Disaster Medicine

Injuries and illnesses among urban search-and-rescue dogs deployed to Haiti following the January 12, 2010, earthquake

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Objective—To establish types and rates of injuries and illnesses among urban search-and-rescue (USAR) dogs deployed to Haiti following the January 12, 2010, earthquake.

Design—Cross-sectional survey.

Animals—23 Federal Emergency Management Agency (FEMA) USAR dogs deployed to Haiti.

Procedures—An online survey was distributed to the handlers of all FEMA USAR dogs deployed to Haiti in response to the January 12, 2010, earthquake.

Results—Of 33 handlers with 37 dogs that deployed, 19 (58%) handlers completed the survey, providing information on 23 (62%) dogs. Injuries and illnesses were reported in 10 of the 23 (43%) dogs, 8 of which had multiple issues. Dogs worked a total of 250 days and 1,785 hours. Dehydration and wounding were the most common disorders, with incidences of 3.9 and 3.4 events/1,000 h worked, respectively. Other disorders included ocular discharge and appetite decrease (incidence of each, 1.1 events/1,000 h worked) and weight loss, urination changes, skin infection, ear infection, oral abscess, and non-specific illness (incidence of each, 0.56 events/1,000 h worked). Overall, there were 12.6 events/1,000 h worked. All health issues were minor and resolved during the deployment or within 2 weeks after demobilization.

Conclusions and Clinical Relevance—Results suggested that many of the USAR dogs deployed to Haiti developed acute injuries and illnesses. However, despite the high heat index, long hours worked, and dusty conditions, most injuries and illnesses were minor and all had resolved within 14 days. When logistic supplies for USAR teams are limited, minimal basic medical needs to treat common injuries should be a priority. (*J Am Vet Med Assoc* 2012;240:396–403)

The potential for injuries and illnesses is an important concern when personnel are deployed from the United States to respond to disasters in foreign countries, particularly because of the unique challenges that exist with respect to environmental and endemic hazards. Dogs play important roles in search-and-rescue operations, and prompt treatment of injuries and illnesses is paramount in maintaining their ability to perform those roles, such as locating disaster victims buried in rubble.

Knowledge about the most common types of injuries and illnesses experienced by USAR dogs would be helpful in predeployment planning. To date, the only disasters for which injury and illness data for FEMA USAR dogs have been published are the Oklahoma City bombing of April 19, 1995, and the WTC disaster of September 11, 2001.[1–6] To our knowledge, there are no published reports of FEMA USAR task force deployments to areas outside the United States.

Abbreviations

FEMA	Federal Emergency Management Agency
USAR	Urban search-and-rescue
WTC	World Trade Center

On Tuesday, January 12, 2010, at 04:53 PM local time, a 7.0 magnitude earthquake struck 25 km (15 miles) west-southwest of Port-au-Prince, the capital of Haiti.[7] Within 96 hours, 6 FEMA USAR task forces, including 37 dogs, deployed from 4 states (California, Florida, New York, and Virginia) to Haiti. The purpose of the study reported here was to identify injuries and illnesses among the dogs that deployed to Haiti following this earthquake. Results are expected to help guide future predeployment medical training, assist in the

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prioritization of logistic support with respect to medical supplies and equipment, and highlight measures that may prevent or decrease injuries and illnesses during future deployments.

Materials and Methods

Study design—An online survey[a] was distributed to handlers of all 37 FEMA USAR dogs that deployed to Haiti in response to the January 12, 2010, earthquake. Access to the survey was opened on August 19, 2010, and closed on January 19, 2011 (ie, 7 to 12 months after deployment). Questions related to the dogs addressed signalment, deployment logistics (eg, work history and duration of deployment), preventative measures taken, medical examinations performed, illnesses and injuries that occurred, treatments, decontamination procedures, and postdeployment follow-up examinations and tests. Questions related to the handlers addressed education received regarding endemic hazards and involvement in medical examinations of their dogs. Handlers were also requested to provide results of predeployment medical examinations and diagnostic testing for their dogs for comparison with results obtained after deployment.

Weather history—The ranges of average daily temperature and relative humidity for the 14 days prior to the most common arrival date in Haiti (ie, January 1 through 14, 2010) for the cities from which the deployed dogs originated were acquired from online published weather history data.[b] Mean values were calculated from these daily averages. Similarly, average daily temperature and humidity ranges for Haiti for the maximum 14 days of deployment (January 15 through 28, 2010) were acquired,[b] and mean values were calculated from these data.

Results

Survey respondents—Of 33 handlers with 37 dogs that deployed with the 6 FEMA USAR task forces to Haiti, 19 (58%) handlers responded with information on 23 (62%) dogs. Four handlers deployed with 2 dogs each. Breeds represented included Labrador Retriever (10 [43%]), German Shepherd Dog (6 [26%]), Belgian Malinois (3 [13%]), Golden Retriever (2 [9%]), and Australian Shepherd (1 [4%]); 1 (4%) dog was a German Shepherd Dog–Belgian Malinois mix. Ages ranged from 2.3 to 10.2 years. Three dogs were 2 to < 4 years old, 8 were 4 to < 6 years old, 10 were 6 to < 8 years old, 1 was 8 to < 10 years old, and 1 was 10 to < 12 years old. Fifteen of the 23 (65%) dogs were neutered males, 5 (22%) were spayed females, and 3 (13%) were sexually intact males. Body weight ranged from 23 to 38 kg (50.6 to 83.6 lb); most (18 [78%]) dogs weighed between 27 and 34 kg (59.4 and 74.8 lb).

Deployment information—The 23 dogs for which responses were obtained arrived in Haiti between January 13 and 16, 2010, and departed between January 22 and 27, 2010. Total time spent in Haiti, not inclusive of travel to and from the country, ranged from 7 to 14 days: 1 dog spent 7 days, 2 dogs spent 8 days, 1 dog spent 9 days, 3 dogs spent 10 days, 7 dogs spent 11 days, 3 dogs spent 12 days, 4 dogs spent 13 days, and 2 dogs spent 14 days. Base of operations was either at Toussaint Louverture International Airport (4 dogs) or the United States Embassy (19 dogs).

Work history—Dogs worked day and night shifts intermittently for a total of 250 days (day-shift days, 178; night-shift days, 72). Total time worked was 1,785 hours (day-shift hours, 1,342; night-shift hours, 443).

Number of day shifts worked ranged from 0 to 14; 1 dog worked no day shifts, 1 worked 1 day shift, 2 worked 5 day shifts, 4 worked 6 day shifts, 1 worked 7 day shifts, 7 worked 8 day shifts, 1 worked 9 day shifts, 3 worked 10 day shifts, 1 worked 13 day shifts, and 2 worked 14 day shifts. Most dogs (18/22 [82%]) worked 5 to 10 day shifts. Hours worked per day shift, including travel to, between, and from work sites, ranged from 2 to > 12 hours. Most dogs that worked day shifts (16/22 [73%]) worked 7 to > 12 h/day shift. Total travel times to, between, and from work sites ranged from 30 minutes to 6 hours. Multiple searches of various durations were performed during any given shift. Search times ranged from 20 minutes to 1 hour.

Number of night shifts worked ranged from 0 to 11; 6 dogs worked no night shifts, 2 worked 1 night shift, 5 worked 2 night shifts, 3 worked 3 night shifts, 1 worked 4 night shifts, 2 worked 6 night shifts, 2 worked 7 night shifts, 1 worked 10 night shifts, and 1 worked 11 night shifts. Most dogs (11/17 [65%]) worked 1 to 4 night shifts. Hours worked per night shift, including travel to, between, and from work sites, ranged from 1 to > 12 hours. Most dogs that worked night shifts (11/17 [65%]) worked 4 to 12 h/night shift. Total travel times to, between, and from sites ranged from 30 minutes to 4 hours. Multiple searches of various durations were performed during any given shift. Search times ranged from 20 minutes to 1 hour.

Preventative measures—All dogs were up-to-date on their heartworm preventative program at the time of deployment. Six received an additional dose of heartworm preventative while deployed; 2 dogs received an additional dose on day 1 of deployment, 1 received an additional dose on day 5, 2 received an additional dose on day 6, and 1 received an additional dose on day 12. All dogs were treated with a flea-and-tick preventative at the time of deployment. Thirteen of the 23 (57%) dogs were given an additional flea-and-tick preventative while deployed, including 3 dogs each on days 1, 2, and 7 of deployment; 1 dog each on days 4 and 6; and 2 dogs on day 5. One dog that had a flea-and-tick preventative applied on day 1 received an additional dose on day 10.

Medical examinations—A predeployment medical examination was performed on 15 of the 23 (65%) dogs; 9 of these examinations were performed by a veterinarian who was a member of the task force, 3 were performed by the handler, 2 were performed by a medical doctor who was a member of the task force, and 1 was performed by a primary care veterinarian not associated with the task force.

In Haiti, a preshift examination was performed on 12 of the 23 (52%) dogs; 8 dogs underwent an examination before every shift, 3 underwent an examination most of the time (ie, more than half the time), and 1 underwent an examination some of the time (ie, less than half the time). For 10 dogs, preshift examinations

were performed by the handler; for 1, preshift examinations were performed by a medical doctor assigned to the task force; and for 1, preshift examinations were performed by a paramedic assigned to the task force.

In Haiti, a postshift examination was performed on 16 of the 23 (70%) dogs; 13 dogs underwent an examination after every shift, 1 underwent an examination most of the time (ie, more than half the time), and 2 underwent an examination some of the time (ie, less than half the time). For 15 dogs, postshift examinations were performed by the handler, and for 1, postshift examinations were performed by a medical doctor assigned to the task force.

A demobilization examination was performed on 14 of the 23 (61%) dogs. For 6 dogs, the demobilization examination was performed by a veterinarian assigned to the task force; for 2, the demobilization examination was performed by a primary care veterinarian after the handler returned to the United States; for 1, the demobilization examination was performed by a veterinary technician; and for 5, the demobilization examination was performed by the handler.

Additional medical examinations were performed on 10 of the 23 (43%) dogs because of medical issues. Of these 10 dogs, 7 had examinations performed by multiple personnel, including 6 examined by the handler along with a medical doctor and a paramedic assigned to the task force and 1 examined by the handler along with a medical doctor assigned to the task force and a Public Health Service and Disaster Medical Assistance Team member veterinarian who was in Haiti to address human public health issues. In 1 dog, all additional medical examinations were performed by a medical doctor assigned to the task force, and in 2 dogs, all additional examinations were performed by the handler.

Task force medical records could not be obtained. Of the 19 handlers, 9 reported that medical records were kept on their dog, 5 reported that no medical records were kept, and 5 were unsure.

Medical issues, injuries, and treatments—Ten of the 23 (43%) dogs had medical issues, injuries, or other concerns during their deployment (**Figure 1**). Eight of the 10 dogs had multiple issues. The most common medical issues involved dehydration and wounding. A total of 8 wounds were identified. Three wounds were located on a hind limb, 1 was located on the webbing between the digits of a forepaw, 1 was located on a forelimb paw pad, 1 was located on a forelimb, 1 was located on the thorax, and 1 was located on the abdomen. Dehydration and wounds occurred at rates of 3.9 and 3.4 events/1,000 h worked (ie, search hours), respectively. Ocular discharge and decreased appetite each occurred at a rate of 1.1 events/1,000 h worked. Weight loss, urination changes, skin infection, ear infection, oral abscess, and nonspecific illness each occurred at a rate of 0.56 events/1,000 h worked. In total, there were 12.6 events/1,000 h worked. None of the dogs was reported to have developed heat exhaustion or signs of heat stress (core body temperature ≥ 40.0°C [104°F], high heart and respiratory rates, excessive panting, thick ropey saliva, and bright red mucous membranes). For the dogs with dehydration, treatment consisted of provision of water orally (n = 3), SC administration of fluids (3), and SC administration of fluids in conjunction with provision of water orally (1). Dehydration resolved in all 7 dogs.

Handler education regarding endemic hazards—Education regarding endemic canine diseases in Haiti was divided into 3 categories: waterborne diseases (ie, leptospirosis, giardiasis, infectious diarrhea, brucellosis, and schistosomiasis), animal-contact transmissible diseases (ie, rabies, mange, brucellosis, transmissible venereal tumor, and other), and insect-transmissible (ie, plague associated with fleas, babesiosis and ehrlichiosis associated with ticks, leishmaniasis associated with sandflies, and Rift Valley fever) and parasitic (ie, hookworms, screwworms, and tapeworms) diseases. Of the 19 handlers, 10 (53%) reported that they had received some or most of the information, and 4 (21%) reported they did not receive any information. The remaining 5 (26%) handlers provided inconsistent responses; therefore, results for these 5 handlers were not included.

Six handlers reported receiving endemic hazards information from a single source: 3 from their team medical officer and 1 each from their task force veterinarian back in the United States, a safety officer, and a Disaster Medical Assistance Team veterinarian. Five handlers reported receiving this information from 2 or 3 different sources, which included task force medical officers, task force hazardous materials officer, task force safety officers, task force veterinarians in the United States, task force canine coordinators, and a Disaster Medical Assistance Team veterinarian. One handler was unsure about the source of the endemic hazards information received.

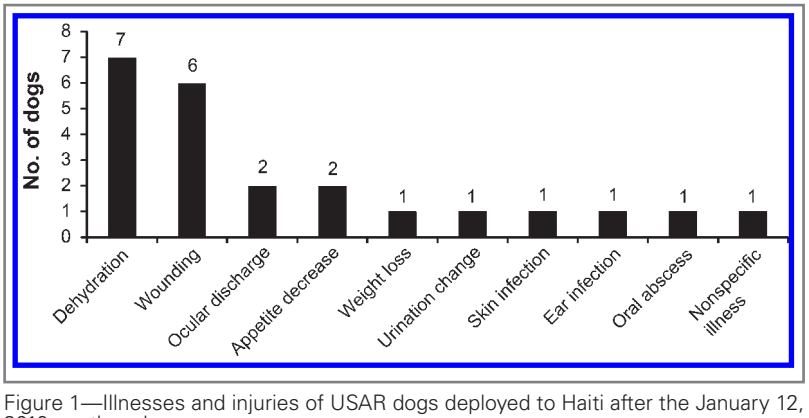

Figure 1—Illnesses and injuries of USAR dogs deployed to Haiti after the January 12, 2010, earthquake.

Decontamination—Twenty-two of the 23 dogs performed searches while deployed. The 1 dog that did not perform any searches was a human remains–detection dog; this dog was 1 of 2 dogs with which a handler deployed, and the other dog was used instead. All 22 (100%) dogs that performed searches received decontamination after a search (20 [91%]), during a search (1 [4.5%]), or both during and after a search (1 [4.5%]). Twenty-one of the 22 (95%) dogs underwent decontamination on all search days; 1 (5%) underwent decontamination on half of the search days. Soap and water were used for decontamination in 18 (82%) dogs, wa-

ter was used for decontamination in 2 (9%) dogs, and a combination of soap, water, moist wipes, and eye flush was used for decontamination in 2 (9%) dogs.

Prophylactic fluid administration—One handler reported that his dog routinely received 500 mL of isotonic fluid SC before each shift. This handler also indicated that some of the other dogs deployed with this task force received fluids SC before a shift; however, none of the other handlers from that task force responded to the survey. Another handler reported fluids were given SC in lieu of water orally when local Haitian onlookers were present and observing the task force's operations. In total, 4 handlers responded that their dogs received fluids SC. However, during follow-up discussions with handlers at subsequent FEMA meetings, it was determined that at least 4 other dogs received fluids SC for reasons other than medical issues (eg, dehydration), including hydration before every shift and, for cultural-sensitivity reasons, to avoid giving water to dogs when it might be observed by local Haitians who did not have clean, fresh water for themselves.

Postdeployment testing—Funding was approved for examinations and diagnostic testing once the dogs were demobilized, and a recommendation was made that dogs be taken to a veterinarian 7 to 10 days after deployment for a complete physical examination with particular attention to wound examination, diagnostic testing, and prophylactic deworming with praziquantel and fenbendazole. Recommended diagnostic testing included a CBC (to detect ehrlichiosis), serum biochemical analyses, a urinalysis, fecal parasite screening, and testing for leptospirosis (urine PCR assay and measurement of blood microagglutination titer). Prophylactic deworming was recommended because of the contaminated environments where the dogs worked in Haiti and the stressful working conditions. Recommended testing 30 to 40 days after demobilization included physical examination, a CBC, serum biochemical analyses, antibody testing for tick-borne diseases (including ehrlichiosis), a urinalysis if urinary tract infection or renal abnormalities had previously been detected, and fecal parasite screening if results of previous fecal testing were positive. If results of the fecal screening test were negative but prophylactic deworming had been performed, funding was not provided for follow-up fecal testing.

For 19 of the 23 (83%) dogs, testing was performed 7 to 10 days after demobilization, and for 18 of the 23 (78%) dogs, testing was performed 30 to 40 days after demobilization. Results were obtained for 8 dogs examined 7 to 10 days after demobilization and for 6 dogs examined 30 to 40 days after demobilization.

For all 8 dogs tested 7 to 10 days after demobilization, CBC and serum biochemical testing results were within reference limits. Urinalysis results were unremarkable for 5 dogs; 1 dog had trace ketones, trace protein, and 4+ ammonium-magnesium-phosphate crystals; 1 dog had 1+ protein and 4+ ammonium-magnesium-phosphate crystals in a urine sample with a specific gravity of 1.024; and 1 had 2+ bilirubin and 2+ protein in a urine sample with a specific gravity of 1.057. Results of fecal screening tests (zinc sulfate centrifugation) were negative in all 6 dogs tested. Results of a leptospirosis PCR assay were negative in all 7 dogs tested; results of a microagglutination test for leptospirosis were negative in 3 of the 8 dogs tested. Five dogs were seropositive for 2 to 5 serovars, with titers ranging from 1:100 to 1:1,600.

For all 6 dogs tested 30 to 40 days after demobilization, CBC results were within reference limits. Results of serum biochemical testing were unremarkable for 5 of the 6 dogs; 1 dog had a high BUN concentration (33 mg/dL; reference range, 7 to 27 mg/dL). A urinalysis was performed in only 1 dog, which had abnormal results 7 to 10 days after demobilization, and trace protein was found. Three dogs in which follow-up microagglutination leptospirosis testing was performed were seropositive for 1 to 5 serovars, with titers ranging from 1:100 to 1:200, consistent with postvaccination titers. Five of 5 dogs tested were seropositive for antibodies against *Borrelia* spp, with titers ranging from trace to 1:800. Four of 6 dogs tested were seronegative for antibodies against *Ehrlichia* spp; the remaining 2 dogs had titers of 1:320 and 1:640. Three of 6 dogs tested were seronegative for antibodies against *Rickettsia rickettsii* (the causative agent of Rocky Mountain spotted fever); the remaining 3 dogs had titers ranging from 1:50 to 1:64. Three of 3 dogs tested were seronegative for antibodies against *Anaplasma* spp. All titers were consistent with postvaccination titers or prior exposure, and no dogs developed any signs of tick-borne illness.

Weather conditions—Means of the average 24-hour temperatures and relative humidity in Haiti for each of the 14 days of deployment (ie, January 15 to 30, 2010) were compared with means of the average 24-hour temperatures and relative humidity for Los Angeles, New York, Miami, and Fairfax and Virginia Beach, Va, for the 14 days prior to the deployment period (ie, January 1 to 14, 2010; **Table 1**).[b] Of the 7 dogs that had evidence of dehydra-

Table 1—Range and mean of daily average temperatures and relative humidity for the 14-day deployment period for FEMA USAR dogs deployed to Haiti following the January 12, 2010, earthquake (ie, January 15 to 30, 2010) and for the 14-day period prior to deployment (ie, January 1 to 14, 2010) for the cities from which the deployed dogs originated.

	Temperature (°C)*		Humidity (%)	
	Range	Mean	Range	Mean
Haiti†	22 to 33	27	41–83	63
Fairfax and Virginia Beach, Va‡	–11 to 12	–0.5	21–100	56
Los Angeles	9 to 27	18	8–89	45
New York City	–10 to 6	–2	31–100	58
Miami	4 to 27	13	22–100	58

*Ranges are averages reported for each 24-hour period; mean was calculated from those daily averages. †Haiti data for January 15 through 30, 2010; US data for January 1 through14, 2010. ‡Fairfax and Virginia Beach results are combined.

tion, 4 originated from Virginia, 3 from Los Angeles, and 1 from New York City. None of the dogs that originated from Florida were reported to have dehydration.

Discussion

The nature of FEMA USAR team deployments ranges from concentrated-area searches where the local infrastructure outside the immediate disaster area is intact (eg, deployments following the Oklahoma City bombing and WTC disaster) to wide-area searches where the local infrastructure has been damaged or destroyed (eg, deployments following Hurricanes Katrina and Ike). Search-and-rescue teams carry sufficient supplies to be self-sustaining for at least the initial 72 hours after deployment to a disaster site. This allows them to perform search-and-rescue operations without limitations during the most crucial time for victims, with minimal impact on the local population. Supplies that team members carry are determined through a meticulous multistep review process and are limited in size, weight, and number. This includes drugs, supplies, and equipment for medical care of dogs deployed with the team. International deployments are even more challenging because supplies that can be carried may be more limited, owing to air travel. Each team deploys with at least 4 dogs but may take up to 6. The limited number of dogs and small range of dog body weights allow for streamlining of the canine medical cache while still allowing for inclusion of appropriately sized supplies (eg, endotracheal tubes and IV catheters), medication strengths, and medication quantities.

The roster for a FEMA USAR task force does not include a position for a veterinary medical officer; however, one may be assigned to the Incident Support Team, which manages a group of task force teams in a disaster area. In the absence of a veterinary medical officer, veterinary care of task force dogs becomes the responsibility of task force doctors, paramedics, and handlers. Their education in canine medical care is provided as part of the FEMA Medical Specialist Course. Information on the most common signalment of USAR dogs would allow for the curriculum to concentrate on breed, age, and sex predispositions. Labrador Retrievers (10/23 [43%]) and German Shepherd Dogs (6/23 [26%]) were the most common breeds in the present study; therefore, conditions common in those breeds (eg, laryngeal paralysis and stress colitis) should be discussed. Eighteen of the 23 (78%) dogs were between 4 and 8 years old; therefore, age-related illnesses would be unusual. Subjects ranging from emergency to nonemergency conditions should be addressed, but common injuries during deployment should be emphasized.

Search-and-rescue dogs may be required to work in shifts of up to 12 hours, in a variety of climatic conditions. Training is rigorous and demanding, taking a minimum of 18 months, but most dogs are 2 to 3 years old before qualifying to take the certifying examination.[8,9] Several factors affect a dog's work performance: age, body weight, athletic condition, health status, stress, adequate work-rest cycles, and environmental conditions. The 28 FEMA USAR teams are located across the United States[10] and train in a wide range of environmental conditions. The 6 teams that deployed to Haiti came from the northeast United States, which was experiencing winter conditions, and from the southeast and southwest United States, which were experiencing more moderate conditions. The need for acclimatization to a new environment, with respect to ambient temperature, humidity, and, potentially, elevation, affects a dog's work performance. Body temperature has been shown as the most important factor in limiting performance during searches in hot climate zones.[11] Although it takes up to 20 days to fully acclimatize to a new climate, demonstrable lower strain on the dogs may be seen within 4 days. Of 8 handlers in the present study that responded to an inquiry regarding the extent of medical examinations they performed on their dogs, only 2 reported taking temperature measurements, which were all within reference limits. Because medical records either were not kept or could not be obtained, it was unknown how many dogs had temperatures measured when being evaluated for a medical condition or for any other reason. Importantly, of the 7 dogs in the present study that had evidence of dehydration, 4 originated from Virginia, 3 originated from Los Angeles, and 1 originated from New York City. None of the dogs from Florida reportedly had evidence of dehydration. Nevertheless, none of the dogs reportedly developed heat exhaustion or heat stress–related signs.

Vulnerability to the environment is multifactorial. Factors include external conditions (heat, humidity, and wind), condition of the dog (body weight, body condition, age, and underlying illness), search conditions (duration of search and difficulty of terrain), and canine management (hydration, shade, cooling methods, and rest periods). Urban search-and-rescue dogs are trained to an athletic status and are well muscled with a high endurance ability. Handlers in the present study reported examining their dogs' breathing, alertness, skin turgor, mucous membranes, and overall body language for abnormalities. Bodies and pads were examined for wounds. Several handlers carried spray bottles to water down coats, put flavor enhancers or electrolyte solutions into water to encourage drinking, increased food provisions, placed cold towels on hairless areas of the body, and monitored rectal temperatures. The preventative care given to the dogs likely contributed to avoidance of dehydration, and prompt treatment avoided progression of illness.

One handler[c] in the present study reported that search areas were dusty from concrete and lime debris. Thick dust ingested during transport, which was often open-air or in the back of an open box truck, was a particular concern. Human task force members wore personal protective equipment such as facial masks, but protective equipment was not used by the dogs because they needed their nose and mouth for scent work and needed their bare pads to maintain traction on rubble. Human task force members used the term Haiti hack[c] for the coughing they were experiencing; however, the dogs did not seem to have similar respiratory difficulties. Interestingly, none of the USAR dogs deployed to the WTC disaster site have developed evidence of the respiratory difficulties that have developed in human workers deployed to that site.[4] The longer nasal passages and necessity for nasal breath-

ing during scent work may have more effectively filtered particulate matter and toxins in the dogs.[3]

It is highly recommended that USAR dogs regularly receive heartworm preventative and flea-and-tick–control products. Thus, it was unknown whether additional doses of flea-and-tick–control products given to dogs at the time of deployment were administered because dogs were due (eg, for dogs receiving products on a regular monthly schedule), because of an increased risk of exposure along with uncertainty regarding the preventative effectiveness, or because dogs were not receiving these products during the winter months. Another factor may be that some of these products require 48 hours to be absorbed before any water exposure. If decontamination was performed before this time period, additional protection may have been advised.

One handler in the present study reported finding a tick attached to the dog that caused skin irritation and localized infection. Various preventative products work in different ways. Also, in austere environments, small wounds that normally heal on their own may require more meticulous care. Preventative programs are the responsibility of the handler; therefore, heartworm preventative and flea-and-tick products are not part of the FEMA canine medical cache. If such products are deemed necessary during a deployment, a request may be made through the Incident Support Team to acquire them.

A predeployment medical examination was performed on 15 of the 23 (65%) dogs in the present study. A complete physical examination by a licensed veterinarian is recommended to confirm health status or to discern an abnormality that may become serious during the rigors of a deployment.

Preshift and postshift examinations were performed on 52% (12/23) and 70% (16/23) of the dogs in the present study, respectively. Postshift examinations are important to detect problems that may not be noticed during work. Preshift examinations are important to detect problems that may have developed since the previous work shift. Handlers performed most of the preshift and postshift examinations in the present study (83% [10/12] and 94% [15/16], respectively). Examination of hydration status and a thorough examination of the entire body (especially the pads) for wounds was performed by all handlers. Body temperature was not consistently monitored, even though body temperature has been shown to be the most important factor in limiting performance during searches in hot climates.[8] Although all handlers are trained to assess basic physical variables (attitude, pulse rate, respiratory rate, mucous membrane color, body temperature, hydration status, wounds, and lameness) before and after each shift, many avoided monitoring body temperature. It is not known whether this was due to a lack of proper equipment, a lack of practice, an uncooperative dog, or a lack of education.

For search dogs that have returned from an international deployment, it is recommended that the demobilization medical examination be performed by a licensed veterinarian both to examine the general health of the returning dog and to detect any evidence of foreign diseases, parasites, or insects. Animals coming from Haiti into the United States are certified healthy by the USDA APHIS. Only 14 of the 23 (61%) dogs in the present study underwent a demobilization examination, and only 8 of these examinations were performed by a licensed veterinarian. Because of the lack of availability of veterinary support, FEMA approved funding for examinations and diagnostic testing once dogs were demobilized.

Ten of the 23 (43%) dogs in the present study developed a medical issue while deployed over a 7- to 14-day period, and 8 of the 10 had multiple health issues. This is higher than the morbidity rate reported for dogs deployed in response to the Oklahoma City bombing (22%) over a 13-day period[6] but lower than rates reported by Fox et al[4] for dogs deployed to the WTC (63%) over a 6-day period and by Slensky et al[3] for dogs deployed to the 3 areas searched during the 9/11 disaster (68%): WTC over a 10-day period, Pentagon over a 12-day period, or Fresh Kills Landfill (which was used as a sorting ground for rubble from the WTC site) over a 7-day period. Overall injury rate was 12.6 events/1,000 h worked for dogs in the present study, compared with rates of 13 events/1,000 h worked[4] and 17 events/1,000 h worked[3] reported in the previous studies. Differences in prevalence and incidence of medical issues among studies are likely attributable to differences in weather conditions, rubble conditions, air quality, shift hours, work-rest cycles, preexisting problems, and medical awareness.

Dehydration was the most common health issue in the present study (7/23 [30%]) and occurred at a rate of 3.9 events/1,000 h worked. This was lower than rates reported for dogs that deployed following the 9/11 terrorist attacks.[3,4] Differences among studies may reflect differences in work-rest cycles and shift hours or may have been a result of increased awareness of hydration needs among handlers who deployed to Haiti given the environment. It was unknown whether prophylactic SC injection of fluids may have played a role in decreasing the incidence of dehydration. Conditions during the Haiti deployment period were hot and humid. Travel to and from search sites took 30 minutes to 6 hours and usually was in open-bed trucks, which created severe dust conditions. There were insufficient numbers of dogs to analyze whether dehydration was more common among dogs that deployed from cooler climates (eg, New York City) than for dogs that deployed from warmer climates (eg, Florida); however, none of the dogs that originated from Florida were reported to have dehydration.

Wounds were the second most common health issue in the present study (6/23 [26%]) and occurred at a rate of 3.4 events/1,000 h worked. This was also lower than rates reported for dogs that deployed to the WTC following the 9/11 terrorist attacks.[3,4] The nature of the rubble may have been a factor in the lower incidence of wounds in the present study. The WTC disaster debris included much more sharp metal and a larger amount of debris in a more concentrated area, whereas most search areas in Haiti consisted of concrete buildings and homes. Of the 8 wounds incurred by dogs deployed to Haiti, 6 were on the limbs but only 2 were specifically on the paws. In comparison, at the Oklahoma City bombing site, footpad injuries comprised 18 of the 20 (90%) injuries incurred by the search dogs. Again, differences in the nature of the rubble and the frequency of night searches may account for these differences. None of the FEMA

USAR dogs wore booties when performing search work. Federal Emergency Management Agency guidelines[8] for training of search-and-rescue dogs stress the need for traction on rubble piles. It is plausible that searches in areas of little to no rubble, such as homes searched in response to Hurricane Katrina, could be safely conducted by dogs wearing booties.

Ocular discharge was reported in 2 of the 23 (9%) dogs in the present study and occurred at a rate of 1.1 events/1,000 h worked. This was lower than the rate reported for dogs deployed to the WTC,[4] but ocular discharge was not a reported problem in the other study[3] of dogs deployed following the 9/11 attacks. Time spent in dusty environments as well as air quality may have been factors in the incidence of ocular discharge. During the first 3 weeks at the WTC disaster site, the air was laden with fine particulate matter that included cement, glass, fiberglass, asbestos, and lead.[4] In addition, there were toxic by-products of jet fuel combustion and fire-related dust, soot, and volatile organic compounds.[4] This may have caused far more ocular irritation than the dust and debris in Haiti. Furthermore, being more out in the open where wind carried some air debris away may have also led to less ocular irritation in the dogs deployed to Haiti.

Decreased appetite was reported in 2 of the 23 (9%) dogs in the present study and occurred at a rate of 1.1 events/1,000 h worked. This was lower than rates reported for dogs deployed to the WTC and Fresh Kills Landfill following the 9/11 attacks,[3,4] but similar to the rate reported for dogs deployed to the Pentagon site. Weight loss commonly was reported in conjunction with decreased appetite among dogs deployed to the Fresh Kills Landfill sites, but only 1 of the 23 (4%) dogs deployed to Haiti was reported to have weight loss (0.56 events/1,000 h worked). Urban search-and-rescue dogs are exposed to both environmental and behavioral stresses during deployment and need to increase their food intake to meet the needs of deployment. Some dogs may not eat enough because of stress, long work hours, and lack of rest. Although many of the work shifts in Haiti were > 12 hours long, the low incidences of decreased appetite and weight loss may have been due to the fact that because of the heat, many dogs performed multiple quick searches with rest periods rather than long searches with little rest between.

Urination changes other than those associated with dehydration were less common (1/23 [4%]; 0.56 events/1,000 h worked) among dogs in the present study than among dogs deployed to the WTC site,[3,4] but were more common among dogs in the present study than among dogs deployed to the Pentagon or Fresh Kills Landfill sites. Urinary tract infection was suspected in 1 dog in the present study, and it was unknown whether there was a subclinical preexisting condition that was manifested with the stress of deployment.

The only reported skin infection in the present study developed secondary to a tick attachment. Dermatitis was not reported in the dogs deployed to Haiti or in a study[3] of dogs deployed to the WTC, Pentagon, and Fresh Kills Landfill sites; however, there were 6.2 events/1,000 h worked among dogs in the other study[4] of the WTC site. It was surprising that, considering the hot and humid conditions and dust and debris, there were no episodes of superficial dermatitis among dogs deployed to Haiti. Part of the reason for the lack of dermatitis may be the decontamination procedures that were performed on all the dogs during and after nearly every search.

Ear infection, oral abscess, and nonspecific illness were each recorded in 1 dog in the present study. These were not reported issues in previous deployment studies.[3,4] Conditions not reported in the present study that did occur in the other WTC site studies[3,4] were fatigue, respiratory tract problems, gastrointestinal problems (diarrhea or emesis), lameness or orthopedic problems, heat exhaustion, and corneal laceration. Fatigue may have been mitigated among dogs in the present study with adequate work-rest cycles, the healthy condition of the dogs, proper food and water management, and prompt attention to and treatment of any encountered health issues. These also are factors in mitigating gastrointestinal problems and heat exhaustion. Despite the dust and debris in Haiti, no canine respiratory problems were observed. It has been suggested that the longer length and greater surface area of the nasal passages in dogs act as superior filters of air particulates.[2]

For USAR teams, daily briefings are scheduled before each shift to update team members on environmental conditions and operations. Distribution of information on endemic hazards is an important safety issue. Eleven of the 19 (58%) handlers in the present study received information on endemic hazards related to waterborne, animal-contact, and insect-transmitted diseases. Possible reasons for handlers not receiving such information included a lack of research because of time constraints associated with team mobilization, sporadic deployment communications, the wide range of team operations, and the fact that teams were divided into 2 bases of operations. Canine Search Specialist training includes canine safety considerations regarding contact with native animals, drinking from water pools, and decontamination procedures. Most, if not all, dogs receive prophylaxis (heartworm preventative, flea-and-tick products, and anthelmintic products), but endemic hazards education is still needed to decrease the chances of contracting endemic disease.

Decontamination procedures[12,13] for USAR dogs can vary in scale. Gross decontamination, both emergency and nonemergency, is an initial phase of the process during which the bulk amount of surface contamination is substantially reduced. It is designed to be done quickly, usually with large amounts of water. The additional effects of cooling down a warm dog in a hot environment are beneficial. Decontamination also promotes a second look at the dog, and injuries not apparent under the fur may become manifest visually or signs of pain (flinching) may be evident when the affected area is touched during the decontamination procedure. When water is limited, moist towelettes are an option for decontamination. Decontamination is a well-recognized part of USAR dog care, as evidenced by the fact that every dog that performed searches in Haiti underwent decontamination.

Some of the handlers in the present study indicated that they did not want to be seen by the local Haitians

giving water to their dogs, owing to the lack of potable water. Because of this, some dogs received fluids SC before their shifts to decrease their need for water. Currently, there are no published data regarding potential benefits of or contraindications for giving a working dog fluids SC in an effort to prevent or delay the onset of dehydration or other heat-related conditions. Factors to consider that argue against this practice include the unsanitary conditions, which increase the potential for infection or abscess formation; the volume needed for large-breed dogs; the fact that a normovolemic dog may not absorb the fluids quickly; and the fact that lumps associated with the SC fluids may interfere with the harnesses or safety vests worn by some working dogs. Those who argue against this practice cite that proper acclimation, enforced work-rest cycles, opportunity to orally hydrate, resting in shade or air-conditioning, maintaining healthy weight, and monitoring temperature are the best ways to maintain hydration or identify a problem early. On the other hand, infection or abscess formation should not be a problem with proper needle site preparation. In addition, even if a large volume of fluid cannot be given, administering even 500 mL may increase the amount of time a dog can work in a hot environment before becoming dehydrated. In certain situations, as occurred in Haiti, when potable water is not available, SC fluid administration may be a viable option.

Maintaining the health and well-being of human and canine team members is an important aspect of care after a deployment. Recommendations for postdeployment medical examinations and diagnostic testing were submitted by the USAR Veterinary Group and approved by the FEMA Program Office for funding. The recommendations were based on the potential hazards and endemic diseases encountered in Haiti.

Urinary tract infections are among the concerns for dogs that have been deployed to a disaster area. Three dogs in the present study had abnormal urinalysis findings during postdeployment medical examinations, but none of these dogs had any signs of urinary tract disease while in Haiti. All but one of the antibody titers for leptospirosis and tick-borne diseases were in the range expected following prior vaccination or exposure, and none of the dogs had clinical signs of these diseases. Because wounds had been treated in austere conditions with limited supplies, follow-up examinations were performed to ensure proper healing. In addition, returning dogs were examined to ensure that foreign insects were not being brought in.

Information on the nature and frequency of injuries and illnesses that occur among USAR dogs during deployments will help in maintaining the dogs' ability to effectively perform their duties and assist in the medical training of handlers, paramedics, doctors, and veterinarians by emphasizing recognition and treatment of the most common conditions. This information can also be used to streamline the medical cache when the number and amount of drugs and supplies that can be carried are limited. In addition, education regarding the recognition, treatment, and prevention of the most common conditions should be emphasized during training.

There are advantages and disadvantages inherent with any survey-based study. Many questions can be asked about a given topic, giving considerable flexibility to the analysis. Because questions are standardized, several types of errors can be avoided. Responders can answer at their leisure, taking time to consider their answers without the pressure of time-limited responses. Problems associated with surveys include the fact that they depend on subjects' motivation, honesty, memory, and ability to respond. Answers obtained 7 to 12 months after deployment in the present study may have been different from answers that would have been obtained immediately after deployment. Even with a response rate of 58% (19/33 handlers), errors due to nonresponse may have existed. In addition, varied interpretation of questions may have occurred. Despite these difficulties, the information gathered has the potential to further our understanding of the various hazards and risks USAR dogs face in performing their jobs.

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