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Canine Chemical, Biological, Radiological, and Nuclear (CBRN) Protection and Countermeasures

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A chief service of the DoD IACs is free technical inquiry (TI) research, limited to 4 research hours per inquiry. This TI response report summarizes the research findings of one such inquiry jointly conducted by HDIAC.

ABSTRACT

Military working dogs are critical force multipliers to the U.S. Department of Defense. Protecting them in a chemical, biological, radiological, and nuclear (CBRN) environment is every bit as important as it is for their human counterparts. The Homeland Defense and Security Information Analysis Center (HDIAC) researched CBRN protective equipment, medical countermeasures, and items available in the medical stockpile at the request of a military veterinarian. HDIAC sent this inquiry to its vast network of subject matter experts to help answer the questions. Additionally, HDIAC conducted a literature search specifically on the use of hydroxocobalamin for use in canines.

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1.0 TI Request

1.1 INQUIRY

In working dogs, what modifications need to be considered to the current deployable force packages (DFPs)/Defense Chemical, Biological, Radiological, and Nuclear (CBRN) Response Force (DCRF) military working dog (MWD) component?

1.2 DESCRIPTION

The inquirer is a military veterinarian who provided the following additional questions to help target her inquiry:

- Does information exist on the use of hydroxocobalamin in canines?
- Does information exist on decontamination technologies or processes for humans or canines in broken or unbroken skin?
- Does information exist on the use of stockpiled or fielded medical countermeasures (MCMs) for CBRN agents in canines?

Other supporting questions are:

- What MCMs in the emergency stockpile have been tried on canines?
- What protective gear is available to consider for MWDs?

2.0 TI Response

The Homeland Defense and Security Information Analysis Center (HDIAC) reached out to several subject matter experts (SMEs) who work with MWDs and other canines in urban search and rescue (USAR). The SME pool provided a wealth of information and resources. HDIAC searched literature for evidence of hydroxocobalamin being tested on canines.

2.1 DECONTAMINATION TECHNOLOGIES

At the crux of this request is the ability to decontaminate canines exposed to chemical, biological, and radiological (CBR) hazards. The following information was collected from discussions with SMEs regarding the decontamination of canines. There was no differentiation made by the SMEs for broken versus unbroken skin.

A veterinary medical officer provided the following guidance for decontaminating canines [1]:

Funding for working-dog decontamination research has only surfaced in the past few years. It is ongoing both for MWDs (focusing on traditional CBR warfare

agents) and search-and-rescue dogs (focusing on post-natural disaster) for unbroken skin. Presently, the U.S. Department of Defense (DoD) protocol is rinse, wash, rinse, using a nonmedicated canine shampoo, going from the top down, and paying attention to the lower half of the body (the body parts that are closest to the ground or have the potential to carry contamination, such as paws, legs, belly, between legs, and tail).

Mr. Jake Hoffman, hazardous materials specialist, Ohio Task Force 1, Federal Emergency Management Agency, USAR, provided the following input [2]:

In addition to specific products the handlers already carry, both Dawn dish soap for general decontamination (human, K9, equipment, etc.) and Johnson's baby shampoo in the cache for radiological K9 decontamination...should be used. A work platform takes up minimal space and makes it far easier to decontaminate the canines. For CBRN needs, reactive skin decontamination lotion (RSDL) wipes or a 1:10 bleach solution (for paws) may be used as indicated.

Mr. Robert Wagner, Army Maneuver Support Center of Excellence, USAR, noted, "RSDL is recommended for use on MWDs in Chapter 12 of [*Field Management of Chemical and Biological Casualties Handbook*] FMCBC Manual" [3, 4]. This manual is produced by the U.S. Army Medical Research Institute of Chemical Defense.

Recently, the U.S. Army Combat Capabilities Development Command (CCDC), Chemical Biological Center (CBC) conducted testing on decontaminating canine skin exposed to bacillus anthracis, commonly known as anthrax. This study found that using Bioxy, a powdered disinfectant, mixed with water at a 5% solution, proved highly efficacious in decontaminating canine skin from anthrax. This was proved more effective than the current rinse-wash-rinse and chlorohexidine sponge wipe-down methods [5].

The previously mentioned study, published in July 2022, demonstrates that research is ongoing into MWD decontamination and protective measures. Similar to their human counterparts, research in MWD decontamination must continue to protect canines.

2.2 STOCKPILE OF MCMS

2.2.1 Supplies in the Stockpile

The United States stockpiles MCMs and other medical supplies in the Strategic National Stockpile (SNS). The SNS can supplement MCMs needed by states, tribal nations, territories, and large metropolitan areas during public health emergencies. A veterinary medical officer provided insight on the availability of MCMs in the SNS. "For medical countermeasures, [the]

DoD has medical CBRN countermeasures for MWDs. They are listed in the Supply Bulletin, Chapter 5, Table 5-2 on page 5-3. It should be noted that this list was last updated in 2008–2009 (when the human medical countermeasures were updated)” [1, 6].

The MCMs included in the canine DFP/DCRF kit are similar to those carried for the individual human Warfighters. It includes:

- 3 antidote treatment, nerve agent autoinjectors
- 4 convulsant antidote for nerve agent (CANA) autoinjectors, human kit includes 1
- 60 doxycycline tablets, which is an antibiotic used to treat or prevent anthrax, plague, and tularemia, which all can be spread via bioterror attack [7]
- 5 atropine injections
- 1 pouch of 3 packets of RSDL

Apart from only having 1 CANA, the human kit includes the same MCMs and decontaminants. Additionally, the human kit includes:

- 42 tablets of soman nerve agent pretreatment pyridostigmine (SNAPP)
- 14 tablets of potassium iodide, used to protect the thyroid from taking in radioactive iodine [8]

Based on the lack of availability of SNAPP and potassium iodide in the canine kits, it appears that MWDs do not have a countermeasure against soman or a release of radioactive iodine. Radioactive iodine, or I-131, is a reasonably plentiful radioisotope used in the treatment of thyroid cancer. This makes it a potential target for bad actors to acquire by taking it from medical facilities, manufacturing facilities, or delivery vehicles.

2.2.2 Supplies Tested on Canines

Dr. Jessica Appler, Senior Executive Service, is the Director, Maintaining Technology Advantage, within the Office of the Under Secretary of Defense for Research and Engineering. She previously worked in multiple roles under the Department of Health and Human Services Assistant Secretary for Preparedness and Response, the office that manages SNS.

In an email [9], she explained:

Many of the older stockpiled countermeasures (e.g., [pralidoxime chloride] 2-Pam, atropine, some antibiotics) have been tested/used on and have dosing for dogs (e.g., some references on 2-PAM with a veterinary-use section in the middle may be found at <https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/pralidoxime-chloride> [10].) There may or may not be specific dosing for use as a CBRN countermeasure, but there is a body of data on safe and effective dosing and, in many cases, availability of veterinary formulations.

However, many of the newer generation of MCMs stockpiled nationally were approved using the U.S. Food and Drug Administration (FDA) animal rule, which requires data in one representative animal species for approval but has never been used for their CBRN purpose in humans or animals. While beagles are a model organism, there are very few in-development or recently approved CBRN MCMs that pursue beagles as their model organism to collect data for FDA approval (most use a rodent, pig, or primate model). Therefore, very few of the newer countermeasures have species-specific data and dosing information for canines. That does not mean that they could not be used for treating service dogs (most of the mechanisms of action are shared), but rather an astute veterinarian with experience adapting dosing across species would be needed because it would be done in the practice of medicine versus by prescription.

2.3 CBRN PROTECTIVE GEAR FOR CANINES

In short, there is nothing fielded by the DoD for protection of canines from a CBRN threat. There are some commercial-off-the-shelf (COTS) items, but they are not proven and may even harm canines. One of the major difficulties arises from the fact that canines are employed primarily for the sense of smell. Wearing protective breathing gear would eliminate their usefulness, making it not only necessary but also pragmatic to remove canines from the hazard. However, canines can also be used for the early detection of many threats. This means that they may be employed in a potential danger zone, cannot wear protective gear, and should be evacuated immediately upon the discovery of a threat.

A veterinary medical officer pointed out, “The majority of ‘protective gear’ that you have seen in pictures...has not been tested or evaluated by the MWD community, any DoD, or associated laboratory, nor had any 3rd-party independent testing to see if those products can actually do what they claim they can do [1].”

Additionally, the *Field Management of Chemical and Biological Casualties Handbook* Chapter 12 “Military Working Dogs in Contaminated Environments” states, “If a CBRN attack is likely, the only reliable method of MWD protection is removal from the area. For immediate field-expedient protection, the MWD can be covered with wet-weather gear, a tarp, or similar impervious materials, which will provide some protection while the MWD is evacuated from the area” [4]. This represents a field expedient measure, albeit one that is approved. Unfortunately, the manual also notes that “the only reliable method of MWD protection [from a CBRN attack] is removal from the area” [4]. This confirms that there is no approved method or equipment of MWD protection from CBRN threats.

From September–October 2020, the CCDC CBC conducted a study, at the request of the Combating Terrorism Technical Support Office, to “collate, report, and advise on factors that canine respiratory protection may impact, including canine health studies and operational considerations of equipment worn by canines” [11]. This report describes historical canine

masks, weight restrictions, biomarkers of physical stress in canines, saliva quantification, and operational canine equipment. This is an early step in addressing canine CBRN protection.

2.4 HYDROXOCOBALAMIN TESTS IN CANINES

A literature search on the National Library of Medicine revealed documentation that showed that hydroxocobalamin had been successfully tested in canines. Borrón, Stonerock, and Reid, treated beagles that had been exposed to potassium cyanide. In the control group, 82% of the animals (not administered hydroxocobalamin after exposure) had to be euthanized within 4 days. Of those given 75 mg/kg (milligrams of dose per kilogram of weight) of hydroxocobalamin, the mortality rate was reduced to 21%. When given 150 mg/kg, the mortality rate dropped to 0, demonstrating the efficacy of hydroxocobalamin [12].

3.0 Conclusion

Canines provide a force multiplier to the DoD in multiple mission areas. HDIAC recommends additional research specific to MWDs operating in a CBRN event. Prevention, protection, decontamination, and medical treatments must all be explored in depth to ensure the MWD population is protected from these growing threats.

COTS solutions are available and should be tested for use on the WMD population. If hydroxocobalamin is not readily available, the previously mentioned testing should be verified by the DoD and the hydroxocobalamin stockpiled specifically for canines. Procedures could be tested to verify efficacy using surrogates in place of chemical warfare agents.

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BIOGRAPHY

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