Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Personnel

National Association of State Public Health Veterinarians

Veterinary Infection Control Committee 2015

The NASPHV VICC

Carl J. Williams (Co-Chair), DVM, DACVPM, State Public Health Veterinarian, North Carolina Department of Health and Human Services, Raleigh, NC 27699.

Joni M. Scheftel (Co-Chair), DVM, MPH, DACVPM, State Public Health Veterinarian, Minnesota Department of Health, Saint Paul, MN 55155.

Brigid L. Elchos, RN, DVM, Deputy State Veterinarian, Mississippi Board of Animal Health, Jackson, MS 39207.

Sharon G. Hopkins, DVM, MPH, Public Health Veterinarian, Public Health, formerly of Public Health—Seattle & King County, Seattle, WA 98104.

Jay F. Levine, DVM, MPH, Department of Population Health and Pathobiology, College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27606.

Consultants to the Committee

Michael R. Bell, MD, CDC, Atlanta, GA 30333.

Glenda D. Dvorak, DVM, MPH, Center for Food Security and Public Health, Iowa State University, Ames, IA 50011.

Renee H. Funk, DVM, MPH&TM, DACVPM, National Institute for Occupational Safety and Health (NIOSH), Atlanta, GA 30333.

John D. Gibbons, DVM, MPH, DACVPM, NIOSH, Cincinnati, OH 45226.

A. Chea Hall, DVM, AVMA, Schaumburg, IL 60173.

Stacy M. Holzbauer, DVM, MPH, DACVPM, Office of Public Health Preparedness and Response, CDC, Atlanta, GA 30333, and Minnesota Department of Health, Saint Paul, MN 55164.

Steven D. Just, DVM, MS, DACVPM, USDA APHIS Veterinary Services (USDA APHIS VS), Saint Paul, MN 55107.

Oreta M. Samples, CVT, NPH, DHS, National Association of Veterinary Technicians in America (NAVTA), Alexandria, VA 22304.

Michelle Traverse, CVT, MLA, American Animal Hospital Association (AAHA), Lakewood, CO 80228.

This article has not undergone peer review; opinions expressed are not necessarily those of the AVMA.

Address correspondence to Dr. Williams (carl.williams@dhhs.nc.gov).

Preface

The VSP outlined in this compendium represent routine infection prevention practices designed to minimize transmission of zoonotic pathogens from animals to veterinary personnel. This compendium has been extensively revised and updated since the 2010 version.[1] Importantly, the concept of occupational safety and health in veterinary medicine is beginning to achieve equity with employee safety and health in human health care. The NORA states that "[v]eterinary 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."[2] The NORA had not previously addressed the veterinary medical workforce, but a shift occurred in 2013, when veterinary medical occupational safety and health was included as a component of the NORA.

Preventing transmission of zoonotic diseases from animals to veterinary personnel represents 1 component of a comprehensive safety and health program. This compendium places infection prevention in this context and endorses the concept of conducting workplace risk assessments and using a hierarchy of controls to minimize employee safety and health risks. The hierarchy of controls refers to a range of measures that may be taken to reduce the risk posed by workplace hazards: elimination, substitution, engineering, and administrative procedures and use of PPE.

A thorough review of the human and veterinary medical literature has been conducted and has resulted in updates to a number of recommendations. Of note, hand hygiene recommendations have been updated to embrace use of alcohol-based hand gels as an important strategy for improving overall hand hygiene compliance in veterinary clinical settings.

I. INTRODUCTION

A. OBJECTIVES

Within the context of a comprehensive employee safety and health program, the objectives of the compendium are to address infection prevention and control issues specific to veterinary practice, provide practical, science-based veterinary infection control guidance, and provide a model infection control plan for use in individual veterinary facilities.

Since 2003, employee safety and health in the veterinary workplace, particularly infection prevention, has garnered increasing attention in the United States and other countries.[3–5] The 2003 monkeypox outbreak was a clear example of the risk of zoonotic disease transmission in veterinary practice and led to the development of a novel set of infection control guidelines for veterinarians.[6,7] A cohort study[8] of potentially exposed veterinary personnel working in veterinary practices in which prairie dogs associated with the outbreak were examined as patients identified occupational risk factors for monkeypox transmission and highlighted the importance of infection control practices.

Abbreviations

ACIP	Advisory Committee on Immunization Practices
ADA	Americans with Disabilities Act
EPA	US Environmental Protection Agency
HCSA	Health care and social assistance
NASPHV	National Association of State Public Health Veterinarians
NORA	National Occupational Research Agenda
OSHA	Occupational Safety and Health Administration
PPE	Personal protective equipment
VSP	Veterinary Standard Precautions

B. BACKGROUND

Zoonotic diseases are recognized occupational hazards faced by veterinary personnel on a daily basis.[9–12] It is known that 868 of 1,415 (61%) known human pathogens and 132 of 175 (75%) emerging diseases that affect humans are zoonotic.[13] There are > 50 zoonotic diseases of importance in the United States (**Appendix 1**).[14,15] Documented zoonotic infections in veterinary personnel include the following: salmonellosis,[16–19] cryptosporidiosis,[20–25] plague,[26,27] sporotrichosis,[28–32] methicillin-resistant *Staphylococcus aureus* infection,[33–35] psittacosis,[36–39] dermatophytosis,[40,41] leptospirosis,[42–44] bartonellosis,[45,46] and Q fever.[47–50]

The American Association of Feline Practitioners published feline zoonoses guidelines in 2005 to provide veterinarians with educational information for clients and to highlight infection control procedures for small animal hospitals.[51] In 2006, the NASPHV published online the first Compendium of Veterinary Standard Precautions that systematically addressed various infection prevention strategies specifically for veterinary personnel. Results of 2 surveys[52,53] published in 2008 identified deficiencies in the awareness and use of personal protective measures among veterinary staff.

In the United States, the OSHA has promulgated a variety of specific standards that apply to individual workplace hazards. Of note, the OSHA has created a Personal Protective Equipment Standard and a Respiratory Protection Standard, which provide guidelines for workers exposed to contact, droplet, and airborne transmissible infectious agents.[54] At the state level, California has developed a General Industry Safety Order that declares "every employer with facilities, operations or services that are within the scope of this standard shall establish, implement, and maintain effective procedures for preventing employee exposure to zoonotic aerosol transmissible pathogens…." This order is inclusive of veterinarians.[55]

For situations where the OSHA has not promulgated specific standards, employers are subject to the general duty clause (29 U.S.C. § 654 Sec. 5) and should provide safety and health control measures to ensure a safe work environment. Consistent with the general duty clause, some states, such as Washington, require employers to develop and

implement a written accident prevention program to identify and address worksite safety and health hazards.[56] This law applies to veterinarians and their staff. A general overview of workers' rights to a safe workplace under the Occupational Safety and Health Act is available.[57]

The NORA was initiated in 1996 to stimulate innovative research and improved workplace practices. There are 10 NORA Sector Councils to guide research in each sector (including but not limited to construction, manufacturing, and HCSA).[58] The HCSA sector includes all aspects of human health care. However, veterinary medicine and animal care were never included in any of the original sectors. Owing to a relative similarity between veterinary and human medicine, and following the one-health concept, veterinary medicine and pet care were rolled into the NORA HCSA sector in 2013.[2] The NORA HCSA sector now identifies goals for improving the workplace safety of veterinary medical and animal care workers.

Within the NORA HCSA sector are several goals that apply to both human and veterinary medical providers. These include the following:

- Promote a culture of safety.
- Reduce the incidence of musculoskeletal disorders.
- Reduce or eliminate exposures to and adverse outcomes from hazardous chemicals.
- Reduce injuries related to sharps.

Also within the NORA HCSA sector are several goals that apply specifically to veterinary medical providers. These include the following:

- Minimize or prevent occupational exposure of personnel to zoonotic diseases.
- Reduce the occurrence of animal-inflicted injuries.
- Minimize or prevent occupational exposures to respiratory hazards.
- Reduce potential reproductive hazards.

C. SCOPE AND LIMITATIONS

This edition of the NASPHV Compendium of Veterinary Standard Precautions provides updated infection prevention recommendations, references, and concepts. However, it should be noted that infection prevention is only 1 component of an employee safety and health program. As indicated in the NORA HCSA goals, worker safety and health extends far beyond preventing zoonotic disease transmission. This compendium provides guidance to minimize transmission of zoonotic pathogens between employees and animal patients. It does not address prevention of disease transmission between patients (nosocomial disease transmission); however, many of the same principles apply.

D. CONSIDERATIONS

In general, provision of a safe work environment is accomplished through the assessment of risks in the workplace and application of a hierarchy of controls to manage those risks. A hierarchy of controls is a systematic method of hazard reduction implemented by employers to control (or eliminate) risks posed by workplace hazards, such as zoonotic diseases (**Figure 1**).

In the context of zoonotic diseases, the aim is to interrupt the disease transmission cycle at 1 or more points. Transmission of disease requires an infectious source (the animal patient), a susceptible host (the veterinary employee), a route of transmission (contact [direct or indirect], aerosol, or vector-borne transmission), and a portal of entry (eg, an open wound or mucous membrane). A successful control measure will reliably interrupt transmission at some point and could be termed infection prevention. Control measures include the following:

- **Elimination or substitution of the hazard**—In general, this is the most effective measure, as it requires no action on the part of the employee. The hazard has been identified and eliminated. An example would be exclusion of exotic pets or native wildlife from a clinic because of the disease risk; such animals would include macaques and skunks that are associated with a risk of herpes B virus or rabies virus transmission.
- **Engineering controls**—A veterinary clinic is designed to facilitate infection prevention best practices. An example would be placement of sinks for handwashing in convenient locations.
- **Administrative controls**—Clinic policies are adopted that mandate appropriate infection prevention practices. Administrative controls are generally not considered as effective as elimination or engineering controls because they require rigorous adherence to the policy by all employees. Examples would be the requirement for handwashing between patient contacts, no recapping of needles, and rabies vaccination of staff.
- **PPE**—This control measure is generally considered the least effective and the last line of defense because it requires the most action from the employee. The use of PPE requires routine adherence to and appropriate use of a variety of equipment and is dependent on employee training. Personal protective equipment is frequently and appropriately used in veterinary practice when engineering and administrative control options are limited. An example would be wearing a mask and face shield while performing dental procedures.

The VSP are derived from standard precautions applicable to human medicine, which are the cornerstone of infection prevention in human health-care settings.[59] In addition, the VSP also include strategies to reduce the potential for animal bites and other trauma that may result in exposure to zoonotic pathogens. During their careers, approximately two-thirds of veterinarians report a major animal-related injury that resulted in lost work time or hospitalization.[9,10,60–62] The most common occupational injuries among veterinary personnel include animal bites and scratches, kick and crush injuries, and needlesticks.[63–72]

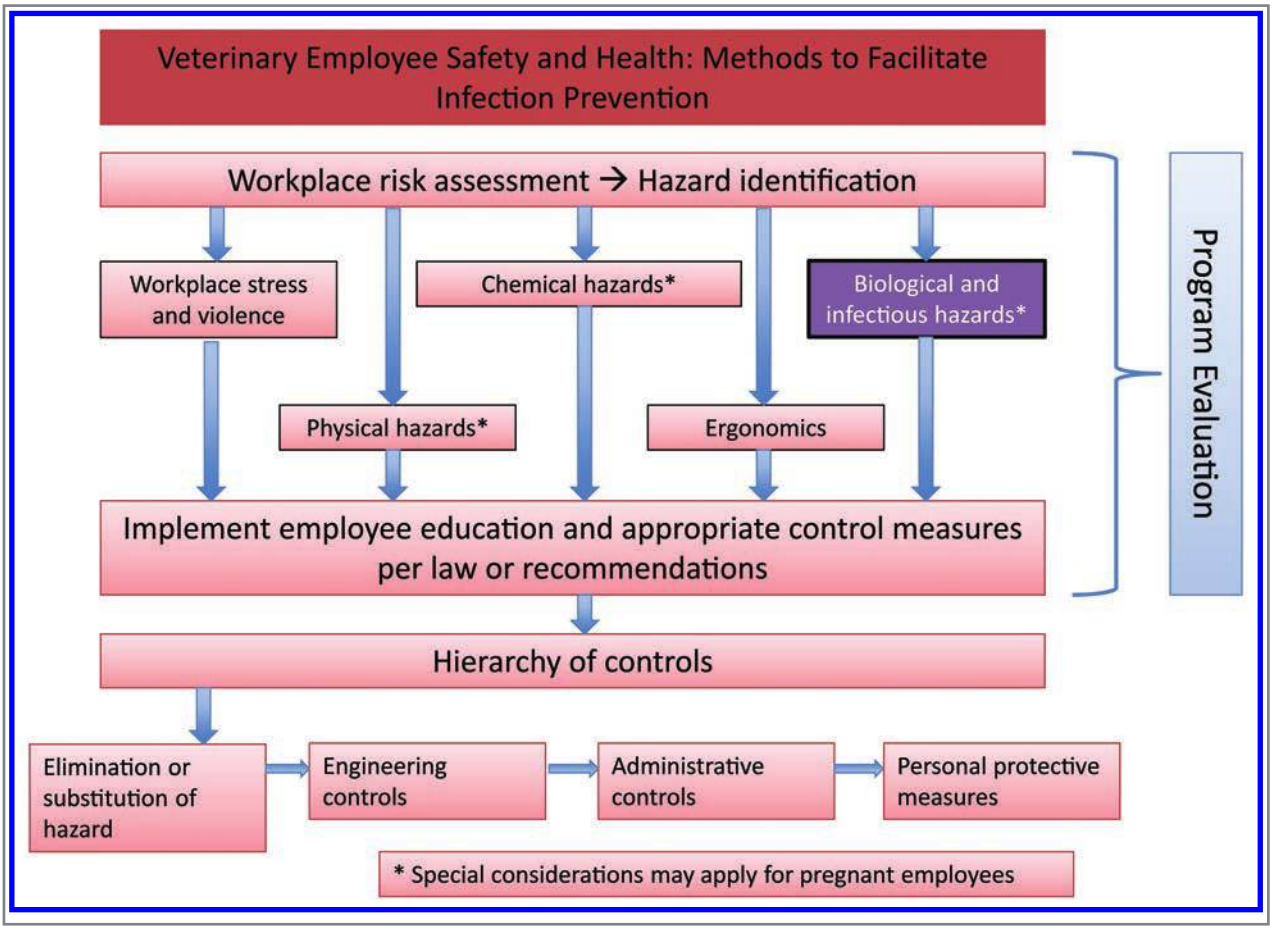

Figure 1—Hierarchy of controls for methods to facilitate infection prevention among veterinary practice employees.

The VSP described in this document should be used consistently by veterinary personnel—regardless of the clinical condition or the presumed diagnosis of animals in their care—whenever personnel may be exposed to potentially infectious materials including feces, blood, body fluids, vomitus, exudates, work surfaces contaminated with these items, and nonintact skin. Although the VSP are intended to be adaptable to individual practice needs and circumstances, any modifications should adhere to basic principles of infection prevention and comply with federal, state, and local regulations.

Although it may not be possible to eliminate all zoonotic disease hazards, employers should conduct a workplace risk assessment and implement appropriate control measures where possible. Adherence to a well-developed employee safety and health program will minimize the risk of injury and illness. This compendium provides reasonable guidance for minimizing 1 type of workplace hazard—zoonotic disease transmission—among veterinary personnel in clinical settings through the application of the VSP.

II. ZOONOTIC DISEASE TRANSMISSION AND INFECTION PREVENTION

Pathogens are transmitted via 3 major routes: contact, aerosol, and vector-borne. Some agents may be transmitted by multiple routes of infection.[59] Infection prevention or control refers to policies and procedures used to minimize the risk of spreading pathogens through any of these routes of transmission.

A. CONTACT TRANSMISSION

Contact transmission occurs when pathogens from animals or their environments enter a human host through ingestion or through cutaneous, percutaneous, or mucous membrane exposure. Many zoonotic pathogens are transmitted from animals to people by hand-to-mouth contact either directly from animals or indirectly through the environment. Direct transmission may occur during examination, treatment, and handling of animals. Indirect transmission involves contact with a contaminated intermediate—objects such as cages, equipment, workplace surfaces, and soiled laundry. The role of the clinic or work environment in transmission of disease can be very important.[16,19,73–75]

B. AEROSOL: AIRBORNE AND DROPLET TRANSMISSION

Droplet transmission occurs when droplets created by coughing, sneezing, and vocalization

are deposited on the mucous membranes. These droplets are typically large, can generally travel only approximately 1 to 2 m (3 to 6 feet), and do not remain suspended in the air. Procedures such as lancing abscesses or dentistry can also produce droplets. Examples of zoonotic pathogens that are transmitted by droplets include avian influenza virus and *Rhodococcus equi*. Risk of pathogen transmission increases with proximity to the source and duration of exposure.

Airborne transmission occurs when small droplets or particles that are created remain suspended in the air for extended periods and are inhaled. These small droplets or particles can be disseminated by air currents in a room or through a facility. They may be generated through medical procedures such as suction and bronchoscopy and during cleaning, particularly with high-pressure sprayers. Certain airborne pathogens may remain infective over long distances depending on particle size, the nature of the pathogen, and environmental factors.[59,76] Two zoonotic pathogens transmitted over long distances are *Coxiella burnetii* and *Mycobacterium bovis*.[77–81]

C. VECTOR-BORNE TRANSMISSION

Vector-borne transmission occurs when vectors such as mosquitoes, fleas, and ticks transmit pathogens. Animals may bring flea and tick vectors into contact with veterinary personnel. Working in outdoor settings may increase the risk of exposure to arthropods.

III. VETERINARY STANDARD PRECAUTIONS

A. HAND HYGIENE

Consistent, thorough hand hygiene is the single most important measure veterinary personnel can take to reduce the risk of zoonotic disease transmission. Most common pathogens are transmitted by hand-to-mouth contact either directly from animals or indirectly through the environment.[82–84] Hand hygiene includes handwashing with soap and water, the use of alcohol-based hand rubs, and appropriate use of gloves. Adequate hand hygiene may include washing the forearms when contamination extends beyond the wrist.

Hand hygiene should be performed after contact with feces, body fluids, vomitus, or exudates; after contact with articles contaminated by these substances; after contact with environmental surfaces in animal areas; and after removing gloves. Hand hygiene should be consistently performed between examinations of individual animals or animal groups (eg, litters of puppies or kittens, groups of cattle).

Either plain or antimicrobial soaps are appropriate for routine handwashing, which removes loosely adherent transient flora from the hands.[85] Transient flora reside in the uppermost layers of the stratum corneum; are acquired through contact with animals, people, or the environment; and are most frequently associated with infection transmission. Transient flora may be removed by the mechanical friction or detergent properties of soap and water or killed by antiseptic agents. In contrast, resident flora are of low pathogenicity, are permanent residents of the deeper layers of the skin, and are not susceptible to mechanical removal; if the goal is to reduce their numbers, such as when scrubbing for a surgical procedure, an antiseptic agent must be used.[85] Several antiseptic products with variable efficacy against different classes of microorganisms are available (**Appendix 2**).[82,84,86]

Hand soaps may be susceptible to bacterial overgrowth and have been associated with nosocomial infections.[87] To prevent creation of a bacterial reservoir or cross-contamination, no additional soap should be added to liquid soap dispensers before they are empty (ie, they should not be topped off); once completely empty, refillable dispensers should be cleaned and dried, then refilled with liquid soap or sealed soap refills.[82] Water temperature has little effect on the removal of microorganisms from hands, but warm (as opposed to cold) water improves compliance.[88] Moisturizing soaps and lotions can preserve skin integrity and encourage adherence to hand hygiene protocols among veterinary staff. Dry, cracked skin is painful, indicates compromised skin integrity, and is more likely to be colonized with staphylococci and gram-negative organisms.[82] When hand lotions are used, personal containers are recommended over use of shared dispensers to prevent contamination.

Staff members who have animal contact should not wear artificial nails and should keep fingernails short.[82,89] Wearing rings and other jewelry reduces the effectiveness of hand hygiene; as a result, the skin underneath rings and other jewelry can become more heavily colonized with organisms.[82] Additionally, the use of community or shared towels should be avoided. Disposable towels should be used for the drying of hands.[82,90]

Alcohol-based hand rubs are fast-acting, broad-spectrum germicides that kill microorganisms by denaturing microbial proteins.[85] They lack residual activity, but can be combined with other antiseptic products (eg, chlorhexidine or triclosan) to enhance persistence (Appendix 2). Hand rubs are generally well tolerated owing to the addition of emollients. Hand rubs, when properly applied for 30 seconds to hands that are not visibly soiled, are highly effective against bacteria, many fungi, and enveloped viruses.[82,91–93] Hand rubs are less effective against bacterial spores, protozoal parasites, and some nonenveloped viruses.[82,94,95] In the field, when running water is not available and hands are visibly soiled, use of a moist wipe to remove organic material prior to application of an alcohol-based hand rub may increase the effectiveness of hand hygiene. Use of moist wipes alone is not recommended.[82] The CDC recommends hand rubs

containing 60% to 95% ethyl alcohol (ethanol) or isopropyl alcohol (isopropanol) for use in health-care settings.[82] Hand antisepsis products containing other disinfectants may be susceptible to bacterial overgrowth and have been associated with nosocomial infections.[96–99]

Hand hygiene performed with an alcohol-based hand rub requires approximately a third of the time required to perform handwashing with soap and water.[85] For this reason and because hand rubs are well tolerated and easily accessible, they are gaining acceptance in veterinary medicine as an important strategy for improving overall hand hygiene in clinical settings.[100,101] Strategic placement of hand rub dispensers increases access to hand hygiene where soap and running water are not immediately available, such as in examination rooms and outdoor stalls.[101] However, it is important to train staff that the visible presence of organic matter (eg, blood or feces) on hands will greatly decrease the efficacy of alcohol-based hand rubs.

The importance of hand hygiene cannot be overemphasized. Personal adherence to hand hygiene protocols can be negatively influenced by several factors including inaccessible hand hygiene supplies, skin irritation, high workload, and insufficient time.[102] Compliance with hand hygiene protocols among veterinary personnel can be improved when adherence is made as simple and convenient as possible, with regular training uniquely tailored to individual workplaces and delivered in innovative ways, and, most importantly, when senior team members consistently display good hand hygiene practices.[103,104]

Correct handwashing procedure:

- Wet hands with running water.
- Place soap in palms.
- Rub hands together to make a lather.
- Scrub hands thoroughly for 20 seconds.
- Rinse soap off hands.
- Dry hands with a disposable towel.
- Turn off faucet using the disposable towel to avoid hand contact.

Correct use of hand rubs:

- Place alcohol-based hand rub in palms.
- Apply to all surfaces of hands.
- Rub hands together until dry.

B. PERSONAL PROTECTIVE ACTIONS AND EQUIPMENT

The following sections highlight a variety of PPE intended to prevent the transmission of zoonotic infectious agents to veterinary employees. However, the personal protective value of PPE is realized only if there is a collective culture that supports the use of PPE and if the necessary gloves, face shields, respirators, gowns, and other supplies are readily accessible when needed.

Personal protective equipment is equipment worn to minimize exposure to serious workplace injuries and illnesses. As stated by OSHA, "when engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, employers must provide PPE to their workers and ensure its proper use. Employers are also required to train each worker required to use PPE to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear, and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment."[105,106]

1. Gloves

Gloves reduce the risk of pathogen transmission by providing a barrier that can be efficiently removed when soiled.[107,108] Gloves should be worn routinely when contact with feces, body fluids, vomitus, exudates, and nonintact skin is likely. They should be worn when performing dental or obstetric procedures, resuscitations, and necropsies and when handling diagnostic specimens (eg, urine, feces, aspirates, or swabs). Gloves should also be used when cleaning cages, litter boxes, and contaminated equipment and environmental surfaces in animal areas and when handling dirty laundry. Gloves should also be worn when personnel have wounds or other compromised skin integrity of the hands. Gloves are not necessary when examining, handling, vaccinating, or obtaining a blood sample from most healthy animals, provided good hand hygiene is practiced.

Gloves should be changed between examinations of individual animals or animal groups, between dirty and clean procedures performed on a single patient, and whenever torn. Gloves should never be washed and then reused for another procedure.[109,110] Gloves should be removed immediately after use and before beginning other activities. During removal, care should be taken to avoid skin contact with the outer glove surface. Wearing gloves (including palpation sleeves) does not preclude the need for hand hygiene. Handwashing should be performed or alcohol-based hand rubs should be used immediately after glove removal because gloves may have undetected microperforations or hands may be contaminated during glove removal.[111,112]

Gloves are available in a variety of materials, such as latex, nitrile, and vinyl. Choice of gloves depends on their intended use; a range of sizes should be available to encourage use. Some personnel exposed to latex may experience allergic reactions. Further information regarding prevention of allergic reactions to natural rubber latex in the workplace is provided by the National Institute for Occupational Safety and Health.[113,114]

2. Facial Protection

Facial protection prevents exposure of the mucous membranes of the eyes, nose, and mouth to infectious materials. Facial protection should be used whenever exposure

to splashes or sprays is likely to occur (eg, when lancing abscesses, flushing wounds, or suctioning and when performing dentistry, obstetric procedures, or necropsies).[59,115–118] A face shield or goggles worn with a surgical mask provide adequate facial protection during most veterinary procedures that generate potentially infectious sprays and splashes.

3. Respiratory Tract Infection

Respiratory tract protection is designed to protect the airways of employees from infectious agents. In veterinary medicine, molded N95 and N99 particulate respirators are the most commonly used equipment option when respiratory tract protection is needed. Employers and employees must understand and distinguish between respirators and surgical masks, which are designed for very different functions. Respirators are designed and certified to prevent inhalation of small airborne contaminants. Surgical masks are designed to protect the patient and do not provide the same level of protection for the wearer as a respirator.[119]

Pathogens such as *C burnetii*, *Brucella* spp, and *Chlamydophila psittaci* are known to present an occupational risk to veterinary staff; use of respiratory tract protection is recommended when exposure to these and other airborne pathogens is likely.[120–122] Additionally, respiratory tract protection is warranted for procedures that are likely to generate aerosols, such as the use of power tools during necropsy.[123]

Respirator use requires compliance with OSHA's respiratory tract protection standard (29 CFR 1910.134), and employers must address the following elements to fulfill the respiratory tract protection program criteria[124]:

- Develop a written respiratory tract protection program.
- Select the appropriate respirator for use.
- Identify a physician to perform medical evaluations and provide a medical determination for each employee.
- Perform fit testing.
- Provide education on proper respirator use including donning and doffing, cleaning, disinfection, maintenance, storage, and repairs.

Given the strict requirements of the respiratory tract protection standard, it may be desirable to identify other means, such as engineering or administrative controls, to address risk from specific airborne pathogens. Nonetheless, in certain situations, use of respiratory tract protection may be the only feasible means of addressing the risk.

4. Protective Outerwear

Protective outerwear includes laboratory coats, smocks, aprons, coveralls, nonsterile gowns, footwear, and head covers. The purpose of protective outerwear is to limit the transfer of pathogens between the wearer and the patient, and its importance in infection control is often underappreciated.[125–127]

a. *Laboratory coats, smocks, aprons, and coveralls*

Laboratory coats, smocks, aprons, and coveralls serve as a temporary layer of protection that prevents contamination of the wearer's garments. Protective outerwear should be worn when attending animals and when conducting cleaning chores. In situations where splashing or soaking with potentially infectious liquids is anticipated, impermeable outerwear, such as a disposable plastic apron, should be used.[128]

Garments should be changed and laundered daily and whenever they become visibly soiled or contaminated. Protective outerwear should not be worn outside the work environment, and coveralls should be changed between visits to different farm premises, facilities, locations, or herds.[59,129,130]

b. *Nonsterile gowns*

Nonsterile gowns are generally worn when attending a single patient to protect the wearer and prevent movement of infectious material from one location to another. Permeable gowns can be used for general care of animals in isolation. Impermeable gowns should be used when exposures to splashes or large quantities of body fluids are anticipated. Disposable gowns should not be reused. Washable protective garments may be used repeatedly to care for the same animal kept in isolation, but should be laundered between contacts with different patients or whenever soiled. Whenever gowns are worn, gloves should also be used; the outer (contaminated) surface of a gown should be touched only with gloved hands. Fabric gowns should be removed and placed in a laundry receptacle and gloves put into a refuse bin before leaving the animal's environment. Hand hygiene should be performed immediately after these items have been removed.[116]

Gowns should be removed as follows[131]:

- After unfastening ties, peel the gown from the shoulders and arms by pulling on the chest surface with gloved hands.
- Remove the gown, avoiding contact between its outer surface and clean surfaces.
- Wrap the gown into a ball while keeping the contaminated surface on the inside; place in a designated receptacle.
- Remove gloves and place them in a refuse bin; wash hands.
- When body fluids have soaked through the gown, promptly remove contaminated clothing and wash the skin.

c. *Footwear*

Footwear should be suitable for the specific working conditions (eg, rubber boots for farm work) and should protect personnel from both trauma and exposure to infectious material. Recommendations include shoes or boots with thick soles and closed-toe construction that are impermeable to liquids and easy to clean. Footwear should be cleaned to prevent transfer of infectious material from one environment to another, such as between farm visits and before returning from a field visit to a veterinary facility or home. Disposable shoe covers or booties add an extra level of protection when heavy quantities of infectious materials are known or expected to be present. When leaving contaminated work areas, promptly remove and dispose of shoe covers and booties. Disposable shoe covers should not be worn on slippery surfaces; water-impervious boots that can be disinfected after use should be worn as an alternative.

d. *Head covers*

Disposable head covers provide a barrier when contamination of the hair and scalp may occur, such as in livestock barns, or in situations involving airborne pathogens. Disposable head covers should not be reused.

C. PROTECTIVE ACTIONS DURING VETERINARY PROCEDURES

1. Patient Intake

Waiting rooms should be a clean and safe environment for clients, animals, and veterinary personnel. Staff training regarding waiting room protocol for reception area personnel should include instruction to pose basic questions to incoming clients about the reason for the visit and to observe every pet for behavioral cues and outward signs of illness. Animals that are fearful, are aggressive, or have a known exposure to an infectious agent should bypass the waiting room and be placed directly into an examination or isolation room, as should those with the following so-called red flag signs: neurologic signs, diarrhea, respiratory tract signs, fever, infected wounds, or chronic infection. Consider providing alcohol-based hand rub dispensers in the waiting room and at the desks where clients check in and out.

2. Animal Handling and Injury Prevention

Proper handling and restraint of animals decrease the possibility of staff receiving bites, scratches, needlesticks, and other animal-related injuries, which are associated with risk for zoonotic infections. Most injuries among veterinary personnel occur during animal handling or treatment.[132] Preventive measures include reliance on experienced veterinary personnel rather than owners to restrain animals and the use of muzzles, bite-resistant gloves, and sedation or anesthesia as necessary.[133] Veterinary personnel should be trained to remain alert for changes in a patient's behavior. Aggressive or fearful tendencies and bite history should be recorded in the patient's record, communicated to personnel, and indicated with signage on cages and enclosures. Those working with large animals are at risk for kick and crush injuries. Proper livestock-handling equipment should be used, and an escape route should be kept in mind at all times.[9,10] Veterinarians have the right to refuse services if large animal–handling facilities are not available or are not adequate to ensure their safety and the safety of those assisting them. Similarly, veterinarians have the right to refuse to provide services for clients with exotic species or wildlife that cannot be handled safely because of physical infrastructure or clinician or staff training limitations.

Preplanning, adequate equipment, and clear communication with coworkers while working with animals are key to preventing animal-related injuries. First aid supplies, including eyewash, should be readily available, and personnel should know where the supplies are located and how to use them. Incident response procedures should be displayed prominently.

3. Examination of Animals

Animals with potentially infectious diseases should be examined in a dedicated examination or isolation room and should remain there until initial diagnostic procedures and treatments have been performed. Contact with animals suspected of having an infectious disease should be limited to essential personnel who should wear protective outerwear and use gloves and other protective equipment appropriate for the situation.

The examination room used for this purpose should remain out of service until properly cleaned and disinfected. Every examination room should have an easily accessible source of running water, a soap dispenser, and paper towels. In addition, it is recommended that alcohol-based hand rubs be available in the examination room.

4. Injection, Venipuncture, and Aspiration Procedures

a. *Needlestick injury prevention*

Needlesticks are common in veterinary medicine, can cause serious injury, and may result in a loss of work time.[70] Needlesticks may result in the inoculation of vaccines containing live organisms, harmful chemicals, hormones, chemotherapeutics, or infective materials; in ad-

dition, the wound can serve as a portal of entry for pathogens.[71] Needlestick injuries are preventable. Following the passage of the Needlestick Safety and Prevention Act in 2000, percutaneous injuries among human hospital employees decreased by 38% in the first year of implementation and remained low in subsequent years.[134] To promote a culture of safety and reduce workplace injuries, a NORA HCSA goal of promoting the use of safety devices to prevent needlestick injuries among veterinary personnel employed in all work settings has been set.[2] Records of needlestick injuries should be kept and analyzed so that interventions specific to the practice may be implemented and protocols corrected as necessary.

Clinic personnel should be educated regarding the serious nature of needlestick injuries. Trained personnel should restrain animals to minimize needlestick injuries resulting from animal movement. Veterinary staff should not bend needles, pass an uncapped needle to another person, or walk around with uncapped needles. Needle caps should never be placed in the mouth. Needles should not be recapped unless the 1-handed scoop method is used:

- Place the cap on a horizontal surface.
- Hold the syringe with attached needle in 1 hand.
- Use the needle to scoop up the cap without use of the other hand.
- Secure the cap by pushing it against a hard surface.[135]

An approved sharps container (puncture- and leak-proof container designed for the safe collection of sharp medical articles for disposal) should be located in every area in which animal care occurs.[136–138] Following most veterinary procedures, a forceps can be used to remove the uncapped needle from the syringe, and the needle alone can be placed in the sharps container. Uncapped needles should never be removed from a syringe by hand. After aspiration of infectious materials or injection of vaccines containing live organisms, the used syringe with needle attached should be placed in a sharps container. Sharps containers should not be overfilled, and sharps should not be transferred from one container to another. Disposal of sharps and sharp containers must be done in accordance with applicable state and local laws.

b. *Barrier protection*

Currently, there are no data indicating that venipuncture of healthy animals constitutes an important risk of exposure to pathogens, and contact with animal blood (except primate blood) has not been reported as a source of occupationally acquired infection. Appropriate PPE should be worn when procedures are performed on animals suspected of having an infectious disease that may result in exposure to blood or other potentially infectious materials.

5. Dentistry

Dental procedures can generate splashes, sprays, and large droplets that are potentially infectious. Veterinary personnel and anyone in range of direct splashes or sprays should wear protective outerwear, a head cover, gloves, and facial protection. Dental procedures should be performed in a dedicated space—ideally a dental suite—with separate, dedicated equipment and appropriate ventilation.[139] Environmental surfaces can be easily contaminated during dental procedures. These surfaces should be cleaned and disinfected between patients and at the end of daily work activities.[140]

6. Resuscitation

The urgent nature of resuscitation increases the likelihood that breaches in infection control will occur. Standard emergency protocols and regular staff training regarding resuscitation are very important to minimize risk and reduce exposures. Barrier precautions, such as the use of gloves and facial protection, should be implemented to prevent exposure to zoonotic infectious agents that may be present. Never blow into the nose or mouth of an animal or into an endotracheal tube; instead, intubate the animal and use a manual resuscitator, anesthesia machine, or ventilator.

7. Obstetrics

Zoonotic agents, including *Brucella* spp, *C burnetii*, and *Listeria monocytogenes*, may be found in high concentrations in the birthing fluids of aborting or parturient animals and in stillborn fetuses and infected neonates. Gloves or sleeves, facial protection, and impermeable protective outerwear should be used routinely to prevent exposure to potentially infective materials.[141] Respiratory tract protection should be used when investigating abortions attributable to *C burnetii* infection (Q fever) or when other airborne pathogens are known or suspected risks.[142]

8. Necropsy

Necropsy is a high-risk procedure because of the possibility of injury and potential contact with infectious agents in body tissues, body fluids, and aerosols.[117,120] Nonessential persons should not be present during necropsy procedures. Veterinary personnel should routinely wear gloves, facial protection, and impermeable protective outerwear. In addition, eye protection

and respiratory tract protection used in the context of a respiratory tract protection program should be employed when band saws or other power equipment is used or there is a high probability of exposure to a zoonotic pathogen. Cut-proof gloves should be used to prevent sharps-associated injuries.

9. Diagnostic Specimen Handling

Samples of feces, urine, or vomitus; aspirate specimens; and swabs collected from the general patient population should be handled as though they contain infectious organisms. The sample containers should bear clear and detailed labeling and be stored in a designated refrigerator. Protective outerwear and disposable gloves should be worn when these specimens are handled. Discard gloves and wash hands before subsequently touching clean items such as telephones, medical records, or computer keyboards.[143] Specimens shipped for diagnostic testing must be packaged and labeled according to applicable regulations.[144]

10. Wound Care and Abscess Treatment

Many zoonotic pathogens can be associated with wound infections and abscesses.[145] Veterinary personnel should wear protective outerwear and gloves for debridement, treatment, and bandaging of wounds; facial protection should be worn when abscesses are lanced and wounds are lavaged. Hand hygiene should be performed after gloves are discarded and following removal of outerwear. Animals with infected wounds should be prevented from contaminating environmental surfaces, including floors. Used bandage materials and equipment such as bandage scissors and clipper blades should be considered contaminated and handled accordingly. Leftover bandaging material should be sterilized (autoclaved or gas sterilized) prior to storage for reuse because unused bandaging material may become contaminated with methicillin-resistant *S aureus* and other wound pathogens during wound care.[a]

D. ENVIRONMENTAL INFECTION CONTROL

The veterinary clinic environment can potentially serve as a source of pathogens for staff and patients. Controlling this potential reservoir of infection is increasingly recognized as an important component of infection control and prevention. Surfaces in a clinic can become contaminated with methicillin-resistant *S aureus*, *Salmonella spp*, and other pathogens; once introduced onto a surface, some pathogens may persist for months in the facility and serve as a source of infection for animals, their owners, and veterinary employees.[16,146–148] Additionally, equipment (eg, stethoscopes) can become contaminated with pathogens following physical examination.[149,150] Guidelines have been developed for hospital layout and design that address infection control issues and provide for ease of cleaning and disinfection of environmental surfaces.[151]

1. Cleaning and Disinfection of Equipment and Surfaces

Regular cleaning and disinfection of equipment and surfaces is critical for environmental control of pathogens. Equipment and surfaces must be cleaned with water and detergent before they are disinfected because organic material decreases the effectiveness of most disinfectants.[151–153] An EPA-registered disinfectant should be used according to label instructions, with attention to storage conditions, proper dilution, and contact time. When selecting a disinfectant, ensure that users will be able to accommodate all label requirements, including appropriate contact time. Quaternary ammonium compounds and hypochlorites are the most common disinfectants used on environmental surfaces in veterinary practices; however, hydrogen peroxide–based oxidizing agents are also effective against a wide range of veterinary microbes (**Appendix 3**).[152]

Equipment and surfaces should be cleaned and disinfected between uses or whenever visibly soiled. Special attention should be paid to surface areas with high contact rates (eg, examination tables, door knobs, cage latches, faucet handles, and sinks).[154] A written checklist should be developed for each area of the facility (eg, waiting room, examination rooms, treatment area, surgery suite, and kennels) that specifies the frequency of cleaning, disinfection procedures, products to be used, and the staff responsible. At a minimum, staff should perform hand hygiene after they have finished cleaning and before beginning other tasks.

Surfaces in areas where animals are housed, examined, or treated should be made of nonporous, easily cleaned materials. Generation of dust that may contain pathogens can be minimized by use of vacuums with high-efficiency particulate air filters, wet mopping, dust mopping, or electrostatic sweeping. Surfaces may be lightly sprayed with water prior to mopping or sweeping to minimize dust generation (wet mopping). Use of high-pressure sprayers and similar devices that can disseminate infectious particles should be avoided. However, if procedures that may generate infectious aerosols are undertaken, appropriate PPE should be worn.

Cleaning products and disinfectants may contain components harmful to human health. It is incumbent on employers to provide appropriate training as required by OSHA. This training must detail all physical, chemical, and biological hazards in the

workplace, and each cleaning and disinfectant products' label and safety data sheet should be easily accessible.[155]

Routine dishwashing is sufficient to clean food and water bowls used for most hospitalized patients. Toys, litter boxes, and other miscellaneous items should be discarded or cleaned and disinfected between patient uses. Litter boxes should be cleaned or disposed of at least daily by a nonpregnant staff member.

2. Isolation of Animals with Infectious Diseases

Animals with suspected or confirmed communicable diseases should be identified prior to arrival if possible and be examined, cared for, and housed in designated isolation rooms (small animals) or areas (large animals) to protect other patients and veterinary personnel. Isolation procedures should be prominently posted.[116] Isolation rooms or areas should be identified with signage, access should be limited, and a sign-in log should be used.

Only the equipment and materials needed for the care and treatment of the patient should be kept in an isolation room or area, and isolation supplies should not be removed for use elsewhere. Whenever possible, use of disposable articles such as bowls, litter pans, and gowns is recommended. Equipment that must be removed from the isolation room or area should be disassembled, cleaned, and disinfected prior to removal to prevent contamination of other areas of the hospital. Potentially contaminated materials should be bagged before transport within the facility and disinfected or disposed of in accordance with state rules governing disposal of medical waste.[116,156]

Limited data are available regarding the effectiveness of footbaths and foot mats for infection control in private veterinary practices.[157–159] Footbaths and foot mats are difficult to maintain properly, which limits their efficacy. Disposable, impermeable shoe or boot coverings made of plastic should be considered for use in isolation rooms. All PPE used when attending animals in isolation should be donned immediately prior to and doffed following care for the animal in an effort to limit movement of infectious organisms within the facility.

3. Handling of Laundry

Although soiled laundry may be contaminated with pathogens, the risk of disease transmission is negligible when soiled items are handled correctly.[160] Personnel should check pockets for sharps before items are removed and laundered. Gloves and protective outerwear should be worn when handling soiled laundry. Bedding and other laundry should be machine washed with any standard laundry detergent and machine dried at the highest temperature suitable for the material.[161] To prevent cross-contamination, separate storage and transport bins should be used for clean and dirty laundry. When soiled clothing is laundered at home, it should be transported in a sealed plastic bag, kept separate from household laundry, emptied from the bag directly into a washing machine, and thoroughly machine dried after completion of the wash cycle.[162–164]

4. Spill Response and Decontamination

Spills and splashes of potentially infective substances should be immediately contained with absorbent material (eg, paper towels, sawdust, or cat litter). Personnel should wear PPE sufficient to protect against potentially infective substances in the spill and the cleaning or disinfectant agent selected for use. The safety data sheet for each EPA-registered disinfectant will indicate appropriate PPE for use with the product.[165] The spilled fluids and absorbent material should be collected and sealed in a leak-proof plastic bag, and the area should be cleaned and disinfected. An EPA-registered disinfectant should be used with attention to storage conditions, label instructions, and contact time. Animals and people who are not involved in the cleanup should be kept away from the area until disinfection is completed. Creating a spill response kit with instructions in advance may expedite cleanup processes and enhance worker safety.

5. Medical Waste

Medical waste is regulated at the state level, and employers should become familiar with the applicable laws in their state.[166] Medical waste is defined by the EPA as "any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals."[167] Sharps and regulated medical waste are generally considered subsets of medical waste, and proper management of them is also based on state medical waste laws.

6. Rodent and Vector Control

Field veterinarians and any accompanying support personnel are likely to have the greatest risk of exposure to arthropod vectors that may transmit zoonotic pathogens. However, the risk of illness for any particular infection is not uniform across the United States.[168,169] Regardless of the geographic location of the field work, permethrin-treated clothing has been demonstrated to be highly effective at reducing tick bites and would be recommended for those veterinarians and assistants with occupational

exposures.[170] Animals may act as mechanical carriers for ticks, and it is important to check patients as they enter a clinic to limit introduction of arthropod vectors into the indoor work environment.[171]

Integrated pest management is the recommended approach to the control of rodents and vectors in veterinary medical buildings. Integrated pest management is a comprehensive approach to pest control based on an understanding of the life cycle and ecological niche of the pest. Pest populations are controlled largely by creating unfavorable environments; by removing the air, moisture, food, or shelter that pests need to survive; or by blocking access to buildings.[172,173] Pesticides and rodent traps may be used as part of a comprehensive plan that includes environmental control measures as follow:

- Sealing of potential entry and exit points into buildings with caulk, steel wool, or metal lath.
- Storage of food and garbage in metal or thick-plastic containers with tight lids.
- Disposal of food waste promptly.
- Elimination of potential rodent nesting sites (eg, clutter).
- Removal of sources of standing water (eg, empty buckets, tires, and clogged gutters) to reduce potential mosquito breeding sites.
- Installation and maintenance of window screens to prevent entry of insects and rodents.

Additional measures may be warranted for control of specific pests. For example, birds and bats should be excluded from hospital barns and veterinary medical facilities. Facility managers may wish to contact a pest control company for additional guidance.

7. Other Environmental Controls

It is important to provide an employee break room or area for eating and drinking. Such activities should be prohibited in laboratories, treatment rooms, and other patient care and housing areas. Separate, appropriately labeled refrigerators should be used for human food, animal food, biologics, and laboratory diagnostic samples. Dishware for human use should be washed and stored away from animal-care areas.

IV. OCCUPATIONAL HEALTH

A. GENERAL

Veterinary clinic managers should develop a comprehensive employee safety and health program on the basis of their own workplace risk assessment addressing the potential for animal-related and non–animal-related occupational injuries and illnesses.[174,175] Utilizing control measures that place the least amount of burden on the individual employee will be most effective. Personal protective equipment (while often essential) represents the least effective and least desirable control measure in any workplace environment. Some elements to consider when implementing a safety and health program follow.

1. Employee Vaccination Policies and Record Keeping

a. *Overview*

Veterinary practices should maintain up-to-date emergency contact information and staff records including vaccinations and rabies virus antibody titers. Employee health information should be collected on a voluntary basis and confidentially maintained. Employees should inform their supervisor of changes in health status, such as pregnancy, that may affect work assignments. New employees should receive training regarding the importance of informing their health-care provider that their work duties involve contact with animals.[176]

b. *Rabies*

Veterinary personnel should receive preexposure rabies vaccination and antibody titer checks in accordance with the ACIP recommendations.[177,178] Preexposure immunization against rabies consists of 3 IM doses of vaccine administered on days 0, 7, and 21 or 28. Periodic titer checks (generally every 2 years) should be performed, and a single rabies booster should be administered when immunity is defined as less than adequate by the performing laboratory. It should be emphasized that preexposure vaccination against rabies does not eliminate the need for additional rabies vaccinations following a known rabies virus exposure. It does, however, simplify the rabies postexposure treatment, and it may be protective in cases of unrecognized rabies exposure or when postexposure treatment is delayed.[178]

c. *Tetanus*

Tetanus prophylaxis and prevention recommendations for veterinary personnel are no different than those for the general public. However, because animal bites are tetanus-prone wounds, veterinarians and their staff may be at an elevated risk of exposure. Veterinary staff should receive a routine tetanus vaccination every 10 years in accordance with ACIP recommendations.[179] New personnel should be screened to ensure they are currently vaccinated for tetanus. Additionally, if a person sustains a wound, including a bite wound, and it has been more than 5 years since his or her last tetanus booster, a single dose of Tdap (tetanus, diphtheria, and pertussis) or Td (tetanus and diphtheria) vaccine should be administered. Persons who are not adequately immunized against tetanus may require tetanus immune globulin in addition to vaccine.[179,180]

d. *Influenza*

Owing to their extensive contact with animals and the public, veterinary personnel should receive influenza vaccine or vaccines in accordance with ACIP guidelines.[181–185]

2. Management and Documentation of Exposure Incidents

Workplace injuries and illnesses will still occur despite best efforts to identify and reduce hazards. The management team should review recent work-related injuries and illnesses in the practice to ascertain any patterns or cause. Additional or new administrative or engineering controls may be warranted. Another important step is to conduct refresher training for employees that addresses the cause of the incident and covers new control measures.

Pursuant to OSHA's recordkeeping and reporting requirement (29 CFR 1904), employers must complete the following[186]:

- Form 301: Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must complete this injury and illness incident report form that is specific to an individual event. This form will contain information about individual employee health and must be used in a manner that protects confidentiality of employees. You must keep this form on file for 5 years following the year to which it pertains.
- Form 300: Each incident, as recorded on Form 301, must be entered on Form 300. This is an injury and illness log that contains summary information for each event recorded on a Form 301. This will help employers identify trends and complete Form 300A. This form will contain information about individual employee health and must be used in a manner that protects confidentiality of employees.
- Form 300A (summary of injuries and illnesses): This report summarizes, for all employees, the number of work-related injuries and illnesses, the number of days away from work, and the total numbers of injury and illness types. This form will not contain confidential information and must be publicly posted for employees to review.
- Employers with 10 or fewer employees throughout the previous calendar year are not required to complete these forms. This exemption applies to employers in states with federal as well as state OSHA plans.[187]

3. Staff Training and Education

Comprehensive staff training and education are essential components of an effective employee safety and health program. Training should have defined objectives and a means of measuring the effectiveness of the training.[188] Furthermore, all training, whether written or oral, must be provided at a level of complexity and in a language that employees can understand.[189] Before new staff begin work, they should receive training that emphasizes infection control practices and the clinic infection control plan, the potential for zoonotic disease exposure, hazards associated with work duties, and injury prevention.[104,190–193] Training should also include instruction in animal handling, restraint, and behavioral cue recognition. Additional in-service training should be provided at least annually and as recommendations or policies change. Staff participation in infection control and hazard awareness training should be documented.

Although training is critical to reducing the incidence of occupational illness and injury, remember that it is only 1 component of an employee safety and health program. Practice managers and supervisors must ensure that all feasible engineering and administrative controls have been implemented on the basis of a workplace risk assessment.

B. IMMUNOCOMPROMISED PERSONNEL

Personnel with a weakened immune system as a result of disease or medication and pregnant women are more susceptible to infection with zoonotic agents and more likely to develop serious complications from zoonotic infections.[194] Employees with immunocompromising conditions should talk to their primary health-care provider to clarify work parameters and obtain guidance.

Occupational activities associated with a higher risk of exposure to zoonotic pathogens include processing laboratory samples, necropsy, and care of certain high-risk animals. High-risk animals include those that are young, parturient, unvaccinated, stray or feral, fed raw-meat diets, or housed in a shelter; animals with internal or external parasites; wildlife; reptiles and amphibians; and exotic or nonnative species.[195,196]

Although data regarding the risks of zoonotic infection for HIV-infected persons employed in veterinary settings are limited, there are none that justify their exclusion from the veterinary workplace.[197] Risk of exposure to zoonotic pathogens in the workplace can be mitigated through consistent use of the VSP outlined in this compendium.

C. PREGNANCY

Pregnancy presents a situation in which multiple potential occupational hazards must be addressed. The employer, on the basis of a workplace risk assessment, should provide information about hazards to which the employee and fetus may be exposed. Pregnant employees should consult with their health-care provider about potential hazards including zoonotic disease, chemicals, waste anesthetic gas, radiation, and lifting hazards. Employers must then provide reasonable workplace accommodation for the employee.

The ADA as amended in 2008 states that while pregnancy itself is not a disability, pregnant workers and job applicants are not excluded from the protections of the ADA. Pregnant workers with pregnancy-related impairments may demonstrate that they have

disabilities for which they may be entitled to a reasonable accommodation under the ADA. Also, if an employee is temporarily unable to perform her job because of pregnancy, the employer must treat her the same as any other temporarily disabled employee; for example, by providing light duty, modified tasks, alternative assignments, disability leave, or leave without pay.[198,199] Employees should notify managers as soon as they know they are pregnant so that potentially harmful activities may be avoided and necessary adjustments to workplace activities can be addressed.

Pregnant women are more susceptible to certain zoonotic infections owing to physiologic suppression of cell-mediated immunity. Conditions to which pregnant women are more susceptible include toxoplasmosis, lymphocytic choriomeningitis, brucellosis, listeriosis, and psittacosis.[200] Vertical transmission of certain zoonotic agents may result in miscarriage, stillbirth, premature birth, or fetal congenital anomalies.

V. CREATING A WRITTEN INFECTION CONTROL PLAN

Veterinary practices should have a written infection control plan.[3,53] A model infection control plan that can be tailored to individual practice needs is available in electronic format from the NASPHV website (**Appendix 4**).[201] Effective infection control plans should do the following:

- Provide explicit and well-organized guidance specific to the facility and practice type.
- Be flexible so that new issues can be addressed easily and new knowledge incorporated.
- Indicate the staff members responsible for each area, activity, or function.
- Provide contact information, resources, and references.

A. INFECTION CONTROL PERSONNEL

All veterinary personnel are responsible for supporting and carrying out the activities outlined in the practice's infection control plan; however, it is the practice management team and senior clinicians who must play a leadership role in establishing the culture of infection control practice. Staff members should be designated for development and implementation of specific infection control policies such as monitoring compliance, maintenance of records, and management and documentation of workplace exposures and injuries. Breeches in infection control practice should be addressed.

B. IMPLEMENTING THE INFECTION CONTROL PLAN

1. Leadership

The management team should set the standard for infection control practices, champion the importance of infection prevention in daily activities, and model desired behaviors such as hand hygiene after every patient contact.

2. New Staff

New staff members should be given their own copy of the infection control plan. Detailed training should be provided. Receipt of the plan and training should be documented for each employee.

3. Review and Revision

Practice management should evaluate incidents as they occur and evaluate processes and identify deficiencies that may necessitate engineering or administrative changes. Revisions should be communicated to all staff members. If deficiencies in training are identified, the management team should ensure that corrective measures are taken and employee retraining is instituted.

4. Compliance

All team members should ensure that infection control policies and protocols are carried out consistently and correctly.

5. Availability

Copies of the infection control plan and resource documents should be readily accessible to all staff, including reception, administration, animal care, and housekeeping personnel.

a. Bender J, Professor, College of Veterinary Medicine, University of Minnesota, Saint Paul, Minn: Personal communication, 2015.

VI. REFERENCES

1. Scheftel JM, Elchos BL, Cherry B, et al. Compendium of veterinary standard precautions for zoonotic disease prevention in veterinary personnel. National Association of State Public Health Veterinarians Veterinary Infection Control Committee 2010. *J Am Vet Med Assoc* 2010;237:1403–1422.
2. CDC. National Occupational Research Agenda: *National Healthcare and Social Assistance Agenda—February 2013*. Atlanta: CDC, 2013.
3. Australian Veterinary Association. Guidelines for veterinary personnel biosecurity, 2013. Available at: www.ava.com.au/biosecurity-guidelines. Accessed Aug 24, 2015.
4. Gyles C. Infection control in veterinary clinics. *Can Vet J* 2009;50:339–344.
5. Prescott JF, Weese JS. Infection control and best practice for small animal veterinary clinics. *Vet Rec* 2009;165:61.
6. CDC. Multistate outbreak of monkeypox—Illinois, Indiana, and Wisconsin, 2003. *MMWR Morb Mortal Wkly Rep* 2003;52:537–540.
7. CDC. Monkeypox infections in animals: updated interim guidance for veterinarians. Available at: stacks.cdc.gov/view/cdc/22657. Accessed Oct 7, 2015.
8. Croft DR, Sotir MJ, Williams CJ, et al. Occupational risks during a monkeypox outbreak, Wisconsin, 2003. *Emerg Infect Dis* 2007;13:1150–1157.
9. Langley RLPW, O'Brien KF. Health hazards among veterinarians: a survey and review of the literature. *J Agromedicine* 1995;2:23–52.
10. Nienhaus A, Skudlik C, Seidler A. Work-related accidents and occupational diseases in veterinarians and their staff. *Int Arch Occup Environ Health* 2005;78:230–238.
11. Robinson RA, Metcalfe RV. Zoonotic infections in veterinarians. *N Z Vet J* 1976;24:201–210.
12. Schnurrenberger PR, Masterson RA, Russell JH. Serologic surveys for selected zoonoses in Ohio veterinarians. *J Am Vet Med Assoc* 1964;144:381–383.
13. Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. *Philos Trans R Soc Lond B Biol Sci* 2001;356:983–989.
14. CDC. National Notifiable Disease Surveillance System (NNDSS). 2015 national notifiable conditions. Available at: wwwn.cdc.gov/nndss/conditions/notifiable/2015/. Accessed Oct 7, 2015.
15. USDA. NAHRS reportable disease list, 2011. Available at: www.

aphis.usda.gov/animal_health/nahrs/disease_list.shtml. Accessed Feb 18, 2015.
16. Cherry B, Burns A, Johnson GS, et al. *Salmonella* Typhimurium outbreak associated with veterinary clinic. *Emerg Infect Dis* 2004;10:2249–2251.
17. Pantekoek JF, Rhodes CS, Saunders JR. *Salmonella* folliculitis in veterinarians infected during obstetrical manipulation of a cow. *Can Vet J* 1974;15:123–125.
18. Visser IJ. Cutaneous salmonellosis in veterinarians. *Vet Rec* 1991;129:364.
19. Wright JG, Tengelsen LA, Smith KE, et al. Multidrug-resistant *Salmonella* Typhimurium in four animal facilities. *Emerg Infect Dis* 2005;11:1235–1241.
20. Anderson BC, Donndelinger T, Wilkins RM, et al. Cryptosporidiosis in a veterinary student. *J Am Vet Med Assoc* 1982;180:408–409.
21. Gait R, Soutar RH, Hanson M, et al. Outbreak of cryptosporidiosis among veterinary students. *Vet Rec* 2008;162:843–845.
22. Levine JF, Levy MG, Walker RL, et al. Cryptosporidiosis in veterinary students. *J Am Vet Med Assoc* 1988;193:1413–1414.
23. Pohjola S, Oksanen H, Jokipii L, et al. Outbreak of cryptosporidiosis among veterinary students. *Scand J Infect Dis* 1986;18:173–178.
24. Preiser G, Preiser L, Madeo L. An outbreak of cryptosporidiosis among veterinary science students who work with calves. *J Am Coll Health* 2003;51:213–215.
25. Reif JS, Wimmer L, Smith JA, et al. Human cryptosporidiosis associated with an epizootic in calves. *Am J Public Health* 1989;79:1528–1530.
26. Gage KL, Dennis DT, Orloski KA, et al. Cases of cat-associated human plague in the Western US, 1977–1998. *Clin Infect Dis* 2000;30:893–900.
27. McElroy KM, Blagburn BL, Breitschwerdt EB, et al. Flea-associated zoonotic diseases of cats in the USA: bartonellosis, flea-borne rickettsioses, and plague. *Trends Parasitol* 2010;26:197–204.
28. Clinkenbeard KD. Diagnostic cytology: sporotrichosis. *Compend Contin Educ Pract Vet* 1991;13:207–211.
29. Dunstan RW, Langham RF, Reimann KA, et al. Feline sporotrichosis: a report of five cases with transmission to humans. *J Am Acad Dermatol* 1986;15:37–45.
30. Dunstan RW, Reimann KA, Langham RF. *Feline sporotrichosis*. In: *Zoonosis updates from the* Journal of the American Veterinary Medical Association. 2nd ed. Schaumburg, Ill: AVMA, 1995;79–82.
31. Nusbaum BP, Gulbas N, Horwitz SN. Sporotrichosis acquired from a cat. *J Am Acad Dermatol* 1983;8:386–391.
32. Reed KD, Moore FM, Geiger GE, et al. Zoonotic transmission of sporotrichosis: case report and review. *Clin Infect Dis* 1993;16:384–387.
33. Wulf MW, Sorum M, van Nes A, et al. Prevalence of methicillin-resistant *Staphylococcus aureus* among veterinarians: an international study. *Clin Microbiol Infect* 2008;14:29–34.
34. Loeffler A, Pfeiffer DU, Lloyd DH, et al. Meticillin-resistant *Staphylococcus aureus* carriage in UK veterinary staff and owners of infected pets: new risk groups. *J Hosp Infect* 2010;74:282–288.
35. Verkade E, van Benthem B, den Bergh MK, et al. Dynamics and determinants of *Staphylococcus aureus* carriage in livestock veterinarians: a prospective cohort study. *Clin Infect Dis* 2013;57:e11–e17.
36. Gosbell IB, Ross AD, Turner IB. *Chlamydia psittaci* infection and reinfection in a veterinarian. *Aust Vet J* 1999;77:511–513.
37. Heddema ER, van Hannen EJ, Duim B, et al. An outbreak of psittacosis due to *Chlamydophila psittaci* genotype A in a veterinary teaching hospital. *J Med Microbiol* 2006;55:1571–1575.
38. Palmer SR, Andrews BE, Major R. A common-source outbreak of ornithosis in veterinary surgeons. *Lancet* 1981;2:798–799.
39. Vanrompay D, Harkinezhad T, van de Walle M, et al. *Chlamydophila psittaci* transmission from pet birds to humans. *Emerg Infect Dis* 2007;13:1108–1110.
40. Constable PJ, Harrington JM. Risks of zoonoses in a veterinary service. *Br Med J (Clin Res Ed)* 1982;284:246–248.
41. Maslen MM. Human cases of cattle ringworm due to *Trichophyton verrucosum* in Victoria, Australia. *Australas J Dermatol* 2000;41:90–94.
42. Baer R, Turnberg W, Yu D, et al. Leptospirosis in a small animal veterinarian: reminder to follow standardized infection control procedures. *Zoonoses Public Health* 2010;57:281–284.
43. Kingscote BF. Leptospirosis: an occupational hazard to veterinarians. *Can Vet J* 1986;27:78–81.
44. Whitney EA, Ailes E, Myers LM, et al. Prevalence of and risk factors for serum antibodies against *Leptospira* serovars in US veterinarians. *J Am Vet Med Assoc* 2009;234:938–944.
45. Lantos PM, Maggi RG, Ferguson B, et al. Detection of *Bartonella* species in the blood of veterinarians and veterinary technicians: a newly recognized occupational hazard? *Vector Borne Zoonotic Dis* 2014;14:563–570.
46. Breitschwerdt EB. Bartonellosis: one health perspectives for an emerging infectious disease. *ILAR J* 2014;55:46–58.
47. Abe T, Yamaki K, Hayakawa T, et al. A seroepidemiological study of the risks of Q fever infection in Japanese veterinarians. *Eur J Epidemiol* 2001;17:1029–1032.
48. Bosnjak E, Hvass AM, Villumsen S, et al. Emerging evidence for Q fever in humans in Denmark: role of contact with dairy cattle. *Clin Microbiol Infect* 2010;16:1285–1288.
49. Marrie TJ, Fraser J. Prevalence of antibodies to *Coxiella burnetii* among veterinarians and slaughterhouse workers in Nova Scotia. *Can Vet J* 1985;26:181–184.
50. Whitney EA, Massung RF, Candee AJ, et al. Seroepidemiologic and occupational risk survey for *Coxiella burnetii* antibodies among US veterinarians. *Clin Infect Dis* 2009;48:550–557.
51. Brown RR, Elston TH, Evans L, et al. Feline zoonoses guidelines from the American Association of Feline Practitioners. *J Feline Med Surg* 2005;7:243–274.
52. Lipton BA, Hopkins SG, Koehler JE, et al. A survey of veterinarian involvement in zoonotic disease prevention practices. *J Am Vet Med Assoc* 2008;233:1242–1249.
53. Wright JG, Jung S, Holman RC, et al. Infection control practices and zoonotic disease risks among veterinarians in the United States. *J Am Vet Med Assoc* 2008;232:1863–1872.
54. US Department of Labor Occupational Safety and Health Administration. Safety and health topics. Healthcare. Infectious diseases. Available at: www.osha.gov/SLTC/healthcarefacilities/infectious_diseases.html. Accessed Mar 23, 2014.
55. California Occupational Safety and Health Administration. Respirator use in health care workplaces: Cal/OSHA Aerosol Transmissible Diseases Standard. Available at: www.cdph.ca.gov/programs/ohb/Pages/ATDStd.aspx. Accessed Mar 23, 2014.
56. Washington State Department of Labor and Industries. Veterinary hazards. Available at: www.lni.wa.gov/Safety/Topics/AtoZ/HazardsVeterinary/. Accessed Feb 16, 2014.
57. US Department of Labor Occupational Safety and Health Administration. Workers' rights, 2011. Available at: www.osha.gov/Publications/osha3021.pdf. Accessed Aug 19, 2015.
58. CDC, National Institute of Occupational Safety and Health. The National Occupational Research Agenda (NORA), 2015. Available at: www.cdc.gov/niosh/nora/. Accessed Jan 17, 2015.
59. Siegel JD, Rhinehart E, Jackson M, et al. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. *Am J Infect Control* 2007;35:S65–S164.
60. Gabel CL, Gerberich SG. Risk factors for injury among veterinarians. *Epidemiology* 2002;13:80–86.
61. Jeyaretnam J, Jones H, Phillips M. Disease and injury among veterinarians. *Aust Vet J* 2000;78:625–629.
62. Landercasper J, Cogbill TH, Strutt PJ, et al. Trauma and the veterinarian. *J Trauma* 1988;28:1255–1259.
63. Hafer AL, Langley RL, Morrow M, et al. Occupational hazards reported by swine veterinarians in the United States. J *Swine Health Prod* 1996;4:128–141.
64. Leggat PA, Smith DR, Speare R. Exposure rate of needlestick and sharps injuries among Australian veterinarians. *J Occup Med Toxicol* [serial online]. 2009;4:25. Available at: www.occup-med.com/content/4/1/25. Accessed Aug 18, 2015.
65. Oliveira AM, Maggi RG, Woods CW, et al. Suspected needle stick transmission of *Bartonella vinsonii* subspecies *berkhoffii* to a veterinarian. *J Vet Intern Med* 2010;24:1229–1232.
66. Poole AG, Shane SM, Kearney MT, et al. Survey of occupational hazards in large animal practices. *J Am Vet Med Assoc* 1999;215:1433–1435.

67. Poole AG, Shane SM, Kearney MT, et al. Survey of occupational hazards in companion animal practices. *J Am Vet Med Assoc* 1998;212:1386–1388.
68. Rycroft AN, Assavacheep P, Jacobs M, et al. Necrosis from needlestick injury with live *Actinobacillus pleuropneumoniae* porcine vaccine. *BMJ* 2011;343:d6261.
69. Thompson RN, McNicholl BP. Needlestick and infection with horse vaccine. *BMJ Case Rep* 2010;doi:10.1136/bcr.11.2009.2444.
70. Weese JS, Faires M. A survey of needle handling practices and needlestick injuries in veterinary technicians. *Can Vet J* 2009;50:1278–1282.
71. Weese JS, Jack DC. Needlestick injuries in veterinary medicine. *Can Vet J* 2008;49:780–784.
72. Wilkins JR III, Bowman ME. Needlestick injuries among female veterinarians: frequency, syringe contents and side-effects. *Occup Med (Lond)* 1997;47:451–457.
73. Bender JB, Waters KC, Nerby J, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA) isolated from pets living in households with MRSA-infected children. *Clin Infect Dis* 2012;54:449–450.
74. Ghosh A, Kukanich K, Brown CE, et al. Resident cats in small animal veterinary hospitals carry multi-drug resistant enterococci and are likely involved in cross-contamination of the hospital environment. *Front Microbiol* [serial online]. 2012;3:62. Available at: journal.frontiersin.org/article/10.3389/fmicb.2012.00062/pdf. Accessed Aug 19, 2015.
75. KuKanich KS, Ghosh A, Skarbek JV, et al. Surveillance of bacterial contamination in small animal veterinary hospitals with special focus on antimicrobial resistance and virulence traits of enterococci. *J Am Vet Med Assoc* 2012;240:437–445.
76. Lenhart SW, Steitz T, Trout D, et al. Issues affecting respirator selection for workers exposed to infectious aerosols: emphasis on healthcare settings. *Appl Biosaf* 2004;9:20–36.
77. Acha PN, Szyfres B. *Zoonoses and communicable diseases common to man and animals*. 3rd ed. Washington, DC: Pan American Health Organization, 2003.
78. Kersh GJ, Fitzpatrick KA, Self JS, et al. Presence and persistence of *Coxiella burnetii* in the environments of goat farms associated with a Q fever outbreak. *Appl Environ Microbiol* 2013;79:1697–1703.
79. McQuiston JH, Childs JE. Q fever in humans and animals in the United States. *Vector Borne Zoonotic Dis* 2002;2:179–191.
80. Nation PN, Fanning EA, Hopf HB, et al. Observations on animal and human health during the outbreak of *Mycobacterium bovis* in game farm wapiti in Alberta. *Can Vet J* 1999;40:113–117.
81. Tissot-Dupont H, Amadei MA, Nezri M, et al. Wind in November, Q fever in December. *Emerg Infect Dis* 2004;10:1264–1269.
82. Boyce JM, Pittet D. Guideline for hand hygiene in health-care settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR Recomm Rep* 2002;51:1–48, CE-1–CE-4.
83. Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *Am J Infect Control* 1995;23:251–269.
84. World Health Organization. *WHO guidelines on hand hygiene in health care*. Geneva: WHO Press, 2009.
85. Bolon M. Hand hygiene. *Infect Dis Clin North Am* 2011;25:21–43.
86. Kampf G, Kramer A. Epidemiologic background of hand hygiene and evaluation of the most important agents for scrubs and rubs. *Clin Microbiol Rev* 2004;17:863–893.
87. Zapka CA, Campbell EJ, Maxwell SL, et al. Bacterial hand contamination and transfer after use of contaminated bulk-soap-refillable dispensers. *Appl Environ Microbiol* 2011;77:2898–2904.
88. Michaels B, Gangar V, Schultz A, et al. Water temperature as a factor in handwashing efficacy. *Food Serv Technol* 2002;2:139–149.
89. Lin CM, Wu FM, Kim HK, et al. A comparison of hand washing techniques to remove *Escherichia coli* and caliciviruses under natural or artificial fingernails. *J Food Prot* 2003;66:2296–2301.
90. Huang C, Ma W, Stack S. The hygienic efficacy of different hand-drying methods: a review of the evidence. *Mayo Clin Proc* 2012;87:791–798.
91. Laustsen S, Lund E, Bibby BM, et al. Effect of correctly using alcohol-based hand rub in a clinical setting. *Infect Control Hosp Epidemiol* 2008;29:954–956.
92. Sickbert-Bennett EE, Weber DJ, Gergen-Teague MF, et al. Comparative efficacy of hand hygiene agents in the reduction of bacteria and viruses. *Am J Infect Control* 2005;33:67–77.
93. Widmer AE, Dangel M. Alcohol-based handrub: evaluation of technique and microbiological efficacy with international infection control professionals. *Infect Control Hosp Epidemiol* 2004;25:207–209.
94. Gehrke C, Steinmann J, Goroncy-Bermes P. Inactivation of feline calicivirus, a surrogate of norovirus (formerly Norwalk-like viruses), by different types of alcohol in vitro and in vivo. *J Hosp Infect* 2004;56:49–55.
95. Oughton MT, Loo VG, Dendukuri N, et al. Hand hygiene with soap and water is superior to alcohol rub and antiseptic wipes for removal of *Clostridium difficile*. *Infect Control Hosp Epidemiol* 2009;30:939–944.
96. Fox JG, Beaucage CM, Folta CA, et al. Nosocomial transmission of *Serratia marcescens* in a veterinary hospital due to contamination by benzalkonium chloride. *J Clin Microbiol* 1981;14:157–160.
97. Frank MJ, Schaffner W. Contaminated aqueous benzalkonium chloride. An unnecessary hospital infection hazard. *JAMA* 1976;236:2418–2419.
98. Oie S, Kamiya A. Microbial contamination of antiseptics and disinfectants. *Am J Infect Control* 1996;24:389–395.
99. Weber DJ, Rutala WA, Sickbert-Bennett EE. Outbreaks associated with contaminated antiseptics and disinfectants. *Antimicrob Agents Chemother* 2007;51:4217–4224.
100. Smith JR, Packman ZR, Hofmeister EH. Multimodal evaluation of the effectiveness of a hand hygiene educational campaign at a small animal veterinary teaching hospital. *J Am Vet Med Assoc* 2013;243:1042–1048.
101. Traub-Dargatz JL, Weese JS, Rousseau JD, et al. Pilot study to evaluate 3 hygiene protocols on the reduction of bacterial load on the hands of veterinary staff performing routine equine physical examinations. *Can Vet J* 2006;47:671–676.
102. Nakamura RK, Tompkins E, Braasch EL, et al. Hand hygiene practices of veterinary support staff in small animal private practice. *J Small Anim Pract* 2012;53:155–160.
103. Rome M, Sabel A, Price CS, et al. Hand hygiene compliance (lett). *J Hosp Infect* 2007;65:173.
104. Shea A, Shaw S. Evaluation of an educational campaign to increase hand hygiene at a small animal veterinary teaching hospital. *J Am Vet Med Assoc* 2012;240:61–64.
105. US Department of Labor Occupational Safety and Health Administration. Personal Protective Equipment Standard 29 CFR 1910.132. Available at: www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9777. Accessed Mar 23, 2014.
106. US Department of Labor Occupational Safety and Health Administration. Safety and health topics. Personal protective equipment. Available at: www.osha.gov/SLTC/personalprotectiveequipment/. Accessed Jan 17, 2015.
107. Goldmann DA. The role of barrier precautions in infection control. *J Hosp Infect* 1991;18(suppl A):515–523.
108. Olsen RJ, Lynch P, Coyle MB, et al. Examination gloves as barriers to hand contamination in clinical practice. *JAMA* 1993;270:350–353.
109. Doebbeling BN, Pfaller MA, Houston AK, et al. Removal of nosocomial pathogens from the contaminated glove. Implications for glove reuse and handwashing. *Ann Intern Med* 1988;109:394–398.
110. Patterson JE, Vecchio J, Pantelick EL, et al. Association of contaminated gloves with transmission of *Acinetobacter calcoaceticus* var. *anitratus* in an intensive care unit. *Am J Med* 1991;91:479–483.
111. Casanova L, Alfano-Sobsey E, Rutala WA, et al. Virus transfer from personal protective equipment to healthcare employees' skin and clothing. *Emerg Infect Dis* 2008;14:1291–1293.
112. Hansen ME, McIntire DD, Miller GL III. Occult glove perforations: frequency during interventional radiologic procedures. *AJR* 1992;159:131–135.
113. CDC National Institute of Occupational Safety and Health. Occupational latex allergies. Available at: www.cdc.gov/niosh/topics/latex/. Accessed Mar 23, 2014.

114. CDC National Institute of Occupational Safety and Health. *High impact: preventing occupational latex allergy in health care workers.* DHHS (NIOSH) publication No. 2011-118. Atlanta: CDC, 2011. Available at: www.cdc.gov/niosh/docs/2011-118/pdfs/2011-118.pdf. Accessed Feb 18, 2015.
115. Bemis DA, Craig LE, Dunn JR. *Salmonella* transmission through splash exposure during a bovine necropsy. *Foodborne Pathog Dis* 2007;4:387–390.
116. Weese JS. Barrier precautions, isolation protocols, and personal hygiene in veterinary hospitals. *Vet Clin North Am Equine Pract* 2004;20:543–559.
117. Posthaus H, Bodmer T, Alves L, et al. Accidental infection of veterinary personnel with *Mycobacterium tuberculosis* at necropsy: a case study. *Vet Microbiol* 2011;149:374–380.
118. Miller JM, Astles R, Baszler T, et al. Guidelines for safe work practices in human and animal medical diagnostic laboratories. Recommendations of a CDC-convened, Biosafety Blue Ribbon Panel. *MMWR Surveill Summ* 2012;61(suppl):1–102.
119. US Department of Labor Occupational Safety and Health Administration. Respiratory infection control: respirators versus surgical masks, 2009. Available at: www.osha.gov/Publications/respirators-vs-surgicalmasks-factsheet.pdf. Accessed Mar 2, 2014.
120. CDC. Human exposures to marine *Brucella* isolated from a harbor porpoise—Maine, 2012. *MMWR Morb Mortal Wkly Rep* 2012;61:461–463.
121. Anderson A, Bijlmer H, Fournier PE, et al. Diagnosis and management of Q fever—United States, 2013: recommendations from CDC and the Q Fever Working Group. *MMWR Recomm Rep* 2013;62:1–30.
122. Williams CJ, Sillis M, Fearne V, et al. Risk exposures for human ornithosis in a poultry processing plant modified by use of personal protective equipment: an analytical outbreak study. *Epidemiol Infect* 2013;141:1965–1974.
123. Gibbins J, Niemeier RT, de Perio MA, et al. *Health hazard evaluation report: evaluation of zoonotic disease and exposures in persons working with marine mammals.* NIOSH HETA No. 2011–0105–33173. Cincinnati: US Department of Health and Human Services, CDC National Institute for Occupational Safety and Health, 2013.
124. US Department of Labor Occupational Safety and Health Administration. Respiratory protection OSHA standards. Available at: www.osha.gov/SLTC/respiratoryprotection/standards.html. Accessed Mar 2, 2014.
125. Treakle AM, Thom KA, Furuno JP, et al. Bacterial contamination of health care workers' white coats. *Am J Infect Control* 2009;37:101–105.
126. Singh A, Walker M, Rousseau J, et al. Methicillin-resistant staphylococcal contamination of clothing worn by personnel in a veterinary teaching hospital. *Vet Surg* 2013;42:643–648.
127. Munoz-Price LS, Arheart KL, Mills JP, et al. Associations between bacterial contamination of health care workers' hands and contamination of white coats and scrubs. *Am J Infect Control* 2012;40:e245–e248.
128. Pratt RJ, Pellowe CM, Wilson JA, et al. epic2: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect* 2007;65(suppl 1):S1–S64.
129. Belkin NL. Use of scrubs and related apparel in health care facilities. *Am J Infect Control* 1997;25:401–404.
130. Belkin NL. Home laundering of soiled surgical scrubs: surgical site infections and the home environment. *Am J Infect Control* 2001;29:58–64.
131. CDC. Protecting healthcare personnel. Available at: www.cdc.gov/HAI/prevent/ppe.html. Accessed Apr 4, 2014
132. Nordgren LD, Gerberich SG, Alexander BH, et al. Evaluation of factors associated with work-related injuries to veterinary technicians certified in Minnesota. *J Am Vet Med Assoc* 2014;245:425–433.
133. Sheldon CC, Sonsthagen TF, Topel J. *Animal restraint for veterinary professionals.* St Louis: Mosby Elsevier, 2006.
134. Phillips EK, Conaway MR, Jagger JC. Percutaneous injuries before and after the Needlestick Safety and Prevention Act (lett). *N Engl J Med* 2012;366:670–671.
135 FDA. What to do if you can't find a sharps disposal container, 2014. Available at: www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/HomeHealthandConsumer/ConsumerProducts/Sharps/ucm263259.htm. Accessed Mar 31, 2015.
136. Brody MD. Safety in the veterinary medical workplace environment. Common issues and concerns. *Vet Clin North Am Small Anim Pract* 1993;23:1071–1084.
137. Grizzle WE, Fredenburgh J. Avoiding biohazards in medical, veterinary and research laboratories. *Biotech Histochem* 2001;76:183–206.
138. Seibert PJ Jr. Hazards in the hospital. *J Am Vet Med Assoc* 1994;204:352–360.
139. Holmstrom SE, Bellows J, Juriga S, et al. 2013 AAHA dental care guidelines for dogs and cats. *J Am Anim Hosp Assoc* 2013;49:75–82.
140. Kohn WG, Collins AS, Cleveland JL, et al. Guidelines for infection control in dental health-care settings—2003. *MMWR Recomm Rep* 2003;52:1–61.
141. National Association of State Public Health Veterinarians. Public health implications of *Brucella canis* infections in humans. Available at: www.nasphv.org/Documents/BrucellaCanisInHumans.pdf. Accessed Aug 19, 2015.
142. National Association of State Public Health Veterinarians. Prevention and control of *Coxiella burnetii* infection among humans and animals: guidance for a coordinated public health and animal health response, 2013. Available at: www.nasphv.org/Documents/Q_Fever_2013.pdf. Accessed Aug 19, 2015.
143. Bender JB, Schiffman E, Hiber L, et al. Recovery of staphylococci from computer keyboards in a veterinary medical centre and the effect of routine cleaning. *Vet Rec* 2012;170:414.
144. AVMA. Required training for packaging and shipping lab specimens. Available at: www.avma.org/PracticeManagement/Administration/Pages/Required-Training-for-Packaging-and-Shipping-Lab-Specimens.aspx. Accessed Oct 6, 2015.
145. Meyers B, Schoeman JP, Goddard A, et al. The bacteriology and antimicrobial susceptibility of infected and non-infected dog bite wounds: fifty cases. *Vet Microbiol* 2008;127:360–368.
146. van Balen J, Kelley C, Nava-Hoet RC, et al. Presence, distribution, and molecular epidemiology of methicillin-resistant *Staphylococcus aureus* in a small animal teaching hospital: a year-long active surveillance targeting dogs and their environment. *Vector Borne Zoonotic Dis* 2013;13:299–311.
147. Hoet AE, Johnson A, Nava-Hoet RC, et al. Environmental methicillin-resistant *Staphylococcus aureus* in a veterinary teaching hospital during a nonoutbreak period. *Vector Borne Zoonotic Dis* 2011;11:609–615.
148. Burgess BA, Morley PS, Hyatt DR. Environmental surveillance for *Salmonella enterica* in a veterinary teaching hospital. *J Am Vet Med Assoc* 2004;225:1344–1348.
149. Whittington AM, Whitlow G, Hewson D, et al. Bacterial contamination of stethoscopes on the intensive care unit. *Anaesthesia* 2009;64:620–624.
150. Longtin Y, Schneider A, Tschopp C, et al. Contamination of stethoscopes and physicians' hands after a physical examination. *Mayo Clin Proc* 2014;89:291–299.
151. Portner JA, Johnson JA. Guidelines for reducing pathogens in veterinary hospitals: disinfectant selection, cleaning protocols, and hand hygiene. *Compend Contin Educ Vet* 2010;32:E1–12.
152. Dwyer RM. Environmental disinfection to control equine infectious diseases. *Vet Clin North Am Equine Pract* 2004;20:531–542.
153. Rutala WA, Weber DJ, Healthcare Infection Control Practices Advisory Committee. Guideline for disinfection and sterilization in healthcare facilities, 2008. Available at: www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf. Accessed Aug 19, 2015.
154. Loeffler A, Boag AK, Sung J, et al. Prevalence of methicillin-resistant *Staphylococcus aureus* among staff and pets in a small animal referral hospital in the UK. *J Antimicrob Chemother* 2005;56:692–697.
155. AVMA. Guidelines for hazards in the workplace. Available at: www.avma.org/KB/Policies/Pages/Guidelines-for-Hazards-in-the-Workplace.aspx. Accessed Jun 14, 2014.
156. Brody MD. AVMA guide for veterinary medical waste management. *J Am Vet Med Assoc* 1989;195:440–452.

157. Amass SF, Arighi M, Kinyon JM, et al. Effectiveness of using a mat filled with a peroxygen disinfectant to minimize shoe sole contamination in a veterinary hospital. *J Am Vet Med Assoc* 2006;228:1391–1396.
158. Dunowska M, Morley PS, Patterson G, et al. Evaluation of the efficacy of a peroxygen disinfectant–filled footmat for reduction of bacterial load on footwear in a large animal hospital setting. *J Am Vet Med Assoc* 2006;228:1935–1939.
159. Morley PS, Morris SN, Hyatt DR, et al. Evaluation of the efficacy of disinfectant footbaths as used in veterinary hospitals. *J Am Vet Med Assoc* 2005;226:2053–2058.
160. Sehulster LM, Chinn RYW, Arduino MJ, et al. *Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC)*. Chicago: American Society for Healthcare Engineering/American Hospital Association, 2004.
161. The Canadian Committee on Antibiotic Resistance. *Infection prevention and control best practices for small animal veterinary clinics, 2008*. Available at: ovc.uoguelph.ca/sites/default/files/users/ovcweb/files/GuidelinesFINALInfectionPreventionDec2008.pdf. Accessed Aug 19, 2015.
162. Hammer TR, Mucha H, Hoefer D. Infection risk by dermatophytes during storage and after domestic laundry and their temperature-dependent inactivation. *Mycopathologia* 2011;171:43–49.
163. Lakdawala N, Pham J, Shah M, et al. Effectiveness of low-temperature domestic laundry on the decontamination of healthcare workers' uniforms. *Infect Control Hosp Epidemiol* 2011;32:1103–1108.
164. Patel SN, Murray-Leonard J, Wilson AP. Laundering of hospital staff uniforms at home. *J Hosp Infect* 2006;62:89–93.
165. Environmental Protection Agency. Selected EPA-registered disinfectants. Available at: www.epa.gov/oppad001/chemregindex.htm. Accessed Aug 1, 2014.
166. Environmental Protection Agency. Where you live—state medical waste programs and regulations. Available at: www.epa.gov/osw/nonhaz/industrial/medical/programs.htm. Accessed Aug 1, 2014.
167. Environmental Protection Agency. Medical waste. Available at: www.epa.gov/osw/nonhaz/industrial/medical/. Accessed Aug 1, 2014.
168. Diuk-Wasser MA, Hoen AG, Cislo P, et al. Human risk of infection with *Borrelia burgdorferi*, the Lyme disease agent, in eastern United States. *Am J Trop Med Hyg* 2012;86:320–327.
169. Adjemian JZ, Krebs J, Mandel E, et al. Spatial clustering by disease severity among reported Rocky Mountain spotted fever cases in the United States, 2001–2005. *Am J Trop Med Hyg* 2009;80:72–77.
170. Vaughn MF, Meshnick SR. Pilot study assessing the effectiveness of long-lasting permethrin-impregnated clothing for the prevention of tick bites. *Vector Borne Zoonotic Dis* 2011;11:869–875.
171. Dantas-Torres F. Biology and ecology of the brown dog tick, *Rhipicephalus sanguineus*. *Parasit Vectors* [serial online]. 2010;3:26. Available at: www.parasitesandvectors.com/content/3/1/26. Accessed Aug 19, 2015.
172. Kogan M. Integrated pest management: historical perspectives and contemporary developments. *Annu Rev Entomol* 1998;43:243–270.
173. Peter RJ, Van den Bossche P, Penzhorn BL, et al. Tick, fly, and mosquito control—lessons from the past, solutions for the future. *Vet Parasitol* 2005;132:205–215.
174. Epp T, Waldner C. Occupational health hazards in veterinary medicine: physical, psychological, and chemical hazards. *Can Vet J* 2012;53:151–157.
175. Epp T, Waldner C. Occupational health hazards in veterinary medicine: zoonoses and other biological hazards. *Can Vet J* 2012;53:144–150.
176. Mobo BHP, Rabinowitz PM, Conti LA, et al. Occupational health of animal workers. In: Rabinowitz PM, Conti LA, eds. *Human-animal medicine: clinical approaches to zoonoses, toxicants and other shared health risks*. Maryland Heights, Mo: Saunders, 2010;343–371.
177. Trevejo RT. Rabies preexposure vaccination among veterinarians and at-risk staff. *J Am Vet Med Assoc* 2000;217:1647–1650.
178. Manning SE, Rupprecht CE, Fishbein D, et al. Human rabies prevention—United States, 2008: recommendations of the Advisory Committee on Immunization Practices. *MMWR Recomm Rep* 2008;57:1–28.
179. Broder KR, Cortese MM, Iskander JK, et al. Preventing tetanus, diphtheria, and pertussis among adults: use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine. Recommendations of the Advisory Committee on Immunization Practices (ACIP) and recommendation of ACIP, supported by the Healthcare Infection Control Practices Advisory Committee (HICPAC), for use of Tdap among health-care personnel. *MMWR Recomm Rep* 2006;55:1–33.
180. Talan DA, Abrahamian FM, Moran GJ, et al. Tetanus immunity and physician compliance with tetanus prophylaxis practices among emergency department patients presenting with wounds. *Ann Emerg Med* 2004;43:305–314.
181. Grohskopf LA, Olsen SJ, Sokolow LZ, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP)—United States, 2014–15 influenza season. *MMWR Morb Mortal Wkly Rep* 2014;63:691–697.
182. Olsen CW, Brammer L, Easterday BC, et al. Serologic evidence of H1 swine influenza virus infection in swine farm residents and employees. *Emerg Infect Dis* 2002;8:814–819.
183. Myers KP, Setterquist SF, Capuano AW, et al. Infection due to 3 avian influenza subtypes in United States veterinarians. *Clin Infect Dis* 2007;45:4–9.
184. Myers KP, Olsen CW, Setterquist SF, et al. Are swine workers in the United States at increased risk of infection with zoonotic influenza virus? *Clin Infect Dis* 2006;42:14–20.
185. Gray GC, McCarthy T, Capuano AW, et al. Swine workers and swine influenza virus infections. *Emerg Infect Dis* 2007;13:1871–1878.
186. US Department of Labor Occupational Safety and Health Administration. Recording and reporting occupational injuries and illness. Available at: www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=STANDARDS&p_toc_level=1&p_keyvalue=1904. Accessed Aug 19, 2015.
187. US Department of Labor Occupational Safety and Health Administration. State plans. Available at: www.osha.gov/dcsp/osp/. Accessed Aug 1, 2014.
188. US Department of Labor Occupational Safety and Health Administration. Training requirements in OSHA standards. Available at: www.osha.gov/Publications/osha2254.pdf. Accessed Aug 1, 2014.
189. Occupational Safety and Health Administration. OSHA training standards policy statement. Available at: www.osha.gov/dep/OSHA-training-standards-policy-statement.pdf. Accessed Aug 19, 2015.
190. Steneroden KK, Hill AE, Salman MD. A needs-assessment and demographic survey of infection-control and disease awareness in western US animal shelters. *Prev Vet Med* 2011;98:52–57.
191. Dowd K, Taylor M, Toribio JA, et al. Zoonotic disease risk perceptions and infection control practices of Australian veterinarians: call for change in work culture. *Prev Vet Med* 2013;111:17–24.
192. D'Souza E, Barraclough R, Fishwick D, et al. Management of occupational health risks in small-animal veterinary practices. *Occup Med (Lond)* 2009;59:316–322.
193. Chomel BB, Marano N. Essential veterinary education in emerging infections, modes of introduction of exotic animals, zoonotic diseases, bioterrorism, implications for human and animal health and disease manifestation. *Rev Sci Tech* 2009;28:559–565.
194. Trevejo RT, Barr MC, Robinson RA. Important emerging bacterial zoonotic infections affecting the immunocompromised. *Vet Res* 2005;36:493–506.
195. Freeman LM, Chandler ML, Hamper BA, et al. Current knowledge about the risks and benefits of raw meat–based diets for dogs and cats. *J Am Vet Med Assoc* 2013;243:1549–1558.
196. National Association of State Public Health Veterinarians Animal Contact Compendium Committee 2013. Compendium of measures to prevent disease associated with animals in public settings, 2013. *J Am Vet Med Assoc* 2013;243:1270–1288.
197. Kaplan JE, Benson C, Holmes KK, et al. Guidelines for prevention and treatment of opportunistic infections in HIV-infected

adults and adolescents: recommendations from CDC, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America. *MMWR Recomm Rep* 2009;58:1–207.
198. Equal Employment Opportunity Commission. EEOC enforcement guidance on pregnancy discrimination and related issues. Available at: www.eeoc.gov/laws/guidance/pregnancy_guidance.cfm. Accessed Jan 11, 2015.
199. Equal Employment Opportunity Commission. Pregnancy discrimination. Available at: www.eeoc.gov/laws/types/pregnancy.cfm. Accessed Jan 11, 2015
200. Moore RM Jr, Davis YM, Kaczmarek RG. An overview of occupational hazards among veterinarians, with particular reference to pregnant women. *Am Ind Hyg Assoc J* 1993;54:113–120.
201. National Association of State Public Health Veterinarians. Model infection control plan for veterinary practices. Available at: www.nasphv.org/documentsCompendia.html. Accessed Aug 19, 2015.

Continued on next page.

Appendix 1

Selected zoonotic diseases of importance in the United States, 2015.

Disease	Agent	Means of transmission to humans	Most common species associated with transmission to humans	Nationally notifiable for human (H) or animal (A) cases	Severe or prolonged infection usually associated with immunosuppression	Deaths in humans reported
Acariasis (scabies)	*Sarcoptes scabiei, Notoedres cati*, and other species of mites	Contact	Dogs, cats, horses, goats, sheep, swine, birds	No	No	No
Anthrax	*Bacillus anthracis*	Contact, aerosol, vector	Cattle, sheep, goats, horses	H, A	No	Yes
Avian influenza	Highly pathogenic avian influenza viruses	Contact, aerosol	Poultry, pet birds	H, A	No	Yes
Babesiosis	*Babesia microti* and other *Babesia* spp	Vector	Cattle, rodents	A	Yes	Yes
Bartonellsois	*Bartonella henselae*, other *Bartonella* spp		Cats, other species possible	No	Yes	Rare
Baylisascariasis	*Baylisascaris procyonis*	Contact	Raccoons	No	No	Yes
Bordetella bronchiseptica infection	*Bordetella bronchiseptica*	Aerosol	Dogs, cats, swine, rabbits, guinea pigs, horses	No	Yes	No
Brucellosis	*Brucella melitensis, Brucella abortus, Brucella suis, Brucella canis*	Contact, aerosol	Goats, cattle, swine, feral pigs, dogs, horses	H, A	No	Yes
Campylobacteriosis	*Campylobacter jejuni*, other *Campylobacter* spp	Contact	Poultry, cattle, sheep, goats, swine, dogs, cats, mink, ferrets, hamsters, racoons, other wildlife	No	No	Yes
Capnocytophaga spp infection	*Capnocytophaga canimorsus, Capnocytophaga cynodegmi*	Contact	Dogs, cats	No	Yes	Yes
Chlamydiosis (mammalian)	*Chlamydophila abortus, Chlamydophila felis*	Aerosol, contact	Sheep, goats, llamas, cats, cattle	No	Yes, preganant women	Yes
Contagious pustular dermatitis (orf or contagious ecthyma)	Parapoxvirus	Contact	Sheep, goats	No	No	No
Cryptococcosis	*Cryptococcus neoformans*	Aerosol	Pigeons, other birds	No	Yes	Yes
Cryptosporidiosis	*Cryptosporidium parvum*	Contact	Cattle (typically calves)	H	Yes	Yes
Dermatophilosis	*Dermatophilus congolensis*	Contact, vector	Goats, sheep, cattle, horses	No	No	No
Dermatophytosis (ringworm)	*Microsporum* spp, *Trichophyton* spp, *Epidermophyton* spp	Contact	Cats, dogs, cattle, goats, sheep, horses, rabbits, rodents	No	No	No
Dipylidium infection (tapeworm)	*Dipylidium caninum*	Vector	Dogs, cats	No	No	No
Escherichia coli O157:H7 infection	*Escherichia coli* O157:H7	Contact	Cattle, goats, sheep, deer	No	No	Yes
Echinococcosis	*Echinococcus granulosus, Echinococcus multilocularis*	Contact	Dogs, cats, wild canids	A	No	Yes
Ehrlichiosis or anaplasmosis	*Ehrlichia* and *Anaplasma* spp	Vector	Deer, rodents, horses, dogs	H	Yes	Yes
Equine encephalomyelitis	Togaviridae (eastern, western, and Venezuelan equine encephalomyelitis viruses)	Vector	Birds, horses	H, A	No	Yes
Erysipeloid	*Erysipelothrix rhusiopathiae* (multiple subtypes, called assemblages, exist, several of which can be transmitted to people)	Contact	Pigs, poultry, lambs, calves, birds, fish, crustaceans, mollusks	No	No	Yes
Giardiasis	*Giardia intestinalis* (*Giardia lamblia*)	Contact	Beavers and other wild rodents, dogs, cats, guinea pigs, ferrets, livestock	H	Yes	No
Hantaviral diseases	Hantaviruses	Aerosol	Rodents	H	No	Yes
Herpes B virus infection	Macacine herpesvirus	Contact	Macaque monkeys	No	No	Yes
Histoplasmisosis	*Histoplasma capsulatum*	Aerosol	Bats, soil enriched with wild bird guano	No	Yes	Yes
Influenza A	Influenza A virus	Contact, aerosol	Poultry, swine, ferrets	H, A	No	Yes

Continued on next page.

Appendix 1

Zoonotic diseases of importance in the United States, 2015 (continued).

Disease	Agent	Means of transmission to humans	Most common species associated with transmission to humans	Nationally notifiable for human (H) or animal (A) cases	Severe or prolonged infection usually associated with immunosuppression	Deaths in humans reported
Larval migrans: cutaneous (hookworm)	*Ancylostoma* spp	Contact	Dogs, cats	No	No	Rare
Larval migrans: visceral, ocular, neuro (roundworm)	*Toxocara canis, Toxocara cati*	Contact	Dogs, cats, racoons	No	No	Rare
Leishmaniasis	*Leishmania* spp	Vector	Dogs, wild canids	A	No	Yes
Leptospirosis	*Leptospira* spp	Contact, aerosol	Rodents, swine, cattle, sheep, goats, horses, dogs	A	No	Yes
Listeriosis	*Listeria monocytogenes*	Contact	Cattle, sheep, goats, pigs, birds, dogs, cats	H	Yes, particularly pregnant women	Yes
Lyme disease	*Borrelia burgdorferi*	Vector	Small rodents, wild large mammals	H	Yes	Yes
Lymphocytic choriomeningitis	Arenavirus (lymphocytic choriomeningitis virus)	Contact, aerosol	Mice, hamsters, guinea pigs	No	Yes, particularly pregnant women	Rare
Monkeypox	Orthopoxvirus	Contact, aerosol	Nonhuman primates, rodents	A	No	Yes
Mycobacteriosis (nontuberculous)	*Mycobacterium avium* complex, *Mycobacterium marinum*	Aerosol, contact	Poultry, pet birds, aquarium fish, reptiles	No	Yes	Yes
Pasteurellosis	*Pasteurella multocida* and other species	Contact	Dogs, cats, rabbits, rodents	No	Yes	Rare
Plague	*Yersinia pestis*	Vector, contact, aerosol	Rodents, cats, rabbits	H, A	Yes	Rare
Psittacosis (human) chlamydiosis (avian)	*Chlamydophila psittaci*	Aerosol, contact	Pet birds, poultry	H, A (poultry)	Yes	Yes
Q fever	*Coxiella burnetii*	Contact, aerosol, vector	Goats, sheep, cattle, rodents, rabbits, dogs, cats	H, A	No	Yes
Rabies	Lyssavirus	Contact	Cats, dogs, cattle and other domestic animals, wild carnivores, raccoons, bats, skunks, foxes	H, A	No	Yes
Rat bite fever	*Streptobacillus moniliformis, Spirillum minus*	Contact	Pet rats, wild rats	No	No	Yes
Rhodococcus equi infection	*Rhodococcus equi*	Aerosol, contact	Horses	No	Yes	Yes
Rocky Mountain spotted fever	*Rickettsia rickettsii*	Vector	Dogs, rabbits, rodents	H	No	Yes
Salmonellosis	*Salmonella* spp	Contact	Reptiles, amphibians, poultry, horses, swine, cattle, pocket pets, many species of mammals and birds	H	Yes	Yes
Sporotrichosis	*Sporothrix schenckii*	Contact	Cats, dogs, horses	No	Yes	Rare
Staphylococcosis	*Staphylococcus* spp	Contact	Dogs, cats, horses	H (certain drug-resistant strains of *S aureus)*	Yes	Yes
Streptococcosis	*Streptococcus* spp	Contact, aerosol	Swine, fish, other mammals	H (some forms)	No	Yes
Toxoplasmosis	*Toxoplasma gondii*	Contact	Cats	No	Yes	Yes
Trichinellosis	*Trichinella spiralus*	Contact	Feral pigs, swine	H, A	No	Rare
Trichuriasis (whipworm infection)	*Trichuris suis, Trichuris trichiura, Trichuris vulpis*	Contact	Dogs, swine	No	No	Rare
Tuberculosis, bovine	*Mycobacterium bovis*	Contact, aerosol	Cattle, swine, sheep, goats, bison, elk, deer, reindeer	H, A	No	Yes
Tularemia	*Francisella tularensis*	Vector, contact, aerosol	Rabbits, pocket pets, wild aquatic rodents, sheep, cats, horses, dogs	H, A	No	Yes
Vesicular stomatitis	Vesicular stomatitis virus	Vector, contact, aerosol	Horses, cattle, swine, sheep, goats	A	No	No
West Nile fever	West Nile virus	Vector	Wild birds	H, A	No	Yes
Yersiniosis	*Yersinia enterocolitica*	Contact	Swine, many species of mammals and birds	No	Yes	No

Data regarding nationally reportable diseases were obtained from the CDC's nationally notifiable infectious diseases list, the World Organization for Animal Health (OIE) notifiable animal diseases list, and the USDA APHIS reportable-diseases list.[14,15] Cases may also be notifiable at the state level; state veterinarians or state public health veterinarians should be consulted for current listings of reportable diseases in specific areas.

Appendix 2

Antimicrobial spectrum of hand-hygiene antiseptic agents.[82,84,86]

Target organism or or agent characteristic	Alcohols (ethanol or isopropanol)	Chlorhexidine (2%–4%)	Iodophors[a]	Triclosan	Quaternary ammonium compounds[b,c]
Gram-positive bacteria	+++	+++	+++	+++	++
Gram-negative bacteria	+++	++	+++	++	+
Enveloped (lipophilic) viruses	+++	++	++	+++	+
Nonenveloped viruses	++	+	++	++	±
Mycobacteria	+++	+	+	±	–
Fungi	+++	+	++	±[d]	–
Spores	–	–	–	–	–
Protozoal oocysts	–	–	–	–	–
Speed of action	Fast	Intermediate	Intermediate	Intermediate	Slow
Residual activity	No	Yes	Variable	Yes	No
Comments	Optimum concentration 60%–85%	Persistent activity; potential allergic reactions	Less irritating than iodine	Tolerability on hands varies; decreases skin hydration and possible irritation	Used in combination with alcohols; activity limited by organic matter and hard water; prone to contamination

+++ = Excellent. ++ = Good. + = Fair. ± = Variable. – = No or insufficient activity.
[a]Iodine compounds are usually too irritating for hand hygiene; iodophors are specially formulated iodine compounds that are less irritating.
[b]Quaternary ammonium compounds are not recommended as a sole antiseptic agent. [c]Efficacy against dermatophytes may be less than indicated.
[d]Activity against some fungi, but much less against filamentous fungi.

Appendix 3

Selected disinfectants used in veterinary practice.

Disinfectant Category	Alcohols	Alkalis	Aldehydes	Halogens: Chlorine	Halogens: Iodine	Oxidizing Agents	Phenols	Quaternary Ammonium Compounds
Example Active Ingredients	•ethanol •isopropanol	•calcium hydroxide •sodium carbonate •calcium oxide	•formaldehyde •glutaraldehyde •ortho-phthalaldehyde	•sodium hypochlorite (household bleach) •calcium hypochlorite •chlorine dioxide	•providone-iodine	•hydrogen peroxide •peracetic acid •potassium peroxymonosulfate	•ortho-phenylphenol •orthobenzylpara-chlorophenol	•benzalkonium chloride •alkyldimethyl ammonium chloride
Mechanism of Action	Precipitates proteins; denatures lipids	Alters pH through hydroxyl ions; fat saponification	Denatures proteins; alkylates nucleic acids	Denatures proteins	Denatures proteins	Denature proteins and lipids	Denatures proteins; disrupts cell wall	Denatures proteins; binds phospholipids of cell membrane
Characteristics	•Fast acting •Rapid evaporation •Leaves no residue •Can swell or harden rubber and plastics	•Slow acting •Affected by pH •Best at high temps •Corrosive to some metals •Severe skin burns; mucous membrane irritation •Environmental hazard	•Slow acting •Affected by pH and temperature •Irritation of skin/ mucous membrane •Only use in well ventilated areas •Pungent odor •Noncorrosive	•Fast acting •Affected by pH •Requires frequent application •Inactivated by UV radiation •Corrodes metals, rubber, fabrics, •Mucous membrane irritation	•Stable in storage •Affected by pH •Requires frequent application •Inactivated by QACs •Corrosive •Stains clothes and treated surfaces	•Fast acting •Damaging to some metals (e.g., lead, copper, brass, zinc) •Potential eye and skin damage; mucous membrane irritation	•Residual film on surfaces •Can damage rubber, plastic; non-corrosive •Stable in storage •Irritation to skin and eyes	•Stable in storage •Best at neutral or alkaline pH •Effective at high temps •High concentrations corrosive to metals •Irritation to skin, eyes, and respiratory tract
Precautions	Flammable	Very caustic	Carcinogenic	Toxic gas released if mixed with strong acids or ammonia			May be toxic to animals, especially cats and pigs	
Gram-positive Bacteria	++	++	++	++	++	++	++	++
Gram-negative Bacteria	++	++	++	++	++	++	++	+
Mycobacteria	++	+	+	+	+	±	±	-
Endospores	-	+	++	+	+	++	-	-
Enveloped Viruses	+	+	++	++	++	++	+	+
Non-enveloped Viruses	±	±	++	++	+	±	-	-
Fungi/Fungal spores	±	+	++	+	+	++	±	+
Efficacy with Organic Matter	Reduced	Variable	Variable	Rapidly reduced	Rapidly reduced	Variable	Effective	Inactivated
Efficacy with Hard Water	?	Reduced	Reduced	Effective	?	?	Effective	Reduced
Efficacy with Detergents	?	?	Reduced	Inactivated	Effective	?	Effective	Reduced by soaps and anionic solutions

++ = highly effective; + = effective; ± = variable or limited activity; - = not effective; ? = data not found

DISCLAIMER: The information provided generalizes data for each class of products; antimicrobial activity may vary with formulation and concentration. Always read and follow the product label. The preparation and application of disinfectant solutions must be in accordance with product label directions. Only EPA-registered products should be used.

REFERENCES: Fraise AP, Lambert PA et al. (eds). *Russell, Hugo & Ayliffe's Principles and Practice of Disinfection, Preservation and Sterilization*, 5th ed. Ames, IA: Wiley-Blackwell; Rutala WA, Weber DJ, Healthcare Infection Control Practices Advisory Committee (HICPAC). 2008. Guideline for disinfection and sterilization in healthcare facilities. Available at: http://www.cdc.gov/hicpac/Disinfection_Sterilization/toc.html; Quinn PJ, Markey FC et al. (eds). *Veterinary Microbiology and Microbial Disease*. 2nd ed. West Sussex, UK: Wiley-Blackwell;2011:851-889.

the Center for Food Security & Public Health
IOWA STATE UNIVERSITY

Appendix 4

Model Infection Control Plan for Veterinary Practices, 2015

National Association of State Public Health Veterinarians (NASPHV)
Veterinary Infection Control Committee (VICC)

This plan should be adapted to your practice in keeping with local, state, and federal regulations. A modifiable electronic version is available on the NASPHV Website (www.nasphv.org). Please refer to the full Compendium of Veterinary Standard Precautions for complete information and guidance (also available at www.nasphv.org).

Clinic: _____
Date of Plan Adoption: _____
Date of Next Review: _____
Infection Control Officer: _____

This plan will be followed as part of our practice's routine procedures. The plan will be reviewed at least annually and as part of new employee training.

PERSONAL PROTECTIVE ACTIONS AND EQUIPMENT

Hand hygiene: Perform hand hygiene between examinations of individual animals or animal groups (eg, litters of puppies or kittens, groups of cattle) and after contact with feces, body fluids, vomitus, exudates, and articles contaminated by these substances. Perform hand hygiene before eating, drinking, or smoking; after using the toilet; after cleaning animal cages; after contact with environmental surfaces in animal areas; after handling laboratory specimens; after removing gloves; and whenever hands are visibly soiled. Keep fingernails short. Do not wear artificial nails or hand jewelry when handling animals. Keep hand-hygiene supplies stocked at all times.
Staff responsible: _____

Correct handwashing procedure:
- Wet hands with running water.
- Place soap in palms.
- Rub hands together to make a lather.
- Scrub hands thoroughly for 20 seconds.
- Rinse soap off hands.
- Dry hands with disposable towel.
- Turn off faucet using the disposable towel to avoid hand contact.

Correct use of hand rubs:
- Place alcohol-based hand rub in palms.
- Apply to all surfaces of hands.
- Rub hands together until dry.

Gloves: Gloves are not necessary when examining or handling healthy animals. Wear gloves when touching feces, body fluids, vomitus, exudates, and nonintact skin. Wear gloves for dentistry, resuscitations, necropsies, and obstetric procedures; when cleaning cages, litter boxes, and environmental surfaces and equipment in animal areas; when handling dirty laundry; when handling diagnostic specimens (eg, urine, feces, aspirates, or swabs); and when handling an animal with a suspected infectious disease. Wear gloves if you have wounds or compromised skin integrity of the hands. Change gloves between examination of individual animals or animal groups (eg, a litter of puppies), between dirty and clean procedures performed on the same patient, and when torn. Gloves should be removed promptly and disposed of after use. Disposable gloves should not be washed and reused. Hands should be washed immediately after glove removal.

Facial protection: Use a face shield or goggles worn with a surgical mask whenever splashes or sprays are likely to occur. Wear facial protection for the following procedures: lancing abscesses, flushing wounds, dentistry, nebulization, suctioning, lavage, obstetric procedures, and necropsies.

Respiratory tract protection: Use a molded particulate respirator (N95 or N99) when exposure to airborne pathogens is likely. Use respiratory protection under the supervision of a veterinarian and following OSHA regulations. Training and fit testing are required for their use.

Protective outerwear: Wear a protective outer garment such as a laboratory coat, smock, nonsterile gown, or coveralls when attending animals and when conducting cleaning chores in animal areas. Protective outerwear should be changed after handling an animal with a known or suspected infectious disease, after working in an isolation room, after performing a necropsy or other high-risk procedure, and whenever soiled. Impermeable outwear should be worn during obstetric procedures and necropsies and whenever substantial splashes or large quantities of body fluids may be encountered. Shoes or boots should have thick soles and closed toes and be impermeable to water and easily cleaned. Disposable shoe covers or washable boots should be worn when heavy quantities of infectious materials are expected. Garments should be changed and laundered daily and whenever they become visibly soiled or contaminated. Coveralls should be changed and boots cleaned between farm premises, facilities, locations, or herds. Protective outerwear should not be worn outside of the work environment. Keep clean outer garments available at all times.
Staff responsible: _____

PROTECTIVE ACTIONS DURING VETERINARY PROCEDURES

Patient Intake: Place animals that have neurologic signs, diarrhea, respiratory signs, fever, infected wounds, chronic infections, or a known exposure to an infectious agent directly into a designated examination or isolation room. Bring them in a side entrance if possible.

Animal handling and injury prevention: Take precautions to prevent bites and other animal-related injuries. Identify aggressive animals and alert clinic staff. Use physical restraints, muzzles, bite-resistant gloves, and sedation or anesthesia as necessary in accordance with practice policies. Plan an escape route when handling large animals. Do not rely on owners or untrained staff for animal restraint.
- If there is concern for personal safety, notify: _____
- When injuries occur, wash wounds with soap and water, then immediately report incident to: _____(infection control officer)
- If medical attention is needed contact: _____(health-care provider)
- Bite incidents will be reported to: _____(public health agency) as required by law.
  Telephone number:_____

Examination of animals: Wear protective outerwear and perform hand hygiene before and after examination of individual animals or animal groups (eg, a litter of puppies). Use gloves and other protective equipment as appropriate to examine potentially infectious animals. Keep potentially infectious animals in a designated examination room until diagnostic procedures and treatments have been performed.

Continued on next page.

Appendix 4 (continued)

Injections, venipuncture, and aspiration procedures: Wear gloves when performing soft tissue or body fluid aspirations and while performing venipuncture on animals suspected of having an infectious disease. Trained personnel should restrain animals to minimize needlestick injuries due to animal movement. Do not bend needles, pass an uncapped needle to another person, or walk around with uncapped needles. Do not remove an uncapped needle from the syringe by hand or place a needle cap in the mouth. Do not recap needles unless the 1-handed scoop method is used.

1-handed scoop method for recapping needles:
- Place the cap on a horizontal surface.
- Hold the syringe with attached needle in 1 hand.
- Use the needle to scoop up the cap without use of the other hand.
- Secure the cap by pushing it against a hard surface.

Dispose of all sharps in designated containers. After injection of live vaccines or aspiration of soft tissue or body fluid, dispose of the used syringe with needle attached in a sharps container. Otherwise, you may remove the needle with a forceps and throw the syringe away in the trash. Do not transfer sharps from one container to another. Replace sharps containers before they are completely full.
Staff responsible: _____

Dental procedures: Wear protective outerwear, a head cover, gloves, and facial protection when performing dental procedures or when in range of splashes or sprays (such as when monitoring anesthesia).

Resuscitation: Wear gloves and facial protection. Use a manual resuscitator, anesthesia machine, or ventilator to resuscitate animals. Do not blow directly into the mouth, nose, or endotracheal tube of the animal.

Obstetrics: Wear gloves or shoulder-length sleeves, facial protection, and impermeable outerwear. Do not blow directly into the nose or mouth of a nonrespiring neonate.

Necropsy: Wear cut-resistant gloves, facial protection, and impermeable outerwear. Also wear eye protection and a respirator when using a band saw or other power equipment. Only necessary personnel are allowed in the vicinity of the procedure. If an animal is suspected of having a notifiable infectious or a foreign animal disease, consult with the State Veterinarian before proceeding with a necropsy.
Contact information for State Veterinarian's office:_____

Diagnostic specimen handling: Wear protective outerwear and gloves. Handle feces, urine, vomitus, aspirates, and swabs as if they were infectious. Discard gloves and perform hand hygiene before touching clean items (eg, medical records, keyboard, or telephone). Eating and drinking are not allowed in the laboratory.

Wound care and abscesses: Wear protective outerwear and gloves for debridement, treatment, and bandaging of wounds. Facial protection should also be used when lancing abscesses or lavaging wounds. Discard used bandages. Handle used scissors, clipper blades, and other equipment as if contaminated. Autoclave or gas sterilize leftover bandaging material before putting it away. Perform hand hygiene after removing gloves.

ENVIRONMENTAL INFECTION CONTROL
Cleaning and disinfection of equipment and environmental surfaces: Wear gloves when cleaning and disinfecting cages and other surfaces in animal areas. Perform hand hygiene afterwards. Clean surfaces and equipment to remove organic matter, and then use a disinfectant according to manufacturer's instructions. Clean and disinfect animal cages, toys, and food and water bowls between uses and whenever visibly soiled. Clean litter boxes at least once daily. Keep clean items separate from dirty items.

Isolation of infectious animals: Put animals with an infectious disease in isolation as soon as possible. Clearly mark the room or cage to indicate the patient's status and describe additional precautions. Limit access to the isolation room. Keep a sign-in log of all people (including owners or other nonemployees) having contact with an animal in isolation. Keep only the equipment needed for the care and treatment of the patient in the isolation room, including dedicated cleaning supplies. Personal protective equipment should be donned immediately prior to care of the animal in isolation and removed just prior to leaving isolation. Discard gloves after use. Leave reusable PPE (eg, gown, mask) in the isolation room. Clean and disinfect or discard protective equipment between patients and whenever contaminated by body fluids. Disassemble and thoroughly clean and disinfect any equipment that has been used in the isolation room. Place potentially contaminated materials in a bag before removal from the isolation room.
Staff responsible: _____

Handling laundry: Wear gloves and protective outerwear when handling soiled laundry. Check for sharps before items are laundered. Wash animal bedding and other laundry in the facility with standard laundry detergent, and completely machine dry at the highest temperature suitable for the material. Use separate storage and transport bins for clean and dirty laundry. Outerwear to be laundered at home should be transported in a plastic bag, kept separate from household items, washed separately, and then thoroughly machine dried.

Spill response and decontamination: Immediately contain spills and splashes of potentially infective substances with absorbent material (eg, paper towels, sawdust, or cat litter). Use PPE to protect against potentially infective agents and the cleaning agent or disinfectant to be used. Consult and follow the label recommendations for the cleaning agent or disinfectant. Pick up the material, seal it in a leak-proof plastic bag, and clean and disinfect the area. Keep clients, patients, and employees away from the spill area until disinfection is completed.

Veterinary medical waste: *Insert here your local and state ordinances regulating disposal of animal waste, pathology waste, animal carcasses, bedding, sharps, and biologics. Refer to the US Environmental Protection Agency website* (www.epa.gov/epawaste/nonhaz/industrial/medical/programs.htm*) and the AVMA website (www.avma.org/PracticeManagement/Administration/Pages/AVMA-Policies-Relevant-to-Waste-Disposal.aspx) for guidance.*

Rodent and vector control: Seal entry portals, eliminate clutter and sources of standing water, keep animal food in closed metal or thick-plastic covered containers, and dispose of food waste properly to keep the facility free of rodents, mosquitoes, and other arthropods. Check and treat animals entering the veterinary facility for vector parasites.

Other environmental controls: Use the employee break room or designated area for eating, drinking, smoking, application of makeup, and similar activities. These activities should not occur in animal-care areas or in the laboratory. Do not keep food or drink for human consumption in the same refrigerator as food for animals, biologics, or laboratory specimens. Dishes for human use should be washed and stored away from animal-care and animal food preparation areas.

OCCUPATIONAL HEALTH
Infection control and employee health management: The following personnel are responsible for development and maintenance of the practice's infection control policies, record keeping, and management of workplace exposure and injury incidents.
Staff responsible: _____

Record keeping: Current emergency contact information will be maintained for each employee. Records will be maintained on vaccinations, rabies virus–specific antibody titers, and exposure and injury incidents. Changes in health status (eg, pregnancy) that may affect work duties should be reported to and recorded by the office manager so that accommodations may be made.