Occupational Safety and Health in the Veterinary Field: 
A Review of Employee Perceptions, Training, and Educational Materials

By

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Abstract

The practices of veterinary and human medicine have numerous similarities, though the former is believed to be a more hazardous for its employees, due in large part to the aspect of working with animal patients (Weaver et al., 2010). In fact, Veterinary Services ranks as the fifth highest industry for non-fatal workplace injuries and illnesses, not far behind police and fire protection. To address these similarities and differences, the fields of Veterinary Medicine and Animal Care (VM/AC) were added to the Health Care and Social Assistance sector of the National Occupational Research Agenda in 2013, which guides research performed by the National Institute for Occupational Safety and Health (NIOSH). To aid NIOSH as it continues its investigation of the current status of occupational safety and health (OSH) in the VM/AC fields, this document evaluates the education this workforce receives on the subject. This review builds upon work completed during the author’s Masters Practicum on policy documents relating to OSH provided by over 40 veterinary professional organizations. Based on a relative lack of information found in the earlier review, the next logical step was to identify where this workforce receives information on OSH and the quality of these materials. Instructional materials presented by formal educational organizations (veterinary colleges, veterinary technology programs) as well as materials from an array of informal educational sources were collected and analyzed. Perceptions of veterinary employees on their safety in the workplace was also investigated, but there was little information available on this population’s perceptions of the quality of the safety training they have received. While only a fraction of the U.S. veterinary colleges and veterinary technology programs had publicly available educational materials relating to OSH, there is evidence these students are receiving consistent training for
some, but perhaps not all occupational hazards. There is also evidence that educational gaps are being filled by for-profit entities as continuing education or consultation services to veterinary clinics. Taken together, there is ample room for the creation of educational materials to better protect this population of workers, and ideally these would be widely shared as a single, comprehensive resource. As the preeminent experts in this domain, NIOSH and groups like the AVMA could collaborate to develop and distribute these materials for the benefit of VM/AC employees.
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1. Introduction to occupational health and safety in veterinary medicine

1a. Scope of the hazards these employees face

According to the 2009 U.S. Census, there were 28,691 establishments providing veterinary services, 586 zoos, 719 nature parks, and 12,080 other establishments that provide pet care, employing a total of 442,000 people (U.S. Census Bureau, 2009). These employees fill a variety of roles, such as kennel staff, animal trainers, animal control officers, veterinarians, veterinary technicians and assistants, and zookeepers (Centers for Disease Control and Prevention, CDC, 2015). These employees work with a literal menagerie of animals, each with their own unique hazards for handling and treatment, mirrored by a large number of specialties within veterinary medicine, such as small animal (primarily dog and cat), large animal (livestock and horse), zoo, laboratory animal, and exotic animal medicine.

In addition to the wide variety of veterinary clinics, it is not uncommon for veterinary clinics to function as miniature full-service hospitals, with laboratory-based diagnostics (bloodwork, cytology, urinalysis, etc.), radiology, surgery, outpatient and inpatient care, dentistry, and other functions being performed under the same roof. It is similarly not uncommon to have veterinarians and technical staff who perform tasks in some or all of these areas of the clinic, and as each area comes with its own hazards, this compounds the sources of potential harm for these employees. Occupational hazards in veterinary medicine and animal care are generally divided into five categories, summarized in Table 1.

In fact, Veterinary Services currently rank as the fifth highest industry for the incidence of nonfatal occupational illnesses and injuries, not far behind police and fire protection, while hospitals and ambulatory clinics were not in the top 20 (U.S. Bureau of Labor Statistics, 2015).
Table 1. The five classifications of hazards used by NIOSH with veterinary examples, CDC, 2015.

<table>
<thead>
<tr>
<th>Hazard type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td>Infectious agents (bacterial, parasitic, viral, prion, fungal), including zoonotic agents such as rabies and ringworm, as well as opportunistic pathogens or diseases acquired from interacting with humans</td>
</tr>
<tr>
<td>Chemical</td>
<td>Waste anesthetic gases, hazardous medications, disinfectants and cleaners, pesticides</td>
</tr>
<tr>
<td>Enviromechanical</td>
<td>Injuries caused by an unsafe work environment: slippery floors, unsafe equipment, non-ergonomic work spaces, animal bites and scratches, sharps injuries (needlesticks and scalpel blade cuts), back injuries from lifting large dogs, repetitive motion injuries, crushing injuries from large animals</td>
</tr>
<tr>
<td>Physical</td>
<td>Injuries caused by energy-based damage to tissues: Noise pollution from barking dogs, ionizing radiation from radiographic equipment, exposure to heat and cold, vibration</td>
</tr>
<tr>
<td>Psychological</td>
<td>Long work hours, fatigue, grief from administering euthanasia, stress from working in a fast-paced, high-stress environment</td>
</tr>
</tbody>
</table>
Animal-related injuries are the most common (Weaver et al., 2010) and 90% of workers’ compensation claims from veterinary practices from 2002-2004 involved animal-related injuries (Hub International, 2007). Veterinarians and their staff also have a higher likelihood of contracting a number of zoonotic diseases, such as *Brucella spp*, *Coxiella burnetti*, avian and swine influenzas, *Chlamydia psittaci*, and *Bartonella henselae* (Baker and Gray, 2009). These and the other hazards in the field have prompted increased attention from federal agencies on how to address occupational hazards for this unique group of workers.

**1b. Overview of NIOSH and the inclusion of VM/AC into the HCSA sector**

The National Institute for Occupational Safety and Health (NIOSH) is part of the Centers for Disease Control and Prevention (CDC), and has existed for over 40 years, (U.S. Department of Labor, 1970). NIOSH works towards their goal of protecting worker health by conducting research in the field of occupational safety and health (OSH) and translating these findings into guidance on how to prevent injuries and illnesses in the workplace (CDC, 2016).

NIOSH utilizes the National Occupational Research Agenda (NORA), a research framework that helps set priorities for investigations into workplace safety. Since 2006, NORA has been made up of 10 Sector Councils (NORA, 2013a) with the Health Care and Social Assistance Sector (HCSA) Council serving the fields of human and more recently, animal medicine (NORA, 2013b). Due to the commonalities between human and animal medicine, Veterinary Services and Animal Care were added to the HCSA sector in 2013. This coverage applies to the employees of veterinary clinics (establishments of licensed/certified veterinary practitioners), related services such as veterinary diagnostic services and livestock inspection, and facilities that provide animal boarding, grooming, and training. It is also applied more
broadly to people working in animal shelters, zoos, aquariums, laboratory animal facilities, academic institutions, and veterinary pharmaceutical industries (NORA, 2013b).

The addition of Veterinary Medicine and Animal Care (VM/AC) to the HCSA sector brought several new research goals, a new working group, and a call to action, stating that “Veterinary medicine and other animal care personnel are at substantial risk for various occupationally acquired injuries and illnesses, many of which parallel and even exceed those encountered in human healthcare” (NORA, 2013b). The group identified 10 strategic research topics for increased knowledge, risk reduction, or management approaches, with 5 safety topics common to both human and veterinary medicine, and another 5 specific to veterinary medicine, summarized in Figure 1.

More specifically in the veterinary field, NIOSH is currently focused on research on preventing zoonotic disease, reducing the common injuries found among VM/AC workers (bites, scratches, kicks, etc.), reducing respiratory hazards (animal allergies, asthma), reducing reproductive hazards (radiation safety, gas anesthetic inhalation, safe handling of drugs and hormones, etc.), and reducing physical hazards, such as exposure to heat, cold, and noise pollution (NORA, 2013b). NIOSH is also still gathering information on the hazards in the VM/AC fields as a whole, and how to interface with this group of employees.

1c. Purpose of literature review

During this author’s practicum experience and to aid of NIOSH in their ongoing inquiry of the veterinary and animal care fields, a review of occupational safety and health (OSH) policies from a subset of 45 veterinary professional organizations was completed. These groups were chosen because they have a leadership role in guiding best practices in the field and have
Figure 1. The ten strategic goals guiding HCSA research, with both shared and unique goals for Veterinary Medicine and Animal Care, adapted from NORA, 2013b.
a wide membership in the veterinary community. Ultimately, there was a noticeable lack of policies and educational materials on OSH coming from these organizations. This presented an opportunity for NIOSH to provide guidance to VM/AC employers and employees, but still begged the question of where these employees were receiving training in OSH topics and the quality of this education.

This current document is the next logical step, which is to understand where VM/AC employees are receiving their education in OSH topics and if there are ways this education could be improved. An additional goal is to help expedite and guide NIOSH to helpful sources outside of those already utilized by NIOSH and other federal agencies, and conversely, steer them away from investigating unhelpful resources, as their last collection of resources appears to have taken place four years ago (CDC, 2016).

Based on this author’s experience and from conversations with other veterinary staff, it is common for veterinarians and veterinary or animal care technicians, assistants, and technologists to be first exposed to the field and its hazards as early as high school. (If the person is working in a family member’s practice, this exposure may start at an even younger age from frequently visiting the practice.) Formal OSH training is provided in veterinary colleges and veterinary technology programs, while informal, on-the-job training in safety measures from more seasoned staff is also common. From personal experience, the level of competence and attention to occupational safety can vary between clinics and among employees at these clinics, forming a helpful or harmful culture for worker safety. In human medicine, this safety climate has been shown to strongly correlate with not only rates of injury on the job, but also how well the workplace adopts OSH practices (Weaver et al., 2010; Gershon et al., 2000),
making it an important place to initiate and have OSH education. Lastly, and while it varies by state, most veterinarians and veterinary technicians have an annual requirement for continuing education courses (DVM360, 2013), which may also be a source of OSH education.

2. Literature Review

2a. Search criteria

This search focused on materials and training provided in the United States, and relied on publicly available sources. The search was web-based, and conducted using institutional access to UNC and NCSU libraries, as well as Google Scholar. Typical search terms were variations on “occupational safety and health” and “veterinary” or “animal care,” such as “veterinary safety educational materials,” “radiation safety veterinary training,” and “veterinarian perceptions of safety.” The focus was on finding materials with educational content over pedagogical texts when possible. The identified sources included primary literature (peer-reviewed journal articles) and grey literature (materials on veterinary and technical college websites, lecture presentations, etc.). Formal training materials were those being presented in veterinary colleges and veterinary technology programs, while the classification of informal training materials was much wider, including training at continuing education seminars and in-house reference material (i.e., safety manuals, written protocols, etc.). These were the two divisions used for the review, followed by VM/AC employee perceptions of their safety and the quality of their education in OSH topics.

2b. Formal educational materials

Veterinary medicine and veterinary technology programs provide an opportunity for training new members of the field in appropriate occupational safety and health practices,
especially during a time when the students’ inexperience also puts them at a greater risk of injury (Weaver et al., 2010). In the United States, these programs are accredited by the American Veterinary Medical Association (AVMA). In addition, the AVMA generates guidelines on the standard of veterinary care, has active dialogues with federal agencies on OSH topics, and provides continuing education resources for its members (AVMA, 2016a). For the veterinary colleges and veterinary technology programs that follow, each institution’s website was thoroughly searched for curriculum information, required skills of graduating students, and any materials relating to OSH that would be accessible to students.

2b.1. Materials from AVMA-accredited veterinary colleges

To receive AVMA accreditation, veterinary colleges must ensure that “New graduates must have the basic scientific knowledge, skills, and values to provide entry-level health care, independently, at the time of graduation,” which would logically include some amount of safety knowledge, and the topics of health promotion, biosecurity, and prevention of zoonoses are included in one of the required competency statements (AVMA, 2016b). However, past evidence shows OSH training in veterinary colleges has been inconsistent and no standalone training program for this group of students exists (Langley and Morrow, 1996). In fact, there has only been one published study on the depth OSH training in veterinary colleges (Langley and Morrow, 1996), and the one source on creating an OSH program for students at a veterinary school dates back to 1977 (Hagstad).

The most comprehensive information on the subject was compiled by Langley and Morrow (1996). They sent surveys to the deans of the 28 veterinary schools in existence at the time in the United States and Canada in 1996, receiving responses from 18 schools on work-
related illnesses and injuries the students experienced in the preceding two years, student vaccination history, and specific safety training topics, the latter summarized in Table 2. While only 16 of the 18 schools responded they had specific OSH training, this specificity was most likely in reference to standalone (i.e., OSH-specific) training, as some OSH topics were covered by all 18 schools. Most or all of the schools said they taught animal handling, including handling of rabies suspect animals and how to safely perform a necropsy (animal autopsy), and covered zoonotic diseases, biosafety, anesthetic safety, radiation safety, and chemical safety. Notable deficiencies were training in how to correctly lift loads (a common occurrence in small animal medicine, where patients are routinely lifted and carried), and the use of breathing masks and ear protection (both worn in production animal housing). Of note, 15 of the 18 schools responded they did not have plans to change their safety training, despite some shortcomings, and despite the group’s average self-score on their OSH training being a 6.8 on a 10-point scale (range, 4-10, 1 being inadequate and 10 being adequate) (Langley and Morrow, 1996).

Twenty years have passed since the work of Langley and Morrow, and so websites of each of the 30 AVMA-accredited veterinary colleges were reviewed for educational materials on OSH and whether each had course(s) in the curricula on safety, summarized in Table 3. This information was publicly available on the institutions’ websites and can be provided upon request. No veterinary school had a separate course on OSH in veterinary medicine, but may have had required student competencies in these topics, described later. While the home institution of each of the 30 veterinary schools had a division for safety and health, with materials covering the entire institution (biosafety manuals, chemical handling manuals, etc.), and safety training materials for the employees in the veterinary colleges, these materials
Table 2. Responses from 18 American and Canadian veterinary schools on OSH topics, reproduced from Langley and Morrow, 1996. The author’s (Bradshaw, E.) personal responses based on veterinary school experiences (2007-2011) are also included.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>Author experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you offer any specific OSH training?</td>
<td>16 (89)</td>
<td>2 (11)</td>
<td>Y</td>
</tr>
<tr>
<td>Do your students receive training in physical safety, e.g.,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling animals?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>Handling suspect rabid animals?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>How to correctly lift loads?</td>
<td>3 (17)</td>
<td>15 (83)</td>
<td>Y</td>
</tr>
<tr>
<td>Choosing and wearing breathing masks in confinement animal operations?</td>
<td>7 (39)</td>
<td>11 (61)</td>
<td>Y</td>
</tr>
<tr>
<td>Choosing and wearing ear protection?</td>
<td>2 (11)</td>
<td>16 (89)</td>
<td>Y</td>
</tr>
<tr>
<td>Operator safety when euthanizing animals?</td>
<td>12 (67)</td>
<td>6 (33)</td>
<td>N</td>
</tr>
<tr>
<td>Safety procedure when doing a necropsy?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>Do your students receive training in:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoonoses?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>Biosafety (disposing of sharps, accidental injections)?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>Anesthetics?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>Hazardous chemical safety?</td>
<td>17 (94)</td>
<td>1 (6)</td>
<td>Y</td>
</tr>
<tr>
<td>Fire safety?</td>
<td>9 (50)</td>
<td>9 (50)</td>
<td>N</td>
</tr>
<tr>
<td>Radiation safety?</td>
<td>18 (100)</td>
<td>0 (0)</td>
<td>Y</td>
</tr>
<tr>
<td>Laser safety?</td>
<td>7 (39)</td>
<td>11 (61)</td>
<td>Y</td>
</tr>
<tr>
<td>Ultrasonic safety?</td>
<td>11 (61)</td>
<td>7 (39)</td>
<td>Y</td>
</tr>
<tr>
<td>Drug abuse prevention?</td>
<td>14 (78)</td>
<td>4 (22)</td>
<td>Y</td>
</tr>
<tr>
<td>Policies for immunocompromised people?</td>
<td>3 (17)</td>
<td>15 (83)</td>
<td>N</td>
</tr>
<tr>
<td>Risks to pregnant workers?</td>
<td>16 (89)</td>
<td>2 (11)</td>
<td>Y</td>
</tr>
<tr>
<td>Do you have specific plans to change your safety training?</td>
<td>3 (17)</td>
<td>15 (83)</td>
<td>NA</td>
</tr>
<tr>
<td>Do you have any restrictions placed on pregnant students?</td>
<td>10 (56)</td>
<td>8 (44)</td>
<td>Y</td>
</tr>
<tr>
<td>Are your students instructed in first aid (for humans)?</td>
<td>2 (11)</td>
<td>16 (89)</td>
<td>Optional training</td>
</tr>
<tr>
<td>Are your students instructed in CPR (for humans)?</td>
<td>5 (83)</td>
<td>13 (17)</td>
<td>Optional training</td>
</tr>
</tbody>
</table>
would not necessarily be available to students and were excluded. The same logic was applied when the institution had a research animal facility onsite, since students working with these animals would receive hazard training, but it would fall outside the normal curriculum of veterinary students. Seven schools had OSH materials (Table 3) and 6 had OSH-related competencies required for graduating students (Table 4).

Colorado State University was an impressive outlier when it came to OSH. They have a short yet detailed factsheet (see Appendix) on zoonotic agents prepared for employees and students working in their veterinary teaching hospital (Colorado State University, n.d.). They also have a large, standalone OSH program that is funded by the state, trains workers in safety, and provides OSH consultation services to businesses (Colorado State University, 2015a). This department has an extensive online library of information and training on OSH topics relating to VM/AC and general safety, and a massive infection control manual for the veterinary teaching hospital (Colorado State University, 2015b), which other veterinary hospitals reportedly use for reference, and the university undertakes active, in-house surveillance of occupational hazards among its employees (Colorado State University, 2015a). They also took the most proactive role in their approach to student training, saying: “We believe our students are full partners with our safety program and do not presume they know the requirements upon entry into the program. We ensure they participate in safety programs and attempt to instill a culture of safety through their education.” (Colorado State University, 2015b).

As for the other schools, The Ohio State University had a short but informational video on handling dissection instruments, which covers sharps safety for scalpel blades (Inpanbutr, 2008). Iowa State University is home to the Swine Medicine Education Center, which provides
Table 3. The 7 of the 30 American, AVMA-accredited colleges of veterinary medicine that had publicly-available sources found on their websites relating to OHS training\(^1\). Several items are already on the NIOSH website\(^2\), and all sources are listed in the literature cited.

<table>
<thead>
<tr>
<th>Institution name, State</th>
<th>Evidence of OSH training or specific materials found</th>
<th>OSH course? Y/N</th>
<th>Number of sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auburn University, AL</td>
<td>Livestock handling(^2)</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>Colorado State University, CO</td>
<td>Zoonotic disease prevention</td>
<td>N</td>
<td>2</td>
</tr>
<tr>
<td>Iowa State University, IA</td>
<td>Handling swine, biosecurity on pig farms; exotic diseases</td>
<td>N</td>
<td>2</td>
</tr>
<tr>
<td>Tufts University, MA</td>
<td>Radiation safety</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>The Ohio State University, OH</td>
<td>Sharps safety; livestock handling(^2)</td>
<td>N</td>
<td>2</td>
</tr>
<tr>
<td>Washington State University, WA</td>
<td>Radiation safety, including during pregnancy</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>University of Wisconsin-Madison, WI</td>
<td>Mental health, wellness, substance abuse</td>
<td>N</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^1\)The 23 schools for which no OSH materials were found: Tuskegee University, Midwestern University, University of California Davis, Western University of Health Sciences, University of Florida, University of Georgia, University of Illinois, Kansas State University, Louisiana State University, Michigan State University, Purdue University, The University of Minnesota, Mississippi State University, University of Missouri-Columbia, Cornell University, North Carolina State University, Oklahoma State University, Oregon State University, University of Pennsylvania, University of Tennessee, Lincoln Memorial University, Texas A&M University, and Virginia Tech.
Table 4. Clinical competencies and skills relating to OSH from six U.S. veterinary colleges for which this information was available.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Number OSH skills / Total number of skills:</th>
<th>Specific competencies relating to OSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Ohio State University (n.d.)</td>
<td>8 / 168</td>
<td>- Apply leather muzzle, dog*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Demonstrate proper animal restraint for blood collection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Demonstrate proper animal physical restraint for patient evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Demonstrate use of “clipnosis” (cat)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Demonstrate use of EZ-grabber/burrito (cat)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Demonstrate use of gauze roll muzzle (dog)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Demonstrate proper restraint of an adult cow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Properly place a cattle halter*</td>
</tr>
<tr>
<td>Louisiana State University (n.d.)</td>
<td>N/A, skills are grouped</td>
<td>- Know application of practices to prevent and control infectious diseases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Practice good hygiene in the clinical setting to prevent spread of disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Know safe use of hazardous materials: chemotherapeutic agents, radioisotopes, biological products,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sharps, and sharps containers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Excel in working knowledge of zoonotic agents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27. Capture, lead and halter a horse*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51. Demonstrate knowledge of rules and regulations regarding reportable diseases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52. Demonstrate knowledge of rules and regulations pertaining to rabies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54. Demonstrate the appropriate use of personal protective equipment (PPE) for zoonotic diseases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>56. Demonstrate understanding of biosecurity principles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>103. Perform proper restraint on cats</td>
</tr>
<tr>
<td></td>
<td></td>
<td>104. Perform proper restraint on dogs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>106. Place a nose twitch on a horse*</td>
</tr>
<tr>
<td>North Carolina State University (2015)</td>
<td>18 / 317</td>
<td>- Cast cow with rope*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Place halter (cow, horse)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tie quick release knot (cow, horse)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Restrain and lift foot for trim or lameness exam (cow)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Apply twitch to horse (multiple types)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Catch and restrain safely (chicken, turkey, sheep, goat, pig,</td>
</tr>
<tr>
<td>Institution</td>
<td>Year</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Cornell University (2016)</td>
<td>NA</td>
<td>(summary document only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iowa State University (2014)</td>
<td>NA</td>
<td>(summary document only)</td>
</tr>
</tbody>
</table>

*Items or techniques used for animal restraint and handling.*
veterinary students and visiting veterinarians training and written materials in topics such as safe handling of swine and biosecurity practices (Swine Medicine Education Center, nd). Iowa State University is also home to the Center for Food Security and Public Health, which has a pair of web-based courses on emerging and exotic diseases, one for continuing education and the other for veterinary students (Iowa State University, 2016). According to their website, the latter is now offered at all U.S. veterinary colleges, though this became the norm after the author earned their DVM. The Center also offers a general course on zoonotic agents for both veterinary and human medical practitioners, and in keeping with their focus on infectious agents, provides a wealth of printable resources on species-specific zoonoses and infection control and risk management practices for both brick-and-mortar and mobile veterinary clinics, as well as production animal facilities (Iowa State University, 2016).

While not part of a curriculum, the University of Wisconsin-Madison places a focus on wellness and personal safety, with a veterinary student resource webpage covering topics such as alcohol and drug use, anger management, reducing stress, coping with loss, and self-care (University of Wisconsin-Madison, 2016). Tufts University has a basic presentation on radiation safety it gives to veterinary students entering clinical rotations (Tufts University, 2016) which was almost identical in content to what the author received at this stage in veterinary school. Similarly, at Washington State University, all students and staff must take radiation safety training each year, and they have a separate presentation for pregnant women (Washington State University, 2016). This was also the only resource that mentioned safety of radioactive isotopes used therapeutically. Lastly, since the two materials on livestock handling (Schmidt,
n.d.; Bean, 2008) are already known to NIOSH and are on their website, they will not be reiterated here.

This small collection of materials is clearly not telling the whole story, and the biggest limitation was that a vast majority of the course materials for these schools are kept private for employee and student-only access. However, due to the many complex tasks veterinary and veterinary technology students must perform in clinical practice, it is becoming increasingly common that these students must demonstrate and be “signed off” on a group of competencies or required skills. In the case where the course material and inputs cannot be reviewed directly, these competencies and learning outcomes of the graduating class are a logical place to look for student understanding of OSH activities. These were also sourced from the institutions’ websites and evaluated whenever possible, and six veterinary colleges had OSH activities among their competencies (Table 4), while only one source was found among the veterinary technology programs, described in the next section.

2b.2. Materials from AVMA CVTEA-accredited veterinary technology programs

The AMVA also accredits all of the 228 veterinary technical and technology programs in the country, a task performed by their Committee on Veterinary Technician Education and Activities (CVTEA) (AVMA, 2016c). While these employees often perform similar tasks in the clinic, the educational difference is veterinary technicians receive a two-year degree from AVMA-accredited programs, while veterinary technologists receive a four-year bachelor’s degree from one of 24 AVMA-accredited programs (NAVTA, 2014). For a program to be accredited by the AVMA CVTEA, an institution must comply with “all applicable safety standards and monitor and maintain safety” and “Student understanding of basic OSHA
concepts must be instilled through the curriculum” (AVMA, 2016c). Specific safety topics that are included in the CVTEA’s Essential and Recommended Skills List are summarized below (AVMA, 2016d):

- Perform safe and effective restraint of birds, reptiles, amphibians, horses, rabbits, rodents, ferrets, cattle, sheep, and pigs, and have an understanding of the restraint of non-human primates. Specifics were given for safely removing small animals from cages, applying muzzles and other restraint devices, operating a cattle chute, and loading large animals for transport.
- Safe administration of drugs by mouth and other routes, proper recordkeeping of controlled substances, and safe storage of potentially hazardous drugs and pesticides.
- Radiological safety, including reduction of exposure, maintaining safety records, and knowledge of proper machine maintenance.
- Safe handling of laboratory specimens (nonspecific) and sample preparation and labeling.
- Maintaining anesthesia equipment for safe operation; anesthesia safety did not mention reducing exposure to anesthetic gases.
- Control of zoonoses (in regard to diseases transmitted by nonhuman primates).
- Perform cleanup, including disposal of hazardous medical waste in surgical areas, laboratory areas, and patient areas.

Due to the large number of veterinary technician and technologist programs, attention was paid here to the 24 four-year programs, as a subset believed to have the highest likelihood of having OSH materials. Only two actual resources were found from the 24 accredited veterinary technology programs, and 7 had courses relating to OSH topics (Table 5).

California Polytechnic Institute has a website with a collection of safe animal handling materials made in-house and pulled from other sources. It also details what staff and students should do in the event of an animal bite (California Polytechnic Institute, 2016). The other resource comes from Purdue University, as they have a 99-page Essential Skills Checklist for its Veterinary Technologists (Purdue University, 2015) that the AVMA uses as an archetype for other institutions (AVMA, 2016e). While too thorough to describe in detail, it covered animal
Table 5. AVMA CVTEA-accredited veterinary technology programs with OSH materials or courses*.

<table>
<thead>
<tr>
<th>Institution name, State</th>
<th>Evidence of OSH training or specific materials found</th>
<th>OSH course? Y/N</th>
<th>Number of sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic University, CA</td>
<td>Animal handling</td>
<td>Animal handling</td>
<td>1</td>
</tr>
<tr>
<td>Florida A&amp;M University, FL</td>
<td>NMF</td>
<td>Animal handling; Zoonotic diseases</td>
<td>0</td>
</tr>
<tr>
<td>Lincoln Memorial University, TN</td>
<td>NMF</td>
<td>Zoonotic diseases</td>
<td>0</td>
</tr>
<tr>
<td>Mercy College, NY</td>
<td>NMF</td>
<td>Animal handling</td>
<td>0</td>
</tr>
<tr>
<td>North Dakota State University, ND</td>
<td>NMF</td>
<td>Animal handling</td>
<td>0</td>
</tr>
<tr>
<td>Purdue University, IN</td>
<td>Essential requirements</td>
<td>Safety; Public and Occupational health</td>
<td>1</td>
</tr>
<tr>
<td>St. Petersburg College, FL</td>
<td>NMF</td>
<td>Safety and Regulatory Compliance</td>
<td>0</td>
</tr>
</tbody>
</table>

*The 17 programs for which no OSH materials or courses were found: Becker College (MA), Fort Valley State University (GA), Globe University (WI and MN locations), Medaille College (NY), Michigan State University (MI), Minnesota School of Business (MN), Mississippi State University (MS), Morehead State University (KY), Mount Ida College (MA), Murray State University (KY), State University of New York (2 campuses), Northwestern State University of Louisiana (LA), Texas A&M University (TX), University of Puerto Rico, and Wilson College (PA). NMF = No materials found.
restraint and manipulation to prevent injury to the animal and personnel, preparation and safety checks of an anesthesia machine, and the safety requirement that body parts or lead shielding PPE not appear in radiographs (Purdue University, 2015).

In terms of OSH courses, three were identified from these institutions. St. Petersburg College has a 1 credit hour course on Safety and Regulatory Compliance in Veterinary Technology, with the following description: “This course will introduce and heighten veterinary technician learner's awareness of veterinary specific safety hazards and regulatory compliance issues. The course is designed to acquaint veterinary technician learners to the following: (1) personal safety hazards, (2) patient safety hazards, (3) Human Resource issues related to safety, (4) licenses, permits, and registrations, (5) Occupational and Safety Health Administration (OSHA), and (6) reproductive and gender issues.” (St. Petersburg College, 2016). Purdue University has two courses, a 1-hour course called Safety, Prevention, and Public Health that covers “selected zoonotic diseases, occupational hazards and safety issues related to the veterinary health care team and veterinary facility,” as well as a 1 hour course called Occupational and Public Health for Veterinary Technicians that covers “selected aspects of public health and safety related to the veterinary health care team, patient, client and public” (Purdue University, 2016). While the other animal handling and zoonotic disease courses would almost certainly cover worker hazards, none of the courses had detailed information to review.

2c. Informal educational materials

This section identifies a varied group of resources, such as continuing education seminars, learning through mentorships, and online programs. While this area ultimately has fewer materials than anticipated, this knowledge is still helpful for NIOSH moving forward. This
was also the case in the earlier review of the veterinary professional organizations, where only a couple of educational materials for OSH topics was found. The majority of these were factsheets for specific zoonotic agents and infection control practices (American Association of Zoo Veterinarians, 2013; American Association of Feline Practitioners, 2014; National Research Council, 2011). Since these materials were covered in detail in the previous literature search and some are already known to NIOSH, the author refers the reader to this earlier review.

In terms of free materials, the single most informative online resource was Veterinary Compliance Assistance, a website developed by the National Center for Manufacturing Services with funding assistance from the U.S. Environmental Protection Agency and content assistance from the AVMA (Veterinary Compliance Assistance, 2016). This website focuses on safe handling and disposal of hazardous wastes, chemicals, pharmaceuticals, and animal carcasses, providing state-specific requirements and contacts. For employees in the zoological field, the San Diego Zoo Global Academy has for-fee courses on working safely with dangerous animals, zoonotic diseases, safe animal handling and restraint, and harassment prevention (San Diego Zoo Global, 2016). The American Animal Hospital Association also has a collection of training DVDs and workbooks on workplace safety for practice employees, available for purchase to both their member and non-affiliated clinics (American Animal Hospital Association, 2016). They may also cover OSH topics in their online continuing education portal, but access to these materials is restricted to members. Lastly, while the quality of content varies, there are also innumerable YouTube videos on OSH topics posted by the public and individual veterinary clinics for in-house use, such as “BSVC – Safety Training Video” from Ballston Spa Veterinary Clinic in New York (Fiesty Terrier Productions, 2013).
In almost every state, veterinarians, veterinary technicians, and veterinary technologists must meet an annual continuing education requirement (DVM360, 2013). A lengthy search for continuing education courses on OSH topics yielded an unexpectedly small number of results. For example, a group called Vet Rad CE offers a radiation safety course (VetRadCE.com, 2016), and management of compassion fatigue appeared to be a common subject (VetMedTeam, 2016a). There were also a handful of for-fee courses and publications on OSHA compliance and staff safety training (VetMedTeam, 2016b; OSHA Manuals, 2016; Henry Schein Animal Health, 2016; Safety Vet, 2015), sometimes with safety manuals or on-site visits by consultants, included in the cost.

Perceiving a need, several groups have created for-purchase OSH educational materials for the field of veterinary medicine. For example, Study.com has a series of videos on general hazards in the field, sharps safety, safe animal handling, radiation safety, hazards from anesthetic gases, and a review of the common chemicals used in practice that may pose a health risk, as well as examinations to test user knowledge (Study.com, 2016). The videos are narrated, and appear personable and understandable to a variety of audiences. Similarly, a group called OSHA Manuals has purchasable packages for training, signage, and recordkeeping in clinics (OSHA Manuals, 2016). The AVMA’s veterinary insurance group has created a safety manual for veterinary medicine, but access is restricted to members (AVMA PLIT, 2016).

2d. Employee perceptions

A handful of studies have examined veterinary employee competence and perceptions on personal safety, but the topic of these worker perceptions of their OSH training itself has received very little attention, inside and outside of the United States. A useful comparison of
VM/AC employee beliefs about safety comes from Weaver et al., who analyzed the perceptions of 90 personnel (clinical faculty, staff, and fourth year veterinary students) working at the Colorado State University veterinary teaching hospital and compared them to those held by an expert panel of three OSH specialists (2010). Both groups separately ranked the importance of and assigned frequency and severity to 14 workplace hazards. While there was not a significant difference between the groups on several of their assessments, the personnel felt there were greater risks posed by certain hazards, such as loud noises, sharps injuries, radiation exposure, and chemical exposures in the form of insecticides, pesticides and tissue digesting chemicals used on-site. Conversely, the expert panel perceived bite and crushing injuries, harm from animal restraint, and exposure to anesthetic waste gases and several biological agents (*Toxoplasma gondii*, antibiotic-resistant bacteria, and allergens) as carrying greater concern.

Paradoxically, the staff placed highest concern on chemical and biological hazards, which were rare in occurrence among staff in the clinic, leaving the more common physical hazards of least concern. A reasoning given by the authors was people overestimating the risk of hazards with which they were less familiar.

To assess veterinarian’s existing knowledge and use of infection control practices and perceptions of their risk of zoonotic disease, the CDC partnered with the AVMA in 2005 to collect and analyze surveys from almost 2000 veterinarians in small animal, large animal, and equine practice (Wright et al., 2008). The surveys asked what PPE these vets would wear in different clinical scenarios, as well as their level of concern of personal infection or injury. Veterinarians’ voiced level of concern for contracting zoonotic diseases was usually disproportionately higher than their actual use of preventive measures in practice, and they
generally performed poorly at selecting appropriate PPE to prevent disease transmission. Additionally, the two-thirds of clinics without a written infection control policy were significantly more likely to have less understanding of the necessary precautions to take. To combat these deficiencies in knowledge and practice, the authors proposed the creation of more infection control protocols in veterinary clinics, citing the model protocol provided in the National Association of Public Health Veterinarians’ (NASPHV’s) Compendium of Veterinary Standard Precautions and Model Infection Control Plan for Practices (Wright et al., 2008; NASPHV, 2015a; NASPHV, 2015b). Weese and Prescott (2009) performed a similar survey of 166 veterinarians who perform diagnostic bacterial cultures in their clinic. The researchers identified several poor practices in these establishments that would put staff at risk of infectious diseases, including a lack of biosecurity protocols, inadequate facilities and equipment to handle these samples, and dangerous disposal practices (for example, almost half of clinics put their microbiological waste directly in the regular garbage). In their defense, 94% of respondents said continuing education on laboratory safety and bacterial culture would be helpful, leading the authors to suggest this as an intervention.

Lastly, in terms of risk factors of OSH injuries in general, Nordgren et al. (2014) used a cross-sectional survey to evaluate factors associated with workplace injuries in Minnesota veterinary technicians. Consistent with other studies, they found that most injuries occurred during the restraint of cats and dogs, such as bites and scratches. Risk of work-related injuries was increased among staff who worked more than 40 hours a week, worked with a wider variety of animals, had less than six years of experience, and believed that workplace injuries
were not preventable (2014). This could be extrapolated to suggest that worker inexperience and poor safety climates are involved.

3. Analysis

Veterinary colleges and veterinary technical programs are key OSH training sites for the VM/AC population, providing guidance on best practices at a formative time for these workers (Weaver et al., 2010). However, it appears this topic has not been investigated in detail for almost 20 years (Langley and Morrow, 1996), and no universal educational program for OSH exists at these institutions. Currently, there is no also baseline of safety training that spans all veterinary practices, and while it is likely that on-the-job training and mentoring plays a significant role in developing the OSH knowledge of VM/AC employees, information on this topic was simply not in the literature.

Following a thorough search, very little research has also been done in the U.S. on VM/AC employees’ perceived quality of their education and training in OSH topics, and no materials were available evaluating the training these workers receive. The latter was the biggest limitation for the review, and a reason for this may be that when such metrics and feedback are collected, the results are kept private within the institution or organization. Safety practices are also a possible sensitive issue for educational institutions and veterinary clinics, since it brings up questions of injuries sustained on the premises and may shed light on institutional deficiencies (Wright et al., 2008). As it was, the vast majority of the educational content provided by veterinary colleges and veterinary technical programs was restricted to student and staff access. In the absence of these materials, supporting documents, such as core competencies and curricula, were used to assess outputs when inputs were not available.
Animal-related injuries are the most common in veterinary medicine (Weaver et al., 2010) and likewise they have been a focus of safety training materials for this field. Looking at the collection of materials as a whole, the most common topics for training were safe animal handling, the prevention of zoonotic disease, and radiation safety. Yet conversely, areas such as chemical safety, and the reduction of enviromechanical and psychological hazards appear to be receiving less attention, similar to the findings of Langley and Morrow (1996). Based on Wright et al. (2008) and Weese and Prescott’s (2009) work, more training in infection control practices and PPE use are warranted as well.

The lack of OSH materials in formal educational programs may be indicative of an assumption students have pre-existing knowledge of safety topics, that safety is so integral to training it need not be mentioned, or a lack of consideration of these topics for inclusion in curricula. The author hopes the latter is not the case, but OSH topics were also not mentioned in the latest Roadmap for Veterinary Medical Education published by the North American Veterinary Medical Education Consortium (NAVMEC, 2011). Additionally, a search of the Journal of Veterinary Medical Education, the official journal of the Association of American Veterinary Colleges, yielded no results on occupational health and safety among U.S. veterinary staff other than prevalence studies related to workplace injuries.

While much may have changed in the 20 years since Langley and Morrow surveyed veterinary colleges (1996), the majority of school administrations at the time thought a separate OSH course was not necessary (7 Yes/11 No), and instead preferred these topics be included as part of other courses (15 Y/3 N) and on-the-job or during rotations in the clinic (15 Y/3N). This seems to have held true, as no separate courses on OSH appear to exist in the
current curricula of U.S. veterinary colleges, while three courses were identified in the veterinary technology programs. Moving forward, an assumption can be made that veterinary colleges will continue to integrate OSH topics into their course materials, which while it is sensible to teach radiation safety with radiology and safe animal handling with a class on performing physical examinations, this piecemeal approach may leave gaps in student knowledge that could result in their own or someone else’s harm in the future.

4. Role of leadership in moving forward

To reach the national VM/AC population and create change, the logical players are NIOSH itself and veterinary professional groups like the AVMA. Both of these groups design and share visions and goals for high standards in the field and are both perceived as the authority on occupational safety and health and the profession of veterinary medicine, respectively. These groups taking a proactive step in improving veterinary employee health will likely be appreciated by the VM/AC community, seen as a sign of understanding that veterinary medicine and animal care are more hazardous than they should be, and get more attention paid to the issue. Providing this community with a freely available resource would likely also be seen as an act of good faith and engagement, rather than a direct request for compliance, as could be the case if the AVMA altered their requirements for program accreditation to include more OSH topics.

5. Recommendations

In the unlikelihood of altering coursework at the U.S. veterinary colleges and veterinary technology programs to add standalone OSH courses or lessons and the time it would take for this to occur, the author proposes a collaboration between NIOSH and the AVMA to create a
free reference manual or website, primarily for veterinary students and veterinary technical students, but available to all interested audiences. Veterinary medicine is entering the age of technology, but there is still a reliance on hardcopy reference books in veterinary practices. Since it would be coming from these two groups it would have the utmost credibility and could set a new norm for training in OSH. A guidebook could go with these graduates to their clinics, and distribution through the AVMA would widen the text’s reach. NIOSH and the AVMA are both about promoting best practices, and this would be tangible evidence of their expertise.

This guidebook could incorporate and distill several NIOSH documents already in existence, such as the wealth information provided by Gibbins and MacMahon on U.S. occupational health standards and regulations, identifying hazards, and developing an OSH program in a veterinary clinic (2015), while expanding upon the AVMA’s 16 Guidelines for Veterinary Practice Facilities (AVMA, 2016f). It could cover the gamut of hazards expected in veterinary clinics, with the understanding this would not be a binding document or a definitive statement on what must be done, but instead a collection of widely used best practices, designed to educate new employees or serve as a quick reference for more experienced staff.

However, if for political or regulatory reasons NIOSH and the AVMA cannot create such a text themselves, they can do what they have done before, which is draw attention to helpful resources created elsewhere. Colorado State University would be the logical first choice for collaboration or to pilot the guidebook, since they have the most materials available on the topic, and a very proactive OSH group. In keeping with many public health metrics, measuring actual positive health outcomes from this intervention would be a challenge, although feedback on the books and whether they were used in veterinary practices may be sufficient. Using this
feedback to update and improve the text over time would ensure it was a great resource.

Another approach would be to create educational materials for use at continuing education courses around the country, potentially reaching a large portion of the VM/AC community in just a couple of years.

In addition to the creation of educational materials, NIOSH could also consider recreating the tactic of Weaver et al. (2010) with visiting veterinary colleges and technical schools to help them identify gaps. A federal agency would also have a greater chance of seeing this training firsthand or getting access to the course materials. More research could also be done at veterinary clinics to understand the issue and level of employee education where the occupational injuries take place, comparing safety perceptions to actual outcomes.

6. Conclusions

Occupational safety and health in veterinary medicine and animal care is receiving more attention, and NIOSH is currently reviewing the hazards present in the field for generating recommendations and materials (NORA, 2013a). Since VM/AC staff have multiple avenues available for finding OSH guidance materials and it appears that NIOSH’s last compilation of resources for these individuals was four years ago, this project was undertaken to review the current body of literature on the subject and highlight resources that are particularly insightful and/or are not in the current NIOSH resource library.

Looking at Tables 3 and 5, it is apparent that either formal educational materials for OSH topics in veterinary and veterinary technical programs are lacking or are restricted in access. The main limitation of this review is that only publicly available materials were included, which logically misses materials that are solely available to students and staff of the various
institutions. However, not all employees in veterinary clinics receive a formal education in OSH topics, and it is reasonable to assume any VM/AC worker could be interested in learning more about preventing hazards in the workplace and conducting web searches. The materials outside of the institutions that are available are either comprehensive and require purchase or are free but narrow in scope. The overall lack of available materials related to occupational safety and health in veterinary medicine may make a stronger statement than the materials that were found and analyzed. No single, readily accessible, all-hazards compendium or training was found for this field, suggesting this is a gap to be filled. The recommendation to NIOSH is to create such a resource, perhaps as a collaborative effort, to set a new baseline in the OSH knowledge for this group of workers.
7. References


8. Appendix

Handout from Colorado State University (n.d.) for zoonosis prevention in teaching hospital.
Pre-Exposure Rabies Vaccination for Personnel:

- Colorado is a rabies endemic region, and veterinary personnel have an elevated risk of exposure to this critically important zoonotic disease. See the rabies section of the Infection Control and Biosecurity SOP for detailed information about management of patients suspected of having rabies.

- All veterinary students are required to complete a fully rabies pre-exposure vaccination series during the first 45 days of their training, unless they have filed an exemption form with the CVMBS Dean’s office (See the official policy at: http://cvmbs.colostate.edu/Documents/dvm-policy-rabies.pdf).

- Pre-exposure vaccinations and serological testing are provided by CSU for half- to full-time employees meeting the conditions listed in the algorithm provided in the Infection Control SOP.


- Other employees, including hourly-employees that do not meet this criteria are encouraged to receive vaccination or serological testing at their own cost or at the cost of their supervisory unit.

- CSU does not routinely incur the costs for vaccination of hourly students, and work procedures should be amended to help avoid rabies exposures in these individuals.

- Because VVM Students are required to be vaccinated, upon hire, student hourly employees or student interns must provide proof of vaccination or protective filters within the 2 years prior to initiation of work duties in order to be employed in activities that include potential exposure to rabies infected animals.

Respiratory Protection, Splash Shields, and Dust Masks:

- Zoonotic agents transmitted through aerosols and droplets are a common hazard in the JLV-VTH. Information about recommended precautions and routes of transmission are available on the “Contagious and Zoonotic Disease Matrix”. Please refer to this resource when developing differential lists for patients to ensure that all diseases of high concern have been considered.

- The use of all types of respirators at Colorado State University is subject to review and approval by EHS prior to use. No employee may wear a respirator unless they have been through EHS’s respiratory protection program. The OSHA Respiratory Protection Standard regulates any use of respiratory protection.

- Respiratory protection may only be used by JLV-VTH Employees that have been trained, medically screened, fit-tested, and approved by the CSU Environmental Health Services. Every CSU employee that uses respiratory protection must participate in the Respiratory Protection Program. For more information see: http://www.ehs.colostate.edu/wresp.

- Students, volunteers, clients, and employees not enrolled in the CSU Respiratory Protection Program MAY NOT use respirators at the JLV-VTH, and must be excluded from activities where these devices are needed.

- Respiratory protection commonly used in the VTH include N-95 respirators and powered air purifying respirators (PAPRs), and only certified employees may use these devices.

- Dust masks, surgical masks, and splash shields are NOT respiratory protection devices, and do not provide protection from small particle aerosols containing zoonotic agents, chemicals, or vapors. These devices can be worn by anyone in the course of their duties without prior approval, including students.

- Respiratory protection is required when managing patients infected with zoonotic diseases that can be transmitted by small-particle aerosols (i.e., patients known or suspected of having plague, tularemia, tuberculosis, anthrax, Q-fever, influenza [in ferrets, pigs, or birds], or hantavirus).

- Splash shields or other PPE should be worn whenever large droplet aerosols are being generated that may contain infectious agents (e.g., pressure cleaning of contaminated areas, managing dogs with leptospirosis, surgery or post-mortem procedures that generate droplet aerosols, etc).