use of a voltmeter to check the vehicle alternator output is recommended to ensure the vehicle batteries are being adequately charged. A check of the onboard ULV sprayer battery prior to and after operation is also recommended to ensure it is not depleted. Finally, environmental conditions must be taken into consideration. Dusty, hot, and windy operating environments require that the ULV sprayers be dusted and/or rinsed after each mission to ensure maximum equipment operating life. Although the topics discussed here are not the result of an epiphany and seem painfully obvious, if they are not followed, the mission will not be accomplished. These comments are based on the experiences of several preventive medicine detachment commanders since the beginning of operations in Iraq in 2003.

ANIMAL CONTROL

Not only do feral and wild animals pose the danger of animal bites and potential disease (rabies) transmission, but perhaps more importantly for Soldiers in deployed environments, they can act as reservoirs for various vector-borne diseases (eg, leishmaniasis). Therefore, animal control should be part of any comprehensive preventive medicine plan intended to protect US troops and preserve combat power.

The contractor does the vast majority of animal trapping on camps throughout the Iraqi theater of operation, but is prohibited, by contract, from euthanizing captured animals. When available, US

*The vector control supervisor at LSA Anaconda related that complaints and requests for mosquito and/or sand fly control were averaging 16 to 18 a month prior to the Mosquito Magnet control program. Once the program was in place and fully operational, the number of complaints fell considerably to 3 or 4 a month, and those were primarily from temporary housing areas for personnel awaiting redeployment or assignment to permanent quarters.

[†]Clarke Mosquito Control, 110 E. Irving Park Road, Roselle, Illinois 60712

[‡]High mobility multipurpose wheeled vehicles

military veterinary personnel perform the required euthanasia, however, they are not present on all camps and the 903rd Medical Detachment personnel assumed the euthanasia mission. Several forms of euthanasia were authorized in theater based on guidance from the theater veterinarian. The preferred method of control was through the use of euthanasia drugs. Nonveterinary personnel received training in euthanasia procedures and handling and accountability of euthanasia drugs. Once trained and approved by a veterinarian, they were provided with a supply of ketamine and sodium pentobarbital (which were treated as controlled substances). In the absence of personnel trained in administering euthanasia drugs, the use of kinetic means was also authorized and continued to be used for large, potentially dangerous animals, as that method was judged safer than attempting to hold and close with the larger stronger animals. The same personnel handled all euthanasia duties during the deployment, and were responsible for the humane elimination of nearly 200 animals at Camp Echo alone.

Native wild animals that were occasionally captured included small-to-medium-sized predators such as this fox.

Not all animals captured by the contractor required euthanasia. Wild animals, if healthy, were generally released outside the compound. After the presumably unpleasant experience of spending the night in a cage, and the appearance of humans the following morning, wild animals were seldom recaptured. These included native foxes, sand cats, African pygmy hedgehogs, and occasionally large birds such as black francolins. Healthy feral dogs and cats, upon first capture, were marked by a spot of orange paint on the flank or tail, and released outside the camp. If marked animals were recaptured a second or third time, they were deemed inveterate pests and, for the safety of camp personnel, humanely euthanized. To reduce the potential spread of illness and/or parasites to either camp personnel or native animals, ill or unhealthy animals were euthanized upon initial capture.

A sand cat communicates displeasure at its temporary captivity. Most captured native wild animals, including this cat, were released outside of the perimeter.

Complete control is not always desirable for some species. For example, intensive control efforts by the contractor and the 903rd Medical Detachment virtually eliminated the feral feline population at Camp Echo. An increase in rodent and then in snake populations over the following months was indicated by customer complaints and visual surveys. Though anecdotal, the situation illustrates the sometimes confounding relationships between targeted pest species. Presumably, the elimination of a key predator allowed rodent and reptile populations to quickly increase and the larger rodent populations possibly attracted (and maintained) additional snakes in the camp perimeter. Consequently, control measures relative to the cat population were relaxed, and the number of cats allowed to increase to a level deemed adequate for natural rodent control, and subsequent control efforts were aimed at maintaining the population at that arbitrary level.

Bats discovered in bunkers at Camp Echo presented a special problem. First, although the presence of bats in structures is generally undesirable, like feral cats, these flying mammals perform a valuable and beneficial function. Many species of bats are insectivorous and hunt at dusk and during the evening hours, when most

flying blood-feeding insects are active. A single bat can consume 400 to 1,200 mosquitoes and other insects in an hour. Few natural predators are more effective at reducing night-flying insect populations.[2] Also, at least 5 species are listed on the "Iraq Red List" as protected or threatened in Iraq: the Greater Horseshoe Bat (*Rhinolophus ferrumequinum*), the Mediterranean Horseshoe Bat (*R. Euryale)*, Mehely's Horseshoe Bat (*R. mehelyi)*, the Long-fingered Bat (*Myotis capaccinii)*, and the Sind Bat (*Eptesicus nasutus*). Therefore, to conserve valuable predators and avoid the difficulties inherent in attempts by nonexperts to differentiate between protected and unprotected species, nonlethal control of bat populations was pursued. The most practical, and humane, approach was to block available openings in vacated buildings and bunkers after the bats left for their nightly feeding forays to prevent their return. If the openings were blocked while bats were inside, they would starve, producing environmental hazards in the forms of carcasses that are difficult to recover. Parasites would then leave recently-deceased bats and seek the nearest warm-bodied host. In addition, the contractor constructed bat boxes which were installed at suitable locations around the camp to provide alternative roosting sites, and possibly attract additional bats.

While there is little health hazard associated with free-living healthy bats, many personnel expressed a distinct fear or distaste of bats, particularly if encountered inside living and working areas. In addition, bats are commonly associated with rabies by the general public, even though the best available evidence indicates that less than 1% of all bats are infected with the virus.[3] Bat-transmitted rabies is very rare, less than one case per year in the United States. Public education efforts can alleviate some of these concerns.

Animal control is an integral part of the overall preventive medicine responsibility. Flexibility, adaptability, and the willingness to "see the bigger picture" are key components of feral and wild animal control in deployed situations. The operating environment may be considerably different from what preventive medicine units are accustomed to (even from deployment to deployment), and unexpected missions may be incurred. Euthanization of feral and sometimes wild animals is a necessary if often unpalatable mission, and, if veterinary units are not available, it is a mission that logically falls on the preventive medicine personnel. The personnel that perform the euthanasia should be volunteers (many find this task abhorrent, objectionable, and/or stressful), and receive training from veterinary personnel in proper procedures for humane euthanasia. There are strict guidelines for storage, accounting for usage, and monthly inventory of any euthanizing drugs maintained by preventive medicine personnel. If a firearm is used, additional ammunition may be required as well as proper accounting for expended rounds. Finally, it is important to keep in perspective the fact that animal control is not synonymous with euthanasia. Healthy wild animals should generally be released (if practical), and preventive medicine personnel should educate themselves on any protected wild species in their area of operations. It may be preferable to permit some species of feral animals to remain at some (arbitrary) population level in order to help control even less desirable pests, as was the case with cats and bats.

BIRD CONTROL

An often overlooked aspect of animal control efforts during deployments is bird control. Birds pose little problem when tents are the primary form of housing or work areas because of the lack of established roosting/ feeding habitats. Bird control problems in these situations are normally limited to birds feeding on trash. As a theater matures, existing hard stand buildings are utilized, bringing with them attendant bird problems. Pigeons are the primary bird pest in Iraq, although sparrows and other birds also contribute to the problem. Pigeons roost on building ledges and roofs, coating the exteriors with feces. Due to poor construction, birds can readily gain access to building attics. Most rooftops are flat, providing excellent roosting sites for birds.

Forward Operating Base (FOB) Spiecher had one of the most significant bird problems in theater due to the large number of damaged buildings. Open air warehouses, hangars, and abandoned/damaged buildings provided ample roosting sites. Personnel and equipment stored in these buildings were often contaminated by feces and bothered by noise from the large populations. Exclusion of the birds from the buildings was impossible due to the numerous openings. Building renovations were often limited to

repairing rooms and ceilings to make them usable, but the exterior structures were not sealed and birds continued to use the buildings. The 223rd Medical Detachment provided support to camps located in northern Iraq, and dealt with the bird control problem at FOB Speicher by persistently removing suitable habitat. This resulted in the decline of the population to smaller, more manageable populations. Razing of other roosting sites resulted in further dispersion of the population, mainly to the hangars.

One of the numerous damaged buildings at Forward Operating Base Spiecher that was infested with birds. Portions of the interior of this building were being renovated for use. Numerous openings made exclusion of birds impossible.

Bird exclusion measures that we would often use elsewhere were not feasible in Iraq, due to the cost and lack of materials. Bird spikes on ledges, window sills, and other roosting sites were costly and required significant manpower to install. Bird netting was not practical because of the large areas that required coverage to reduce access. Further, the birds were not readily startled by loud noises because of the almost constant noise around the base.

Avicides were authorized for use, but only on a limited basis due to limited efficacy and complaints about dead and dying birds on base. Any report of a dead or dying bird immediately caused concern about avian influenza. The use of live traps was considered, however, such measures would introduce the problem of disposition of the captured birds. Removal from the building and release would only mean they would return immediately if the building was not sealed. Contractor personnel where not authorized to kill the captured birds, so, as with other feral animals, it would have been incumbent on preventive medicine personnel to euthanize them. We lacked a CO_2 chamber and the removal of individual birds from the traps to inject them was not considered a viable option. A few pellet guns were used to shoot pigeons to scare them away, but with only limited results. As with the other methods, shooting pigeons would scare them away for a time, but they returned in force. This method also required extensive coordination and was often not feasible in areas where personnel lived and worked. Pigeons are difficult to control even on the best of days, but pigeon control in Iraq is a constant problem compounded by the threat of avian influenza.

Vector control in Iraq presented many unique and difficult challenges. The military preventive medicine team worked closely with the contractor vector control personnel to do an outstanding job of searching for and identifying new and innovative approaches to problems. Through their efforts, Warfighters are protected from vectorborne diseases and environmental hazards that are so detrimental to the performance of their primary mission.

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AUTHORS

LTC Blow is the Brigade Entomologist, 30th Medical Brigade, Heidelberg, Germany. Previously, she was the Pest Management Consultant, Multinational Coalition-Iraq, with the TF-30 Medical Brigade in Baghdad, Iraq.

CPT Forest is an Entomology Project Officer, USACHPPM, Aberdeen Proving Ground, Maryland. Previously he was the Commander, 255th Medical Detachment, Grafenwoer, Germany, and twice deployed to Iraq.

CPT Lewis is the Executive Officer, 223rd Medical Detachment, Ft. Carson, Colorado.

MAJ Meckel is an Entomological Project Officer, USACHPPM-West, Fort Lewis Washington. Previously, he was the Commander, 898th Medical Detachment, Fort Lawton, Washington, during the detachment's deployment to OIF 05-07.

CPT Raymond is the Commander, 903rd Medical Detachment, Beloit, Wisconsin. He was the Commander during the unit's deployment in support of OIF 05–07.

MAJ Carder is the Commander, 485th Medical Detachment, Fort Polk, Louisiana. Previously, he was the Environmental Science Officer, 61st Multifunctional Medical Brigade, Balad, Iraq.

Using DoD Insect Repellent System as a Personal Protective Measure Against Disease Vectors

Throughout the course of military history, more casualties have resulted from disease and nonbattle injuries than from wounds inflicted by the enemy. The bites of insects and ticks transmit many of the disease-causing germs that give our military the most trouble. Don't let yourself be pestered by arthropods, or worse, become a victim of an arthropod-borne disease. These diseases can take you out of the action, make you miserably sick, or even kill you. The diseases and the creatures that transmit them are as much of a threat during routine training exercises or humanitarian/disaster assistance operations as during actual combat.

The DoD Insect Repellent System is available for use by all personnel to prevent arthropod-borne diseases, such as malaria, leishmaniasis, scrub typhus, West Nile virus, and Lyme disease. When used properly, the DoD Insect Repellent System will prevent disease, pain, and the annoyance caused by bites of insects such as mosquitoes, sand flies, and other arthropods such as ticks and chiggers. The following procedures for the repellent system will ensure maximum protection for you while performing routine training exercises or actual missions in areas where vector (insect)-borne diseases are common:

1. Permethrin on clothing. This can be accomplished in any one of four ways. You can use the Permethrin impregnation kit known as the Individual Dynamic Absorption (IDA) Kit (NSN 6840-01-345-0237). One kit treats one entire uniform, and the treatment lasts for approximately 52 washes (generally considered the combat life of the uniform). If the IDA kit is not available, use the aerosol spray can (NSN 6840-01-278-1336). One application of approximately ¾-can lasts 4 to 6 washes. You can also use a 2-gallon, pump sprayer for permethrin application to many uniforms at the same time. This method must be applied by properly trained personnel who protect themselves from the spray with a respirator. You will not be exposed to as much permethrin because the chemical binds with the cloth after it dries. Another recently approved method is to have uniforms (BDU, DCU, or ACU) factory treated. The factory treatment method results in the same chemical concentration as both the IDA kit and the 2-gal sprayer method. Factory treatment is a big advantage because it is more convenient for the individual and the unit, as well as providing a uniform that retains its repellency for the life of the uniform. If a unit contracts to have their uniforms treated, the uniforms will be returned with a label indicating that they were treated with permethrin. The new ACUs are made of the same fabric as the old BDUs and DCUs, so the ACU treatment is the same. **DO NOT** dry clean a permethrin treated uniform, as dry-cleaning solvents completely remove the permethrin, rendering the treatment ineffective. However, a dry-cleaned uniform can be retreated.

2. Deet on exposed skin. Apply a thin coat of the current standard military skin repellent. This product was carefully developed to minimize the amount of active ingredient (35%) and maximize the duration of protection by incorporating the active ingredient into a sustained-release, polymer formulation known as the extended duration topical insect and arthropod repellent (EDTIAR) (NSN 6840-01-284-3982). Apply it to all exposed skin except areas close to the eyes and mouth. Be sure to follow label directions when applying this or any other repellent. One application lasts up to 12 hours, depending on the climate.

3. Properly wear the uniform. Wear the sleeves rolled down and close all openings on your clothing that might provide access to insects. Tuck pants into your boots and undershirt into your pants. The uniform should be loose and not tight fitting so that insects, particularly mosquitoes, cannot bite through the cloth into your skin. Check your clothing routinely for insects and ticks, and use the buddy system to inspect areas of the uniform that you can't easily see.

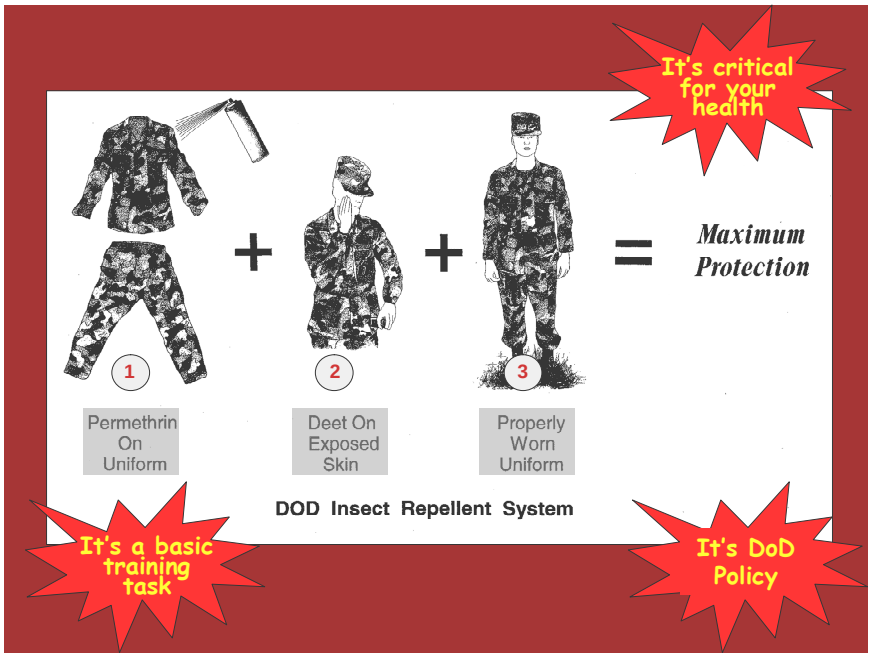
4. Treat bednet. Some insects such as sand flies are smaller and can fit through the mesh of the net. Treat your bednet with permethrin in a well-ventilated area before you bed down. A self-supporting popup bednet is now available (NSN 3740-01-516-4415 [olive drab] and NSN 3740-01-518-7310 [coyote brown]). The new popup bednets are factory treated with permethrin and do not require poles or a separate frame.

5. Malaria pills. There are drugs, known as *chemoprophylaxis*, which can be taken to prevent malaria. Some of these drugs can make a person feel ill, especially when they are first used. Be sure to use only the drugs that are prescribed because an effective drug in one part of the world is useless in another. If you think you are having bad side effects (upset stomach, disturbed sleep, rashes, vision impairment, etc) from chemoprophylaxis, tell a physician as soon as possible.

The DOD Insect Repellent System is critical to the Army's Medical Regiment motto to "Conserve the Fighting Strength." It is a mission essential task located in *STP-21-1-SMCT; Soldier's Manual of Common Task Testing, Skill Level 1* dated 11 Oct 2005. The system is a DoD Policy that every Soldier, Airman, Marine, and Corpsman need to strictly follow.

Additional information on personal protective measures can be found in the Armed Forces Pest Management Board's *Technical Guide 36, Personal Protective Measures Against Insects and Other Arthropods of Military Significance*, which can be downloaded from http://www.afpmb.org/pubs/tims/tims.htm; in the US Army Center for Health Promotion and Preventive Medicine fact sheet on the DoD Insect Repellent System (http://chppm-www.apgea.army.mil/documents/DODInsectRepellentSys.pdf); and in the Army Medical Department Center and School deployment training portal at http://www.cs.amedd.army.mil/deployment2.aspx#.

For further information, contact: COL Debboun (mustapha.debboun@amedd.army.mil [210-221-7649]) and SSG(P) Vincent (andrea.vincent@amedd.army.mil [210-221-6801]), Medical Zoology Branch, Dept of Preventive Health Services, Academy of Health Sciences, AMEDD Center and School, Fort Sam Houston, Texas.



Courtesy of the Entomological Sciences Program, US Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Maryland

Preventive Medicine Support in Afghanistan During Operation Enduring Freedom VI

MAJ Christopher A. Gellasch, MS, USA
CPT Lesly C. Calix, MS, USA

INTRODUCTION

Although US military operations in Afghanistan have been conducted for more than 5 years as part of Operation Enduring Freedom (OEF), the challenges in providing preventive medicine support are not widely recognized by the majority of US military medical personnel. The nature of the climate, terrain, infrastructure, and mission dictated that provision of preventive medicine support was not always according to doctrine.

Terrain and Climate

Afghanistan, located in south central Asia, is 647,500 km^2 (250,000 sq miles) in area, which is slightly smaller than Texas.[1] This landlocked country is dominated by the rugged Hindu Kush Mountains, with plains in the north and southwestern portions and elevations ranging from 258 m (846 ft) to 7,458 m (24,469 ft). Although some US forward operating bases (FOBs) are located at an elevation of 500 m (1,640 ft) above sea level, most are situated above an elevation of 1,500 m (4,921 ft), with some FOBs at elevations approaching 2,750 m (9,022 ft). Higher elevations generally lead to colder temperatures and an increase in cold weather injuries. Altitude sickness is another concern for troops deployed to these high elevation areas.

The climate in Afghanistan is typically dry with hot summers and cold winters. Areas near the Pakistan border are influenced by monsoonal weather patterns that bring significant amounts of rain in short periods of time. The areas of southeastern Afghanistan surrounding Jalalabad and Khowst are classified as a Subtropical Steppe climate.[2] Summer temperatures in Jalalabad reach 46°C (115°F) with high humidity, and winter temperatures normally remain above freezing. Winter temperatures below freezing at Kabul are due mainly to the elevation of 1,791 m (5,876 ft). Many of the FOBs have a climate similar to Kabul because of their high elevations.

Transportation

Transportation infrastructure is limited throughout the country. Only 8,231 km (5,000 mi) of paved roads exist in Afghanistan[1] and most of those are located near Kabul and a few other large cities. The lack of roads combined with the rugged terrain resulted in an almost total dependence on air transportation for movement of military forces between FOBs. Some locations, such as Bagram Airfield, Kandahar Airfield, FOB Salerno near Khowst, and Jalalabad Airfield have runways capable of supporting C-130 aircraft. However, most locations are only accessible by rotary wing aircraft, primarily CH-47 Chinook and UH-60 Blackhawk helicopters. The demand for air transport was high and flights to outlying FOBs were limited to one or two per week. Besides the numbers of personnel vying for transport, a significant amount of space was allocated to mail, equipment, and supplies. Flight operations at higher elevations also reduced the amount of personnel and cargo that the helicopters could carry.

Preventive Medicine Assets in Theater

The dispersed and isolated nature of approximately 18,000 US and Coalition Forces mandated a larger preventive medicine presence than doctrinally specified. The 71st and 480th Medical Detachments (Preventive Medicine) provided support in theater and were task organized under Task Force Strength (comprised mainly of the 249th General Hospital). The 71st Medical Detachment supported Bagram Airfield and the Regional Command (RC) East, based in FOB Salerno. The 480th Medical Detachment supported RC South, based at Kandahar Airfield, and a base at Karshi-Khanabad, Uzbekistan. Two Brigade Combat Teams (BCT) were the primary elements of each RC:

the 1st Brigade, 82nd Airborne Division in RC East and the 173rd Airborne Brigade in RC South. Each BCT had its own Environmental Science and Engineering Officer and one or two Preventive Medicine Specialists (68S). The Medical Detachment and BCT preventive medicine personnel worked together to provide area support within each RC. The technical reporting chain for all preventive medicine assets in theater went through the Combined Joint Task Force-76 (CJTF-76) Surgeon Cell's Force Health Protection Officer. No medical brigade or other higher echelon medical unit was present in Afghanistan. The higher headquarters to CJTF-76, Combined Forces Command-Afghanistan in Kabul, did not have a Surgeon Cell. Reporting of preventive medicine issues went from CJTF-76 to the Coalition Forces Land Component Command.

SUPPORT TO LARGER BASES

Three bases in Afghanistan (Figure 1), Bagram Airfield, Kandahar Airfield, and FOB Salerno were much larger than the others and had populations between 1,500 and 10,000 personnel. The larger bases required a significant amount of man-hours to conduct all required inspections and surveys as they were transportation, logistics, and service hubs with many garrison-type operations. Contractors were responsible for operating dining facilities (DFACs), potable water production, waste disposal, vector control, laundry, and other base operations. Since these locations were transportation hubs, they were ideal locations for preventive medicine units to use as bases of operations. Bagram Airfield is so large that it was divided into approximately 20 smaller base camps, each requiring a separate monthly base camp inspection. The base camps included the hospital compound, engineer task force area, contractor housing, and many others.

Food and Water

Personnel ate most of their meals at the DFACs, but there were also Army and Air Force Exchange Service food concessionaires on each base. The largest base was Bagram Airfield with 7 DFACs and 9 food concessionaires. The food concessionaires consisted mostly of fast food chains familiar to Soldiers (Subway, Burger King, Diary Queen, etc) but were run primarily by third country nationals not accustomed to US standards of food service sanitation. Consequently, several facilities were closed after preventive medicine inspections found serious deficiencies (eg, poor sanitation, expired food) and many had repeat closures. The contractor-operated DFACs, several of which were managed by retired US military food service personnel, had relatively few violations.

Contractor run potable water operations used groundwater from large, deep wells as the primary source. Water quality was good and chlorine residuals at the source were kept between 3 ppm and 5 ppm, and was normally above 3 ppm for water at the point of use. Although there was a low health risk from this water, bottled water was the primary source of drinking water. Weekly testing for chlorine residual, pH, and coliform bacteria was conducted at sites throughout the bases. Due to a lack of water distribution infrastructure at some bases, potable water tanker trucks were used to transport water to shower points, latrines, DFACs, and other sites. The trucks were inspected quarterly by preventive medicine Soldiers.

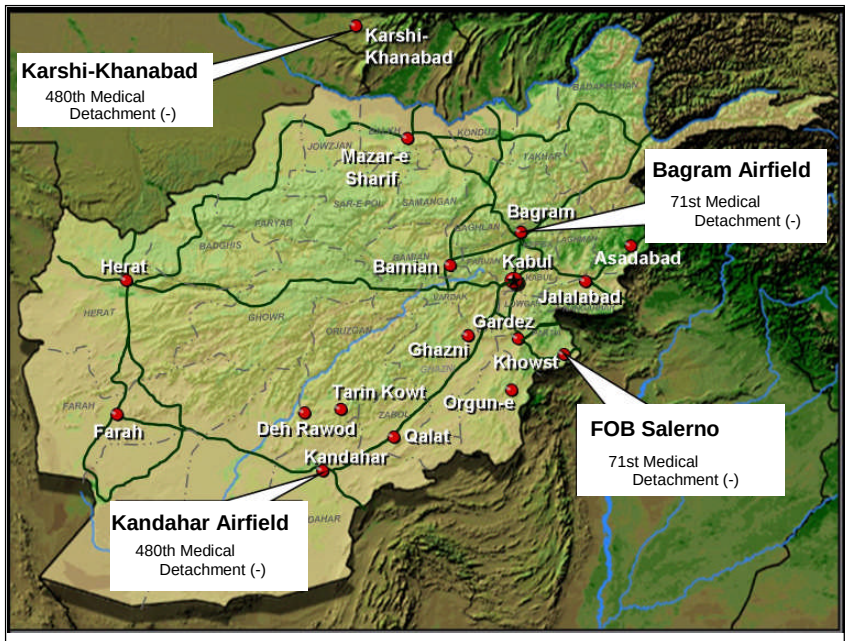


Figure 1. Locations of Army preventive medicine resources at the beginning of OEF VI.

Solid Waste and Wastewater

A significant amount of solid waste and wastewater was generated at these bases. Contractor-operated burn pits were the primary means of solid waste disposal, but they were inefficient and did not completely burn the waste. The

burning created a large plume of smoke that was an irritant if inhaled. Efforts by the CJTF-76 Engineers (J7), Surgeon, and preventive medicine to have incinerators installed for general trash disposal were unsuccessful. No recycling of metal, glass, or paper in the municipal waste stream was undertaken, although the J7 Environmental Officer attempted to find a contractor to initiate a recycling program. Regulated medical waste was taken to a contractor-operated incinerator at Bagram Airfield for disposal.

Wastewater disposal at Bagram Airfield consisted of dumping untreated gray water from showers, laundry, and DFACs into a stream that flowed off the installation. The black water from latrines was taken off-site by a local contractor, but upon investigation, no one could be found that knew exactly where the black water was being disposed. At both Kandahar Airfield and FOB Salerno, large settling basins were used to treat wastewater, but the efficacy of these structures was questionable and they served as breeding sites for *Culex* spp mosquitoes.

Vector Surveillance

The vector control mission (including spraying) had been assumed by the contractor, but the vector surveillance mission was still performed by preventive medicine personnel. Centers for Disease Control and Prevention (CDC) miniature light traps were used to conduct mosquito and sand fly surveillance during the deployment. Traps were set up 2 or 3 times a week, depending on available personnel and threat level. Surveillance was conducted during the summer months with variation between bases due to elevation and average daily temperatures. The collection data from FOB Salerno is presented in Figure 2.

The majority of insects were collected from mid-June to mid-July, when temperatures were highest. Malaria is endemic in Afghanistan and species of *Anopheles* mosquitoes, a vector of malaria, are predominant in the east and south regions.[3] The most common cause of malaria in theater was *Plasmodium vivax* with a smaller number of *P. falciparum* cases. CJTF-76 policy directed all Soldiers in theater to take a chemoprophylaxis, typically doxycycline or mefloquine, during deployment. However, noncompliance with the chemoprophylaxis policy was found in every instance of the more than 40 cases of malaria during 2005. Sand flies are a vector of leishmaniasis, however, the risk level for this disease was low in the southern and eastern portions of the country. Rodents and house flies were the most common pests found throughout the theater.

Light trap installation at a forward operating base

SUPPORT TO FORWARD OPERATING BASES

In contrast to the larger bases, many of the FOBs had little or no contractor support, and most DFACs were staffed by military food service specialists. In some cases, there were several smaller camps present within

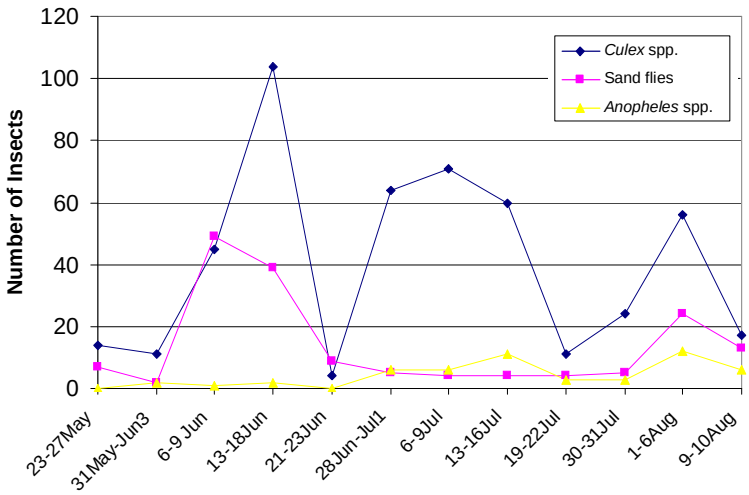


Figure 2. Insect collection data from FOB Salerno, 23 May to 10 August 2005.

the FOB (eg, Special Forces, Provincial Reconstruction Team, infantry company) with some duplication of base operations in each camp.

Concept of Support and Limitations

During the previous rotation, only the 172nd Medical Detachment (Preventive Medicine) was in theater and FOBs were only visited once per quarter. With 2 detachments (the 71st and the 480th) present for OEF VI, the decision was made to visit FOBs every 4 to 6 weeks, with a goal of monthly visits. To illustrate how this process worked, the plan of support to portions of RC East from Bagram Airfield is discussed in the following paragraphs.

The limiting factors in providing support to FOBs were personnel, transportation, and preventive medicine equipment. In order to keep enough personnel at Bagram Airfield to conduct missions on the installation, only one preventive medicine specialist rather than a team of 2 or 3 Soldiers was able to travel to each FOB. Many of the Soldiers in the 71st Medical Detachment were recent graduates of Advanced Individual Training with limited experience. These junior Soldiers were required to fly to an FOB, conduct all inspections, recommend corrections, and provide any other support as needed without any direct supervision. With overlap due to flight availability, at any given time, 2 Soldiers were at FOBs while 2 Soldiers were at Bagram Airfield conducting missions. The typical FOB mission required 2 or 3 days to complete but flights to some FOBs arrived only once every 8 days. This resulted in junior Soldiers remaining at an FOB for several additional days with neither a mission nor noncommissioned officer supervision. Some proactive Soldiers spent the extra time applying preventive medicine principles and looking for additional ways to help the FOB mayor improve living conditions.

Equipment presented another challenge in the support of FOBs. The normal medical equipment sets used by a team in a medical detachment are contained in medical chests and fill an M1114 HMMWV.* Due to space restrictions on aircraft, the preventive medicine specialist visiting an FOB was limited to a personal bag (rucksack or duffel bag) plus one footlocker or similar-sized container for equipment. This required some creativity to maintain capability while meeting space requirements. Typically, preventive medicine specialists would carry the following:

- Binder with forms
- Water Testing
  - Hach† DR/890 Colorimeter
  - Millipore Incubator
  - Colilert media and bottles
  - LaMotte Kit or test strips
- Food Sanitation
  - Copy of *TB MED 530* [4]
  - Food service Cl test paper
  - Food Thermometers
- Entomology
  - One CDC Light Trap
  - Rodent sticky traps
  - Fly strips
  - Mosquito larvacide dunks

Instead of using the standard Hach DREL 2400 water quality analysis laboratory, a Hach DR/890 Portable Colorimeter was substituted. This saved a substantial amount of space while retaining most of the capability required to conduct onsite drinking water analysis. The standard gray Millipore Field Incubator‡ used to incubate samples for the presence or absence of coliform bacteria was essential on FOB missions, but required almost half of the space allotted. Initially, a few of the older model incubators were used since they are much smaller, but they soon stopped functioning and could not be repaired. Only limited entomology equipment and no industrial hygiene equipment was part of the standard kit. If a need for additional

Hach DREL 2400 Complete Water Quality Lab

*High Mobility Multipurpose Wheeled Vehicle
†Hach Company, Loveland, Colorado 80539, 800-227-4224
‡Millipore Inc., Billerica, MA 01821, 978-715-4321

equipment was recognized during a visit, the preventive medicine specialist would bring it on the next month's mission.

Hach DR/890 Portable Colorimeter

Food and Water

The quality of sanitation at the military dining facilities at FOBs was variable. In general, larger FOBs had higher-ranking supervision at the DFAC and better compliance with food service sanitation standards. Common deficiencies at FOB DFACs included improper food holding temperatures and poor sanitation practices.[4] Poorly maintained or malfunctioning equipment such as steam tables or refrigerators could not be repaired or replaced quickly. Most food was transported to FOBs via local national trucks over Afghanistan's primitive road system. The frozen and refrigerated food often arrived at the FOB above the acceptable temperatures or was clearly allowed to thaw and then refreeze. This resulted in an increased risk of foodborne illness to US and Coalition troops.

Although bottled water was used for drinking, well water was utilized for personal hygiene, laundry, and washing dishes at the DFAC. In general, wells were not properly constructed, did not have a sanitary seal, and were contaminated with coliform bacteria. Some wells did have chlorine injectors but most did not function. The only locations with a consistent chlorine residual in the water supply were those in which personnel (normally medics) manually added calcium hypochlorite to storage tanks and tested chlorine residual on a daily basis. During FOB visits, preventive medicine specialists provided assistance by ensuring that water tank chlorination was conducted by trained personnel and that a supply of calcium hypochlorite and chlorine test strips was on hand.

Solid Waste

Solid waste was burned at most FOBs, although the effectiveness ranged from moderate to poor. At some locations, waste was dumped outside the FOB perimeter and not burned immediately. Groups of local nationals would rummage through the waste looking for useful items and subsequently spread the trash over a large area. Other locations would pour fuel on trash piles and ignite them without ensuring proper combustion. Although the term "burn pit" was normally used, high water tables in some areas prevented excavating more than a few feet below ground level and burned trash was not always covered with soil. Most solid waste disposal areas became magnets for rodents, house flies, and stray dogs.

Vector Surveillance and Control

Vector surveillance data was valuable for efficient control. Contractor personnel applied chemical control only following a recommendation by a military entomologist. Mosquito breeding sites were identified and larvae controlled by applying Altosid or *Bacillus thuringiensis* briquettes.[5] Sand fly and Anopheles mosquito specimens were sent to the Biosystematics Unit of the Walter Reed Army Institute of Research and the US Army Center for Health Promotion and Preventive Medicine (USACHPPM)-North, respectively, to be tested. House fly infestations were widely problematic, particularly around the DFACs. Sanitation practices were instituted and then supplemented with fly bait and fly strips such as Quikstrike.[*] Integrated pest management practices used throughout the year of deployment significantly reduced the use of pesticides.

Uniform Treatment

The proper chemical treatment of uniforms, as mandated by Department of Defense directives, is imperative for the prevention of vectorborne diseases. Soldiers need greater awareness and training in uniform treatment procedures before deploying. The imminent threat of diseases such as leishmaniasis and malaria made the treatment of uniforms in theater a priority for many units that were not able to do so prior to deploying. Preventive medicine personnel treated uniforms at many FOBs where troops did not have spray equipment or permethrin.[5]

Environmental Sampling

Soil and water samples were collected periodically in support of the Army Deployment Occupational and Environmental Health Risk Management Program. Since water at FOBs was not treated (with the exception of some chlorination), raw water sampling was required at each well. Two or three wells were in

[*]Do-It-Yourself Pest Control, Inc., Atlanta, Georgia 30341

A preventive medicine specialist treats uniforms with the clothing repellent Permethrin

use at many FOBs, which required a large cooler for each sample. Normally, an Environmental Science and Engineering Officer (ESEO) accompanied a preventive medicine specialist to an FOB during a normally scheduled visit in order to collect these samples. As mentioned earlier, the logistics of bringing extra equipment to an FOB was problematic. In addition, after the raw water samples were collected they had to be maintained at 4°C, and during the summer months ice packs only kept samples chilled for a limited time. Some analytes have short holding times and there were challenges getting water samples from a FOB to a main base, such as Bagram Airfield, and then to USACHPPM for laboratory analysis. It was difficult to move samples from remote locations to a USACHPPM laboratory within a 14-day holding time.

Preparing to conduct raw water sampling at a forward operating base

OTHER PREVENTIVE MEDICINE MISSIONS

Closure of Karshi-Khanabad

The airbase at Karshi-Khanabad (K2), Uzbekistan, was used primarily as a logistics hub for equipment and supplies flowing into Afghanistan. The preventive medicine team at K2 consisted of an ESEO, and 2 preventive medicine specialists from the 480th Medical Detachment. The routine mission to provide preventive medicine support changed in July 2005 when the Government of Uzbekistan ordered US forces to vacate K2 within 6 months. The rapid drawdown and closure of the airbase presented some challenges that were handled by preventive medicine personnel, including the discovery of a 20-foot long shipping container that had been accumulating regulated medical waste (RMW) for more than 3 years. No inventory existed and the Level II clinic personnel had been adding red bags of RMW to the container on a regular basis. The ESEO had to quickly determine the proper way to categorize and dispose of all of the RMW. A local contractor was found that could properly handle and incinerate the contents of the shipping container. This saved the US government the cost of shipping the container of RMW to Germany for disposal. Another major issue related to closure activities involved proper disposal of a large amount of hazardous waste and hazardous materials. An Army Reserve Officer that works for the State of Missouri dealing with hazardous waste issues in his civilian job was the ESEO at K2. His civilian experience made him an invaluable asset to the K2 mayor cell and prevented a potentially serious issue with disposal of hazardous waste and materials.

Earthquake Support in Pakistan

On 8 October, 2005, a 7.6 magnitude earthquake struck northern Pakistan, killing more than 86,000 people, leaving more than 4 million people homeless, and causing massive destruction.[6] A task force comprised mostly of aviation units from CJTF-76 rapidly deployed from Afghanistan to Qasim Airfield near Islamabad, Pakistan, to provide humanitarian relief. No preventive medicine personnel were authorized to accompany the initial group into Pakistan. One week later, the CJTF-76 headquarters received numerous reports that US Soldiers in Pakistan suffered from foodborne illness, poor sanitary conditions, and a large number of mosquito bites. At that point, the Commander of the 71st Medical

Detachment was dispatched to Pakistan to direct efforts to improve the situation. Although the mission was initially focused on correcting existing problems, preventive medicine measures were also quickly implemented to reduce the disease and nonbattle injury rate. Working with the task force engineer, a semipermanent base camp for use by the aviation task force was designed and a food service contractor was selected. After one week, a Navy Forward Deployable Preventive Medicine Unit arrived and assumed the mission at Qasim.

Malaria and Leishmaniasis Investigations

In September 2005, a Soldier contracted *P. falciparum* malaria in Paktika province, Afghanistan. *Falciparum* malaria is the most serious malarial infection and may cause coagulation defects, shock, renal and liver failure, pulmonary and cerebral edema, coma, and death. The Soldier was evacuated by air to the level III treatment facility at Bagram Airfield, then to the Landstuhl Regional Medical Center, Germany, and eventually to the Walter Reed Army Medical Center. The Soldier survived, but suffered permanent liver damage.

An *Army Regulation 15-6* investigation[7] conducted by the Executive Officer of the 71st Medical Detachment revealed that the Soldier contracted malaria individually as the result of a combination of factors. He did not take his malaria prophylactic or use any other personal protective measures to reduce the risk of contracting malaria. Personal protective measures include chemoprophylaxis, permethrin treated uniforms, proper wearing of uniforms, use of military DEET skin cream and mosquito bed nets. A combination of all of these preventive measures could have protected him from malaria. The chain of command failed to ensure that malaria medication was part of the precombat inspections and checks.

LESSONS LEARNED

Decentralized Preventive Medicine Operations

With the initial split-based operations used by preventive medicine in the early part of the deployment, most of the larger FOBs received a monthly assistance visit. However, some of the smaller FOBs and fire bases could only be reached by irregular flights or ground convoys from a larger FOB. Attempts to coordinate visits to these smaller FOBs regularly failed due to changing convoy schedules or the inability to coordinate flights with convoys. The alternative was to have a Soldier on the ground for 16 days to accomplish 4 days worth of work.

The solution in RC East was the reorganization of preventive medicine personnel—the 82nd Airborne Division organic preventive medicine assets covered FOB Salerno and teams of 2 Soldiers from the 71st Medical Detachment and their equipment were forward positioned at the battalion-level FOBs. This allowed greater integration with the maneuver units and allowed one preventive medicine specialist to be available to accompany a convoy or flight to the smaller outlying FOBs. Although having a forward presence resulted in many benefits, a lack of equipment resulted in limited capability and/or portability for some teams. Teams usually consisted of 2 junior enlisted Soldiers that had minimal supervision by a preventive medicine noncommissioned officer (NCO) for months at a time. It also lowered morale for Soldiers that covered only the Bagram Airfield mission and no longer had the opportunity to travel to FOBs. A plan was developed to rotate Soldiers at Bagram Airfield and the FOBs every 3 to 4 months to mitigate these issues.

Field Sanitation Teams

Based on unit reports and observations in the field, most company-sized units in theater did not have functioning Field Sanitation Teams. *Army Regulation 40-5* requires that "Company-sized units will establish and employ manned, trained, and equipped unit field sanitation teams (FSTs)."[8] When questioned about the status of their FSTs, many units replied that they had ordered the required equipment before deployment, but it never arrived. If Soldiers in the FST had received the 40-hour FST training course, they did not use that knowledge in the field. One example: during the Pakistan earthquake support mission, a Sergeant in the aviation task force mentioned that he attended an FST class taught by the 71st Medical Detachment a few months prior to the earthquake. This NCO had the knowledge to correct many of the sanitation problems negatively impacting the mission at his location. He chose not to take action or inform his chain of command of the corrective actions that were needed. As a result, an ESEO was required to deploy to Pakistan and correct these problems.

The importance of the FST must be stressed to units during predeployment training and field sanitation should be incorporated into training scenarios. The 71st Medical Detachment has worked with observer/ controllers at the Joint Multinational Training Center (JMTC) (formerly the Combat Maneuver Training Center) in Hohenfels, Germany, to have units construct latrines, determine the wet bulb globe temperature, and perform other FST functions during training and predeployment rotations at the JMTC.

Clinical Preventive Medicine

During OEF VI there were adequate numbers of ESEOs, medical entomologists, preventive medicine specialists, and NCOs to handle most problems requiring their skills sets. However, no clinical preventive medicine expertise was present at any of the level II or level III medical treatment facilities. Issues such as tuberculosis and hepatitis policies for local national and third country national workers on base, pandemic influenza, sexually transmitted diseases, and tracking of reportable medical events belong in the purview of preventive medicine physicians and Army Public Health Nurses (APHN). According to Hollandsworth et al,[9] the role of the APHN (formerly Army Community Health Nurse) is expanding to cover these topics in deployed settings. There are now authorizations for APHNs in the combat support hospitals, but none were deployed in OEF VI or the following rotation. These clinical preventive medicine specialists must be present in deployed settings to ensure the proper mix of skill sets is available to maximize Force Health Protection.

Water Well Construction

In the summer of 2005, while conducting an assessment of water supplies used by US and Coalition Forces, several organizations were contacted to determine the number and location of wells at each FOB. No one within CJTF-76 had a comprehensive census of wells at each location, and planning for raw water sampling was difficult. Further, at each FOB no information related to the construction, depth, or geology of the well sites existed. Wells were typically constructed by local contractors at the request of the FOB mayor, and higher headquarters was not informed. Most wells were not constructed to US standards and frequently became contaminated with coliform bacteria.

To correct this situation, preventive medicine personnel worked with the J7 Environmental Officer in an attempt to bring in US military well drilling teams to construct new wells at FOBs. Although water well drilling units exist in the Army, Navy, and Air Force,[10] none were available for deployment to Afghanistan. All Army well drilling units have been moved to the Reserve components and their equipment is aging and in need of replacement. In order to ensure US troops are receiving water from properly constructed wells that minimize the risk of contamination, military well drilling units should be deployed to construct wells at FOBs.[11] In an effort to construct wells to US standards, a well specification guide template was developed by preventive medicine personnel working in conjunction with the Army Corps of Engineers. The guide can be used by FOB mayors when hiring local contractors for well construction.

Environmental Sample Analysis

Soil, water, and particulate air samples comprised the bulk of media collected and sent out of theater for analysis. The logistics of collecting and shipping samples posed multiple problems. Some samples shipped by commercial carriers were left sitting at the point of departure for days, and it could take weeks for samples to arrive at the laboratory. The most reliable method of shipping samples was the US Air Force medical evacuation flights from Bagram Airfield to Ramstein Airbase, Germany. A patient escort would maintain accountability for the samples during the flight to Ramstein and subsequent trip to the nearby Landstuhl Regional Medical Center (LRMC). Once at LRMC, the patient escort would call the contact numbers provided for the USACHPPM-Europe to arrange pickup. The limitation to this procedure was that evacuation flights were not regularly scheduled, and not all flights went directly from Bagram Airfield to Germany. In some cases, a week would elapse between flights. A solution to the problem of having samples quickly analyzed would be the deployment of an Area Medical Laboratory (AML) to the US Central Command Area of Responsibility. Neither of the 2 AMLs has deployed since their formation in 2004, even though they have the capability to perform most, if not all, analyses required by the Army Deployment Occupational and Environmental Health Risk Management Program.[12] At a minimum, one AML should be deployed to Kuwait to support units deployed in both Afghanistan and Iraq.

CONCLUSION

The climate and terrain of Afghanistan combined with transportation limitations complicated the preventive medicine mission during OEF VI. The keys to success were providing the maximum amount of support given the limitations, and always remaining flexible. A wide range of preventive medicine support was required, and knowledge of which in-theater personnel had expertise in industrial hygiene, drinking water, hazardous waste, and other areas was critical to ensuring the proper person was consulted for a particular mission. On several occasions, missions occurred that were outside the normal areas of responsibility for a preventive medicine unit. Flexibility and the ability to think outside the box were important to success. When determining the proper mix of medical support required for any large scale deployment, it is very important to include clinical preventive medicine personnel.

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AUTHORS

MAJ Gellasch is the Chief, Environmental Health Engineering Division, US Army Center for Health Promotion and Preventive Medicine-West, Fort Lewis, Washington. From 2003 to 2006, he was the Commander, 71st Medical Detachment which deployed to Afghanistan from April 2005 to April 2006.

CPT Calix is the Executive Officer, 71st Medical Detachment, Grafenwoehr, Germany. She was also the Detachment Executive Officer during the unit's deployment to Afghanistan from April 2005 to April 2006.

Preventive Medicine Support to Operation Lifeline: Pakistan 2005

CPT E. Owen Price, MS, USA
LTC David F. West, MS, USA
MAJ James D. Mancuso, MC, USA

INTRODUCTION

On October 8, 2005, a magnitude 7.6 earthquake struck the Pakistani-controlled region of Kashmir. The quake was centered near the city of Muzaffarabad, but the damage was widespread. The affected population was spread over an area of 30,000 km^2, most of which was inaccessible. The final death toll was estimated to be 86,000 people, but the exact figure may never be known. Population data for many locations were incomplete or inaccurate before the quake, and it is thus impossible to know who perished or who simply moved away. Similarly, the figure of 3.5 million people left homeless will remain an estimate. Initial damage estimates conducted from the air were also low, and it was not until responders walked the ground that the true magnitude of the destruction was realized. Structures collapsed internally, leaving the roof largely intact but crushing all inhabitants. Consequently, the structures appeared intact from the air, but the ground truth was quite different. The multinational response to assist the people of Kashmir was tremendous. The United Nations (UN), the World Health Organization, military forces from several nations (including Austria and Australia), the US Department of State, and numerous nongovernmental organizations converged on the affected area to provide varying types and levels of aid.

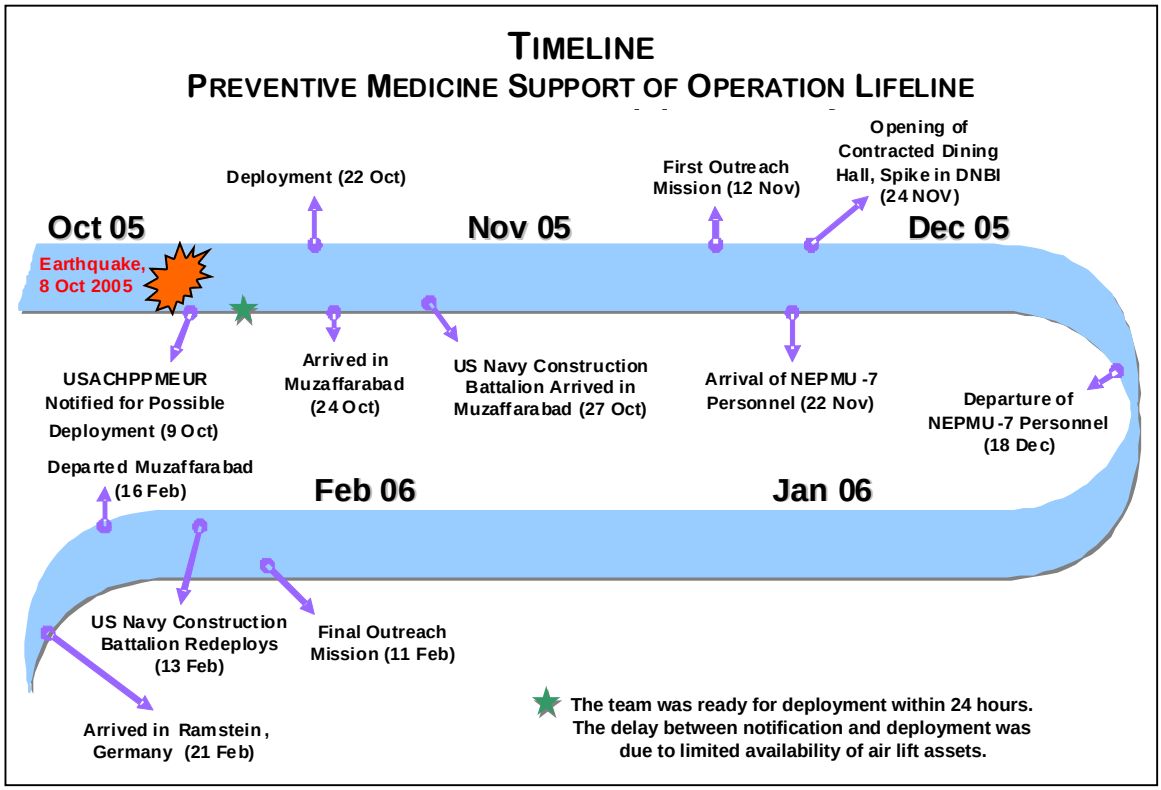
RESPONSE BACKGROUND

The US military immediately responded with helicopters from Afghanistan (relocated into Pakistan) which airlifted supplies to remote villages and brought out the wounded. This was followed by the formation of the Disaster Assistance Center Pakistan (DACPAK) on October 10. This Navy-led task force (TF) was headquartered in the capital city of Islamabad and had command and control of all US military assets responding to the disaster. Under DACPAK was the 212th Mobile Army Surgical Hospital (MASH), the command element of Medical TF 212, operating out of Muzaffarabad. The main body of the MASH arrived at Muzaffarabad on October 25. The preventive medicine section of Medical TF 212 consisted of personnel from the US Army Center for Health Promotion and Preventive Medicine–Europe (USACHPPMEUR), the 133rd Medical Detachment, the 100th Medical Detachment Veterinary Services, and the Navy Environmental and Preventive Medicine Unit 7. The specialties represented by the team included entomology, environmental science, epidemiology, food inspection, infectious diseases, preventive medicine, and public health. The preventive medicine team ultimately included 12 personnel, but due to personnel shifts, no more than 10 personnel were assigned to the team at any time. There were only 7 personnel on the team during 75% of the deployment.

PREDEPLOYMENT SUPPORT

Prior to deployment, the preventive medicine team provided medical threat consultation to the task force leadership. It was initially unclear into which area of Kashmir the MASH would deploy, and threats imposed by a variety of environments had to be evaluated. Deploying personnel were briefed on high altitude operations, cold weather operations, rabies, communicable diseases endemic in the area, hygiene and sanitation, malaria prevention and prophylaxis, pre- and postdeployment medical requirements (eg, vaccination), and other standard predeployment topics.

Since health threat data indicated a very high risk of rabies in Pakistan, we elected to follow a selective vaccination strategy, vaccinating only those at highest risk for exposure on and off base—the preventive medicine team. The team also evaluated the malaria threat based upon geographical, climatic, and historical



data and suggested that the low risk of malaria did not make chemoprophylaxis necessary. However, the MASH command elected to remain consistent with US Central Command (USCENTCOM) policy and required chemoprophylaxis throughout the duration of the deployment.

BASE CAMP SUPPORT

Following deployment, the preventive medicine team was initially tasked with a base support role and was responsible for the initial setup of the task force base camp, as well as support to the aircraft refueling point located at the Muzaffarabad airport. This included the proper placement of latrines, drainage for showers and laundry facilities, trash disposal sites, and design of the hospital's medical waste disposal system. The MASH deployed with wooden latrine boxes that were intended to be used with metal barrels for collection and burning of waste. The barrels did not arrive with the boxes, however, and replacement barrels had to be purchased from the local economy. Burning of waste was not a long term solution, as Pakistani guards expressed a dislike for the smoke and MASH personnel expressed a dislike for burning waste. The boxes were modified for use as deep pit latrines and pits were dug by the Naval Mobile Construction Battalion 74, colocated with the MASH on the base camp.

Proper disposal of regulated medical waste was a problem for other hospitals in the city, and a safe and reliable system had to be in place before the MASH began receiving patients. The task fell to the preventive medicine section, and a burn and bury plan was developed. Small, forklift-movable containers were installed near the hospital, and a large pit was constructed separate from the regular waste pit. Complete incineration was assured for each load of waste. The system worked efficiently and a visiting health team from the UN stated that it was the model for other facilities struggling to cope with the growing quantities of medical waste.

As the camps became better established, the preventive medicine team took on a maintenance role. Base camp assessments were conducted on a weekly basis with recommendations provided to the company level commander for action. Areas of focus included drainage, noise levels, proper waste disposal, living space within sleep tents, condition of latrines, quality of water produced by the camp's reverse osmosis water purification unit, and any other areas of concern

identified during the inspection. The camp assessments also included water testing and an inspection of the dining facility. Responsibility for correcting many of the issues fell to the task force's field sanitation team, which was trained and supervised by the preventive medicine section. Vector control operations were limited to filth fly control involving residual treatments of latrine boxes and placement of bait stations. Food service sanitation inspections became a critical mission as the task force moved away from meals-ready-to-eat to contracted meal service. The team's food inspector became a valuable asset. Failure to use approved food sources and low holding temperatures were the most common infractions, but there was a general deficit in sanitary food service techniques. The preventive medicine section provided a food service course to the contracted dining facility workers and managers, and the instances of minor violations dropped considerably.

The preventive medicine team also conducted baseline environmental sampling. Concerns were raised about the ever-present cloud of dust over the city, and sampling was conducted to assess the risks posed by particulate matter less than 10 μm in diameter. Surface soil sampling was conducted upon arrival and just prior to redeployment, both at the MASH base camp and at the aviation refueling point (located at the Muzaffarabad airport), so that any environmental changes caused by the US presence could be evaluated. A deployment screening kit was used to evaluate water used for cooking and hygiene.

In addition to supporting the MASH and the refueling point, the preventive medicine team provided support

to personnel based at the military airbase in Islamabad, and to personnel temporarily assigned to the US Embassy in Islamabad. Food service sanitation inspections were conducted at the embassy, at 3 houses where catered food was provided to US personnel, and at the dining facility at the military air base at Qasim. Gastrointestinal illness investigations were also conducted when the number of cases increased beyond baseline rates, which happened twice at the military air base. These investigations were conducted in collaboration with the Australian Armed Forces, as they also suffered gastrointestinal illness above the baseline rates.

PATIENT TRACKING

A key component of the base support mission, and one that continued throughout the deployment, was the tracking of disease and nonbattle injury (DNBI) for both US and Pakistani patients seen at the MASH. Within a deployed medical facility, the Composite Health Care System II–Theater (CHCS II-T) is used to track patient data. Although USCENTCOM policy mandates the use of CHCS II-T in deployed locations, the system was not available to the MASH at the time of deployment. Consequently, the MASH used the Joint Patient Tracking Application (JPTA). There are several differences between the systems, two of which directly impacted DNBI tracking during the mission. In CHCS II-T, the physician enters patient data into the system at the time of the consultation. Data are thus recorded immediately with little chance for error. In JPTA, however, data are input by patient administration technicians at a later time with paper medical records as a reference. This resulted in data of varying quality and frequent coding errors. For example, a patient would identify knee pain as a chief complaint, and the physician would record the visit as a musculoskeletal or overuse injury. The technician coding the visit, however, would code the visit by the chief complaint as "TB of the knee," which is a diagnosis of Tuberculosis of the knee. These errors in coding may have been caused by technician unfamiliarity and difficulties in adapting to the system. Additionally, some patient visits were not recorded at all, either through unfamiliarity with the JPTA tool or through lost paperwork. Documents were often lost in paperwork piles or within the paperwork given to the patients themselves. These difficulties highlight the rapidly changing nature of DNBI surveillance tools, as well as the need for constant vigilance and careful

monitoring of the data to ensure data completeness and quality.

Another difference between the 2 systems is the link to the Joint Medical Workstation (JMEWS), the classified system used to compile patient data among the various military services. There is a link between CHCS II-T and JMEWS which updates automatically, but this is not true of JPTA. Data from JPTA must be manually entered into JMEWS, a process involving access to a secret level computer terminal and enough time to make the entries. The bottom line is that an all encompassing system for patient data entry and tracking does not exist. Each system has positives and negatives, and the process of capturing surveillance data is still evolving.

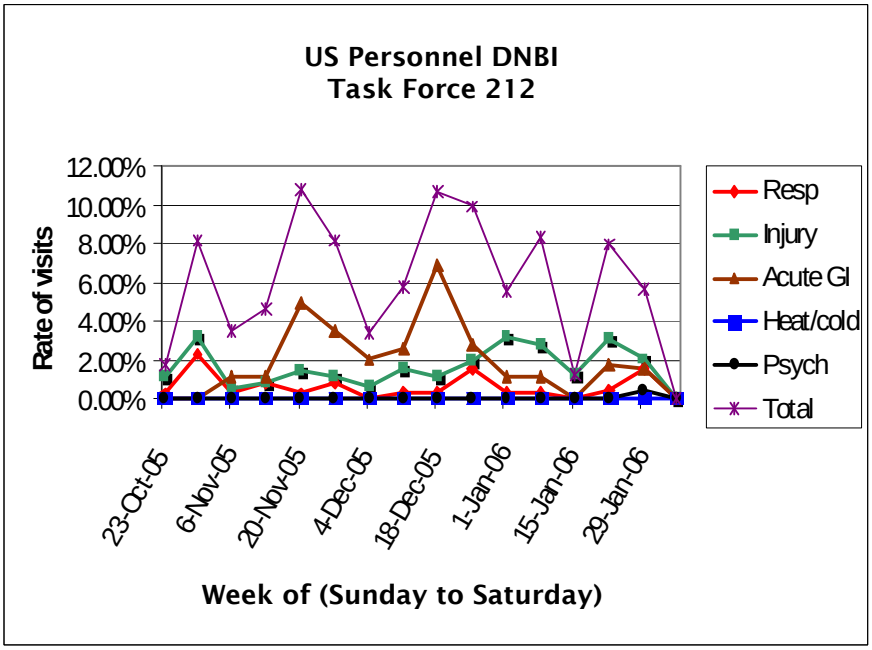


Figure 1. Nature of US military personnel DNBI complaints presenting at Camp Resolute during Operation Lifeline.

Patient data tracking allowed the team to observe trends among TF personnel, and this view adequately complemented information collected during camp inspections. This multifront approach allowed the team to focus its efforts on areas of concern and resolve many issues before they became problems. The average DNBI rate among US military at Camp Resolute was 6.4% (range: < 2% to > 10%). As shown in Figure 1, gastrointestinal illness represented the greatest number of sick call visits. When an increase in gastrointestinal illness was noted among MASH personnel, the team's epidemiologist was able to conduct a thorough investigation which included patient interviews. Possible sources of infection were eliminated through increased dining facility inspections and water monitoring, as well as the identification of commonalities among patients. All cases were nonbloody and nontoxic, and several stool samples were submitted to local laboratories for culture to confirm the absence of bacterial pathogens. All results were negative, and the presence of a Norwalk-like virus was considered likely. Occurrences of such viruses are not atypical of such deployments.[1]

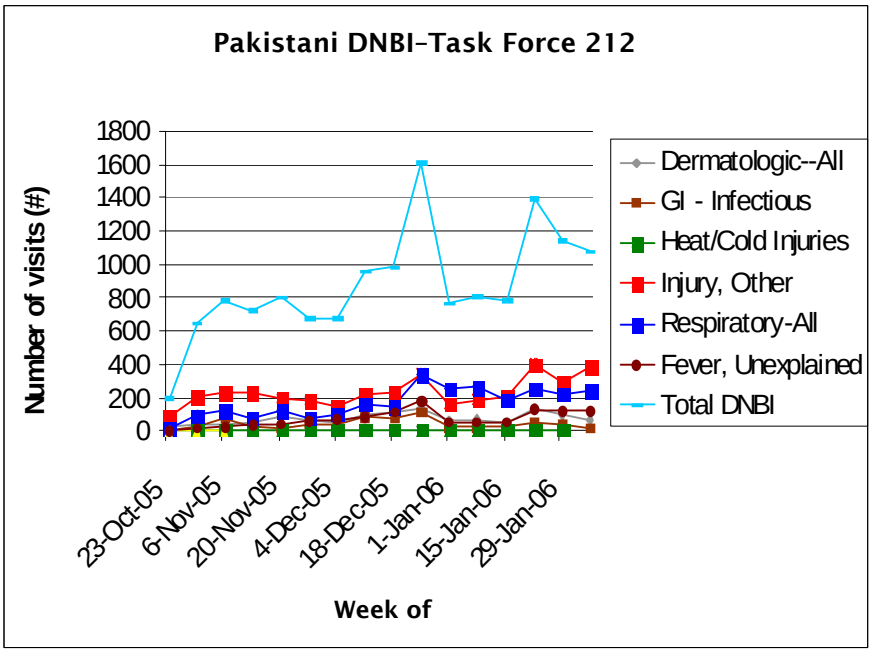


Figure 2. Nature of Pakistani civilian DNBI complaints presenting at the MASH during Operation Lifeline.

Analysis of Pakistani patient data presents an interesting view of how

patient care changed from the onset of the relief effort through the course of the MASH's operations in Pakistan. It was expected that the MASH would see primarily traumatic injuries, but this was true only at the beginning. The DNBI data, shown in Figure 2, reflects a transition from traumatic primary effects into secondary and tertiary effects, and then a transition towards care of routine and chronic illnesses not necessarily associated with the earthquake.

COMMUNICABLE DISEASES

Related to tracking host nation patient data was the investigation of communicable disease outbreaks. These diseases, rare in the United States, included outbreaks of measles, tetanus, diphtheria, meningococcus, and scabies. There were many challenges associated with tracking down these outbreaks, some due to the chaos following the earthquake, others inherent in the way population data and vital statistics were kept historically. The earthquake itself isolated many remote villages, making them accessible only by air or by long hikes over difficult terrain. Even if villages could be reached, patient home of record information was often inaccurate or villagers were not familiar with everyone in their own village. In one instance, the preventive medicine team traveled by air to the village of Sarli Satchel to vaccinate contacts of a diphtheria patient, only to be told the patient did not live in that village. The team hiked to a second village to be told that the patient did, in fact, live in the first village.

Other problems included a lack of communication between the various relief agencies. Often a team would trace an outbreak to a village but arrive to find one or more relief agencies already working there. This unnecessary expenditure of time and resources could have been prevented if good communications channels had been established from the onset. It is difficult to know whether these outbreaks were occurring in greater frequency due to the earthquake and the crowded conditions common in camps for internally displaced persons (IDP). The accuracy of historical data is questionable at best, but it indicates many of these diseases—measles, diphtheria, hepatitis, tetanus, and many others—were occurring at the same levels as experienced prior to the quake.

As patients arrived at the MASH suffering from these communicable diseases, the need for isolation facilities grew, as did the number of questions the preventive medicine team received concerning infection control. No ideal setup for the isolation of patients with contagious respiratory illnesses existed, but a makeshift isolation cell was built using plastic sheets. The lack of isolation facilities within the MASH highlights commonalities with combat support hospitals in Iraq and Afghanistan and the need to better address infection control issues in deployed theaters.[2] This is particularly true in light of the *Acinetobacter* issues seen in both theaters.[3]

Intestinal parasites were also common, and the preventive medicine team answered questions about the likelihood of parasites being spread to other patients or to providers. Similarly, providers sought advice on protection from scabies as the condition became essentially ubiquitous among earthquake victims. Basic concerns, such as latrine usage by patients and family members, became an infection concern when it was discovered that the traditional style of latrine utilized by US forces was unfamiliar to most Pakistanis. The MASH deployed with several box-style latrines equipped with seats, but a squat-style latrine was far more common in Pakistan, and many patients and family members were simply unable to use the latrines. Some were so unwilling to use them that they urinated in hospital hallways and defecated near the latrine boxes. The situation was remedied by the purchase of several squat-style latrine plates and the Navy's modification of the box latrines to accommodate the plates.

OUTREACH PROGRAM

Once the base camp was stabilized, the preventive medicine team began looking for more opportunities to leave the camp and work within the city of Muzaffarabad and beyond. These opportunities came first in the form of support to IDP camps as the team's involvement with the United Nations Children's Fund (UNICEF) water and sanitation cluster. The team did not have the capability to dig latrines or supply water, but it could provide technical support through sanitary inspections and the testing of drinking water. Inspections were documented on a standardized UNICEF form, and feedback was provided directly to UNICEF. Resources and materials could then be directed to where they were most needed. The team

had very limited ability to directly enact change within the camps and could often only make recommendations to UNICEF or camp managers. The recommendations were not always implemented.

The largest component of the preventive medicine mission was one that started out on a small scale and grew to be one of the MASH's highest-visibility missions. When a vaccination initiative was undertaken by the local government and UNICEF, the preventive medicine team offered to assist in reaching the program's goal of vaccinating 800,000 children against measles over a 2-week period. Numerous nongovernment organizations (NGOs) also supported this effort. When the initial drive ended, the preventive medicine team continued providing vaccinations within and beyond Muzaffarabad. The continuation of the program was possible in part because it was a very small logistical burden for the MASH. All vaccines and supplies were provided by UNICEF to the Pakistani Ministry of Health (MOH), as well as NGOs and other relief organizations, including the US military. In addition to measles, the team provided vaccinations against diphtheria, tetanus, and polio, and Vitamin A to reduce the effect of measles. Personnel challenges included a training deficit as traditionally nonclinical occupational specialties (entomologists, preventive medicine technicians, and food inspectors) required training before vaccines could be given. The high tempo of the mission and large geographical area covered also meant the team was continually on the go, but medical and nursing personnel assets from within the MASH were used to augment the preventive medicine team.

The vaccination program became the MASH's Medical Outreach Program as it incorporated nutrition and wellbeing surveys and the water and sanitation inspections. By the time the outreach program ended, the team had given 16,205 vaccinations to 6,050 people in more than 50 villages, schools, and IDP camps in the Muzaffarabad area. The population well-being program (11 camps visited, 316 patient contacts) resulted in an accurate and timely description of the health status of the IDP population in Muzaffarabad. The MOH for the Muzaffarabad District incorporated the water and sanitation assessments to develop a district-wide needs assessment that was briefed to the military chief of the medical effort in the region. In addition to medical tasks, the team also distributed approximately 200 boxes of clothing, blankets, and toys donated by the American people, and raised funds to purchase books for a local school. The outreach program may have had the biggest long-term health benefit to the people living in the affected area of any of the US-led relief programs. The health benefits of the vaccinations will be felt for decades, and the team's frequent personal contacts with Pakistanis gave the US a personal face, which resulted in a strong positive impact on Pakistani-US relations.

LIAISON EFFORTS

The outreach program was not a standalone effort, however, and the preventive medicine team worked closely with several organizations through the course of the mission. The closest and most important relationship was with the host nation's military. Pakistani military and police forces provided all security for the outreach program and its team members. They were also very familiar with regional roads, and many provided valuable translation assistance. Collaboration with the Pakistani Army Medical Department was essential, and the medical personnel provided information on remote locations that were not receiving aid. They coordinated helicopter transportation to many areas, and they possessed a wealth of knowledge on the prevalence of communicable diseases and vaccination coverage. Similarly, liaison efforts with the World Health Organization (WHO) epidemiology cell kept the team abreast of disease outbreaks and provided an avenue through which diagnostic samples could be routed. Additionally, the WHO collected all patient information from area hospitals and closely tracked emerging issues, providing direct feedback to relief organizations.

The preventive medicine team also maintained a close relationship with UNICEF, attending both the health and water/sanitation cluster meetings on a regular basis. The cluster concept was introduced by the UN for earthquake relief operations, and reviews were mixed. The intent of the concept was to appoint a lead agency within each relief sector and to improve coordination between relief agencies. In Pakistan, 10 clusters were established that focused on health, emergency shelter, water and sanitation, logistics, camp management, protection, food and nutrition, information technology and communications, education, and reconstruction. The concept was strong, as it allowed the focus of resources and technical

specialties. Unfortunately, individuals appointed to lead the clusters often lacked the experience, technical knowledge, or leadership skills to effectively conduct the meetings. As a result, priorities were often incorrectly set, and communications among relief agencies were poor.

Working relationships with other militaries and NGOs varied by group. The outreach team maintained a partnership with the Austrian armed forces which maintained a reverse osmosis water purification unit and delivered water to most of the IDP camps within Muzaffarabad. The outreach team worked within the camps to verify water sanitation while the Austrians worked to purify water and establish a delivery system that ensured a safe product from purification to delivery. Encounters with Cuban hospitals were tense, and several NGOs chose to distance themselves from any military activities. For example, a team member took a photograph of himself near a Medecins Sans Frontieres (MSF) sign, and an organization member became very upset. He proclaimed that MSF is only successful because it has no affiliations with governments and militaries, and to have a photo with an MSF sign and a US military member could be detrimental to their credibility. Other groups welcomed the sanitary inspections, technical advice, and water testing capabilities the outreach team brought, as they either lacked those capabilities or appreciated the opportunity to focus on other areas.

The preventive medicine team, US State Department, and the US Agency for International Development (USAID) worked well together in the majority of cases, but the relationships could have been improved. The preventive medicine team was limited in its ability to leave the MASH base camp early in relief operations, which may have influenced USAID's view of the team as a useful resource. Additionally, the high turnover rate among USAID personnel (teams rotated approximately every month) made it difficult to form contacts and establish good relationships. Whatever the reason, the preventive medicine team enjoyed a hot and cold relationship with these agencies that could definitely be improved during future operations.

It would be of value to establish a strong relationship between the military and USAID before the next disaster occurs. Most importantly, a single point of contact should be established within each organization that could facilitate better interaction and communication. Pre-event training that incorporates both Department of Defense and USAID personnel would allow better interaction among organizations during the next relief operation, and a more structured use of available resources. The MASH's medical outreach team undoubtedly demonstrated that military preventive medicine does have a role to play in disaster response, within which they can be a very effective tool.

The MASH also retained a close relationship with the media, and the outreach team was included in the coverage. Some reporters proved hostile, others were precisely the opposite. Overall, the coverage was positive, and stories appearing in local papers were valuable in improving the image of the US military presence. Media presence was not always a benefit, however, as schedule matching between the media and visiting dignitaries sometimes led to the rescheduling of outreach missions. A change in plan was easy enough for the team, but the local people often traveled great distances to have their children vaccinated. A change in the date meant either waiting in the area for the next opportunity or returning to their villages without vaccination.

MISSION CHALLENGES

The outreach mission had to overcome the challenges of security and transport in order to be successful. All US personnel were entirely dependent upon the Punjabi Rangers or the Elite National Police for security, both within the compound and while out on missions. The outreach team relied on them to provide convoy security, traffic control, crowd control, and even translation assistance when needed. As with any force, some members were very attentive while others were not. Security was a nonnegotiable requirement in the eyes of the host nation, but escorts were not always available or were not always ready on time. This sometimes resulted in the cancellation, or at least a delay, of missions. As mentioned earlier, any such occurrence was always a huge disappointment for the local population.

Road conditions throughout the region posed an obstacle to transport, as well as creating unpredictable and often dangerous traveling conditions. While roads within Muzaffarabad remained largely intact, virtually all roads outside the city suffered damage. The main roads into the Neelum and Jellum river valleys were

impassible for the first month of relief efforts, and later were only marginally passable. For the first 2 months, the outreach team used 3 M998 HMMWVs* to negotiate the roads, but they were simply too wide and too heavy to be safe on the loose and narrow roads that served as the only access to remote villages. The outreach teams changed to the use of sport utility vehicles which considerably improved the overall safety of outreach missions. While air travel would have been a better means of travel in some cases, it was not always available. Air assets were limited less by number and more by priority, with food and supply lifts and medical evacuations having higher priority.

CONCLUSION

The relief operation was an extremely rewarding experience for all involved, as well as a great learning opportunity. The 212th MASH was a proactive organization that utilized preventive medicine assets from the outset, allowing the team to practice preventive rather than reactive medicine, and encouraging outreach programs that positively affected US relief operations. The efforts of the US task force not only reduced the ongoing and future suffering of those affected by the earthquake, but also made considerable progress in reversing the negative image of Americans held by many Kashmiris. The preventive medicine team demonstrated that military preventive medicine and public health has a clear mission in disaster relief and humanitarian operations, and that it can perform this mission well. Relationships with other US agencies, such as USAID, should be improved, and collaboration between agencies would improve future relief missions. The establishment of points of contact and conducting of dual-agency training events prior to the next disaster would set the stage for a streamlined US response.

*High mobility multipurpose wheeled vehicle

ACKNOWLEDGEMENT

The success of the preventive medicine mission would not have been possible without the diligent efforts of each team member.

LTC West, Team Leader
MAJ Mancuso, Epidemiologist
LCDR Jobanputra, USN, Infectious Disease Physician
LT Lyons, USN, Environmental Health Officer
CPT Price, Entomologist
SFC Garcia, Team NCOIC
SGT Russell, Preventive Medicine NCO
SGT Rivera, Food Inspector
HM1 Pallesco, USN, Preventive Medicine NCO
SPC Finucane, Preventive Medicine Specialist
SPC Choate, Preventive Medicine Specialist

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AUTHORS

CPT Price is a medical entomologist in the Entomological Sciences Division, USACHPPMEUR, Landstuhl, Germany.

LTC West is Chief of the Entomological Sciences Division, USACHPPMEUR, Landstuhl, Germany.

MAJ Mancuso is an epidemiology fellow at the Uniformed Services University of Health Sciences, Bethesda, Maryland.

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