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JOURNAL

THE US ARMY VETERINARY SERVICE: A NATIONAL DEFENSE RESOURCE FOR HEALTH

January – March 2013

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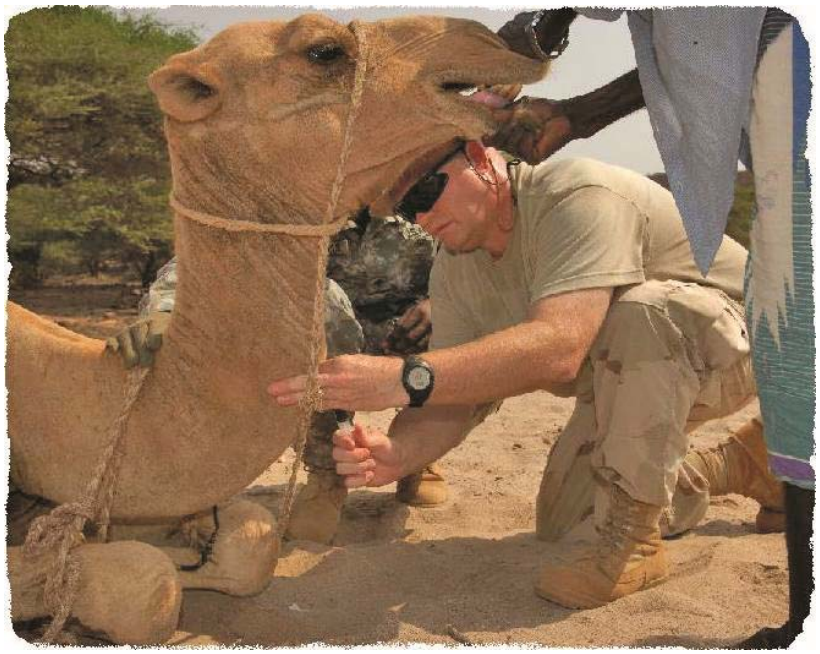

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Perspectives

Commander's Introduction

MG Philip Volpe

Veterinarians were first brought into US military service in 1776 by General George Washington to care for the horses of his Revolutionary Army. As the US military grew along with the expanding nation, veterinarians became even more important in caring for the numerous draft and cavalry horses and cattle required for armies to move and survive during campaigns. During the last half of the 19th century, veterinarians became increasingly in demand within the Army as their academic and scientific educations were recognized as valuable for functions beyond the care of animals. In 1916, the Veterinary Corps became part of the regular US Army, and veterinarians entered the service as commissioned officers.

The US Army Veterinary Corps has been featured in past issues of the *AMEDD Journal*. However, for this issue dedicated to military veterinary topics, BG John Poppe, the 25th Chief of the Army Veterinary Corps, has instituted a shift of focus. As a result, this issue expands the perspective with articles demonstrating the variety and importance of the Army Veterinary Service's responsibilities as a vital component of US military readiness and capability.

The veterinary medicine component of the Army Medical Department has undergone significant changes over the last few years, as the Army Veterinary Command was disestablished, and its resources, functions, and responsibilities became the province of the newly established US Army Public Health Command. BG Poppe opens this issue with a clear statement of his vision for Army Veterinary Services role in The Surgeon General's strategic initiatives for Army medicine and how it will be achieved, as well as an overview of the Services' organizational responsibilities and structure.

Most people who directly benefit from the work of the Army Veterinary Service have no idea that their good health is in many ways directly dependent on the education, training, skills, and motivation of these dedicated professionals. Although the articles in this issue provide considerable insight into the variety of capabilities and responsibilities of the Veterinary Service, the full extent of what they do every day far exceeds a single *AMEDD Journal*'s capacity for presentation.

A number of readers will no doubt be surprised to learn of the scope of the Service's work, as well as the high levels of qualification and education that are found among its professionals. Each day they are hard at work in the field and laboratories, conducting research on communicable diseases and biological weapons, protecting our food and water supplies, and caring for the military working dogs that are vital contributors to front line combat operations. Further, the dynamic character of the current conflicts has presented an entirely new set of previously undefined operational and support challenges and responsibilities. Army Veterinary Service personnel have repeatedly risen to the occasion, adapting, innovating, and doing what is necessary to protect the health and wellness of US citizens, our Warriors, and our invaluable military working dogs.

EDITOR'S PERSPECTIVE

This issue of the *AMEDD Journal* is the first to feature the work of Army veterinary professionals since the establishment of the Army Public Health Command, which absorbed the resources and functions of the now closed Army Veterinary Command. In his article, BG Poppe introduces the Veterinary Service, which, as the only US military veterinary asset, has both Army and Department of Defense missions. As an Army Medical Department organization, it supports The Surgeon General's concepts, initiatives, and plans, while meeting the veterinary support demands of the entire US military, both in garrison and deployed. The article also details all the professional specialties represented in the Veterinary Service, including the Veterinary Corps officers and the enlisted and civilian professionals, providing a complete, concise description of their functions and qualification requirements. Finally, BG Poppe presents his ideas and vision to ensure that support for the constantly evolving requirements facing the Army's unique resource will continue uninterrupted, while always maintaining the highest standards expected of military professionals. This is an excellent overview of the Army's veterinary capabilities and those dedicated individuals working in locations around the world who provide them.

Certainly, Army veterinarians represent "the best of the best" in education, skills, and training. However, even

they cannot make optimal use of those attributes without the services of skilled and dedicated assistants to complement and expand their capabilities. LTC Boris Brglez, LTC James Giles, and COL Kelly Mann have contributed an excellent, well-written article that chronicles the history of those assistants in Army service, describes the current status of their training, responsibilities, and assignments, and projects the logical course to address future animal care requirements. Today, those assistants are the Army Animal Care Specialists (military occupational specialty 68T) who are trained and assigned to provide the first level of animal care directly and independently, as well as provide assistance to veterinarians and more advanced animal care under their supervision. This article is a comprehensive, well-researched, and detailed look at this critically important personnel resource without which military veterinary medical care simply could not function. It should become an important source of information for anyone interested in the history not only of the animal care specialists, but also in the evolution of US Army veterinary medical care in general.

Veterinarians were engaged by the Army beginning in 1776 to provide care for the large animals which were vital for transport, and in some cases food. Today, of course, the military owns only a few horses, but military working dogs (MWDs) have become an increasingly important asset, especially in the nonlinear combat environments which have evolved since the Korean War. Those dogs are now the focus of the animal care specialties in the Veterinary Service, and in many ways present more complex concerns than did horses and cattle. In their article, LTC Janice Baker and MSG Laura Miller discuss an area of physiologic concern that must be addressed by military veterinarians because dogs now accompany human Warfighters into virtually every climatic environment. Military veterinarians in the Special Operating Forces are driving a collaborative initiative to investigate the physiologic capabilities of working dogs in order to define their limits for safe and effective use in extreme environments, which are currently grouped into 4 broad areas: extreme heat, extreme cold, maritime, and high altitude. This article's descriptions of the sophisticated research and analysis involved in this effort are excellent examples of the high levels of sophisticated technical and scientific skills that today's Veterinary Service professionals bring to work every day.

CPT Miranda Andress and MAJ Michelle Goodnight continue the topic of environmental concerns for MWDs in their article describing recognition and treatment of heatstroke. To underscore the potential seriousness of the problem, they open the article with a detailed clinical vignette of an incident involving an MWD who developed and subsequently succumbed to heatstroke in the summer of 2012, even with the immediate availability and application of veterinary care. They then provide a comprehensive, well-referenced description of the pathophysiology of veterinary heatstroke, its risk factors, and diagnosis and treatment of the condition. Their article is an excellent tutorial (or refresher) on this serious but highly preventable environmental threat to our valiant 4-legged Warriors.

CPT Curtis Cline also collaborates with MAJ Goodnight to contribute an article dealing with another environmental threat that our MWDs share with us, that posed by venomous reptiles. Their article centers around an MWD's encounter with a pit viper and the subsequent treatment of the resulting envenomation. Veterinary care was quickly obtained, but unfortunately there was no antivenin locally available with which to treat the dog. A quick assessment of the alternatives and rapid action allowed the MWD to be moved by air to another military veterinary treatment facility where the appropriate antivenin was available, resulting in a complete recovery. This article presents a textbook example of the application of clinical skills, initiative, resourcefulness, and quick coordination by which the veterinary staff successfully saved a valuable animal. Again, similar to the earlier article, CPT Cline and MAJ Goodnight have provided a comprehensive tutorial/refresher (and some lessons learned) concerning this very real and not uncommon threat to our MWDs.

Public health professionals have worked for years to establish surveillance systems and databases for communicable diseases over as much of the world as possible. Such systems are invaluable for spotting outbreaks, disease migrations, trends, etc, and for predicting disease incidents based on past data and current occurrences. However, as Dr Will Reeves and colleagues point out in their article, such surveillance systems do not capture data on zoonotic pathogens from veterinary clinics. Since a number of zoonotic diseases and parasites first present in animals that share human living spaces, the presence of such organisms in those animals would likely be detected before infections in the human population became evident. Dr Reeves and his team studied the records of veterinary care facilities on US military bases on the home islands of Japan from the past 10 years to evaluate the potential threat posed by zoonotic organisms to US military personnel and families. The article is a detailed, thoroughly referenced synopsis of their findings. The wide range of zoonotic parasites and pathogens found among the relatively small bases in an advanced country such as Japan should interest public health researchers in the potential value of veterinary

clinic surveillance data within their existing data structures and algorithms.

In addition to zoonotic diseases and parasites, veterinary and other public health professionals are concerned with reservoirs and vectors of infectious diseases, especially communicable viruses. Although most people are familiar with insect disease vectors such as the mosquito, there are animal vectors as well, including human beings. In her excellent, extremely interesting article, CPT Virginia White reviews influenza viruses that infect humans and pinnipeds, the species that includes seals, walruses, and sea lions. Surprisingly, mass mortality in pinniped populations infected with influenza has been observed for decades. CPT White's article is a compendium of detailed information about the various influenza viruses that infect pinnipeds, including etiology, epidemiology, pathology, diagnosis, and control, as well as transmission to humans. Especially interesting and concerning is her discussion of the presence of avian influenza strains in almost every analysis of pinniped influenza infection. This well-organized and extensively referenced article is a valuable introduction to the presence and pandemic potential of pinniped-borne influenza, as well as providing a virtual directory of information sources contained within its reference list.

For many decades, US travelers to undeveloped areas in the world have faced the possibility of developing digestive distress and illness from consumption of local foods. Indeed, most of us are familiar with semihumorous clichés coined for regularly visited areas, such as "Montezuma's revenge." Unfortunately, for a military force operating in undeveloped areas, such food-derived illnesses are absolutely not humorous—incapacitated military personnel can seriously degrade readiness, as has been demonstrated time and again throughout military history. Today's US military personnel receive some predeployment training in food choices, however, gastrointestinal illness still is in the top 5 diagnosed diseases among deployed personnel. In their article, Esther Pfau and her coauthors describe a joint initiative by the Army Public Health Command and the Army Medical Department Center and School to develop a different approach to predeployment training regarding food-borne hazards, and measure the effectiveness of that approach in comparison to existing training packages. The new training is designed to educate individuals on the hazards represented by different types of local foods they will encounter throughout the deployment area, not just about the foods available from "approved" sources. Ideally, such training would allow them to make informed decisions about which foods are safer than others simply based on the food itself, no matter where they are located. While not eliminating it altogether, informed choices should significantly reduce the incidence of gastrointestinal illness while deployed. This article is an excellent example of a carefully designed and implemented study, with meticulous attention to the determination of statistically valid effectiveness. The final product of such efforts is meaningful, effective training, actually of value to all who receive it.

Although the Department of Defense (DoD) conducts audits of food production facilities worldwide and maintains a directory of those that have met the inspection standards, it is unrealistic to think that an approved establishment will be available in every area, especially in remote locations, into which our Warriors are sent. Therefore, as discussed in the previous article, the risk of gastrointestinal disease is significant in such areas. LTC Jerrod Killian and his coauthors have contributed an article concerning an additional tool for US military commanders' efforts to provide safe food and water to US personnel working in or deployed to foreign countries. The Food and Water Risk Assessment (FWRA) program is designed to allow trained assessors to evaluate and communicate food-borne risks on a local, situational basis, allowing commanders to determine the level of acceptable risk in conjunction with the assessor who has veterinary risk mitigation expertise. The FWRA allows consideration of higher risk food operations than does the DoD audit and is therefore more dependent on local focus on mitigation. However, there are many situations in which a commander may have few options for feeding the force (at least in the short term), so the FWRA is a tool to help reduce the risk to manageable levels. This interesting and informative article is a tutorial for anyone planning for visits or deployments, operational or training, to less developed areas of the world.

As LTC (Ret) Nancy Vincent-Johnson explains in her article, until relatively recently, veterinary facilities on military bases within the continental United States were restricted, as a matter of policy, from providing more than the most basic of animal care services to non–government-owned animals. This limitation was imposed partly from tradition, partly from limited availability of veterinary personnel beyond their primary missions, and partly from political concerns regarding civilian practices in the areas of military installations. Such limitations were not imposed on remote installations where civilian veterinary care was not locally available, nor on overseas bases because of language barriers and the lack of equivalent standards of care. Eventually, the Army Veterinary Corps realized that these limitations were increasingly harmful to both recruiting and retaining high-quality veterinarians, as they saw their proficiency

in animal care skills atrophy from lack of application, thus depreciating the value of the considerable investments of time and money they had committed to their educations. The professional environment and policies had to change. LTC (Ret) Vincent-Johnson's interesting and very informative article describes the evolution of policies and standards that created a clinical credentialing program for new Army veterinarians, established an Army veterinary medical standardization board, and put in place the funding mechanism and structure to enable military veterinary clinical care of privately-owned animals on military installations. This is an excellent overview of positive, proactive actions by the Army Veterinary Service to ensure critical veterinary resources are available both now and in future years.

Among the many responsibilities and missions of the US military are those of Foreign Humanitarian Assistance (FHA), the most visible of which are disaster relief. Obviously, disaster relief missions must include military medical personnel, whose first responsibility is the health and well-being of the US personnel deployed, and who secondarily may be called upon to provide medical care to sick and injured local nationals, as well as to other foreign relief personnel. By their very nature, disasters usually provide minimal notice and preparation time, and sometimes achieving the optimum mix of skilled personnel may not be possible. MAJ Ronald Burke's article describes one such scenario for Army medicine's participation in relief operations for the devastating floods in Pakistan during 2010. This FHA was primarily transportation and logistics support, and as such only included medical support for the US contingent. However, because of political concerns, the US strength was limited to approximately 600 total, which meant that the organization was truly "contingency," as portions of units were mixed and matched to optimize capabilities with minimal personnel. The medical support contingent was likewise very basic, and included only a single veterinarian without enlisted preventive medicine or veterinary personnel. Of course the environment was austere, unsanitary, and remote, presenting a major threat of disease. MAJ Burke points out that a number of factors combined to allow the AMEDD professionals to successfully protect the deployed personnel, perhaps the most important of which was propitious cross-training within the 30th Medical Brigade of a year earlier which exposed the healthcare practitioners to preventive medicine tasks and procedures. Under the guidance of the veterinarian, the bare bones medical staff was therefore able to minimize the incidence of sickness among US personnel, especially achieving no cases of malaria or other arthropod-borne diseases. This article is an excellent lessons learned for AMEDD personnel who may find themselves attempting to assemble an austere but fully capable medical detachment with only immediately available personnel. The overall lesson: plan ahead for flexibility and shared responsibilities.

Throughout military history, interoperability among forces has simultaneously been a cherished goal and frustratingly difficult to achieve. The majority of experienced military personnel have likely dealt with challenges of operating with other services, and sometimes with diverse units within their own service. Communications, equipment, parts, and terminology are only a few of the areas of potential difficulty. The challenges become exponentially more numerous and complicated when operations involving multinational forces are considered. There are 28 nations in the NATO alliance, each one bringing a different perspective and capability into any discussion. It is, therefore, not surprising that achieving agreements involves considerable bureaucracy and negotiation, as well as a multilayered documentation scheme designed to address the concerns of all allies. In their article, MAJ Burke and his coauthors clearly illustrate the complexities involved in defining and adopting meaningful standardization across the NATO structure. Their article deals strictly with the areas of food, water, and animal use and care standardization, presenting them within the framework of NATO documentation and organization. This is an eye-opening look at the inner workings of NATO that work endlessly in efforts to achieve alliance-wide standards and understandings. NATO forces must deploy quickly and effectively when required, and there may not be time to worry about the source and quality of the food and water provided until you need it. Alliance-wide standardization is intended to allay those concerns and allow commanders to focus on the combat missions ahead.

The US Army Veterinary Service 2020: Knowledge and Integrity

BG John L. Poppe, VC, USA

As the 25th Chief of the US Army Veterinary Corps, I am honored to dedicate this issue of the *Army Medical Department Journal* to the US Army Veterinary Service. Although two previous issues focused on the US Army Veterinary Corps in 2007 and 2009 respectively, this is the first issue dedicated to the US Army Veterinary Service. The Army Veterinary Corps, represented by the caduceus with a black V, is comprised of officers, both veterinarians and warrant officers. The Army Veterinary Service includes those officers along with the outstanding enlisted Soldiers, both animal care specialists and veterinary food inspection specialists, and civilian professionals who span the spectrum from administrators to veterinarians. The Veterinary Service is represented by a distinctive insignia with a banner foundation of "Knowledge and Integrity," crowned by a unicorn. That insignia is featured as the background for the cover of this issue of the *AMEDD Journal*. It is a powerful image that will continue to represent our unique organization and remain the symbolic cornerstone of our Veterinary Service culture.

The insignia of the US Army Veterinary Corps.

My specified role as Chief of the Veterinary Corps has the additional implied task of representing the entire Veterinary Service.[1] The Veterinary Service has a Department of Defense (DoD) mission delegated from the Secretary of the Army through The Army Surgeon General. It is important that we remember that the center of gravity for the Veterinary Service is our deployable veterinary forces,[2] which are represented by a guidon with a green cross on a field of white.[3] These units and all Veterinary Service personnel support The Surgeon General's 3 strategic imperatives of creating capacity, enhancing diplomacy, and improving stamina[4] which similarly follows the Chief of Staff of the Army's imperatives of prevent, shape, and win.[5] Soldiers and their Families benefit daily from the Veterinary Service's installation support activities and research and development work, both of which contribute directly to the health and wellness of the Army.

The guidon of deployed military veterinary units.[3]

The US Army Veterinary Service is the undisputed world leader in the provision of military veterinary services, and has continued to grow with the demands of supporting an Army and nation at war in multiple theaters of operations over the last decade of conflict. In the future, we will continue to set the example for the nation in animal health, food protection, and research. As an integral component of Army medicine, it is imperative that the Veterinary Service continues to have a significant, positive effect on the health and readiness of the nation's Warriors. In accomplishing this, we follow the guidelines prescribed by The Surgeon General in Army Medicine 2020 Strategy.[4] We must create capacity to influence and enable individual, unit, and organizational health; enhance diplomacy by strengthening existing partnerships while building new ones to promote unity of effort in the pursuit of health; and improve organizational and individual stamina, an essential element in our transition to a system of health that will increase organizational depth, resilience, and endurance.

CREATE CAPACITY

The Veterinary Service must maintain its collective ability to develop the capabilities and core competencies necessary to deliver services and programs that influence overall health, and enhance Army Medicine's role as a strategic enabler for both the Army and the DoD as a whole. This includes optimization, innovation, and organizational learning. Creating capacity is about increasing the ability to influence health and readiness. It includes the delivery of animal health programs, food protection, biosurveillance, research, and the development of new methods to positively affect our beneficiaries' lives.

We must leverage technology through information management systems for animal health, food protection, and biosurveillance. We are currently in our second iteration of animal health electronic records that will replace our legacy systems and be

the link between our animal health and human health responsibilities. We continue to explore food protection solutions to enhance the ability to report those programs within the Defense Occupational Environmental and Health Readiness System to replace our legacy food audit and inspection programs. We must continue to seek solutions in biosurveillance that support the Army's and the nation's strategic defense priorities.

ENHANCE DIPLOMACY

The Veterinary Service leads the way with veterinary diplomacy, shaping dialogue on veterinary services within DoD, national, and international communities to build enduring relationships in line with Army values, interests, and objectives. Diplomacy begins with enlisted Soldiers, who provide the first line of defense in food protection and Role 1 veterinary care[6] to DoD military working dogs. Veterinary Service diplomacy is exemplified in 58 years of sponsoring the International Military Veterinary Medical Symposium, the 5 years of veterinary sessions of the Asia Pacific Military Medicine Conference, and the dedicated veterinary support of the series of training courses focused on stability operations. However, there is always more to be accomplished. For example, Veterinary Service personnel in the combatant commands must be proactive to identify military veterinary personnel in each of the countries in their respective areas of responsibilities, and seek venues within which to engage and build enduring relationships.

The US Army Veterinary Service continues to lead the way in the education and training of stability operations by developing the Veterinary Support of Stability Operations series of courses: Assessment and Production Systems, Global Veterinary Medicine, and Production Medicine Proficiency.

These courses, in conjunction with the Foreign Animal Disease Diagnosticians and the Medical Stability Operations courses, will ensure that Veterinary Services continues as the medical force of choice for the Army, DoD, and the nation in building partner capacities.

IMPROVE STAMINA

Recognizing that health is an integral component of readiness, the Veterinary Service will continue to improve organizational depth, resiliency, and endurance in order to withstand periods of intense change and unexpected challenges, and help ensure that the Army Medicine System for Health is supportable over the long term. The Veterinary Service supports the focus on health through food protection programs targeting both food safety and food defense, animal health programs which affect public health, and support of research that benefits all military personnel, both Warfighters and civilians, as well as their families. The Veterinary Service must increase both organizational and individual stamina throughout this intense period of institutional transformation, and then sustain the system for health for years to come.

CONTINUING 96 YEARS OF EXCELLENCE

Veterinary Corps

Veterinary Corps officers (VCOs) have supported virtually every US military involvement since World War I. They are not only skilled veterinary professionals, but also adaptive leaders trained for full spectrum military operations. Comprised of approximately 800 veterinarians and warrant officers, the Corps' expansive breadth of knowledge, training, and expertise in veterinary preventive medicine, laboratory animal medicine, veterinary pathology, veterinary comparative medicine, and a wide spectrum of animal health fields including surgery, internal medicine, and critical care medicine is an exceptional, invaluable resource, both nationally and internationally.

The Army Veterinary Corps is an invaluable resource of diverse veterinary experience and talent, sourced from an array of veterinary academic environments. Among its veterinarians are graduates from all 28 colleges of veterinary medicine in the United States, as well as from international veterinary colleges in Canada, the United Kingdom, Australia, the West Indies, Korea, and Mexico. The Corps is focused on the professional growth of its officers, who learn and train throughout their careers. In fact, postgraduate education or training is a requirement for career progression for VCOs. They have many options, including the pursuit of masters, PhD, and DrPH degrees in fields such as public health, epidemiology, or toxicology. They can also enter residency programs in laboratory animal medicine, pathology, clinical medicine, and other areas. Army veterinarians continue to achieve the highest rate of board certification of veterinary organizations of similar size worldwide.

In addition to the caliber and spectrum of talent among VCOs, the training and skills they acquire while serving strengthens the Corps' leadership position in the world. The Veterinary Corps maintains its level of professional excellence by providing Army veterinarians the training and skill sets needed to fulfill the Corps' crucial role within the defense structure of this nation. In this spirit, the Corps developed and implemented a First Year Graduate Veterinary Education program which aligns with similar existing programs for Army physicians and nurses. In the future, all new VCOs will start their Army careers at one of 8 projected veterinary centers of excellence throughout the United States. For their first

year, VCOs will acquire, develop, and refine the animal health, food protection, and leadership skills necessary to be a successful veterinarian, Army officer, and adaptive leader. Then, typically following 2 tours of duty, a VCO may choose to specialize in one of the following 5 areas of concentration:

Veterinary Preventive Medicine

Veterinary preventive medicine officers are leaders in public health functions and responsibilities at DoD installations throughout the world, as well as the austere operating environments of operational deployments. At the core of this specialty are the 5 core competency areas of the American College of Veterinary Preventive Medicine: epidemiology, infectious disease, food safety, environmental health, and public health. Through diverse education programs, they may add additional areas of expertise including human-animal bond, agricultural development, equine medicine, food laboratory diagnostics, wildlife management, humanitarian assistance, disaster response, and fellowships with the Centers for Disease Control and Prevention Epidemic Intelligence Service.[7] With the establishment of the US Army Public Health Command, veterinary preventive medicine officers will continue to be leaders in military medicine in the collaborative One Health Initiative, a global strategy to link animal, human and environmental health.*

Laboratory Animal Medicine

Laboratory animal medicine officers perform missions in animal care and use in research, development, training, and evaluation activities across DoD. They provide key oversight in DoD-funded animal care and use programs, both intramural and extramural, to safeguard animal welfare. They are skilled clinicians and surgeons, and are leading experts in animal facility management and animal husbandry. They collaborate closely with researchers. The US Army Laboratory Animal Medicine Residency Program is the nation's premier training program for laboratory animal veterinarians. Officers completing the program are eligible to sit for examination to achieve board-certification by the American College of Laboratory Animal Medicine. Select students may complete a one year master of public health program combined with a 2-year residency in laboratory animal medicine. The Army's program is the largest and most successful in the United States, with usual pass rates of over 90% compared to overall pass rates which typically range from 35% to 45%.

*The One Health Concept, first articulated by early scientists such as Rudolph Virchow, recognizes the intimate relationship between human health, animal health and the environment, and calls for an integrative, synergistic approach to health by encouraging collaboration among experts of diverse fields of study.[8]

Veterinary Pathology

Veterinary pathologists serve as integral members of DoD animal medicine programs and public health missions of the US Army Veterinary Service. They provide and manage comprehensive veterinary pathology training, consultation, education, and support for DoD diagnostic requirements and animal-use medical research and development programs. They train and educate VCOs in the specialty of veterinary pathology for field deployments and rapid assimilation into the research and development environment, and provide consultation and support to public health efforts in the diagnosis, surveillance, monitoring, and control of emerging, zoonotic, and foreign animal diseases in various operational settings. Veterinary pathologists are experts in diagnostic; toxicological; chemical, biological, radiological, and nuclear (CBRN); and comparative medical pathology. Such expertise is critical for medical countermeasure development, disease pathogenesis support, animal model development, research protocol design, ultrastructural and molecular pathology, and current and emerging infectious disease surveillance. The veterinary pathologist training program is a structured, proven training and education program.

Veterinary Comparative Medicine

Veterinary comparative medicine officers are the intellectual center of the Veterinary Corps. They are research principle investigators for CBRN, infectious and emerging infectious diseases, and environmental and toxicological studies. They are also program managers for CBRN programs and provide scientific management of the research disciplines. These highly specialized veterinary research officers are key contributors to developing countermeasures against biological agents. These include diagnostics, vaccines, therapeutic agents, and operational practices. They are highly skilled in complex study design, critical analysis, and decision-making, and are called upon as subject matter experts in the areas of DoD medical research and translational medicine.

Veterinary Clinical Medicine

Veterinary clinical medicine officers are highly skilled animal healthcare providers, trained in surgery, internal medicine, emergency/critical care, diagnostic imaging, canine sports medicine and rehabilitation, and animal behavior. They play an indispensable role in the medical care of military working dogs (MWDs) and provide deployment Role 1-3 MWD care in austere environments and at DoD installations throughout the United States. They provide Role 4 MWD consultation and referral care at the world-renowned Holland DoD Military Working Dog Hospital at Lackland Air Force Base,

Texas. They have an outstanding reputation throughout not only the Army Medical Department (AMEDD), but also the veterinary medical community at large as champions of MWDs and their well-being. In the future, this specialty will focus on a more generalized skill set to sustain MWD populations and to better support the requirements of deployable forces and units.

Other Veterinary Service Professionals

Veterinary Service warrant officers, noncommissioned officers, enlisted Soldiers, and civilians are essential in the execution of the full spectrum of our veterinary service mission.

Veterinary Corps Food Safety Officers are highly specialized in the area of food protection. They are selected from the noncommissioned officer ranks by a competitive application process. After completing the Warrant Officer Candidate Course, the basic course, and several assignments, most are selected to further their food protection education in bachelors or masters programs in civilian institutions.

Veterinary Food Inspection Specialists inspect foods of both animal and nonanimal origin, as well as operational rations at depots, supply points, and on military installations to assure a safe, high quality food supply for DoD personnel. We encourage them to broaden their expertise by continuing their civilian education. One avenue is a bachelor of science degree program in food science available through DoD's Servicemembers Opportunity Colleges.*

Animal Care Specialists provide the care, management, and treatment for animals, as well as ensuring sanitary conditions in their environments. Their primary responsibility is comprehensive care for government-owned animals and the prevention and/or control of diseases transmitted from animal to man. Animal care specialists are encouraged to advance their professional education by pursuing an associate of arts in veterinary technology degree through the Servicemembers Opportunity Colleges.

Veterinary Service Civilians are veterinarians, animal care technicians, receptionists, secretaries, laboratory technicians, instructors, and other administrative and technical support in the ever-expanding Veterinary Service mission. We encourage them to continue their civilian leader development with courses available through the AMEDD Civilian Corps.

*A DoD sponsored association representing a consortium of approximately 1900 institutions of higher learning which works to make educational opportunities available to servicemembers and their families, despite the frequent relocations and disruptions demanded by their military service. Information available at http://www.soc.aascu.org/.

THE WAY AHEAD

The US Army Veterinary Service will continue to man, equip, and train the best military veterinary force in history. The leader development of our Veterinary Corps officers, which ensures mission excellence, will continue to produce a range of experts from generalists to specialists while maintaining a core set of competencies. We choose to promote veterinarians not by specialty, but with the understanding that no matter what specialty a veterinarian may choose, at some point he or she may be asked to take leadership positions outside that specialty area.

Training

The Veterinary Service must continue its training excellence by standardizing terminology. To fulfill that need, an impending DoD directive will codify the Service's primary mission as food protection, animal health, veterinary public health, and support of research, development, test, and evaluation. We must continue to develop the doctrine that supports recent changes to force structure that require updated manuals and combined arms training strategy as well as supporting our new relationship within the Public Health Command. In order to better prepare our enlisted Soldiers, especially for service within deployable formations, we may want to consider developing phase 2 training sites for veterinary food inspection and animal care specialists in conjunction with our First Year Graduate Veterinary Education locations. We must prepare the leaders of veterinary support deployable units in the lost art of training management for full spectrum operations, and ensure each veterinary Soldier receives appropriate proficiency training by leveraging installation veterinary support opportunities.

Organization

The Corps Chief's office consists of the Deputy Chief, who also serves as the Director of the Department of Defense Veterinary Service Activity, who is responsible for policy, coordination, and the primary staff officers for the Office of The Surgeon General; two Assistant Corps Chiefs, one for Human Resources who also serves as the Corps Specific Branch Proponency Officer (CSBPO) and the other for Reserve Affairs. Two of the primary responsibilities of the CSBPO are the Long Term Health Education and Training (LTHET) program and the Post Professional Short Course Program (PP-SCP). A unique characteristic of the Veterinary Corps LTHET programs is that all who complete the program are qualified for a specific Army area concentration of

veterinary medicine. The focus of the Corps Chief's office is reflected in PPSCP courses such as the Veterinary Support of Stability Operations. The Corps Assistant Chief for Mobilization and Reserve Affairs coordinates the activities of our Army Reserve and National Guard veterinary personnel.

Governance of the Veterinary Service is executed through the Veterinary Executive Council, which includes the previously mentioned officers from the Corps Chiefs office and consultants for each of Veterinary Corps areas of concentration, as well as the senior warrant officer and enlisted consultants. Rounding out the group is the chief of the AMEDD Center and School Department of Veterinary Science as the primary educator and trainer, the Veterinary Corps officer at the AMEDD Personnel Proponency Directorate as the personnel life-cycle designer, our officer at the Directorate of Combat Development and Doctrine (DCDD) as the developer of force structure and doctrine, and the Deputy Commander for Veterinary Services, US Army Public Health Command.

Veterinary support is one of the 10 functional areas within the AMEDD. The coordination and synchronization of Veterinary Service personnel—the family of veterinarians, warrant officers, enlisted Soldiers, and civilians—is unique within AMEDD, the Army, DoD, and the nation. The special skill sets and expertise of the US Army Veterinary Service are needed by many federal and other agencies, and make it a distinct national treasure. It is this culture that we have developed, started long before the 1916 inception of the Veterinary Corps, which must be maintained, no matter the changes made in the constant structural adjustments and transitions of the Army.

Leadership

The Veterinary Service will continue to embrace leadership that recognizes that we are Soldiers first; officers, warrant officers, noncommissioned officers, or enlisted second; and veterinary medicine specialists third. We will continue to foster the culture of integrity—one that plans to not just meet the standard but to exceed it, each and every day, even when no one is watching. We will continue to seek leaders that lead by example, recognizing that you cannot ask anyone to do anything that you would not do yourself.

CONCLUSION

After more than 10 years at war with an all-volunteer force, we are stronger and in a better position to support the nation. The Army Veterinary Corps is supported by an exceptional team of 2,100 enlisted Soldiers and noncommissioned officers, and nearly 600 Army Veterinary Service civilian personnel. They are instrumental in the provision of outstanding veterinary support to almost 500 installations, a multitude of deployable units, and research laboratories across the DoD. Veterinary Service officers, warrant officers, noncommissioned officers, Soldiers, and civilians are guardians of the DoD food supply, leaders in animal health, and provide critical support to research. They are a highly skilled, adaptive, and empowered veterinary team in support of full spectrum operations for the DoD. What truly makes our organization unique is the wide spectrum of professionals and their breadth of knowledge and experience. As we approach the US Army Veterinary Corps' centennial anniversary, it is clear that the Veterinary Corps and Service are resilient organizations and together form a crucial part of the Army Medicine team in support of our nation's security and safety.

Knowledge and Integrity!

ACKNOWLEDGEMENT

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The Army Animal Care Specialist; Past, Present, and Future

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This article reviews the history of the Animal Care Specialist, military occupational specialty (MOS) 91T; summarizes recent innovations in the Animal Care Specialist, MOS 68T; and discusses future trends in military veterinary medical care affecting these Soldiers and the Army, Navy, Marine Corps, and Air Force units they support.

HISTORICAL BACKGROUND

The US Army Veterinary Corps was established in 1916. The *1926 Army Medical Bulletin* indicates that Veterinary Corps officers of 1926 trained enlisted specialists in the Veterinary Service in the following areas:

- Veterinary Technician, General (dealing principally with the duties of animal nursing)
- Veterinary Laboratory Technician
- Veterinary Pharmacy Technician
- Veterinary Sanitary Technician
- Veterinary Surgical Technician
- Veterinary Hygienist, Meat and Dairy
- Veterinary Clinical Horseshoer

The *1926 Army Medical Bulletin* defined the responsibility of the veterinary technician as:

> …an assistant to the veterinary officer who must learn to appreciate the seriousness of any communicable disease and to thoroughly acquaint [themselves] with the cause and details of control and eradication in order that he may be entrusted with routine procedures. The senior veterinary technician must be competent to prepare and keep up to date all the required records.

Field Manual 8-5: Mobile Units of the Medical Army (1945)* defined the veterinary technician as:

> …specially trained in the following procedures as they pertain to animals: practical nursing under the restricted conditions obtained in the field; in taking and recording temperature, pulse, and respiration; in catheterization; in giving of enemas and irrigations; in the administration of medicines; in the application of special dressings and bandages; in the application of blisters† and their aftercare; in the handling of cases of communicable diseases; and in the preparation of veterinary records, reports, and returns.

In 1941, the Army published *Technical Manual (TM) 8-450: Veterinary Administration*,* a 28-page administrative technical manual for veterinarians and technicians that emphasized the care of horses and food inspection. A year later, change 1 expanded *TM 8-450* to 39 pages. The 1951 edition of *TM 8-450* for the first time included a 16-page chapter on dogs called "Canine Management" which discussed canine anatomy, physiology, and medicine. In the March 1966 Monthly Memorandum (MEDVS) published by the Office of The Surgeon General, *TM 8-450* was not listed as a study guide for the Animal Care Specialist, MOS 91T. The manual had become outdated and was discontinued until an update was published in July 1968. The updated *TM 8-450 (Animal Specialist)** manual had grown to more than 200 pages and was intended for use as a training aid and reference study guide for the MOS 91T Soldier. It was the first Army technical manual specifically addressing canine care for the animal care specialist and was the forerunner of the MOS 91T Soldier's Manual. After updates in 1972 and 1977, this manual was replaced in 1985 by the current *Soldier's Manual and Trainer's Guide: MOS 91T, Animal Care Specialist*.[1]

Field Manual 8-5, Medical Service Units Theater of Operations (1959),* documented the transition from the veterinary troop cavalry hospital to the veterinary small animal hospital detachment known as TOE‡ Team ID. This detachment was allocated on the basis of one per field army and one per 500 animals in the communications zone. The veterinary small animal hospital detachment had the capacity to treat 50 small animal patients. The responsibilities of the veterinary small animal hospital detachment were as follows:

*Obsolete, no longer in effect.
†Blistering was an old and controversial practice of applying an irritating substance to an injured area in order to increase the inflammatory reaction and possibly speed the healing process.
‡Table of Organization and Equipment: Defines the structure and equipment for a military organization or unit.

- Provide veterinary care and treatment for all small animal patients (dogs) evacuated to the detachment.
- Restore small animal patients to service as soon as possible.
- Dispose of small animals deemed unfit for further service.
- Treat and prepare for further evacuation small animal patients requiring prolonged treatment beyond the capabilities of the detachment.

Team ID included 2 veterinarians, one of whom was the commander. Twelve enlisted personnel included in this detachment were:

- One chief veterinary animal specialist (NCO,* MOS 91T/E5)
- One senior veterinary animal specialists (MOS 91T/E5)
- One veterinary laboratory specialist (MOS 92B/E5)
- 6 veterinary animal assistants (MOS 91T, 2 E4s and 4 E3s)
- One clerk (MOS 71A/E3)
- One patient administration clerk (MOS 71G/E4)
- One animal tender (MOS 91T/E2)

In order to provide a country-wide veterinary hospitalization capability, the 936th Medical Detachment (ID), Veterinary Small Animal Hospital, was activated on August 19, 1965, at Fort Ord, California.[2] It had 2 officers and 10 enlisted Soldiers, with Captain Bernard Mistretta commanding and Captain Howard Hamby as deputy commander. In December, the detachment embarked from Long Beach, California on the USSN *Leroy Eltinge*. After 3 days at sea, the unit gathered to open their classified orders. The envelope only contained 12 pamphlets entitled "Welcome to Vietnam." CPT Mistretta had been in the Army for a few months following his college graduation, CPT Hamby had just graduated, and the noncommissioned officer-in-charge (NCOIC) was a young sergeant. The unit arrived in Saigon, Republic of South Vietnam on December 23, 1965, and prevailed in the task ahead despite the odds.

In 1961, veterinary specialists began receiving more formalized training in canine and laboratory animal medicine at the Walter Reed Army Medical Training Center. SGM William Kadic (MOS 91T) and CPT Randy Vanderhurst formalized the 91T training, culminating with the first "official" 91T graduation on December 16, 1966. The *US Army Formal Schools Catalog* (*DA Pam 350-10*,

SGM William Kadic

CPT Randy Vanderhurst

1968)† contained the first entry for the Veterinary Specialist Course (321-91T 20) to be presented at the Walter Reed Army Institute of Research (WRAIR), Walter Reed Army Medical Center, Washington, DC. The Randall Building at WRAIR, which opened on August 10, 1971, was specifically designed to house dogs, monkeys, and chimpanzees used in research and in the training of Veterinary Specialists, MOS 91T.

While the US Army and the Veterinary Technology Schools were credentialing technicians, the American Association for Laboratory Animal Science (AALAS) was doing the same. In 1966, AALAS formed the Animal Technician Certification Board program to begin the certification of laboratory technicians.[3] In 1967, AALAS published the first Manual for Laboratory Animal Technicians. One year later SGM Kadic became one of the first MOS 91T Soldiers to receive Laboratory Animal Technologist certification, followed later in the 1970s by SFC William Wade and others. On December 3, 1971, the Veterinary Corps announced 3 AALAS certification programs: Assistant Laboratory Animal Technician, Laboratory Animal Technician, and Laboratory Animal Technologist. The position of licensed veterinary technician had yet to be defined. The first Animal Technician National Examination was given in 1986 in the state of Maine. In 1989, the American Veterinary Medical Association (AVMA) House of Delegates approved the use of the term "veterinary technician" to replace "animal technician"; ironically, the Army first used the term "veterinary technician" in the 1920s.

The creation of civilian veterinary technology programs is credited to Dr Walter Collins, a former Air Force veterinary technician (1952-1956) and later Director of Veterinary Technology at the State University of New York Agricultural and Technical School in Delhi, NY. Dr

*Noncommissioned officer

†Obsolete, no longer in effect.

Airman Walter Collins, 1952

Dr Walter Collins, 1980s

1LT Douglas McBride, 1956

Collins and his staff, some of whom had prior military backgrounds (Army veterinarians Douglas McBride and Randy Vanderhurst; Veterinary Technician Daniel Walsh), were instrumental in getting AVMA involvement and accreditation for technician programs. During a conversation between author LTC Brglez and Dr Collins (2011), he reminisced:

> Everyone must understand, when this program (and many like us) first started there were many naysayers and practitioners even (not to mention Veterinary Colleges and the AVMA) who were very skeptical about the training of veterinary technicians and were worried we might be producing charlatans or quacks. This did not deter our faculty from its goal of reversing this archaic prevailing belief of the 1960s.

Despite initial resistance, veterinary technology became AVMA accredited in 1973, beginning at Michigan State University and later the Nebraska College of Technical Agriculture. Dr Walter Long (University of Nebraska), Dr Vanderhurst (Colorado Mountain College), and Dr Roger Lukens (Purdue University) were pioneers in the establishment of veterinary technology programs throughout the United States. By the year 2000, 86 programs were accredited by the AVMA, including 2 distance learning programs. SFC William Wade (1974-1994), prior Air Force veterinary technician and later Army 91T, was one of the first to become a licensed veterinary technician (LVT). Today there are 203 AVMA-accredited veterinary technology programs, including 22 four-year degree programs and 9 distance learning programs.[4]

FROM CAVALRY TO K-9 CORPS

American Expeditionary Forces of World War I had no organized canine units. The French and Belgian armies provided US forces with dogs used for casualty, messenger and guard duty. Prior to World War II (WWII), the US military had 50 sled dogs in Alaska and 40 dogs used in Admiral Byrd's Antarctic Expedition. Additionally, there were a handful of dogs at Camp Haan and Fort MacArthur in California, and local sentry dog programs for the Coastal Artillery. An official, systemic dog program did not exist. In January 1942, Congress enacted "Dogs for Defense Inc," and on March 13, 1943, the US Quartermaster Corps established the K-9 Corps. Of the 20,000 dogs procured throughout WWII, more than 11,000 were trained for service as messengers (151), scouts (595), mine detectors (140), sled and pack use (368), and sentries (9,298). During the Korean War, the Army used approximately 1,500 dogs, primarily for sentry duty.[5] About 4,000 dogs were employed during the Vietnam War, of which 281 were officially designated as killed in action.[6]

The first graduating class of Veterinary Specialist Course (321-91T 20) at the Walter Reed Army Institute of Research. Front row, left to right: PVT Kenneth Poston, PVT Kenneth Rosak, PVT Robert Miller, COL Stephen G. Asbill (Director), PVT Leanard J. Berube, PVT Richard Bernyk, PVT Jerry Ford, PVT Jerry Ehrhart. Back row: PVT Robert L. Tokin, PVT James Wade, PVT John Redmond, PVT Ike Bootsman, PVT Eugene Morris, PVT Erving Gustafson, PVT William Buckman, PVT Gerald Alexander. Photo by PFC Ford, US Army Signal Corps, December 16, 1966.

The advent of fighting with mechanized vehicles during WWII greatly reduced the need for horse-mounted cavalry. This transition, coupled with the creation of the K-9 Corps, transformed Army Veterinary Services. Veterinarians and animal care technicians had to realign doctrine, organization, training, leadership, equipment, and personnel to support the European and Pacific theaters. Horses remained necessary to fight on terrain ill-suited for vehicles, such as the Italian mountains and dense jungles of Burma. However, use of horses was minimal compared to that of leashed and unleashed war dogs. Prior to 1941, US Army veterinary manuals and medical records for canines were nonexistent, unlike the volumes of regulations and field manuals regarding equine care, shoeing, medical equipment, and veterinary cavalry hospitals. For example, *Field Manual 8-5: Mobile Units of the Medical Army* (1945)* described Veterinary Services' role in the horse cavalry and contained no mention of supporting roles for canine units.

The US Infantry capitalized on the dogs' extraordinary sensory capabilities, fearless nature, and ability to track the enemy. Scout dogs were considered the most critical; their ability to detect the enemy and provide a silent warning in semidark, dense, thick jungles was invaluable, and could not be duplicated. Although originally trained for sentry duty while in Sicily, Chips, the most famous dog of WWII, was an excellent scout and attack dog. As reported by Company I, 30th Infantry Regiment, 3rd Infantry Division, Chips attacked an enemy machine gun crew in a pillbox off-leash, seizing one man and forcing the remaining crew of four to surrender.[7]

Following WWII, the USAF had an increased demand for sentry dogs as a result of a lack of personnel to guard Strategic Air Command bases. In October 1958, the USAF became the executive agent for military working dogs (MWDs), and the Sentry Dog Training Branch of the Department of Security Police Training was established at Lackland Air Force Base, Texas.

The first significant Army manual devoted to training and care of war dogs was *FM 25-6: Dog Team Transportation* (1941).* This manual included an additional 70 pages on canine care not found in the first edition published in 1926. *Field Manual 72-20: Jungle Warfare* (1942)* discussed working dogs' valued roles as scouts and messengers with proven value in combat. Jungle warfare doctrine anticipated that dogs would be commonly used in the future, a prediction that came true, as illustrated in today's special and conventional forces. With the establishment of the K-9 Corps, the Quartermaster Corps released *Technical Manual 10-396: War Dogs* (1943),* the first comprehensive manual on dog care, of which 11 pages were dedicated to canine preventive medicine and treatment. *Field Manual 70-15: Operations in Snow and Extreme Cold* (1944),* reiterated canine capability for scouting and messaging and as excellent sentinels.

*Obsolete, no longer in effect.

The 91T MOS was changed to 68T in 2006.[8] Today, increased numbers of Soldiers with MOS 68T are being permanently slotted in combat organizations without the direct supervision of a veterinarian. The increased responsibility of those Soldiers requires reassessment of the MOS 68T skill set and redefinition of Veterinary medical care Roles 1-4.

FROM ECHELONS TO ROLES OF VETERINARY MEDICAL CARE

Army Tactics, Techniques, and Procedures No. 4-02[9] defines Roles 1, 2, 3, and 4 of military veterinary care, formerly specified as I through V echelons of care in the 1942 release of *Field Manual 8-10: US Army Medical Service Field Units*.* In today's Army, Role 1 veterinary medical care is provided by an animal care specialist, MOS 68T (who is often referred to simply as 68T), assisted in his/her duties by the handlers of military working dogs (MWD), equestrian, livestock, or Navy marine mammals, who provide immediate first aid for animals in their charge in the event of injury, with or without a Veterinary Corps officer (area of concentration (AOC) 64A) present. The capabilities for Roles 2 and 3 veterinary care are found in the Medical Detachment (Veterinary Service Support) (MD(VSS)). Role 2 is provided by 5 identical Veterinary Service Support Teams (VSSTs), each staffed by one Veterinary Corps officer (AOC 64A), one 68T, and 5 food inspection specialists (MOS 68R). Role 3 veterinary care is provided by a Veterinary Medical Support Team (VMST), consisting of one veterinary clinical medicine officer (AOC 64F) and 3 animal care specialists (MOS 68T).

The treatment goal for each role of medical care is to provide definitive treatment for return to duty or evacuation to a higher role of care. Veterinary Role 1 medical care may be provided by either a 68T or Veterinary Corps officer (VCO) who is individually assigned to various Army, Marine Corps, Navy, or Air Force field units or VSSTs. In the event a 68T or VCO cannot provide Role 1 care at the point of injury/sickness, a handler will perform basic emergency first aid procedures and prepare the animal for evacuation to a higher role of veterinary medical care. Depending on the type of emergency, the 68T or VCO will evaluate and stabilize the traumatized or ill patient to enable the patient to withstand further evacuation for definitive treatment at either a forward deployed Role 2 VSST or Role 3 VMST.

The VSST Role 2 veterinary medical care includes veterinarian-directed resuscitation and stabilization and may include advanced trauma management, emergency medical procedures, and forward emergency resuscitative surgery for dogs, horses, livestock, or Navy marine mammals. This role may provide care for up to 10 MWDs.

Role 3 veterinary medical support by the VMST is designed to care for dogs only. It includes veterinary diagnostic, therapeutic, and surgical procedures. Veterinary care administered at this role requires advanced clinical capabilities and can provide care for up to 50 MWDs. Veterinary Role 3 capability is not routinely provided for horses, livestock, or Navy marine mammals. Prior coordination is necessary for any veterinary Role 3 care required for horses, livestock, or Navy marine mammals.

No kennels are provided for Veterinary Role 2 or Role 3 medical care in the MD(VSS). In common usage, the term "kennel" is a fixed habitat for boarding dogs, whereas "crate" refers to a mobile carrier for transporting individual dogs. Crates may be used for temporary housing of dogs as necessary. Fixed veterinary treatment facilities located on military bases have kennels, and may have crates available for transport of dogs. In a deployed environment, tents may be used for veterinary surgical treatment facilities and crates are used as kennels. Each dog has a crate and the handler is expected to remain with the animal at the facility. The VMST can provide a minimum of 8 crates where dogs may be housed. As with dog handlers, horse riders, livestock caretakers, and Navy marine mammal handlers must remain with animals in their custody while at a treatment facility.

Veterinary Role 4 medical care is provided in the United States by the Department of Defense (DoD) MWD Veterinary Service at the LTC Daniel E. Holland MWD Hospital located on Lackland Air Force Base, Texas. Veterinary Role 4 medical care expands the capabilities available at veterinary Roles 1, 2, and 3 medical care facilities and provides additional specialized veterinary medical and surgical care, rehabilitative therapy, and extended convalescent capability.

Currently, animal care specialists are organic to specific units, such as Army Engineer and Ranger, the Navy Marine Mammal Program, and the Medical Detachment (Veterinary Service Support). The animal care specialist supervises or provides the care, management, treatment, and sanitary environment for animals. A primary responsibility of the 68T is the prevention and control of diseases transmitted from animal to human and comprehensive care for government-owned animals. Nonveterinary personnel, such as handlers, are trained to perform lifesaving and first aid procedures until an animal care specialist or a veterinarian is available.

ANIMAL CARE SPECIALIST (68T) TRAINING UPDATE

The 68T10 advanced individual training (AIT) program is currently an 11-week in-residence training program at the Army Medical Department Center and School (AMEDDC&S). There are 5 to 6 courses with class sizes ranging from 15 to 30 conducted annually, available to both active duty and reserve Soldiers. Eighty-two of the 101 68T10 level skills on the critical tasks list are addressed during AIT. The skills not trained during AIT are primarily laboratory animal and large animal tasks designated as on-the-job training for Soldiers assigned to units performing those missions. The 68T10 students are exposed to a broad range of veterinary topics, some of which include basic anatomy and physiology, system diseases and disorders, pharmacology, parasitology, mathematics and dose calculations, hematology, radiology, surgery support, anesthesia, dentistry, shock management, wound management, initial management of various MWD emergencies, canine and feline care and management. Approximately 30% of the training is classroom environment, the remainder is conducted in hands-on demonstrations, exercises, and practical examinations. The areas of largest focus include monitoring the anesthesia patient, animal husbandry, and MWD emergency management. The training is divided between the AMEDDC&S, the Holland MWD Hospital, Fort Sam Houston Veterinary Treatment Facility, Camp Bullis field training site, and the Fort Sam Houston Equestrian Center. The primary goal is to graduate a 68T10 that is in the "walk" phase of the "crawl, walk, run" concept for most of the 68T critical tasks. The majority of the 68T critical tasks list trained by AIT is intended to maximize the skill set of the junior 68T assigned to table of distribution and allowances* and modified table of organization and equipment (MTOE) veterinary assets. The 11-week duration of the course, coupled with the broad scope of veterinary practice, necessitates that many skills will need extensive development at the 68T's first duty station. Without additional training, graduates of the 68T10 program are not eligible to take state or national examinations to gain licensure as an AVMA registered (or certified, licensed) veterinary technician. As a comparison, the AVMA-accredited residence training program for veterinary technicians is 2 years in length.

The next available course in the 68T lifecycle following AIT is the 68T Clinical Proficiency Course (CPC),

*Prescribes the organizational structure, personnel and equipment authorizations, and requirements of a military unit to perform a specific mission for which there is no appropriate table of organization and equipment

first offered in 2006. A 5-day residence course at the AMEDDC&S offered semiannually to both active duty and reservists with at least one year experience in the MOS, the CPC has a class size up to 24 students. The target rank is E4 and E5, but exceptions are frequently granted for Soldiers who are deploying or assigned to an independent 68T duty site. There are currently 22 critical tasks for the 68T20, however, the short duration of this course requires a number of the tasks to be conducted at unit level or the next phase of residence training. The focus of this course is to prepare the 68T to perform advanced technical skills with minimal Veterinary Corps officer oversight. For that reason, 60% to 70% of the material is taught through hands-on exercises, wet laboratories, and student-led presentations. Some of the topics include the MWD handler training support package, foreign animal disease, rabies management, MWD program overview (deployment issues, medical evacuation, physical conditioning, and rehabilitation), canine cardiopulmonary resuscitation/basic cardiac life support, advanced hematology, advanced trauma laboratory, anesthesia monitoring problems, wound management techniques, equine management, necropsy, radiology and ultrasound examination. The trauma and wound management scenarios are conducted on a combination of patient simulators and canine cadavers. The 68T CPC is strongly encouraged, but not a mandatory part of the 68T track.

The next phase in the 68T career track is the 3-week technical track of the Advanced Leader Course (ALC), which is preceded by 3 weeks at the NCO Academy and 40 hours of NCO Academy distributed learning. The target population is E5 and E6, both active Army and reservists. Due to the longer duration of ALC relative to the CPC, a number of 68T20 critical tasks in addition to the 68T30 tasks are taught in this course. Those tasks deal with Occupational Safety and Health Administration rules and requirements, and controlled substance management. Approximately 35 hours of the course are dedicated to NCOIC duties in the veterinary treatment facility (VTF). Formerly, the Army Veterinary Command provided this training in the VTF Management Course designed for prospective VTF NCOICs. The inclusion of this content in ALC ensures it is a part of the 68T education experience. However, some Soldiers may attend ALC after they served as a VTF NCOIC, missing the optimal training window. The course content is approximately 60% hands-on/demonstration and 40% classroom instruction. Sixteen hours of the course are student-led foreign animal disease and parasitology research, and papers and presentations in the adult-learning model concept. There is moderate reinforcement of topics from the 68T CPC course, although trained to a greater depth in areas such as MWD program and issues, advanced laboratory diagnostics, advanced principles of anesthesia, abdominal ultrasonography, triage and emergency patient management, veterinary nursing management, and critical skills lane training. Both ALC and 68T CPC are scheduled to coincide with the Veterinary Support to a Theater of Operations Course or the Veterinary Corps Officer Basic Officer Leadership Course, which feature a live-tissue training laboratory for Veterinary Corps officers and affords the 68T hands-on opportunity for surgical preparation and support, anesthesia induction and maintenance, and emergency procedures. Other emergency and nursing care skills are reinforced on simulator and cadaver models. In the near future, the VTF Management Course will transition to the Army Public Health Command, and the MOS portion of the 68T ALC will decrease to 2 weeks.

A 68T30 distributed-learning package is in development and pending approval from the Army Learning Management System (ALMS) and US Army Training and Doctrine Command. The online course consists of 5 in-depth training and testing modules covering small and large animal medicine, diagnostic testing, anesthesia, surgery, and office management. The original intent of the 80-hour distributed-learning product was to serve as a prerequisite for the ALC technical track in order to reduce track length and enhance training time for advanced tasks. However, the maximum distributed-learning time is already in use by the NCO Academy. When approved and placed on the ALMS site, the product will be available for unit and individual training, but not included in a mandatory component of the 68T lifecycle. To increase its use, there is a proposal to designate the distributed-learning package as a prerequisite for the 68T CPC.

Animal Care Specialists assigned to a DoD research institution will undergo an internal training program to meet the technical proficiency standards outlined by the animal use program description. While further laboratory animal technical training and certification is not a requirement, it is highly encouraged and the institutions generally do pay for the 68T to take certifying examinations from AALAS. The 3 levels of certification—Assistant Laboratory Animal Technician (ALAT), Laboratory Animal Technician (LAT), and Laboratory Animal Technologist (LATG)—correlate with specific requirements for education and experience. While a college degree is not required for the ALAT, LAT, or LATG examinations, the on-the-job experience requirement is reduced for college graduates. The AALAS also maintains a technician certification registry with the "R" designator with those certifications for technicians that maintain requisite continuing education units.

In 2010, the Army approved a veterinary technology associate's degree in the Servicemembers Opportunity College Army Degree program with the AVMA-accredited online institution, San Juan College (http://www.sanjuancollege.edu/vettech). The program is funded through tuition assistance for eligible Soldiers. Graduates of the 68T Animal Care Specialist Course are awarded 26 credit hours, and 68T ALC graduates receive an additional 6 credit hours towards the 75 credit hour Associates in Applied Sciences degree. Completion of this AVMA-approved program allows a graduate to sit for the Veterinary Technician National Examination to become a registered veterinary technician. Historically, veterinary technicians of varying educational backgrounds could challenge the certifying examination, however, current examinees must be graduates of an approved AVMA program. The credits are fully transferrable to other AVMA-accredited institutions, including the 4-year veterinary technology program. This represents an excellent opportunity for the 68T to obtain a degree relevant to their field, improve their skill set, obtain national certification, improve the professional standard of the Veterinary Corps, and increase their postservice civilian earning potential. The American Animal Hospital Association reports that in 2009 the national average salary for a registered veterinary technician was $32,635, compared to $27,518 for a nonregistered technician.[10] At the time of this writing, 22 animal care specialists are actively enrolled in the San Juan College veterinary technology degree program. While there is no current requirement for 68Ts to have civilian licensure as a veterinary technician, it is a point of discussion as a future lifecycle requirement as we seek to improve the professional standards of the Veterinary Corps and keep pace with civilian education trends.

CURRENT OPERATIONAL SUPPORT AND FUTURE TRENDS

Defense security industries and the MWD community experienced exponential growth in their missions after the terrorist attacks of September 11, 2001. The expansion is evident in both raw end-strength numbers and the increasing variety and specialization of working dog and handler programs. Prior to 2001, the majority of MWDs were dual-trained (patrol/narcotics and patrol/explosives detector dogs). In the years after the terrorist attacks, the Army, Marine Corps, Navy, and Air Force MWD program managers researched, developed, and deployed working dog and handler teams of combat tracker dogs, specialized search dogs, improvised explosive device detector dogs, and tactical explosives detector dogs.

Contractors on the battlefield are not new to warfare, and many forward operating base security contracts include detector dogs for entry control point and mine detection operations. The majority of these dogs are found in controlled security zones guarding military and civilian assets. For the purposes of this article, those statements are necessarily broad and are not meant to diminish known uses of contract working dogs in other areas. However, their typical use is for protection of high-value areas so that MWD teams are available for other missions. The history of the mine detection dog (MDD) program provides a good example. Contracted MDD teams have performed humanitarian assistance and other mine clearance operations for decades, but in 2001 the DoD did not have a military MDD program of record. At the onset of Operation Enduring Freedom, civilian MDD teams were initially contracted for vital inside-the-wire mine clearance missions to ensure safety of areas adjacent to seized airfields. Combat engineers recognized the increasing need for MDDs and developed their own military MDD program to directly support engineer operations. In order to ensure veterinary care under early entry, austere, and remote operating conditions, the newly formed combat engineer mine detection dog unit MTOE included one 68T per squad of 6 MDDs plus handler teams. Today, 68Ts also serve in support of medical training and canine programs associated with Special Operations Forces and Marine Expeditionary Forces.

Perhaps the greatest change in MWD medicine during the past decade has been the emphasis on training the MWD handler to act as a first responder for his/her MWD. It seems intuitive now, but prior to 2001, handlers were taught veterinary medical care and husbandry topics that were informative but did not bring the subjects together in a way that maximized their capabilities as the earliest responder to every MWD injury. For the past 10 years, a MWD handler emergency care training support package has been available for training all MWD handlers as first responders for their MWDs. The training tasks were originally designed by veterinary clinical specialists to fulfill 3 purposes: (1) introduce handlers in the MWD Basic Handler Course to routine canine care and first responder medical tasks, (2) train all handlers on all first responder medical tasks in follow-on courses or at the handler's first duty site, and (3) serve as the basis for all Veterinary Corps officers and kennel masters to use as refresher/sustainment training for US MWD handlers at all duty sites around the globe. This training package was also adopted and modified by the Royal Army Veterinary Corps for British MWD handler deployments.

The latest edition (July 12, 2012) of the MWD Handler Training Manual, *Medical Care and Management of Military Working Dogs by Handlers*, supersedes all previous training materials and medical care guidance. The training

manual and PowerPoint presentations covering 36 individual tasks are available for download (restricted access, Army Knowledge Online password protected) through: http://phc.amedd.army.mil/organization/phcrsouth/dodmwdvs/Pages/DoDMWDVSHandlerTraining.aspx. This revision of training for military MWD handlers qualified by MOS, Air Force specialty code, or Navy enlisted classification redirects the focus of medical care to 3 specific areas of concentration: tactical combat casualty care, noncombat emergency care, and preventive medical care. The tasks have been revised to reflect current practices based on experience with MWDs injured in combat operations by focusing on procedures most critical to preservation of life, limb, and eyesight of working dogs. Handlers now provide the most effective immediate care to prevent further injury, reduce effects of trauma and illness, and stabilize the patient while coordinating rapid evacuation. The new MWD Handler First Aid Kit has been compartmentalized to ensure the exact medical supplies needed to perform every task are available, but in a format that maximizes flexibility in meeting mission requirements. The kit contents are linked to the training tasks. Handlers are authorized resupply of class VIII items from all supporting veterinary units, including medications that they are trained and authorized to administer to their MWD. Similar to food and water requirements, handlers will pack first aid items essential for urgent or routine care of their MWD as appropriate for each mission.

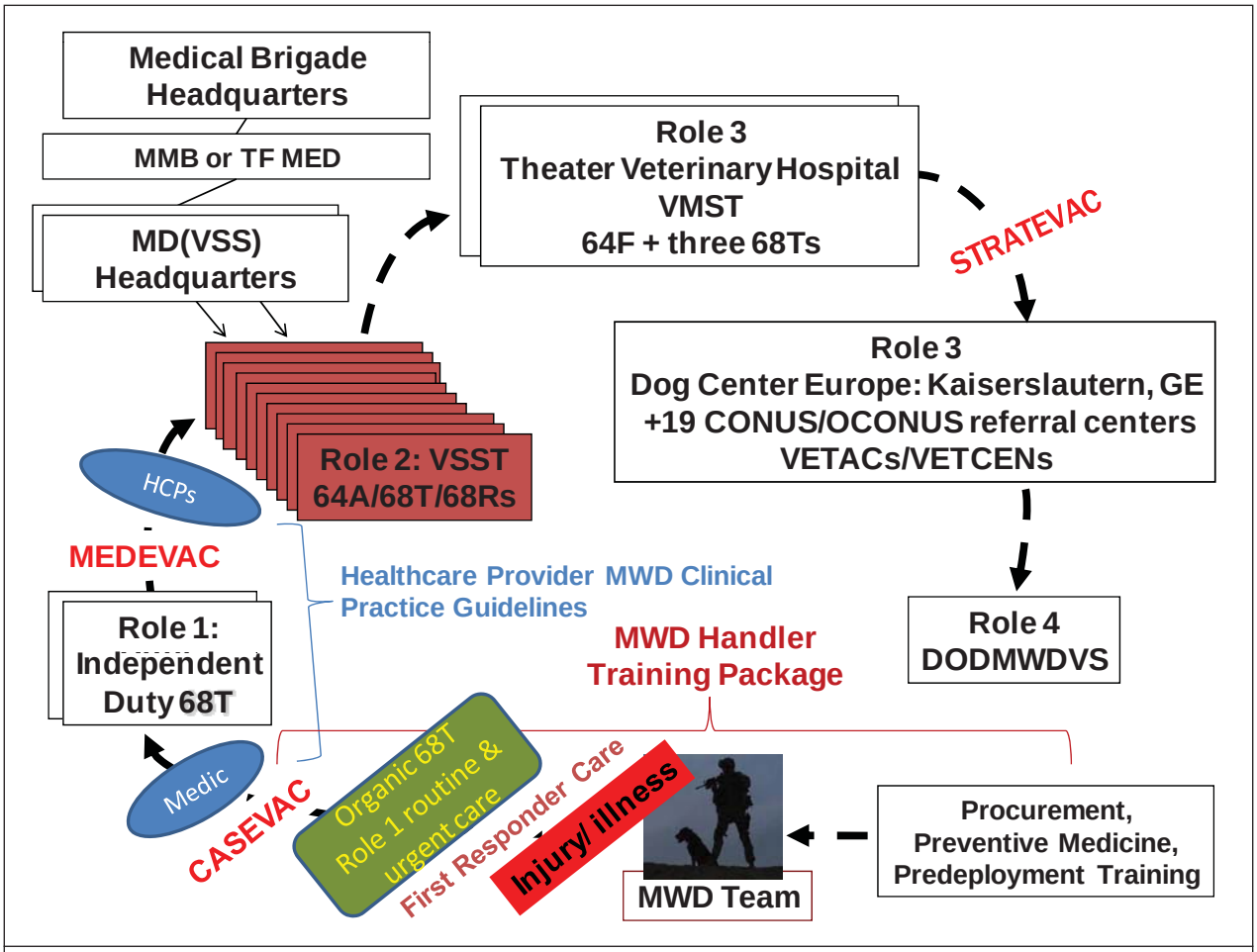
The manual *Medical Care and Management of Military Working Dogs by Handlers* contains important information for combat medics and corpsmen working directly with MWD detachments, however, medics and other nonveterinary healthcare providers (HCPs) should also refer to the updated (February 2012) Joint Trauma System Clinical Practice Guideline, *Clinical Management of Military Working Dogs.*[*] It contains concise, stepwise instructions and applicable decision-trees, algorithms, tables, charts, photos, and diagrams which assist the HCP in understanding or reviewing the medical information provided. The format works well because the annexes are mutually supporting with referenced and hyperlinked passages throughout the document. *Clinical Management of Military Working Dogs* is the culmination of research, review, and collaboration with numerous veterinary and human medical professionals in the Army Medical Department (AMEDD) and Special Operating Forces, including individuals deployed in Operations Iraqi Freedom, New Dawn, and Enduring Freedom. This update provides nonveterinary healthcare providers with general information concerning handling of MWDs and with clinical medical guidance for management of seriously ill or injured MWDs to assist in recognition and initial resuscitation and stabilization of life- and limb-threatening conditions.

Military working dogs are critical assets in today's combat environment. Expectations are that injured working dogs will receive a high level of resuscitative care as far forward as possible. The ideal medical providers for MWDs are military veterinarians and animal care specialists supporting the assigned dog handler. However, HCPs may be the only medical personnel available for gravely ill or injured MWDs. Provision of medical care by HCPs should be limited to circumstances in which the dog is too unstable to transport or medical evacuation is not possible, or immediate care is necessary to preserve life, limb, or eyesight, and veterinary personnel are not available. Healthcare providers should only perform medical or surgical procedures commensurate with their training and necessary to prepare the dog for evacuation to definitive veterinary care available at multiple locations throughout the theater. *Clinical Management of Military Working Dogs* is the standard of care for HCPs regarding their scope of practice in the medical treatment of MWDs, and guides the actions of all veterinarians and animal care specialists tasked with predeployment, deployment, or sustainment training of HCPs.

In the current deployed MWD care and referral network illustrated in the Figure, the MWD handler is first responder and then transports the MWD to veterinary medical care via casualty evacuation or medical evacuation assets, often with the help of a combat medic or corpsman. The organization and units providing Roles 1, 2, 3, and 4 veterinary care were described in detail earlier (pages 14, 15). The decision to strategically evacuate or return an MWD to duty varies, based on the injury or disease process and operational unit considerations. Every effort is made to do what is best for the MWD, as well as to support the mission of the operational unit. Dog Center Europe is the strategic evacuation destination for all MWDs in the US Central Command area of responsibility. However, there are 19 additional military veterinary activities and veterinary centers located throughout the world that could provide definitive care for an MWD in consideration of proximity to the MWD's home station and the availability of clinical specialists.

The DoD MWD Veterinary Service (MWDVS) has 45 Soldiers and Department of the Army civilian personnel assigned to the Holland MWD Hospital and the Medina MWD Clinic facilities at Lackland Air Force Base,

*http://www.usaisr.amedd.army.mil/assets/cpgs/Clinical_Mgmt_of_Military_Working_Dogs_Combined_19_Mar_12.pdf



Deployed environment military working dog care and referral network.[11]

Glossary:
CASEVAC - casualty evacuation (from point of injury)
CONUS - continental United States
DODMWDVS - Department of Defense MWD Veterinary Service
HCP - healthcare provider (nonveterinary)
MMB - multifunctional medical battalion
MD(VSS) - medical detachment (veterinary service support)
MEDEVAC - medical evacuation (within theater)
MWD - military working dog
OCONUS - outside of CONUS (overseas)
STRATEVAC - strategic evacuation (from theater)
TF MED - task force, medical
VETAC - veterinary activity
VETCEN - veterinary center
VMST - veterinary medical support team
VSST - veterinary service support team

Texas. They provide routine and specialized veterinary care for up to 1,150 working dogs onsite; conduct basic and advanced veterinary medical training for handlers, 68Ts, and VCOs in partnership with the AMEDDC&S Animal Health and Veterinary Specialist Branches and the 341st Training Squadron (DoD MWD Training Center); and provide global referral and consultation support to working dogs throughout the DoD and other federal agencies. Recently, the DoDMWDVS achieved accreditation by the Association for the Assessment and Accreditation of Laboratory Animal Care International to comply with new DoD regulations and advance the unit's roles and responsibilities in all areas of MWD health, welfare, and operational support. One-half of the assigned personnel are 68Ts or civilian registered veterinary technicians (RVTs). These facts emphasize the expanding roles and importance of veterinary technicians. Without their assistance and advanced training, the DoDMWDVS could not perform its Role 4 missions.

Current licensure requirements and future trends in the profession of veterinary technology are important to the AMEDD and the DoD. It is no longer possible for 68Ts to challenge board examinations based on work experience alone. National and state certification examinations are required for RVT licensure after completion of an AVMA-accredited associates degree program. The National Association of Veterinary Technicians in America (NAVTA) Committee on Veterinary

Technician Specialties is recognized by the AVMA and sets forth standards for all specialty academies analogous to the American College of Veterinary Specialties. There are currently 11 veterinary technician specialties and 6 additional certification programs recognized by the AVMA and NAVTA[12] and, according to the Bureau of Labor Statistics, employment of veterinary technologists and technicians is expected to grow 52% during the 2010-2020 projection period.[13] Today's Soldier has unprecedented access to distance learning opportunities, and there is renewed Army emphasis on the Enlisted Degree Program.[14] However, civilian credentialing of Army animal care specialists as RVTs through AVMA-accredited degree programs has not been identified as critical to the AMEDD. The new Enlisted Degree Program is not MOS-specific and participants are still required to use their tuition assistance benefits. The AMEDD has recognized the advantages of civilian credentialing for the combat medic (MOS 68W) and medical laboratory specialist (MOS 68K) and should now provide support to the 68T similar to these existing, centrally-funded health education training programs. These recommendations are in the best interest of the Soldier and the Army. Strategic investment in 68T RVT licensure engages the Soldier in personal discipline and study habits conducive to lifelong learning, which promote professionalism within the MOS and elevated veterinary medical standards of care throughout the DoD. In the short term, leaders should encourage their 68Ts to become associate members of NAVTA in order to raise awareness of licensure and specialty certification opportunities. Over the long term, the AMEDD should leverage the 32 American Council of Education credits already available in the 68T AIT and ALC courses, and fund 68T enrollment in AVMA-accredited veterinary technology associates degree distance-learning programs leading to RVT licensure. The continued success and future advancement of MWD medicine depends on the Soldiers' dedication to lifelong learning, the professionalism of the 68T and civilian RVTs in the Veterinary Corps, and AMEDD support of training programs that consistently produce and retain credentialed and competent Animal Care Specialists.

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Two animal care specialists assist veterinarians performing a surgical procedure on a military working dog in Kandahar, Afghanistan.

The Effects of Environmental Extremes on Working Dogs: A Collaborative Initiative

LTC Janice Baker, VC, USAR
MSG Laura Miller, USA

Military working dogs (MWDs) are employed in a variety of austere and extreme environments, yet the environmental limits in which they can safely and effectively operate have never been thoroughly defined. A combat unit utilizing canine teams may experience an altitude change of 5,000 feet elevation or more for a single mission or an elevation change of over 10,000 feet within a few days of being deployed from its home base. Operational needs may dictate a rapid change in the footprint of forces on the battlefield, requiring movement to a vastly different terrain and environment. Dogs deploying in support of combat or other contingency operations where there is little time for acclimation may experience rapid changes in altitude, temperature, and humidity. A collaborative initiative spearheaded by special operations forces (SOF) veterinary personnel across the range of the US Special Operations Command seeks to characterize the physiologic capabilities of working dogs and advance their safe and effective use in these environments.

Extensive information is already known about human responses to these environments, with subspecialties in military medicine such as aviation and dive medicine. Civilian subspecialties such as wilderness medicine focus on conditions and treatment associated with exposure to the elements in various outdoor environments. These subspecialty areas of medicine provide evidence-based guidelines to ensure the safety and effectiveness of humans operating in these conditions. In addition, they are constantly advancing the ability of our forces to push further into new and unique operating environments.

The Veterinary Corps officer (VCO) and Animal Care Specialist (military occupational specialty 68T) are in a position to assist canine programs in ensuring readiness for rapid deployment, or sustained deployment to areas of extreme environmental conditions. Canine programs look to Veterinary Corps personnel for answers to questions directly affecting combat operating ability:

- Will high altitude will affect his scent detection ability?
- When my dog is deployed to the desert, it is better to have air conditioning in the kennel to help him rest between operations, or no air conditioning to help get acclimated to hot weather?
- How high can we (parachute) jump a dog before he needs supplemental oxygen?
- What ocean temperature is too cold to use the dogs in maritime operations?
- Do nutritional supplements help prevent heat injury?
- Does prehydration with subcutaneous fluids help prevent heat injury?

All of these questions were asked of the authors by canine program managers within the past year. It is important for veterinary personnel to remember that canine program managers are looking for facts to aid the combatant commanders, who may use this information to make high-level decisions on the use of MWDs in combat and contingency operations. The responses we provide must be accurate, evidence-based, and realistic with regard to operational tempo, environment, and operational capabilities and limitations.

Faced with these important questions, the VCO and Animal Care Specialist will naturally want to provide answers. However, based on the actual evidence in the veterinary literature, the correct answer to each of the questions above is: we don't know.

Collectively called "the effects of environmental extremes on military working dogs," the goal of the initiative is to characterize the normal and abnormal physiologic responses of MWDs to these environments, and provide recommendations based on a combination of scientific evidence, lessons learned, and practical experience of the canine units and veterinary support personnel. The effort includes extensive literature research, tracking the work of ongoing research in these areas, promoting research and development projects among our military and civilian colleagues, and conducting original research in the field.

This multifaceted initiative is not a SOF-exclusive endeavor, nor is it a finite project. It is a process that will evolve, change through research advances as well as combat lessons learned, and is expected to continue

indefinitely. Our approach follows these basic principles of the process:

1. Determine what is normal—what are physiologic parameters of MWDs in their working state?

2. Define the problem—determine end-user requirements and evaluate the epidemiologic data existing on those topics.

3. Critically evaluate the existing evidence to determine current best practices for prevention and treatment of adverse reactions to extreme environmental conditions (hyperthermia, hypothermia, etc).

4. Conduct research and development, based on validated requirements, to overcome the defined problems and increase effective range of MWDs on the battlefield.

Current efforts focus on 4 broad operational environments: extreme heat, extreme cold, maritime, and high altitude. Within those 4 environments are many subsets, such as desert versus tropical heat, and mountain-based versus aviation-based altitude. In the following sections, we highlight some of the efforts and initial accomplishments of this team, the impact of this initiative on the operational canine unit, and discuss the way ahead.

Telemetric measurement of body temperature allows a SOF Animal Care Specialist IDVT to ensure safety of a dog during cold water training.

1. Determine what is normal.

The standard range for canine temperature is typically stated as between 99°F and 102.5°F, assuming that the dog is in a resting, relaxed state when examined. Several studies in canine athletes and working dogs have shown rectal temperatures to exceed 108°F during moderate exercise with no adverse effects.[1-4] Similarly, Animal Care Specialists serving as SOF Independent Duty Veterinary Technicians (IDVTs) have observed for several years that many of their unit's dogs routinely develop temperatures up to or above 107°F during work without any adverse effects. Yet, by convention, most veterinary personnel learn that any rectal temperature over 106°F is a critical temperature indicating heat injury.

Body temperature and physical performance is closely monitored in new accession dogs intended for use in select SOF multipurpose canine (MPC) programs. This monitoring helps assess their physical suitability for the program. It is also performed for safety and prevention of heat injury while they acclimate to the 20°F or more increase in environmental temperature at their new location compared to their countries of origin. Using an ingestible thermistor and radiofrequency reader (CorTemp Core Temperature Monitoring Systems, HQ Inc, Palmetto, FL), as well as standard digital rectal thermometers, the Animal Care Specialists noted that all of the dogs that were monitored developed rectal temperatures of over 108°F during bite and explosive detection work of less than 10 minutes duration, despite the relatively mild ambient temperatures. In contrast, their core temperatures remained between 103°F-104°F. Fully trained and acclimated dogs showed the same patterns of core and rectal temperature differential. Their relative tolerance to high rectal temperatures may be explained by the lower core temperature readings.

Veterinary personnel who work with canine athletes and working dogs are familiar with these high temperatures, and tend to rely more on the dog's physical appearance and performance than the thermometer reading when assessing the dog's thermoregulatory status. Subtle changes in these factors of performance appear to be much more predictive of heat-related illness than rectal body temperature alone.

To truly understand what is "normal" for working dogs, the VCO and Animal Care Specialist must move from behind the veterinary clinic examination table into the working and training environment of MWDs. In dogs with intensely high drive, physiologic and behavioral response of the dog during a period of recovery may be a better predictor of the dog's physical state. For example, the intensity of a dog's run toward a decoy or reward may not diminish until late in the progression of heat stress, due to his high drive. However, during the recovery phase after obtaining the reward, the dog might show more obvious signs of reaching his limits earlier than while in pursuit of a reward. When there is no incentive to work for the reward, the dog may focus more on recovery and cooling. Research on associations between subtle canine behavioral changes, body

Core temperature may be a more accurate measure of a dog's temperature while working in extreme environments.

temperature, and heat tolerance may provide insight on this topic, and lead to new approaches in educate canine handlers on prevention of heat injury in their dogs.

In humans and other species, changes in metabolic rate and peripheral vasoconstriction at various altitudes and environmental temperatures affect body heat production and loss.[5-7] Considering this model, it is possible that changes in core versus rectal temperature may differ between dogs in different states of conditioning, and between environmental extremes of heat, humidity, and extreme cold or altitude.

Teaming with researchers from Oklahoma State University and North Carolina State University, the team has performed testing to compare core against rectal temperature of canine athletes in a variety of environmental conditions, including heat and humidity, extreme cold, and high altitude. In addition, they are conducting research and development (R&D) of aids to prevention of heat injury, such as cooling mats and muzzles, that allow maximum air movement while retaining safety features.

Desert and Tropical Hot Weather Operations

At a field research station in North Carolina, part of the SOF veterinary team works with university researchers to characterize the response of heat, humidity, and comparative cooling methods in Labrador retriever explosive detection dogs undergoing exercise. As an adjunct to this study, a prototype battery-operated cooling blanket designed by a SOF canine program and Army Research Office R&D personnel is being evaluated for use in the field. The effectiveness of the blanket is being evaluated against other methods of cooling, including immersion in an ambient temperature water trough, simulating wading in natural water sources for cooling.

High Altitude Mountain Operations

In Alaska, the SOF veterinary team works with the Oklahoma State University researchers in a field station to study the effects of extreme cold and altitude on thermoregulation on dogs during exercise and anesthesia. Working in an environmentally controlled, low-oxygen chamber that simulates up to 15,000 ft altitude and 10°F, the VCO and Animal Care Specialist on this project don extreme cold weather gear and oxygen masks to monitor physiological parameters such as core and rectal temperature changes in Iditarod-proven Alaskan husky sled dogs running on a treadmill. This is followed by a field anesthesia protocol in a "warm" room at 50°F, simulating a field aid station at a remote mountain forward operating base. In addition, the cold weather team studied rapid acclimatization to high altitude in conditioned and unconditioned dogs. As part of the project in Alaska, the team worked closely with veterinary specialists and mushers during the Iditarod dog-sled race. The team noted the dogs' exceptional ability to withstand temperatures as low as -50°F, and tendency for heat intolerance in ambient temperatures above only 20°F. This was an excellent example of how heat injury or intolerance cannot always be attributed to high ambient temperatures. Analysis of the data may lend insight into differences in the relation of core and rectal temperature in hot versus cold environments. In addition, initial data on maintenance of body temperature during anesthesia in cold environments is hoped to aid in the development of safe protocols for short-term field anesthesia for working dogs in high altitude, cold weather environments.

Maritime Operations

Similar to monitoring the dogs in hot weather, select Navy dogs swimming in ocean waters during the winter as part of their initial assessment and training are closely monitored for hypothermia and accidental ingestion or aspiration of salt water. To ensure the dogs' safety, SOF veterinary personnel and handlers in the water with the dogs monitor their core temperatures and other measures. Data from this type of preventive monitoring is being assessed to design further study, similar to the heat, cold, and altitude studies.

2. Define the problem, determine end-user requirements, and evaluate the epidemiologic data.

A combination of evidence and lessons learned from practical experience is necessary to drive advances in military veterinary medicine. Prevention and treatment guidelines for any condition in veterinary medicine should be based on the available evidence and end-user requirements whenever possible. But as discussed previously, there has been little study into unique conditions

of working dogs on which to base MWD-specific guidelines. Two retrospective studies currently provide the only statistical analysis of possible risk factors and outcome of heat injury in dogs.[8,9]

By collecting and analyzing the available epidemiological data, we can validate end-user requirements and focus our efforts in providing accurate guidelines to canine programs that are also relevant to their needs. Retrospective analysis of the available data can determine the significance of individual occupational problems and hazards for MWDs.

Before dedication of extensive effort or funds for research and development in prevention of environmental-associated conditions, we must clearly define the problem. For example, heat injury issues requiring defintion might include:

- What is the incidence and prevalence of heat injury in MWDs?
- Was there any association with the type or use of dog and the likelihood of heat injury, or the experience of the handler?
- How many were working in muzzle when injury occurred?
- Is heat injury more likely in a deployed environment than a US environment?
- Is it more likely during training than actual operations?
- What is the rate of survival versus nonsurvival?
- What treatment measures did the handler or other nonveterinary first responders apply prior to arrival at veterinary care, and were any of these factors associated with survival or nonsurvival?

In order to provide the most accurate widespread recommendations on prevention or treatment, we need to know what risk factors are truly most commonly associated with specific conditions, and any factors that influence outcome. As there is currently no central database for cataloging and retrieving MWD medical data, this process will involve an intensive, combined effort of conventional and SOF veterinary personnel to retrieve and compile the data.

3. Critically evaluate the existing evidence to determine current best practices for prevention and treatment.

As discussed above, prevention and treatment guidelines for best practices in veterinary medicine should be based on critical evaluation of the available evidence whenever possible. A critical review by the SOF team of the veterinary literature on canine heat injury found that there was very little in the veterinary literature to provide evidence-based guidelines on any aspect of canine heat injury for either working or companion dogs.[10] Furthermore, the review revealed that some widely-accepted guidelines for treatment and long-term management have never been scientifically validated, and, in some cases, may actually be refuted in the literature. For example, most treatment guidelines caution against using cold or ice water for cooling dogs with heat stroke, claiming that this can slow cooling or lead to complications such as disseminated intravascular coagulopathy (DIC). The review found that, according to the available veterinary literature, there was no evidence that ice or cold water cooling was associated with slower cooling, DIC, or worse outcomes in dogs. In fact, ice water immersion was found to be the most rapid method of cooling in hyperthermic human athletes, and is the recommended method of cooling in human medicine.[11-14] The few canine-specific studies on cooling methods were conducted 20 to 30 years ago, and involved a very small number of animals in experimental studies of induced heat stroke models.[15-20] Prospective, randomized, controlled clinical trials of different cooling methods would be necessary to make definite conclusions and provide evidence-based guidelines on best practices for cooling.

Along with addressing unanswered questions with research, it is equally important to not propagate guidelines that are not supported by the evidence. If tap water and fanning (rather than cold or ice water) is effective in cooling dogs with hyperthermia,[17] it should be stated as no more or less than that when the information is relayed to others. Veterinary personnel should be aware that the precept that ice water is contraindicated because it leads to DIC is a guideline that is not supported by the evidence; it is simply another question that falls into the "we don't know" category of answers.

It is also often asserted that dogs with history of heat injury are at more risk for recurrence in the future. In actuality, the review found no reports in the literature that this had ever actually been studied in canines, and that this assertion appears to be extrapolated from the human literature. Several human studies have shown evidence of heat intolerance in military recruits for up to 6 months following an initial occurrence of heat injury,[21-24] and standardized heat tolerance tests have been used to assess fitness for return to duty.[21,22]

Anecdotally, veterinarians may see individual dogs with repeated heat injury, apparently confirming this phenomenon. However, before blaming the recurrence on an altered thermoregulatory mechanism from prior heat injury, the veterinarian should consider if the repeated

heat injury is due to conditions which can be improved, such as decreasing body weight, increased physical conditioning, a surgically repairable upper airway condition, or improved handler education. Once these factors have been ruled out, then they can consider the concept that something within the dog's thermoregulatory mechanism has been altered, making him more prone to heat intolerance. Until there is adequate evidence to support it, we cannot make this assertion to canine programs with any accuracy.

Fitness for duty following heat injury should be based on evaluation of the dog under increasingly strenuous conditions of work, similar to heat tolerance testing in human service members who have incurred heat injury. Veterinary assessments on fitness for duty based on prior heat injury have the potential to affect management decisions regarding individual MWDs within a unit, especially regarding deployment. Finding a scientifically-validated answer to the question of recurrence of heat injury could have direct effect on combat units utilizing MWDs. Thus, this topic is an excellent example of a valid end-user requirement that warrants further research.

4. Conduct research and development, based on validated end-user requirements, to overcome the defined problems and increase effective range of military working dogs on the battlefield.

The first 3 steps discussed above determine normal physiologic reactions, baseline epidemiological evidence, and evidence-based best practices. The results of these steps drive a focused effort to develop new technologies beyond what are already available. Steps in this process will also overlap to some degree. The ongoing research to determine normal working temperatures and thermoregulatory responses of dogs in environmental extremes spans multiple phases of the process.

It is crucial to the R&D phase in development of new methods, equipment, or technologies that these efforts are based on validated operational needs of the canine unit and the mission requirements of their combat command. To truly serve the Warfighter, we must listen to what they want from us, and what they regard as an operational problem or obstacle with their dogs. It does little good for us to develop a new tool or treatment regimen for their use on the battlefield if the data on battlefield injuries indicate the tool or treatment has never been needed, or they simply will not carry it with them due to size, weight, or other inconvenience. Similarly, our canine healthcare guidelines must be relevant and realistic in their operating environment. The best way to determine what they need is to listen, and to ask:

- What does the canine unit want from us?
- What do they view as their most significant canine problems?
- What factors of the environment (heat, cold, altitude, etc) are limiting what they can accomplish with their dogs?
- What type of solution do they propose, that will fit into their existing operational tactics, techniques, and procedures?

CONCLUSION

The Veterinary Corps is in the unique position to facilitate not only the advancement of military working dog clinical care, but also extending the effective range of this special force protection resource on the battlefield. From determining the operational requirements through gathering the evidence and creating new and advanced capabilities, Veterinary Corps personnel have a vital role in advancement of the capabilities of military working dogs under environmental extremes. The best approach to this effort is ultimately a collaboration between the end-user canine units, the VCOs and Animal Care Specialists supporting the canine units, the Veterinary Corps clinical and epidemiology specialists, military R&D specialists, and our civilian veterinary counterparts with the resources and experience in the conduct of basic science and clinical research. Each of these collaborators has a vital role in the support of Warfighter canine programs and their operational requirements.

A SOF Animal Care Specialist IDVT works with racing sled dogs during the Iditarod sled dog race in Alaska.

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Pit Viper Envenomation in a Military Working Dog

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ABSTRACT

Military working dogs are often trained and/or work in locations where the potential for snake bites is increased. Knowledge of the local venomous snakes, the effects of their venom, and appropriate initial stabilization is essential for the US Army Veterinary Corps officer (VCO). As military practitioners, VCOs are uniquely situated to benefit from collaboration with other military assets for air evacuation and treatment of their patients. A recent clinical case of envenomation is presented, along with a review of the most current literature regarding treatment of envenomation in veterinary patients.

During routine training in a wooded area on Marine Corps Air Station Cherry Point, North Carolina, on December 5, 2011, military working dog (MWD) Dingo M063 was bitten by a pit viper on the left front limb. The MWD handlers rushed the dog to the Cherry Point Veterinary Treatment Facility (VTF) for initial stabilization. The dog had profound swelling and bruising of the affected limb, along with puncture wounds consistent with a potentially fatal venomous snake bite. The patient was assessed and initial stabilization performed at the Cherry Point VTF. Based upon consultation and Dingo's clinical condition, administration of antivenin was selected as the course of treatment. After initial efforts to obtain the antivenin locally were unsuccessful, the decision was made to evacuate Dingo to the Norfolk (Virginia) Naval Station VTF for antivenin administration and continued intensive care and monitoring.

When a snake bite occurs, occasionally the dog handler, or owner in the case of a pet, sees the offending snake. Often the snake is never seen or identified. The attending veterinarian must use the clinical presentation, patient history, and knowledge of the local fauna to determine the appropriate treatment protocol. Occasionally the dog may vocalize, which is followed by lameness, swelling, bruising, and sometimes bleeding from the bite wounds. Many venomous bites are due to accidental contact with the snake. There are 37 species of snakes located throughout North Carolina; of those only 6 are venomous,[1] and only 5 of the 6 could inflict a venomous bite consistent with that suffered by Dingo. The 5 snakes all belong to the family *Viperidae*, subfamily *Crotalinae*.[2] Specifically, they are the Copperhead (*Agkistrodon contortrix*), Canebrake rattlesnake (*Crotalus horridus atricaudatus*), Eastern Diamondback rattlesnake (*Crotalus adamanteus*), Pigmy rattlesnake (*Sistrurus miliarius*), and Cottonmouth or Water Moccasin (*Agkistrodon piscivorus*).[1]

When the snake bite occurred, the area veterinary clinical medicine officer was consulted to provide guidance on the immediate treatment of the bite and aid in development of the most appropriate treatment plan. This input facilitated prompt decision-making, resulting in evacuation of the MWD. The local kennel master at Cherry Point reported the incident to his chain of command, and helped coordinate with Marine Transport Squadron One to arrange emergency medical evacuation from Cherry Point to the Norfolk Naval Station. Dingo M063 was transported to Norfolk in a Marine Corps HH-46D Sea Knight search and rescue helicopter. The MWD did well during transport and arrived at Norfolk in stable, albeit critical, condition. The antivenin, CroFab (BTG International Ltd, London), was provided by the Naval Medical Center, Portsmouth, Virginia. The MWD was treated with antivenin and received supportive care overnight. Dingo M063 improved significantly after antivenin administration and made a full recovery with return to duty one week later.

CLINICAL VIGNETTE

At time of initial presentation, the handlers did not report any vocalization or decrease in effort while working, but noticed profound swelling of the left front leg after clearing the edge of a wooded area. Dingo M063 was bright, alert, responsive, and panting heavily upon presentation. He had a barely perceptible lameness in the left front limb, despite marked swelling in the area of the distal elbow. Abnormal physical exam findings included an elevated temperature at 106.4°F (99.5°F –102°F), tachycardia at 140 beats per minute (bpm) (80 bpm–100 bpm) with strong synchronous pulses, and a small spot of fresh blood on the left dorsal antebrachium. He also had moderate to severe firm swelling extending from the left mid-antebrachium to the region of the elbow. The area of the swelling was gently palpated to rule out trauma and/or fracture, and then the skin overlying

Figure 1. Marked swelling and bruising of left front limb approximately four hours after snake envenomation.

Figure 2. First bite location noted on dorsal aspect of left front leg.

the swelling was shaved (Figure 1). Two small puncture wounds (Figure 2) and severe bruising were noted on the left dorsal antebrachium. Based on the history, presentation, and initial findings, it was determined the MWD had been struck by a venomous pit viper.

A cephalic intravenous catheter was placed, and the MWD was given 2 quarter shock doses of intravenous crystalloid fluids (1,500 mL lactated ringers), followed by a maintenance fluid rate. The area of the puncture wounds was scrubbed with an antiseptic solution. As shown in Figure 1, the margin of the bruising was marked with permanent ink to allow monitoring for progression of the swelling. The blood pressure was normal, and an electrocardiogram (ECG) showed a normal sinus rhythm. A complete blood count and serum biochemistry profile were performed. A mild decrease in platelet count was noted (125,000/µl, reference interval 200,000/µl to 400,000/µl), and all other values were normal. An intravenous dose of buphrenorphine (0.0075 mg/kg, 0.0034 mg/lb) was given to relieve discomfort associated with the bite. The patient's temperature dropped to 99.1ºF within 35 minutes after presentation, and the pulse and respiratory rate normalized. The mucous membranes were pink, but tacky. The MWD was quiet, alert, and responsive, but clearly uncomfortable.

The MWD was evacuated to the Norfolk Naval Station VTF by helicopter, and arrived in stable condition. The swelling and bruising showed significant progression since presentation, and a second bite wound was noted on the mid-caudal aspect of the antebrachium (Figure 3). Activated partial thromboplastin time, and prothrombin time were normal upon arrival at the Norfolk VTF. After Dingo M063 was reassessed, one vial of intravenous Crotalidae Polyvalent Immune Fab (CroFab) was administered. Marked improvement in the swelling and bruising (Figure 4) was noted within one hour of beginning administration of the antivenin. The majority of the swelling resolved over the next 24 to 48 hours. The MWD was bright and alert the next morning, and using the limb with minimal signs of discomfort. He was transported back to Cherry Point 72 hours later (Figure 5), and was returned to work within one week. He went on to make a full recovery, with no lasting effects of the envenomation.

Figure 3. A second bite was noted on the medial aspect of the left front leg.

Figure 4. Moderate improvement in degree of swelling and bruising approximately one hour after intravenous antivenin administration.

CURRENT TREATMENT FOR PIT VIPER ENVENOMATION

Background

The name pit viper is derived from the presence of a heat sensing pit organ located on the head.[3] Pit viper envonomation occurs throughout the United States, with the majority of bites occurring between the months of April and October.[4] However, the seasonal occurrence can vary significantly depending on location and weather patterns, as was the case with Dingo M063. Approximately 25% of pit viper bites are known as "dry bites," meaning no venom was injected.[3-5] As expected, dry bites result in a much less severe presentation. In the absence of the snake itself, or accurate owner/handler identification of the snake, the clinician must use the history and physical examination to rule out other causes for the given presentation, such as trauma, other animal bites, wounds, or bites from venomous insects.

The severity of the bite can vary considerably between patients. Factors such as size and age of the victim, species of snake, size and age of the snake, amount of venom injected, location of bite, number of bites, and depth of envenomation can all play a role in the severity of clinical signs in the patient.[5,6] General location of the bite may vary between patients, but bites to the head and neck can be particularly serious if swelling causes obstruction of airflow. Studies have found the majority of dog envenomations occur in the head and neck.[7]

The venom itself is 90% water[6] combined with a very stable and complex mix of proteins such as phospholipase, hyaluronidase, collagenase, and proteases.[3] These compounds cause various local and systemic effects on the victim, including local tissue destruction, and endothelial damage. Endothelial damage results in extravasation of fluid and red blood cells, followed by edema, swelling, and potentially reduced circulating blood volume leading to hypotension, hypovolemia, and shock.[4] Pooling of blood within the shock organ (liver and spleen in dogs) also contributes to hypotension and shock.[6] The venom proteins also have a variety of toxic effects on other cells throughout the body, including blood cells, myocardium, skeletal muscle, soft tissues, and cells of the respiratory and nervous systems.[5] Venom characteristics vary significantly across snake species, with some causing more

severe and varied damage compared to others.[6] Some pit vipers, such as the Mojave rattlesnake and several others, possess a neurotoxin containing venom which results in ascending flaccid paralysis. These snakes can possess only a neurotoxic venom, which would cause neurologic dysfunction in the absence of the other clinical signs, or a combination of neurotoxic and hematoxic venom.[8]

The complex venom composition can also have various effects on the coagulation system. The venom proteins have pro- and anticoagulant properties, and can cause fibrin degradation, direct damage to blood vessel walls, and impaired platelet function.[3] These changes can result in an anticoagulant condition similar to disseminated intravascular coagulation.[3] Therefore, monitoring clotting times, (prothrombin time (PT), activated partial thromboplastin time (APTT)), and platelet levels is an important component of patient evaluation and monitoring.

Initial Evaluation

A thorough evaluation and physical examination should be performed when a pit viper envenomation is suspected. Signs observed are related to the toxic effects of the venom as previously discussed, and vary in onset. Most commonly, the first clinical signs appear 30 to 60 minutes after the bite,[4] but may take up to 24 hours to develop in some cases.[5] Due to the wide-ranging effects of venom throughout the body, a varying array of both local and systemic clinical signs can be observed. These clinical signs include hypotension, tachycardia, tachypnea, swelling and bruising in the area of the bite, bleeding/oozing puncture wound, pain, weakness, nausea, diarrhea, mental depression, and potentially neurologic deficits.[9] A snake bite severity score is a useful tool for determining severity of the bite, and for monitoring progression. This can allow the clinician to make a more impartial patient assessment.[10]

A complete blood count, serum biochemistry profile, and coagulation parameters (PT, APTT, and fibrinogen if available) should be checked as soon as possible after presentation. Thrombocytopenia and coagulation abnormalities are common with pit viper envenomation, and echinocytosis is commonly seen on blood film examination.[9] Other diagnostic tests should include ECG, urinalysis, and blood pressure.[5] Repeat tests should be conducted as necessary, based on the patient's clinical condition and response to treatment.

Treatment

Significant variation in treatment protocols for pit viper envenomation exists in both human[11] and veterinary medicine.[5] Evidenced-based support in veterinary medicine for therapies commonly used in the past, such as glucocorticoids and antihistamines, is not available and therefore these therapies are controversial. They are often reserved for treatment of antivenin hypersensitivity reactions, as opposed to the envenomation itself. Emergency treatments such as tourniquets, incision and suction, and cryotherapy are not recommended in human[11] or veterinary medicine[6] due to lack of efficacy. Immobilization and timely transport to the nearest veterinary treatment facility is the most appropriate emergency treatment.[4,5] The fundamentals of treatment are fluid therapy, pain management, wound management, and antivenin therapy when appropriate and practical.

Figure 5. Mild bruising and minimal swelling remaining 3 days after snake envenomation.

The area around the envenomation site is clipped and scrubbed to allow visualization of the degree of bruising and swelling; the area is scrubbed with an antiseptic to prevent further infection. It is useful to mark the area of swelling and bruising with a marker every 15 minutes, and to measure the circumference of the limb. This will help determine severity and progression, and aid in determining the need for antivenin administration.[3,4]

Crystalloid fluid therapy is administered to correct hypovolemia and treat shock. It is generally administered

in one-quarter shock doses, followed by a maintenance rate. Assessment of response to therapy and need for additional boluses is generally done using clinical parameters such as mucous membrane color, capillary refill time, blood pressure, and urine output.[3]

Administration of antibiotics is left to the discretion of the clinician, but is generally not recommended for prophylactic treatment,[5] but rather if there are signs of an actual infection.[3,11] Venom can travel in the lymphatics, resulting in a lymphadenopathy which may be mistaken for secondary infection.[9] The human literature only advocates the use of antimicrobials where there is evidence of wound infection, and then the choice should be based on culture and sensitivity.[4] There are recommendations in the veterinary literature suggesting broad-spectrum antibiotics are appropriate due to the degree of tissue damage that occurs, and because of the population of bacteria found in the mouth of snakes.[6,9]

Opioids are a good analgesic choice for snakebite envenomation. It is important to avoid high doses of potent opioids in the acute treatment phase to prevent masking of the patient's neurologic status. Nonsteroidal anti-inflammatory drugs (NSAIDs) are generally not recommended due to risk of associated side effects such as gastrointestinal ulceration and nephropathy in a compromised patient. The use of NSAIDS can also increase the risk of bleeding due to impaired platelet aggregation in a coagulopathic patient.[5]

One of the primary therapies for pit viper envenomation is administration of antivenin. Historically, not all studies have supported the use of antivenin in every type of pit viper envenomation[9,12] and others have found a higher survival rate in dogs administered antivenin as compared with those that did not receive it.[7] These converging findings from studies of different pit viper species highlights the significant variation in venom composition among species, which influences the severity of the bite. Indications for use include rapidly advancing local swelling and tissue damage, severe and ongoing coagulation abnormalities, neurologic signs, and cardiovascular compromise.[13] In general, its use in veterinary medicine is determined by affordability, availability,[5] severity of envenomation, and the clinician's education and experience in treating snake envenomations. It is ideally administered within 4 hours of the bite, but may be effective up to 24 hours after envenomation.[3] Antivenin administration is known to slow the progression of swelling and resolve venom-associated coagulopathies,[5] and is the only proven specific therapy to treat pit viper envenomation.[6]

There are currently 2 antivenin products available in the United States, Antivenin (Crotalidae) Polyvalent (ACP) (Boehringer Ingelheim Vetmedica, St Joseph, MO) and CroFab. The ACP product has been around much longer, contains whole IgG, and is an equine-derived product. The CroFab product is ovine-derived. The individual molecules in CroFab are much smaller because the antigenic F_c portion of the antibody is eliminated, and the product contains much less constituent total protein than the ACP product.[4] CroFab is more potent than ACP (5.2 times),[14] but it is also more expensive. A recent study found that the CroFab antivenin was effective in treating rattlesnake envenomation in dogs.[14] The smaller sized Fab molecules are also eliminated much faster, and therefore could result in excretion prior to neutralization of all venom and recurrence of clinical signs, which would necessitate re-dosing. This has been observed in humans.[14] CroFab antivenin was available at the Naval Medical Center, Portsmouth, and was used to treat Dingo M063.

The newer ovine-derived product carries a lower risk of reaction following administration.[3,8] The occurrence of adverse reactions following administration is less common with CroFab (14.3%) than with ACP (23% to 56%) in human medicine.[4] The above mentioned study using CroFab in dogs showed a 5.2% incidence rate of adverse reactions.[14] Hypersensitivity reactions can occur, resulting in anaphylaxis (type 1), anaphylactoid reactions (complement mediated), or delayed serum sickness (type 3), and are treated with a combination of diphenhydramine and epinephrine.[5] Anaphylactoid reactions are most common,[6] but delayed serum sickness has been reported following ACP administration.[15] Antivenin dosing in dogs is based on clinical signs and coagulation parameters,[3] and can therefore vary significantly between patients. A snake bite severity score can also aid in guiding antivenin dosing.[14]

Even with antivenin administration, significant tissue damage can occur. Due to the toxic and complex nature of the venom, the damage can occur quickly depending on the location of the bite and amount of venom injected. Once tissue necrosis has occurred, antivenin administration will not reverse the damage, only prevent further damage.[3,5] If tissue sloughing occurs, long term wound management becomes necessary.

PREVENTION

There is a veterinary-approved rattlesnake vaccine available (Red Rock Biologics, Woodland, CA) which was developed to provide protection against envenomation by a Western Diamondback Rattlesnake. However,

there are no peer-reviewed canine studies available to document its efficacy. The 2011 American Animal Hospital Association Canine Vaccination Guidelines do not make a specific recommendation for or against the vaccine due to lack of available data regarding its efficacy.[16] As a practical matter, prevention of the actual bite would be very challenging in most dogs because of their curious disposition and the nature of pit vipers.

CONCLUSION

In certain parts of the United States, pit viper envenomation can occur throughout the year, particularly during mild winters when envenomation is unexpected. It is useful for veterinary practitioners to be aware of the local fauna, and which animals or insects commonly cause illness/injury to dogs. This can be challenging for Veterinary Corps officers who are frequently assigned to duty sites in areas with which they are unfamiliar, but should be a priority if they are caring for military working dogs. It is also important to know the availability of antivenin in the local area. Cornerstones of treatment include pain management, intravenous fluid administration, antivenin administration, and wound management as needed. Prompt decision making, use of available resources, and appropriate treatment of clinical signs can result in a very positive outcome in these cases.

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Heatstroke in a Military Working Dog

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ABSTRACT

Military working dogs are often trained and/or worked in locations where the environment is rigorous and austere. Knowledge of training conditions, environmental risks, and appropriate treatment of environmental injuries is essential for the Veterinary Corps officer (VCO). As military practitioners, VCOs are potentially placed in situations where quickly recognizing environmental emergencies, such as heatstroke, and initiating treatment or evacuation is essential. A recent clinical case of heatstroke is presented, along with a review of the most current literature regarding treatment of heat-related injury in veterinary patients.

CLINICAL VIGNETTE

Max II F241, an 11-year-old castrated male Dutch shepherd, presented to the Fort Bragg Veterinary Medical Center at approximately 1030 on June 7, 2012 for possible bloat. Max II F241 had episode history of bloat while deployed to Afghanistan in May 2011, and had a gastropexy performed at that time. In July 2011 he developed acute hindlimb lameness, which was attributed to severe lumbosacral spondylosis and progressive degenerative joint disease (DJD). At that time he was prohibited from further bite work and work on the obstacle course. Max II F241 had a history of extreme aggression, with several serious bites to handlers. Prior to presentation, he had been receiving Rimadyl (carprofen, an nonsteroidal anti-inflammatory drug) (75 mg orally twice a day) and tramadol (50 mg to 100 mg orally 3 times a day) to control pain associated with DJD. He was undergoing disposition due to his inability to function as a military working dog (MWD). To evaluate his suitability for adoption, a behavioral assessment termed a bite muzzle video (BMV) was required.

The Military Police MWD handlers were filming the BMV for Max II F241's disposition packet. He had successfully completed the first section of the video and was rested in a shaded area. He was observed to have an increased respiratory rate and effort that resolved during the rest period. After completing the second portion of the BMV, Max II F241 developed marked respiratory distress, a distended abdomen, and an episode of diarrhea. The handlers immediately brought him to the Veterinary Medical Center, which is located close to the Military Police kennels and training yard, for treatment.

On presentation, Max II F241 was distressed, with a temperature of 108.8°F (99.5°F-102.5°F), pulse of 140 beats per minute (bpm) (70 bpm-120 bpm), markedly increased respiratory rate (>100 respirations per minute (rpm) (8 rpm-40 rpm)) with severe distress, and cyanotic, injected mucous membranes. Thoracic auscultation revealed moderate crackles in all lung fields, normal cardiac sounds, and weak femoral pulses. No gastric distension was noted on abdominal palpation, and other organs appeared normal. No ping was heard during simultaneous percussion and auscultation of the abdomen, and a slight ping was heard in the caudal thorax. The presumptive diagnosis for Max II F241 was heatstroke with possible gastric distension due to aerophagia.

Flow-by oxygen was provided on presentation, an 18 gauge intravenous catheter was immediately placed in the left cephalic vein, and a 1 liter bolus of lactated ringer's solution was given rapidly. Active cooling measures were initiated immediately following assessment of his temperature: soaking with room-temperature water, applying isopropyl alcohol to the pads of his feet, and using fans to provide evaporative cooling. Due to marked distress of the patient, Max II F241 was sedated with 1 mg acepromazine and 2 mg hydromorphone injections. Max II F241 remained distressed and cyanotic, and was given an intravenous (IV) bolus of propofol and then intubated, whereupon his color and pulse oximetry improved. A second 18 gauge IV catheter was placed in the right cephalic vein. Vital signs were continuously monitored and reassessed. Initial complete blood cell (CBC)/chemistry panel showed hemoconcentration (packed cell volume, total protein, etc.). His blood glucose (BG) on presentation was 67 mg/dL, and 30 ml 50% dextrose diluted with 30 ml 0.9% NaCl was given IV. After administration of dextrose, his BG increased to 255 mg/dL. After over an hour of active cooling measures, Max II F241's rectal temperature was 102.7°F. Active cooling measures were stopped, and he was dried off.

Radiographs of the thorax and abdomen were obtained after he was cardiovascularly stabilized and his temperature had decreased. There was no evidence of bloat on abdominal radiographs, and thoracic radiographs showed diffuse pulmonary disease, which could have been caused by acute respiratory distress syndrome/acute lung injury, pneumonia, or noncardiogenic pulmonary edema, none of which could be ruled out.

The CBC/chemistry panels were repeated approximately 90 minutes postpresentation. Hemodilution was characterized by a panhypoproteinemia and decreased hematocrit. Ninety minutes after presentation, his BG was 86 mg/dL. Nasal catheters were placed in both nares for oxygen administration. One hundred five minutes after presentation, Max II F241's BG had dropped to 70 mg/dL, so a 5% dextrose constant rate infusion (75 mL/hr) was initiated. Despite additional dextrose support, his BG continued to fall, with a maximum value of 69 mg/dL. Two and a half hours postpresentation, Max II F241 was extubated and placed on 10 L/min oxygen via nasal catheter, maintaining his P_{AO_2} at 92%. Petechiae developed on mucus membranes, his abdomen, and areas of shaved skin, and hemorrhage was noted from IV catheter and nasal catheter sites, as well as venipuncture sites. Coagulation testing was performed. Both a PTT and PT were within normal limits, although his platelet levels dropped markedly from 349 K/µL to 213 K/µL (175 K/µL-500 K/µL). He developed hypothermia (T=98.2°F) 3 hours postpresentation.

Due to worsening prognosis for recovery from heatstroke and poor prognosis for adoption, euthanasia was elected and performed immediately. A complete necropsy was performed with tissue samples submitted to the Joint Pathology Center. Notable gross lesions on necropsy were hemorrhagic streaks throughout duodenum, jejunum, and ileum, enlarged gastric blood vessels, and atelectasis in approximately 25% of lung tissue.

HEATSTROKE IN VETERINARY PATIENTS

Pathophysiology

The development of heat injury is a multifaceted physiological process that encompasses varied cellular and systemic responses to heat stress.[1-5] Thermoregulatory processes initially attempt to control the internal body temperature. If the body's ability to control internal temperature via evaporative (panting, sweating), conductive (laying on a cool tile floor), or convective (sitting by a fan) methods is exceeded, heat illness occurs.[2,3] Over time, the body can acclimate to environmental temperatures above those found in the dog's habitual location. This acclimatization occurs through the enhancement of cardiovascular performance, alterations in kidney salt and water processing, plasma volume expansion, and mechanisms to resist exertional rhabdomyolysis. This process takes several weeks to occur in humans.[4]

When an animal is rapidly exposed to prolonged, increased body temperatures due to environmental or exertional causes without the ability to acclimate properly, heat stress occurs.[4,5] The physiologic response to this heat stress has 2 components: the acute-phase response and the heat-shock response. The acute-phase response occurs at the cellular level, primarily involving the leukocytes, while the heat-shock response occurs at the gene transcription level in cells throughout the body.[1-5]

During the acute-phase response, interleukin-1 (IL-1), interleukin-6 (IL-6), and various other cytokines are produced.[4] These cytokines act to stimulate hepatic acute-phase protein synthesis, endothelial cell adhesion, and angiogenesis, along with a myriad of other responses.[4] The sequence of leukocyte activation and amplitude of the acute-phase response in heat injury is known to be similar to that seen in septic patients.[4,6] This acute-phase response is initially protective, although it becomes detrimental when auto-regulation is lost and the response is exaggerated.[2]

Working in conjunction with a controlled acute-phase response, the heat-shock response acts to protect individual cells.[4] When exposed to extreme heat, almost all cells in the body have the capability to activate heat-shock transcription factors. These bind to the genome and upregulate the production of heat-shock proteins.[4] These heat-shock proteins then act as chaperones, preserving the conformation and function of enzymes throughout the body.[2,4,7] Decreases in the levels of heat-shock proteins are associated with an increased risk of heat injury, and may contribute to the increased risk of heat injury in elderly patients.[2,4]

When the acute-phase and heat-shock responses fail to protect the animal from heat stress, heat injury develops. Heat injury is a continuum of disease severity, ranging from slight physiologic stress (heat cramps) up to severe physiologic derangement (heatstroke) and potentially death.[1-4,8,9] Multiorgan dysfunction in the presence of prolonged elevated body temperature is the hallmark of heatstroke. Typically, patients suffering from heatstroke present in shock secondary to decreased effective circulating volume. They are typically dehydrated, and the heat injury compromises vasoconstriction, leading to decreased systemic vascular resistance and pooling of blood in the splancnic vasculature.[2,3] Altered

cardiovascular function combined with direct cytotoxicity and increased metabolic demand leads to multiorgan failure which, if progressive, can quickly result in patient death. Compounding these problems are coagulation abnormalities brought on by the heat injury.[2-4] Ultimately, if not controlled by appropriate medical treatment, these systemic disruptions lead to multiorgan dysfunction, disseminated intravascular coagulation, and potentially death.[2-4]

Risk Factors

There are numerous risk factors for the development of heat-related illness in veterinary patients. Exogenous factors include lack of acclimation to a new environment, elevated humidity (prevents evaporative cooling), lack of access to potable water, confinement in a poorly ventilated space, and some medications.[1-3] Endogenous factors include laryngeal paralysis or brachycephalic syndrome (unable to pant effectively), cardiovascular or neurologic disease, advanced age, obesity, and hair coat thickness and color.[1-3] The risk for development of a heat injury can be reduced by controlling some of the predisposing factors, such as obesity and acclimation. There is some thought that a previous heat injury may predispose veterinary patients to successive heat injuries.[1-3] However, this belief is extrapolated from human medicine[4] and has yet to be documented in the veterinary literature through a peer-reviewed study.

Diagnosis and Treatment

The diagnosis of a heat-related injury is based largely upon the history of the patient, clinical signs on presentation, and potentially the patient's rectal temperature. It is important to remember that during the heat injury process, the patient's ability to thermoregulate is compromised. This may lead to heat injury patients presenting persistently hyperthermic, normothermic, and even hypothermic if excessively cooled prior to arrival at the treatment facility.[1-4] In human medicine, a diagnosis of heatstroke requires the presence of central nervous system dysfunction accompanied by hyperthermia.[4] There is not a single diagnostic test that can confirm the presence of heat injury. Thus initial therapy should never be delayed while awaiting diagnostic testing results for any patient presenting with a potential heat injury.

Current therapy for heat injury in military working dogs is initiated by their handlers in the field.[8,9] If the rectal temperature is above 106°F, handlers are trained to begin active cooling measures: removing any muzzle, moving the dog to shade, rubbing alcohol to pads of feet and ears, soaking the dog in tepid water (no ice or chilled water), and placing the dog in a vehicle with the air conditioning on full and directed at the MWD. If an air conditioned vehicle is not available, the MWD will be transported in a vehicle with windows down. If the MWD is showing clinical signs of heat injury, such as uncontrollable panting, dyspnea, increased upper airway noise, tachycardia, dark mucous membranes, collapse, altered mentation, vomiting, or diarrhea, the handlers are trained to place an intravenous catheter and adminster room temperature fluids. All MWDs suffering heat-related injury are then immediately transported to a veterinarian.[8-9].

Two IV catheters are placed to allow for rapid fluid therapy. The shock dose of IV fluids in dogs is 80 mL/kg, given at ¼ dose increments with reassessment between doses.[10] Blood products, such as plasma, are given if indicated. Diazepam or midazolam are used to control seizures if present. Mannitol is administered if increased intracranial pressure is suspected. Dextrose is given if hypoglycemia is present. Lidocaine is used as a free radical scavenger and for control of arrhythmias, if present. Broad spectrum antibiotics are used only if indicated (hemorrhagic diarrhea, evidence of infection).[1-4] Gastroprotectants, such as famotidine or omeprazole, may also be indicated.

The initial minimum database includes CBC, chemistry, electrolytes, and bedside blood glucose assessment, and is repeated as often as necessary.[1-4] Care should be taken in smaller patients to ensure repeated monitoring does not exsanguinate the patient. Coagulation tests and lactate monitoring can also be useful in these cases, and should be performed if available. Electrocardiogram, blood pressure, vitals, and blood glucose are continually monitored.

Cooling measures are maintained until the MWD's rectal temperature falls to 103°F, at which point all active cooling measures are ceased, and the dog is dried completely.[1-4] The rectal temperature must be continually monitored for persistent hyperthermia or the development of hypothermia. Once cooled, it is beneficial to maintain the patient in a normal, physiologic temperature range.

Complete blood cell abnormalities associated with heatstroke often include[1-4] thrombocytopenia, neutrophilia with a left shift, toxic changes in neutrophils, and nucleated red blood cells. Abnormalties in the chemistry panel can include alterations in total protein or electrolytes, increases in creatinine kinase, lactate dehydrogenase, alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase, azotemia, hypoglycemia, and elevated lactate. Coagulation abnormalities can include

prolonged clotting times, which may progress to disseminated intravascular coagulation.

Respiratory alkalosis can develop as a result of increased panting. Metabolic acidosis often develops secondary to increased lactate, hypoperfusion, and electrolyte abnormalities. Additionally, the development of confounding disease processes, such as acute renal failure, can compound acid-base disturbances. As such, the patient's acid-base status should be closely monitored.[3]

Negative prognostic indicators include semicoma/coma, seizures, coagulopathy on presentation (PT>18s, PTT>30s), hypoglycemia unresponsive to treatment, elevated creatinine after 24 hours of therapy, hypothermia, and greater than 18 nucleated red blood cells per 100 white blood cells.[11]

SUMMARY

Heatstroke is an environmental emergency that threatens our MWDs throughout the world. Proper education of the handlers, veterinary technicians, and Veterinary Corps officers is essential to minimize the risk of losing an MWD to this condition. Understanding the risk factors, initial therapy, and pathophysiology is key to prevention and treatment of heat illnesses regardless of location.

Max II F241 had many of the predisposing factors for a heat injury. He was an elderly dog (11 years old), was obese (body condition score 7/9), had not been worked for a few months, so he was not acclimated to the level of exercise required for the BMV, and the temperature and humidity were both elevated. The personnel involved worked to minimize his risk by completing the video in the early morning, prior to the day becoming extremely hot. Ultimately, Max II F241 died as he lived, happily biting anyone who offered an available limb.

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Veterinary Diseases Review for Mainland Japan, 2000-2010

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ABSTRACT

We reviewed all of the paper records on all of the animals treated at the military veterinary clinics on mainland Japan from 2000 to 2010 and present a review of the parasites and pathogens of zoonotic potential. Over 16,764 veterinary visits from more than 5,400 animals were recorded. Zoonotic protozoa were detected in both military working dogs and pets. Parasitic helminthes included numerous nematodes and tapeworms. We discuss the limitations of veterinary records and the relevance of zoonotic disease reporting for public health.

Zoonotic diseases and parasites infect animals and circulate in animal populations. They do not require a human host. Many debilitating and occasionally fatal zoonotic diseases are newly recognized threats to humans. Veterinary data are often unavailable for public health professionals, and their surveillance systems do not capture data from veterinary clinics. However, veterinary practitioners can report zoonotic pathogens to public health officials. Veterinarians are part of the first line of defense and detection[1] for many human pathogens. Veterinary facilities can provide potentially life-saving data on the prevalence and local transmission of pathogens. They also give guidance and training to pet owners or public health officials on zoonotic diseases and risk management.

As an initial step in improving the surveillance of zoonotic diseases for US military bases in Japan, we conducted a physical audit and data analysis of all animal records at the US military veterinary care facilities in mainland Japan. The following report focuses on the major parasitic agents likely to infect humans or cause disease in military working dogs (MWDs). Veterinary clinic reviews could be useful for civilian public health organizations in monitoring zoonotic diseases.

METHODS

Military veterinary clinics in Japan maintain paper records on animals that were owned by both military personnel and civilians. Almost all animals that enter the country with incoming personnel are initially quarantined and examined by military veterinarians. We visited the veterinary care facilities at Camp Zama, Marine Corps Air Station (MCAS) Iwakuni, US Fleet Activities Sasebo, Misawa Air Base, Yokota Air Base, and Yokosuka Naval Base and manually reviewed more than 5,400 animal medical files to capture all reports of parasitic or pathogen activity reported in the last 10 years (2000 to 2010). Paper records were entered into an electronic database, and each animal was given a unique identification number not tied to personal clinical records. Each record included species, animal name, arrival date, examination dates, and working dog status. All reports of parasites or infectious diseases were annotated in the computer database with the date the animal presented at the clinic.

The database was organized by military base. The US military bases in Japan with veterinary clinics include Camp Zama, Yokota Air Base, and Yokosuka Naval Base in the Kanto Plain region near the Tokyo metropolitan area. The veterinary clinics on these bases also serve neighboring military facilities without clinics. These include base housing areas, Atsugi Naval Air Station, Yokohama North Dock, Sagamihara Army Depot, and the US Embassy in Tokyo. Misawa Air Base is in Aomori Prefecture, one of the northernmost prefectures on Honshu Island. MCAS Iwakuni is located in southwestern Honshu in Yamaguchi Prefecture. US Fleet Activities Sasebo is in Nagasaki Prefecture on the southern island of Kyushu. Kadena Air Base on the island of Okinawa has a large veterinary facility that supports numerous military bases in Okinawa Prefecture. We did not review the records from Okinawa.

Data was analyzed using SAS version 9.1 (SAS Institute Inc, Cary, NC). Temporal analysis was not possible due to insufficient date denominator data, ie, when an animal tested negative, only year was available, not month. The frequency of positive test results by location and host was investigated.

RESULTS AND DISCUSSION

A total of 5,418 animals, predominately dogs and cats, were included in the database during the 10-year period for which data are available. Animals were tested 16,764 times. There were 91 unique working dogs.

The review focused on internal parasites and pathogens. While some external parasites such as fleas, mites, and ticks are potential vectors of zoonotic diseases, we do not discuss them. The majority of animals were cats and dogs, and results are summarized in Tables 1 and 2. The majority of parasites were unidentified worms followed by "Coccidia" (Figure 1).

Protozoons

Protozoan parasites are diverse and range from intestinal parasites with simple, direct life cycles to vector-borne agents that undergo complex life cycles. Parasitic protozoons cause some of the most significant zoonotic diseases worldwide. Several parasitic protozoons were reported from animals at the military veterinary clinics.

There are case reports of 2 dogs at the Camp Zama veterinary clinic infected with *Leishmania infantum* Nicolle, a visceral leishmania species.[2] The presence of *L. infantum* in military pets recently imported from southern Europe was not surprising but could be politically sensitive if a foreign disease were introduced into Japan. A review of the published literature on the phlebotomine sand flies in Japan revealed that they do not feed on mammals.[3]

Numerous gastrointestinal protozoan parasites were reported from animals. For example, *Giardia lamblia* was detected by fecal flotation or with ELISA SNAP tests (IDEXX Laboratories, Ontario, Canada) from both cats and dogs. *Giardia lamblia* (Stiles) is one of the more common zoonotic protozoa and has a relatively stable encysted stage that remains infectious in water or wet soil.[4] Both acute and cryptic cases occur in humans and animals. The taxonomy of *Giardia* spp is somewhat convoluted, with a variety of serotypes recognized.[4,5] Not all serotypes cause clinical illness in humans, and they are indistinguishable in fecal flotations. *G. lambia* was the most frequently reported parasite of MWDs. The infected MWDs were from Misawa Air Base and Camp Zama. The reservoir of the infections remains an unknown potential threat to human health. In addition to dogs and cats, several fecal samples from water birds on Camp Zama were tested for *G. lamblia*, but all were negative.

Coccidia, gastrointestinal protozoa, were reported in 18 animals including dogs, cats, a rabbit, and a military working dog from Camp Zama. Unfortunately, the term coccidia is inclusive of many parasitic protozoa. Based on conversations with veterinary staff, some coccidia were *Isospora* spp. One sample was positively identified as an *Isospora* sp from a dog at Misawa Air Base. In general, *Isospora* spp do not infect humans. However, several other parasitic protozoa such as *Cryptosporidium* spp and *Toxoplasma gondii* (Nicolle and Manceaux) might be mistaken as a "coccidia." One of the animals with coccidia was a cat, which could shed *T. gondii*. *Toxoplasma gondii* was detected by the veterinary staff in some animals from a petting zoo adjacent to Camp Zama (unpublished data).

A dog in Sasebo was reported to harbor *Cryptosporidium canis* Fayer, Trout, Xiao, Morgan, Lai, and Dubey. This gastrointestinal protozoon has a wide distribution throughout the world,[6] including Japan. Like other species of *Cryptosporidium,* an infected animal can present with diarrhea. This parasite has some zoonotic potential, but the

Table 1. Positive results in dogs from all mainland military veterinary clinics in Japan 2000-2010.

Parasite	Location					
	Zama	Sasebo	Iwakuni	Misawa	Yokota	Yokosuka
Nematode						
Dirofilaria immitis	13	6	6	17	3	8
Trichuris vulpis	1*	-	1	-	-	1
Toxocara spp	3	2	-	8	-	-
Nematode (no further ID)	-	7†	-	-	5	1
Strongyloides stercoralis	-	1	-	-	-	-
Aelurostrongylus abstrusus	-	-	-	-	-	-
Capillaria/Dioctophyma sp	1‡	-	-	-	-	-
Hookworm	5	-	-	-	1	-
Tapeworm						
Unidentified tapeworm	2	3	3	6	3	15
Dipylidium caninum	2	1	1	-	-	-
Taneia sp	-	-	-	1	-	-
Diphyllobothrium latum	-	-	-	-	1	-
Protozoa						
Giardia	4**	-	2	3†	-	3
Coccidia	5**	-	1	2	-	-
Cryptosporidium canis	-	1	-	-	-	-
Isospora	-	-	-	1	-	-

*Tested positive 4 times.
†Two military working dogs included in the total.
‡Military working dog.
**One military working dog included in the total.

taxonomy of *Cryptosporidium* is unclear and humans are not susceptible to all species.[7]

Nematodes

Nematodes are some of the most diverse and common parasites throughout the world. These worms range from commensal internal associates, to near-mutualists, to blood-sucking and life-threatening parasites. Numerous nematodes from veterinary clinics were identified as "worms" and nematodes. Based on interviews with the veterinary staff, most of these nematodes were ascarids.

Table 2. Positive results in cats from all mainland military veterinary clinics in Japan 2000-2010.

Parasite	Location					
	Zama	Sasebo	Iwakuni	Misawa	Yokota	Yokosuka
Nematode						
Dirofilaria immitis	-	-	-	-	-	1
Toxocara spp	-	-	-	1	-	-
Nematode (no further ID)	-	7	-	-	5	1
Aelurostrongylus abstrusus	-	-	2	-	-	-
Hookworm	-	-	-	-	1	-
Toxascaris leonina	-	1	1	-	-	-
Tapeworm						
Tapeworm	1	5	2	9	7	9
Dipylidium caninum	2	1	-	3	-	-
Protozoa						
Giardia	2	-	-	-	-	-
Coccidia	2	-	-	2	2	2

The veterinary clinics captured data on one species of filarial nematode, *Dirofilaria immitis* (Leidy) (heartworm). Both pet owners and veterinarians are aware of the risks of heartworm disease. This explains the frequent sampling and subsequent detection of this parasite. *Dirofilaria immitis* is transmitted by mosquitoes and vector populations on most installations, and are significant during the summer and fall.[8] Stray dogs are rare on most installations, however, wild tanuki (*Nyctereutes procyonoides viverrinus* Temminck) (Figure 2) are susceptible to *D. immitis*[9] and live on bases. The zoonotic risk of *D. immitis* is low, as most human infections do not progress. However, larvae can die in the lungs and superficially resemble tuberculosis or cancer.[10] Heartworm was the most commonly reported parasite of dogs seen at US military veterinary care facilities in mainland Japan. A single feline case was reported from Yokosuka. There were no infections in MWDs, but they are regularly treated with preventive drugs.

The primary diagnostic tests for heartworm are serologic and detect adult antigens. Identification of microfilaria in blood smears was rare, however, blood smears were performed on some animals. Microscopic examination of blood smears will detect other filarial nematodes, *Babesia*, etc. There are several species of *Dirofilaria* in wildlife, and animals from Europe pose the risk of arriving with *Dirofilaria repens* (Railliet and Henry). The serologic ELISA SNAP tests (IDEXX Laboratories, Ontario, Canada) for heartworm will not detect infections with species other than *D. immitis*.

There were numerous other species of parasitic worms that develop in the gastrointestinal tracts of animals. Unfortunately, the majority of records on parasitic worms were recorded as nematodes or worms. Poorly identified parasites and recordkeeping present a consistent problem in veterinary data from clinics. Interviews with the veterinary staff allowed some to be identified, but incomplete data reduce the value of veterinary clinics in disease surveillance. We summarize the worms that were identified to at least the genus level.

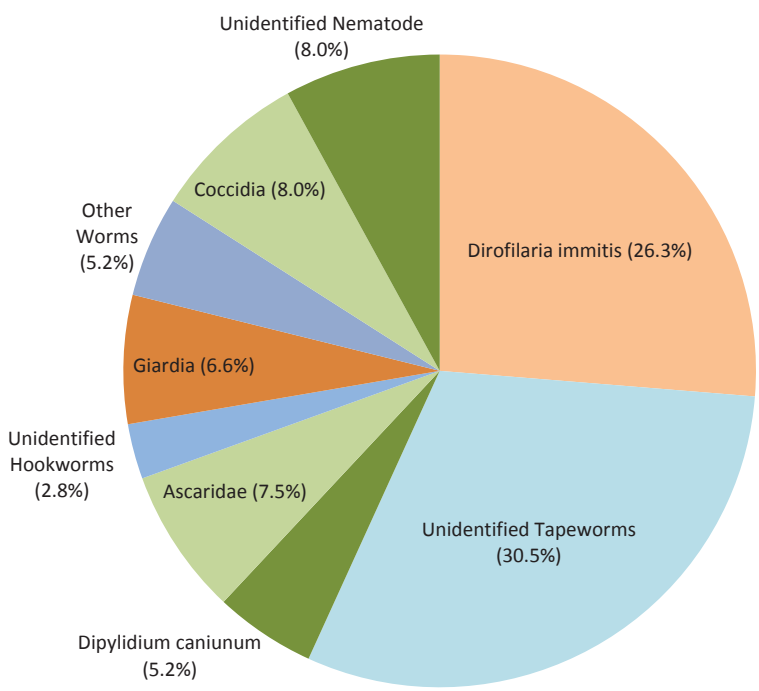

Figure 1. The overall percentage each taxon contributed to the sum of all pathogens reported by veterinary clinics of US military bases in Japan from 2000 to 2010.

A dog at the Sasebo clinic was diagnosed with *Strongyloides stercoralis* (Bavay), presumably during a fecal analysis. Strongyloidiasis was found throughout Japan, and recent data indicate it can be locally common.[11] *Strongyloides stercoralis,* a zoonotic nematode, readily infects humans and companion animals, causing strongyloidiasis.[12] There are several morphologically similar species of *Strongyloides* in dogs and cats. Humans and companion animals are generally infected when nematode larvae in the soil pierce their skin, invade the circulatory system, and move into the body. However, *S. stercoralis* can autoinfect or reinfect a host.[13]

Eggs of unidentified hookworms were occasionally reported from dogs at Camp Zama but not other veterinary clinics. This probably represents a sampling anomaly or variation in the diagnostic abilities of the veterinary staff. Larval hookworms are infectious as free-living worms in the soil. They have a life cycle similar to that of *S. stercoralis* and can penetrate the skin of humans and dogs. Humans are accidental hosts to these worms. In humans, the larval worms usually die near the point of exposure, but occasionally the migration tract of the larval worm becomes infected and inflamed.[14] The resulting cutaneous larval migrans (usually from *Ancylostoma* sp) may last weeks to months and at times causes intense itching, but the condition is self-limiting.

Both wildlife and cats harbored hookworms. Some tanuki on base were infected with *Ancylostoma kusimaense* Nagayosi or a related species. Two were removed from the intestine of a dead tanuki on Camp Zama. These worms are reported to infect domestic dogs.[15] A cat from Yokota harbored hookworms. Based on a review of the Japanese parasitological literature, this worm was most likely *Ancylostoma tubaeforme* (Zeder), which is the primary hookworm of domestic cats reported near this region of Japan.[16] Exotic worms could be introduced in pets, but local acquisition of *A. tubaeforme* is probable. Symptoms from infestations with *A. tubaeforme* can range from asymptomatic to a serious disease in cats.

Trichuris vulpis (Froelich) is a whipworm of canids. It infects the intestine, but in humans and aberrant hosts it can infect other organs.[17] Human infections are rare.[17] Adult worms can live for years if an animal is untreated, although most animals with low level infestations are asymptomatic. Heavy infestations can cause rectal prolapse or bloody diarrhea. Eggs are shed in the feces and are somewhat environmentally resistant and remain infectious in the soil, allowing reinfection.[18] They resemble the eggs of most other whipworms and could be misidentified. Eggs from *T. vulpis* were discovered in 3 dogs in the last 10 years, one each at Yokosuka, Iwakuni, and Zama veterinary facilities. The one dog at Camp Zama was repeatedly seen at the clinic for over 8 months in 2008 and continued to be actively infected despite repeated treatments.

Dog and cat roundworms (*Toxocara canis* (Werner)/*T. cati* (Zeder)) were occasionally reported in fecal samples. In addition, numerous unidentified nematodes from the clinics were probably *Toxocara* spp. Both dog and cat roundworms are mildly zoonotic geohelminths.[19] The eggs are environmentally stable and infectious in soil contaminated by animal feces.[18] When the eggs are consumed, the infectious larvae invade host tissues and can cause visceral larval migrans.[19] In rare cases, visceral larval migrans is fatal.[19]

Toxascaris leonina (von Linstow) was reported from 2 cats at the Sasebo and Iwakuni veterinary facilities. The adult worms live in the intestine like other ascarids. Eggs are shed in the feces and are infectious to cats.[20] This worm is not a zoonotic parasite, but it can infect dogs.[20]

In addition to the *Toxocara* species found in domestic animals, there are numerous species in wildlife. Several feral animals were necropsied at veterinary clinics. Two adult *T. tanuki* Yarnaguti were removed during the necropsy of a dead tanuki on Camp Zama. Exotic North American raccoons live on base, and these animals can harbor other ascarids.

The feline lungworm, *Aelurostrongylus abstrusus* (Railliet), was reported from 2 cats from the same household at MCAS Iwakuni. Lungworms have a wide geographic range and occur in up to 22% of cats in some surveys.[21] Many cats are asymptomatic when infected. These worms are not a zoonotic threat.

Figure 2. The tanuki (*Nyctereutes procyonoides viverrinus*) found on some US military bases in Japan. Photo courtesy of 663 highland, Wikimedia Commons (Creative Commons Attribution2.5 Generic).

One rather cryptic handwritten note in a record of a military working dog at Camp Zama seems to imply that there were worm eggs in the urine. The notes were not complete and cannot be fully interpreted. The only worms likely to infect the bladder are *Capillaria* or *Dioctophyma* spp.[22,23] The notes later mention the presence of tapeworm proglottids in the same urine sample. The urine sample was probably contaminated with fecal material or with tapeworm proglottids that crawled into the wrong orifice as they moved out of the anus. Yet, based on the incomplete data, there was no way to rule out *Capillaria* or *Dioctophyma* spp.

Cestodes and Trematodes

Like nematodes, flatworms are some of the most diverse and commonly reported endoparasites of domestic animals. There are 2 primary groups of parasitic flatworms: the flukes (trematodes) and tapeworms (cestodes). The eggs of most parasitic species are shed in the host's feces. These are often detected by fecal flotation and microscopy. Unfortunately, for surveillance purposes, the eggs of most flukes do not float on the frequently used solutions, but tapeworm and nematodes eggs do. There were no reports of trematodes in any animals despite the fact that the intermediate host snails and crustaceans live on several bases.

Although tapeworms were reported at every clinic, the vast majority (85%) of them were not identified. Molecular techniques or serologic techniques are required for some identifications. At least 65 animals were diagnosed with unidentified "tapeworms." The majority were from dogs, however, some cats were infected. One case was noted in a military working dog from Camp Zama. Based on additional information from the veterinary staff, many of the infections were *Dipylidium caninum* (Linnaeus), the dog tapeworm.

The most significant tapeworm of public health concern in Japan is *Echinococcus multilocularis*.[24] This worm is known to infect dogs in northern Japan, with sporadic cases in the Tokyo area.[25] Unlike the majority of the detected zoonotic parasites which are mildly debilitating and not life threatening, an infection with *E. multilocularis* is likely to be fatal.[26] The eggs of *E. multilocularis* are almost impossible to differentiate from *Taenia* spp.[27]

The similarity between *Taenia* and *Echinococcus* was a problem when a dog from Misawa was reported to shed eggs from a *Taenia* sp. However, the eggs are morphologically identical to *E. multilocularis* (Leuckart).[27] *Echinococcus multilocularis* was reported from pet dogs in the Tokyo area in 2005 and 2009 and is regularly reported in Hokkaido near Misawa AB.[25] A 2009 survey of endoparasites in dogs and cats in Saitama, Japan, indicated that *E. multilocularis* could be as common as *D. caninum* in some pet populations.[16] Identification and treatment of *E. multilocularis* in dogs are critical for the prevention of hydatid disease in humans. People are infected with larval tapeworms when they accidentally consume the eggs[26] by allowing their dogs to lick their face, which is a route of exposure. The lack of identification of tapeworms in animal feces is a failure to protect the public's health.

Two additional species of zoonotic tapeworms were identified from dogs. A dog from Yokota Air Base was positive for *Diphyllobothrium latum* (Linnaeus) in a fecal float. *D. latum,* the broad fish tapeworm, is one of the best studied and broadly distributed species in the genus throughout Asia.[28] These tapeworms use fish as intermediate hosts and infect fish-eating mammals. Based on published surveillance, humans in Japan are infested with *D. latum* from eating fish.[29] Dogs are susceptible to this worm if they eat raw fish. This tapeworm does not cause major diseases in dogs. However, it can cause serious anemia in some humans, and the detection of the worm indicates infected fish were available to the pet. Sushi is a popular food in Japan and could be the source of the parasite.

One of the most frequently reported tapeworms was *D. caninum,* the double-pored dog tapeworm. It is a zoonotic parasite transmitted by arthropods[30] but rarely is a serious problem. Tapeworm larvae develop in invertebrates and are not a health threat. Humans are susceptible to infection if they eat infected lice or fleas. Young children are most likely to be infected when playing with infected animals.[31] Dog tapeworms were reported from dogs and cats at almost all installations. In addition, a large proportion of the unidentified tapeworms were probably *D. caninum*.

Veterinary clinics maintain records on zoonotic diseases and parasites. Our review of veterinary data indicates that there is a wide range of zoonotic parasites and pathogens circulating in the environment on military bases. This information is helpful for public health officials and could serve as a model for civilian public health agencies to determine which threats are present.

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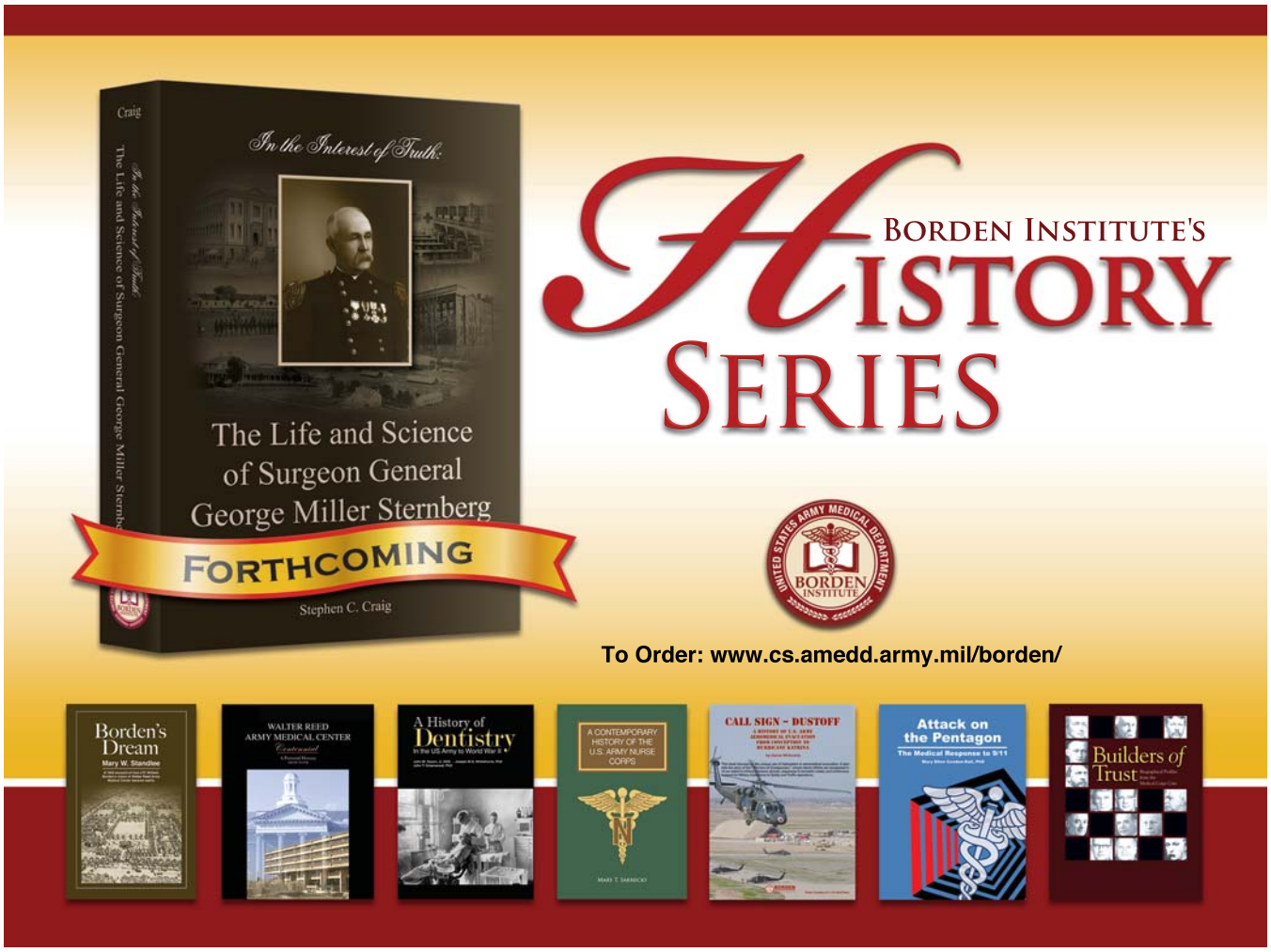

A Review of Influenza Viruses in Seals and the Implications for Public Health

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ABSTRACT

With the public health community and general population more concerned with influenza than ever before, it is important to explore all potential vectors for the next pandemic. Potential sources include pinnipeds (seals and sea lions). Between subsistence hunting, managed animals, and shared shoreline habitat, humans are more likely to interact with pinnipeds than any other marine mammal. This paper summarizes documented influenza events and research on *Phocidae* and *Otariidae* and discusses the potential challenges they present to public health.

Influenza is a common virus that affects many species to varying degrees of severity. Pinnipeds are particularly interesting animal models because both influenza A and B virus infections have been identified in wild populations. This is significant because, before the year 2000, influenza B virus infection had only been reported in primates.[1] Influenza virus infections in seals have historically caused mass mortality events in affected populations.[2-6] An influenza virus was first isolated from harbor seals (*Phoca vitulina* (Linnaeus)) in 1980; the virus was identified as belonging to the H7N7 subgroup and the naturally infected cases were described by Geraci et al and Webster et al.[5-7] The first isolation of a seal influenza virus from a human occurred in a researcher studying this first known epizootic, confirming that influenza viruses carried by seals could infect humans.[5]

Pigs are commonly known to be a species in which genetic reassortment of novel influenza viruses can occur because they have receptors that allow attachment to both mammalian and avian influenza virus strains.[8] Receptors that recognize avian sialyloligosaccharide 2,3 Galactose (SAα2,3Gal), and mammalian sialyloligosaccharide 2,6 Galactose (SAα2,6Gal), influenza viruses have been identified in seal lung tissue.[3,9] The H3N8 strain isolated from dead seals in the 2011 outbreak was found to bind both mammalian and avian influenza receptors.[3] Additionally, experimental infections in primates with a 1980 seal influenza virus resulted in significant systemic disease.[10] These findings demonstrate the potential for seals to harbor viruses to which humans are susceptible and immunologically naïve.

Shortridge and Stuart-Harris proposed the idea of an influenza epicenter; a geographical area where birds, humans, and other animals live in intimate contact, providing optimal conditions for viruses to cross species.[11] Traditionally, research has focused on agricultural influenza epicenters, that is, where humans, birds, and pigs live in close contact. Waterfowl are the natural reservoir for all known subtypes of influenza A viruses and share many resources with pinnipeds at sea.[12,13] Additionally, between subsistence hunting, managed animals, and shared shoreline habitat, humans are more likely to interact with pinnipeds than any other marine mammal. This article provides a review of influenza viruses in pinnipeds with the goal of increasing recognition of potential wildlife influenza epicenters, particularly in coastal centers with large pinniped populations.

METHODS

Search Strategy

The PubMed database was searched in July 2007, February 2010, and again in August 2012. The searches were performed without language restriction and used the key words "seal," "Phoca," "phocid," "pinniped," "otaria," "otariid," "otariidae," "Arctocephalus," Zalophus," "Callorhinus," "fur seal," "sea lion," "marine," or "marine mammal," along with "influenza," "orthomyxovirus," "zoonoses," "zoonosis," "zoonotic," "H1," "H3," "H4," "H5," or "H7" to find reports on cases of influenza in seals or seal strains found in man. Additional articles were located through the reference sections of the selected papers.

Selection of Articles

The title and abstracts of all search results were reviewed for inclusion using the following criteria: the article mentioned at least one case of influenza in pinnipeds, a seal influenza strain found in humans, or discussion of pathology or environmental interaction of influenza strains found in seals.

RESULTS

The PubMed searches yielded 112 different results. Of these, 26 articles, spanning from 1978 to 2012, were

selected for review because they met the above inclusion criteria. The remaining 86 studies were not applicable to this review.

Etiology

Influenza viruses belong to the Orthomyxovirus family of enveloped viruses with segmented, single-stranded negative-sense RNA. Influenza viruses are divided into 3 types (A, B, and C) based on the 2 major core proteins, the nucleoprotein and the matrix protein.[14] Of these types, only influenza A and B viruses tend to cause epidemics in humans and are the main focus of this review. Each influenza A virion consists of a host-derived lipid bilayer envelope and an 8-segmented genome, which codes for the 11 virion proteins. These proteins are the 3 transmembrane glycoprotein spikes (hemagglutinin (HA), neuraminidase (NA), and matrix protein 2 (M2)), a nucleocapsid (matrix protein 1 (M1)), a nucleoprotein (NP), 3 polymerase proteins (PA, PB1, and PB2), an apoptosis-inducing protein (PB1-F2), and 2 nonstructural proteins (NS1 and NS2). The segmentation of the genome allows for genetic reassortment within and between viruses, readily creating new phenotypes (antigenic shift).[15] Additionally, mutations may occur, especially in the H region, creating an antigenic drift.[15] M1 and M2 are involved in virion coating and uncoating.[15] Nucleoprotein and polymerases aid in transcription. Hemagglutinin and NA are responsible for viral attachment and release and are also the antigens involved in host immunity.[2] Additionally, HA plays a role in determining host range, since membrane fusion and genome penetration only occur if the proper cellular proteases are present to cleave the HA into the disulfide-linked polypeptides HA_1 and HA_2.[16] Currently, 16 HA and 9 NA serotypes have been recognized for influenza A viruses, all of which have been isolated from birds.[12,13] Each virus has one HA and one NA subtype, which theoretically may occur in any combination. Specific influenza strains are identified by a standard nomenclature specifying virus type, host, geographic origin, sequential number of isolation, and HA and NA serotype, for example: A/Seal/Mass/1/80/(H7N7).

Transmission and Epidemiology

Waterfowl, particularly of the orders Anseriformes and Charadriiformes, are the natural reservoir for all known subtypes of influenza A viruses.[12,13] Avian influenza viruses replicate mainly in the birds' intestinal tract and are spread from bird to bird by a fecal-oral route.[17] Spread of avian influenza viruses to seals may occur through direct contact, such as predation on birds, inhalation of aerosolized virus, or indirect contact with bird feces through contaminated food or water.[17] Avian influenza viruses have been shown to be most stable in fresh to brackish water (0-20,000 ppm) with colder temperatures (4°C-17°C), and a slightly basic pH (7.4-8.2).[18] In seals, influenza binds to the same type of sialyloligosaccharide receptors, SAα2,3Gal, as birds, but the receptors are located in their lungs instead of in their intestinal tract, making inhalation the most likely route of transmission.[9,19]

The first recorded epizootic of influenza in seals occurred from 1979-1980 on the New England coast. An H7N7 influenza virus was repeatedly isolated from the lungs, brain, and hilar lymph nodes of dead seals.[20] Approximately 600 seals died; an estimated mortality of 20%.[5,6] From 1982-1983, an H4N5 influenza virus caused a 2% to 4% mortality of harbor seals on Cape Cod.[2] H4N6 and 3 strains of H3N3 were isolated from harbor seals in another Cape Cod epizootic in 1991 and 1992.[21] In 2011, again on the New England coast, 162 harbor seals died in an outbreak of pneumonia lasting less than 4 months. This was 4 times greater than the expected mortality rate in a healthy, wild seal population.[3] An H3N8 strain was isolated from several of the seals.[3] Antigenic and genetic analyses showed that all genes from each of the epizootic strains were of avian origin.[3-6,9,21,22] Furthermore, a study by Mandler et al demonstrated that the closest-matching avian strains to the 1980 H7N7 virus were from the same geographic region as the seal isolate.[23]

Evidence of influenza virus infection by many different influenza serotypes has been found through antibody and virus isolation from seals around the world. Serotypes H7N7, H4N5, H4N6, H3N8, and H3N3 have been found in harbor seals (*Phoca vitulina*) on the New England coast of the United States.[3-7,21,22] De Boer et al found antibodies to H1, H3, H4, H7, and H12 in sera from seals from the Bering Sea.[24] Interestingly, all NP-ELISA positive sea lions were negative in Hemagglutinin inhibition tests, suggesting the sea lions carried antibodies to a then unknown hemagglutanin serotype.[24] Danner and McGregor found H3 and H7 antibodies in a ringed seal (*Phoca hispida*) in Alaska.[25] In contrast, Calle et al did not find antibodies to influenza A in sera from the 6 bearded seals (*Erignathus barbatus)* sampled near St. Lawrence Island, Alaska.[26] Austin and Webster did not find antibodies to influenza A or B virus in sera from the 237 Weddell seals (Leptonychotes weddelli) sampled near Cape Armitage, Antarctica.[27] In Arctic Canada, 2.5% of the ringed seals that were tested by Nielsen et al were seropositive for influenza A, but were not tested for serotype.[28] Antibodies from H3 and H6 were found in sera from Kuril harbor seals (*Phoca vitulina stejnegeri*) in Hokkaido, Japan.[29] Ohishi et al reported evidence of H3N2 in Baikal (*Pusa sibirica*) and ringed

seals from Lake Baikal and the Kara Sea in Russia.[22] Researchers believe seals caught this serotype from humans.[1,13,22] Additionally, in 2002, Ohishi et al found antibodies to H3N2, H2N2, H3N8, and influenza B in Caspian seals (*Pusa caspica*) from the Caspian Sea.[30] Until Osterhaus et al identified antibodies to an influenza B virus in 2000 from a harbor seal in Pieterburen, Netherlands, influenza B was thought to be a strictly human virus.[1] More recently, antibodies to influenza B virus and to H1N1 have been isolated in fur seals (*Arctocephalus australis*) from Lobos Island, Uruguay.[31] It appears that severe influenza virus infection is sporadic in seals and, fortunately, does not usually lead to a mass die-off. More research is needed to explore the cause, likely multifactorial, for such epizootics and the role of evolving influenza viruses and influenza-associated mortality events in pinnipeds.

Clinical Signs and Pathology

Clinically affected seals appear weak and may exhibit respiratory distress and ataxia. Additional clinical signs include a frothy white or blood-tinged nasal discharge, mild cough, pneumonia, conjunctivitis, and swollen, emphysematous necks.[3,5-7] Affected seals are often in good body condition due to the rapid course of disease. Experimental infection of harbor seals induced clinical signs in as little as 24 hours and naturally infected seals were observed to have died just hours after feeding normally.[5-7] Cause of death is acute hemorrhagic pneumonia. Postmortem lesions include necrotizing bronchitis and bronchiolitis and hemorrhagic alveolitis.[5-7]

Diagnosis

Virus isolation from culture of nasal or pharyngeal swabs or enzyme-linked immunosorbent assay (ELISA) can be used to test for influenza antibodies in serum.[5-7,21,22,24,28-32,33] Hemagglutinin inhibition and Neuraminidase inhibition tests are necessary for subtyping isolates.[24] Differential diagnoses include phocine and canine distemper viruses, phocine herpesvirus-1, and Mycoplasma.[7]

Treatment and Control

Due to the viral etiology, there is no specific treatment for influenza virus infection in seals. Supportive care may be helpful in rehabilitation, though may not be feasible in the case of an epizootic event. The development of antibodies in naturally and experimentally infected seals suggest that immunity through vaccination is possible, but this would be impractical and cost prohibitive in wild pinniped populations.[4] Measures to prevent influenza transmission to captive pinnipeds include covering pens to minimize exposure to bird feces and designing enclosures to prevent direct contact with feral pinnipeds. Additionally, in zoo settings, vaccination of birds in conjunction with strict biosecurity measures and viral monitoring can reduce the amount of influenza virus present in the environment, decreasing the likelihood of viral transfer to other species in the collection.[34]

Human Cases

The first recorded cases of influenza transfer from seals to humans were during the study of the 1979-1980 epizootic on Cape Cod. Within 2 days of known contamination of the eyes during seal necropsies, 4 people developed purulent conjunctivitis with intense periorbital swelling and pain. Recovery was uneventful and complete in 4 to 5 days.[6] Another case occurred during a study of experimental infection of harbor seals with A/Seal/Mass/1/80 (H7N7) when an infected seal sneezed into the face and right eye of an investigator. A severe conjunctivitis developed in the person's right eye within 40 hours and the periauricular lymph nodes were enlarged by 96 hours postexposure. High levels of the virus, confirmed as A/Seal/Mass/1/80 (H7N7), were recovered in conjunctival swabs from the infected eye. The conjunctivitis resolved by the fourth day.[6] Antibodies to the seal virus were not detected in sera from any of the human cases, but this is not unusual since a blood-ocular barrier exists, preventing induction of a systemic immune response when only the eye has been exposed.[6]

COMMENT

The subject of influenza in seals raises many questions. There appears to be several ways in which seal-human interactions, both direct and indirect, could contribute to the development, spread, or exacerbation of influenza outbreaks.

Are influenza outbreaks in seals more prevalent than realized?

Harkonen et al investigated a 2007 epizootic of harbor seals from the Danish island of Anholt and along the Swedish coast.[35] Thousands of seals were reported to have perished in the outbreak. Observation and necropsy of affected seals revealed weakness, swollen, emphysematous necks, dyspnea, hemoptysis, interstitial pneumonia, and necrotizing tracheitis and bronchitis.[35] Additionally, an increase in stranded harbor porpoise (*Phocoena phocoena*) carcasses, also exhibiting emphysema, was found in the same area.[35] Bacteriology and PCR for phocine distemper virus performed on seal and porpoise samples yielded no answers as to the cause of the mass mortality.[35] Agreeably, due to the lack of recovery of pathogenic bacteria in combination with the histpathological findings, Harkonen et al suggested the etiology was viral.[35] It is possible this was an influenza mortality event. Influenza infection causes similar symptoms and pathology as those described by

Harkonen et al, and has also been reported in cetaceans, who also have SAα2,3Gal influenza receptors in their lungs.[5-7,9,17,19,28,35-37] This, however, would be the first recorded influenza epizootic affecting both pinnipeds and cetaceans and could indicate either an independent, yet simultaneous, introduction of novel influenza virus into both species or an important cross-species transmission. ELISA for influenza virus could be performed on remaining samples to rule this out as a cause.

Can marine mammals act as an intermediary species in the spread of avian influenza from birds to humans?

Antigenic and genetic analyses of epizootic strains from seals revealed that all genes from each of the epizootic strains were of avian origin.[3-7,9,22] Additionally, researchers believe that seals acquired, and may be reservoirs for, human H3N2 and influenza B viruses.[1,13,22,30] A study by Scheiblauer et al demonstrated that a variant of A/Seal/Massachusetts/1/80 adapted to cause severe systemic disease in mice, ferrets, and rats, all commonly used animal models for human influenza studies.[38] It has already been shown that influenza virus from seals can replicate in human tissue and that seal influenza viruses can be systemically virulent in primates.[5,10] Perhaps most concerning is the fact that the H3N8 virus isolated from carcasses in the 2011 seal outbreak has the ability to transmit between seals, which may become infected with multiple influenza virus subtypes.[3] It is probable that seals could act as a "mixing vessel" for creating pandemic strains by mixing genes from avian and mammalian viruses.[3,30]

Can marine mammals spread avian influenza viruses through their migrations?

Little is known about the role of migratory patterns of and interactions between the various species of pinnipeds in the spread of disease. Harris et al used an individual-based model of seal movement to evaluate the influence of epidemiological parameters and host ecology on the spread of phocine distemper virus through populations of harbor seals.[39] It was determined that short foraging trips with short haulout durations or long infectious periods allowed for more traveling by the seals and increased the likelihood that disease would spread between haulouts.[39] Since phocine distemper virus, a morbillivirus, has a similar mode of transmission and pathology as influenza virus in seals, this model might be useful in predicting the spread of influenza infections in seals as well.[7] More research is needed to better understand the behavior of seals and its effect on epidemiology.

Do fish and sediment harbor influenza?

Little is known about the influence of abiotic or biotic environmental factors on the persistence and spread of influenza virus. Brown et al reported that water is intimately connected with the transmission of avian influenza viruses and that these viruses can remain infective in this medium for months under natural conditions.[18] Influenza virus can also be preserved in environmental ice or concentrated in filter-feeding invertebrates.[40,41] Fish feed on many things, including sediment, bird feces, and detritus, which could potentially contain large quantities of influenza virus.[11] Piscivorous birds, such as those in the order Charadriiformes, who ate these virus-laden fish would have the virus in their gastrointestinal tract, where influenza virus receptors are concentrated.[17] In addition to sharing shoreline habitats, seals and seabirds may also feed on the same fish species.[17] Thanawongnuwech et al proposed an oral route of transmission for avian influenza virus infection for tigers feeding on H5N1 infected bird carcasses.[42] The virus may enter the gastrointestinal tract of carnivorous mammals and infect the liver through the portal system.[17,42] The demonstration of avian influenza virus receptors (SAα2,3Gal) in the liver, kidney, spleen, brain, intestine, and endothelium of humans supports this theory, but it has not been investigated in pinnipeds.[43]

Can marine mammals be sentinels for the presence of highly pathogenic avian influenza (HPAI)?

Because of seals' increased risk of acquiring avian influenzas due to their intimate association with seabirds, and their possible role as "mixing vessels" for pandemic strains, they could be used as sentinels for HPAI. Wildlife rehabilitation centers could opportunistically monitor seal populations through their stranded patients' serology. In addition to HPAI surveillance, this data could also be used in marine mammal conservation efforts. Admittedly, since the prevalence of influenza in seals is suspected to be low, waterfowl would be more sensitive sentinels.[28]

Can indigenous peoples involved in the hunting or consumption of marine mammals be at greater risk for transfer of avian influenza?

This has been suggested by multiple researchers.[22,28] Seals are still commonly hunted in the Arctic Ocean for food and fur.[22,28] Since human endothelial cells have avian influenza virus receptors (SAα2,3Gal), knife injuries during processing of seal carcasses could potentially cause vasculitis or systemic infection.[43] These carcasses undergo no official inspection and are sometimes consumed raw, presenting the opportunity for oral virus transmission as well.[28,42] To date, no such infections have been reported. This may be due to a lack of recognition, reporting, or incidence. A study by Siembieda et al reported that waterfowl hunters were 8 times more likely to be exposed to avian influenza-infected wildlife than

were biologists, veterinarians, and the general public.[44] It would be reasonable to extrapolate these findings for seal subsistence hunters, though their risk may be smaller due to the low prevalence of viral infection in seals.[28]

Can active metabolites of antivirals, such as oseltamivir (Tamiflu®), in wastewater lead to antiviral resistance in marine mammals and birds, creating a cycle that breeds increasingly virulent strains?

Research has shown that the antiviral Tamiflu is largely excreted from the human body in its active form and that current methods of wastewater treatment do not remove many types of antiviral drugs from effluent.[45,46] A study by Ellis reported low risk exposure levels of oseltamivir in wastewater and underscored that little is known about long term chronic exposure to low-level water and sediment concentrations of antiviral drugs.[45] It stands to reason that waterfowl, such as ducks, sifting through antiviral-contaminated sediment would provide a good breeding ground for resistant strains of influenza. This would increase the risk of both seals, who share haul out sites with and predate on waterfowl, and subsistence hunters of acquiring antiviral-resistant influenza infections.[17,28,47] More research is needed on long term effects on wildlife and humans and on the effective removal of antiviral drugs and their metabolites from wastewater.

Further research is needed in these areas, including whether each potential threat could act in tandem with another to produce a greater negative effect than each alone. Such research would also be instrumental in allowing public health professionals to form plans of action and intercession in the event of an influenza outbreak.

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Communicating Local Food Risk During Counterinsurgency Operations: Development and Evaluation of a Risk Communication Campaign

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BACKGROUND

There are numerous threats to the health and safety of US military members, particularly in areas with significant endemic disease and minimal public health infrastructure. Illness prevention is key to ensuring military operational readiness. Gastrointestinal illness, such as infectious diarrhea, commonly afflicts deployed US military personnel and can adversely affect operational readiness.[1-5] In addition to degrading operational readiness, diarrheal illness in theater may burden available healthcare resources.[2] A systematic review of scientific literature to determine regional estimates of pathogen-specific prevalence and incidence from January 1990 to June 2005 found that approximately 25% of individuals seeking treatment for diarrhea were reported to be incapacitated because of the illness.[6]

Between 1990 and 2005, infectious gastrointestinal illness was listed as the fourth most commonly reported diagnosis during US military deployments, following noncombat orthopedic injuries, respiratory infections, and skin diseases.[2] According to Sanders et al,[2] a survey of military personnel deployed to Afghanistan from 2003 through 2004 found that 54.4% of respondents reported experiencing diarrhea while deployed. The number of diarrhea cases in theater is likely underreported. A 2006 study of US military personnel deployed to the Middle East found that while 60% of survey respondents reported an episode of diarrhea and/or vomiting during their deployment, only 30% reported seeking care.[7]

A number of infectious agents commonly associated with diarrhea and certain food-borne illnesses, such as brucellosis, hepatitis E, leptospirosis, and typhoid fever, are present in Afghanistan and can pose a potential threat to US forces stationed there.[8] In a summary of pathogen prevalence and diarrhea incidence among US military and similar populations by region, enterotoxigenic *Escherichia coli* (28.3%), enteroaggregative *Escherichia coli* (16.8%), norovirus (7.1%), and *Shigella* (7.1%) were listed as the most common infectious agents identified in the Middle East and north Africa. Infection with multiple pathogens was also common (9.3%).[6]

Time spent off base and consumption of local food have been identified as important risk factors for diarrhea,[4,5] and consumption of local food is strongly associated with reports of multiple episodes of diarrhea.[4] According to Putnam et al,[4] a survey of US military personnel deployed to Afghanistan found that 52.8% of respondents reported eating local food at least monthly while deployed, and some (8.8%) reported eating it daily. Accordingly, food-borne illness has played, and continues to play, a role in diarrhea incidence. It is obvious that consumption of food from local, unapproved sources is a risk behavior for contracting diarrheal illness.

Recent changes in strategy and the importance placed on counterinsurgency operations in Afghanistan and other areas of the world have increased the amount of time certain service members spend off base, immersed in the lives of local populations.[9,10] Part of this cultural immersion involves participating in local customs, which includes dining with local populations and an increased exposure to local Afghan foods. Service members throughout Afghanistan are consuming local Afghan foods on and off forward operating bases. The magnitude of consumption is unknown but has likely increased under the counterinsurgency strategy where building relationships with Afghan partners is paramount. Sharing local Afghan food is a critical and unavoidable culture-bridging activity. Any program to mitigate the risk of food-borne illness from consuming local foods must take into account that such behaviors have become mission-essential.

Historically, predeployment training has focused on the consumption only of foods approved by US military

preventive medicine and veterinary personnel and does not prepare service members to make informed local Afghan food choices to decrease the risk of food-borne illness. Tailored and targeted communication strategies and messages have been associated with changes in various health-related behaviors.[11] Thus, development of a targeted communication strategy to change local food consumption behaviors by service members as a means of mitigating a major risk factor for food-borne illness in overseas contingency operations is appropriate. Realistic and targeted risk communication can improve service member readiness and empower service members to consume lower risk local Afghan foods (eg, bread, hot tea, fully cooked meat) in lieu of higher risk foods (eg, dairy products, leafy vegetables). This study evaluates targeted health information and communication efforts to determine the impact of additional training and information on service member knowledge of food safety and the food choices they intend to make.

METHODS

The US Army Public Health Command (USAPHC) and the US Army Medical Department Center and School formed a multidisciplinary food safety communication team (FSCT) comprised of health communication specialists/health analysts, epidemiologists, food safety and environmental health specialists, statisticians, and recently deployed preventive medicine and veterinary personnel. The FSCT's task was to craft a comprehensive health communication package to empower service members to make informed food choices and to develop the survey and methods to evaluate the communication package. The package consisted of a 15-minute predeployment briefing, materials that would be available to service members during deployment (poster, sticker, smart card, reminder e-card), and 2 leader items (toolkit and smart card).

Health Communication Message and Product Development

Health communication specialists/health analysts from USAPHC worked closely with the FSCT to develop the health communication package. The team used Rogers' innovation-diffusion theory[12] as a framework to develop the health communication package messages and products. Rogers' innovation-diffusion theory has been examined in a variety of studies, has contributed to a greater understanding of behavioral change, and has been found to have numerous applications in public health.[13,14] In his innovation-diffusion model, Rogers[12] describes the types of knowledge individuals need to make decisions and identifies 5 sequential stages through which individuals move in the decision-making process. These stages are (1) knowing about the behavior, (2) forming an attitude toward the behavior, (3) making a decision to adopt or reject the behavior, (4) implementing the new behavior, and (5) confirming the decision to implement the new behavior.[12]

The communication to service members was designed to assist them in making lower risk food choices by providing information on how to identify the risk level of common local food items and why it is important to avoid high risk food items when possible. The communication package included 7 products, each designed to address various stages in Rogers' innovation-diffusion theory.[12] The predeployment briefing addressed stages one and two by generating awareness of the risks of eating local foods, providing information on choosing lower risk local foods and the importance of making smarter local food choices. The food risk smart card, sticker, and poster for service members addressed stage two and served as simple, quick references, outlining commonly available lower risk and higher risk local Afghan foods in formats that can be used throughout deployment. The e-card for service members was designed for distribution midway into deployment, after service members adopt local food consumption behaviors, and addressed stage five by confirming or reaffirming the benefits of making smart local food choices. Two products were designed specifically for leaders: a smart card and toolkit that addressed stages one and two and contained information on how leaders can communicate with their personnel about the risks of eating local foods, choosing lower risk local foods and the importance of making smarter local food choices. The development team ensured that no communication product compromised the mission or superseded command guidance or policy regarding service member interactions with local populations.

Strategies to target communication materials, such as ensuring that characteristics of the intended audience (age, gender, other demographic characteristics) are reflected in the materials, allow for enhanced message relevance to audience members.[11] For this reason, the FSCT incorporated linguistic, imagery, and stylistic components associated with military service, deployment, and service member demographics when developing each product. Furthermore, tailored messages are more effective in stimulating health behavior change than more generic messages.[15] Although it was not possible to tailor messages to each individual in a unit, stratifying unit members into groups (such as lower enlisted service members, noncommissioned officers, and other leaders) allowed for a degree of customization that would likely enhance overall relevance of products to audience members.

Evaluation Plan

A pretest and posttest design was used to evaluate the effectiveness of the briefing* and 3 of the communication products (poster, sticker, and service member smart card). A unique identifier was used to ensure pairing of each individual respondent's pretest and posttest. The evaluation plan was approved by the USAPHC Public Health Review Board prior to implementation. In May 2012, a group of more than 100 service members was given a prebriefing survey to evaluate their baseline knowledge and perceptions about deployment local food safety. Following the pretest, a preventive medicine physician gave the briefing and presented the 3 additional food safety communication materials to the group. A posttest was then administered to determine if any new knowledge was gained from the material and to gauge service members' perceptions of the products themselves. The prebriefing questionnaire asked each respondent to rate (high, medium, low) the level of risk for food-borne illness of 13 different food categories and to provide his/her level of agreement to some attitudinal statements. The postbriefing questionnaire asked the same questions and also collected specific feedback on 4 campaign materials: the briefing, the poster, the sticker, and the service member smart card. The e-card and leader materials were not evaluated. The content of each questionnaire is reproduced in Figures 1 and 2 respectively. The following explanatory paragraph introduced each questionnaire:

> This survey is designed to help us determine your basic knowledge of the safety of local foods that you may encounter during deployment. Local foods are those eaten on the economy and/or from sources not approved by US military preventive medicine and veterinary personnel. They are found off the FOB [forward operating base] and also on the FOB in host country owned and operated food establishments. Your responses to this survey will remain anonymous. Thank you for your participation.

RESULTS

Respondent Profile

Of the approximately 115 service members who attended the briefing, 106 completed both questionnaires and were included in this analysis. Over 90% of respondents were in the Army and were male. Most (81%) had never deployed. About 70% were enlisted and 24% were noncommissioned officers (NCOs). For demographic subgroup analysis the NCOs, warrant officers, and commissioned officers were combined to form an "officer" group. Over half of the respondents were younger than 24 years of age, and approximately a third were aged 25 to 34 years. The 2 groups were included in subgroup analysis. The majority of respondents had education at high school level and another 18% had some degree above high school, but not a bachelor's degree. In the demographic subgroup analysis, attempts were made to explore differences between the high school/below group and the higher educated group, but there were not enough respondents in the higher group (n=18) to statistically assess the results.

Foodborne Illness Risk for Specific Food Groups

Overall Ending Knowledge

Overall most respondents were knowledgeable about the level of risk for food-borne illness for specific food groups at the conclusion of the briefing. In some cases, respondents knew the level of risk for food-borne illness of a particular group before the briefing. In many cases, however, they did not; and over 85% of all respondents, regardless of their starting knowledge, were able to correctly identify the risk level of each food category after the briefing.

As shown in Table 1, the food categories that had the highest percentage of incorrect answers (over 10%) and may represent an opportunity for continuing education were generally "low" risk groups. The only "high" risk category in that group was locally canned or packaged

Table 1. Ability to identify risk level of specific food categories after the briefing.†

Food	"Right" Risk Level	Subtotal "Right" (%)	Subtotal "Wrong" (%)
Bread	Low	96.2	3.8
Fully cooked vegetables, beans and rice that are kept and served hot	Low	96.2	3.8
Milk and other dairy products (eg, cheese, ice cream, butter)	High	99.0	1.0
Meats such as lamb, beef, poultry and fish that are boiled or well done and eaten within 2 hours of cooking	Low	89.5	10.5
Partially cooked or raw meats or fish	High	99.0	1.0
Raw, leafy vegetables	High	95.2	4.8
Locally canned or packaged products	High	89.5	10.5
Hard-skin fruits and vegetables that you peel yourself before eating (eg, bananas, oranges, limes)	Low	88.6	11.4
Hot tea	Low	89.4	10.6
Leftovers, take home, "doggie bag"	High	93.3	6.7
Ice, iced drinks, frozen desserts and juices	High	93.3	6.7
Bottled water or canned carbonated drinks	Low	86.4	13.6
Opened/unsealed beverage containers	High	95.2	4.8

†N varied by category, values between 103 and 105.

*The briefing materials, including pictures of the poster, sticker, and smart card, are available at http://phc.amedd.army.mil/PHC%20Resource%20Library/Deployment_Food_Risk_Briefing.pdf.

1. Please rate each of the below local foods based on your understanding of their level of risk for food-borne illness. For each statement below, fill in the circle for the most appropriate response.

		Don't Know the level of risk	High Risk for food-borne illness	Moderate Risk for food-borne illness	Low Risk for food-borne illness
a.	Breads	☐ 0	O 1	O 2	O 3
b.	Fully cooked vegetables, beans and rice that are kept and served hot	☐ 0	O 1	O 2	O 3
c.	Milk and other dairy products (eg, cheese, ice cream, butter)	☐ 0	O 1	O 2	O 3
d.	Meats such as lamb, beef, poultry and fish that are boiled or well done and eaten within 2 hours of cooking	☐ 0	O 1	O 2	O 3
e.	Partially cooked or raw meats or fish	☐ 0	O 1	O 2	O 3
f.	Raw, leafy vegetables	☐ 0	O 1	O 2	O 3
g.	Locally canned or packaged products	☐ 0	O 1	O 2	O 3
h.	Hard-skin fruits and vegetables that you peel yourself before eating (eg, bananas, oranges, limes)	☐ 0	O 1	O 2	O 3
i.	Hot tea	☐ 0	O 1	O 2	O 3
j.	Leftovers, take home, "doggie bag"	☐ 0	O 1	O 2	O 3
k.	Ice, iced drinks, frozen desserts and juices	☐ 0	O 1	O 2	O 3
l.	Bottled water or canned carbonated drinks	☐ 0	O 1	O 2	O 3
m.	Opened/unsealed beverage containers	☐ 0	O 1	O 2	O 3

2. Please rate your level of agreement with each of the following statements. Fill in the circle for the most appropriate response.

		Strongly Agree ←						→ Strongly Disagree
a.	I can identify the symptoms of food-borne illness.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
b.	Foodborne illness should be taken seriously.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
c.	I need more information to help make less risky food choices when eating local foods in Afghanistan.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
d.	Local foods available on forward operating bases in Afghanistan are from approved sources.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
e.	Foodborne illness is an unavoidable occurrence during deployment.	O 0	O 1	O 2	O 3	O 4	O 5	O 6

3. Current Branch or affiliated Service	4. Rank	5. Age (years)	6. Gender	7. Highest level of education completed
O 0 Air Force	O 0 Enlisted	O 0 18-24	O 0 Male	O 0 Did not complete high school
O 1 Army	O 1 NCO	O 1 25-34	O 1 Female	O 1 High school graduation or equivalent
O 2 Coast Guard	O 2 Warrant Officer	O 2 35 and older		O 2 Associates/technical/vocational degree
O 3 Marine Corps	O 3 Officer			O 3 Bachelor's degree
O 4 Navy	O 4 Civilian			O 4 Graduate or professional degree
	O 5 Contractor			

Figure 1. Pretest local foods communication materials questionnaire.

1. Please rate each of the below local foods based on your understanding of their level of risk for food-borne illness. For each statement below, fill in the circle for the most appropriate response.

Briefing	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly DIsagree
a. The purpose of the briefing is clear.	O 0	O 1	O 2	O 3	O 4
b. The briefing is easy to understand.	O 0	O 1	O 2	O 3	O 4
c. The briefing provides enough information about the risks of eating local foods during deployment.	O 0	O 1	O 2	O 3	O 4
d. The briefing provides enough information for me to make smart local food choices during deployment.	O 0	O 1	O 2	O 3	O 4
e. I would recommend this briefing to other deploying service members.	O 0	O 1	O 2	O 3	O 4

Comments on the briefing:

Poster					
a. The purpose of the poster is clear.	O 0	O 1	O 2	O 3	O 4
b. The poster is easy to understand.	O 0	O 1	O 2	O 3	O 4
c.. The poster provides enough information about the risks of eating local foods during deployment.	O 0	O 1	O 2	O 3	O 4
d. The poster provides enough information for me to make smart local food choices during deployment.	O 0	O 1	O 2	O 3	O 4
e. The poster text is easy to read.	O 0	O 1	O 2	O 3	O 4
f. The poster grabs my attention.	O 0	O 1	O 2	O 3	O 4
g. I would read or refer to the poster if deployed or deploying.	O 0	O 1	O 2	O 3	O 4
h. I would recommend this poster to other deploying service members.	O 0	O 1	O 2	O 3	O 4

Comments on the poster:

NOTE: This blank cell was a typographic error on the form used in the survey. The effect on data analysis is explained on page 61.

Sticker					
a. The purpose of the sticker is clear.		O 1	O 2	O 3	O 4
b. The sticker is easy to understand.	O 0	O 1	O 2	O 3	O 4
c. The sticker provides enough information about the risks of eating local foods during deployment.	O 0	O 1	O 2	O 3	O 4
d. The sticker provides enough information for me to make smart local food choices during deployment.	O 0	O 1	O 2	O 3	O 4
e. The sticker text is easy to read.	O 0	O 1	O 2	O 3	O 4
f. The sticker grabs my attention.	O 0	O 1	O 2	O 3	O 4
g. I would read or refer to the sticker if deployed or deploying.	O 0	O 1	O 2	O 3	O 4
h. I would recommend this sticker to other deploying service members.	O 0	O 1	O 2	O 3	O 4

Comments on the sticker:

Figure 2. Posttest local foods communication materials questionnaire (Figure 2 continued on next page).

Smart Card	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly DIsagree
a. The purpose of the smart card is clear.	O 0	O 1	O 2	O 3	O 4
b. The smart card is easy to understand.	O 0	O 1	O 2	O 3	O 4
c.. The smart card provides enough information about the risks of eating local foods during deployment.	O 0	O 1	O 2	O 3	O 4
d. The smart card provides enough information for me to make smart local food choices during deployment.	O 0	O 1	O 2	O 3	O 4
e. The smart card text is easy to read.	O 0	O 1	O 2	O 3	O 4
f. The smart card grabs my attention.	O 0	O 1	O 2	O 3	O 4
g. I would read or refer to the smart card if deployed or deploying.	O 0	O 1	O 2	O 3	O 4
h. I would recommend this smart card to other deploying service members.	O 0	O 1	O 2	O 3	O 4

Comments on the smart card:

2. Please rate each of the below local foods based on your understanding of their level of risk for food-borne illness. For each statement below, fill in the circle for the most appropriate response.

	Don't Know the level of risk	High Risk for food-borne illness	Moderate Risk for food-borne illness	Low Risk for food-borne illness
a. Breads	☐ 0	O 1	O 2	O 3
b. Fully cooked vegetables, beans and rice that are kept and served hot	☐ 0	O 1	O 2	O 3
c. Milk and other dairy products (eg, cheese, ice cream, butter)	☐ 0	O 1	O 2	O 3
d. Meats such as lamb, beef, poultry and fish that are boiled or well done and eaten within 2 hours of cooking	☐ 0	O 1	O 2	O 3
e. Partially cooked or raw meats or fish	☐ 0	O 1	O 2	O 3
f. Raw, leafy vegetables	☐ 0	O 1	O 2	O 3
g. Locally canned or packaged products	☐ 0	O 1	O 2	O 3
h. Hard-skin fruits and vegetables that you peel yourself before eating (eg, bananas, oranges, limes)	☐ 0	O 1	O 2	O 3
i. Hot tea	☐ 0	O 1	O 2	O 3
j. Leftovers, take home, "doggie bag"	☐ 0	O 1	O 2	O 3
k. Ice, iced drinks, frozen desserts and juices	☐ 0	O 1	O 2	O 3
l. Bottled water or canned carbonated drinks	☐ 0	O 1	O 2	O 3
m. Opened/unsealed beverage containers	☐ 0	O 1	O 2	O 3

Figure 2 (continued). Posttest local foods communication materials questionnaire.

(Figure 2 continued on next page)

3. Please rate your level of agreement with each of the following statements. Fill in the circle for the most appropriate response.

		Strongly Agree ←						→ Strongly Disagree
a.	I can identify the symptoms of food-borne illness.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
b.	Foodborne illness should be taken seriously.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
c.	I need more information to help make less risky food choices when eating local foods in Afghanistan.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
d.	Local foods available on forward operating bases in Afghanistan are from approved sources.	O 0	O 1	O 2	O 3	O 4	O 5	O 6
e.	Foodborne illness is an unavoidable occurrence during deployment.	O 0	O 1	O 2	O 3	O 4	O 5	O 6

4. Do you think the information you've just heard will influence the local food choices you will make during your deployment?

O 0 YES O 1 NO

Why or why not?

5. For each question below, fill in the circle for the most appropriate response.

	YES	NO		YES	NO
Have you ever been deployed to CENTCOM?	O 0	O 1	If yes, then would the information you've just heard have been useful for that deployment(s)?	O 0	O 1
Have you ever been deployed to AFRICOM?	O 0	O 1	If yes, then would the information you've just heard have been useful for that deployment(s)?	O 0	O 1
Have you ever been deployed to PACOM?	O 0	O 1	If yes, then would the information you've just heard have been useful for that deployment(s)?	O 0	O 1
Have you ever been deployed to SOUTHCOM?	O 0	O 1	If yes, then would the information you've just heard have been useful for that deployment(s)?	O 0	O 1

Comments on why these products would/would not have been useful during deployment:

6. Any additional comments about the briefing or communication materials that you saw today?

Figure 2 (continued). Posttest local foods communication materials questionnaire.

products, with 10.5% incorrect answers. Respondents who gave "wrong" answers were often those who had been deployed and rated "low" risk categories as moderate risk. Within the demographic subgroups, there were no other differences or trends of note either between subgroups or pre- or postpattern across subgroups.

Actual Learning

Following the briefing, participants had the "right" answer for one of 2 reasons: either they did not know the food's risk level prior to the briefing but learned it during the briefing, or they already knew the risk level prior to the meeting. In the former case, the briefing was clearly beneficial; in the latter, the briefing did not change knowledge but served to reinforce it.

"Learning" was calculated as the number of respondents who incorrectly identified the risk level in the prebriefing questionnaire, but correctly identified it in the postbriefing questionnaire. As shown in Table 2, the percentage of respondents who learned from the briefing varied from 6.7% to 80% across the categories. There were no differences by demographic subgroup.

The amount of a priori knowledge and learning with regard to the proper risk classification of each food group also varied widely among the food groups. The a priori knowledge ranged from 13.3% to 92.4%.

No respondent correctly classified all the categories in the prebriefing. Every respondent learned the correct

answer for at least one category during the briefing, and, on average, changed to the correct answer for 5 of the 13 categories as shown in Figure 3. There were no demographic distinctions among the top 10% of learners (those who changed 8 or more answers) except that all were enlisted personnel.

Confusion and Opportunities for Clarity

Both the hot tea and the bottled water or canned carbonated drinks categories confused several respondents. They initially had the correct answer but changed to the incorrect answer following the briefing. Those in the "didn't help or hurt" column gave an incorrect risk level before the briefing and also gave (the same or different) incorrect answer following the briefing. As shown in Table 3, the total number of incorrect responses was minimal in both of these "wrong risk" categories.

Attitudes Toward Food-borne Illness

Respondents rated their agreement with different statements reflecting attitudes toward food-borne illness both before and after the briefing. Overall, they gained confidence in their ability to identify symptoms of food-borne illness. They increasingly agreed that food-borne illness should be taken seriously and understood that local foods available on forward operating bases were not necessarily from approved sources. Respondents did not, however, agree that food-borne illness was avoidable during deployment.

All changes were significantly different at the 0.01 level, indicating a 99% confidence that the changes before and after the briefing reflected a conscious shift in agreement level. Changes toward the desired direction (agree or disagree) ranged from less than one point to almost 2 points on a zero to 6 point scale.

After the briefing, respondents were more likely to agree that food-borne illness was unavoidable. The intent of the communication materials was just the opposite—to help respondents understand that they could avoid illness with good food choices. Respondents may have been confused by the phrasing of the question (do you disagree that something is unavoidable) or respondents may have become discouraged by content of the briefing, which pointed out the likelihood of getting ill during deployment. Those who had been deployed tended to believe that illness was not unavoidable both before and after the briefing. Otherwise, there were no significant differences between demographic groups or in the pre- or postpatterns across groups. The statistics are presented in Table 4.

Table 2. Learning: how respondents came to the "right" answer.*

Food	Already Knew (%)	Learned (%)
Bread	29.8	66.3
Fully cooked vegetables, beans and rice that are kept and served hot	76.2	20.0
Milk and other dairy products (eg, cheese, ice cream, butter)	58.3	40.8
Meats such as lamb, beef, poultry and fish that are boiled or well done and eaten within 2 hours of cooking	35.2	54.3
Partially cooked or raw meats or fish	92.4	6.7
Raw, leafy vegetables	35.6	59.6
Locally canned or packaged products	20.0	69.5
Hard-skin fruits and vegetables that you peel yourself before eating (eg, bananas, oranges, limes)	51.4	37.1
Hot tea	52.9	36.5
Leftovers, take home, "doggie bag"	54.3	39.0
Ice, iced drinks, frozen desserts and juices	13.3	80.0
Bottled water or canned carbonated drinks	59.2	27.2
Opened/unsealed beverage containers	67.3	27.9

*N varied by category, values between 103 and 105.

Table 3. Confusion and opportunity for clarity.*

Food	Neither Help nor Hurt (%)	Confused (%)
Bread	2.9	1.0
Fully cooked vegetables, beans and rice that are kept and served hot	0.0	3.8
Milk and other dairy products (eg, cheese, ice cream, butter)	0.0	1.0
Meats such as lamb, beef, poultry and fish that are boiled or well done and eaten within 2 hours of cooking	9.5	1.0
Partially cooked or raw meats or fish	1.0	0.0
Raw, leafy vegetables	3.8	1.0
Locally canned or packaged products	9.5	1.0
Hard-skin fruits and vegetables that you peel yourself before eating (eg, bananas, oranges, limes)	7.6	3.8
Hot tea	3.8	6.7
Leftovers, take home, "doggie bag"	5.7	1.0
Ice, iced drinks, frozen desserts and juices	5.7	1.0
Bottled water or canned carbonated drinks	4.9	8.7
Opened/unsealed beverage containers	2.9	1.9

*N varied by category, values between 103 and 105.

Table 4. Changes in attitudes toward food-borne illness.

Statement	N	Ended in the "Right" Place* (%)	Moved in the "Right" Direction† (%)	Moved from "Wrong" to "Right"‡ (%)	Average Point Change
I can identify the symptoms of food-borne illness.	105	97.1 (Agree)	78.10	23.0	1.82
Foodborne illness should be taken seriously.	105	100 (Agree)	26.37	5.7	0.36
Local foods available on forward operating bases in Afghanistan are from approved sources.	105	69.5 (Disagree)	65.70	32.4	1.34
Foodborne illness is an unavoidable occurrence during deployment.	104	64.4 (Disagree)	18.30	3.8	-0.72 (respondents moved toward agree)

*Respondent gave 3 or "better" on a 0 to 6 point scale) in their post- score.
†Respondent moved at least 1 point better on the scale.
‡Respondent started worse than midpoint (3 on a 0 to 6 point scale) and changed to midpoint or "better."

Information Needs

Respondents were asked before and after the briefing how much they agreed or disagreed with the statement "I need more information to help make less risky food choices when eating local foods in Afghanistan." As shown in Table 5, over 85% of respondents indicated they wanted more information in their prebriefing score. About one third indicated that they did not need more information after receiving the briefing; however, nearly half of them still wanted more information after the briefing.

A paired *t* test of before and after scores indicated that, on average, respondents moved nearly 1 point away from the "agree" and toward the "disagree" end of the zero to 6 spectrum. This was a significant change with a $P<.001$ and indicated that, overall, respondents did not need as much information as they had prior to the briefing. Eighty-nine individuals had a prebrief score of 3, 2, 1, or zero, and 29 (31.4%) of those had a postbrief score of 4, 5, or 6, indicating a change from needing information to not needing more.

Since there was no "right" answer to this question, interpretation of the results is unclear. Some respondents could have indicated they did not need more information because the briefing was clear. Others may have indicated the same thing because they were overwhelmed or simply tired of hearing the information. Conversely, those who thought they did not need information before the briefing but wanted more after the briefing could have been confused by the information presented, or were genuinely interested in learning more about the topic.

Communication Campaign Materials

Overall Material Effectiveness

Most respondents had a positive reaction to each of the 4 campaign materials presented to them. Virtually all respondents agreed that the purpose of the 4 products was clear, they were easy to understand, they provided enough information about risks, and they enabled smart local food choices. The same proportions would recommend these communication products to other deploying service members.

The "Top 2 Box" scores, shown in Table 6, represent those who said "Strongly Agree" or "Agree" on a 5-point agreement scale. Typically, about 75% of respondents strongly agreed regarding the briefing, and about 55% strongly agreed about each of the specific materials. The briefing was the most well-received while the sticker and smart card were slightly less so. This could have been the result of respondents having less exposure to the sticker and smart card during the briefing or not fully understanding the intended use for the materials during deployment. Nonetheless, agreement levels regarding these items were still nearly 90%.

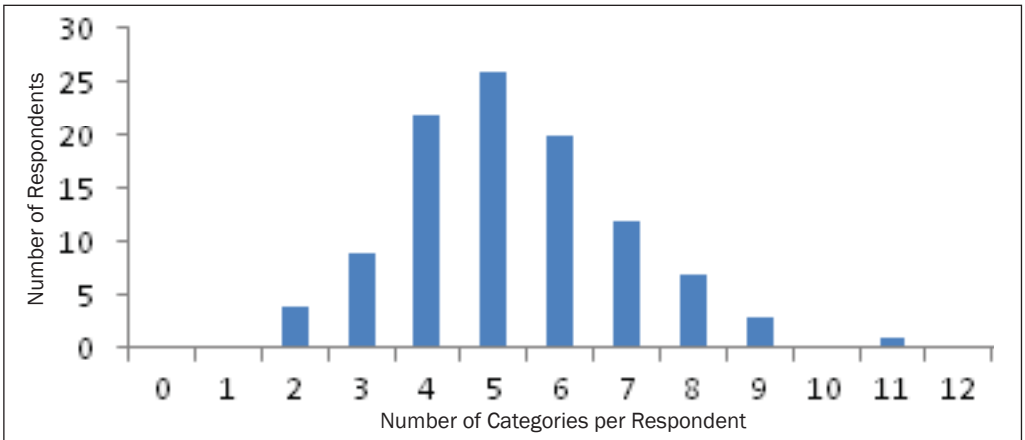

Figure 3. Categories changed from "wrong" to "right."

Table 5. Information needs of respondents.

Statement: I need more information to help make less risky food choices...

Rating Before Briefing		Rating After Briefing: Strongly Disagree 6	5	4	3	2	1	Strongly Agree 0	Total
Strongly Disagree	6	2	1	1	0	0	0	0	4
	5	2	0	1	1	1	0	1	6
	4	1	0	1	1	2	0	0	5
	3	1	7	3	5	4	1	3	24
	2	0	6	1	5	2	3	2	19
	1	0	2	1	2	9	8	1	23
Strongly Agree	0	1	4	2	7	2	3	4	23
Total		7	20	10	21	20	15	11	104

n=89 (85.6%)

≈31% of "needed more before" did not need more after

≈47% of "needed more before" still needed more after

Table 6. Top 2 box agreement, overall material effectiveness.

Communication Element	Purpose was clear (%)	(Material was) easy to understand (%)	Provides enough information about risks of eating local foods during deployment (%)	Provides enough information for me to make smart local food choices during deployment (%)	Respondent would recommend (%)
Briefing	100	100	100	98.1	97.1
Poster	97.1	98.1	97.1	95.2	91.4
Sticker	84.6*	93.3†	89.5*	88.6†	86.7†
Smart Card	92.4†	92.4†	91.4†	93.3	90.5

N varied by individual question, value either 104 or 105.
*Significantly lower than the poster and the briefing, using a Bonferroni correction for multiple comparisons.
†Significantly lower than the briefing, using a Bonferroni correction for multiple comparisons.

"Bottom 2 Box" analysis showed no significant differences across elements. However, respondents gave more disagreement scores for the sticker than for the other elements on virtually every question, reinforcing that the sticker was not as well received as the other communication elements.

The results for specific print material attributes are presented in Table 7. The majority (85% to 96%) of respondents believed that the poster, sticker, and smart card grabbed their attention and were easy to read. Respondents also said they would refer to these products during their deployment. The poster was typically the most well received material and the sticker the least, but the differences were not statistically significant.

Table 7. Top 2 box agreement, print material attributes.

Communication Element	Text was easy to read. (%)	(Element) grabs my attention. (%)	I would read or refere to it if deployed or deploying. (%)
Poster	96.2	81.0*	90.5
Sticker	91.4	84.8	83.8
Smart Card	93.3	90.5	87.6

N varied by individual question, value either 104 or 105.
*P=.02 vs the smart card—not significant, using a Bonferroni correction for multiple comparisons.

Again, Bottom 2 Box analysis showed no significant differences, although, respondents gave more disagreement scores for the sticker than for the other materials on virtually every question, reinforcing that the sticker was not as well received as the other communication elements.

Effect During Deployment

Following the briefing, virtually all respondents said that information they had just heard would influence their local food choices during deployment. Comments reflected that respondents felt more informed after the briefing and would make better choices than they would have previously. The main reason given for why the information would influence respondents was that they did not want to get sick. A few respondents also noted the deleterious effect that illness would have on their mission.

CONCLUSIONS AND RECOMMENDATIONS

Overall, the materials were well received and the content was "learned." Respondents were prepared to make better local food choices and indicated that this preparation would translate into less risky behavior during their deployment. Everyone learned at least something, and several respondents indicated they learned a great deal, about which food categories are high/low risk. Attitudes changed such that respondents became more aware of the causes, severity, and impact of food-borne illness.

Evaluation of the communication products enabled identification of information gaps and areas needing improvement during future risk communication efforts to address deployment local food choices. During the briefing, respondents seemed to become confused about the risks of both hot tea and bottled water or canned carbonated drinks. These 2 categories need more clarity in future communication. Additional communication should be concentrated on the categories of meats such as lamb, beef, poultry, and fish that are boiled or well done and eaten within 2 hours of cooking; locally canned or packaged products; and hard-skin fruits and vegetables that you peel yourself before eating (bananas, oranges, limes, etc).

The following limitations must be taken into account when assessing the impact of the results. Nearly all respondents were in the Army and were male. Future testing should strive to include other service members as well as female service members, as their perceptions could differ from male Soldiers. While there were few differences noted between the demographic groups, a limited number of groups were explored, given the homogeneity of the respondent pool. Besides service and gender, which were noted above other demographics such as age, officer/enlisted status, education, and previous deployment experience could influence comprehension of the materials but were not able to be fully assessed in this study. The materials were only tested with one group of service members. While this means that all respondents were exposed to the exact same presentation (which is good), in real-life situations, the briefing would not always be given by the same individual. Therefore, the quality of the briefer could have impacted respondent comprehension of the materials. Future work should likely have different briefers so that the briefing itself, rather than the briefer, could be more independently evaluated. The posttest questionnaire was fielded with a typographic error in Q1-Sticker-a (Figure 2, page 55). Consequently, the coded responses were shifted to the right by one category. These answers were correctly recoded for analysis. However since respondents could not physically check a box for the first category, no differentiation could be made between the first and second choice. As is often done with rating scales, a Top 2 Box score was used and the first and second choices were combined for all analyses. Therefore the impact of the typo was negligible to the results.

This effort illustrated the benefit of not only developing, but also testing communication materials that address local food safety. As a result of the evaluation, service members are now equipped to make better local food choices during deployment, and areas of improvement were identified to guide future communication development.

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Food and Water Risk Assessments: Empowering Commanders and Protecting Service Members

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THE EMERGENCE OF THE FOOD AND WATER RISK ASSESSMENT PROGRAM

There are inherent risks associated with the purchase and consumption of subsistence procured in some overseas locations. In many countries, food-borne diseases are endemic and exacerbated by poor hygienic practices in restaurants and other commercial catering establishments. Sanitation risks include lack of potable water and sanitizing supplies, improper sanitizing procedures, poor sanitary standards, questionable health standards among workers, a poorly trained workforce, and manual or hands-on food processing techniques. There are also risks unique to particular countries or regions such as lack of food sanitation hygiene laws and insufficient oversight by the local civilian government (regulators), lack of animal herd health monitoring programs and associated controls for endemic diseases, inadequate health care systems, improper use of pesticides and chemicals, and the lack of food vendor accountability in the event of food-borne illnesses. To reduce these risks, commercial food establishments who sell to the Department of Defense (DoD) are audited by US Army Veterinary Corps officers, ensuring compliance with regulatory, industry, and DoD requirements. When a food production facility passes a food protection audit in accordance with *Military Standard 3006A*[1] (MIL-STD-3006A), it is placed on the Worldwide Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement.[2] The DoD food protection audit assures that set food protection (food safety and defense) benchmarks have been achieved for those establishments listed in the directory, thus reducing the risk of food-borne disease to service members and their families worldwide.

Unfortunately, the ability to purchase food from DoD-approved food sources is limited in more remote locations where US military service members are increasingly engaged. These engagements range from Beyond the Horizon exercises in Panama to foreign humanitarian assistance operations in Pakistan. While most major exercises are conducted near larger cities where DoD-approved food sources are more readily available and logistically feasible, often the main thrust of these exercises and operations is to serve the most in-need populations in rural areas where DoD-approved food sources may be unavailable or impractical. Issues surfaced when assessors applied MIL-STD-3006A to food operations in developing countries, particularly in more rural areas where local food safety practices were less stringent and often did not meet the military requirements. This resulted in Veterinary Corps officers often failing the majority of the facilities audited in developing countries, leaving commanders without realistic feeding options. Over time, this issue eroded the Veterinary Corps ability to support worldwide missions the DoD considers essential. Veterinary Corps leaders recognized that a new approach had to be crafted to support the mission and commanders while still preventing food-borne disease. This new approach is the Food and Water Risk Assessment (FWRA) program which created a framework for trained assessors to identify, assess, and communicate food-borne illness risks associated with food preparation operations, including hotel kitchens, restaurants, caterers, and military feedings operations, such as field exercises and host nation dining facilities.

Both the MIL-STD-3006A and the FWRA program are based upon the same federal food safety laws of the United States. However, while MIL-STD-3006A is coupled with a "pass/fail" audit, the FWRA program does not pass or fail an establishment, but instead identifies the level of risk to commanders. Consequently, leveraging the FWRA program is a double-edged sword that allows higher risk food operations to be considered for use but requires an increased focus on food-borne disease mitigation. The danger is that some uninformed commanders may assume that food operations contracted under the FWRA program are as safe as DoD-approved sources. Specifically, FWRAs provide commanders with the ability to determine the level of acceptable risk

and keeps the assessor at the commander's side with veterinary risk mitigation expertise.

LOCAL FOOD BENEFITS AND RISKS

Service members who have served in Operations Enduring and Iraqi Freedom or other operations and exercises understand the importance of building relationships and bridging cultures. In fact, successful counterinsurgency operations hinge on building trusting relationships, a major component of which can be the sharing of local foods. While often not officially approved, consuming local foods is a reality in most deployed locations. This reality also brings profound food safety risks. Among personnel deployed to Iraq and Afghanistan between 2003 and 2004, 78.6% of troops in Iraq and 54.4% of those in Afghanistan experienced diarrhea, with 80% seeking care from their unit medic. The consumption of local foods from non-US sources was associated with the increased risk of illness.[3]

Local foods also have an impact on service members in South and Central America. A diarrhea outbreak occurred during US military training and humanitarian assistance in El Salvador in 2012. While service members frequently report getting diarrhea during short deployments, in-depth investigations like the one conducted by the Naval Medical Research Unit No. 6 (NAMRU-6) with epidemiological surveys, microscopy, and polymerase chain reaction analysis of stool samples are rarely performed. This investigation concluded that the consumption of food from on-base local vendors (relative risk (RR)=4.01 (95% confidence interval (CI), 1.53-10.5), $P<.001$) and arriving on base within the past 2 weeks (RR=2.79 (95% CI, 1.35-5.76), $P<.001$) were associated with increased risk of developing diarrheal disease.[3] Although many exercises are short in duration, local food risks must be still considered by mission planners. In these situations, FWRAs may be the most effective tool to reduce the local food risks and disease.

FOOD-BORNE ILLNESS PREVENTION CHALLENGES WITH LOCAL FOODS

One of the biggest challenges in preventing food-borne illness during smaller military operations is demonstrating to medical and nonmedical leaders the importance of command involvement in preventing disease. While the benefits of consuming local foods are visible and compelling, commanders and staffs may be unaware of objective evidence, such as the NAMRU-6 study, which examines the associations between local foods and service member disease. Even though the true burden of food-borne diseases from eating local host nation foods in unknown, leaders who believe that local food consumption is not a serious mission consideration, fail to employ FWRAs, and do not apply their risk mitigation recommendations may find their personnel and mission seriously impacted by preventable diseases. A study of acute diarrhea in US military personnel deployed to Sinai, Egypt described such mission impacts. One of every 5 individuals who became ill with diarrhea while deployed to Egypt reported being unable to work because of their illness (missing an average 2 days), and an additional 2 of 5 reported that their work performance was decreased because of their illness. Multiple episodes of diarrhea during deployment equates to a large number of lost and impacted duty days for the Warfighter, and is legitimate cause for concern.[4]

INTEGRATING DoD-APPROVED FOOD SOURCES AND FWRAs DURING MILITARY EXERCISES

Rarely is there a "silver-bullet" in the prevention of food-borne diseases, and demonstrating the effectiveness of a sound food-borne disease prevention strategy remains challenging.* Nevertheless, food-borne disease prevention through timely interventions provides the "biggest bang for the buck" by preventing more disease with fewer resources. The goal is to prevent deployed personnel from consuming higher risk local foods, if possible (Figure 1). Planners supporting service members in these developing areas must construct the safest feeding plan possible within the mission requirements. Applying an integrated risk-based intervention approach to food protection in deployed settings can significantly reduce the incidence and impact of food-borne diseases. During the August 2012 Operation Martillo in Guatemala, multiple food options were leveraged. Bottled water came from a DoD-approved source in Guatemala City, fresh fruit and vegetables came from a local supermarket, Unitized Group Rations† and Meals Ready to Eat† were served at operation sites, and occasional catered meals were provided by a local hotel restaurant. Of all these food and water sources, local restaurants

*See related article on page 51.
†US military small unit and individual field (operational) rations

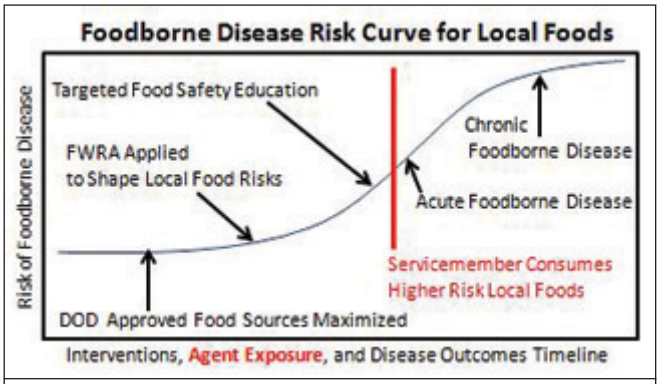

Figure 1. Food-borne disease risk curve for local foods.

(in a hotel or standalone facility) usually present the highest risk of food-borne illness. Common risks include unapproved raw materials, inadequate refrigerator or freezer space, unsanitary food preparation surfaces, and improper handling of potentially hazardous foods. Ice is one potentially hazardous food for which the risk of contributing to food-borne disease is commonly underestimated. Food service personnel often fail to recognize ice as a ready-to-eat food that is easily contaminated from improper handling (Figure 2), such as in restaurants in developing countries which make their own ice.

Figure 2. Ice that is used directly in drinks held in unsanitary buckets and plastic bags.

DoD-approved food sources provide the foundation of food protection and should be considered before higher risk local food sources. When DoD-approved food sources are unavailable, planners may turn to operational rations as the next preferred option for food safety. When a feeding plan cannot rely solely on either DoD-approved food sources or operational rations because of availability or logistic feasibility, exercise planners may request the FWRA for local food procurement.

When small numbers of troops are deployed, planners may elect to provide per diem (daily allowance for expenses). Service members usually choose where they eat (spend their per diem) and contracted meals are not required. While placing service members on per diem allows them to eat at any number of facilities, FWRAs should still be considered to lower the risk at the food operations that will likely be frequented by service members. Another option is contracting with local restaurants or caterers to provide meals (no per diem). This option requires service members to eat local foods from the contracted local food operations. Under this scenario, an FWRA is required to ensure that food protection risks are understood and mitigated.

Figure 3. Reverse osmosis water purification system in a bottled water plant.

The FWRA can roughly be divided into 2 categories: those performed on upscale hotels (often large hotel chains) that host DoD sponsored conferences in major cities, and those in support of military exercises, often outside urban areas, where in-need rural populations are located. The bulk of FWRAs currently performed are on upscale hotels in major cities. This is certainly the case in the US Southern Command's (SOUTHCOM) area of focus where upscale hotels are routinely assessed every 6 months and maintain food protection practices arguably comparable to similar hotels in the United States. These upscale hotel assessments are largely facility-based assessments that evaluate individual hotel kitchens outside the context of larger exercises.

In contrast to urban assessments, FWRAs conducted in support of exercises in less developed areas often require assessors to evaluate higher risk moderate scale hotel kitchens and consider the complete (beyond the hotel) exercise feeding plan. Heightened water quality concerns in rural areas due to inferior water distribution systems and increased agricultural use create a need for safe bottled water sources (Figure 3). In addition to bottled water, fresh fruits and vegetables, local restaurants and caterers are assessed to build feedings plans.

Assessors who understand how each food operation impacts the overall feeding plan remain agile and able to advise contractors and commanders on less obvious risks. For example, a hotel kitchen with a moderate risk of food-borne illness when serving below its maximum capacity may present an extremely high food-borne illness risk if required to double the number of meals served. The risks of food-borne illness spikes when food operations surge to meet increased demand. The challenging task of developing the safest possible feeding plan requires assessors to consider both the overall feeding plan and the intended use of each food operation.

FWRA RISK COMMUNICATION

Unbroken risk communication to supported commanders and service members who may encounter higher risk local foods can prevent food-borne diseases. Besides commanders and service members, other key stakeholders include the assessor and the contractor. The assessor evaluates food operation risks and assists contractors in embedding food safety requirements into statements of work. This relationship with

contractors is crucial to effect the most change within the food operation. For example, statements of work can require the replacement of excessively worn cutting boards, the purchase of additional freezers to ensure ample cold storage, building and kitchen improvements, or even direct the use of thermometers.

Figure 4. Risk management matrix.

Hazard Severity	Hazard Probability				
	Frequent (A)	Likely (B)	Occasional (C)	Seldom (D)	Unlikely (E)
Catastrophic (I)	Extremely High	Extremely High	High	High	Moderate
Critical (II)	Extremely High	High	High	Moderate	Low
Marginal (III)	High	Moderate	Moderate	Low	Low
Negligible (IV)	Moderate	Low	Low	Low	Low
	Risk Estimate				

Hazard probability definitions:
Frequent - occurs very often, continuously experienced.
Likely - occurs several times.
Occasionally - occurs sporadically.
Seldom - remotely possible, could occur at some time.
Unlikely - can assume will not occur, but not impossible.
Hazard severity definitions:
Catastrophic - loss of ability to accomplish the mission or mission failure. Example indicators: death or widespread severe illness
Critical - significantly (severely) degraded mission capability or unit readiness. Example indicators: multiple food-borne illness incidences.
Marginal - degraded mission capability or unit readiness. Example indicators: sporadic food-borne illness, loss of confidence in food supply safety.
Neglible - little or no adverse effect on mission capability.

Source: *Field Manual 5-19: Composite Risk Management*[5]

The assessor communicates risk using the risk assessment matrix (Figure 4) contained in *Field Manual 5-19*.[5] Since commanders are accustomed to this risk communication tool, its use allows food-borne illness threats to be placed in the same context as other operational risks.[6] This concept must remain central to the medical planning perspective so that threats may be compared and communicated to commanders as transparently as possible. A commander can then give this information appropriate weight with other risks present on the battlefield.

FWRAs IN THE US SOUTHERN COMMAND

The US Army South (ARSOUTH) Deputy Chief of Staff, Medical administers SOUTHCOM's FWRA program. The program's success hinges on partnerships between the Army Public Health Command (USAPHC) and other SOUTHCOM organizations. Specifically, USAPHC Region-South plays a critical role not only in executing the majority of FWRAs performed, but also in maintaining a FWRA database. This success is maintained by clearly delineating roles and responsibilities within SOUTHCOM's FWRA Standard Operating Procedure (SOP). This SOP provides guidance to US military groups (MILGROUPs) within host countries, FWRA assessors, and contracting officers within SOUTHCOM.

The US military groups facilitate FWRAs by coordinating assessment schedules, in-country transportation, translators, laboratory sample shipping, and country clearance. The assessor's role is to coordinate FWRAs with the military groups, perform assessments, and submit completed documents to the ARSOUTH Command Veterinarian. Contracting officers are pivotal in ensuring that the statement of work incorporates realistic risk mitigation requirements, and supported commanders receive the risk mitigation recommendations. While other combatant commands may not yet have the mature, standardized program found in SOUTHCOM, FWRAs are being conducted regularly across the DoD.

FWRAs IN FOREIGN HUMANITARIAN ASSISTANCE OPERATIONS

Natural disasters and other humanitarian crises often occur in regions of the world where DoD-approved sources are not present or are no longer present due to the disaster. Because foreign humanitarian assistance (FHA) operations often involve a rapid response to address human suffering, establishing a formal supply (DoD-approved sources or operational rations) system or conducting sanitary food protection audits of suppliers in a timely manner may not be practical. Finally, the transient nature of FHAs limit the long-term value of the audits as the operation may be over before final approval is granted. Consequently, in FHA operations, the FWRA offers commanders a valuable alternative for providing sustainment to US service members while still ensuring force health protection, as was the case during the 2010 DoD flood relief operations in Pakistan.

FWRAs were conducted at each of 3 US base camps in Pakistan. The initial overall risk assessment for all locations was "high," primarily due to the threat of microbial contamination of food and water. However, the implementation of recommended control measures reduced the overall risk to "moderate." Several of the key recommendations were:

- Remove all ruminant meat and meat products from the menu (due to the potential risk of bovine spongiform encephalopathy).

- Increase the cooking times and temperatures to US required levels.
- Use bottled water (from a former approved source) for cooking.
- Substitution of high-risk food items on the menu with lower-risk food items which were exempt from requiring approval (for example, replace locally manufactured products with imported products from Europe).
- Chlorination of bulk water tanks used for washing dishes and cookware with monthly testing for residual chlorine (Figure 5).
- Establish mess trailers for food preparation and dining (Figure 6).

While these recommendations did not completely eliminate the risk of food-borne illness, they did reduce the overall risk to a level that was acceptable to the commander and did not negatively impact the FHA operations in Pakistan.*

COMMENT

The FWRA program expanded the Veterinary Corps officers' toolbox, allowing them to better deliver food protection expertise and broadly shape risk in local food operations. Actively mitigating risk and guiding commanders to relatively lower-risk food operations has created new challenges and opportunities. The FWRA program is transitioning to a military standard, handbook, and checklist (see extracted sample on the following page) to be released in 2013. Improvements include a consolidated and updated checklist that allows assessors to systematically evaluate food operations in the context of exercise feeding plans. Another change provides the assessor with the tools to recommend exclusion of higher risk food items (for example, unpasteurized dairy products that pose a threat of brucellosis) from food operations. These changes will facilitate the evolution of this rapidly growing program.

*See related article on page 81.

Figure 5. Bulk water tanks for the kitchen and dining facility.

Figure 6. A portable, commercial kitchen for on-site food preparation.

Probably the greatest challenge is effective risk communication. Veterinary Corps officers do an excellent job of identifying threats and assessing food protection risks, but this risk must be communicated effectively to commanders and Warfighters who will use these food operations. Additionally, as combatant commands mature their FWRA programs, great care should be taken to develop processes that do not sacrifice risk communication for convenient contracting. Specifically, food operations should not receive a pass/fail designation based on the FWRA. Rather, informed commanders must weigh the FWRA risk level assigned against mission requirements and accept or reject the risk. Contracts should only be formed after risks are accepted by supported commanders. Further, these risks should be fully reevaluated prior to any contract renewal.

While challenges exist with the FWRA program, it also provides several opportunities to improve food safety, including the latitude to provide food operations recommendations and on-site training. These training opportunities create an avenue for skilled assessors to impart their expertise. Additionally, the ability to directly engage partner nations and deliver simple and sustainable food protection training that directly effects host nation health may open the door to exercise-related training engagements apart from the FWRA program.

Even when DoD-approved food sources or operational rations are maximized and FWRAs are leveraged,

deployed personnel still encounter higher risk local foods, often by choice. They must, therefore, be forearmed with enough food protection knowledge to make safer choices with local foods. Educational materials such as those available online from the USAPHC (http://phc.amedd.army.mil/topics/foodwater/ifs/Pages/LocalFoodChoicesDuringDeployment.aspx) provide realistic guidance on local food consumption to reduce food-borne diseases.[2] These diseases range from acute bouts of diarrhea from *Campylobacter* spp to life-long spondylodiscitis and sacroilitis from diseases such as brucellosis from unpasteurized milk.

CONCLUSION

The FWRA program has experienced rapid growth because it empowers supported commanders and assessors with essential information, meshes with counterinsurgency operations, and is especially applicable to developing countries. This empowerment is accomplished by packaging veterinary expertise into realistic risk mitigation recommendations. More than ever, assessors must understand and assist planners and contractors in assembling the safest feeding plan possible. This understanding allows assessors to engage and exercise their veterinary technical knowledge, better partner with assessed food operations, and ultimately protect Warfighters by reducing the risk of food-borne illness.

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Step-II Risk Description

*Only address items from Step I rated High or Extremely High (Significant Risks).

1st Significant Initial Risk (SIR) – Item #: O5

● High ○ Extremely High

Describe SIR: Thermometers were not used to verify internal temperatures of chicken or beef before serving. While the chefs were very experienced with using cooking time / observation to determine when the chicken and beef were ready, using thermometers will verify product-specific internal temperatures were reached.

Mitigation for SIR: Assessor provided establishment a thermometer and on-site training with meals being prepared. Training included recalibrating thermometer in ice-water. Lead chef was receptive, engaged, and likely to use thermometer in future. Compliance probable.

Residual Risk When Mitigated: ● Low ○ Moderate ○ High ○ Extremely High

Affected Product Exclusions (if not mitigated): _____ ●None

Reason for Exclusion: N/A

Extracted portion (Step II) from draft Food and Water Risk Assesment checklist.

The Role of the US Army Veterinary Corps in Military Family Pet Health

LTC (Ret) Nancy A. Vincent-Johnson, VC, USA

HISTORY OF PRIVATELY OWNED ANIMAL CARE BY MILITARY VETERINARIANS

A major focus of the Veterinary Corps is public health, thus the prevention of zoonotic disease transmission to service members and their families has been of utmost importance throughout its history. Military veterinary care of service members' pets originally focused on prevention of zoonotic diseases, especially rabies, a fatal disease in humans. As far back as 1928, Army veterinarians were given the mission of vaccinating pet dogs, cats, and other animals against rabies.[1] Prior to World War II, military officers' privately-owned horses were provided the same veterinary care as that provided for Army horses and mules.[1] Although some general veterinary care was provided to privately-owned dogs, cats, and other pets of service members, the primary responsibility of the Army Veterinary Corps with regard to pets was to prevent disease transmission to military animals, humans, and communities, particularly during animal movement. In addition to the obligatory rabies vaccination program, Army veterinarians were responsible for conducting physical examinations and issuing veterinary health certificates to pet animals prior to their transportation. Upon arrival at their destination, these animals were kept under quarantine or veterinary observation until declared free of contagious diseases. On Army installations, the provost marshal required registration of pet dogs and cats, and annual rabies vaccinations were required to renew the registrations each year. Unregistered animals and strays were subject to impoundment and disposal. Later, vaccination programs were expanded to include those diseases that could be transmitted to military working dogs, including distemper, adenovirus (hepatitis), parainfluenza, and leptospirosis, followed years later by parvovirus. Vaccination programs also expanded to provide vaccines to cats for common feline viruses.

ADPACS TO VETERINARY TREATMENT FACILITIES

After establishment of the US Air Force Veterinary Corps in 1949, the Army Veterinary Corps provided veterinary services to Army installations, the Air Force Veterinary Corps to Air Force installations, and both shared responsibility for provision of veterinary services to Navy and Marine Corps installations. Upon dissolution of the Air Force Veterinary Corps in 1980, the Army became the executive agent for all Department of Defense (DoD) veterinary services and expanded to provide animal health care to all Air Force, Army, Navy, and Marine Corps installations.[2] At that time, military veterinary facilities were referred to as ADPAC, the acronym for Animal Disease Prevention and Control. This terminology emphasized the preventive medicine nature of the services offered and downplayed the veterinary capabilities of the facility. Although pets presented to ADPAC facilities for a variety of clinical complaints, essentially only health certificates, vaccinations, deworming, and diagnosis and treatment of potentially zoonotic conditions were allowed by policy. All other medical and surgical conditions were referred to local civilian veterinarians off the installation for workup and treatment. An agreement was established between the US Army Veterinary Corps and the American Veterinary Medical Association (AVMA) limiting the practice of military veterinary medicine for pets to those aforementioned services within the United States. Surgery in pets was restricted to those emergency procedures necessary to save life, limb, or eyesight before transportation to a civilian veterinarian for further care. Most of the impetus behind this policy was to limit competition for the civilian veterinarians in the local communities surrounding military installations. It also kept the focus of Army veterinarians on their primary missions. Care of privately-owned pets was, and remains today, a secondary mission that ranks in priority behind the primary missions of veterinary care for military working dogs and other government-owned animals, food inspection, and public health.

In US military terms, overseas locations are referred to as outside the continental United States (the 48 contiguous states), or OCONUS. Due to language barriers and a lack of equivalent veterinary standards in several countries where US service members and their families were stationed, full service military veterinary clinics were established at many OCONUS locations. A wider array of veterinary services, including surgery and treatment for conditions other than zoonoses, were provided for pets of authorized personnel. At some locations, 24-hour emergency services were also provided by military veterinarians. This was not against policy since the AVMA agreement only applied within the United States. In some

remote locations within the United States, exceptions to policy were granted to provide full service veterinary clinics because there were no civilian veterinary clinics located nearby. These locations included Fort Irwin, California, and White Sands Missile Range, New Mexico, both located in the desert a long distance from a city or large town. New Veterinary Corps officers relished being stationed at these full service locations because they could perform the full spectrum of veterinary care, including surgery, to pets of service members stationed there. At OCONUS and some remote US locations, veterinary care for pets of DoD civilians was authorized because those personnel are authorized DoD medical care.

By the early 1990s, the Veterinary Corps realized that policy limitations prohibiting Veterinary Corps officers from practicing surgery and services beyond preventive medicine in pets were causing those officers to lose some of their hard-earned veterinary skills, and perhaps interest in remaining in the Veterinary Corps. The neglected skills of military veterinarians were reflected in a declining quality of care they provided to military working dogs. Very slowly things began to change. In the 1994 version of the triservice veterinary regulation,[3] there was a slight easing of the restrictions which allowed establishment of authorized population control and other surgical programs within the United States and its territories. The changes meant that, with approval from the local chain of command, Army veterinarians could start programs to spay and neuter unclaimed, adoptable stray dogs and cats from their installations. Around that same time, there was also a switch in terminology from ADPAC facility to veterinary treatment facility (VTF). In addition to aligning with the new terminology for human medical facilities (medical treatment facility), veterinary treatment facility represented a major change in philosophy in that the veterinary mission role was no longer minimized by withholding the term "veterinary" from names of facilities operated by the Veterinary Corps. The newly established US Army Veterinary Command (VETCOM) united the various veterinary activities scattered across the United States and instituted new common goals and policies. Seeing a strong need for Army veterinarians to maintain and develop their clinical skills, VETCOM initiated a clinical proficiency initiative in which each Veterinary Corps officer was required to perform a small number of surgeries, medical case workups, and emergency medicine cases or scenarios per quarter. Although there was some initial resistance within VETCOM and from civilian veterinarians who practiced near military installations, the initiative was enthusiastically welcomed by younger military veterinarians who were eager to reinforce and further develop their clinical skills. Eventually the required cases within each category expanded to 7 and that number, 7-7-7, became a minimum standard with no set limits on the maximum. The AVMA agreement was altered to remove the past limitations, and in 2008 was revised to the current version which reads in part as follows:

> Veterinary services will be provided across the full spectrum of veterinary medicine, as directed by the Department of Defense. These services are an important benefit for the Department of Defense service member and their family and also provide a critical training and proficiency base for the Army Veterinary Service personnel.

The entire text of the AVMA agreement and policy on military veterinary treatment facilities is presented on the next page.

STRAY ANIMAL FACILITIES

Although collection of stray animals on military reservations is the responsibility of the installation commander, the Army Veterinary Corps has traditionally played important roles in stray animal control. On many military (mostly Army) installations, the Army Veterinary Service traditionally had the responsibility of confinement of strays, and hence maintained the stray animal facility. By regulation, stray animals are required to be held for a minimum of 3 working days to provide owners sufficient time to reclaim their animals. After that waiting period, animals with good dispositions are typically put up for adoption while feral animals and those with bad temperaments or severe medical problems may necessarily be euthanized. Animals in the "stray facility" were cared for by veterinary staff before and after clinical hours, as well as on weekends and holidays. The workload took a toll on unit morale and detracted from the other veterinary missions. Over the last decade, VETCOM moved to ensure responsibility for stray animal confinement is assumed by the individual installations. As of 2012, most installation veterinary service activities no longer have responsibility for a stray animal facility. At each military installation with such a facility, the Army veterinarian is still responsible for performing sanitary inspections of the facility at least quarterly, but preferably on a monthly basis to ensure that it meets a minimum standard of safety and cleanliness. The Army veterinarian also examines injured or ill strays, which are considered government-owned animals for the first 3 working days, and takes the appropriate course of action depending on the nature and severity of the medical condition. In addition to providing veterinary care to ill or injured animals, the installation's Army veterinarian may manage a population control program which involves neutering stray animals prior to their adoption. All expenses for neutering and vaccinating the adoptable strays are recouped through an adoption fee paid by the new owner.

ANIMAL BITE/RABIES CONTROL PROGRAM

Of all the missions performed by the Army Veterinary Corps, one of the most important is that of preventing rabies in humans. Rabies is a viral disease, transmitted through contamination of wounds or mucous membranes by the saliva of an infected animal. Most commonly, this occurs when an individual is bitten by a rabid animal. The rabies virus causes inflammation of the brain known as encephalitis. The inflammation results in severe neurological signs typified by aggression and, in wild animals, a loss of fear of humans. The incubation period for rabies is long, usually weeks to months after being bitten by a rabid animal. In humans and most domestic animals, death occurs within a matter of days once neurological signs become apparent. Because of this, a 10-day quarantine period is established for dogs and cats which bite humans. If the animal does not die of rabies during this period, there is virtually no chance that rabies has been transmitted to the victim. Veterinary Corps officers and their staff are considered the subject matter experts in rabies for all branches of the US military. Knowing which species of animals possess a risk of rabies and which do not, knowing how to manage dogs and cats that may have been exposed to a rabid animal, and knowing when and how to test rabies suspects are just a few examples of essential knowledge of the Army veterinarian. When a human patient presents to a military treatment facility for any animal bite, a DD Form 2341 (Animal Bite Report) is generated to record all the details about the bite, including a description of the biting animal, and if it is a pet, hopefully the name and address of its owner. The report is then forwarded to the local military veterinary service staff which is responsible for investigation of the biting animal to determine risk of exposure to rabies for the patient. This, in turn, will assist the attending physician in deciding whether or not to vaccinate the patient against rabies. Fortunately, rabies postexposure treatment is extremely successful as long as it is initiated in a timely manner, but it is never undertaken lightly as it is expensive, somewhat painful, and not without risk of adverse effects.

Agreement Between the American Veterinary Medical Association and the US Army Veterinary Corps Establishing Policy Regarding Services Provided at Military Veterinary Treatment Facilities

Army veterinarians provide health care for government-owned animals and for animals of individuals authorized military privileges, with an emphasis on wellness, preventive medicine, and outpatient services. Veterinary services will be provided across the full spectrum of veterinary medicine, as directed by the Department of Defense. These services are an important benefit for the Department of Defense service member and their family and also provide a critical training and proficiency base for the Army Veterinary Service personnel. Authorized veterinary services, for both active duty and retired personnel, are the same for personnel living off post as for those living on post. The military Veterinary Treatment Facility is operated by the Veterinary Corps officer or designated Veterinary Service civilian veterinarian, and all assistants are under their direct supervision. A valid Veterinarian-Client-Patient relationship (VCPR) will be established prior to initiating treatment. Veterinary services will not be provided in support of any commercial operations raising animals (pet or livestock) for sale or profit.

Cooperation and referral between civilian and military veterinary personnel are strongly encouraged. Participation of military veterinary service personnel in local and state veterinary activities such as associations, immunization campaigns, fairs, epizootic control programs, public relations functions, etc. in a professionally complementary manner is authorized and encouraged. The vital "One Medicine" human and animal health effort may require military and civilian veterinarians to partner in an overwhelming event such as natural or man-made disasters or disease outbreaks. Army veterinarians are authorized to assist the local veterinary association or other appropriate civilian authority in these situations, upon request and, with the approval of their chain of command.

The AVMA recognizes and supports Department of Defense animal medicine and public health programs administered by military veterinary personnel. In the event clarification is needed on the activities of a particular military Veterinary Treatment Facility, the president of the local veterinary association should first contact the local Veterinary Corps Officer and his or her chain of command, and, if further clarification is needed, the American Veterinary Medical Association.

Approved by the American Veterinary Medical Association Executive Board, April 2008.
Oversight: Council on Veterinary Service

The veterinary service staff attempts to locate the biting animal. This effort may involve contacting the military police, contacting civilian health departments and animal control officers, or contacting the animal owner directly if the animal lives on a military installation. If the latter is the case with a biting dog or cat, the owner must bring the pet to the veterinary treatment facility for the veterinarian to review the animal's record and perform an exam to determine whether the animal is current on its rabies vaccination, and whether the animal is exhibiting any clinical signs suspicious of rabies. Depending on the findings, the pet may be allowed to undergo a home quarantine at the owner's house, or it may be required to undergo quarantine in a veterinary facility under the observation of a veterinarian. While some military veterinary treatment facilities have the isolation kennels necessary to perform rabies quarantine, some do not. In the latter case, a civilian veterinary clinic would be used to conduct the quarantine at the owner's expense. If the animal is exhibiting neurological signs consistent with rabies at either the prequarantine examination, the end-of-quarantine examination, or at any time during the quarantine, the animal must be euthanized and tested for rabies. Feral or wild animal rabies suspects which are captured after biting a person must be euthanized and tested. On military installations, the Veterinary Corps officer is responsible for euthanizing and submitting the animal for rabies testing and for ensuring that the result of the rabies test is immediately communicated to the patient's physician as soon as it becomes available.

TALENTED TANGOs

The role of the Army Animal Care Specialist in the provision of military veterinary care to pets is extremely important. The military occupational specialty (MOS) is 68T, and the specialist is known colloquially as a "Tango." The skilled Tango is a talented individual because the MOS requires the skills of a medic, a laboratory technician, an x-ray technician, a nurse anesthetist, an operating room technician, a pharmacy technician, a patient administration specialist, and a dental hygienist, all combined in one. Amazingly, their Advanced Individual Training (AIT) school is shorter than any of those other AIT schools, so they must learn many of their skills on the job. The Army Animal Care Specialist AIT school is also much shorter than that of their civilian counterpart, the veterinary technician. Because of the length and scope of their education, graduates of civilian programs are eligible to sit for the state veterinary technician licensing examinations, whereas the Tango is not due to the brevity of their AIT. (See related article on page 11.)

Since there are relatively few Army veterinarians to cover all four of the US military services worldwide, the Tangos' assistance is imperative to the success of the mission of the Veterinary Corps. As in civilian practice, the Tango assists the veterinarian in seeing sick call appointments. Unlike the veterinary technician in civilian practice, after being credentialed by the veterinarian, the Tango often sees wellness appointments independently of the veterinarian. This is a force multiplier which enables many more pets to be seen than could be seen by the veterinarian alone. During these wellness appointments, the Tango performs vital signs, obtains a brief health history, performs a screening physical exam, obtains blood for heartworm and feline leukemia tests, performs other laboratory procedures, administers vaccines and microchips, and dispenses preventive heartworm and flea/tick products. The Tango also answers client questions regarding health and training, and alerts the veterinarian when health problems are identified. When the veterinarian is off the premises, the Tango is normally limited to performing noninvasive procedures such as fecal examinations. However, an exception to policy has occasionally been allowed for select remote OCONUS locations, such as the Azores, to allow the Tango to perform vaccinations, heartworm testing, and minor treatment for parasites and ear infections in the absence of the veterinarian. These "super techs" enable the provision of increased veterinary services to clients at remote locations which have no permanently assigned veterinarian. This allows the veterinarian to concentrate on more serious health issues and perform surgical procedures during their limited visits. At all duty locations, Tangos perform anesthesia, place IV catheters, prep animals for surgery, assist the veterinarian in surgery, test blood and urine, perform dental cleanings, take x-rays, manage the animal bite/rabies control program, and more.

FINANCING VETERINARY CARE FOR PRIVATELY-OWNED PETS

While funds are appropriated by Congress to provide veterinary care to government-owned animals, privately-owned animal veterinary care operations are financed through nonappropriated funds, commonly called NAF, which are self-supporting funds generated through the sale of goods and services to support or provide authorized programs. By law, NAFs are used for the collective benefit of those who generate them. Examples of entities that operate using NAF funds include the base exchanges (which generate the bulk of those funds), and morale, welfare, and recreation (MWR) facilities such as bowling alleys, clubs, child development centers, and temporary/visitor lodging facilities.

Veterinary facilities are not considered MWR activities. Consequently, the Veterinary Service Fund, a supplemental mission fund, is separate and quite different

from funds that support other NAF activities. Operational control of the veterinary facility, including fiscal decisions, is exercised by the responsible Veterinary Corps officer. As a nonprofit activity, a military veterinary treatment facility charges pet owners for veterinary services and products to cover expenses. Any profits are invested in the veterinary facility for new equipment, increased services, facility upgrades, etc. Of course the Army Veterinary Corps officers and the Army animal care specialists are active duty military personnel, but the civilian receptionists that work at the veterinary facility are paid from the NAF funds generated by the facility. The collected funds must also be sufficient to purchase and restock the large inventory of medications and supplies that are used in the course of providing care to privately-owned animals. In addition to the fees collected to cover the actual costs of the products and services rendered, a $2.00 user fee is charged with each transaction. This mandated fee goes to the US Treasury to offset the use of appropriated fund resources, namely military personnel, which support the NAF activity.

In most veterinary treatment facilities (VTFs), demand for pet appointments usually exceeds the availability. To better meet the demand, years ago a number of veterinary facilities began to hire civilian veterinary technicians using NAF funds. These NAF technicians helped fill the gaps during shortages of Army Tangos, and also allowed increased numbers of appointments. However, the civilian technicians could only work when the Veterinary Corps officer was at the facility to run appointments. Years later, VTFs were given authorization to employ civilian veterinarians using NAF to expand the number of available appointments when the Veterinary Corps officer is absent from the VTF. The NAF veterinarians also provide continuity during the gaps that sometimes occur when the Army veterinarian must attend a lengthy military school, or is transferred. Because military veterinarians spend a significant amount of time performing their primary missions of food inspection, military working dog care, and public health responsibilities, the use of NAF veterinarians allows an increased number of pet care appointments when the Veterinary Corps officer is working on station. As the number of NAF employees increase, the fees charged to clients must increase to cover the cost of the additional wages. More recently, some Veterinary Corps officer authorizations as well as some noncommissioned officer-in-charge (NCOIC) authorizations have been changed from military positions to government civil service (GS) employee positions. The new positions retain the same spectrum of responsibilities as the Veterinary Corps officer or NCOIC. All government employees are paid with appropriated funds, not NAF.

Although each assigned Veterinary Corps officer is responsible for clinical operations of their respective VTF, fiscal decisions were reviewed and often influenced by the local installation's NAF council which managed the individual veterinary NAF fund. Historically, this resulted in large variations between VTFs with regard to the scope of services offered and the fees charged. In 2008, VETCOM undertook the consolidation of all VTF funding under one central NAF fund, the Veterinary Service Central Fund. The goals were to standardize fees, expand services, and increase continuity of care by hiring additional NAF veterinarians and technicians where needed. In addition, consolidation under a single umbrella account allows price breaks on bulk purchases of drugs and supplies, creating cost savings that can be passed to clients. By May 2012, VTFs on Army, Navy, and Marine Corps installations had been converted from individual NAF accounts to the central NAF fund. Operations on USAF installations were converted in October 2012.

STANDARDS OF CARE: CLINICAL CREDENTIALING

In 2005, the VETCOM Commander proposed development of a clinical credentialing program to assure that all Veterinary Corps officers assigned within VETCOM meet a set standard of clinical skills. An existing credentialing program in the Southeast Regional Veterinary Command was used as a model for the new VETCOM credentialing program. A newly created regional clinical consultant position within the North Atlantic Regional Veterinary Command made that region the logical place to develop, test, and refine the new VETCOM clinical credentialing program.

Clinical credentialing tests a new Veterinary Corps officer's ability to apply his or her knowledge and skills in a clinical setting, focusing on critical skills necessary to provide the best veterinary care to the military working dog and privately-owned pet populations. It is based on a clinical credentialing checklist, reproduced in the Figure, that is divided into 4 broad areas of general medicine, anesthesia, radiology, and surgery, plus a second page of optional tasks if time permits. During credentialing, Veterinary Corps officers demonstrate that they know how to conduct a comprehensive physical examination, neurologic exam, orthopedic exam, and ocular exam, interpret ECGs and radiographs, and perform anesthesia and 2 different types of surgery. Working in small groups of 2 to 5 officers over a period of one week, credentialing is normally carried out at the various duty sites to evaluate them in their own working environment using their facilities, equipment, and clinical staff. The program was highly successful. As a result, clinical credentialing is now a VETCOM policy which mandates that credentialing be conducted within

VETCOM VCO Clinical Credentialing Checklist

Name:_____ **Rank:**_____

Duty Site:_____ **DVC:**_____

Proctor's Name:_____ **Proctor's Signature:**_____

Primary Tasks

General Medicine	Go	No Go	Proctor's Initials	Date
Authorized the perform General Medicine without direct supervision*	☐	☐		
Perform physical exam on a MWD	☐	☐		
Perform orthopedic exam	☐	☐		
Perform neurologic exam	☐	☐		
Perform ocular examination	☐	☐		
Interpret ECG	☐	☐		
Manage GDV	☐	☐		
MWD Deployment Processing	☐	☐		
Properly write a SOAP entry	☐	☐		
Maintain a MWD record	☐	☐		
Manage the Trauma Patient	☐	☐		

Sedation and Anesthesia	Go	No Go	Initials	Date
Authorized the perform Sedation and Anesthesia without direct supervision*	☐	☐		
Inhalation anesthesia	☐	☐		
Staff safety - initial and annual briefings	☐	☐		
Pre-operative equipment check	☐	☐		
Determine patient's physical status risk category	☐	☐		
Plan individualized anesthetic protocol	☐	☐		
Preparation of patient	☐	☐		
Induction	☐	☐		
Maintenance and Monitoring (manually; Propaq/equivalent) ETCO2, SpO2, Body temperature, HR/RR, NIBP, ECG, Fluids	☐	☐		
Postoperative recovery	☐	☐		
Sedation Protocols	☐	☐		
Pain control (postoperative and chronic pain)	☐	☐		
Anesthetic documentation	☐	☐		

Radiology	Go	No Go	Initials	Date
Authorized the perform Radiology without direct supervision*	☐	☐		
Radiation safety ALARA, staff safety briefings (initial and annual), radiation badge program, shielding, annual testing of protective equipment	☐	☐		
Critique standard radiographs and identify features of common MWD disease	☐	☐		

Surgery	Go	No Go	Initials	Date
Authorized the perform General Surgery without direct supervision*	☐	☐		
Prepare patient for surgery (clip, scrub, position)	☐	☐		
Scrub, gown, and glove-in for a surgical procedure	☐	☐		
Properly drape a surgical patient	☐	☐		
Demonstrate proficiency at the following surgical procedures	☐	☐		
Laparotomy (Incisional Gastropexy)	☐	☐		
Other Laparotomy procedures (ie, OHE, exploratory)	☐	☐		
Neuter/scrotal ablation	☐	☐		

* Credentialing certification entered into DTMS.

Note: Blue font indicates items taken directly from VETCOM training guidance Attachment 3.

US Army Veterinary Command (now US Army Public Health Command) clinical credentialing checklist for Veterinary Corps officers (page 1 of 2; checklist continued on next page).

Secondary (Optional) Tasks as Time Permits	Go	No Go	Initials	Date
CPR (Basic and Advanced)	☐	☐		
Administer Oxygen Therapy	☐	☐		
Manage dermatologic conditions (skin, ears, perianal fistula, etc.)	☐	☐		
Manage GI disease (diarrhea, parasites)	☐	☐		
Perform dental notations and prophylaxis	☐	☐		
Perform dental x-ray views with proper positioning and technique	☐	☐		
Evaluate dental radiographs	☐	☐		
Manage anaphylactic shock	☐	☐		
Manage heat injury	☐	☐		
Total IV Anesthesia (TIVA)	☐	☐		
Supervise surgical pack and autoclave maintenance	☐	☐		
Evaluate and treat envenomation	☐	☐		
Manage toxin exposure/ingestion	☐	☐		
Infection control/zoonosis	☐	☐		
Perform standard x-ray views with proper positioning and technique	☐	☐		
Develop an x-ray with automatic processor *or Develop an x-ray with Orex CR*	☐	☐		
Perform abdominal ultrasound	☐	☐		
FAST Exam (Focused Assessment with Sonography for Trauma)	☐	☐		
Perform ultrasound-guided percutaneous cystocentesis and aspiration	☐	☐		
Properly write a SOAP entry	☐	☐		
Maintain a MWD record	☐	☐		
Perform fine needle aspirate	☐	☐		
Interpret Cytology Specimen	☐	☐		
Interpret CBC and chemistry results	☐	☐		
Review MWD necropsy techniques and specimen submission	☐	☐		
Process a blood sample	☐	☐		
Prepare and review blood smear slide	☐	☐		
Process a urine sample	☐	☐		
Examine microscopic urine sediment	☐	☐		
Demonstrate bandaging techniques	☐	☐		
Perform basic parasitology tests (fecal flotation, skin scraping, HW test)	☐	☐		
Perform clinical decision-making; determine when to refer an MWD	☐	☐		
Perform root canal	☐	☐		
Perform dental extraction	☐	☐		
Perform exploratory laparotomy	☐	☐		
Operate and maintain Piccolo or VetScan chemistry analyzer	☐	☐		
Operate and maintain I-stat machine	☐	☐		
Operate Magellan anesthesia machine and oxygen concentrator	☐	☐		
Operate Propaq monitor	☐	☐		
Operate IV fluid pump	☐	☐		
Operate syringe pump	☐	☐		

Note: Blue font indicates items taken directly from VETCOM training guidance Attachment 3.
Italics indicates items that are dependent on having the proper equipment or opportune clinical cases.

US Army Veterinary Command (now US Army Public Health Command) clinical credentialing checklist for Veterinary Corps officers (page 2 of 2; checklist continued from previous page).

120 days of arrival of a new Veterinary Corps officer or GS veterinarian. Tasks are graded as a "go" or "no go." Any tasks that are graded "no go" are trained and retested during the same credentialing period, if possible. If still not successful, the veterinarian's commander can set clinical limitations for that person until he or she successfully passes the tasks in question. The retesting follows additional extensive training in identified weak areas. Besides ensuring a minimal level of clinical competency in the new Veterinary Corps officer, additional benefits of clinical credentialing were found to include instilling confidence levels in new Veterinary Corps officers, providing an opportunity to ask questions as well as gain additional training in weak areas, and developing a rapport with the region's clinical consultant. The benefits were also found to facilitate later consultations and referrals which resulted in improved veterinary care for both government-owned and privately-owned animals.

VETERINARY MEDICAL STANDARDIZATION BOARD

In 2006, the VETCOM Commander directed the formation of the VETCOM Veterinary Medical Standardization Board (VMSB), modeled after medical standardization boards from some of the most successful health maintenance organizations and medical institutes across the country. Bringing together a talented team of officers from throughout the Veterinary Corps, the VMSB members comprised a wide variety of ranks and specialties who worked together to create a set of high, but practical standards. Three committees were initially organized: the Formulary Committee, the Equipment Committee, and the Protocol Committee.

Formulary Committee

Veterinary Corps officers generally change duty stations every 2 to 3 years. A common problem upon arrival at the new duty location is that the shelves are stocked with different medications than those they typically prescribe. Expired items are replaced with slightly different versions of similar medications. The Formulary Committee was tasked with creating a standardized formulary similar to that found in military medical treatment facilities. Standardization has obvious benefits: easier transition for military veterinarians from one facility to another as inventories are the same or very similar; no change of inventory with each incoming Veterinary Corps officer; and money saved by the combined purchasing power across all facilities. It was also necessary to form a standardized formulary in preparation for consolidation of the various individual NAFs into one centralized NAF account. Items not used frequently enough to be included in the formulary could still be prescribed for an individual patient for purchase at an outside pharmacy.

Equipment Committee

When Veterinary Corps officers or Tangos moved from one veterinary facility to another, they often found either a lack of essential equipment or the presence of equipment with which they were unfamiliar. Due to a number of factors, there was disparity among the equipment found in different veterinary facilities, some were very well equipped while others did not have the items necessary to properly conduct some procedures such as anesthesia. Learning to use a different piece of equipment could be difficult, especially when a veterinarian or animal care specialist was working temporarily in the facility. Sometimes purchased equipment was incompatible with existing systems or expendable supplies, and replacement parts were hard to come by. These factors often led to disuse of the item.

The goal of the Equipment Committee was to select one brand and model of each equipment item that would best serve all of the veterinary facilities. The selection was based on a number of factors: functionality, compatibility, reliability, ease of use, maintenance requirements, procurement and operating costs, availability of expendable supplies and parts, and others. Standardized equipment provides each facility with the same capabilities with respect to performing procedures such as anesthesia, x-rays, laboratory testing, and more. Also, equipment training can be done once, and Veterinary Corps officers and Tangos could carry that training with them from one facility to the next. As with the standardized formulary, purchasing numerous identical items allows better pricing from manufacturers, resulting in substantial cost savings to the government. Standardization also ensures that the equipment is ordered with the same options rather than different configurations as is the case with the nonstandard equipment. The Equipment Committee researched numerous manufacturers and models before recommending the initial selections. The committee reviews new equipment items as well as feedback and requests from the field, and adjusts the list of standardized equipment accordingly. Rather than automatically replacing functional equipment items with the standardized item, existing equipment is kept in place until its service life has expired, then it is replaced. This avoids waste and excessive expenditures.

Protocol Committee

The Protocol Committee is chartered to establish standards of care predicated on evidence-based medicine whenever possible. Rather than forcing veterinarians to practice an algorithm style of medicine, the Committee intended to set a minimum bar with parameters on the right and left and no ceiling, leaving the practitioner with the opportunity to apply experience and skills to

the practice. This was to ensure that patients received high quality care, although the specifics of that care could vary depending on the individual veterinarian.

The first product that emerged from the Protocol Committee was the Handbook of Anesthesia/Pain Management Standards. During anesthesia, the patient's life is completely in the hands of the anesthetist and so it is extremely important to use safe methods and critically monitor the patient. Unfortunately, anesthesia is an area in which many new veterinarians lack confidence. The Handbook helps by establishing a specific protocol for "normal" patients as well as establishing additional protocols for those suffering from various conditions, such as heart disease, kidney disease, liver disease, and many others. There is also a protocol for emergency procedures and another for critically ill patients, as well as recommendations on various methods of controlling pain before, during, and after surgery. The comprehensive document sets minimal standards in such areas as preanesthetic workup, anesthetic monitoring, and postprocedure pain management. It offers numerous tips and advice on what to do if one encounters abnormal findings on preanesthetic bloodwork or during anesthetic monitoring.

The Protocol Committee also produced the Small Animal Vaccination Guidelines. The Guidelines standardize vaccination protocols and vaccine products so that clients will not encounter drastic differences in vaccination schedules or vaccine types when they move from one facility to another. It takes into account risk factors for specific diseases which vary among geographical areas. For instance, Lyme disease vaccine is highly recommended for dogs in northeastern and midwestern states, while not advocated for dogs living in the southeast or the west. The Protocols Committee continues to work at developing additional standards of care documents for implementation within Army veterinary facilities.

Business Practices Committee

The Business Practices Committee was later added to the VMSB. Its goal is to make best practices decisions for the business side of the veterinary facilities and to safeguard the financial aspects. A Clinical Operations Handbook was developed to standardize the way that each Veterinary Facility operates in order to give the client a consistently good experience at every facility. Today, business practices are largely developed and implemented by the Veterinary Service Central Fund.

The VMSB committees are dynamic entities—committee chairpersons discuss issues with committee members as necessary to consider additions and changes to their specific areas. Requests for additions or changes to the formulary, equipment items, and protocols or business practices can be made by any military, NAF, or GS veterinarian at any time using a standard request form. Feedback on experiences using the formulary, equipment, and protocols are also welcome and help the committees refine and improve their products.

VETERINARY CLINICS, CENTERS, AND ACTIVITIES

As the VMSB began its work, VETCOM leaders acknowledged that not all veterinary facilities would be able to offer the full spectrum of veterinary services due to size or inadequacy of physical facilities, lack of a permanently assigned veterinarian, and other factors. In the past, veterinary facilities had been classified into 3 tier levels. However, the terminology was confusing even to those within the Veterinary Corps and certainly to clients. New terminology was developed in conjunction with the VMSB standards discussed earlier. The majority of veterinary facilities continue to be veterinary treatment facilities. Wellness and sick call appointments continue to be available at VTFs, which also have the capability to perform routine surgery (spay/neuter, small mass removal, etc), and basic emergency care. The smaller VTFs are now veterinary clinics, they do not have a full-time assigned veterinarian, but are staffed either as an attending site or with a NAF veterinarian. Veterinary clinics would primarily offer wellness appointments and basic sick call with no surgery capability. After basic stabilization, emergency patients would be transported from a veterinary clinic to an appropriate civilian or military facility. The highest level facility is now a veterinary center (VETCEN). The VETCEN has a training mission (see section First Year Graduate Veterinary Education Program on the following page) and is staffed with more than one veterinarian, including a clinical specialist with expertise in surgery, internal medicine, or critical care. In addition to the same capabilities for appointments and basic routine surgery offered at the VTFs, some advanced procedures and surgeries are available at the VETCEN depending on equipment, staffing, and the capabilities of the assigned specialist. VETCENs could also accept referrals from other veterinary facilities on a space available basis if time and resources permit. A veterinary activity (VETAC) is similar in concept to the VETCEN, however, it does not have a training mission. Examples of VETACs are the facilities in Okinawa and Vogelweh, Germany, which have an assigned clinical specialist, increased technical staff, and equipment to manage more involved cases.

PRIVATELY-OWNED ANIMAL HEALTH RECORDS

Veterinary medical records are initiated on privately-owned animals at the time of animal registration or at the first visit to the veterinary facility. Traditional hard

copy medical records consist of the green record jacket (DD Form 2344) which contains a Veterinary Health Record (DD Form 2343) used as a cover sheet to display pertinent items such as owner information, animal data, immunization data, a master problem list, and a record of laboratory tests procedures. The record jacket holds the Standard Form 600 containing the doctor's and technician's medical notes. There are a number of DoD and standard forms used in the pet health record, including the rabies vaccination certificate, health certificates, records of various laboratory results, and much more. For years the healthcare industry, military and civilian, has worked to develop and implement electronic medical records, with varying levels of success. Within military veterinary medicine, individual facilities implemented electronic record applications of their choice. As a result, there was a large variety of software applications in use throughout the facilities. Most applications were used only for invoicing and inventory control, not for medical notes or treatment records. The existence of many various programs complicated personnel movement between locations because of the learning curve for a different system. Each of the multiple programs generated a different style report, making it difficult to compare data across the facilities. These issues prompted VETCOM to mandate the system-wide implementation of the commonly used veterinary medical record software application, AVImark (McAllister Software Systems, Piedmont, MO). Over time, all facilities have made the transition. Veterinary personnel also began to use the medical recordkeeping feature to document their medical notes directly into digital format. For obvious reasons, the use of a single system has dramatically improved efficiency across the Army Veterinary Service. However, AVImark is an individual device installation that is not networked among facilities, so AVImark records and data cannot be electronically transferred. Consequently, animal data must be completely re-entered when a client changes veterinary facilities. Further, veterinarians and staff cannot retrieve records from another facility, a problem when proof of a previous vaccination is required. The VETCOM initiated development of a new Veterinary Electronic Medical Record (VEMR). The VEMR will be built as a web-based system accessible by authorized, credentialed personnel from any military network location. The VEMR will solve the problems of record access and transfer, as well as significantly enhance productivity and patient treatment capabilities.

FIRST YEAR GRADUATE VETERINARY EDUCATION PROGRAM

Most veterinarians enter the Army Veterinary Corps shortly after graduation and are typically assigned to duty sites where they are the only veterinarian. This can be somewhat overwhelming to the new graduate with much knowledge, but limited experience. Unlike most of their civilian counterparts who enter internships or go into private practice under the wing of an experienced clinician/practice owner, the new Veterinary Corps officers often feel isolated when it comes to performing surgery, seeking advice on medical cases, or managing a business. Although the issue had been recognized for quite some time, a solution was not simple. It took much work and several briefings to the staff of The Army Surgeon General, but eventually a First Year Graduate Veterinary Education (FYGVE) program was approved. The first FYGVE class started in the fall of 2010 with 5 new graduate veterinarians who reported to the Fort Belvoir VETCEN for the first iteration of the 10-month program. The participants alternated between clinical and nonclinical (for example, food protection/public health) rotations every few weeks. During a typical 3-week clinical rotation, one week is spent with military working dog appointments, another week seeing privately-owned pet appointments, and the third week performing surgery and other procedures. During the week assigned to working dog appointments, the veterinarian is also on call for working dog emergencies. Clinical rotations at the VETCEN are supervised by a clinical specialist. Learning is supplemented by daily group case discussions, critical review of journal articles, pathology rounds, topic presentations, outside speakers, and more. Participants are also allowed one to 2 weeks to perform off-site elective rotations. So far, participants have spent time with a veterinary ophthalmologist, a veterinary neurologist, a veterinary emergency practice, and the equine veterinarian at Fort Myer. At the start of the second year, additional FYGVE programs were established at Fort Bragg, North Carolina, and Joint Base Lewis-McChord, Washington, allowing approximately 15 total participants in the program. Additional sites will open in the future at Fort Benning, Georgia, Fort Campbell, Kentucky, and Camp Pendleton, California. Adjustments and refinements are continuously made to improve the program which is beginning its third year as of this writing. Eventually, all new Veterinary Corps accessions will participate in the FYGVE program.

Veterinarians who decide to stay in the Army after their initial 2 tours are encouraged to apply for long-term health education training, choosing from several different programs including clinical medicine. Officers have completed residencies in internal medicine, surgery, emergency medicine/critical care, and radiology. Veterinarians who successfully complete their clinical residency and become board certified in their specialty are given the Area of Concentration designator 64F as a Veterinary Clinical Medicine Officer. The FYGVE

program enables participants to get solid clinical experience which is very beneficial for those who later decide to pursue one of the clinical specialties.

MILITARY INSTALLATION HORSE STABLES

As mentioned earlier, from the beginning of formal Army veterinarian services early last century, privately-owned mounts received the same veterinary care provided by the Army Veterinary Corps as Army horses and mules. Not surprisingly, today's situation with regard to equine care is very different. Although there are still a few Army owned horses and mules, primarily for ceremonial events, most installation stables have disappeared. Of those boarding stables that still exist, most are operated by private clubs. However, the installation veterinarian is still responsible for performing sanitary inspections of the facilities on a quarterly or monthly basis. In recent years, most newly graduated veterinarians are focused on small animals and often are not comfortable working with or around horses. For those Veterinary Corps officers, the sanitary inspections and occasional end-of-quarantine examinations are the only contact they have with horses. Installations that stable government-owned horses such as Fort Myer, Virginia, Fort Sam Houston and Fort Hood, Texas, and Fort Huachuca, Arizona, are assignments highly requested by those Army veterinarians with an interest in horses. Such Army veterinarians often provide some services to privately-owned horses stabled on military installations for vaccinations and annual Coggins (equine infectious anemia) testing. Additional services generally are not offered due to limitations in time and resources.

ABOVE AND BEYOND

Each year the Army Public Health Command* reviews nominations from military veterinary facilities to select one to receive the annual Above and Beyond Award. This coveted award recognizes units which go beyond their designated functions and duties. The accomplishments and generosity of the personnel at the nominated units are very impressive, and it has often been difficult to narrow the selection to just one. Further, many units which are not nominated are also very actively involved in their community beyond their required functions. A few examples from the extensive list of accomplishments are:

Pet Fairs: community events which host activities such as pet and owner health walks; pet shows; demonstrations from military working dog teams, dog agility clubs, and dog obedience clubs; distribution of free samples; information booths; tours of the VTF; and more.

*In July 2011, the US Army Veterinary Command was merged with the US Army Center for Health Promotion and Preventive Medicine to form the US Army Public Health Command.

Pet Visitation to Hospitals (governed by *DoD Technical Bulletin TB MED 4*[4]): after undergoing screening for health and temperament, animals can be certified by the American Red Cross and other agencies to perform pet visitation to patients in military and civilian hospitals. Several military veterinarians and technicians participate in this program with their own pets and also provide support to others who participate.

Vaccination Clinics: some VTFs take the clinic on the road to neighborhoods in military housing areas so that families who cannot transport their animals to the VTF can still obtain care. Some VTFs host Saturday or evening clinics for those clients whose schedules will not allow them to come during the week.

Visits to Schools and Daycare Centers: many veterinarians and technicians visit elementary and preschool classes to give talks and demonstrations on important topics such as prevention of animal bites. These activities are always enjoyed by the children who especially look forward to seeing the animals that usually accompany the staff, and receiving educational coloring books.

SUMMARY

Even though privately-owned pet care is a lower priority mission than military working dog care, food inspection, and the public health mission, it is still very important, and the one that many Veterinary Corps officers, civilian veterinarians, and technicians enjoy the most. The vast majority of veterinarians and technicians went into veterinary medicine because of a love for animals. It is fulfilling to offer guidance to a client with a new puppy or kitten, see a sick pet improve after treatment, and interact with dozens of animals and clients in a day. The services provided by the Army Veterinary Corps in caring for pets has expanded over the years and the standard of care has improved as well. It is truly a privilege to serve those who dedicate themselves to the protection of our Nation. The Army Veterinary Corps is indeed proud to provide care to the pets of Warfighters of the Army, Navy, Marine Corps, Air Force, and Coast Guard; their family members; and our military retirees.

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One Health and Force Health Protection During Foreign Humanitarian Assistance Operations: 2010 Pakistan Flood Relief

MAJ Ronald L. Burke, VC, USA

ABSTRACT

Restrictions on the number of troops that could enter Pakistan in support of the 2010 flood relief efforts limited the type and number of deployed medical personnel. Although this created the potential for mission gaps, the assigned personnel were able to perform additional functions beyond those normally associated with their particular health specialty to help close these gaps, which was largely made possible due to prior cross-training and predeployment refresher training. Given the rapid and unpredictable nature of disaster response, future foreign humanitarian assistance operations may face similar issues with assigned personnel. Promotion of the One Health concept through instruction and training will help to increase awareness among US Army Medical Department personnel about the roles and functions of health specialties, facilitate the identification of critical gaps during deployments, and provide personnel with the knowledge and skills needed to address them.

Army Regulation 40-1[1] defines the duties of the various Army Medical Department (AMEDD) Corps. Traditionally, there has been a clear distinction between the duties of one Corps and those of the others with little overlap, although exceptions do exist, such as food inspections performed by both veterinary and preventive medicine personnel. This is largely a result of the specialized training that AMEDD personnel receive. Officers often require 4 to 8 years or more of formal education prior to entry into military service, which is followed by additional Corps specific training within the military, and oftentimes annual professional continuing education. This training is necessary to ensure officers possess the knowledge, skills, and proficiency to carry out the demanding requirements of their respective professions. These individuals are subsequently assigned to specific medical units which have clearly defined capabilities that are distinct from the medical units of the other AMEDD Corps.[2] Deployment of these units during military operations is generally related to the size of the supported force (for example, one medical detachment, veterinary services per 70,000 Army personnel in a combat zone). This basis of allocation is intended to ensure that adequate numbers of trained individuals are present in the theater to carry out the broad range of medical missions necessary to protect and promote the health of the fighting force.

Unfortunately, during foreign humanitarian assistance (FHA) operations such as disaster relief, it may not be possible to deploy these medical units in their entirety. The number of deployed servicemembers in the area of operations may not warrant an entire unit, or a complete unit may not be readily available for a rapid response to an unexpected disaster. In other situations, the existing status of forces agreement, or lack of one, may have restrictions which limit the number of US servicemembers that may be present in the country or disaster area. Although the US forces supporting FHA operations may have some reduced medical requirements, (for example, no combat realted trauma care), they are not completely eliminated. In some instances, as in the case of preventive medicine, the requirements and workload may actually be increased compared to other military operations.[3] In such situations, AMEDD personnel should prepare themselves to perform additional duties beyond those normally associated with their military specialty.

A CASE EXAMPLE: FORCE HEALTH PROTECTION DURING THE 2010 PAKISTAN FLOOD

Sustained, torrential rains beginning in July 2010 resulted in widespread flooding of over 795,000 sq km, one-fifth of Pakistan's total land area, and directly affected over 20 million residents (Figure 1).[4] Similar to the 2005 earthquake response, beginning in August 2010, the US Department of Defense (DoD) deployed troops to Pakistan as part of a coordinated US foreign humanitarian assistance response. However, unlike the 2005 response, the DoD's 2010 response did not provide direct medical care to the local population and instead was primarily directed at supporting the movement of people and supplies to and from flood affected areas.

Restrictions on the number of US servicemembers in Pakistan limited the in-country FHA force to approximately 600 total personnel.[5] US military helicopters were deployed to Ghazi Aviation Base in the north and Pano Aqil Army Airfield in the south, with a small central hub at Chaklala Airbase outside Islamabad for coordination of transient fixed-wing airplanes. Limited medical assets consisting of 2 physicians, a physician assistant, a veterinarian, and several medics/corpsmen were deployed to help protect and sustain the health of the deployed force. Although the risk of combat related injuries was low for US personnel in Pakistan (in comparison to neighboring Afghanistan), disease and nonbattle injuries remained a significant threat which required the continued attention of the medical staff, particularly with regards to implementation of preventive medicine measures.[6] In many deployments, these measures are implemented by traditional preventive medicine units, but due to the troop limitations in Pakistan, they were instead implemented by nontraditional medical personnel.

Figure 1. Flooding of the Indus River in Sindh Province, Pakistan as a result of excessive rains in the summer of 2010. Photo courtesy of the author.

One of the initial preventive medicine issues which required attention was an Occupational and Environmental Health Site Assessment (OEHSA) for each of the 3 US military base camps to identify health threats and develop recommendations to minimize their potential impact on US servicemembers. An OEHSA is normally conducted by trained preventive medicine personnel with specialized equipment which is used to detect and measure potential health threats such as exposure to contaminated air, soil, and water, excessive noise, nonionizing radiation, and arthropod borne diseases. It was not possible to complete an OEHSA in its entirety due to a lack of certain equipment, such as a noise dosimeter, and properly trained personnel. However, a thorough OEHSA was still performed at each base camp thanks to previous cross-training and subsequent refresher training of personnel prior to deployment. The cross-training was conducted several years prior by members of the 30th Medical Brigade to improve awareness and coordination of efforts between veterinary and preventive medicine personnel and units in the US European Command area of responsibility. This training provided participants with a basic understanding of the roles, responsibilities, and methods of their medical counterparts in promoting force health protection through food, water, and environmental health safety. The subsequent predeployment training by US Army Public Health Command (USAPHC) personnel was able to rapidly build off this basic training so that non-preventive medicine personnel were able to competently perform OEHSAs for all 3 sites, identify significant health threats, and develop mitigative measures which were instrumental in reducing incidence of disease and nonbattle injuries, and protecting the servicemembers' health.

A significant health threat identified during the OEHSA was the lack of DoD-approved sources for food and water within Pakistan. While shipment of operational rations and bottled water via military airlift was available, it was only possible with a like reduction in the transportation of humanitarian goods. Fortunately, trained veterinary personnel were available to conduct Food and Water Risk Assessments (FWRAs) of local caterers which provided the base camp commanders with an alternative to operational rations (see related article on page 63). Like the OEHSA, a key principle behind the FWRA is the identification of food and water associated health threats and development of mitigative measures to reduce the overall risk to acceptable limits. A common finding among all 3 FWRAs was general noncompliance with US requirements for cooking/holding times and temperatures, and cleaning and sanitation of food and food contact items and surfaces. Noncompliance was largely due to the contractor's unfamiliarity with US requirements which was partially corrected during the FWRA inspection and outbrief, as well as subsequent training of food service personnel by the contractor. Compliance was further improved by deploying US military food service personnel to provide oversight of the kitchens and dining facilities at the 2 larger US base camps. The deployment of these individuals in the face of the restrictions on the number of US servicemembers allowed in Pakistan is a testament to the importance that the base camp commanders placed on food safety. Neither of the 2 camps where US food service personnel were deployed experienced any significant food borne incidents during the deployment. Unfortunately, the third camp which did not have a US cook supervising operations experienced a

food-borne outbreak which affected approximately 50% of the US personnel. As a final step towards improving safety, medical staff at each of the 3 base camps received instruction on basic food sanitation and guidance on critical items to look for during food service operations. Those personnel then performed local food safety inspections in the absence of formally trained veterinary or preventive medicine food inspectors.

Another major challenge facing the medical personnel in Pakistan was surveillance and control of arthropod vectors, particularly mosquitoes. Application of most DoD approved insecticides, and all ultra-low volume (ULV) insecticide applications, requires special training and certification due to their potential health risks. In some instances, insecticides may not be applied unless warranted by vector surveillance conditions such as confirmed presence of malaria positive mosquitoes. Although the force restrictions in Pakistan prevented the deployment of traditional DoD vector surveillance and control teams, vector surveillance and control was still performed by the deployed medical force through coordination with organizations. Part of the rapid predeployment training conducted by the USAPHC included refresher instruction on the use of Centers for Disease Control and Prevention light traps for mosquito and sand fly surveillance. Those items were shipped to the deployed medical personnel in Pakistan, along with shipping material and containers, so that local arthropods could be trapped and sent to the laboratory at USAPHC Region Europe for identification and testing. Although *Anopheles* sp mosquitoes (Figure 2) were identified from the samples, none of the specimens tested positive for malaria. However, malaria was eventually diagnosed in one US servicemember at Pano Aqil, at which point the deployed personnel consulted with the Armed Forces Pest Management Board (AFPMB) to determine an acceptable insecticide. That insecticide was subsequently applied by Pakistani military personnel via ULV application. Additionally, all personnel were reminded of the importance of proper wear of permethrin treated uniform, daily compliance with doxycycline malaria chemoprophylaxis, and the proper use of bed-nets. No additional cases of malaria among US servicemembers were detected following these actions.

Figure 2. *Anopheles minimus* mosquito blood feeding. Photo by James Gathany courtesy of the Centers for Disease Control and Prevention.

Other medical challenges encountered during the Pakistan flood relief operations included outbreak investigations and laboratory analysis of food and water samples, patient movement within and out of country, and obtaining advanced diagnostics and care. In some of these instances, DoD medical personnel were able to make arrangements with Department of State medical personnel at the US Embassy in Islamabad. In other cases, coordination with DoD assets at sea and in Afghanistan, Germany, and the United States facilitated accomplishment of the mission.

LESSONS LEARNED

Although it's unlikely that any future FHA operation will be exactly the same as the 2010 Pakistan Flood Relief, similarities are bound to occur, especially with regards to the numbers and types of personnel deployed. Whether or not the affected country places restrictions on the number of US servicemembers which may enter the country or disaster area, other factors such as the limited availability of qualified personnel during the initial rapid disaster response deployment may exist which limit the number of deployed medical personnel. In these instances, medical personnel may have to cover gaps and mission responsibilities traditionally performed by other personnel, including tasks which may fall outside of their normal military occupational specialty.

Fortunately, while Pakistani restrictions limited the number of deployed servicemembers in country, the gradual onset of the flood disaster, as opposed to an earthquake or tsunami, facilitated a more measured deployment of troops compared to some previous FHA operations. The additional time allowed limited refresher training for the deploying medical personnel which aided them in their ability to perform additional force health protection duties. However, this refresher training would likely have been much less effective, and potentially impossible, if it were not for the previous cross-training that had been conducted by the 30th Medical Brigade veterinary and preventive medicine units several years earlier. This prior training was instrumental in raising awareness, not only regarding other military medical missions and responsibilities, but also on the availability of medical resources such as the AFPMB and its disease

vector ecology profiles,[7] the Walter Reed Biosystematics Unit vector identification services and tools,[8] and the USAPHC's environmental sampling program.

THE WAY AHEAD

The One Health* mission statement asserts:

> Recognizing that human health (including mental health via the human-animal bond phenomenon), animal health, and ecosystem health are inextricably linked, One Health seeks to promote, improve, and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians, other scientific health and environmental professionals and by promoting strengths in leadership and management to achieve these goals.[10]

The One Health initiative is recognized by over 4 dozen health-related organizations, including the American Medical Association, the American Nurses Association, the American Veterinary Medical Association, and the National Environmental Health Association. The US Army is uniquely positioned to implement the One Health concept as health personnel from all 3 disciplines (animal, environment, and human) work to protect and promote health. Unfortunately, the current lack of awareness of the One Health concept and the current structural relationships of professionals across the 3 healthcare disciplines have resulted in virtual stovepipe organizations† of efforts and a failure to share information across the health systems. In normal operations, such a construct jeopardizes our ability to rapidly detect emerging health threats. In operations where limited personnel are deployed such as the 2010 Pakistan Flood Relief, this lack of awareness and "stovepiping" may result in mission failure if deployed medical personnel lack the training needed to accomplish missions which are nontraditional for their career field. Even worse, the deployed personnel may not even be aware of the other mission requirements and gaps in responsibilities.

While the recent creation of the USAPHC has brought together members from the 3 health professions into a single organization, additional efforts are still needed to increase awareness of the One Health concept at all levels of the military. Cross-training programs such as the one conducted by 30th Medical Brigade units should be encouraged, particularly between veterinary and preventive medicine units. Although complete cross-training between specialties may not be possible, particularly for functions which require special training and certification such as pasteurized milk audits and pest control application, these joint training programs are nonetheless valuable. At a minimum, these training programs will increase awareness of the roles, responsibilities, methods, and equipment of each health profession. This basic understanding can then be rapidly refreshed and expanded as part of predeployment training for FHA and other military operations. Perhaps of greatest importance, these cross-training exercises can facilitate the identification of existing gaps and serve as a platform for developing future collaborations in force health protection.

The AMEDD Basic Officers Leaders Course (BOLC) is another potential opportunity to promote the One Health concept. Students from all 3 health professions receive combined training as part of the "All-Corps" portion of BOLC. However, while the 3 professions train together, little discussion is provided as to how the actions of one health profession impact the other two. Formal introduction of the One Health concept during the All-Corps portion of BOLC would not only increase awareness, but also increase information sharing and coordination of efforts during the officers' future assignments. It would also improve their knowledge of the numerous resources in other health fields, both human and electronic, which can be readily consulted during military deployments.

CONCLUSION

Many of the functions performed by AMEDD personnel require highly specialized training. However, this specialization, while necessary, may lead to stovepiping of efforts in which many AMEDD personnel may not be aware of the other efforts that exist, let alone how they are accomplished, particularly if these efforts are in different health professions. This may result in ignorance of mission gaps and an inability to deal with them during FHA operations where limited medical personnel are deployed. Promotion of the One Health concept through instruction and training will help to increase awareness of these efforts, facilitate the identification of critical gaps during deployments, and provide personnel with the knowledge and skills needed to address them.

*The One Health Concept, first articulated by early scientists such as Rudolph Virchow, recognizes the intimate relationship between human health, animal health and the environment, and calls for an integrative, collaborative approach to health by encouraging collaboration between experts of diverse fields of study.[9]

†A stovepipe organization is defined as a structural model in which the management and workers have narrowly and rigidly defined responsibilities. Projects involving such organizations are characterized by lack of integration and interoperability, and duplication of efforts.[11]

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US Veterinary Support to Standardization of Food and Water Safety and Animal Care and Use Within NATO

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The North Atlantic Treaty Organization (NATO) Standardization Agency was established in 1951 as the Military Standardization Agency upon the recognition that NATO military effectiveness and efficiency could be greatly enhanced through increased standardization and interoperability of the Allied forces (specific NATO definitions of terms are provided in the inset below).[1] Through improved standardization, NATO militaries and partner forces can optimize their available resources by leveraging and utilizing the capabilities of other alliance militaries with the stated assurance that common policies, procedures, and equipment will be used. A key component of this assurance is the development and ratification of standardization agreements within which NATO member nations agree to implement a common standard, either in whole or in part. Within NATO, the Committee of the Chiefs of Military Medical Services (COMEDS) has the authority to develop and maintain medically-related standardization agreements. It is assisted by the Military Committee Medical Standardization Board which coordinates the efforts of multiple working groups and expert panels dealing with military medical structures, operations and procedures, military medical healthcare, force health protection, medical standardization, and medical issues related to chemical, biological, radiological, and nuclear threats (displayed in the Figure). One of these expert panels is the Food and Water Safety and Veterinary Support Expert Panel (FWSVS), which is charged with "initiating and developing common principles, policies, doctrines, concepts, procedures, programs and techniques for advice to COMEDS and for standardization and coordination in order to enhance interoperability within food and water safety, environmental health, and for veterinary medicine aspects, in the operational environment."[2] The FWSVS, which reports to the Force Health Protection Working Group, is comprised of military veterinary officers (or their designated representatives) from the NATO member nations, as well as representatives from NATO Partnership for Peace countries.

The FWSVS has primary responsibility for 8 standardization agreements as shown in the Table. In compliance with NATO Standardization Agency requirements, all standardization agreements and the associated Allied Medical Publications are reviewed every 3 years to ensure the principles, policies, procedures, and techniques included in the agreements are consistent with current medical standards and technologies and in compliance with the doctrine and capabilities of NATO military partners. In addition to these 8 primary standardization agreements, the FWSVS also provides expert consultation on veterinary and food and water safety related issues in several additional standardization agreements which are the responsibility of other working groups and expert panels within COMEDS and the greater NATO Standardization Agency community, such as the recently formed expert panel for the use of military working dogs (MWD) in counter-improvised explosive device (C-IED) operations.

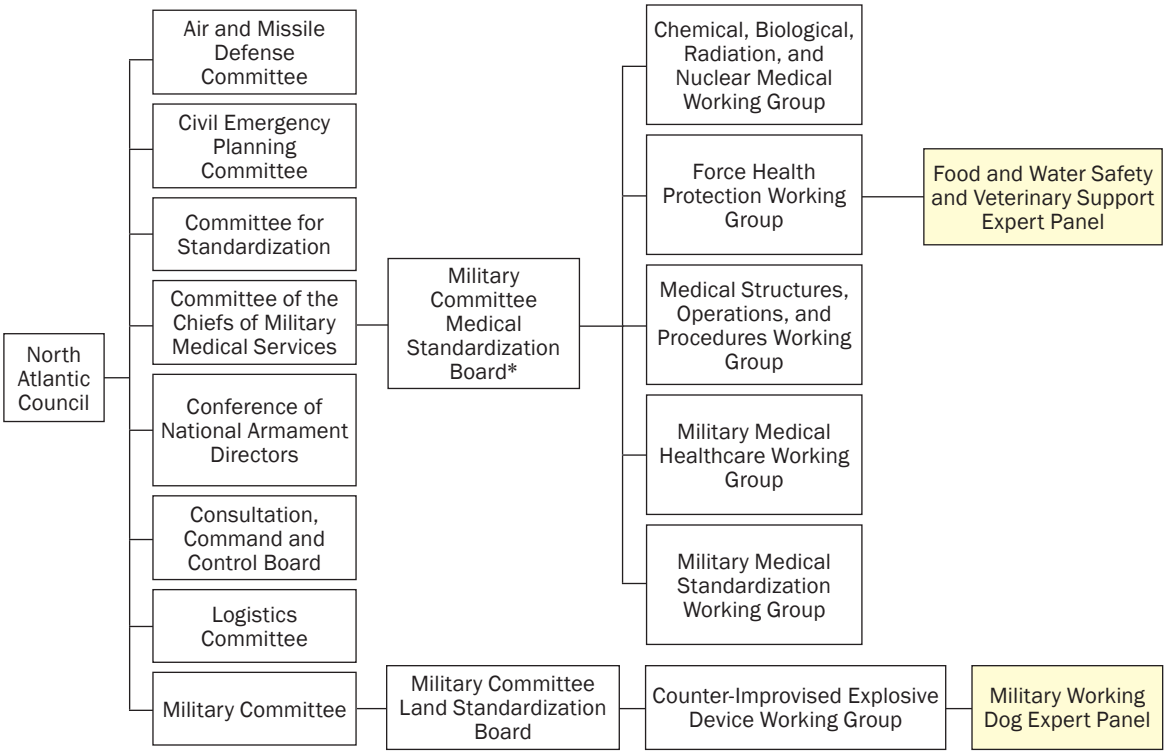
Definitions of NATO Standardization Agency Terms

Interoperability: The ability to act together coherently, effectively and efficiently to achieve Allied tactical, operational and strategic objectives.

Standardization: The development and implementation of concepts, doctrines, procedures and designs in order to achieve and maintain the compatibility, interchangeability or commonality which are necessary to attain the required level of interoperability, or to optimize the use of resources, in the fields of operations, materiel and administration.

Standardization Agreement: A standardization agreement is a normative document recording an agreement among several or all NATO member nations, which has been ratified at the authorized national level, to implement a standard, in whole or in part, with or without reservation.

Source: *NATO Standardization Organization*[1]



The positions of the Food and Water Safety and Veterinary Support Panel and the Military Working Dog Expert Panel within the NATO hierarchy.

*Officially, the Military Committee Medical Standardization Board also reports directly to the Military Committee, as the Committee of the Chiefs of Military Medical Service is not a primary NATO tasking authority organization.

Current NATO Standardization Agreements of Responsibility for the Food and Water Safety and Veterinary Support Expert Panel. Source: NATO Standardization Document Database (http://nsa.nato.int/nsa/nsdd/ListPromulg.html).

Standardization Agreement	Title and Associated Allied Medical Publication (AMedP)	Custodian Nation
2136	Minimum Standards of Water Potability During Field Operations and in Emergency Situations (AMedP-18)	Netherlands
2534[a]	Welfare, Care and Veterinary Support for Deployed Military Working Animals	United States
2538	Animal Care and Welfare and Veterinary Support During All Phases of Military Deployments (AMedP-19)	France
2541	Audit Principles and Risk Assessment of Food Processors and Distributors Associated With Military Deployments (AMedP-20)	Belgium
2550	Minimum Standards of Food Safety and Hygiene on Operations (AMedP-XZ)	United Kingdom
2556[b]	Food Safety in the Provision of Food and Catering Services Support to Deployed Operations (AMedP-25)	Canada
2557	Preventing the Transfer of Animal Or Plant Diseases and Pests to Nonindigenous Areas (AMedP-26)	Greece
2937	Survival, Emergency, Individual Combat and Group Rations Nutritional Values and Packaging (AMedP-60)	Germany

[a]Standardization Agreement 2534 is merging with AMedP-19 into a single consolidated document.[3]
[b]Standardization Agreement 2556 will cover AMedP-20, AMedP-25, and AMedP-XZ in the future.[3]

ANIMAL MEDICINE AND USE

The past 18 months have been a time of significant change for agreements covering military animal medical care and welfare. Military animals are critical assets and injured working animals are expected to receive a high level of care during military service. National systems of military veterinary medical support are well-established, but recent reviews by the FWSVS led to the merging of Standardization Agreements 2534 and 2538 and a major rewrite of *Allied Medical Publication 19: Animal Care and Welfare and Veterinary Support During All Phases of Military Deployments*.[4] The new document retains a phased approach and updates some health certificate and medical data, but the posture of the comments has changed from implicit instructions for veterinarians to improved education and guidance for commanders and staff. New definitions for veterinary roles of care were also added in order to maximize communication of veterinary medical capabilities and foster greater interoperability of medical assets on deployment.

In support of the NATO C-IED Action Plan, the Allied Command Transformation C-IED Integrated Product Team leader from the Unites States organized 2 NATO C-IED MWD workshops which were conducted at the Defense Animal Centre (Melton Mowbray, United Kingdom) in May 2011 and the Defense MWD School (Madrid, Spain) in January 2012. Both workshops focused on 6 priority areas designed to optimize use of MWDs to support defeating the device, countering threat networks, and harmonizing MWD activities as a C-IED enabler in NATO C-IED strategy. The participating nations and C-IED organizations came to consensus on terms of reference for the expert panel which were approved by the Military Committee Land Standardization Board, C-IED Working Group, officially creating an expert panel in May 2012 (shown in the Figure). The inaugural meeting for the new NATO Expert Panel on MWDs for C-IED was hosted by Italy at the Military Veterinary Centre in Grosseto, Italy, in June 2012. The Expert Panel chairman from the United Kingdom led 43 participants in work on developing NATO MWD certification standards, measures of performance and effectiveness, and capability matrix and terminology. Although interoperability of MWD capabilities must consider the personnel and organizational differences across a wide group of NATO stakeholders, outstanding advance work conducted by the Nordic Defense Cooperation MWD Working Group led to agreement on a matrix defining 5 primary MWD C-IED capabilities within NATO. Other international products that improve command and staff awareness and understanding regarding the operational use of MWDs are under review, which may result in quick advancement of NATO objectives. Additional interests include improved common operational pictures for in-theater MWD capabilities and veterinary medical support locations; use of MWD advisory teams and program managers in mission planning and deployments; and combining mutually independent methods of detecting items of interest with MWD capabilities to find personnel and materials to exploit and strengthen the intelligence cycle. Future standardization agreement and concept of employment considerations regarding operational interoperability, synergy, and unified efforts of all NATO and partner countries are ongoing.

DRINKING WATER QUALITY ASSURANCE

Drinking water must be readily available and consumed in adequate quantities to prevent dehydration. It must be potable or otherwise it may have adverse health effects on the consumers. It must also be palatable so personnel will be willing to drink it in adequate quantities. Standardization Agreement 2136 implements *Allied Medical Publication 18: Minimum Standards of Water Potability during Field Operations and in Emergency Situations* (*AMedP-18*),[4] and provides procedures and water quality standards for field water that is shared among nations during NATO operations. The documents have undergone many improvements over more than a decade, as nations have worked together to ensure the Warriors of each nation receive water that is safe and acceptable for drinking. The aims or purposes of Standardization Agreement 2136 and *AMedP-18* include standardizing the approach for ensuring the quality of drinking water provided to the troops during field operations; establishing the minimum requirements for potable drinking water provided to troops in a theatre of operations during emergency situations; and establishing the minimum water quality testing capabilities required in the field.

All nations do not have the same water treatment and testing capabilities, and may not be able to meet all of the standards in *AMedP-18*. A caveat has been included in the document to ensure all participating nations have the ability to share drinking water with other nations. A nation that produces water which does not comply with all the requirements of the Allied Medical Publication (AMedP) must maintain a document detailing what procedures or parameters of the AMedP are not met, and provide a copy to the nation or nations who would receive the water. The receiving nations can then decide to accept the water as is, accept it and provide additional treatment and monitoring, or decline to use that nation's water.

AMedP-18 provides agreed-upon definitions of all salient water supply terms and phrases used in the publication (from "approved sources" to "water treatment"), to

ensure that all nations that use the document interpret it the same way. It describes the desirable qualities of raw water sources, and methods to assess the quality and determine the type of treatment necessary to obtain levels required for emergency, short-term, or long-term use. All participating nations agree to the following:

- The provision of safe drinking water in the field is an operational necessity.
- All health-related risks will be assessed in setting criteria for the quality of drinking water during operations.
- The minimum criteria for the quality of drinking water based on performance-related risks will only be applied in emergency situations.
- To follow the procedures of risk management described within the document.

AMedP-18 contains a list of emergency water quality standards with maximum allowable concentration levels (MCLs) and indicators. Water that contains contaminants at the indicated levels is only to be used for drinking water for 7 days or less. If either the MCLs or the usage period is exceeded, the capabilities of some Soldiers to complete their missions could be compromised by performance degradation. These standards were developed in the 1980s through a comprehensive study[5] by Lawrence Livermore National Laboratories, and are still applicable today.

The operational and long-term standards in the current *AMedP-18* (edition 5) were selected in the early 2000s by the executive committee members and included MCLs from the European Union Standards, the US Triservice Field Water Standards, and the former US Army Center for Health Promotion and Preventive Medicine. In order to simplify the defense of the long-term standards to all participating nations, the draft of edition 6 of *AMedP-18* proposes to replace the current standards with primarily standards copied from the World Health Organization's *Guidelines for Drinking-water Quality*,[6] with some additional aesthetic standards from the current Army *Technical Bulletin MED 577.*[7]

AMedP-18 gives guidance for storage and handling procedures for both commercially bottled and packaged field water that will protect them from the weather, sunlight, and potential adversaries, while maximizing their shelf life. Commercially bottled and packaged field water are generally considered food products and are handled, stored, and inspected by Quartermaster personnel, augmented by veterinary and preventive medicine personnel in a manner similar to other purchased packaged food products. This guidance differs somewhat from the very robust surveillance system the US Army has for its surveillance program, but is considered adequate, and the next edition of *Technical Bulletin MED 577* will be more in line with the standardization agreement procedures.

AMedP-18 also addresses the situation in which a nation's bulk water may be taken from a local municipal water supply or produced by a commercial contractor. It requires that water produced by either source must meet all the criteria described for military-produced water, and that the chemicals, materials, and ultraviolet disinfection systems (if used) be tested and certified to meet the applicable NSF International® (Ann Arbor, MI) standards. The water purveyors must also provide documentation that they meet these requirements together with water quality test results to all nations that use the water.

FOOD AND WATER SAFETY

Much of the early work of the FWSVS focused on operational rations, ensuring that rations were prepared and stored in a manner to maximize safety and usability by NATO forces. This effort continues today, with the most recent draft of Standardization Agreement 2937 and *AMedP-60: Survival, Emergency and Individual Combat Rations–Nutritional Values and Packaging*,[4] to ensure nutritional equivalency so combat rations may be shared with other NATO countries.

When combat operations continue beyond the initial entry phase, most nations quickly transition from combat rations to catered meals prepared in dining facilities. These catering operations have evolved over the past decade from primarily individual national catering operations to multinational NATO catering operations. The NATO Support Agency (NSPA) provides logistic support to NATO operations, much like the Defense Logistics Agency does for US forces. In Afghanistan, NSPA is the contracting agency that provides most of the meals for US and allied forces. This has created a demand for a standardization agreement covering all aspects of catering operations from the facility infrastructure to food storage, processing, and service. The current Standardization Agreement 2541 and *AMedP-20: Audit Principles and Risk Assessment of Food Processors and Distributors Associated With Military Deployments*,[4] incorporates many of the requirements within the US *Military Standard 3006*,[8] and standardizes the auditing of commercial food and water facilities by NATO forces.

A revised draft of Standardization Agreement 2541, which should be promulgated for ratification this year [2012], covers all aspects of the food chain from the audit of the food processing establishment to the inspection of

the catering operation on the battlefield. The new Standardization Agreement 2556 will replace Standardization Agreements 2541 and 2550, and will cover *AMedP-25: Food Safety, Defense, and Production Standards in Deployed Operations*,[4] and another AMedP which has not yet received a numerical designator, "Inspection of Food Services Catering Facilities on Deployed Operations," in addition to *AMedP-20*. These new documents will standardize the requirements for operation of military and commercial dining facilities during NATO operations, and also provide guidance for inspection of these facilities. Ratification of these new documents will help close an existing critical gap in food and water safety during NATO military operations, resulting in improved force health protection.

PREVENTION OF DISEASE TRANSMISSION

Standardization Agreement 2557 implementing *AMedP-26: Veterinary Guidelines on Major Transmissible Animal Diseases and Preventing Their Transfer Summary*,[4] the newest standardization agreement produced by the FWSVS, was ratified and implemented in February 2011. A driving force behind its development is the realization that NATO forces may be exposed to zoonotic and transboundary animal diseases during combat, foreign humanitarian assistance, or other military operations. These diseases may have significant negative effects on military readiness and force health protection in situations involving highly pathogenic avian influenza, rift valley fever, and other zoonoses. Further, some transboundary animal diseases could have significant economic effects if they are inadvertently transported and introduced into a NATO country's domestic animal population during redeployment of personnel and equipment.

In order to address the health threat posed by these animal diseases, *AMedP-26* provides NATO personnel with a list of important animal diseases, as determined by the World Organization for Animal Health, as well as the risk factors associated with their transmission and recommendations for controlling or preventing transmission through disinfection of personnel and equipment. Included with these recommendations and guidance are document templates to rapidly develop notices which can be disseminated to military personnel, caterers, or transportation personnel to inform them of imminent health threats and reduce the likelihood of inadvertent disease transmission.

Although Standardization Agreement 2557, implemented in 2011, is less than 3 years old, the FWSVS panel is already working on revisions to improve future versions. One proposed improvement is additional guidance for preventing transmission to or by military personnel through avoidance and the use of personal protective measures such as gloves or disposable outer garments. Another important change is the reporting of confirmed or suspected diseases not only to NATO preventive medicine staff officers, but also the host nation's chief veterinary authority. This latter report is especially important as each nation's chief veterinary authority is responsible for reporting new occurrences of domestic transboundary animal diseases to the World Organization for Animal Health so that neighboring countries and trading partners can be informed in a timely manner and take necessary precautions to prevent the introduction of the disease into their own countries. The revised version of Standardization Agreement 2557 and *AMedP-26* should be available for review in 2013, with ratification potentially in 2014.

SUMMARY

NATO requires all standardization agreements and Allied Medical Publications to be reviewed at least once every 3 years to ensure they reflect current technologies and national military policies and procedures. This is particularly applicable with regard to veterinary medicine and food and water safety where advances in scientific knowledge and practices may result in documents quickly becoming obsolete. Such is the case with the 8 standardization agreements for which the FWSVS has responsibility; all are currently undergoing major revisions. With each revision, national representatives, including US veterinary and preventive medicine personnel, must review the documents to ensure there are no significant issues which would prevent ratification and implementation. This improves standardization and enhances interoperability between NATO partners to minimize duplication. This is accomplished by leveraging other national military capabilities, while maintaining confidence that the food, water, and veterinary support provided to their Warriors, support personnel, and animals in the field is safe and high in quality. Adherence to such standards is a major factor in maintaining the operational readiness of all alliance armed forces.

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The North Atlantic Treaty Organization

The United States Army Veterinary Corps

Hydration Status of New and Experienced Officers Prior to the Army Physical Fitness Testing

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INTRODUCTION

Background

- There is a high prevalence of athletes starting practice or competition in a mildly hypohydrated state.[1]
- Dehydration reduces skin blood flow and sweating responses during exercise increasing core temperature and cardiovascular strain.[2]
- Dehydration is a primary factor in the onset of heat related injuries.
- Individuals exercising and living in hot environments who are accustomed to cooler climates and are not fully acclimatized frequently fail to consume adequate fluids.[3]
- In 2010, there were 2,887 documented incidences of heat stroke and/or heat injury in active service members.[4]
- Service members in health care related fields were not immune to heat stroke and illness with 170 documented cases reported in 2010.[4]

Purpose

The purpose of this study was to investigate hydration status of newly and experienced officers prior to the Army Physical Fitness Test (APFT), and to evaluate the relationship between hydration status and several descriptive variables. The hypothesis was that Soldiers relocating from a temperate/cool environment are more likely to be hypohydrated than those acclimated to a hot environment.

STUDY DESIGN AND SUBJECTS

Study Design

Cross sectional descriptive study assessing hydration status. Participants (n=196) were recruited in July 2012 from the Basic Officer Leadership Course (BOLC) and Captains' Career Course (CCC) after a ten minute briefing on the importance of optimal hydration and study design. Urine samples and completed surveys were collected the morning of the APFT.

The study met qualifications for exempt research and exempt status was granted by the AMEDDC&S HPA (32 CFR 219.191(b)).

Inclusion Criteria

- Minimum age of 18 years
- Active duty Army officers attending BOLC or CCC during July 2012

Exclusion Criteria

- Officers not completing all regular fitness testing events (push-ups, sit-ups, and two mile run)
- Pregnancy

ACKNOWLEDGEMENTS

Special thanks to the US Military Baylor University Graduate Program in Nutrition Class of 2013 for the endless hours they spent developing briefings, recruiting subjects, and analyzing the urine samples.

Funding for this study was provided by Baylor University.

METHODS

Measures

Anthropometric: Height, Weight, Body Mass Index (BMI)

Clinical: Urine Specific Gravity via refractometer, Hydration Status determined using the National Athletic Trainer's Association Hydration Status Clasification[5]

Demographics: Age, Gender, Rank, Time at Ft. Sam Houston (FSH), Commissioning Source, Prior Climate (hot defined as average temperature in June and July $\geq 86^{\circ}$ F)

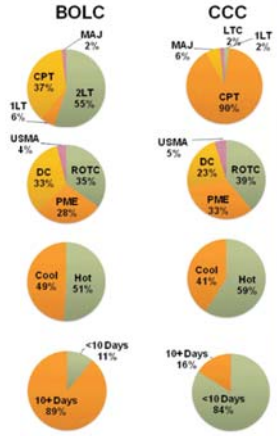
Statistics

- SPSS 18.0 (SPSS Inc., Chicago, IL)
- T-Test: differences between BOLC and CCC demographics
- Kendall's tau: hydration status and APFT day of the week, hydration status and gender, hydration status and prior climate
- $P<0.05$

Demographics

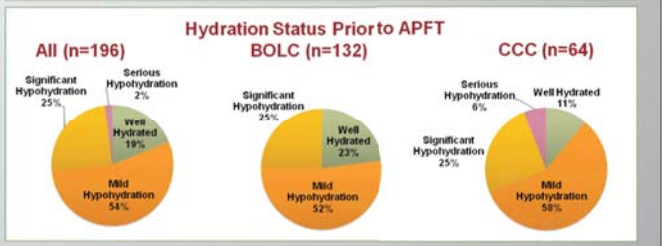
	All (n=196)	BOLC (n=132)	CCC (n=64)
Age (years)*	30.3 ± 6.1	28.3 ± 5.0	34.3 ± 6.2
Weight (kg)*	74.2 ± 13.3	72.6 ± 12.3	76.9 ± 14.8
Height (cm)	171.5 ± 8.5	171.0 ± 8.1	172.4 ± 9.2
BMI (kg/m²)	25.1 ± 3.2	24.8 ± 3.0	25.6 ± 3.2

*p<0.05



RESULTS

- Majority of Soldiers (81%) met the criteria for mild, significant, or serious hypohydration prior to the APFT.
- Soldiers testing on Monday were more likely to be hypohydated than those testing on Tuesday ($p=0.009$, $r=0.167$).
- BOLC males were more likely to be hypohydrated than BOLC females ($p=0.034$, $r=0.176$).
- CCC Students relocating from a cool climate were more likely to be hypohydrated than those from hot climates ($p=0.017$, $r=0.293$).
- No relationship was found between hydration status and rank or commissioning source.



DISCUSSION & CONCLUSION

- The majority of CCC students were in the FSH area less than ten days, an inadequate amount of time for students relocating from cool climates to acclimatize, while the majority of BOLC students were in the FSH area longer than ten days providing adequate time for students from cool climates to acclimatize.
- Waiting ten days to administer the APFT after Soldiers report to Ft. Sam Houston will give those relocating from a cooler climates time to acclimatize and should reduce the number of Soldiers starting the event in a hypohydrated state.
- Holding APFTs on Tuesday mornings rather than Monday mornings may result in fewer Soldiers testing in a hypohydrated state.

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