Equine Decontamination

Guidelines for Emergency, Gross, and Technical Decontamination of the Search and Rescue and Disaster Refugee Equid

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INTRODUCTION

Equids have been utilized in search and rescue, as well as military operations in both our country and in lesser developed theaters of operation. They have been used as beasts of burden for centuries in order to transport people and cargo to areas inaccessible to motorized, wheeled conveyances. As such, they are exposed to a variety of environmental contaminants ranging from benign dirt to residue from chemical, biological, radiological, nuclear, and explosive (CBRNE) substances – all of which may be life-threatening. In remote areas of military operations, horses, mules and donkeys have been used in the carrying out of unit operations in areas not amenable to mechanized operations, as in Afghanistan. They are encountered during natural disasters like floods, hurricanes, and earthquakes, as well as man-made accidents like fires, explosions, radiological accidents as is currently ongoing in Japan, and terrorist events.

These contaminants may come in several different forms, including solids, liquids, powders, and gas. Search and rescue operations involve covering large areas, some remote, as well as urban settings where collapsed materials may have aerosolized any hazards that may otherwise settle during a deployment. Working without the personal protective equipment that humans use, an equine's risk of exposure is increased. In addition, as equids are grazing animals by nature, and many hazardous materials are heavier than air and tend to pool low to the ground, the equine's risk of exposure is elevated.

Decontamination of animals is an important component of responsible emergency response management and is a recognized part of an emergency response plan. The importance is for the health and well being of the animals affected as well as the humans to whom they may transmit hazardous materials.

This paper is designed specifically as a guide to the practical, day-to-day operations of providing a means of decontaminating an equine in the variety of situations that may occur. Hazmat -related information on contamination detection, avoidance, and identification are covered elsewhere by multiple sources. Common hazards and equine medical issues are touched on briefly, with greater detail also available elsewhere.

Over the past twenty years as an emergency medicine and surgical clinician at various referral institutions, I have gained an appreciation for the particular challenges in working with and decontaminating large animal species. I wish to thank Lori E. Gordon, DVM of the Massachusetts Task Force 1 Urban Search and Rescue team, with whom I am honored to be a long-term acquaintance, for the invitation to be involved in this important project aimed at expanding decontamination protocols to include our large animal friends. It is upon her previous work outlining decontamination protocols for canine search and rescue teammates which a huge part of this treatise is built.

Respectfully submitted,

Thomas L. Wooten, DVM

I. DEFINITIONS

When discussing decontamination there are two basic levels: gross decontamination and technical decontamination. Whether one, the other, or both are used is dependent on the particular contaminant or hazardous material involved. Having a system on site with the ability to adapt to a range of needs, from benign to emergent, is important. This will allow protection and provide safety to the equines, their handlers and partners, and especially everyone else around them. Due to their size and speed when evading a perceived threat, equids are inherently dangerous to persons in the close vicinity to their decontamination area and all persons should be aware of their movements.

A. GROSS DECONTAMINATION

This is an initial phase of the decontamination (decon) process during which the bulk amount of surface contaminant is significantly reduced. It is designed to be done quickly.

Two types of gross decontamination are described: emergency and non-emergency.

- 1. <u>Emergency Gross Decontamination</u> is used to immediately reduce contamination of those with potentially life-threatening exposure, where immediate medical attention is required. The goal is to save lives.
- 2. <u>Non-Emergency Gross Decontamination</u> is bulk removal of a non-life threatening contaminant, although also designed to be done as quickly as possible.

B. TECHNICAL DECONTAMINATION

This process involves an established corridor, specific stations, and detailed guidelines designed for complete removal of contaminants, leaving no residual hazard, and addressing the medical needs of victims and responders as needed. This is a meticulous process to remove as much contaminant as possible utilizing several methods such as brushing, vacuuming, desorption, absorption, washing, chemical detoxification, chemical neutralization, and others.

Two types of technical, also known as thorough, decontamination are described: emergency, which always includes a medical component and non-emergency, which may or may not involve a medical component.

- 1. <u>Emergency/Medical Technical Decon</u>tamination refers to a Hazardous Materials (Hazmat) or CBRNE situation, where complete decontamination is a necessary component of the medical treatment in a life-threatening situation
- 2. <u>Non-emergency +/- Medical Technical Decon</u>tamination refers to a contaminant that is not immediately life threatening, but must be removed completely to avoid future complications. Regardless, a medical check is always recommended.

II. EQUINE FACTORS TO CONSIDER

Many factors regarding contamination, for equine and human, share decontamination and treatment properties. These properties make equine decontamination procedures similar, and therefore familiar to first responders. Many current decontamination stations are easily adapted for our working equine team members.

Several other factors have dissimilar aspects: search method, anatomical differences, and behavior. It is important to become familiar with the special considerations for equines in order to effectively decontaminate without doing further harm to them well as the humans involved.

A. EXPOSURE – ROUTES, ANATOMY, and BEHAVIORAL ASPECTS

- 1. Ocular the Eye
 - Situational aspects include that there is no eye protection worn by the equids during search and other operations. Their head (therefore their eyes) is often close to the ground, where contaminants may concentrate and sniffing aerosolizes particles into their eyes
 - Anatomically the equine eye is somewhat similar to the human eye and is treated for injury and irritation in like manner.
 - Options are limited except to rinse the eyes, place equine in a protected environment away from dust and debris during their downtime, and treat appropriately. Goggles designed for horses are available; familiarize before introducing them at disaster.



Horse with goggles in place. They were never used in WWI due to fogging.

2. Inhalation – Nose

- ∞ The equine, like the canine, is especially in tune with their environment. Scent, along with vision and hearing, is one of those primary senses that is constantly used to sample the environment. Their nose is used to its utmost without the protective benefits of respiratory protective gear. The respiratory system also receives increased exposure if a contaminant is concentrated on or near the ground.
- Anatomically there are advantages and disadvantages to their particular nasal traits: the relatively long length and intricate inner 'scrolled' surface area allows for better trapping of particulate matter before it reaches the lungs. Equine lung defense mechanisms and mediators of inflammation also contribute to disease resistance; but the sensitive and vascular mucosal surface may absorb contaminants into the blood stream as well

 ∞ Options include rinsing the nose (a rather unrealistic and problematic solution when put into practice) but horses have a great response: sneezing



US Caisson drawn by horses wearing masks

3. Ingestion – Behavioral Aspects, Tongue Exposure

- ♦ Equine species tend to be a "Fight or Flight" type of animal with emphasis toward the "Flight" aspect of their behavior. Training which emphasizes overcoming alarming factors such as scurrying animals and abnormal smells can be undertaken but is time consuming and needs to be part of their preparedness training. But hunger, and more of a concern thirst, may override even the best trained.
- Behavior also plays a role: licking to clean off the hair of herd mates, especially the body and legs, face or licking, scratching an ear or rubbing eyes on their legs or on objects in the environment, increases ingestion exposure if these areas were contaminated; also while increasing respiration to cool off the nasal passages are exposed to dust and debris which may be swallowed periodically.
- Options include maintaining hydration, and periodically taking a moist towel to wipe the legs, face, nostrils, and ears

4. Dermal – Skin and Hair; Ears, Tails, Hooves and Sheath

Without personal protective equipment, a search equine's entire body is exposed to all manner of contaminants and hazards. Anatomically their particular skin and hair make-up has both advantages and disadvantages; the inner ear is considered an extension of their skin:

- Hair can trap contaminants, keep them from contacting skin, especially if the agent is caustic or burns; but this hair 'trap' also makes decontamination more difficult and may hide wounds, especially punctures, along the lower limbs where hair may grow longer (fetlocks and below)
- Be aware of less-haired areas susceptible to exposure (some are thinlayered and more susceptible to wounding): inner ears, tip of nose, axilla (arm pit), underbelly, inner flank, scrotum, heel bulbs
- The ears offer some protection. The horse can pin its ears tightly enough to prevent a lot of substances from entering the ear canal and traveling to the ear drum. Also there is hair protecting the canal.
- The tail, as in the canine, is an indicator of mood and behavior. It may be tucked in tight to the body, trapping contaminants underneath; don't forget to decontamination under and around the tail. Personnel need to practice caution as equids are unpredictable about persons working around their rear.
- The soles, frogs, and heel bulbs are thick and tough providing great protection. However, their exposure to the environment during search or other operations make them one of the most at risk structures of the equine body. Also, soles and frogs will absorb some toxins from the environment.
- Options to decrease contamination include periodic wiping, picking debris out of soles and sulci of frogs, palpating for wounds, and thorough decontamination appropriate to the situation at the end of the shift, even during a shift if deemed appropriate

- The sheath, a protective covering for the penis in males, forms a pocket where dirt, debris, and contaminants accumulate. It is important to include this area in the decontamination process.
- Of particular importance are hands-on body checks, because skin wounds may be hidden by hair and the only symptom is pain. Due to differences in blood supply, equine skin does not blister like human skin, and must be carefully checked.
- Periodic sole and frog checks, and decontamination procedures are important to prevent tracking contaminants back to the rest area.
- Glue-on shoes and sole pads and/or rubberized coating may be applied to the hooves providing protection to the vulnerable hooves when tracking over rubble, but there is concern about decreased traction. Protective splint boots which attach via Velcro[™] or straps provide additional protection to at risk lower limb structures. Most American-trained equids do not learn to work with these, but familiarization may be useful (Katrina debris).

5. Injection

- I Disaster environments (equid disaster victims) as well as Search and other operations (MSAR) may be fraught with physical hazards, including some very sharp debris. The lack of PPE increases the risk of wounding as well as contamination by injection into the body. This may be in the form of punctures, scrapes, burns, or lacerations.
- Wounds are an entry point into the body's vascular system. Behaviorally a equine licks their wound, further increasing contamination by ingestion. The compromised tissue may be very small or quite obvious. Areas that are more heavily haired will hide wounds from the casual observer (fetlocks, mane, tail)
- **1** Options include being vigilant with observation and hands-on checking of the equine. It falls to the handler, especially if medical personnel are not directly present, during search and rescue. Then, after decontamination, it is recommended that a veterinarian or medical personnel examine them.

Additional Prevention Methods:

1. Hydration

Maintaining adequate hydration, in cold weather as well as warm, is a constant challenge. Many equids defer drinking due to the excitement and stress levels; however, there are some who will drink whatever is available when thirst becomes extreme. Because of this, special care must be taken to ensure sufficient quantities of potable water are available.

- Encourage drinking of bottled water in small, frequent amounts.
- Maintenance ~ 2-4 ml/kg/hr; additional for heat, workload, time this translates to approximately 5 to 10 gallons of water per day depending on ambient conditions and work load!
- Flavoring the water is an option for equines that won't drink
- Dehydration documented in 48.1% of NYC Police canines at WTC

2. Adequate Work-Rest Cycles

This is an important aspect in maintaining health

- Minimizes fatigue, illness; maximizes work efficiency and safety
- FEMA guidelines: for every 20-45 minutes of work, equal time rest
- Fatigue was the other most common documented injury reported in New York State Police Canines at the World Trade Center attack (62.9%)

B. AMBULATION, EXPOSURE PROXIMITY and RISK

Many hazardous materials tend to concentrate on the ground or low surfaces. Chemical agents are often disbursed as gases or aerosols that are heavier than air and therefore tend to pool nearer to the ground where equines naturally lower their heads to investigate the ground.

Being without protective gear, working close to the ground, and ambulating on four unprotected limbs increases the equid's risk for contact and inhalation exposure to contaminants.

C. EQUINE METABOLISM

Metabolic differences between humans and equids are difficult to qualify or quantify. These refer to the rate at which the body organs handle various contaminants: absorption through the mucous membranes of the respiratory tract, digestive tract, and skin into the blood, then filtering through the liver, spleen, and kidneys. Equids are more sensitive to some bacterial and fungal contaminants (next section). How much they are affected depends on many factors: personal health, condition, and age; concentration of and length of exposure to contaminant. Treatment should be based on signs, symptoms, diagnostic tests, and response to treatments.

D. SENSITIVITY

Sensitivity comparisons are meant as a guide for risk assessment in sending search equines into an area. Medically one initially evaluates the patient and treatment is provided accordingly, so relative sensitivity plays little role. Toxidromes and further diagnostics are then used to determine the underlying etiology in order to administer antidotes and monitor certain values. This is of paramount importance when the contamination is unknown. Equine sensitivity to many agents of concern is not known. The authors continue to search for documentation. Understanding the effect these agents have will guide decontamination needs and medical treatments.

1. Chemical Agents

Threat chemicals are classified into industrial, warfare, and riot control agents. These may be incapacitating or lethal. Lethal substances include choking, blood, blister, and nerve agents. No matter the sensitivity, decontamination is recommended

\triangle Nerve Agents - cholinergic

- Tabun (GA), Sarin (GB), Soman (GD), Venom X (VX)
- Inhalation, skin and mucous membrane contact
- Inhibit acetylcholinesterase at the nerve-muscle or nerve-gland junction
- Solution DUMBELLS and SLUDGE

Diarrhea	Bronchospasm	S alivation
U rination	Emesis	Lacrimation
Miosis	Lacrimation	Urination
B radycardia	Limp	Defecation
5	Salivate/Sweat	GI upset

Emesis

\triangle BlisterAgents, Vesicants

- Mustards (HD, HN), Lewisite (L), Phosgene (CX)
- Direct contact and inhalation, eyes and respiratory tract most sensitive
- L & CX acute symptoms, mustards often delayed symptoms
- Irritation to what is exposed to irritant

\triangle Blood agent - Asphyxiants

- CO2, CO, Hydrogen cyanide (AC), Cyanogen chloride (CK)
- Inhalation exposure, immediate effects
- Solution via decreased availability, transport, utilization
- Antidotes for definitive cyanide diagnosis

△ Choking, Pulmonary Agents; Riot Control Agents:

- Chlorine (CL), Phosgene (CG), Ammonia
- Riot: chloroacetophenone (CN) and chlorobenzylidenemalononitrile (CS)
- Dogs and horses exhibit lower sensitivity to effects and are therefore used by police under these conditions

2. Biological Agents

With respect to terrorism, equine partners would not make good carriers of disease like animals in our food supply chain. Also it does not make sense that they would be the intended victims. Therefore purposeful exposure to a biological agent is of less concern, but a concern nonetheless. While equids may not be a primary target, they may be equally effected by some of the biological agents which have been developed for terrorist use.

Venezuelan Equine Encephalitis is an example of a disease in which the horse is a primary host and develops a high enough blood level of virus during infection to pose a threat to human populations in that arthropod vectors such as mosquitoes may pick up the virus and by biting humans transmit the disease to humans. Among the 300 or so possible human pathogens that could be used for terrorist purposes, few have been investigated due to characteristics that make them ideal for military use. These fall in the bacteria, rickettsia, virus, and toxin categories.

- **& Bacteria**
 - Anthrax (*Bacillus anthracis*) equines susceptible, acute onset, fatal 2-3 days, zoonotic (transmissible to humans)
 - Typhoid (Salmonella typhus) equines susceptible, potentially fatal
 - **Brucellosis** (*B. abortus, B. meltensis, B. sius*) equines susceptible, highly contagious
 - Plague (Yersinia pestis) never reported in the horse
 - **Tularemia** equids a reservoir for tick hosts rather than infection reservoir

• **Q Fever** (*Coxiella burnetti*) - equines susceptible but uncommon host

- & Virus
 - Venezuelan Equine Virus (VEE virus) equines susceptible
 - Smallpox (Variola virus) equines resistant

Y Toxins

- **Botulinim** (Botulinim toxins)
- **Ricin** (from castor beans)
- **Staphylococcal Enterotoxin B** (*Staph aureus*)

equines susceptible

3. Radiological Agents

Exposure occurs by external irradiation, when all or parts of the body are exposed to penetrating radiation from an external source. This is primarily an *external* exposure, but may become *internal* through wounds or broken skin.

Contamination occurs when the radioactive materials in the form of gases, liquids, or solids are released into the environment. This can result in both *external* and *internal* contamination. The concern with terrorism is the use of a Radiological Dispersal Device (RDD) or 'dirty bomb' to effect contamination.

Briefly:

☆ Alpha particles

- $\frac{1}{27}$ Limited penetration: stopped by superficial dead skin layer or paper sheet
- $\frac{1}{2}$ Ingestion is very dangerous
- $\frac{1}{2}$ Presence may be masked by water

😚 Beta Particles

- $\mathfrak{S}_{\mathcal{T}}$ More penetration but generally travels just a few inches in the air
- Stopped by inner skin layers but also dangerous if ingested

Gamma Radiation

- $\frac{1}{2}$ Not particulate, more like a high-energy x-ray with long range
- $\frac{1}{2}$ Significant penetration; dangerous weather external or ingested

☆ Neutrons

- $\mathcal{S}_{\mathcal{T}}$ Most immediately damaging to cells on contact, travel far in air
- Stopped by water, paraffin, or plastic

Effects are usually delayed, and specific signs and symptoms depend on many factors.

Time, distance, and shielding are still the best option in a radiation hazard event!

E. TOXICOLOGIC AGENTS of CONCERN for DECONTAMINATION

Toxicology experts in the field have named some of the more common substances, but not all, that may be encountered by an urban search equine. Details may be found in other sources. The importance of their decontamination lies with the health of the equine and everyone with whom they may come in contact. I Studies in a real world event (World Trade Center) have revealed other contaminants.

- 1. Hydrocarbons
- 2. Polychlorinated Biphenyls (PCBs)
- 3. Hazardous Metals
- 4. Asbestos
- 5. Soaps and Detergents

- 6. Acids and Alkalis
- 7. Ethylene Glycol
- 8. Propylene Glycol
- 9. Phenol
- 10. Alcohols

F. ENVIRONMENTAL TOXIN EXPOSURE – WORLD TRADE CENTER

To illustrate the presence of toxins in the environment of a disaster, and to show that equids involved in sear and rescue, as well as equids resident in the disaster area, a study was performed (ref #4) to assess environmental toxin exposure of the New York Police Department working canines. The twenty-seven canines tested were divided into prolonged exposure and brief exposure groups. All were deployed during the initial three weeks after the attack. Blood and hair samples were obtained for toxicologic evaluation, including many of the agents of concern described in the previous two pages.

References cited in the paper analyzed the air surrounding ground zero, which contained clouds of visible particulate matter: cement, glass, fiberglass, asbestos, and lead. Jet fuel combustion and structure fires resulted in release of soot, dust, polychlorinated biphenyls, chlorinated hydrocarbons, and dioxins. Clean-up operations continued to release polycyclic aromatic hydrocarbons.

Results for the canines included the following:

- 1. **Blood lead** concentrations (normal < 10 μ g/dL)
 - a. Significantly higher in 17 prolonged exposure canines (5.6-22.6 μ g/dL) when compared to brief exposure canines
 - b. Clinical signs of lead toxicosis were not appreciated in these canines

2. Polychlorinated biphenyls

- a. All blood concentrations were less than the limit of detection
- b. Dust samples collected at the site had low concentrations
- 3. Metals
 - a. Serum copper, iron, zinc, and magnesium were detected
 - b. All levels were within reference ranges
- 4. Arsenic
 - a. 21 of 25 canines tested had detectable levels, all within normal ranges
 - b. 2 canines had levels of 0.56 ppm, more than background threshold of 0.4 ppm

- 5. Environmental toxins detected in 22 of 27 canines (81%)
 - a. 3-methyl quinoline

e. Diphenylamine

b. Isoquinoline

f. Surfynol g. Cedrol

- c. Quinoline
- d. 2-(1-phenylethyl) phenol

a, b, and c are compounds known to be carcinogenic, mutagenic

- 6. Negative for:
 - a. Polycyclic aromatic hydrocarbons: naphthalene, acenaphthalene, anthracene, fluorine, phenanthrene, fluoranthrene, pyrene, chrysene, and others.

G. PHYSICAL SIGNS and SYMPTOMS

Many signs of toxin exposure (chemicals, blister agents, nerve agents, blood agents) can be seen in both humans and equines:

- Cough, choking, gasping for air
- Red eyes and gums, tearing, salivation
- Pupils pinpointed or dilated
- Nausea, abdominal cramps, diarrhea, fatigue
- Muscle twitching, disorientation, seizures, paralysis, involuntary urination/defecation

Other signs are difficult to recognize or confirm in the equine:

- Headache
- Chest tightness
- Sweating detectable in the poorly-haired areas of the body (axilla/arm pits, flank/upper-inner thigh) and hooves, soles, and frogs
- Skin rash if not on poorly haired areas, fur makes it difficult to visually detect redness and rashes until the skin begins to ooze from secondary infection and inflammation. A good physical examination can pick up a sensitive affected area
- Blisters the blood supply to the equine skin differs from humans, and they do not form blisters. Burns-like wounds will occur instead, so the wetness and pain from the injury can be detected on the skin

H. FAMILIARIZATION and TRAINING

Like humans, equids need training. Although the equids will not be setting up a decontamination station, they certainly will be going through it. They are highly intelligent and advanced in their training, but their nature being derived from evolution as a prey-type animal and having a tendency to flee unfamiliar circumstances, familiarizing them with a decontamination procedure will make the real thing that much less stressful.

Equines may have a limited understanding of a dangerous environment, so it falls to the handlers and other team members to protect them. But they also pick up on our emotions. They use their sense of smell and their expectation of their handler's normal reactions. When these are off, make no mistake, they know there is something different going on. Familiarization and training will help reduce the apprehension of actual deployment.

III. DECONTAMINATION PRINCIPLES, PROCEDURES, and GOALS

A. EQUINE DECONTAMINATION BASIC REMOVAL INFORMATION

1. Consult reference book if possible

- Material Safety Data Sheet (MSDS)
- Emergency Response Guidebook (ERG by U.S. Department of Transportation

2. Powders

- Initially wipe off with a moist towel to decrease the amount to be washed
- Brushing is not recommended as this will aerosolize the contaminant and possibly further inhalation exposure

3. Thick Caked On Contamination

- Break down with mechanics' hand wash products, mineral oil (good for petroleum-based contaminant), or scrape off with a putty knife, water scraper
- Use scissors with caution so as not to lacerate the equid. Clippers will not work for long if hair is dirty or if caked with oils and fine dust.

4. Physical removal of the contaminant:

- High volume, low pressure water augmented by soap is the recommendation
- Rinse-wash-rinse cycle 3 times for maximum benefit
- Lukewarm water and standard household dish soap (Dawn®, Palmolive®) are common; military known to use lower-suds Prell®
- **CAUTION**: some Hazmats become reactive when exposed to water. Check pages 342-347of the 2008 ERG for a partial listing.
- The soap's high pH begins to neutralize many chemical agents and dissolve small amounts or thin-coated petroleum agents
- Go from head to tail, shoulder to forelegs, back to belly, hips to back legs

5. Eyes, Ears, Nose and Mouth

- Small bottles of over-the-counter eye rinse (ophthalmic saline and sterile water available) ideal to gently but firmly flush eyes
- If too difficult to manage (uncooperative equine, too difficult with all your protective gear on) then remove as much contaminant around eyes with non-alcohol based towelettes; further eye issues can be handled at medical or veterinary station
- Do not apply petroleum-based or other eye ointments which may absorb contaminant and worsen corneal damage
- Avoid getting soap into eyes, nose, and mouth. Although neutral shampoos may be safer for the cornea and mucous membranes, they are not as effective as the higher pH shampoos in neutralizing many chemical agents
- 6. Soaps are not as harmful in ears, however a horse will shake its head vigorously if water gets inside their ears; we are trying to delay the inevitable shake until the end! There are commercially available ear solutions designed for use in the horse.

7. Special Considerations

- Alternate decontamination agents for *chemicals that worsen if exposed to water* include applying baking soda or flour to form a caked-on product, then brushed or comb out or physically remove by wiping, brushing or combing off
- Special care and attention should be directed to adequately decontaminate *the hooves*; deep-crevassed sulci, cracks in the hoof wall, and the frog can trap debris. Use a medium-bristled brush
- *Eye flushing* with 0.9% saline, purified water, or tepid tap water for 15 minutes is important for blistering (mustard, Lewisite), blood and metabolic agents (arsine, cyanide)
- Bathing the equine with 0.5% hypochlorite (bleach) followed by pH-balanced shampoo and water is recommended for blistering agents (vesicants). Some decontamination protocols actually include a dilute bleach wash down after soap and water for other hazardous materials, especially flood water deployments.
- Dermal exposure to *phenols* requires all personnel wear gloves, gowns, and masks then blot the fur and skin with hyperabsorbent towels, towels, or paper towels before washing
- *Never use hydrocarbon-based solvents* to clean a horse! They cause their own painful damage by defatting the skin as well as increasing dermal absorption of other contaminants like polychlorinated biphenyls (PCBs)
- Do not allow the equine to drink any *contaminated run-off* if your decontamination station is not elevated or the run-off is not draining away to a collection spot. Basket muzzles will not prevent this, regular muzzles do not allow for decontamination of the face. Consider elevation of the wash/rinse site or providing for drainage of run-off
- Important to *clean the area around the nose and mouth* to decrease what licking will bring into the mouth, leading to ingestion exposure of contaminants. Oral exposure and subsequent ingestion increase absorption and worsen medical problems
- The oral cavity of the horse and mule is very long with large vestibules between the cheek teeth and cheeks where equids habitually hold feedstuffs. Flushing the buccal cavity requires either a large dose syringe or an inline cutoff valve with a short piece of soft hose material which may be placed along the outside of the cheek teeth and used to flush debris from the oral cavity. Care should be taken not to spray water directly over the tongue to the back of the oral cavity as the horse or mule will resent water being sprayed at

the opening of the trachea. Holding the head down and extending the neck augments removal of material from the buccal cavity.

- Be cognizant of the *weather conditions* and include necessary shelters in postdecontamination care of your set-up: fans and shade if warm/humid to avoid hyperthermia; dryer or heated protective environment to avoid hypothermia in cold climates
- Post decontamination *veterinary check* should always be included in the protocol, after decontamination

B. HUMAN SAFETY in a DECONTAMINATION LINE

Basic guidelines for PPE when handling animals include gloves, protective eyewear, durable clothing, and protective footwear. Each disaster presents its own health and safety risks. The safety officers, Hazmat specialists, and command staff should continuously monitor the deployment site conditions and modify the PPE as needed.

Other factors, like heat stress and hypothermia, are also conditions to be considered under which the personnel are clothed as well as their time involved.

Additional considerations are directed toward the behavior of the equine partner. As previously stated, horses have evolved as prey animals and, as such, tend to evade unfamiliar situations which they interpret as threatening. The Hazmat PPE may cause a fear response in equids if not previously indoctrinated to this situation.

Some PPE suggestions include:

- 1. Knee-length rubber boots with slip-resistant soles
- 2. Nitrile and polyvinyl chloride gloves offer good protection from acids and other chemicals (often in flood waters), are durable and resistant to abrasion and tearing
- 3. Double gloving with an outer heavy fabric glove may provide additional protection against bites and scratches
- 4. N-96 particulate respirators to protect against spray mists during decontamination
- 5. Eye protection with tight fitting goggles to protect against splash hazards (safety glasses do not protect from splashes)
- 6. If the hazard does not require level A or B suits, a waterproof over-garment can be used to prevent liquids from soaking through to undergarments
- 7. Individuals working in the human decontamination line must be attired in PPE not more than one level less than that of the individuals they are decontaminating, and this should apply to the canine decontamination line even though they are without PPE
- 8. AVMA had one level higher for decontamination during the EBOLA outbreak
- 9. Back and knee injuries are common when working with animals; remember posture, knee pads.

C. GOING THROUGH DECONTAMINATION WITH AN EQUID

1. Assessment – Emergency (Life-Threatening) or Non-Emergency

- If emergent but the contaminant is itself not life threatening, gross emergency decontamination is performed and medical attention given
- If emergent and the removal of the contaminant is itself part of the treatment, technical emergency decontamination is performed and further medical treatment given
- In a non-emergent situation, gross and/or technical decontamination is performed based on the contaminant involved

Solution Note: the handler should accompany the equine through decon if possible.

- If the handler is unable to, another experienced handler may do so
- If an equine cannot be safely taken through without the handler, confine equine to contain contamination
- If handler requires decontamination and no other can take equine through, confine equine until handler is clean, can don protective clothing, then take equine through
- If handler unable to take equine through and no other can safely do it, confine equine, consult to consider options, including sedation, without getting hurt!

2. Preparation

- Remove all equipment and gear from the equine and place in Hazmat container until cleansed (bleach solution), deemed safe, or disposed
- Muzzle use considered to prevent licking, drinking wash water, or bite prevention
- Maintain control so as not to spread contaminants to clean areas by maintaining a decontamination corridor via physical barriers
- Prior to walking the horse onto the wash rack, utilize a "dirty" hoof pick and hoof brush to remove heavy dirt and/or contaminants from the hooves. This will limit the amount of gross contaminants tracked onto the wash rack
- Sedation may be needed to continue with decontamination procedures. Xylazine: 1 mg per Kg may be given in the muscle. It is important to WAIT until sedation begins to set in prior to beginning more stressful steps in the decontamination procedures.

3. Wash - Rinse

- Initial gross decontamination water removal of bulk of contaminant, or other methods for water-reactive substances, powders, and very thick contaminants
- Using mineral oil sparingly, dissolve any petroleum-based contaminants on the limbs and or body prior to moving onto the wash rack. Horses develop a high degree of anxiety when they begin to lose their secure footing, thus, limiting 'slipperiness' to areas more amenable to oil-based products will help the decontamination procedure move along more smoothly
- Start with the head, eyes, ears, nostrils and buccal/oral cavity.
 - A sponge filled with water may be used to wash off the head and avoid distress over being sprayed with hose.

- > Sponge may also be used for gross decontamination of nares/nostrils
- The eyes may be flushed with a balanced saline, ophthalmic solution. Keep in mind that the horse has extremely strong eyelid muscles and it may be necessary to remove gloves to manipulate the eyes. Water-based ointment may be deposited in the eyes after lavage to help prevent irritation during shampooing/decontamination. Extreme care should be exercised in this procedure or not done at all if the handler does not feel comfortable performing this or if the equine is of a fractious nature when working about its head.
- The ears may be flushed with commercially-available ear solution and then wiped down after the horse shakes its head (Everybody else, as well!)
- Rinse the buccal cavities remember both sides, but don't drown the beast! With the water set at cool, turned on and the inline attached cutoff valve/ hose extension turned off so that no water is flowing out of the hose, insert the short extension of soft hose along the side of the mouth observing the "lump" as it moves along the side of the head to about half the length of the extension. SLOWLY turn on the water at the cutoff valve and lavage the buccal cavity. Remember, try not to spray water directly at the back of the throat as the horse will not be your friend in this instance. Don't forget to repeat this procedure for the other side of the mouth.
- Using high volume, low pressure water flow (keeps dust contaminants from being aerosolized by high pressure water), rinse down the entire remaining body of the horse starting at the top of the neck and working towards the rear and from the topline to the ground.
- Using the large sponges, begin the shampoo process by squeezing large amounts of premixed antibacterial shampoo from buckets onto the equine starting at the poll(top of the neck just behind the ears) and working towards the rear and from the topline to the ground.
 - Work the shampoo into the coat vigorously to loosen any deeplyimbedded contaminants.
 - Don't forget the sheath(in males) and underneath the tail in the perineum area. They can really tuck their tails and are sometimes a little shy about having their sheaths cleaned but if you go slowly, most will allow this to be accomplished – at least at the most superficial level of the sheath.
 - The sheath catches an amazing amount of dirt and contaminants so don't leave this little detail out!
 - Learn to work from the side with one hand/arm draped over the equine's back or hip in a constant, confident manner. This will help keep the horse calm and keep you out of the firing zone!
 - > Use the water scraper to remove excess water.
 - Pay particular attention to fetlock, pastern, and heel bulbs as these areas frequently sustain wounds which may need immediate veterinary care.
- Rinse completely, then scrape off as much water as possible before repeating as needed, based on the contaminant and success of decontamination.

4. Final Drying

- After the inevitable equine shuffle to shake-off water, towel dry as much as possible.
- Allow air drying with attention to the weather conditions (shelter if cold/windy; shade if hot/humid)
- If cold, blanket with turn-out sheet/blanket designed for horses and properly fit until dry
- Option to dry with an air dryer
- Equines now should be next to or within the designated 'cold zone'

2. Antimicrobial Station Option

Sponge down the equine with antimicrobial of choice and allow to stand for 10 to 15 minutes(this may not be necessary depending on degree of infectious agent threat and shampoo products used in "Hot" zone)

contamination suspected. There are several options, each with their own spectrum of activity, advantages and disadvantages.

- *Hypochlorite* (bleach) 0.5%; this is household bleach diluted 1:10. Be sure and rinse off bleach solution once done; a range of 100-500 ppm may be used on equipment
- *Biguanide* (chlorhexidine) 0.05-4%
- *Quaternary ammonium* 400 ppm, 0.1-2%
- *Iodophore* (povidone-iodine) 100ppm
- *Peroxygen* 20 g/L or 1%
- *Alcohol* (ethyl, isopropyl) 70%

3. Monitor, Treat, Return to Service

- Monitor for contamination, including radioactive checks when dry
- Special attention to eyes, ears, muzzle, oral cavity, hooves, lower limbs, and under the tail
- Repeat decontamination if necessary, otherwise new halter and lead rope and continue to medical

Complete medical/veterinary evaluation and treatment as needed. In addition to vitals, close inspection of the equine's body, limbs and hooves for evidence of wounds paying close attention to the lower limbs, soles, and frogs for puncture and/or laceration type wounds

• Return to service

D. DECONTAMINATION CORRIDOR

BIN for Dirty Equipment

> WASHING RACK (or initial two wash And rinse cycles)







RINSING RACK (or final wash and rinse cycle)

0.5% HYPOCHLORITE SOLUTION FOOT BATH Several minutes for solution To have maximum effect



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 \mathbf{V}

CLEAN WATER RINSE



DRYING AREA

VETERINARY CHECK

E. HAZMAT SPECIFICS: CHEMICAL, BIOLOGICAL, and RADIOLOGICAL

1. Chemical Exposure

Remove

- Relocate to a well-ventilated upwind area
- Remove, replace all gear with metal or nylon disposable items
- Remove liquid contaminant by pinching or blotting (do not rub, as this spreads the contaminant)
- Wet down if contaminant is dry/powder (brush may aerosolize) then brush coat to remove most of it

Wash

- High-volume, low-pressure lukewarm water, soap if available
- Do not delay if warm water or soap is not available
- Special attention to paws and pads that can trap material in crevices

Monitor

- Immediate medical evaluation, veterinary if available
- Solution Continued monitoring for changes in health status
- Recheck and monitor for contamination

2. Biological Exposure

One of the concerns with biological exposure is that it will likely go unnoticed until victims develop symptoms and seek medical attention. The bad news for horses is they are potential transmission vectors for many of the organisms, such as VEE, and they are susceptible to many of the toxins such as Clostridium botulinum toxin. Prior vaccination to common pathogens and stockpiling of particular antitoxin to biological agents as Cl. Botulinum toxin or tetanus antitoxin would be advisable to prevent loss of animals.

Decontamination is essential if exposure to particulate, liquid or aerosol biological agent has occurred within the past several hours. It may not help but certainly won't hurt if the exposure is not discovered for several days.

Remove

- \otimes Relocate to a well-ventilated upwind and upgrade area
- \otimes Remove, replace all gear with metal or nylon disposable items
- \otimes If agent is in powder form, wet down the equine to prevent it from aerosolizing and being breathed in by them or anyone else
- ⊗ Remove visible dust or solid with a brush, pinch or blot liquid contamination (don't wipe as this just spreads it around)

Wash

- ⊗ High-volume, low-pressure lukewarm water, soap if available
- \otimes Do not delay if warm water or soap is not available
- $\otimes~$ Special attention to lower limbs/hooves that can trap material in crevices Monitor
 - \otimes Dry the equine, monitor both the equids and yourself for health changes
 - \otimes Monitoring by Hazmat
 - \otimes $\;$ Veterinary examination and rechecks, possibly long term

3. Radiological Exposure

- Radioactive materials do not give immediate signs of exposure. Detectors are the most sensitive indicators of exposure. Due to the threat of terrorists using a dirty bomb, any explosion should be assumed a radiological hazard until determined otherwise.
- Contamination can be picked up on the equine's coat and hooves. Decontamination is critical to prevent further spread, limit absorption (beta and gamma), and remove a source for further inhalation or ingestion of the hazard. Decontamination is similar to other hazard removal.

Remove

- $\frac{1}{2}$ Relocate to a well-ventilated upwind and upgrade area
- $\frac{1}{2}$ Remove, replace all gear with metal or nylon disposable items
- $\frac{1}{2}$ If in dust or powder form, wet down so as not to aerosolize agent into equine's breathing zone

Wash

- High-volume, low-pressure lukewarm water, soap if available
- Baby shampoo has Trisodium EDTA, chelates heavy metal ions and some radioisotopes
- $\frac{1}{2}$ Do not delay if warm water or soap is not available
- $\frac{1}{2}$ Special attention to lower limbs/hooves that can trap material in crevices

Monitor

- $\frac{1}{2}$ Alpha radiation is masked by water, so thoroughly cleanse and rinse the equine and be checked for radiation once dried off
- $\frac{1}{\sqrt{2}}$ Medical examination
- Hazmat and medical monitoring

F. CONCERNING PETROLEUM-BASED CONTAMINANT

"Like dissolves like"

If the solvent/solute molecules are structurally similar, then the substance will dissolve in the solvent. Or, substances that have the same polarity (either polar or non-polar) dissolve into each other. Mineral oil, placed in a spray bottle and applied to petroleum-based contaminant, will help break it up, making the decontamination easier, more efficient.



Black light shows oil-based contamination



Soap and water only still contaminated



Mineral oil, then soap and water

IV. EQUINE DECONTAMINATION

A. EXERCISE DRILL

The Large Animal Rescue Team at the University of Florida, lead by John Haven, is a statewide response team. Each year they conduct large scale exercise with several other state agencies, including deploying self-contained for a few days. In April-May,



2011 equine decontamination was included in the exercise.



Familiarization with humans in PPE (the marshmallow people)



Washing, rinsing with high-volume low pressure water hose



Hoof Decontamination

Sheath Decontamination

Lori E. Gordon, DVM and Thomas L. Wooten, DVM

B. Commercial System - Limited Water Availability

- 1. Anivac is a self-contained 'dry-vac' system for animals
 - a. Sends water through adjustable nozzles deep into hair coat directly to skin
 - b. Adjacent to the nozzles are the suction unit to take away the 'dirty' water
 - c. Contaminated water is released into self-contained pan within the unit
 - d. Design overcomes natural resistance of animal hair to the penetration of moisture; spray action washes the skin of the animal first, pushing the dirt up and into the vacuum force of the wand, and then washes the animals coat as the solution is being vacuumed up by the wand.
 - e. The vacuuming action pulls majority of water from coat, leaving the animal only damp to the touch.
 - f. Uses 90% less water than regular bathing

2. Accelerated Hydrogen Peroxide

- a. **AHP** (Accelerated Hydrogen Peroxide) is a synergistic blend of commonly used, safe ingredients that when combined with low levels of hydrogen peroxide produce a potent germicide and cleaner.
- b. In-use dilution of AHP for bathing the active ingredient is less than 0.1% as opposed to 3% available in stores
- c. Non-irritating to eyes and skin, free of Volatile Organic Compounds (VOC's), no toxic ingredients, no residual
- d. Efficacy: AHP is EPA approved for killing both enveloped and non-enveloped viruses as well as bacteria (including mycobacteria such as Tuberculosis)
- e. Speed: existing disinfectants generally take 10 minutes to kill since surfaces dry quicker than that the product must be reapplied in order to ensure sufficient contact time. In Canada AHP products are approved with a 5 minute kill time. This quicker kill time better assures an effective end result and greatly lessens the chance that reapplication will be needed.
- f. Personnel safety: AHP converts to water vapor and oxygen when drying and in it's in use form does not require personnel protective equipment.
- g. Environmental: AHP is Volatile Organic Compound (VOC) and Nonylphenol Ethoxylates (NPE) free. While drying it converts to water vapor and oxygen

3. Advantages

- a. Minimal water required
- b. 5-8 average horses take 13 gallons (49 liters)
- c. Accelerated oxygen for biological decontamination
- d. H2O2 solution 3 minutes to sanitize, 5 minutes to disinfect
- e. Larger unit weighs 108 pounds/49 kg. and has own heating unit

4. Disadvantages

- a. Requires power source
- b. Vacuum noise
- c. May not work for thick petroleum; loosen up first (like dissolves like)



Quick Release for Wand Changes

Comfort Grip

Trigger and Handle

body clipped animal



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V. EQUINE DECONTAMINATION KIT

A. Equipment – General

- 1. Box container
 - Pack supplies in appropriate sized container(s)
- The larger items (pools and shelving) are separate but kept in the same area.
- 2. Sealable industrial strength plastic bags
 - These are used to contain contaminated items
 - Either this or a length of heavy plastic sheeting is placed over where the 2 pools meet to prevent contaminated water from leaking between the pools
- 3. 2 Hoses, 50 feet each, heavy duty, kink resistant
- 4. Spray nozzle or wand
 - Allows for water to be better directed underneath the canine (belly wash)
 - An adjustable water flow
- 5. Buckets
 - Used to throw in the contaminated lead ropes and halters, and used brushes until they can be collected in bags for decontamination
 - Also can be used to decontaminate metal items that will be reused
- 6. Water heater (separately stored item)
 - To prevent hypothermia in a cold weather deployment
 - A tent or other environment that can be warmed and provides wind protection is needed as after water decontamination the equines will not be dry for a while
 - If not available, consider a groomers drying unit to quickly dry the equine
- 7. Non-slip standing racks
 - Elevate horse slightly to allow for run-off
- 1. Fans and/or dryer with shelter from cold
 - In addition to warm water, a heated shelter area is good to continue the drying process during cold weather
 - A groomer's dryer or fans in a heated a heated environment will hasten the drying process, but a warm protected environment will be fine along with monitoring the equine for signs of hypothermia (temperature check is the easiest!)

B. Equipment – Human PPE

- 1. Eye protection
 - 4-8 pairs of goggles if needed to protect from contaminated water spray
 - The canines will inevitably shake themselves at some point as well
- 2. Gloves -2 boxes
 - Latex or all non-latex to cover latex allergies, these often tear with much use
 - A heavier over-glove if needed for protection from more hazardous materials
- 3. Masks
 - Situation-appropriate issue
- 4. Tyvek Suits or situation-appropriate issue protective suit

C. Decontamination Supplies

- 1. Mineral Oil estimate1-2 gallons/horse
 - We put this in spray bottles for easy application to areas of petroleum-based contamination
 - The adage 'like dissolves like' is the basis for using this oil to break up the contaminant, then applying a shampoo or soap to remove it from animal
- 2. Spray bottles 2-4, for mineral oil application
- 3. Ophthalmic (Eye) Rinse 4-8 bottles
 - This is used if there are clear signs of eye irritation or contamination, otherwise it is left for the post-decontamination medical check to use if needed
 - There are over-the-counter saline and purified water solutions
- 4. Liquid soap
 - Dish detergents Dawn® or Palmolive® traditionally used in animal decontamination; baby shampoo for radiation and heavy metal decontamination
 - For a low suds alternative dilute the above 50:50 with water or use Joy® or Prell® products. These work just as well with a thorough scrub
- 5. Horse shampoo -1 to 2 gallons per animal per deployment
 - After several soap washes, the oil-based protection on their skin is gone and the coat becomes dull
 - This will help re-establish the coat after several soap shampoos
- 6. Medium bristle brushes
 - Not too harsh but stiff enough to get out the packed-in debris from the hooves
- 7. Absorbent material
 - Baking soda or cornstarch are typically used to absorb a liquid contaminant and then be wiped off
 - This decreases the contaminant burden that must then be removed
- 8. Moist towelettes
 - They can be used to wipe sensitive areas around the eyes, nose, mouth, and inner ears as well as prepuce and vulva where soaps can be very irritating
 - These can be used to wipe off powder contaminants before they aerosolize, as brushing may put powders into the air and further contaminate personnel
- 9. Large absorbent towels
 - For drying equine after decontamination (estimate 10 per animal)

D. Equine Supplies

- 1. Emergency Blankets
 - Protection if wet in a cold environment
- 2. Scissors
 - Bandage scissors are preferred as they have a blunted tip that won't cut the skin when taking off bandages
 - Never shave or use clippers to remove hair to skin level, as this may cause abrasions and worsen contamination

- 3. Muzzles
 - 6 large animal muzzles, 2 each various sizes
 - These can be manufactured from round gallon plastic bottles with respiration holes cut over the nostrils and tied to the halter with synthetic rope or white surgical tape.
 - Intended use is to prevent inappropriate ingestion of contaminated feed or water if animal cannot be placed in crossties, portable stocks or controlled by a handler.
- 4. Lead ropes and halters
 - Synthetic leads and halters which can be sanitized should be available to replace the tack taken off the animal during the decontamination procedures in order to control the animal and allow contaminated tack to be cleaned.
- 5. Blankets
 - a. There are commercially-available turn-out blankets (rugs) which will help keep the animal warm and assist in drying.
 - b. Tail and leg wraps will assist in keeping the tails and lower limbs from becoming contaminated during downtime
- 6. Hoof Picks with/ without stiff, synthetic bristles
- 7. Small, stiff-bristled brushes with handles for cleaning heavy debris from the hooves
- 8. Medium stiffness grooming brushes for brushing off contaminants from coat. These should be synthetic so as to augment sanitation
- 9. Soft-bristled grooming brushes to finish coat grooming
- 10. Water scrapers to assist in the removal of shampoo and/or water from the coat during decontamination procedures
- 11. In-line cutoff valve for those with 18 to 20 inch length of soft hose for rinsing buccal/oral cavity

E. Feed stuffs

- 4. While equines are herbivores, it is not safe to assume that they will be able to acquire feed in the disaster zone.
- 5. Weather conditions may render forages toxic
 - Certain forages when frozen and or in drought may produce cyanide –like compounds
- 6. Feed contaminated with dead animals may be compromised with botulinum toxin or be a source of Clostridium botulinum causing botulism in equines
- 7. Flooding may render available forages contaminated by coliform bacteria commonly found in raw sewage
- 8. Improperly stored hay or forage which has become wet may be fermenting mold which may be toxic resulting in Moldy Corn or Moldy Hay disease (polioencephalomalacia) which is fatal.
- 9. Sufficient hay and potable water should be transported to area of operations during initial deployment or very soon thereafter.

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