

Awareness-level information for veterinarians on control zones, personal protective equipment, and decontamination

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Veterinarians who may respond to emergency incidents should be aware that traditional first responders (eg, firefighting, emergency medical, and law enforcement personnel) typically establish control zones around contaminated or otherwise dangerous sites. Work inside these zones is organized according to the Incident Command System, which requires that tasks be assigned to those who are trained and certified for them. Inside these zones, there are also requirements regarding the use of PPE, which are typically dictated by Occupational Safety and Health Administration standards. Use of some components of PPE, especially respiratory protection, requires regular training, certification, and recertification. People and equipment that leave the controlled areas must be decontaminated to protect themselves and others and to prevent dissemination of harmful agents.

One of the earliest and most important steps in mitigating the dangers surrounding any incident involving the potential for mass casualties is identification of the causative agent. If the incident is possibly the result of terrorist or other criminal activity, the potential for multiple harmful devices or agents must be considered. Should the attack or accident potentially involve a biological agent and especially if it affects animals, a veterinarian's expertise, advice, or opinion may be valuable in establishing the character and details of the response, such as the appropriate disinfectant to be used.

Identification of the agent that causes an incident is imperative because the components of a safe and orderly response depend on knowledge of the causative agent. For instance, the shape and size of the control zones around an incident caused by an explosive device depend on the size of the explosive charge, while the control zones around an incident caused by a chemical agent depend more on the particular agent and the direction and speed of the wind. Likewise, the type and extent of PPE and decontamination depend heavily on identification of the causative agent.

Veterinary Medical Assistance Teams^{1,2} functioning as part of the National Disaster Medical System under the National Response Plan and, more locally, State Animal Response Teams^{3,4} are capable of disease identification, agent control, and decontamination functions, among many others, in the face of disastrous cir-

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ABBREVIATION

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| PPE | Personal protective equipment |
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cumstances. They can deploy quickly with applicable equipment and supplies and remain self-sustaining for several days. Detailed information on planning and response resources are available,⁵ but because of the potential for being involved in an emergency incident, all veterinarians should have at least some awareness-level knowledge of the components of emergency response, including control zones, PPE, and decontamination.

Control Zones

Control zones are established around dangerous sites in an attempt to lend order to the situation, prevent unauthorized access to the hazard, contain the agent, and provide functional boundaries for responders. The most common examples involve chemical spills addressed by hazardous materials workers. Where available, natural obstacles (eg, gullies and rivers) or man-made barriers (eg, walls and highways) may prove useful. In other instances, control zones can be demarcated with temporary materials, such as parade barriers, snow fences, and barrier tape.⁶

Inside the isolation perimeter for any incident, 3 control zones—hot, warm, and cold—will be established. The hot zone, or exclusion zone, is the area in which the hazard itself is located and is bounded by the hot line. Appropriate PPE must be worn by anyone entering the hot zone.

The hot zone is surrounded by the warm zone, or contamination reduction zone, which is bounded by the contamination control line. Movement out of the hot zone and through the warm zone should be restricted to the contamination reduction corridors or decontamination lines, where victims, responders, and equipment are cleaned so as to prevent dissemination of the causative agent.

The cold zone, or support zone, surrounds the warm zone and is restricted to authorized personnel. It is bounded by the isolation perimeter.⁶

The names of the control zones used by hazardous materials, firefighting, and law enforcement personnel may differ slightly. In particular, the World Organization for Animal Health defines several types of zones⁷ that may be analogous, in part or in whole, to the hot,

warm, and cold zones. However, interpretation and explanation of the function of these zones may require veterinary expertise with an appreciation of the traditional control zones. According to the Terrestrial Animal Health Code, for instance, infected zones are those in which a disease agent has not been demonstrated to be absent. In contrast, hot zones are zones in which an agent has been demonstrated to be present. According to the Terrestrial Code, free zones are those zones demonstrated to be free from the disease agent and would be most comparable to cold zones. Buffer zones might be considered to be types of warm zones because they are intended to protect free zones from infected zones, but more by epidemiologic methods (eg, restriction of movement, vaccination, and surveillance) than by decontamination of all material and animals that move through them. Thus, although the Terrestrial Code zones may be used for disease control, they are primarily used by the World Organization for Animal Health to establish the disease status of subpopulations of animals for international trade.⁷

PPE

Personal protective equipment is classified on the basis of level of protection from contamination from level D (least amount of protection) to level A (greatest amount of protection). Importantly, each type of protection from a lower level is incorporated, as needed, in the next higher level of protection. For instance, if head trauma is a possibility, then responders must find a way to incorporate a hard hat inside or on top of any other headwear applicable to the appropriate level of PPE.⁸ For veterinarians performing postmortem inspections, it has become increasingly common to require that the noncutting hand be protected by a cut-resistant glove.

Level D PPE—Level D PPE consists of everyday occupational safety equipment, such as coveralls, steel-toed boots, protective gloves, safety glasses, hard hats, and hearing protection. This level of PPE is appropriate if there is minimal risk of injury following skin contact with liquids or vapors containing the agent or inhalation of gases or airborne particles, including toxins or microbes. For hazardous material incidents, level D PPE is often appropriate only in the cold zone and only for support personnel.⁸ However, level D PPE would be adequate for many veterinary activities if the agent was determined to have little zoonotic potential and the zone was determined to be free from other agents and devices.

Level C PPE—In addition to the appropriate components of level D PPE, level C PPE includes chemical-resistant boots and outer gloves, a chemical- and splash-resistant suit, and an air-purifying respirator. Most air-purifying respirators require that an effective seal be formed around the mouth and nose or around the entire face. Therefore, they must be tested to ensure they fit correctly, and documentation of this testing is a portion of the certification required to work in level C PPE. Even so, air-purifying respirators have important limitations. There must be at least 19.5% oxygen in the air; the agent must be filterable, the appropriate type of filter must be available, and there should be minimal

risk of circumstances that would impede the function of the filter.⁸

There is general agreement that level C PPE would be adequate for most microbial diseases, once properly identified and given the appropriate type of air-purifying filter. When properly used, level C PPE provided adequate protection from Nipah virus during depopulation of hogs in Malaysia, but lapses in donning, doffing, and decontamination protocols resulted in human exposures and deaths. It has been suggested that half-face respirators (ie, respirators covering only the nose and mouth) would be adequate for working with potentially zoonotic strains of influenza virus (eg, H5N1), but if conjunctival exposure is considered a risk, then a full-face air-purifying respirator should be required. Theoretically, use of a respirator could prevent contamination of human nasal passages with foot-and-mouth disease virus while working with diseased animals and allow veterinary personnel to more quickly resume contact with unaffected animals.

Although the Occupational Safety and Health Administration did not enforce many requirements for rescue workers in the immediate aftermath of the 2005 hurricanes that devastated the Gulf Coast region, they have returned to enforcing several requirements for level C PPE and have provided several other recommendations. Because of potential contamination of flood waters with microbes and dangerous agricultural, industrial, and unknown chemicals, responders should wear chemical-resistant suits, boots, and gloves when working in flood waters. Because of the potential for contamination with various microbial agents, such as *Salmonella* spp, *Shigella* spp, *Escherichia coli*, and hepatitis virus, those handling human corpses should wear foot, hand, and face protection that is resistant to puncture. Respiratory protection is important in the presence of high concentrations of molds, fungi, and other airborne contaminants.⁹ Veterinary responders would be advised to incorporate these elements of level C PPE under similar circumstances, regardless of whether the statutory requirements are being enforced at the time.

Safe and effective donning, doffing, and decontamination of level C and higher PPE requires assistance. Liquid or vapor penetration is often a concern when level C PPE is required. Thus, the suit zipper and the junctions of the suit with the boots, gloves, and respirator may be covered with chemical-resistant tape. Responders so attired should use a buddy system and always work in groups of 2 or more. This is important in observing and covering breaches in the PPE and in evacuating disabled team members should this be necessary.

Levels A and B PPE—Levels A and B PPE are distinguished by the use of respirators supplied with air from an air line or tank. Air lines typically allow more working time, but tanks afford greater range of movement.⁸ Thorough training and frequent recertification are necessary to remain qualified to work in these levels of PPE.

Level B PPE includes, like level C PPE, a chemical- and splash-resistant suit, along with a supplied-air apparatus that may be affixed to the outside of the suit. Level A PPE affords the greatest possible chemical and

biological protection and differs from level B PPE in that everything is enveloped in a totally encapsulating chemical protective (TECP) suit. The highest level of protection is required in the presence of unidentified agents and agents in high concentrations.^{8,10}

Although it seems unlikely that many veterinary activities would require such high levels of PPE, they are not outside the realm of possibility, especially since until the agent is identified, the highest level of protection is required. The possibility also exists that an accident or attack with multiple agents (eg, biological and chemical) could occur or that too little oxygen or dangerous gases might be present, as in manure pits or silos. For example, responders to the 2005 Graniteville, SC, railroad derailment and chlorine spill required a self-contained breathing apparatus to enter the area affected by the vapor plume. This included public health and animal control personnel who entered the hot zone to deliver food and water to or evacuate family pets.¹¹

Decontamination

The goals of decontamination are removal of hazardous agents from people, animals, and material leaving a contaminated area and containment, neutralization, and disposal of the agent. From the veterinary perspective, planning for decontamination of different types and species of animals presents unique challenges, but should be part of an overall response plan. For instance, handling disciplined working dogs or horses may be quite different from managing more excitable individuals of the same species. These are some of the many response functions for which the Veterinary Medical Assistance Teams and State Animal Response Teams have trained.¹⁻⁵

A great deal of chemical, biological, or external radiologic contamination of humans can be removed with clothing and personal belongings, but these should be retained, contained, labeled as evidence, and, possibly, eventually returned to their owners. Further physical decontamination may be accomplished through rinsing, washing, brushing, scraping, or, in some cases, heating or cooling. Chemical decontamination may be an aid to physical decontamination (eg, detergents) or may neutralize the agent directly (eg, dilute sodium hypochlorite). In any case, attempts should be made to contain the runoff from the decontamination process.¹² Communicable biological agents that have been inhaled or swallowed by people or animals present a unique set of challenges for the responder community, and the value of quarantine may supersede that of decontamination.¹⁰

Technical decontamination—Responders who commonly work in contaminated environments, such as hazardous materials technicians, will not enter into such areas until a technical decontamination line is in place, manned, and equipped. Stepwise technical decontamination includes, at a minimum, when moving from hot to cold zones, equipment drop; 2 or more stages of outer layer washing, rinsing, and neutralizing; boot and glove removal; outer suit removal; respirator removal; and field washing.¹² Individuals working in the decontamination line must be attired in PPE no

more than 1 level less than that of the individuals they are decontaminating.

Current concepts and practices involving decontamination of animals most closely resemble the outer layer washing stages of technical decontamination. Water is used because of its availability. Dishwashing detergents are recommended, in part because they aid in removing the oils in which some toxins may be dissolved.^{13,14} Chemical decontamination may be considered if there is reasonable assurance that the decontaminant is not dangerous to the affected species. For example, 0.5% sodium hypochlorite is used for deactivation of organophosphates on human skin¹⁵ and so might be considered for animals. In the absence of eye and respiratory tract protection, the eyes and nasal and oral cavities of animals may be lavaged. Some means of physical and chemical restraint should be available for the control of aggressive and otherwise dangerous animals. The effects of agents that may have been inadvertently imbibed or absorbed may be reduced by use of agent-specific treatment in facilities beyond the decontamination line.^{13,14}

Mass decontamination—When large numbers of people are contaminated, as in an attack involving chemical weapons, technical decontamination may not be feasible. The best military and civilian solution has been removal of clothing and washing with copious amounts of water, plus chemical decontaminants if applicable and available. Mass decontamination shower tents and trailers are available, but fire hoses, fire hydrants, large locker rooms, and swimming pools might be considered.¹⁶ Lenience in environmental protection is expected in mass casualty incidents, but runoff containment remains an important consideration, secondary only to attempts at preservation of life.

Should the need for mass decontamination of animals arise, veterinary expertise could lend itself to the assembly of some equally inventive decontamination lines befitting the animal species and contaminants involved. However, depending on the offending agent and species affected, especially if food animals or poultry are involved, different federal agencies are dictated by the National Response Plan to take the leading role in control of the agent, with others playing supporting roles. Should the agent be one that causes animal disease, then the USDA is the primary agency. If it is, however, one that causes zoonotic disease, then the US Department of Health and Human Services, which includes the FDA and CDC, takes the lead. Incidents involving animals affected by chemical agents are to be overseen by the Environmental Protection Agency.¹⁷

Emergency decontamination—Hastened forms of technical or mass decontamination may be conducted in emergency situations, but emergency decontamination is more often taken to mean evacuation, cut-out (from clothing, if applicable), and washing of unconscious or nonambulatory victims,¹⁶ which could include animals. Responders performing emergency decontamination must wear adequate PPE so as to avoid becoming victims themselves, but evacuation of affected, injured, or otherwise disabled responders is also considered emergency decontamination.

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