Compendium of Zoonotic Disease Infection Prevention and Control in Veterinary Personnel

nasphv

The National Association of State Public Health Veterinarians, Infection Prevention and Control Committee:

Karen A. Alroy, DVM, MPH, DACVPM (Co-Chair);
New York City Department of Health & Mental Hygiene

Emily J. Curren, DVM, MPH, DACVPM (Co-Chair);
Wyoming Department of Health

Vance Kawakami, DVM, MPH, DACVPM;
Public Health-Seattle & King County

Janna L. Kerins, VMD, MPH, DACVPM;
Chicago Department of Public Health

Darby McDermott, DVM, MPH;
New Jersey Department of Health

Erin Petro, DVM, MPH, DACVPM;
Kansas Department of Health and Environment

Consultants to the Committee:

Chumkee Aziz, DVM, DABVP (Shelter Medicine Practice);
University of California, Davis, School of Veterinary Medicine

Ian Battersby, BVSc, DSAM, DipECVIM-CA;
Ian Battersby Consulting Ltd

Katharine M. Benedict, DVM, PhD;
National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Centers for Disease Control and Prevention (CDC)

Melissa Cumming, MS, CIC;
Massachusetts Department of Public Health

Brandy Dozier, DVM, DACLAM;
Oregon National Primate Research Center

Heather Fowler, VMD, PhD, MPH, DACVPM;
National Pork Board

John D. Gibbins, DVM, MPH;
National Institute for Occupational Safety and Health, CDC

Allison E. James, DVM, PhD, MPH;
NCEZID, CDC

Sherrie Jean, DVM, DACLAM;
Office of Laboratory Systems and Response, CDC

Leslie Kollmann, AAS, LVT, CIC;
Minnesota Department of Health

Molly Lee, DVM, MPH, DACVPM;
Center for Food Security and Public Health, Iowa State University

Souci Louis, VMD, MPH, DACVPM;
NCEZID, CDC

Sara F. Margrey, DVM, MPH;
American Veterinary Medical Association, Council on Public Health

Paul S. Mead, MD, MPH;
NCEZID, CDC

Alexandra M. Medley, DVM, MPH, DACVPM;
NCEZID, CDC

Dallas Smith, PharmD;
NCEZID, CDC

Sean Stapleton, DVM, MPH;
NCEZID, CDC

Danielle M. Tack, DVM, MPVM;
NCEZID, CDC

Victoria Trinies, MPH;
NCEZID, CDC

Grace M. Vahey, DVM, MPH, DACVPM;
NCEZID, CDC

Regina Wagner, JD, MSN, MHQS, RN;
University of Pennsylvania, School of Veterinary Medicine

J. Scott Weese, DVM, DVSc, DACVIM;
University of Guelph, Ontario Veterinary College

Robert A. Weinstein, MD;
Rush University Medical College

Jean M. Whichard, DVM, PhD;
NCEZID, CDC

Acknowledgements:

The authors would like to acknowledge and express appreciation to the many consultants who reviewed and provided feedback, as well as the following individuals whose contributions were vital to this update:

Amanda L. Beaudoin, DVM, PhD, DACVPM;
University of Minnesota, College of Veterinary Medicine

Kelly Giesbrecht, DVM, MPH, Hon. Dipl. AVOHS;
Kentucky Department for Public Health

Angie Maxted, DVM, PhD, DACVPM;
Wisconsin Department of Health Services

Rachel Radcliffe, DVM, MPH;
Council of State and Territorial Epidemiologists

Carl Williams, DVM, DACVPM;
North Carolina Division of Public Health

This publication is supported by the Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services (HHS) as a part or component of a financial assistance award totaling $100,000 with 100 percent funded by CDC/HHS. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement by, CDC/HHS, or the U.S. Government.

Acronyms:

ABHS
Alcohol-based hand sanitizer

CDC
Centers for Disease Control and Prevention

CRE
Carbapenem-resistant Enterobacterales

EPA
Environmental Protection Agency

FDA
Food and Drug Administration

HAI
Healthcare-associated infection

IPC
Infection prevention and control

IV
Intravenous

MDRO
Multidrug-resistant organism

OSHA
Occupational Safety and Health Administration

PAPR
Powered air-purifying respirator

PPE
Personal protective equipment

WHO
World Health Organization

Proposed citation for this document: Curren EJ, Petro E, Kawakami V, McDermott D, Kerins JL, Alroy KA. Compendium of Zoonotic Disease Infection Prevention and Control in Veterinary Personnel, 2026, 4th ed. National Association of State and Public Health Veterinarians.

Contents

Preface **7**

Introduction **8**

Background 8

Objectives 8

Defining Infection Prevention and Control (IPC) 8

Regulations in IPC and Veterinary Medicine 9

Zoonotic Disease Chain of Infection **10**

Modes of Transmission 10

Breaking the Chain of Infection 11

Layered Interventions 11

Implementing Interventions 11

The Hierarchy of Controls 11

Implementing IPC in Veterinary Settings **13**

Standard Precautions 14

Key Elements of Standard Precautions 14

Risk Assessment 14

Hand Hygiene 15

Implementing Hand Hygiene 15

Hand Hygiene Compliance 15

Alcohol-Based Hand Sanitizer (ABHS) 15

Hand Washing with Soap and Water 16

Fingernails and Jewelry 16

Protective Outerwear 16

Animal Handling Strategies 17

Sharps Management 17

Cleaning and Disinfection 18
General Cleaning and Disinfection 18
Reprocessing of Equipment 19
Laundry and Bedding 20
Spill Response and Decontamination 20
Medical Waste 20
Pest and Vector Control 20
Transmission-Based Precautions 21
Types of Transmission-Based Precautions 21
Contact Precautions 21
Droplet Precautions 22
Aerosol Precautions 22
Isolation of Animals with Infectious Diseases 22
Personal Protective Equipment (PPE) 23
Protective Outerwear 23
Non-Sterile Gloves 23
Non-Sterile Gowns and Protective Suits 24
Footwear 24
Respiratory Protection 24
Facial Protection 25
Head Covers 25
Donning and Doffing 25
Design of Veterinary Facilities 26
Floors and Surfaces 26
Storage Cabinets 26
Sinks 26
Employee Breakroom 26

Policies and Practices 27
Patient Movement 27
Phone Triage 27
Patient intake 28
Staff Training and Education 28
Auditing 28
Cleaning and Disinfection Auditing 28
Hand Hygiene Auditing 29
PPE Use Auditing 29
Education and Training Auditing 29
Developing a Written IPC Plan 30
How to use Appendix 4 30
Figures **31**
Appendices **35**
References **52**

Preface

Preventing disease is a key objective of public health and veterinary medicine. In human healthcare settings, preventing disease transmission has historically been regulated by federal and state agencies and advanced by accreditation programs.[1] These regulatory efforts have resulted in substantial reductions of certain healthcare-associated infections (HAI) among human healthcare workers and their patients, demonstrating the value of this type of primary prevention.[2] Yet, preventing zoonotic disease transmission during the practice of veterinary medicine is seldom governed by federal or state regulations. This is further complicated by the diversity of settings where veterinary medicine is practiced, from pastures and barns to animal hospitals, mobile units, and laboratories. While some literature and professional societies have offered important recommendations for general disease prevention in veterinary practice,[3-5] few offer veterinary infection prevention and control (IPC) guidelines specifically with an occupational health focus. Veterinary IPC has been inconsistently applied in veterinary practice,[6] and veterinary workers across various animal settings are exposed to and infected by zoonotic pathogens from their patients.[7-11]

In 2006, the National Association of State Public Health Veterinarians (NASPHV) published the first Compendium of Veterinary Standard Precautions. This current revision updates the prior 2015 Compendium of Veterinary Standard Precautions for Zoonotic Disease Prevention in Veterinary Personnel.

This compendium offers technical guidance to minimize transmission of zoonotic pathogens from animal patients to veterinary personnel. Applying many of the recommendations can also minimize disease transmission in general, including pathogen transmission between humans, between animals, from humans to animals, and from environmental contamination and fomites. In addition to preventing clinical infections, effective veterinary IPC can play an important role in limiting the spread of harmful pathogens even when this spread is not apparent.

There are many components to a comprehensive veterinary personnel safety and health program, but the scope of this compendium is focused on zoonotic disease prevention across all types of veterinary practice. Given the breadth of the veterinary profession, it is prudent to review any specialty-specific guidance related to implementing IPC for specific veterinary practice types (e.g., small animal, large animal, laboratory animal, zoo animal, etc.) and different work environments (e.g., ambulatory veterinary teams, mobile veterinary practices, farms, shelters, etc.).

Updates from the 2015 Compendium of Veterinary Standard Precautions

This updated compendium has a new name, which indicates a focus on veterinary infection prevention and control (IPC), including both veterinary standard precautions and transmission-based precautions.

Appendix 1 describes a list of selected zoonotic diseases of importance, and now it also has recommended transmission-based precautions for each of these zoonotic diseases.

An important feature of standard precautions is a point-of-care risk assessment to determine if any transmission-based or additional precautions are needed. An explanation of how to do this point-of-care risk assessment is emphasized in the updated text as well as in Figure 3.

Appendix 4 provides an updated model IPC plan including template language as well as a tiered checklist that reflects the essential, important, and ideal components of a veterinary IPC plan.

Introduction

Background

Zoonotic pathogens are harmful microorganisms that can be transmitted between animals and people.[12] Approximately 61% of all human pathogens and 75% of emerging pathogens are zoonotic.[13] However, these known infectious organisms are likely a small fraction of potential pathogens in nature, many of which are yet undiscovered.[14] Zoonoses, diseases caused by zoonotic pathogens, are recognized occupational hazards for veterinary personnel. Appendix 1 describes select zoonoses with an emphasis on those that can be transmitted during veterinary occupational exposures in the United States. This appendix lists disease and organism name(s), type of agent(s), mode(s) of transmission, recommended patient precautions, animals associated with human transmission, other concerns for transmission, if nationally notifiable, and other pertinent notes.

In veterinary settings, HAI can cause infections in patients, veterinary personnel, or animal owners. Outbreaks at veterinary facilities have been documented, but little is known about routine transmission of harmful microbes during the practice of veterinary medicine.[2, 15, 16] Nearly 1 out of every 38 hospitalized people in the United States will develop an HAI, yet the equivalent estimate in veterinary medicine is unknown.[17] While veterinary HAIs are not always zoonotic, zoonotic pathogen transmission within veterinary facilities can and does occur.[16, 18, 19] Routine HAI surveillance among animals or workers in veterinary medicine is rare. Without routine surveillance, it is particularly challenging to identify when transmission of certain harmful microbes occurs.[19, 20] Antimicrobial-resistant organisms represent a particular challenge for veterinary IPC because silent transmission can occur through asymptomatic colonization, environmental contamination, and routine patient care activities. This colonization can lead to the establishment of reservoirs within the clinical environment and spread within a facility and in the community.[19]

Objectives

The objectives of this compendium are to:

- Serve as a technical guide for preventing zoonotic disease transmission through the implementation of IPC during the practice of veterinary medicine.
- Provide a model IPC plan for use in a wide range of veterinary settings.

The intended audience for this compendium includes veterinary and human clinicians, veterinary technicians, veterinary practice administrators, veterinary educational institutions, animal health students and trainees, public health practitioners, and other veterinary, livestock, and animal health organizations and professional societies.

Defining Infection Prevention and Control (IPC)

IPC is a targeted approach to decrease the spread of disease in settings where healthcare is provided[21] and it includes a wide range of policies and actions that are described below. While biosecurity aims to reduce the risk of introduction and spread of disease agents,[22] veterinary IPC is more broadly focused on preventing infections, and stopping the chain of infection among patients, visitors, and veterinary personnel during the practice of veterinary medicine.

Several publications show biosecurity and IPC deficiencies among veterinary staff. The evidence suggests limited IPC policies guiding veterinary practice, inconsistent adherence to existing IPC policies,[23-25] and therefore, a common occurrence of occupational illnesses.[7, 26] In a survey of 466 veterinarians across 36 states, one-quarter reported contracting a zoonosis originating from their practice.[7] In a survey of United States veterinary teaching hospitals, half of the institutions reported zoonotic infections among hospital personnel during the two years prior.[26]

This threat of zoonotic diseases to veterinary personnel demonstrates the need for IPC as a component of occupational health and safety programs in veterinary medicine.

Regulations in IPC and Veterinary Medicine

Veterinary medical practice in the United States is regulated by state-level veterinary practice acts, and while these often include statements promoting disease prevention, they seldom include IPC-specific regulations. The Occupational Safety and Health Administration (OSHA) is a federal regulatory agency that has established specific standards to prevent workplace hazards. OSHA standards are inclusive of, but not specific to, the workplace hazards that veterinary personnel encounter. The National Institute for Occupational Safety and Health (NIOSH) within the Centers for Disease Control and Prevention (CDC) provides additional, more specific recommendations for veterinary personnel and animal care workers but it is not a regulatory agency. Additional regulations may apply at the state level, such as the General Industry Safety Order in California.[27]

Key IPC Resources for Veterinary Medicine

American Animal Hospital Association (AAHA)
Infection Control, Prevention, and Biosecurity Guidelines https://www.aaha.org/resources/2018-aaha-infection-control-prevention-and-biosecurity-guidelines/aaha-infection-control-prevention-and-biosecurity-guidelines/

Association for Professionals in Infection Control and Epidemiology (APIC)
Veterinary Medicine IPC Council
https://community.apic.org/veterinarymedicineinfection/home

Australian Veterinary Association
Guidelines for Veterinary Personal Biosecurity guidelines-for-veterinary-personal-biosecurity-2017-final-1.pdf

Center for Food Security and Public Health (CFSPH), Iowa State University
Infection Control https://www.cfsph.iastate.edu/infection-control/

National Research Council
Occupational Health and Safety in the Care and Use of Research Animals https://www.nationalacademies.org/publications/4988

National Institutes of Health (NIH)
Guidelines for Personal Protective Equipment in Animal Facilities https://oacu.oir.nih.gov/system/files/media/file/2025-12/d2-personalprotection.pdf

Biosafety in Microbiological and Biomedical Laboratories, 6th edition (NIH and CDC)
https://www.cdc.gov/labs/media/pdfs/2025/08/SF__19a_308133-A_BMBL6_00-BOOK-WEB-final-3.pdf

Ontario Animal Health Network (OAHN)
https://www.oahn.ca/resource-type/infection-prevention-and-control/. OAHN Companion Animal Research Project: Update of Infection Prevention and Control Best Practices for Small Animal Veterinary Clinic https://www.oahn.ca/resources/oahn-companion-animal-research-project-infection-prevention-and-control-best-practices-for-small-animal-veterinary-clinics/

Zoonotic Disease Chain of Infection

Successful transmission of infectious diseases requires a pathogen (such as the bacterium, virus, parasite, or fungus), an infectious source (the animal patient), a portal of exit (such as the animal coughing or passing stool), a mode of transmission (direct or indirect contact, through the air, or vector-borne), a portal of entry (such as an open wound or mucous membrane), and a susceptible host (such as the veterinary employee). Understanding a pathogen's mode of transmission helps to determine which IPC measures are needed to interrupt the chain of infection.

Modes of Transmission

Zoonotic pathogens can be transmitted in the workplace via three main modes of transmission: direct or indirect contact, through the air, and through the bites of arthropods (vector-borne). Foodborne and waterborne transmission of zoonotic pathogens is also possible, but unlikely in the context of veterinary occupational exposures. Many pathogens can be transmitted through multiple modes, and ultimately IPC policies and procedures can minimize the risk of spreading pathogens through any type of transmission.

- **Contact transmission** can occur either directly or indirectly.
  - **Direct contact** occurs through ingestion, percutaneous (e.g., animal bites, contamination of open wounds, or needlestick injuries), or hand-to-mouth contact resulting in mucous membrane exposure. Many zoonotic pathogens are transmitted from animals to people by hand-to-mouth contact. Direct transmission can occur during petting or handling an animal, examination, or treatment. Rabies virus is an example of a zoonotic pathogen transmitted through direct contact with an animal's saliva.
  - **Indirect contact** occurs through an intermediary fomite, such as contaminated workplace surfaces, objects, equipment, or soiled laundry.[11, 28-32] Fungal dermatophytes (e.g., ringworm) or antimicrobial-resistant bacteria, such as methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) and carbapenem-resistant Enterobacterales (CRE), are examples of pathogens that can be transmitted through direct or indirect contact.[7, 19, 33]
- **Transmission through the air** occurs when an infectious agent is inhaled or deposited on the mucous membranes of the eyes, nose, or mouth either directly or through a fomite. While traditionally categorized as droplet or aerosol transmission, there is likely a continuum of transmission between these two, rather than a strict dichotomy.[34, 35] For instance, evidence from the COVID-19 pandemic helped to clarify that particle size is not the only factor determining how infectious agents are transmitted through the air.[34] As traditionally defined:
  - **Droplet transmission** occurs through splashes or sprays of body fluids, which can be inhaled or absorbed through mucous membranes. Droplets can be created by coughing, sneezing, and vocalization, or through procedures such as dentistry or lancing abscesses. These droplets are typically large (≥5 µm), can travel 1 to 2 m, and do not remain suspended in the air. This distance provides a conservative practical guideline but is not a strict evidence-based boundary. Examples of zoonotic pathogens transmitted by droplets include *Yersinia pestis* and *Sporothrix* spp.[36, 37] In addition to particle size, risk of pathogen transmission through the air generally increases with proximity to the source and duration of exposure.

- **Aerosol transmission** occurs when small particles become suspended in the air. Particles may travel through a room or facility by air currents and can be inhaled or ingested. They may be generated through respiration, vocalization, during medical procedures such as suction and bronchoscopy, and during facility cleaning, particularly with high-pressure sprayers. Certain pathogens may remain infective over long distances depending on multiple factors such as particle size, the nature of the pathogen, and environmental conditions.[38, 39] Two zoonotic pathogens that can be transmitted over long distances are *Coxiella burnetii* and *Mycobacterium bovis*.[40-44]

- **Vector-borne transmission** occurs when arthropods such as mosquitoes, flies, fleas, and ticks transmit pathogens to a susceptible host. Veterinary workers can be exposed to fleas and ticks through close contact with their veterinary patients. Additionally, those who work in outdoor settings may be at increased risk of arthropod exposure. West Nile virus is an example of a zoonotic pathogen that is transmitted through mosquito vectors.

As the scientific community learns more about disease transmission, especially with new or re-emerging infectious diseases, prevention guidance can be updated accordingly. Readers should use this compendium's information to make the best decision for themselves and other personnel based on current scientific evidence. As described below in 'Breaking the Chain of Infection,' this compendium's recommendations are meant to be used concurrently to strengthen the layers of protection for veterinary personnel in their specific practice setting using available resources.

Breaking the Chain of Infection

Layered Interventions

Many factors can influence whether and how a pathogen is transmitted to a susceptible host. These include characteristics of the environment, attributes of the pathogen, the animal patient, and the human host. Because transmission can occur through multiple modes, the most effective way to reduce the spread of zoonotic pathogens is to use a multi-layered IPC strategy.[45] This approach is consistent with the 'Swiss cheese' model, which illustrates how layered interventions can collectively prevent transmission.[46, 47] In this model, each IPC measure is represented as a slice of cheese with holes, namely, weaknesses or failures of the intervention, such as using a disinfectant with inadequate contact time. The redundancy of multiple concurrent interventions (multiple cheese slices) helps to minimize the alignment of the different holes, preventing pathogens from getting through, and ultimately stopping transmission from occurring.

Implementing Interventions

All members of a veterinary practice are responsible for keeping themselves safe and minimizing pathogen transmission between people and animals. In many ways preventing zoonotic infections in the workplace begins with practice leadership.[48] The leadership of a veterinary practice helps to create a safe work environment, establishes the organization's culture of safety, oversees the training of staff, and sets the standards, policies, and practices that staff must adhere to. At each veterinary practice, leadership must assess risks that are specific to their workplace and manage those risks by applying interventions according to the hierarchy of controls.

The Hierarchy of Controls

The hierarchy of controls is a way to categorize and prioritize safety measures that can be implemented by employers to control or eliminate risks from workplace hazards, including zoonotic diseases (Figure 1). The hierarchy of controls describes five levels of control measures, and in this framework, interventions are arranged from

most effective at the top to least effective at the bottom. The lower tiers of this hierarchy are more dependent on human behavior for successful implementation and therefore, more prone to error. While implementing the hierarchy of controls does not eliminate all workplace hazards, it does minimize exposures and potential harm to the employee. Below are descriptions of the five levels, with examples of different safety measures that can be used in all settings of veterinary medicine to interrupt zoonotic disease transmission:

- **Elimination of the hazard:** Elimination is the most effective way to prevent zoonotic disease transmission because it removes the hazard entirely. However, it may also be the most challenging, if not impossible to implement, since it is often difficult to predict what zoonotic disease an animal patient might have. One elimination strategy is excluding examination of certain species, with known risks, such as macaques (herpes B virus) or skunks (rabies virus), when adequate staff training, provider experience, and facility design do not allow for the safe examination and treatment of such species. These animals should be referred to facilities capable of providing safe and appropriate care.
- **Substitution of the hazard**: Substitution involves replacing a material or process with a safer alternative. An example is using needleless intravenous (IV) systems instead of traditional IV tubing to reduce the risk of needlestick injuries. However, substitutions can introduce new hazards, highlighting that hazard assessments must be iterative and continuously reviewed.
- **Engineering controls:** Engineering controls are safety measures that are incorporated into the facility or product design to remove a hazard at its source or improve IPC compliance. Veterinary facilities should incorporate these features during design or renovation, though many can also be added to existing facilities. Examples include: installing nonporous floors and surfaces for easy cleaning and disinfection, using biosafety level facilities to evaluate animal specimens suspected to have higher-risk diseases, designating isolation rooms or spaces, separating staff break areas from animal treatment areas, and conveniently placing dispensers for alcohol-based hand sanitizer (ABHS) or sinks to promote hand hygiene.
- **Administrative controls:** Administrative controls are facility policies that change how people work and require staff to follow appropriate IPC practices. While administrative controls are essential, they are considered less effective than elimination, substitution, or engineering controls because they require ongoing staff training and monitoring for compliance. Examples include performing hand hygiene between patients, employee vaccination requirements, prohibiting eating or drinking in treatment areas, not recapping needles, and screening cases at reception (e.g., if brucellosis is suspected in a dog or large animal at the time of scheduling, make sure the veterinary team is notified in advance to examine the animal with appropriate supplies).
- **Personal protective equipment (PPE):** PPE can interrupt pathogen transmission but it is considered the last line of defense because it relies on correct and consistent use and carries the risk of human error. An example of using PPE is wearing face protection during dental procedures. Effective PPE use requires ongoing staff training on how and when to wear PPE, specific PPE needed for a given situation, keeping an adequate PPE supply, and staff monitoring for correct use and disposal. **PPE should never replace good hand hygiene.** In fact, misuse (e.g., not changing non-sterile gloves) can worsen pathogen spread.[49]

Implementing IPC in Veterinary Settings

It is critical to train staff and other personnel about safety measures before, during, and after IPC implementation. This is particularly true for interventions where the safety measures are dependent on human behavior for success, and thus rely on personnel being trained, monitored, held accountable, and supported as new interventions become refined and routine. In multiple studies, educational interventions including training and audits have been found to improve IPC adherence.[6, 50] The first key step in implementing IPC is educating *all* personnel on infection control measures as part of onboarding. Ongoing training on IPC concepts should then be conducted at routine intervals.

IPC precautions, including standard and transmission-based precautions, are a predetermined set of interventions that create barriers between people and pathogens to reduce pathogen transmission.[51] Standard veterinary precautions are implemented for every patient that is seen in practice regardless of whether or not the patient has a known or suspected zoonotic disease. Transmission-based precautions, namely contact, droplet, and aerosol precautions, are interventions used when a veterinary patient is known or suspected to have a pathogen that can be transmitted via contact or through the air (Figure 2).

Building the Evidence Base for Implementing IPC in Veterinary Settings

IPC recommendations in this compendium are supported by veterinary-specific evidence when available; however, if veterinary-specific IPC evidence is unavailable, general infection prevention guidance or evidence from human healthcare settings is offered.

The medical care of animals and people can be quite different, including the:

- Environment where veterinary medicine takes place (a barn, field, laboratory, hospital environment, and many others)
- Amount of biological material present with implications for pathogen transmission
- Cost of diagnostic testing and infrastructure for nosocomial and occupational disease surveillance
- People and culture influencing how recommendations are implemented

These differences can lead to veterinary IPC-related knowledge gaps.

Examples of domains that warrant additional veterinary-specific research include:

- **Diagnostic testing and reporting to health officials**
  - Antimicrobial susceptibility breakpoints
  - Specimen testing costs and logistics for public health purposes
  - Optimal implementation of environmental surveillance
  - Communication with animal or public health officials
- **Hand hygiene**
  - Implementation of hand hygiene programs
  - Optimal use of ABHS
- **Cleaning and disinfection**
  - Device reprocessing
  - Effective disinfectants in veterinary settings
  - Utility of footbaths and footmats
- **Implementation of IPC in different animal care settings**
  - Design of veterinary facilities to promote effective IPC
  - Behavioral research of IPC implementation in veterinary settings
  - Validation of IPC checklists and tools in a diversity of veterinary settings
  - Research trials to test the validity of IPC related recommendations

Standard Precautions

Standard precautions are the minimum standard of IPC practices that should be used by all veterinary personnel during the care of all patients, at all times, in all settings regardless of diagnosis or presumed infection status. These practices are based on the principle that all blood, body fluids, secretions, and excretions should be considered potentially infectious. A routine point-of-care risk assessment is the foundation of standard precautions. Before every interaction, veterinary personnel should assess the likelihood of exposure to blood and body fluids, splashes or sprays, contaminated surfaces, and animal-related injury. This assessment also considers whether the patient is presenting with signs of undiagnosed infection (such as cough, diarrhea, fever, or rash) or visible contamination (such as blood, urine, or feces). These risk assessment findings guide the selection of PPE, patient placement, and other preventive actions.

Key Elements of Standard Precautions

- Point-of-care risk assessment
- Hand hygiene
- Protective outerwear
- Animal handling strategies
- Sharps management and safe injection practices
- Cleaning and disinfection

Risk Assessment

Prompt identification of patients with a known or suspected infectious disease that warrant transmission-based precautions is critical to stop potential spread to other patients and personnel.[52-55]

Conducting a point-of-care risk assessment with each patient is an important way to determine if transmission-based precautions are needed (Figure 3). A risk assessment begins at initial triage and evaluation, but it should be an on-going process as more information becomes available during the examination, care, and diagnostic testing of animals, to determine if additional precautions are necessary. If a patient is confirmed or suspected of having an infectious disease, transmission-based precautions should be applied. Even if an infectious disease is not suspected, certain high-risk species (such as wild animals, rabies vector species, and non-human primates), animal behaviors, or procedures, may increase the level of disease transmission risk, warranting higher-level precautions (Appendix 2). While some veterinary professionals already implement these steps routinely, naming and acknowledging this risk assessment process can potentially strengthen infection prevention practices.

Risk Assessment Take-Aways

A point-of-care risk assessment for each patient is an important way to determine if transmission-based precautions are needed.

Transmission-based precautions should be applied if a patient is confirmed or suspected of having an infectious disease.

Certain species, animal behaviors, veterinary procedures, or personal circumstances can increase disease transmission risk, warranting veterinary personnel to wear PPE or implement additional precautions, even without suspecting or confirming the animal has an infectious disease.

Staff with weakened immune systems due to age, pregnancy, medical conditions, or treatments are often at increased risk for serious zoonotic infections and may be inclined to take additional precautions to minimize their own zoonotic disease risk.[56] Pregnant individuals are particularly vulnerable to infections such as toxoplasmosis, brucellosis, and listeriosis, which may result in miscarriage, stillbirth, premature birth, or fetal congenital anomalies.[57] Veterinary staff should inform their healthcare provider about their occupational exposure to animals and discuss ways to mitigate workplace risks.

Hand Hygiene

Consistent, thorough hand hygiene is the single most important measure veterinary personnel can take to reduce transmission of zoonotic pathogens.[58] Hand hygiene should be consistently conducted before and after examination of individual animals or animal groups (e.g., litters of puppies or kittens, groups of cattle), before beginning an aseptic task, after contact with body fluids, and after being in an animal's environment (e.g., World Health Organization 5 Moments of Hand Hygiene).[59, 60] When visible contamination extends beyond the wrist, hand hygiene should include washing the forearms in addition to the hands.

Hand Hygiene Take-Aways

Hand hygiene is the single most important measure veterinary personnel can take to reduce the transmission of zoonotic pathogens.

Readily available alcohol-based hand sanitizer (ABHS) can greatly improve hand hygiene compliance.

Adequate availability of hand hygiene supplies in all patient contact areas is critical, whether that is ABHS or sinks, liquid soap, and disposable towels.

Implementing Hand Hygiene

Hand Hygiene Compliance

The importance of hand hygiene for IPC cannot be overemphasized. Despite acknowledgement of the importance of hand hygiene, studies have demonstrated that compliance with hand hygiene best practices among veterinary professionals is low.[6, 61-63] Adherence to hand hygiene protocols can be negatively influenced by several factors including inaccessible hand hygiene supplies, skin irritation, high workload, and insufficient time to name a few.[61] Hand hygiene protocol adherence can be improved by several factors such as when protocols are made simple, convenient, and culturally acceptable; regular training is uniquely tailored to individual workplaces; hand hygiene audits are conducted, with constructive feedback provided to staff; and, most importantly, when senior team members consistently display good hand hygiene practices.[64-66]

Alcohol-Based Hand Sanitizer (ABHS)

ABHS is a rapid and efficient way to conduct hand hygiene and is recommended for when hands are not visibly contaminated with organic matter.[67] Using an ABHS requires approximately one third of the time compared with handwashing with soap and water, is generally well tolerated, and can be easily accessible. ABHS effectively reduces colony-forming bacterial units on hands as well as, if not better than, other methods when used in veterinary clinical and surgical settings, although more veterinary-specific studies could be valuable.[68, 69]

ABHS is a fast-acting, broad-spectrum germicide that kills microorganisms by denaturing microbial proteins.[70] ABHS is highly effective against bacteria, many fungi, and enveloped viruses[64, 71-73] although less effective or ineffective against bacterial spores, protozoal parasites, and some nonenveloped viruses, such as clostridial spores, *Cryptosporidium*, and parvovirus respectively.[71, 74, 75] The CDC recommends that ABHS contain 60% to

95% ethyl alcohol (ethanol) or isopropyl alcohol (isopropanol) for use in healthcare settings.[71] Products containing other disinfectants may be susceptible to bacterial overgrowth and have been associated with nosocomial infections.[76-79]

When ABHS dispensers are readily available and conveniently located, hand hygiene compliance is greatly improved as shown in acute and long-term human healthcare settings.[80, 81] Strategic placement of ABHS dispensers in veterinary healthcare settings, such as in examination rooms and ambulatory practice vehicles, has the potential to increase compliance for veterinary personnel as well.[68] It is important to train staff that the visible presence of any organic matter on hands will reduce ABHS efficacy. When running water is not available and hands are visibly soiled, use a moist wipe to remove organic material prior to using an ABHS to increase the effectiveness.

Hand Washing with Soap and Water

Washing hands with soap and water is recommended when hands are soiled with debris or organic material, particularly after exposure to feces, blood, or other bodily fluids. Either plain or antimicrobial liquid soaps, but not bar soaps, are appropriate for routine use. Handwashing removes loosely adherent transient flora from the hands.[70] 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. Several antiseptic products with variable efficacy against different classes of microorganisms are available.[58, 71, 82]

Hand soaps may be susceptible to bacterial overgrowth and have been associated with nosocomial infections.[83] To prevent creation of a bacterial reservoir or cross-contamination, no additional soap should be added to liquid soap dispensers before they are empty (i.e., 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.[71] 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.[71] When hand lotions are used, personal containers are recommended over using shared dispensers to prevent contamination. When drying hands, the use of community or shared towels should be avoided. Instead, soft and absorbent disposable towels are preferred.[71, 84, 85]

Fingernails and Jewelry

Fingernail length and adornment of the hands and nails are important considerations for effective hand hygiene. Fingernail length is directly correlated with higher microbial cell counts, artificial nails harbor more bacteria when compared with natural nails,[86] and fingernail stickers can increase fingernail bacterial load despite surgical scrubbing.[87] This underscores the risk of long fingernails in harboring and transmitting bacteria during patient care.[86, 88] Staff members who have animal contact should keep fingernails short.[71, 86, 88] Biosafety regulations and guidance on jewelry vary widely in laboratory settings[89] yet limited evidence from veterinary clinical settings is available. Wearing rings and other jewelry can potentially impact hand hygiene effectiveness leading to microbial contamination.[71]

Protective Outerwear

Dedicated workclothing, such as scrubs, or protective outerwear such as a laboratory coat or coveralls should be worn whenever personnel have contact with animals or their environment. This helps prevent the transfer of pathogens between the wearer and the patient and is a critical part of infection control that is often overlooked in everyday veterinary practice.[90] Clean protective outerwear should be worn each day, it should be

washed frequently, and changed immediately mid-day if it becomes visibly soiled during use. Do not wear protective outerwear outside of work (e.g., during lunch breaks or when commuting), and change coveralls between visits to different facilities, farms, or herds.[38, 91-93] Personnel should wear street clothes to work which are kept in a locker or changing room, then change into dedicated work clothing, such as scrubs, after arriving at work, and remove clothing before leaving the workplace each day, changing back into street clothes. Dedicated footwear for work settings should also be considered. Ideally, protective outerwear should not be taken home and instead laundered onsite at the veterinary facility, or with a professional service. Use impermeable outerwear when splash or soaking exposure is likely.[94]

Animal Handling Strategies

The most common occupational injuries among veterinarians include animal bites, scratches, and needlesticks,[95-100] all of which can serve as a portal of entry enabling transmission of infectious agents. During their careers, approximately two-thirds of veterinarians report a major animal-related injury that resulted in lost work time or hospitalization.[101-105] All personnel should be trained on species-specific, low stress animal handling, restraint, and behavioral cue recognition as an important way to minimize workplace injuries. This includes the appropriate use of equipment for the animal (such as a well-fitting muzzle), and appropriate equipment for the personnel restraining the animal (such as cat gloves). Equipment should undergo routine cleaning and disinfection between patients to prevent indirect pathogen transmission.

Sharps Management

Needlesticks are common in veterinary medicine, can cause serious injury, and may result in a loss of work time.[99, 106] Needlesticks can cause accidental inoculation of vaccines containing live organisms, harmful chemicals, hormones, chemotherapeutics, or infective materials into veterinary personnel; additionally, the wound can serve as a portal of entry for pathogens.[100] A designated sharps container should be located in every area where animal care occurs.[107-109] Sharps, such as needles and scalpel blades, should be immediately placed in a sharps container after use. Sharps containers should not be overfilled and they should be disposed of in accordance with applicable state and local laws.

Needles should not be recapped by hand as recapping needles causes more injuries than it prevents.[3] The one-handed scoop method to recap needles is considered to be a safer approach than traditional recapping. [3]

One-Handed Scoop Technique:

- Place the cap on a horizontal surface
- Hold the syringe with attached needle in one hand
- Use the needle to scoop up the cap without use of other hand
- Secure the cap by pushing it against a hard surface[3, 110]

Alternatively, forceps can be used to either recap the needle or remove an uncapped needle from a syringe, and the needle alone can be placed in the sharps container. Uncapped needles should never be removed from a syringe by hand.

Several needle-free injection systems have been explored in veterinary medicine. These devices rely on forced air to administer drugs rather than through a needle. Needle-free injection systems offer several advantages including improved worker safety by eliminating needlestick injuries and the need for needle disposal, as well as improved animal welfare with less pain and stress.[111, 112]

Cleaning and Disinfection

Both field and facility settings can serve as a source of zoonotic pathogens for veterinary staff, patients, and their owners. For example, in the field, carcasses from anthrax-infected livestock must be incinerated, and decontamination of surface soil and equipment is needed to prevent further transmission of anthrax spores.[113, 114] In clinical settings, surfaces and equipment can become contaminated with zoonotic pathogens that may persist for months and continue to serve as a source of infection for animals, their owners, and veterinary employees.[18, 19, 115-117] This section will address cleaning and disinfection of surfaces and equipment in field and clinical settings.

General Cleaning and Disinfection

Cleaning involves the removal of visible matter, scrubbing with a soap or detergent, followed by a water rinse. Disinfection is the use of a chemical or other procedure to kill most microbes that cannot be removed by cleaning alone. Sterilization is a procedure that kills all microbes, including hardy ones such as protozoal oocysts or bacterial endospores, and is needed in particular circumstances (see more below). Regular cleaning and disinfection of equipment and surfaces is critical for environmental control of pathogens, including antimicrobial-resistant organisms that may persist on surfaces or colonize patients even when clinical disease is not apparent. Equipment and surfaces must be cleaned before they are disinfected because organic material decreases the effectiveness of most disinfectants.[4]

Surfaces within a veterinary facility or ambulatory vehicle should be cleaned and disinfected on a regular schedule and whenever visibly dirty. Some items and surfaces warrant cleaning and disinfection between each patient's use or at a minimum multiple times daily (e.g., examination table and stethoscope) whereas others require routine attention on a daily or weekly basis (e.g., high contact surfaces such as doorknobs and handles, cage latches, scales, faucet handles, and sinks).[5, 118, 119]

Generation of dust that may contain pathogens can be minimized by using vacuums with high-efficiency particulate air filters or by lightly spraying surfaces with water prior to mopping or sweeping (wet mopping). Other methods to minimize dust generation include dust mopping or electrostatic sweeping. Avoid using high-pressure sprayers and similar devices that can disseminate infectious particles. However, if high-pressure spraying is unavoidable, ensure that non-sterile gloves, respiratory and eye protection are worn at a minimum since these procedures can generate infectious aerosols. Additional care should be taken when using mops, as these may harbor pathogens and contribute to spreading pathogens from one area to another. To avoid this, mop water and mop heads should be changed routinely, and between use in different animal housing areas; mop heads should be laundered daily.[120] An alternative to wet mopping may be using low pressure sprayers, scrub brushes, and squeegees for areas where a drain is present.

All disinfectants are required to list their active ingredients on their label, as well as the organisms that the disinfectant is capable of inactivating, also known as the disinfectant's 'kill claim'. Disinfectants are registered with the U.S. Environmental Protection Agency (EPA). An EPA-registered disinfectant is required by federal law to be used in accordance with label instructions, with attention to storage conditions, shelf-life, proper dilution, and contact time. Figure 4 provides guidance on how to read the label on a disinfectant container, and Appendix 3 provides a select list of disinfectants and describes their classes, active ingredients, mechanism of action, characteristics, health hazards, and spectrum of activity. EPA-registered disinfectants are designated for the inactivation of particular microbes on hard, nonporous surfaces.

The EPA uses different methods to determine disinfectants' efficacy on soft surface textiles. Consequently, disinfection in farm and field settings can be challenging because of the variety of surface types. Resources exist to help in the selection and application of disinfectants in these settings.[121]

When choosing a disinfectant, each veterinary practice should ensure that their selected disinfectants will inactivate the intended targets and commonly encountered microbes, be effective on the surfaces present in the practice environment, and that personnel will be able to accommodate all label requirements. This includes accurate product dilution to the appropriate concentration and correct application of the disinfectant with adequate wet contact time to sufficiently kill microbes.[122, 123] Additional considerations when selecting a disinfectant include human and animal health and safety concerns (Does the product have an acceptable toxicity or flammability rating? Do personnel need to wear PPE when the disinfectant is being used?); compatibility with the facility's surfaces (Will the intended concentration erode or cause damage to equipment, surfaces, or floors?); ease of use (Do the available formats, whether liquid concentrates, ready to use dilutions, wipes etc., meet the needs of the veterinary practice?); as well as other practical factors (Is the cost acceptable? Does the manufacturer offer training or support? etc.).[123]

Specific surfaces, animal care items, and veterinary medical equipment differ with regard to the type of disinfection or sterilization needed between use.[124] Critical items that enter sterile tissues or cavities such as surgical and dental equipment should either be single-use items or be sterilized in between each patient's use, killing all microbes through a chemical or physical process such as autoclaving. Semi-critical items that contact mucous membranes or non-intact skin, such as thermometers or esophageal probes, need a high-level of disinfection where most microbes are killed or deactivated.

In contrast, non-critical items such as exam tables and surfaces that do not touch patients or only contact intact skin do not require all microbes to be destroyed, and a lower-level of disinfection is sufficient. Some chemical disinfectants can be used at different concentrations or with different contact time durations to achieve either a high-level bactericidal, virucidal, and fungicidal disinfection or a routine low-level disinfection. Accelerated hydrogen peroxide can be used for high-level disinfection at a 1:16 dilution with 5 minutes of contact time, for example, when disinfecting surfaces to control transmission of carbapenem-resistant *Klebsiella pneumoniae*, a type of CRE. Alternatively, the same disinfectant can be used at a 1:64 dilution with 5 minutes of contact time for routine low-level disinfection for floors and surfaces.[45, 122]

Good technique matters: carefully and accurately following the manufacturer's instructions for use is critical to ensure that any given disinfectant is working appropriately. Strategies to audit cleaning and disinfection practices is a way to confirm that procedures and application of disinfectants have been completed correctly.

Reprocessing of Equipment

Certain veterinary medical items, such as endotracheal tubes, intravenous catheters, needles, and syringes, are broadly designed for single-use. Inadequate reprocessing of single-use items between patients has led to the spread of zoonotic pathogens within veterinary facilities.[16] In veterinary medicine, reprocessing single-use items by cleaning and disinfection or sterilization, is an "off-label" practice that can be conducted under the purview of a veterinarian.[125] There are circumstances where reprocessing single-use items is appropriate and can effectively eliminate or minimize microbial contamination. While there are evidence-based studies to inform equipment reprocessing,[126-128] there is no consensus on how

reprocessing should occur for all items across all practice types. Therefore, veterinary professionals and practice leadership must consider if and how infection prevention protocols will direct equipment reprocessing between patients or if items must be dedicated to one patient or used only once.

Laundry and Bedding

Although soiled laundry may be contaminated with pathogens, the risk of disease transmission can be reduced when soiled items are handled correctly.[129, 130] Personnel should check pockets for sharps before items are removed and laundered. Gloves and protective outerwear should be worn when handling soiled laundry, and any visible debris or bulk solids should be removed from soiled textiles before washing. Bedding and other laundry should be machine washed with any standard laundry detergent and machine dried at the highest temperature suitable for the material.[131] To prevent cross contamination, separate storage and transport bins should be used for clean and dirty laundry.

Spill Response and Decontamination

Spills and splashes of potentially infective substances as well as broken containers made of glass or hard materials can pose a risk to veterinary personnel. Any spill or broken container should be immediately contained with absorbent material (e.g., paper towels, sawdust, or cat litter). When containing a spill, staff should avoid injuries from any sharp debris and wear the appropriate PPE for both the potentially infective substance and the cleaning or disinfectant product being used. The product's EPA-registered safety data sheet will indicate the appropriate PPE to use.[132] Collect the spilled fluids and absorbent material in a sealed, leak-proof plastic bag; clean the area; and then disinfect with an EPA-registered product with attention to label instructions and contact time. Keep animals and people who are not involved in the cleanup away from the area until disinfection is completed. Prepare a spill response kit with clear instructions to ensure a faster and safer cleanup.[133, 134]

Medical Waste

Medical waste is a specific subset of waste produced by veterinarians and other healthcare professionals. Medical waste poses a sufficient potential risk of causing infection during handling and disposal. The EPA defines medical waste as "healthcare waste that may be contaminated by blood, body fluids or other potentially infectious materials and is often referred to as regulated medical waste."[135] Sharp items such as surgical blades and needles must be disposed of as medical waste. Veterinarians and practice leadership should familiarize themselves with medical waste-related federal and state regulations for their particular jurisdiction, to appropriately implement and maintain compliance.

Pest 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.[136, 137] 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.[138] Additionally, animals may act as mechanical carriers for fleas and ticks, and it is important to check patients as they enter a clinic to limit introduction of arthropod vectors into the indoor work environment.[139] Personnel regularly working with animals that have a heavy ectoparasite burden, such as stray dogs and cats entering a shelter, are also at higher risk for zoonotic vector-borne disease transmission.

Integrated pest management is a comprehensive pest control approach based on an understanding of the life cycle and ecological niche of the pest. This integrated approach is recommended to control pests like rodents and insects in veterinary facilities. 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. [140, 141] Pesticides and rodent traps may be used as part of a comprehensive plan that includes environmental control measures as follows:

- Seal potential entry and exit points into buildings with caulk, steel wool, or a metal lath.
- Store food and garbage in metal or thick-plastic containers with tight fitting lids.
- Dispose of food waste promptly.
- Eliminate potential rodent nesting sites (e.g., clutter) in and around buildings.
- Remove sources of standing water (e.g., empty buckets, tires, and clogged gutters) to reduce potential mosquito breeding sites.
- Install and maintain 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.

Transmission-Based Precautions

Transmission-based precautions are prevention measures that veterinary personnel utilize when a patient is infected or colonized with a known or suspected pathogen.[124] These precautions are based on the pathogen's mode or transmission, and in general there are three types: contact precautions, droplet precautions, and aerosol precautions. If a patient has a suspected or confirmed disease with multiple modes of transmission, more than one type of transmission-based precautions can be used for the patient during their examination, care, and treatment. Transmission-based precautions are always applied in addition to existing standard precautions. Veterinary personnel can determine if transmission-based precautions are needed by conducting a point-of-care risk assessment to determine if an infectious organism is suspected. When veterinarians apply transmission-based precautions they will most often use contact precautions; in some less common but important situations droplet or aerosol precautions are warranted. When seeing patients in the field, ambulatory veterinarians and their staff should always be equipped with a kit of materials in case transmission-based precautions are appropriate, such as PPE, supplies to manage potentially contagious waste, disinfectant(s), and cautionary signs to decrease traffic to the area among other items.[91] For additional information see Appendix 2 and the section below on PPE.

Types of Transmission-Based Precautions

Contact Precautions

Use contact precautions to prevent transmission of pathogens through direct or indirect contact with animals or their environment. Contact precautions are recommended when patients are known or suspected to be carrying zoonotic pathogens like *Leptospira* spp., dermatophytes, or multidrug-resistant organisms (MDRO). In addition to direct contact, these organisms may persist in the clinical environment and contribute to occupational and facility-based transmission through indirect contact. Contact precautions can help minimize exposure to potential fomites and limit indirect transmission. Contact precautions include wearing appropriate PPE (gloves, non-sterile gown or protective suits, and shoe covers

or water-resistant boots when needed) during contact with the patient or their environment. Hand hygiene should be performed before donning and after doffing PPE, and before touching a shared patient care environment. Disposable or dedicated equipment should be used for patients on contact precautions and all reusable equipment should be cleaned and disinfected. Additionally, animals on contact precautions should have limited movement within the facility, and if possible, a dedicated pet relief area and separate entryways from the general population. Clean and disinfect all animal occupied areas regularly, per facility protocols.

Droplet Precautions

Use droplet precautions to prevent transmission of large respiratory droplets (typically travelling less than 3 feet). For example, droplet precautions are recommended when euthanizing an animal suspected to have rabies.[142] PPE for personnel handling animals on droplet precautions include a surgical mask, eye protection, and gloves during close contact. Additional PPE may be indicated based on the risk assessment and activity being performed. Animals should be separated from the general patient population by placing them in a private room or kennel at least 3 feet away from other animals. Additionally, as described in contact precautions, personnel should perform hand hygiene before donning and after doffing PPE, and before touching a shared patient care environment. Limiting animal movement within the facility and preventing animals from shared facility areas, using disposable and/or dedicated equipment for each patient, and cleaning and disinfecting animal occupied areas regularly per facility protocols remain important steps to take for animals under droplet precautions.

Aerosol Precautions

Use aerosol precautions to prevent transmission of small infectious particles that stay airborne and travel long distances. Patients that are known or suspected to be carrying zoonotic pathogens like novel influenza viruses, *Coxiella burnetii*, or *Chlamydophila psittaci* are examples where using aerosol precautions are appropriate. Use a negative pressure room (airborne infection isolation room, or AIIR) if available. However, since these are rare in veterinary facilities, prioritize isolating the patient in a private room with the door closed or separate isolation room, away from others. Personnel should use fit-tested N95 respirators or powered air-purifying respirators (PAPR) when caring for the patient. N95 respirators should be discarded every time after leaving the isolation room, and hand hygiene performed. If fit-tested N95 respirators or PAPRs are not available, use the highest level of respiratory protection available. Gloves should also be worn, and the risk assessment should inform if additional PPE is indicated. Performing hand hygiene, limiting animal movement within the facility, preventing animals from accessing shared facility areas, using disposable and/or dedicated equipment for each patient, and cleaning and disinfecting animal occupied areas regularly per facility protocols remain important steps to take for animals under aerosol precautions.

Isolation of Animals with Infectious Diseases

Animals with a known or suspected communicable disease should be examined, treated, and housed in a designated isolation room or area when possible to protect other patients and veterinary personnel. Isolation rooms or areas should be clearly identified with signage and access should be limited to essential personnel, with sign-in logs used to track who is entering the designated space. There should be designated PPE for isolation rooms or areas, with instructions for use, including donning and doffing. Protocols, including areas for donning, doffing, and how to dispose of used PPE after caring for animals in isolation, should be established by the facility. Impermeable shoe and boot coverings made of plastic are preferred over footbaths and

footmats. In addition to being difficult to properly maintain, there are limited data available regarding the effectiveness of footbaths and footmats for infection control in veterinary practices.[143-145]

Store only the necessary equipment and materials needed for the care and treatment of the patient in the isolation room or area, and do not use isolation supplies elsewhere. Whenever possible, single-use items such as bowls, litter pans, and gowns are 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. Bag potentially contaminated materials before transport within the facility and disinfect or dispose of in accordance with state rules governing disposal of medical waste.[106, 146]

Animals requiring isolation should have a dedicated area for urination and defecation that is not accessible to the general population. If it is necessary for infectious patients to leave the isolation area for a procedure (e.g., radiology, surgery), surfaces contacted by the patient should be cleaned and disinfected immediately after. Depending on the type and size of the animal, use of a transport cart with disposable pads could be considered to minimize hallway contamination where other patients and personnel may transit.

Personal Protective Equipment (PPE)

PPE includes clothing and devices that protect workers from disease and injury. When there is risk of exposure to biological hazards, employers must provide PPE and ensure it is used correctly.[61, 89] The following sections highlight a variety of PPE intended to prevent the transmission of zoonotic infectious agents to veterinary personnel. The recommended PPE that should be worn during routine veterinary procedures can be found in Appendix 2.

Protective Outerwear

Protective outerwear protects against pathogen transfer from patients to staff. Clean protective outerwear should be worn daily as part of standard precautions. For more information see the section above on protective outerwear in standard precautions.

Non-Sterile Gloves

Use of clean, non-sterile gloves prevents contamination of hands during patient care and environmental contact. Gloves also serve as barrier protection when contact precautions are indicated. Sterile gloves may also protect the hands, but are primarily intended to protect the patient from contamination during surgical or other invasive procedures that require aseptic technique; the remainder of this section focuses on non-sterile glove use.

Gloves should be worn when contact with feces, body fluids, vomitus, exudates, and non-intact skin is likely. Additionally, wear gloves when cleaning cages, environmental surfaces in animal areas, litter boxes, or contaminated equipment, and when handling dirty laundry. Gloves are not necessary when examining or handling healthy animals.

Importantly, wearing gloves is not a substitute for performing hand hygiene. If worn inappropriately (e.g., not changing gloves between procedures or patients), wearing gloves can increase the risk of an IPC lapse such as cross-contamination.[49] Before donning gloves, perform hand hygiene to prevent contamination from pathogens on hands. Gloves should always be disposed of after use or if torn and should never be washed and re-used. Change gloves between dirty and clean procedures performed on a single patient. Always perform hand hygiene immediately after removing gloves because gloves may have hidden tears or may contaminate hands during removal.[147, 148]

Non-Sterile Gowns and Protective Suits

A non-sterile gown or protective suit should be used when working with a single patient or a group of co-housed patients that are on contact precautions to protect the wearer and prevent fomite transmission.

A protective suit offers 360° coverage whereas a gown may have an opening in the back and coverage to the mid-calf. A gown can be easier to put on and take off in contrast to a protective suit. Either design can be used during patient care and neither has been shown to be clinically superior.[149]

The characteristics of these coverings can influence how they are used, for example:

- **Permeable gowns** can be used for general care of animals in isolation.
- **Impermeable gowns** should be used when exposure to fluids or splashes is likely.
- **Disposable gowns** are meant for single-use and should not be reused. Ideally a disposable gown is used when handling an animal on transmission-based precautions.
- **Washable gowns** can be reused for the same animal, but must be laundered when visibly soiled. Between uses with the same patient, gowns should be hung to prevent contamination of nearby surfaces or contact of the dirty side with clothing when re-gowning.

Wear non-sterile gowns or protective suits in conjunction with gloves and only touch contaminated surfaces of the gown or suit with gloved hands. After use, place washable gowns into laundry receptacles; discard disposable gowns and gloves before leaving the animal's environment.

Footwear

Footwear prevents the spread of pathogens from one environment to another. Shoes or boots should have thick soles and closed toes, be impermeable to water and easily cleaned. Disposable shoe/boot covers or waterproof overboots should be used when gross contamination is expected.

Remove and discard shoe covers or clean and disinfect reusable overboots immediately after leaving contaminated areas. Clean or replace footwear between locations (e.g., farm visits, returning to veterinary facilities, or home).[91, 150] Contaminated footwear has been implicated in the transmission of antibiotic-resistant bacteria from veterinary to home environments.[151]

Respiratory Protection

Two broad categories of respiratory protection exist, surgical masks and respirators, and veterinary staff should be trained on the difference between them.

- **Surgical masks** protect against large droplets and splashes, and serve as a physical barrier from such hazards. Surgical masks protect the patient (i.e., to prevent contamination during surgery) but don't offer the same level of protection for the wearer against aerosol pathogens in the air.[152]
- **Respirators** are certified to protect the wearer from inhalation of aerosolized infectious particles. They form a tight seal around the wearer's face and require fit-testing for maximum protection. Examples include disposable (N95 respirators) and reusable respirators.

Wear respiratory protection during possible exposure to pathogens transmitted through the air such as avian influenza (H5N1), *C. burnetii, Brucella* spp., and *Chlamydophila psittaci* [153-156] as well as during aerosol-generating procedures (e.g., using power tools during necropsy or pressure washing kennels).[157]

Any required respirator use must follow OSHA requirements (Standard 29 CFR 1910.134), which includes fit-testing and fit-checking training requirements.[158] While not a replacement for fit-testing, guidance is available to perform a user seal check which could confer improved protection compared with a surgical mask but not as much as a fit-tested respirator.[159]

Facial Protection

Facial protection protects the face, eyes, nose, and mouth against infectious droplets, splashes, and sprays. Wear facial protection, such as a face shield or goggles plus a surgical mask, when there is a risk of splashes or sprays into the mucous membranes, especially during procedures such as lancing abscesses, flushing wounds, suctioning, dentistry, obstetrics, or necropsies.[38, 106, 160-162] Facial protection should also be considered during close contact with animals that may generate infectious droplets through coughing, sneezing, or excessive salivation.

Head Covers

Head covers provide a barrier when contamination of the hair and scalp may occur, such as in livestock barns or in situations involving pathogens transmitted through the air. Scrub caps are a type of head cover that is primarily used to prevent contamination of the surgical field, but may also serve as a physical barrier against large droplets and splashes. Disposable head covers should not be reused.

Donning and Doffing

It is critical to ensure proper use and appropriate donning and doffing of any PPE used in the veterinary setting. Personnel should receive training on correct and safe PPE use in general, and protocols applicable to specific procedures or locations should be highlighted with signage or other reminders as applicable. Instructional videos are one type of education tool that can be used to train healthcare personnel on how to correctly and safely don and doff PPE.[163] Some institutions, such as The Ohio State University College of Veterinary Medicine, have created freely available instructional videos for PPE use in veterinary medicine. Hand hygiene should always be performed immediately after removing PPE.[106]

The sequence below provides a step-by-step description for donning (putting on) and doffing (removing) PPE. Perform hand hygiene between steps if hands become contaminated.[5, 164]

Donning PPE:

- Perform hand hygiene
- Put on shoe covers (if applicable)
- Put on gown/protective suit
- Put on mask/respirator (if applicable)
- Put on eye protection (if applicable)
- Put on gloves

Doffing PPE:

- Remove shoe covers (if applicable)
- Remove gown/protective suit and gloves*
- Remove eye protection (if applicable)
- Remove mask/respirator (if applicable)
- Perform hand hygiene

* If gloves are removed first, hands must only touch uncontaminated surfaces of the gown, typically behind the neck (ties) and at the back of the shoulders. The gown is then peeled down off the body and arms, balling or rolling in the contaminated surfaces (front and sleeves). This is difficult to do, however, without contaminating the hands. The preferred method for doffing a disposable gown and gloves is to break the ties at

the neck by pulling on the upper front portion of the gown with the hands still gloved, balling or rolling in the contaminated surfaces, and pulling the gloves off inside-out as the hands are withdrawn from the gown's sleeves. The gown and gloves can then be placed in a disposal receptacle together.

Design of Veterinary Facilities

General design considerations for veterinary facilities can be found in veterinary IPC resources.[3, 5] While experiences and recommendations specifically for facility design and construction are available for human healthcare settings,[165-167] additional veterinary literature on these topics could be valuable.[168] The following aspects of veterinary facility design should be prioritized to support infection prevention.

Floors and Surfaces

Surfaces in areas where animals are housed, examined, or treated should be made of nonporous, easily cleaned materials. Avoid surfaces and flooring, such as carpet, that cannot easily be cleaned and disinfected. Likewise, when placing drains, ensure they allow for effective cleaning and sanitation.

Storage Cabinets

Storage cabinets can keep equipment, supplies, and laundry that is new or already clean, disinfected, and ready to use. Identifying locations of these cabinets in the facility is important to consider (e.g., a dedicated storage cabinet in an isolation room) and helps minimize clutter in other areas of the facility, enabling thorough cleaning and disinfection of surfaces and minimizing any potential contamination or splashes. Adequate storage, including dedicated storage rooms and storage cabinets, should be well-maintained and kept organized.

Sinks

Sink design is important to enable hand hygiene and minimize microbial contamination. Choosing sink designs with an adequate depth (a basin size of at least 144 square inches, minimum width or length of 9-inches) and an angled or offset faucet that does not pour directly into the drain, can help prevent contamination of nearby areas such as countertops or equipment adjacent to sinks.[165, 169] To help prevent cross-contamination, a 3-foot zone around the sink, known as the "splash zone" should be kept clear of supplies and medication.[170] When space does not allow for a 3-foot zone, splash guards can be installed on either side of the sink to contain water.[171]

Ensure sinks are placed in appropriate facility locations to minimize multi-purpose use. For example, when possible, a separate dedicated sink for handwashing should be provided. Conveniently located handwashing sinks and ABHS stations increase hand hygiene compliance among personnel.[172] This sink should not be used for cleaning and disinfecting husbandry items like animal food bowls or litterboxes. If the sink used for cleaning these items is full, consider using a holding bin for dirty items until they can be washed or placed in a dishwasher, decreasing the splash risk from these items. Running water should comply with primary drinking water regulations and be available at suitable temperatures and pressure to allow for effective sanitation and hand hygiene compliance (i.e., cold water and low pressure will not encourage correct hand-washing for the recommended 20-30 second duration).

Employee Breakroom

Every facility should prioritize having a dedicated employee breakroom or area for storing and consuming food. Eating and drinking should never occur in patient care and housing areas, laboratory spaces, or treatment rooms.

Separate and appropriately labeled refrigerators should be used for human food, animal food, biologics, and laboratory diagnostic specimens. When it isn't feasible or safe for staff to walk a long distance to a breakroom, a hydration point, such as a designated drink-only shelf just outside the clinical environment, can be considered as a reasonable and necessary staff accommodation. To minimize contamination in this area, however, the hydration point should be clearly labeled (such as "Drink Station – No Food or Patient Care Materials"), equipped with sanitation supplies (such as ABHS and disinfectant wipes), and have a routine schedule for cleaning and disinfection.

Policies and Practices

Infection prevention is built on the policies and practices of a workplace. These measures provide structured guidelines that help reduce the spread of disease and ensure the health and safety of personnel and patients. By promoting consistency, accountability, and evidence-based practices (through self-auditing), these policies play a vital role in minimizing disease transmission risks and improving outcomes.

Patient Movement

The movement of patients through a veterinary facility, including patient triage and intake, are important aspects of infection prevention. There is a greater chance of exposing other patients, personnel, and clinical spaces if an animal with an infectious disease is moved throughout a facility. Consequently, early identification of any animals with harmful microbes, can help staff restrict unnecessary patient movement.

Phone Triage

When scheduling appointments, staff should ask about the reason for the visit and identify patients that may be infectious so they can be examined outside of the facility, in an area with increased ventilation, or immediately escorted to a private exam room. Sample questions are provided below, but should be tailored to the specific patient population serviced (e.g., livestock, equine, companion animal, etc.). Reviewing prior medical records can also help identify patients with a potential infectious disease (e.g., history of an MDRO), helping reduce unrecognized transmission of antimicrobial-resistant organisms within veterinary facilities. Depending on the findings from triage and the medical record, staff should don appropriate PPE before patient handling.

Example Phone Triage Questions

Has the patient recently:

- Been adopted, purchased, or changed ownership? If so, when?
- Boarded, been to a kennel, shelter, or other care facility? If so, when?
- Attended a show or competition? If so, when?
- Traveled outside of the state or country? If so, when and where?

Has the patient been exposed to other ill animals?

- Clinical signs of ill contacts?

Has the patient been previously diagnosed with an MDRO?

- Date of diagnosis and type of infection?

Has the patient been experiencing any of the following?:

- Acute vomiting
- Blood in the stool
- Open or seeping wounds
- Acute respiratory signs (coughing or sneezing)
- Neurologic symptoms
- Aggression
- Three or more loose or watery stools in last 24 hours (diarrhea)

Patient intake

Staff should briefly evaluate patients for signs of illness that might have been missed during triage such as acute respiratory signs (coughing or sneezing), acute gastrointestinal signs (vomiting or diarrhea), open or seeping wounds, neurologic signs, and behavioral issues such as aggression. Any patients with these signs should be placed in a private stall, exam or isolation room upon check-in and an identification placed on the enclosure and patient chart (e.g., a colored dot system, standardized cage cards, or similar consistent, internal marker so that patients are easily recognized as needing special handling, PPE, or other IPC precautions). Including patient vaccination status for zoonotic diseases like rabies and leptospirosis on intake forms can also assist in risk assessment.

Staff Training and Education

Before new staff or volunteers begin work, they should receive training that emphasizes IPC practices, including when to report incidents like animal bites or needlesticks, that could result in zoonotic disease transmission.[173-177] Ongoing, comprehensive, and properly documented training for veterinary staff and volunteers is a critical part of any effective infection control program. Each training should have clear objectives and a way to evaluate effectiveness of the training. [178] A dedicated IPC lead within the workplace who can answer questions and address issues as they arise will contribute to the success of IPC plans and interventions. Refresher training should be conducted at regular intervals (e.g., annually), when policies change, and during outbreaks of known or emerging pathogens. Consider conducting IPC trainings that engage personnel, for example games and interactive learning exercises.[179, 180]

Auditing

Veterinary practices need systems to audit the various aspects of the veterinary IPC program including adequate cleaning and disinfection, correct and consistent hand hygiene, and effective education and training. Below are suggestions for specific areas of auditing and potential methods to consider, keeping in mind that different practice types may have specific industry or employer auditing standards. Overall, auditing is an opportunity to give employee feedback and improve the IPC program, and outcomes should not be used punitively. Before beginning, consider the areas you want to audit, what resources are available, and how you plan to use and share the results of audits.

Cleaning and Disinfection Auditing

Auditing is a way to confirm that cleaning and disinfection is occurring, implemented correctly, and that microbes are killed as expected. There are many ways that these audits can take place, and often multiple approaches are needed. Performance observation entails having trained observers watch staff clean and disinfect, ensuring that it is done correctly (e.g., protocol adherence with adequate disinfectant contact time), and offering timely and constructive feedback.[181] For disinfectants requiring dilution, indicator testing strips can be used on a regular cadence to confirm the correct dilution of the disinfectant.[45] Some tools can be applied to surfaces, such as an ultraviolet pen for environmental marking applied before cleaning to ensure adequate mechanical action of cleaning or using adenosine triphosphate (ATP) bioluminescence to measure any remaining organic matter after cleaning and disinfection.[182, 183] Both are straightforward to implement and provide easily understandable feedback to personnel if their cleaning and disinfection practices need to be refined.[181] While environmental bacterial culture can also be

considered, it remains a topic of debate.[184] Some advocate for its routine use;[185] others suggest that other lower cost auditing options are just as effective for IPC purposes and that veterinary facility environmental culture is most useful during outbreak investigations to identify a reservoir where environmental contamination is suspected.[186]

Hand Hygiene Auditing

As discussed previously, consistent hand hygiene practices are the cornerstone of an effective IPC program. As with environmental cleaning, there are various techniques for ensuring the adherence to and correct practice of hand hygiene. The gold standard for auditing hand hygiene is through direct observation in which a trained person, such as the clinic IPC champion, observes staff during key moments for hand hygiene (e.g., 5 Moments of Hand Hygiene).[59, 62] Such observational methods have been standardized for human healthcare settings which are adaptable to various practice types.[187] Applications exist (e.g., the CleanHands app) to assist with IPC auditing specific to hand hygiene and can help make audits more actionable by providing integrated data analysis and visualization. Other methods of auditing hand hygiene include self-assessment tools, such as application of Glo-germ, performing hand hygiene, and checking effectiveness by looking for residual Glo-germ after hand hygiene with soap and water.

PPE Use Auditing

The purpose of PPE is to protect the wearer from disease or injury. Though it is the last line of defense on the hierarchy of controls, it is critical to ensure personnel know where PPE is located, are trained on the proper selection of PPE for a given situation, and demonstrate correct donning and doffing procedures. All of these elements are part of a comprehensive (holistic) PPE audit.[188] As with hand hygiene, observation of PPE usage in various situations is one auditing method that can be applied to each aspect of PPE usage from selection of appropriate PPE to specific donning and doffing of each PPE type. Holistic PPE audits may also include proper hand hygiene, evaluation of environmental contamination, and use of appropriate supplies and equipment (e.g., using dedicated equipment for a patient on contact precautions).

Education and Training Auditing

Another area for auditing is in the education and training opportunities utilized within a facility. These trainings may cover hand hygiene, PPE use, antibiotic stewardship guidelines, cleaning and disinfection procedures for surfaces and equipment and other practice type-specific training requirements. These audits should evaluate the effectiveness of the specific training or educational campaign of the facility to determine the impact of such training. For example, a study evaluating a hand hygiene compliance campaign at a small animal veterinary teaching hospital found that a multi-modal approach including posted signs to remind personnel to practice hand hygiene and a presentation about the importance of hand hygiene and how to perform it correctly had a significant impact on hand hygiene compliance

How Veterinary Facility Managers Can Champion IPC

Dedicate time and staff for IPC planning, training, and implementation.

Create written protocols and distribute to personnel; create a schedule to review and update.

Allocate resources and ensure availability of sufficient supplies/equipment for successful IPC.

Perform audits to ensure protocols are being followed; provide supportive education and training when gaps are identified.

and use of ABHS.[173] However, a similar study whose intervention included a presentation focused on the effectiveness of hand hygiene lowering HAI and decreasing infections in healthcare workers in human healthcare settings, plus the use of posters throughout the small animal hospital found that there was no difference from pre and post-intervention rates of hand hygiene, in the use of ABHS, or in the quantity of supplies used.[189] These discrepant findings among similar populations emphasizes the importance of conducting training and educational evaluations that are workplace-specific, as methods at one facility may not be transferable to other facility types.

Developing a Written IPC Plan

All veterinary practices should establish a comprehensive written infection prevention and control plan [23, 190] that is tailored to their practice. A customizable IPC checklist and model plan is available as a supplement to this compendium (Appendix 4).

An effective IPC plan should:

- Provide clear and well-organized guidance specific to the facility and practice type.
- Be flexible to accommodate new issues and incorporate new scientific knowledge.
- Identify staff members responsible for specific areas, activities, or functions.
- Include relevant contact information, resources, and references.

How to use Appendix 4

The first part of Appendix 4 is a checklist that covers the key components of veterinary IPC. Each component has a star value. One-star components are essential items that are foundational to IPC and should be implemented in every type of veterinary setting. Two-star components are important and can strengthen the practice of IPC. Three-star components reflect ideal IPC practices.

A designated staff member should initially complete the checklist to establish existing IPC practices and identify areas to prioritize for implementation or improvement. The checklist can then be completed at set timepoints (e.g., on an annual basis) to regularly evaluate progress toward ideal IPC practices or to audit ongoing IPC practices.

The second part of Appendix 4 is a model IPC plan that is customizable for any veterinary practice. The text can be used as is to provide written IPC guidance if none currently exists, or as a template that is amended to reflect existing policies, local ordinances, new knowledge, or other relevant factors.

Copies of the infection control plan and resource documents should be readily accessible to all staff, including reception, administration, animal care, housekeeping personnel and facility volunteers. All veterinary personnel are responsible for supporting and carrying out the activities outlined in the plan; however, it is the practice management team and senior clinicians who must play a leadership role in establishing an effective IPC culture.

Figures

Figure 1. Hierarchy of controls for methods to facilitate infection prevention among veterinary personnel

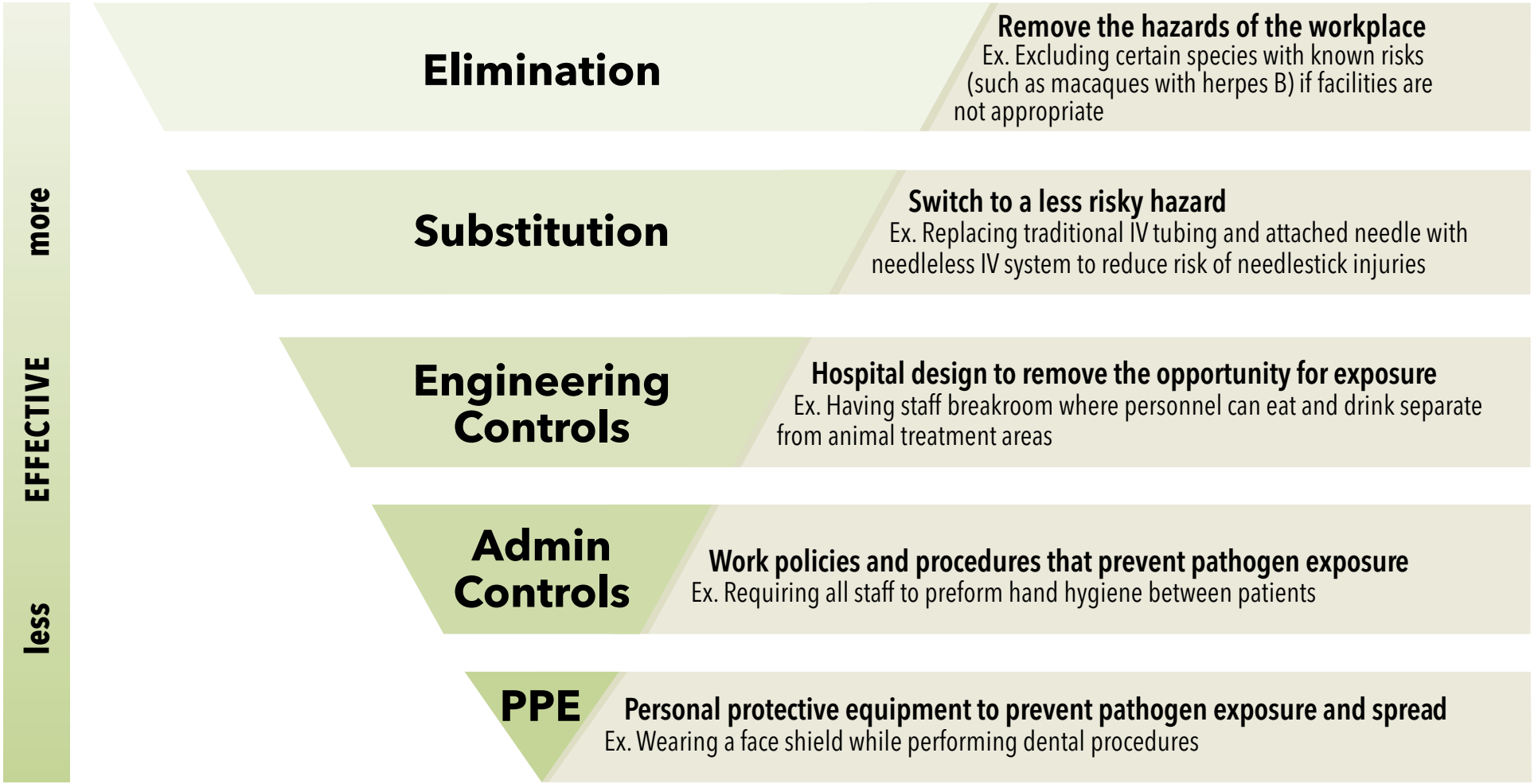


Figure 2. Types of IPC precautions: standard versus transmission-based precautions

<table>
<tr><th>Key Concepts for all Patients</th><th colspan="2">Types of Precautions</th><th>Patient Placement</th><th>Personal Protective Equipment (PPE)</th><th>Shared Equipment</th><th>Environmental Cleaning</th></tr>
<tr><td rowspan="4">• Continuously conduct risk assessments to inform type of precautions
• Perform hand hygiene throughout the day
• Use consistent handling strategies to reduce injury
• Practice safe injection and sharps injury prevention</td><td colspan="2">Standard Precautions</td><td>As needed based on risk assessment</td><td>• Protective Outwear
• Other PPE as needed*</td><td>Decontaminate and reprocess shared items</td><td>Clean and disinfect animal areas regularly</td></tr>
<tr><td colspan="5">+</td></tr>
<tr><td rowspan="3">Transmission-Based Precautions</td><td>Contact Precautions</td><td>Limit patient movement</td><td>• Non-sterile gloves
• Non-sterile gown or protective suit
• Other PPE as needed*</td><td rowspan="3">Use disposable or dedicated patient items</td><td rowspan="3">Clean and disinfect animal areas regularly</td></tr>
<tr><td>Droplet Precautions</td><td>Limit patient movement and separate from other patients by at least 3 feet</td><td>• Non-sterile gloves
• Surgical mask
• Eye protection
• Other PPE as needed*</td></tr>
<tr><td>Aerosol Precautions</td><td>Isolate patient</td><td>• Non-sterile gloves
• Respirator
• Eye protection
• Other PPE as needed*</td></tr>
</table>

* Use of other PPE dependent on risk assessment

Figure 3. Point-of-care risk assessment

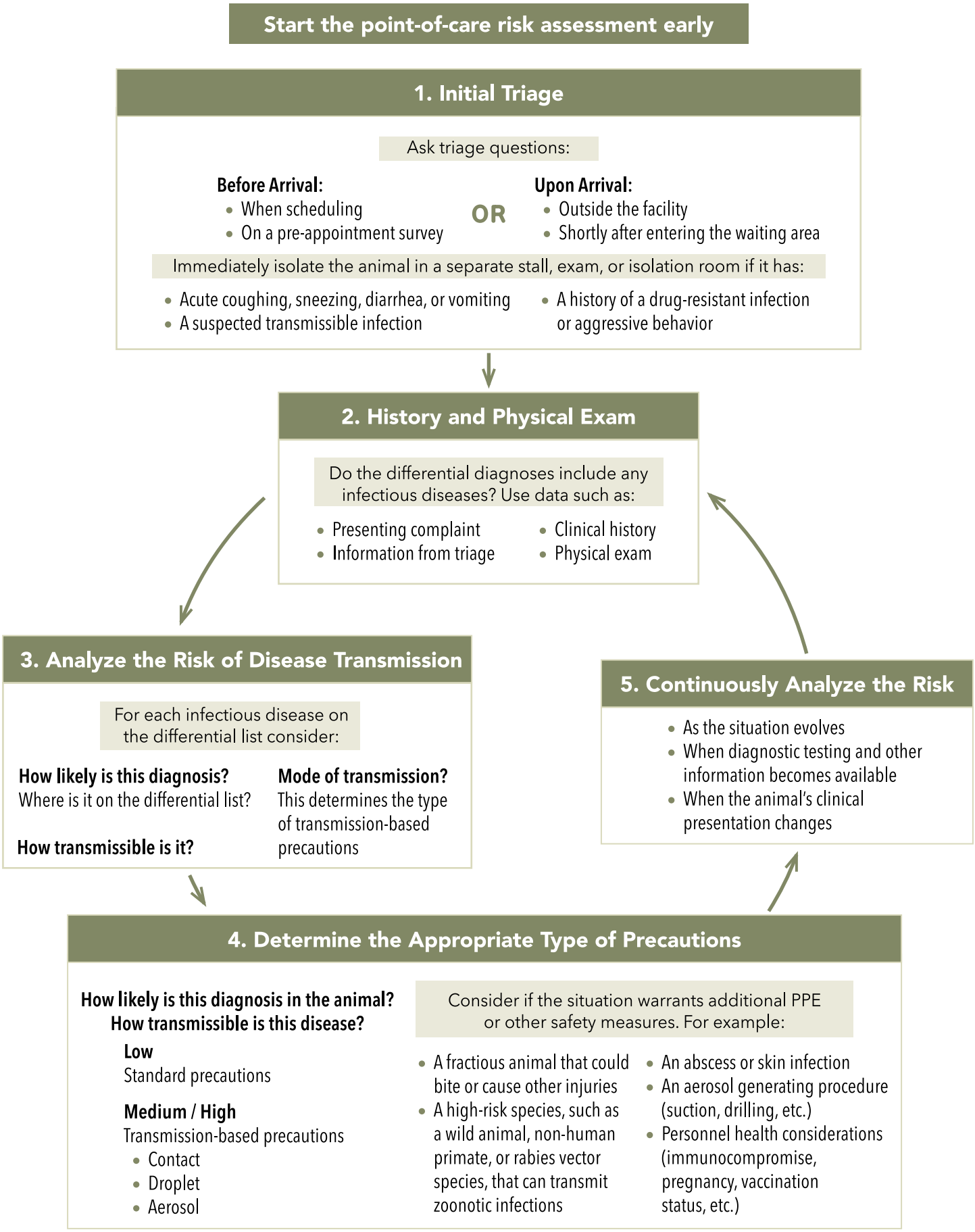
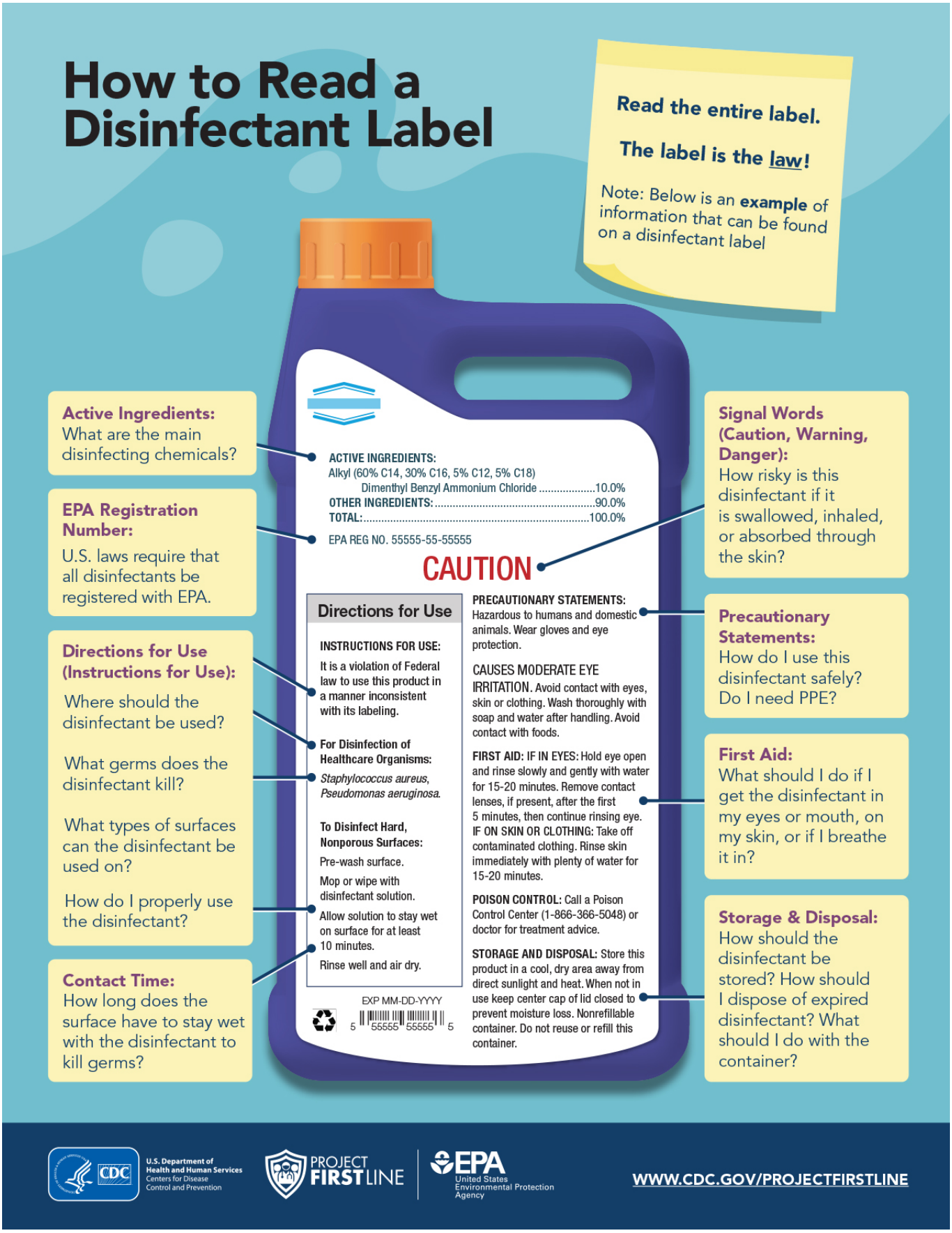


Figure 4. Reading disinfectant labels



Appendices

Appendix 1. Selected zoonotic diseases with potential of occupational exposure to veterinary personnel in the United States, 2026

These recommendations provide a foundation for understanding potential zoonotic disease hazards faced by veterinary and animal care professionals. When engaging with animals suspected or confirmed to have a potentially zoonotic pathogen, additional precautions should be considered and these recommendations should be adjusted based on a risk assessment of the situation.[1] Zoonotic diseases where transmission does not occur during the course of animal care, including those primarily transmitted by ingestion of contaminated food or water, are not included.

					Animals associated with transmission to humans																
Disease	**Organism Type of infectious agent**	**Transmission through**	**Recommended Standard or Transmission-based precautions**	**Isolate or remove affected animals**	Dogs	Cats	Horses	Cattle	Swine	Small Ruminants	Birds	Rodents	Rabbits	Amphibians or Reptiles	Non-human Primates	Wildlife	Fish or Invertebrates	**Concern for bite**	**Concern for environmental contamination**	**Nationally notifiable in the U.S. for human (H) or animal (A) cases[2]**	**Additional Notes**
Acariasis (scabies)	*Sarcoptes scabiei*, *Notoedres cati*, and other species **Mite ectoparasite**	Contact	Contact	Yes	•	•	•		•	•	•	•						No	Yes	No	
Anthrax	*Bacillus anthracis* **Bacterial endospore**	Contact, Air, Vector	Contact	Yes			•	•		•								No	Yes. Carcasses can cause environmental contamination	H, A	Contact with infected animal tissues or products is a greater concern for transmission than exposure to living animals. Exposure to infectious aerosols is rare but possible. Animals infected with anthrax should not be necropsied.
Antibiotic-resistant bacteria	Gram-negative and gram-positive bacteria, in particular ESKAPE organisms (*Enterococcus faecium, Staphylococcus aureus, Staphylococcus pseudintermedius, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa,* and *Enterobacter* spp.) **Most antibiotic-resistant bacteria with zoonotic potential are non-spore forming bacteria**	Contact	Contact	May be required	•	•	•	•	•	•	•	•	•		•			No	Yes	H (for certain antibiotic-resistant bacteria)	Review antimicrobial susceptibility patterns to determine if common resistance patterns are detected among patients as a preliminary way to identify possible healthcare-associated transmission.
Bartonellosis	*Bartonella henselae*, other *Bartonella* spp. **Non-spore forming bacteria**	Contact, Vector	Standard	Not needed		•												Yes	No	No	

Appendix 1.

Disease	Organism Type of infectious agent	Transmission through	Recommended Standard or Transmission-based precautions	Isolate or remove affected animals	Animals associated with transmission to humans													Concern for bite	Concern for environmental contamination	Nationally notifiable in the U.S. for human (H) or animal (A) cases[2]	Additional Notes
					Dogs	Cats	Horses	Cattle	Swine	Small Ruminants	Birds	Rodents	Rabbits	Amphibians or Reptiles	Non-human Primates	Wildlife	Fish or Invertebrates				
Brucellosis	*Brucella melitensis, B. abortus, B. suis, B. canis* **Non-spore forming bacteria**	Contact, Air	Contact; Droplet during high-risk activities; +/- Aerosol during aerosol-generating procedures[3]	Yes	•		•	•	•	•						•		No	Yes	H, A	Consider among animals with compatible symptoms who have been imported from endemic or high-risk areas. High-risk activities include: - Exposure to reproductive fluids - Specimen collection - Surgical procedures - Disinfection and cleaning of contaminated environments
Campylobacteriosis	*Campylobacter jejuni*, other *Campylobacter* spp. **Non-spore forming bacteria**	Contact	Contact	Not needed	•	•	•	•	•	•	•	•	•	•	•			No	Yes	H, A	Campylobacter can be a normal flora of animal stools. Not all Campylobacter species are capable of zoonotic infection.
Capnocytophaga spp. infection	*Capnocytophaga canimorsus, C. canis, C. cynodegmi* **Non-spore forming bacteria**	Contact	Standard	Not needed	•	•												Yes	No	No	Capnocytophaga can be a normal flora of animal mouths.
Chlamydiosis (mammalian)	*Chlamydia abortus, C. felis,* and other *Chlamydia* spp. **Non-spore forming bacteria**	Contact, Air	Contact; Droplet	Yes		•		•		•								No	Yes	No	Zoonotic transmission of *Chlaymdia felis* from cats is rare.
Contagious pustular dermatitis (orf or contagious ecthyma)	Parapoxvirus **Enveloped virus**	Contact	Contact	Yes						•								Yes	No	No	
Cryptosporidiosis	*Cryptosporidium parvum* **Protozoal oocyst**	Contact	Contact	Yes				•										No	Yes	H	
Dermatophilosis	*Dermatophilus congolensis* **Non-spore forming bacteria**	Contact, vector	Contact	Yes			•	•		•								No	Yes	No	
Dermatophytosis (ringworm)	*Microsporum* spp, *Trichophyton* spp., *Epidermophyton* spp. **Fungus**	Contact	Contact	Yes	•	•	•	•		•		•	•					No	Yes	No	
Dipylidium infection (tapeworm)	*Dipylidium caninum* **Cestode parasite**	Vector, ingestion (rare)	Standard	Not needed	•	•												No	No	No	

Appendix 1.

Disease	Organism Type of infectious agent	Transmission through	Recommended Standard or Transmission-based precautions	Isolate or remove affected animals	Animals associated with transmission to humans: Dogs	Cats	Horses	Cattle	Swine	Small Ruminants	Birds	Rodents	Rabbits	Amphibians or Reptiles	Non-human Primates	Wildlife	Fish or Invertebrates	Concern for bite	Concern for environmental contamination	Nationally notifiable in the U.S. for human (H) or animal (A) cases[2]	Additional Notes
Shiga Toxin-Producing *Escherichia coli* (STEC)	*Escherichia coli* O157:H7 and other serotypes **Non-spore forming bacteria**	Contact	Standard	Yes				•		•	•							No	Yes	H	
Echinococcosis	*Echinococcus granulosus, E. multilocularis* **Cestode parasite**	Contact	Standard	Not needed	•	•										•		No	Yes	A	
Erysipeloid	*Erysipelothrix rhusiopathiae* (multiple subtypes, called assemblages, several of which can be zoonotic) **Non-spore forming bacteria**	Contact	Contact	Yes				•	•	•	•						•	No	Yes	No	
Giardiasis	*Giardia intestinalis* **Protozoa**	Contact	Contact	Not needed	•	•	•	•	•	•	•	•			•	•		No	Yes	H	
Hantaviral diseases	Hantaviruses **Enveloped viruses**	Air, Contact	Contact; Aerosol	Yes								•						Yes	Yes	H	Infections are primarily by exposure to infected rodent urine, saliva, or droppings (usually rats and mice). Rarely, by bites or scratches or eating contaminated food.
Herpes B virus infection	Macacine herpesvirus **Enveloped viruses**	Contact	Contact; Droplet	Yes											•			Yes	No	No	Transmission is primarily from exposure to a bite or scratch by an infected macaque or contact with the monkey's eyes, nose, or mouth.
Novel Influenza	Influenza A virus **Enveloped viruses**	Contact, Air	Contact; Aerosol	Yes		•		•	•		•					•		No	Yes	H, A	In addition to contact and aerosol precautions, PPE should include hair covering, shoe covers.
Larval migrans: cutaneous (hookworm)	*Ancylostoma* spp. **Parasitic nematode**	Contact	Standard	Not needed	•	•												No	Yes	No	
Larval migrans: visceral, ocular, neuro (roundworm)	*Toxocara canis, T. cati, Baylisascaris procyonis* **Parasitic nematode**	Contact	Standard	Not needed	•	•										•		No	Yes	No	
Leptospirosis	*Leptospira* spp. **Non-spore forming bacteria**	Contact, Air	Contact	Yes	•		•	•	•	•		•				•		No	Yes	H, A	
Listeriosis	*Listeria monocytogenes* **Non-spore forming bacteria**	Contact	Standard	Yes	•	•		•	•	•	•							No	Yes	H	

Appendix 1.

Disease	Organism Type of infectious agent	Transmission through	Recommended Standard or Transmission-based precautions	Isolate or remove affected animals	Animals associated with transmission to humans													Concern for bite	Concern for environmental contamination	Nationally notifiable in the U.S. for human (H) or animal (A) cases[2]	Additional Notes
					Dogs	Cats	Horses	Cattle	Swine	Small Ruminants	Birds	Rodents	Rabbits	Amphibians or Reptiles	Non-human Primates	Wildlife	Fish or Invertebrates				
Lymphocytic choriomeningitis	Arenavirus (lymphocytic choriomeningitis virus) **Enveloped viruses**	Contact, Air	Standard	Yes								•						Yes	No	No	Wild rodent populations are the natural reservoir for lymphocytic choriomeningitis.
Mpox	Orthopoxvirus **Enveloped viruses**	Contact, Air	Contact; Droplet	Yes								•			•	•		Yes	Yes	H	
Mycobacteriosis (nontuberculous)	*Mycobacterium avium complex, M. marinum, M.microti* and other species **Non-spore forming bacteria**	Contact, Air	Contact; Aerosol	Not needed							•	•		•			•	No	No	No	Opportunistic organisms that can cause infection particularly in immunocompromised individuals. Certain species can be associated with clinical syndromes, for example, *M. avium complex* with lung disease, and *M. marinum, M. ulcerans*, with ulcerative or nodular dermatitis.
Pasteurellosis	*Pasteurella multocida* and other species **Non-spore forming bacteria**	Contact	Standard	Yes	•	•						•	•					Yes	No	A (bovine)	
Plague	*Yersinia pestis* **Non-spore forming bacteria**	Contact, Air, Vector	Contact; Droplet	Yes		•						•	•			•		Yes	No	H, A	
Psittacosis (human) Chlamydiosis (avian)	*Chlamydia psittaci* **Non-spore forming bacteria**	Contact, Air	Contact; Aerosol	Yes							•							No	Yes	H, A (poultry)	
Q fever	*Coxiella burnetii* **Non-spore forming bacteria (has spore-like structure but not true a endospore)**	Contact, Air, Vector	Contact; Droplet; +/- Aerosol during aerosol-generating procedures	Yes	•	•		•		•		•	•					No	Yes	H, A	
Rabies	*Lyssavirus* **Enveloped virus**	Contact	Contact; Droplet; +/- Aerosol during aerosol-generating procedures	Yes	•	•	•	•	•	•		•	•		•	•		Yes	No	H, A	For suspected rabid animals, wear PPE during euthanasia, decapitation, and specimen packaging.[4]
Rat bite fever	*Streptobacillus moniliformis, Spirillum minus* **Non-spore forming bacteria**	Contact	Standard	Yes								•						Yes	No	No	Rodents that carry rat bite fever include rats, mice, gerbils, guinea pigs, and squirrels.
Rhodococcus equi infection	*Rhodococcus equi* **Non-spore forming bacteria**	Contact, Air	Standard	Yes			•											No	Yes	No	
Salmonellosis	*Salmonellosis* spp. **Non-spore forming bacteria**	Contact	Contact	Yes	•	•	•	•	•	•	•	•	•	•	•	•		No	Yes	H	
Shigellosis	*Shigella flexneri, S. sonnei,* and *S. dysenteriae* **Non-spore forming bacteria**	Contact	Contact	Yes											•			No	Yes	H	

Appendix 1.

Disease	Organism Type of infectious agent	Transmission through	Recommended Standard or Transmission-based precautions	Isolate or remove affected animals	Animals associated with transmission to humans: Dogs	Cats	Horses	Cattle	Swine	Small Ruminants	Birds	Rodents	Rabbits	Amphibians or Reptiles	Non-human Primates	Wildlife	Fish or Invertebrates	Concern for bite	Concern for environmental contamination	Nationally notifiable in the U.S. for human (H) or animal (A) cases[2]	Additional Notes
Sporotrichosis	*Sporothrix schenckii, S. brasiliensis, S. globosa* **Fungus**	Contact, Air	Contact; Droplet; +/- Aerosol in animals with multiple skin lesions and respiratory signs	Yes	•	•	•											Yes	Yes	No	
Streptococcosus	*Streptococcus* spp. **Non-spore forming bacteria**	Contact, Air	Contact; Aerosol	Yes	•	•	•	•	•	•		•	•	•	•	•	•	Yes	Yes	H (some forms)	
Toxoplasmosis	*Toxoplasma gondii* **Protozoal oocyte**	Contact	Contact	Not needed		•												No	Yes	No	
Trichuriasis (whipworm infection)	*Trichuris suis, T. trichiura, T. vulpis* **Parasitic nematode**	Contact	Standard	Not needed	•				•									No	No	No	
Tuberculosis	*Mycobacterium bovis, Mycobacterium tuberculosis* **Non-spore forming bacteria**	Contact, Air	Contact; Aerosol	Yes				•	•	•						•		No	Yes	H, A	
Tularemia	*Francisella tularensis* **Non-spore forming bacteria**	Contact, Air, Vector	Contact; +/- Aerosol during necropsy or aerosol-generating procedures	Yes	•	•	•			•		•	•			•		Yes	Yes	H, A	
Vesicular stomatitis	*Vesicular stomatitis virus* **Enveloped virus**	Contact, Air, Vector	Contact	Yes			•	•	•	•								No	Yes	A	
Yersiniosis	*Yersinia enterocolitica* **Non-spore forming bacteria**	Contact	Contact	Yes					•		•							No	Yes	No	

1. Additional information on the clinical manifestations in humans and animals see zoonotic disease tables from the Iowa State University Center for Food Security & Public Health (https://www.cfsph.iastate.edu/zoonoses/) and the Merck Veterinary Manual (https://www.merckvetmanual.com/public-health/zoonoses/zoonotic-diseases).
2. Data regarding nationally reportable diseases were obtained from the Centers for Disease Control and Prevention (CDC) nationally notifiable infectious diseases list (https://ndc.services.cdc.gov/) and the United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) reportable diseases list (https://www.aphis.usda.gov/livestock-poultry-disease/surveillance/reportable-diseases). State reporting requirements may vary.
3. Aerosol-generating procedures include, for example, suctioning, drilling, use of saws, and high pressure hose cleaning.
4. While euthanizing a suspected rabid animal wear gloves, face, and eye protection. While conducting decapitation and specimen packaging wear gloves, a non-sterile gown or protective suit, face, and eye protection. An N95 respirator is warranted if using a band saw for decapitation.

Appendix 2. Personal protective equipment (PPE) guidelines and resources for routine veterinary procedures[1]

Procedure	Protective layer[2] (gown or protective suit)	Gloves[3]	Face and mucous membrane protection (face shield or goggles & mask, etc.)	Comment
Dentistry	+	+	+	• Perform in a dedicated, low-traffic area to minimize environmental contamination
Diagnostic Specimen Handling		+/-		
Intravenous catheter placement		+		
Necropsy	+	+	+	• Non-essential personnel should not be present • Animals suspected or confirmed to have certain high-risk pathogens, such as *F. tularensis or C. burnetii*, should only be necropsied in appropriate biosafety laboratory conditions[4]
Obstetrics	+	+	+	
Physical examination: high-risk species	+/- depending on species	+	+/- depending on species	• High-risk species include, but are not limited to, wild animals, rabies vector species, and non-human primates
Resuscitation		+	+	• Administer rescue breaths using a manual resuscitator, anesthesia machine, or ventilator • Never blow into the nose or mouth of an animal or into an endotracheal tube
Urinary catheter placement		+		
Wound care		+	+/- depending on risk of splash or spray	

[1] Procedure-based PPE are considered standard precautions associated with routine procedures. Conducting a procedure on a patient with a known infectious disease will potentially warrant additional protective measures.

[2] The protective layer described here would be worn in addition to the routine protective outerwear that is part of standard precautions, such as scrubs, coveralls, or a laboratory coat.

[3] The decision to select non-sterile gloves versus sterile gloves will depend on the risk of infection to the patient.

[4] Pathogen-specific guidance for when advanced biosafety conditions are recommended for a necropsy can be found in Biosafety in Microbiological and Biomedical Laboratories, 6th ed by the Centers for Disease Control and Prevention and the National Institutes of Health.

Additional resources for veterinary PPE:

The Ohio State University instructional videos for donning and doffing PPE for veterinary personnel. [Available from: https://ohiostate.pressbooks.pub/osuvcpslhandbook/chapter/bs_ppe_basics_donning-putting-on-ppe/]. Accessed May 22, 2026.

Chapter on Personal Protective Equipment, Ontario Animal Health Network IPC Best Practices for Small Animal Veterinary Clinics. Tables 1 and 2 summarize recommended PPE for routine veterinary procedures and infectious disease control precautions by disease condition and agent, respectively. [Available from: https://www.oahn.ca/resources/ipc-best-practices/]. Accessed May 22, 2026.

Characteristics of Select Disinfectant Classes

This table provides general microbial spectrums for disinfectant chemical classes. Antimicrobial activity and characteristics vary with formulation and concentration.

Always read and follow directions on the product label.

Disinfectant Class	Acids	Alcohols	Aldehydes	Alkalis	Chlorine Compounds	Peroxygen Compounds	Phenols	Quaternary Ammonium Compounds
Example Active Ingredients	citric acid, acetic acid	ethanol, isopropanol	formaldehyde, glutaraldehyde,	sodium hydroxide, ammonium hydroxide	sodium hypochlorite, chlorine dioxide	hydrogen peroxide, peracetic acid, peroxymonosulfates	orthophenylphenol	alkyl dimethyl benzyl ammonium chloride (ADBAC)
Mechanism of Action	• Slow acting • Alters pH	• Fast acting • Precipitates proteins • Denatures lipids	• Slow acting • Denatures proteins • Alkylates nucleic acids	• Slow acting • Alters pH • Fat saponification	• Fast acting • Denatures proteins	• Fast acting • Denature proteins and lipids	• Denatures proteins • Disrupts cell wall	• Denatures proteins • Binds phospholipids of cell membrane
Characteristics	• Characteristics depend on acid type • Corrosive at high concentrations to metals and concrete	• Rapid evaporation • No residue or residual action • Can swell or harden rubber and plastics	• Pungent odor • Noncorrosive	• Corrosive to metals	• Strong oxidizer • Degrades rapidly once prepared • May damage metals, rubber, concrete	• Strong oxidizer • May damage some metals (aluminum, copper, brass, zinc, steel)	• Strong odor • Residual film • Can damage rubber, plastic • Non-corrosive	• Stable in storage • High concentrations corrosive to metals
Factors Affecting Effectiveness	• Affected by pH, organic matter, water hardness	• Inactivated by organic matter •	• Affected by organic matter, hard water, soaps/detergents, pH, temperature, and relative humidity	• Effective in presence of organic matter • Affected by pH, soaps/detergents, hard water, temperature	• Rapidly inactivated by organic matter, UV light, heat • Affected by pH, temperature, cationic products	• Some have efficacy in presence of organic matter, hard water, soaps/ detergents	• Affected by cationic cleaners and temperature • May be effective in presence of organic matter, hard water,	• Inactivated by organic matter, hard water, anionic cleaners • Affected by pH; best at neutral or alkaline
Health Hazards	• Severe skin burns	• Irritation to skin	• Highly irritating to skin, mucous membranes • Only use in well ventilated areas	• Severe skin burns • Mucous membrane irritation	• Irritation to mucous membranes, skin, eyes	• Powder can irritate mucous membranes • Low toxicity at lower concentrations	• Irritation to skin, eyes, respiratory tract • High conc can cause burns	• Irritation to skin, eyes, respiratory tract
Precautions		• Flammable	• Formaldehyde is carcinogenic	• Very caustic	• Toxic gas if mixed with acids or ammonia		• Toxic to animals, especially cats, pigs	• Can accumulate in environment
General Chemical Class Microbial Spectrum								
Bactericidal	+	+	+	+	+	+	+	+ Gram positive +/- Gram negative
Virucidal	+/-	+/-	+/-	+/-	+	+/-	+/-	+/-
Fungicidal	+/-	+	+	+	+	+/-	+	+/-
Tuberculocidal	–	+	+	+/-	+	+/-	+	–
Sporicidal	+/- [A]	–	+	+	+ [A]	+/- [A]	–	–

Microbial spectrum legend: + **effective;** +/- **variable or limited effectiveness;** – **not effective** **A-requires high concentrations**

Data compiled from: Maillard JY. 2013. Factors Affecting the Activities of Microbiocides. IN: Fraise AP et al. (eds). *Russell, Hugo & Ayliffe's Principles and Practice of Disinfection, Preservation and Sterilization*, 5th ed. 2013; McDonnell G. 2020. Microorganisms and resistance. IN: *Block's Disinfection, Sterilization, and Preservation*, 6th edition; Quinn PJ et al. Disinfection and biosecurity in the prevention and control of disease in veterinary medicine. IN: *Block's Disinfection, Sterilization, and Preservation.*

The Center for Food Security & Public Health
IOWA STATE UNIVERSITY®

For more information read *Disinfection 101* on the CFSPH disinfection website.

Appendix 4. Infection prevention and control (IPC) checklist and model plan

Facility Name:	
Date Adopted:	Current IPC Plan Year:
Key Objectives: *ex. Perform a quarterly risk assessment; improve hand hygiene compliance*	

Key Personnel

Name	Role	IPC Responsibilities	Hrs/wk to IPC
	ex. IPC Trainer	*ex. Monitoring & enforcing IPC; determine training schedule*	
	ex. IPC Champion	*ex. Developing & updating policies*	

Key Points of Contact

Title	Name	Contact Info
State Animal Health Official		
State Public Health Veterinarian		
Local Health Department		
State Health Department		
Employee Health Medical Provider or Point of Contact	*ex. occupational health or nearest urgent care*	
Local Emergency Personnel (e.g., Fire, Police)		

How to use this checklist and plan:

Complete the checklist annually (or more frequently) to document adherence over time and to prioritize areas for improvement. Adapt/edit the components to meet unique facility design or practice needs.

★ Essential items foundational to IPC

★★ Important components that improve IPC

★★★ Components that reflect ideal IPC practices

Topic 1: Hand Hygiene

The Checklist

Hand hygiene includes cleaning hands with alcohol-based hand sanitizer (ABHS) or soap and water and is the single most important infection control practice for preventing the transmission of zoonotic pathogens.

	COMPONENT	COMPLETE	DATE
★	ABHS dispenser or sink available in all patient contact areas		
★★	A ~3ft area around each sink remains clear of clutter and storage (a.k.a. splash zone)		
★	Staff consistently perform hand hygiene during patient care		
★	Before touching or examining any patient		
★	After touching or examining any patient		
★	Before beginning an aseptic task		
★	After contact with body fluids		
★	After contact with environmental surfaces in animal areas		
★	Adequate hand hygiene supplies (e.g. ABHS, soap, paper towels) available		
★★	Hand hygiene instructions posted		
★★	Staff trained on hand hygiene procedures		
★★	Written hand hygiene policy available		
★★★	Staff audited on hand hygiene		

Appendix 4.

Topic 2: Personal Protective Equipment (PPE)

The Checklist

PPE includes clothing and devices that protect workers from disease and injury. When there is risk of exposure to biological hazards, employers must provide PPE and ensure it is used correctly.

	COMPONENT	COMPLETE	DATE
★	Protective outerwear available:		
★	Scrubs, laboratory coats, or coveralls		
★	Non-sterile gowns or protective suits		
★	Non-sterile gloves available:		
★	Household rubber, reusable		
★	Latex or other, disposable		
★	Leather bite-proof gloves		
★★	Dedicated footwear available:		
★★	Disposable shoe/boot covers		
★★	Waterproof overboots		
★	Respiratory protection available:		
★	Surgical masks		
★★	N95 Respirator or powered air-purifying respirators		
★★★	N95 Fit-testing program implemented		
★	Facial protection available:		
★	Face shields		
★	Goggles		
★★	Head covers available		
★★	Staff trained on donning and doffing procedures		
★★	Written PPE policy available		
★★	PPE inventory tracked		
★★★	Staff audited on correct PPE use and disposal		

★ESSENTIAL ★★IMPORTANT ★★★IDEAL

Appendix 4.

Topic 3: Environmental Infection Control

The Checklist

Regular cleaning and disinfection of surfaces and equipment is critical for environmental control of zoonotic pathogens.

	COMPONENT	COMPLETE	DATE
	Cleaning / Disinfection		
★	Appropriate detergents/cleaners available		
★	Disinfectants available for:		
★	Patient-contact surfaces		
★	Equipment and instruments		
★	Safety data sheets for disinfectants available		
★★	Staff trained on cleaning and disinfection procedures		
★★	Written cleaning and disinfection protocols for surfaces and equipment available		
★★	Written protocols for use of sterilization available, including cold sterilization and autoclaving		
★★	Written enhanced cleaning protocols for patients with suspected infectious disease available		
★★★	Cleaning and disinfection audits performed		
	Laundry		
★	Gloves used when handling dirty laundry		
★	Dedicated laundry baskets for dirty and clean laundry		
★	Laundry dried at highest safe temperature		
★★	Hand hygiene station available in laundry area		
	Spill Response and Decontamination		
★★	Written spill response protocol available		
★★★	Prepared spill response kit		
	Sharps Management		
★	Needles not recapped		
★★	Staff trained on needlestick prevention practices		
★	Approved, labeled sharps containers available		
★	Sharps containers not more than 3/4 full		
★	Sharps disposed of immediately after use		
★★	Written waste management protocol available		
	Pest and Vector Control		
★★	Written integrated pest management protocol available		

★ESSENTIAL ★★IMPORTANT ★★★IDEAL

Appendix 4.

Topic 4: Policies and Practices

The Checklist

Infection prevention is built on the policies and practices of a workplace and are types of administrative and engineering controls.

	COMPONENT	COMPLETE	DATE
★	Hospital design prioritized to support infection prevention		
★	Animal contact surfaces made of nonporous, easily cleaned materials		
★	Dedicated refrigerator for employee food		
★	Dedicated employee breakroom for storing and consuming food		
★★★	Locker or changing rooms available		
★	Phone triage policy in place to identify signs of potential zoonotic disease		
★	Patient intake policy in place to identify signs of potential zoonotic disease		
★	Designated area for patient isolation		
★	Signage in place to indicate isolation area		
★★★	Dedicated equipment and PPE in isolation area		
★★	Designated area for specimen handling		
★	Staff training and education		
★★	All new hires trained on safe animal handling practices		
★★	Written bite response protocol available		
★★	All new hires trained on IPC		
★★	Training on IPC concepts conducted annually		
★★★	Staff audited on knowledge of IPC practices		
★★	List of reportable diseases maintained		
★	Educational materials for staff and clients on zoonotic disease available		
★	Records kept for staff members		
★	Emergency contact information maintained		
★	Incident and injury reports documented		
★★	Staff participation in trainings maintained		
★★★	Staff immunizations (rabies and tetanus) documented		

★ESSENTIAL ★★IMPORTANT ★★★IDEAL

Appendix 4.

Topic 1: Hand Hygiene

The Plan

Hand hygiene includes the use of alcohol-based hand sanitizer containing at least 60% alcohol or washing hands with soap and water when visible contamination is present. It is the single most important infection control practice for preventing the transmission of zoonotic pathogens.

Conduct hand hygiene before and after examination of individual animals or animal groups (e.g., litters of puppies or kittens, groups of cattle), before beginning an aseptic task, and after contact with body fluids or environmental surfaces in animal areas. Do not use alcohol-based hand sanitizer when hands are visibly contaminated. Wash hands with soap and water when hands are soiled with debris or organic material or when patients are suspected or confirmed to have an infection with a spore-producing bacteria, protozoal parasite, or some nonenveloped viruses. Keep fingernails short and do not wear artificial nails or hand jewelry if performing animal contact. Maintain convenient access to alcohol-based hand sanitizing stations and handwashing sinks to increase hand hygiene compliance. When possible, provide dedicated sinks for handwashing. Keep hand hygiene supplies stocked at all times.

Correct use of alcohol-based hand sanitizer:

1. Place alcohol-based hand sanitizer in palms
2. Apply to all surfaces of hands
3. Rub hands together until dry, this should take a total of about 20 seconds

Correct handwashing with soap and water:

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

Appendix 4.

Topic 2: Personal Protective Equipment

The Plan

PPE includes clothing and devices that protect workers from disease and injury. When there is risk of exposure to biological hazards, employers must provide PPE and ensure it is used correctly.

Protective outerwear: Wear a protective outer garment such as scrubs, a laboratory coat, or coveralls when having contact with animals or their environment. Do not wear protective outerwear outside work. Change daily or after handling an animal with a known or suspected infectious disease, between farms/facilities/herds, after working in an isolation room, after performing a necropsy or other high-risk procedure, and whenever soiled. Wear impermeable outwear during obstetric procedures and necropsies, and whenever substantial splashes or large quantities of body fluids may be encountered.

Non-sterile gloves: Wear gloves when touching feces, body fluids, vomitus, exudates, and non-intact skin. Wear gloves for dentistry, resuscitations, necropsies, and obstetrical procedures; when cleaning cages, litter boxes, and environmental surfaces and equipment in animal areas; when handling dirty laundry; when handling diagnostic specimens (e.g., 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 (e.g., 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. Always perform hand hygiene immediately after glove removal.

Non-sterile gowns and protective suits: Wear when working with a patient or group of co-housed patients on contact precautions. Use disposable gowns when handling animals on transmission-based precautions and do not reuse.

Footwear: Use shoes or boots that are impermeable to water, easily cleaned, and have thick soles and closed toes. Consider having dedicated footwear for work settings. Wear disposable shoe covers or washable boots when heavy quantities of infectious materials are expected. Clean or replace footwear between farm premises/facilities/locations/herds.

Respiratory protection: Use a surgical mask when exposure to pathogens transmitted by droplets is likely. Use a particulate respirator (e.g., N95) when exposure to pathogens transmitted by aerosols is likely or during aerosol-generating procedures. Any required respirator use must follow Occupational Safety and Health Administration (OSHA) recommendations, which includes fit testing and fit checking (user seal check) training requirements. While not a replacement for fit-testing, use available guidance to perform a user seal check for improved protection with a particulate respirator compared with a surgical mask.

Facial protection: Use a face shield or goggles worn with a surgical mask whenever splashes or sprays are likely to occur or during close contact with animals that may generate infectious droplets. Wear facial protection for the following procedures: lancing abscesses, flushing wounds, dentistry, nebulization, suctioning, lavage, obstetrical procedures, and necropsies. Facial protection is not a substitute for respiratory protection.

Head covers: Wear head covers when contamination of the hair and scalp may occur. Do not reuse disposable head covers.

Step by step sequence for donning PPE:

1. Perform hand hygiene
2. Put on shoe covers (if applicable)
3. Put on gown/protective suit
4. Put on mask/respirator (if applicable)
5. Put on eye protection (if applicable)
6. Put on gloves

Step by step sequence for doffing PPE:

1. Remove shoe covers (if applicable)
2. Remove gown/protective suit and gloves
3. Remove eye protection (if applicable)
4. Remove mask/respirator (if applicable)
5. Perform hand hygiene

Appendix 4.

Topic 3: Environmental Infection Control

The Plan

Regular cleaning and disinfection of surfaces and equipment is critical for environmental control of zoonotic pathogens.

General cleaning and disinfection: Clean surfaces and equipment to remove organic matter, and then use disinfectant according to label instructions. Clean and disinfect environmental surfaces in animal areas, 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. Avoid use of high pressure sprayers that can disseminate infectious particles and use appropriate PPE if performed. Change mop water and mop heads routinely, and launder mop heads daily. Ensure disinfectant will inactivate the intended target microbe and that personnel can follow label instructions such as appropriate dilution and contact time. Determine if disinfection or sterilization is needed for medical devices based on use and ensure appropriate concentration and contact time for high-level (for semi-critical items that contact mucous membranes or non-intact skin) vs low-level disinfection (for non-critical items such as exam tables).

Laundry and bedding: Wear non-sterile 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. Transport outerwear to be laundered at home in a sealed plastic bag, keep separate from household items, wash separately and then thoroughly machine dry.

Spill response and decontamination: Immediately contain spills and splashes of potentially infective substances with absorbent material (e.g., paper towels, sawdust, or cat litter). Use PPE to protect against the potentially infective agent and the cleaning product/disinfectant used. Consult and follow the cleaning product/disinfectant label recommendations. 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* (https://www.epa.gov/rcra/medical-waste) *and the American Veterinary Medical Association website* (https://www.avma.org/resources-tools/one-health/waste-disposal-veterinary-practices/avma-policies-relevant-waste-disposal) *for guidance.*

Sharps management: Ensure a designated sharps container is located in every area where animal care occurs and that it is not overfilled. Dispose of sharps in accordance with applicable state and local laws. Do not recap needles. If necessary, use the one-handed scoop technique or forceps to reapply a cap.

Pest and vector control: For staff working outdoors, use permethrin-treated clothing, apply EPA-registered insect repellant and check for ticks. Check and treat animals entering the veterinary facility for vector parasites. Use integrated pest management to control rodents and vectors. Seal entry and exit points, store food properly and dispose of food waste promptly, eliminate rodent nesting sites and standing water, and install and maintain window screens.

Appendix 4.

Topic 4: Policies and Practices

The Plan

Infection prevention is built on the policies and practices of a workplace and are types of administrative and engineering controls. Every clinic should have an infection control plan that is tailored to their unique practice environment.

Hospital design: Ensure surfaces where animals are housed, examined or treated are made of nonporous, easily cleaned material. Maintain adequate storage. Use the employee break room or designated area for eating, drinking, application of make-up, and similar activities. Do not keep food or drink for human consumption in the same refrigerator as food for animals, biologics, or laboratory specimens. If possible, provide changing areas for staff to put on and remove dedicated work clothing at work.

Patient movement: Identify potentially infectious patients when scheduling appointments. Evaluate patients at intake for signs of infectious illness. Examine, treat, and house animals with a known or suspected infectious disease in a designated isolation area. Clearly mark the room/stall to indicate the patient's status and describe isolation procedures. Limit access to the isolation room. Keep a sign-in log of all people (including owners or other non-employees) 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 and reusable PPE (e.g., gown, mask). Don PPE immediately prior to care of the animal in isolation and doff just prior to leaving isolation. 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 training and education: Provide training to all staff prior to starting work on infection control practices, the facility infection control plan, potential work hazards, animal handling, and injury prevention. Ensure clear objectives of training and evaluate effectiveness. Document staff participation in writing. Conduct refresher training at regular intervals.

Record keeping: Maintain current emergency contact information for each employee. Document vaccination status, rabies virus antibody titers, and exposure and injury incidents. Recommend staff report changes in health status (e.g., pregnancy) that may affect work duties and document changes so that accommodations may be made.

Staff vaccination: Have a vaccination plan in place to protect staff. Recommend all staff with animal contact have pre-exposure vaccination against rabies, followed by periodic titer checks and rabies vaccine boosters, in accordance with the recommendations of the Advisory Committee on Immunization Practices (CDC, 2022). Recommend tetanus immunizations, and other routine vaccinations including MMR, be up-to-date. Encourage veterinary personnel to receive the current seasonal influenza vaccine. Consult a health care provider regarding the need for a tetanus booster.

Documenting and reporting exposure incidents: Record and report puncture wounds, animal bites, and other animal-related trauma. Report incidents that result in injury or potential exposure to an infectious agent as applicable based on state and federal laws.

Pregnant and immunocompromised personnel: Identify a point of contact for staff who are concerned that work responsibilities may put them at increased risk of zoonotic disease, so that preventive measures may be taken (such as increased use of PPE) and other accommodations may be made. Consult with a health care provider as needed.

References

1. Waters TM, Daniels MJ, Bazzoli GJ, Perencevich E, Dunton N, Staggs VS, et al. Effect of Medicare's nonpayment for Hospital-Acquired Conditions: lessons for future policy. JAMA Intern Med. 2015;175(3):347-54.
2. Centers for Disease Control and Prevention. Current HAI Progress Report 2024 [Updated Jan 29, 2026. Available from: https://www.cdc.gov/healthcare-associated-infections/php/data/progress-report.html]. Accessed May 22, 2026.
3. Anderson MEC, Wimmers M, Weese JS. Infection Prevention and Control Best Practices for Small Animal Veterinary Clinics, 2nd ed. Guelph: Ontario Animal Health Network, 2019. [Updated Jan 2020. Available from: https://www.oahn.ca/resources/ipc-best-practices/]. Accessed May 22, 2026.
4. Stull JW, Weese JS. Hospital-associated infections in small animal practice. Vet Clin North Am Small Anim Pract. 2015;45(2):217-33.
5. Stull JW, Bjorvik E, Bub J, Dvorak G, Petersen C, Troyer HL. 2018 AAHA Infection Control, Prevention, and Biosecurity Guidelines. J Am Anim Hosp Assoc. 2018;54(6):297-326.
6. Willemsen A, Cobbold R, Gibson J, Wilks K, Lawler S, Reid S. Infection control practices employed within small animal veterinary practices-A systematic review. Zoonoses Public Health. 2019;66(5):439-57.
7. Chakraborty S, Fama A, Sander WE. Zoonoses-specific resources, collaborative networks, and enhanced communication can help US veterinarians tackle zoonotic diseases: results from a national survey. J Am Vet Med Assoc. 2024;262(7):877-86.
8. Paccha B, Neira-Ramirez V, Gibbs S, Torremorell M, Rabinowitz PM. Swine Worker Precautions During Suspected Outbreaks of Influenza in Swine. J Environ Health. 2016;78(9):22-6.
9. Cherry CC, Sureda MEN, Gibbins JD, Hale CR, Stapleton GS, Jones ES, et al. Large animal veterinarians' knowledge, attitudes, and practices regarding livestock abortion-associated zoonoses in the United States indicate potential occupational health risk. J Am Vet Med Assoc. 2022;260(7):780-8.
10. Marx GE, Curren E, Olesen M, Cronquist L, Schlosser L, Nichols M, et al. Tularemia From Veterinary Occupational Exposure. Clin Infect Dis. 2024;78(Suppl 1):S71-S5.
11. Centers for Disease Control and Prevention. Multistate outbreak of monkeypox--Illinois, Indiana, and Wisconsin, 2003. MMWR Morb Mortal Wkly Rep. 2003;52(23):537-40.
12. Centers for Disease Control and Prevention. About Zoonotic Diseases 2025 [Updated Apr 7, 2025. Available from: https://www.cdc.gov/one-health/about/about-zoonotic-diseases.html]. Accessed May 22, 2026.
13. Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. Philos Trans R Soc Lond B Biol Sci. 2001;356(1411):983-9.
14. Bird BH, Mazet JAK. Detection of Emerging Zoonotic Pathogens: An Integrated One Health Approach. Annu Rev Anim Biosci. 2018;6:121-39.
15. Morley PS. Evidence-based infection control in clinical practice: if you buy clothes for the emperor, will he wear them? J Vet Intern Med. 2013;27(3):430-8.
16. Lavigne SH, Cole SD, Daidone C, Rankin SC. Risk Factors for the Acquisition of a blaNDM-5 Carbapenem-Resistant *Escherichia coli* in a Veterinary Hospital. J Am Anim Hosp Assoc. 2021;57(3).
17. Chea N, Li R, Eure T, et al. Health Care–Associated Infections in U.S. Hospitals, 2023 versus 2015. N Engl J Med 2026;384:1–10.

18. Hoet AE, Johnson A, Nava-Hoet RC, Bateman S, Hillier A, Dyce J, et al. Environmental methicillin-resistant *Staphylococcus aureus* in a veterinary teaching hospital during a nonoutbreak period. Vector Borne Zoonotic Dis. 2011;11(6):609-15.

19. DeStefano IM, Fellman CL, Vagnone PMS, Cumming MA, Dale JL, Ruhland A, et al. Human Cas*es of Carbapenemase-Producing Escherichia coli* Linked to Spread Between Animals and the Environment in a Veterinary Facility - Massachusetts, USA, 2023. Clin Infect Dis. 2025.

20. Burgess BA, Morley PS. Veterinary hospital surveillance systems. Vet Clin North Am Small Anim Pract. 2015;45(2):235-42.

21. Centers for Disease Control and Prevention. Infection Control Basics 2025 [Updated June 12, 2025. Available from: https://www.cdc.gov/infection-control/about/index.html]. Accessed May 22, 2026.

22. Food and Agriculture Organization of the United Nations. Biosecurity for Highly Pathogenic Avian Influenza: Issues and Options. 2008.

23. Wright JG, Jung S, Holman RC, Marano NN, McQuiston JH. Infection control practices and zoonotic disease risks among veterinarians in the United States. J Am Vet Med Assoc. 2008;232(12):1863-72.

24. Agrawal I, Varga C. Assessing and comparing disease prevention knowledge, attitudes, and practices among veterinarians in Illinois, United States of America. Prev Vet Med. 2024;228:106223.

25. Baiyasi SJS, Juarez R, Brookins-Fisher J, Inungu JN, Gehring TM, Kozicki ZA. Practice what you preach: Importance of veterinarian involvement in zoonotic disease prevention - A Michigan focus. Vet Evid. 2022;7(2).

26. Benedict KM, Morley PS, Van Metre DC. Characteristics of biosecurity and infection control programs at veterinary teaching hospitals. J Am Vet Med Assoc. 2008;233(5):767-73.

27. Department of Industrial Relations. California Code of Regulations, Title 8, Section 5199.1. Aerosol Transmissible Diseases - Zoonotic. [Available from: https://www.dir.ca.gov/title8/5199-1.html]. Accessed May 22, 2026.

28. Wright JG, Tengelsen LA, Smith KE, Bender JB, Frank RK, Grendon JH, et al. Multidrug-resistant *Salmonella* Typhimurium in four animal facilities. Emerg Infect Dis. 2005;11(8):1235-41.

29. Bender JB, Waters KC, Nerby J, Olsen KE, Jawahir S. Methicillin-resistant *Staphylococcus aureus* (MRSA) isolated from pets living in households with MRSA-infected children. Clin Infect Dis. 2012;54(3):449-50.

30. Ghosh A, Kukanich K, Brown CE, Zurek L. 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. 2012;3:62.

31. KuKanich KS, Ghosh A, Skarbek JV, Lothamer KM, Zurek L. 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(4):437-45.

32. Cognialli RCR, Queiroz-Telles F, Cavanaugh AM, Rediguieri BC, Santos GCD, Matias FM, et al. New Insights on Transmission of *Sporothrix brasiliensis*. Mycoses. 2025;68(3):e70047.

33. Fessler AT, Schuenemann R, Kadlec K, Hensel V, Brombach J, Murugaiyan J, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) among employees and in the environment of a small animal hospital. Vet Microbiol. 2018;221:153-8.

34. World Health Organization. Global technical consultation report on proposed terminology for pathogens that transmit through the air. Geneva; 2024. [Available from: https://www.who.int/publications/m/item/global-technical-consultation-report-on-proposed-terminology-for-pathogens-that-transmit-through-the-air]. Accessed May 22, 2026.

35. Reid JP, Ferro AR, Finn A, Lawler JV, Lednicky JA, Löndahl J, et al. World Health Organization Report Removes the Aerosol/Droplet Dichotomy but Does Not Move Us Forward in Infection Control Strategies. Aerosol Science and Technology. 2024;58(10):1089-92.

36. De Andrade Galliano Daros Bastos F, Raimundo Cognialli RC, Rodrigues de Farias M, Dos Santos Monti F, Wu K, Queiroz-Telles F. Spread of *Sporothrix* spp. through respiratory droplets from infected cats: A potential route of transmission. Med Mycol. 2022;60(11).

37. Siu AW, Tillman C, Van Houten C, Busacker A, Harrist A. Notes from the Field: Diagnosis and Investigation of Pneumonic Plague During a Respiratory Disease Pandemic - Wyoming, 2021. MMWR Morb Mortal Wkly Rep. 2022;71(24): 806-7.

38. Siegel JD, Rhinehart E, Jackson M, Chiarello L. Health Care Infection Control Practices Advisory C. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Health Care Settings. Am J Infect Control. 2007;35(10 Suppl 2):S65-164.

39. Lenhart SW, Seitz T, D Trout, N Bollinger. Issues Affecting Respirator Selection for Workers Exposed to Infectious Aerosols: Emphasis on Healthcare Settings. Applied Biosafety. 2004;9(1).

40. Acha PN, Szyfres B. Zoonoses and communicable diseases common to man and animals.2003.

41. Kersh GJ, Fitzpatrick KA, Self JS, Priestley RA, Kelly AJ, Lash RR, 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(5):1697-703.

42. McQuiston JH, Childs JE. Q fever in humans and animals in the United States. Vector Borne Zoonotic Dis. 2002;2(3):179-91.

43. Nation PN, Fanning EA, Hopf HB, Church TL. Observations on animal and human health during the outbreak of *Mycobacterium bovis* in game farm wapiti in Alberta. Can Vet J. 1999;40(2):113-7.

44. Tissot-Dupont H, Amadei MA, Nezri M, Raoult D. Wind in November, Q fever in December. Emerg Infect Dis. 2004;10(7):1264-9.

45. DeStefano I, Fellman CL, Bergeron AC, Golato LM, Doron S, Cumming M, et al. Effective mitigation of an outbreak of New Delhi metallo-beta-lactamase-producing *Escherichia coli* infections in a small animal veterinary teaching hospital. J Am Vet Med Assoc. 2025;263(7):1-10.

46. Mossialos E, Essack S, Mackay I, Anderson M. A layered strategy for tackling antimicrobial resistance: the Swiss cheese model for policy, prevention, and engagement. Lancet Microbe. 2025:101215.

47. Popescu, SV. Swiss Cheese Model—How Infection Prevention Really Works. Infection Control Today. 2021;25(01).

48. Chen N, Li S, Kuang Z, Gong T, Zhou W, Wang Y. Identifying a competency improvement strategy for infection prevention and control professionals: A rapid systematic review and cluster analysis. Health Care Sci. 2024;3(1): 53-66.

49. Westworth DR, Battersby I, Banks D. Nonsterile gloves: to don, or not to don, what is best practice? J Am Vet Med Assoc. 2025:1-7.

50. Dassler K, Zurfluh K, Stephan R, Willi B. Educational intervention to improve infection prevention and control practices in four companion animal clinics in Switzerland. J Hosp Infect. 2023;139:121-33.

51. Association for Professionals in Infection Control and Epidemiology. Washington (DC): APIC Learning System for a-IPC; 2025. [Available from: https://text.apic.org/]. Accessed May 22, 2026.

52. Zimmerman PA, Mason M, Elder E. A healthy degree of suspicion: A discussion of the implementation of transmission-based precautions in the emergency department. Australas Emerg Nurs J. 2016;19(3):149-52.

53. Lemmermann L, Remppis J, Belard S, Steiner F. Mass rabies exposure of veterinary health care workers in Germany: Management, immune response, and tolerability of post exposure-prophylaxis. One Health. 2025;20:100978.

54. Wenzel JG, Nusbaum KE. Veterinary expertise in biosecurity and biological risk assessment. J Am Vet Med Assoc. 2007;230(10):1476-80.

55. Jones RM, Bleasdale SC, Maita D, Brosseau LM, Program CDCPE. A systematic risk-based strategy to select personal protective equipment for infectious diseases. Am J Infect Control. 2020;48(1):46-51.

56. Trevejo RT, Barr MC, Robinson RA. Important emerging bacterial zoonotic infections affecting the immunocompromised. Vet Res. 2005;36(3):493-506.

57. 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(3):113-20.

58. World Health Organization. WHO guidelines on hand hygiene in health care. WHO Press; 2009. [Available from: https://www.who.int/publications/i/item/9789241597906]. Accessed May 22, 2026.

59. World Health Organization. Five moments for hand hygiene. 2021. [Available from: https://www.who.int/publications/m/item/five-moments-for-hand-hygiene]. Accessed May 22, 2026.

60. Minnesota Department of Health, Veterinary Occupational Health and Infection Ccontrol Assessment Program (VOHICA). Your 5 moments for Hand Hygiene. 2019 [Available from: https://arsi.umn.edu/sites/arsi.umn.edu/files/2020-02/MDH_5%20moments%20for%20hand%20hygiene_8.5x11.pdf]. Accessed May 22, 2026.

61. Nakamura RK, Tompkins E, Braasch EL, Martinez JG, Jr., Bianco D. Hand hygiene practices of veterinary support staff in small animal private practice. J Small Anim Pract. 2012;53(3):155-60.

62. Anderson ME, Sargeant JM, Weese JS. Video observation of hand hygiene practices during routine companion animal appointments and the effect of a poster intervention on hand hygiene compliance. BMC Vet Res. 2014;10:106.

63. Anderson ME, Weese JS. Self-reported hand hygiene perceptions and barriers among companion animal veterinary clinic personnel in Ontario, Canada. Can Vet J. 2016;57(3):282-8.

64. Laustsen S, Lund E, Bibby BM, Kristensen B, Thulstrup AM, Kjolseth Moller J. Effect of correctly using alcohol-based hand rub in a clinical setting. Infect Control Hosp Epidemiol. 2008;29(10):954-6.

65. Rome M, Sabel A, Price CS, Mehler PS. Hand hygiene compliance. J Hosp Infect. 2007;65(2):173.

66. Ahmed QA, Memish ZA, Allegranzi B, Pittet D, World Health Organization Global Patient Safety Challenge. Muslim health-care workers and alcohol-based handrubs. Lancet. 2006;367(9515):1025-7.

67. Lotfinejad N, Peters A, Tartari E, Fankhauser-Rodriguez C, Pires D, Pittet D. Hand hygiene in health care: 20 years of ongoing advances and perspectives. Lancet Infect Dis. 2021;21(8):e209-e21.

68. Traub-Dargatz JL, Weese JS, Rousseau JD, Dunowska M, Morley PS, Dargatz DA. 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(7):671-6.

69. Mann A. In small animal surgery are alcoholic hand rubs superior to scrubbing brushes and antimicrobial soap at reducing bacterial counts? Vet Evid. 2025;10(4).

70. Bolon M. Hand hygiene. Infect Dis Clin North Am. 2011;25(1):21-43.

71. Centers for Disease Control and Prevention. 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 2002;51(No. RR16):[1-45].

72. Sickbert-Bennett EE, Weber DJ, Gergen-Teague MF, Sobsey MD, Samsa GP, Rutala WA. Comparative efficacy of hand hygiene agents in the reduction of bacteria and viruses. Am J Infect Control. 2005;33(2):67-77.

73. Widmer AE, Dangel M. Alcohol-based handrub: evaluation of technique and microbiological efficacy with international infection control professionals. Infect Control Hosp Epidemiol. 2004;25(3):207-9.

74. 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(1):49-55.

75. Oughton MT, Loo VG, Dendukuri N, Fenn S, Libman MD. 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(10):939-44.

76. Fox JG, Beaucage CM, Folta CA, Thornton GW. Nosocomial transmission of *Serratia marcescens* in a veterinary hospital due to contamination by benzalkonium chloride. J Clin Microbiol. 1981;14(2):157-60.

77. Frank MJ, Schaffner W. Contaminated aqueous benzalkonium chloride. An unnecessary hospital infection hazard. JAMA. 1976;236(21):2418-9.

78. Oie S, Kamiya A. Microbial contamination of antiseptics and disinfectants. Am J Infect Control. 1996;24(5):389-95.

79. Weber DJ, Rutala WA, Sickbert-Bennett EE. Outbreaks associated with contaminated antiseptics and disinfectants. Antimicrob Agents Chemother. 2007;51(12):4217-24.

80. Hugonnet S, Perneger TV, Pittet D. Alcohol-based handrub improves compliance with hand hygiene in intensive care units. Arch Intern Med. 2002;162(9):1037-43.

81. Iversen AM, Hansen MB, Munster M, Kristensen B, Ellermann-Eriksen S. Hand hygiene compliance in nursing home wards: the effect of increased accessibility of alcohol-based hand rub. J Hosp Infect. 2024;147:206-12.

82. 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(4):863-93,.

83. Zapka CA, Campbell EJ, Maxwell SL, Gerba CP, Dolan MJ, Arbogast JW, et al. Bacterial hand contamination and transfer after use of contaminated bulk-soap-refillable dispensers. Appl Environ Microbiol. 2011;77(9):2898-904.

84. Huang C, Ma W, Stack S. The hygienic efficacy of different hand-drying methods: a review of the evidence. Mayo Clin Proc. 2012;87(8):791-8.

85. Nursing Royal College of Tools of the trade: guidance for health care staff on glove use and the prevention of work-related dermatitis. 2022. [Available from: https://www.rcn.org.uk/Professional-Development/publications/tools-of-the-trade-uk-pub-010-218]. Accessed May 22, 2026.

86. Lin CM, Wu FM, Kim HK, Doyle MP, Michael BS, Williams LK. A comparison of hand washing techniques to remove *Escherichia coli* and caliciviruses under natural or artificial fingernails. J Food Prot. 2003;66(12):2296-301.

87. Tsao N, Morrison B, Kwong GP, Atilla A. The effect of nail sticker use on hand surface bacterial counts after surgical scrubbing. J Am Vet Med Assoc. 2025:1-7.

88. Hardy JM, Owen TJ, Martinez SA, Jones LP, Davis MA. The effect of nail characteristics on surface bacterial counts of surgical personnel before and after scrubbing. Vet Surg. 2017;46(7):952-61.

89. Bickell J, Boyles D, Altmann S. Piercing Insights: Uncovering the Gaps in Guidance for Body Jewelry in Biological Laboratories. Appl Biosaf. 2025;30(3):239-47.

90. Singh A, Walker M, Rousseau J, Monteith GJ, Weese JS. Methicillin-resistant staphylococcal contamination of clothing worn by personnel in a veterinary teaching hospital. Vet Surg. 2013;42(6):643-8.

91. Burgess BA, Morley PS. Biosecurity and Infection Control for Veterinarians Caring for Livestock: A Guide for Daily Threats. Vet Clin North Am Food Anim Pract. 2025;41(1):11-24.

92. Belkin NL. Home laundering of soiled surgical scrubs: surgical site infections and the home environment. Am J Infect Control. 2001;29(1):58-64.

93. Belkin NL. Use of scrubs and related apparel in health care facilities. Am J Infect Control. 1997;25(5):401-4.

94. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, Browne J, Prieto J, Wilcox M, UK Department of Health. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect. 2014 Jan;86 Suppl 1:S1-70.

95. Hafer A, Langley R, Morrow M, Tulis J. Occupational hazards reported by swine veterinarians in the United States. Journal of Swine Health and Production. 1996;4(3).

96. Poole AG, Shane SM, Kearney MT, McConnell DA. Survey of occupational hazards in large animal practices. J Am Vet Med Assoc. 1999;215(10):1433-5.

97. Poole AG, Shane SM, Kearney MT, Rehn W. Survey of occupational hazards in companion animal practices. J Am Vet Med Assoc. 1998;212(9):1386-8.

98. Weese JS, Faires M. A survey of needle handling practices and needlestick injuries in veterinary technicians. Can Vet J. 2009;50(12):1278-82.

99. Weese JS, Jack DC. Needlestick injuries in veterinary medicine. Can Vet J. 2008;49(8): 780-4.

100. Wilkins JR 3rd, Bowman ME. Needlestick injuries among female veterinarians: frequency, syringe contents and side-effects. Occup Med (Lond). 1997;47(8):451-7.

101. Langley RL, Pryor, W. H., O'Brien, K. F. Health hazards among veterinarians: a survey and review of the literature. Journal of Agromedicine. 1995;2(1).

102. Nienhaus A, Skudlik C, Seidler A. Work-related accidents and occupational diseases in veterinarians and their staff. Int Arch Occup Environ Health. 2005;78(3):230-8.

103. Gabel CL, Gerberich SG. Risk factors for injury among veterinarians. Epidemiology. 2002;13(1):80-6.

104. Jeyaretnam J, Jones H, Phillips M. Disease and injury among veterinarians. Aust Vet J. 2000;78(9):625-9.

105. Landercasper J, Cogbill TH, Strutt PJ, Landercasper BO. Trauma and the veterinarian. J Trauma. 1988;28(8):1255-9.

106. Weese JS. Barrier precautions, isolation protocols, and personal hygiene in veterinary hospitals. Vet Clin North Am Equine Pract. 2004;20(3):543-59.

107. Brody MD. Safety in the veterinary medical workplace environment. Common issues and concerns. Vet Clin North Am Small Anim Pract. 1993;23(5):1071-84.

108. Grizzle WE, Fredenburgh J. Avoiding biohazards in medical, veterinary and research laboratories. Biotech Histochem. 2001;76(4):183-206.

109. Seibert PJ. Hazards in the hospital. J Am Vet Med Assoc. 1994;204(3):352-60.

110. Food and Drug Administration. What to Do if You Can't Find a Sharps Disposal Container [Updated Apr 28, 2021. Available from: https://www.fda.gov/medical-devices/safely-using-sharps-needles-and-syringes-home-work-and-travel/what-do-if-you-cant-find-sharps-disposal-container]. Accessed May 22, 2026.

111. Leslie A, Gomez-Leon VE, Kleinhenz MD, Weeder M, Batey I, Kats K, et al. Needle-free injection device for administration of cloprostenol to induce luteolysis in lactating dairy cows. JDS Commun. 2025;6(6):827-31.

112. Chase CCL, Scanlon Daniels C, Garcia R, et al. Needle-free injection technology in swine: Progress toward vaccine efficacy and pork quality. J Swine Health Prod. 2008;16(5):254-61.

113. World Health Organization. Anthrax in Humans and Animals. 4th ed. Geneva 2008. [Available from: https://www.who.int/publications/i/item/9789241547536]. Accessed May 22, 2026.

114. Environmental Protection Agency. Cleaning Up Soil Contaminated with Pathogens [Updated Feb 12, 2025. Available from: https://www.epa.gov/emergency-response-research/cleaning-soil-contaminated-pathogens]. Accessed May 22, 2026.

115. Cherry B, Burns A, Johnson GS, Pfeiffer H, Dumas N, Barrett D, et al. *Salmonella* Typhimurium outbreak associated with veterinary clinic. Emerg Infect Dis. 2004;10(12):2249-51.

116. Van Balen J, Kelley C, Nava-Hoet RC, Bateman S, Hillier A, Dyce J, 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(5):299-311.

117. Burgess BA, Morley PS, Hyatt DR. Environmental surveillance for *Salmonella enterica* in a veterinary teaching hospital. J Am Vet Med Assoc. 2004;225(9):1344-8.

118. Assadian O, Harbarth S, Vos M, Knobloch JK, Asensio A, Widmer AF. Practical recommendations for routine cleaning and disinfection procedures in healthcare institutions: a narrative review. J Hosp Infect. 2021;113:104-14.

119. Dressler RL, Cruser B, Dressler DD. Hospital Physicians' Stethoscopes: Bacterial Contamination After a Simple Cleaning Protocol. Cureus. 2023;15(4):e37061.

120. Rutala WA, Weber DJ, and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008 [Updated June 2024. Available from: https://www.cdc.gov/infection-control/hcp/disinfection-and-sterilization/index.html]. Accessed May 22, 2026.

121. Center for Food Security and Public Health. Disinfection [Available from: https://www.cfsph.iastate.edu/infection-control/disinfection/]. Accessed May 22, 2026.

122. Center for Food Security and Public Health ISU. Disinfection 101: Key Principles of Cleaning and Disinfection for Animal Settings. 2023. [Available from: https://www.cfsph.iastate.edu/Disinfection/Assets/Disinfection101.pdf]. Accessed May 22, 2026.

123. Allerton F, Blacklock KL, editors. Infection control in small animal clinical practice. CABI; 2023.

124. Sykes JE, Weese JS. Infection Control Programs for Dogs and Cats. Canine and Feline Infectious Diseases. 2014:105–18.

125. Food and Drug Administration. How FDA Regulates Animal Devices [Updated Apr 6, 2026. Available from: https://www.fda.gov/animal-veterinary/animal-health-literacy/how-fda-regulates-animal-devices]. Accessed May 22, 2026.

126. Crawford S, Weese JS. Efficacy of endotracheal tube disinfection strategies for elimination of *Streptococcus zooepidemicus* and *Bordetella bronchiseptica*. J Am Vet Med Assoc. 2015;247(9):1033-6.

127. Ascione F, Radu IL, Di Nola S, Furlanello T, Carli E, Ventura L, et al. Efficacy of an endotracheal tube disinfection protocol and the impact of its steps on tubes collected from dogs anaesthetized for routine clinical procedures. Vet Anaesth Analg. 2026;53(1):101157.

128. Marquis CR, Gull T, Dodam J, Thombs L, Bukoski A. Comparison of four endotracheal tube cleaning protocols in anesthetized dogs. J Am Vet Med Assoc. 2023;261(3):336-41.

129. Lakdawala N, Pham J, Shah M, Holton J. Effectiveness of low-temperature domestic laundry on the decontamination of healthcare workers' uniforms. Infect Control Hosp Epidemiol. 2011;32(11):1103-8.

130. Patel SN, Murray-Leonard J, Wilson AP. Laundering of hospital staff uniforms at home. J Hosp Infect. 2006;62(1):89-93.

131. Canadian Committee on Antibiotic Resistance. Infection Prevention and Control Best Practices for Small Animal Veterinary Clinics. [Updated Aug 2008. Available from: https://www.wormsandgermsblog.com/files/2008/04/CCAR-Guidelines-Final2.pdf]. Accessed May 22, 2026.

132. Environmental Protection Agency. Selected EPA-registered disinfectants 2025 [Updated Sept 11, 2025. Available from: https://www.epa.gov/pesticide-registration/selected-epa-registered-disinfectants]. Accessed May 22, 2026.

133. Kansas State University College of Veterinary Medicine. Chemical Spill Kit Checklist [Available from: https://www.vet.k-state.edu/about/safety/docs/spill-kit-checklist-signs-response.pdf]. Accessed May 22, 2026.

134. Canadian Centre for Occupational Health and Safety. Spill Response - Chemicals [updated Aug 28, 2025. Available from: https://www.ccohs.ca/oshanswers/chemicals/spill-response-chemicals.html]. Accessed May 22, 2026.

135. Environmental Protection Agency. Medical Waste [Updated Apr 20, 2026. Available from: https://www.epa.gov/rcra/medical-waste]. Accessed May 22, 2026.

136. Diuk-Wasser MA, Hoen AG, Cislo P, Brinkerhoff R, Hamer SA, Rowland M, et al. Human risk of infection with *Borrelia burgdorferi*, the Lyme disease agent, in eastern United States. Am J Trop Med Hyg. 2012;86(2):320-7.

137. Adjemian JZ, Krebs J, Mandel E, McQuiston J. 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(1):72-7.

138. 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(7):869-75.

139. Dantas-Torres F. Biology and ecology of the brown dog tick, *Rhipicephalus sanguineus*. Parasit Vectors. 2010;3:26.

140. Kogan M. Integrated pest management: historical perspectives and contemporary developments. Annu Rev Entomol. 1998;43:243-70.

141. Peter RJ, Van den Bossche P, Penzhorn BL, Sharp B. Tick, fly, and mosquito control--lessons from the past, solutions for the future. Vet Parasitol. 2005;132(3-4):205-15.

142. Centers for Disease Control and Prevention. Rabies: Information for Veterinarians [Updated July 7, 2025. Available from: https://www.cdc.gov/rabies/hcp/veterinarians/index.html]. Accessed May 22, 2026.

143. Amass SF, Arighi M, Kinyon JM, Hoffman LJ, Schneider JL, Draper DK. 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(9):1391-6.

144. Dunowska M, Morley PS, Patterson G, Hyatt DR, Van Metre DC. 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(12):1935-9.

145. Morley PS, Morris SN, Hyatt DR, Van Metre DC. Evaluation of the efficacy of disinfectant footbaths as used in veterinary hospitals. J Am Vet Med Assoc. 2005;226(12):2053-8.

146. Brody MD. AVMA guide for veterinary medical waste management. J Am Vet Med Assoc. 1989;195(4):440-52.

147. Casanova L, Alfano-Sobsey E, Rutala WA, Weber DJ, Sobsey M. Virus transfer from personal protective equipment to healthcare employees' skin and clothing. Emerg Infect Dis. 2008;14(8):1291-3.

148. Hansen ME, McIntire DD, Miller GL, 3rd. Occult glove perforations: frequency during interventional radiologic procedures. AJR Am J Roentgenol. 1992;159(1):131-5.

149. Centers for Disease Control and Prevention. Selecting Protective Clothing [Updated Dec 11, 2024. Available from: https://www.cdc.gov/niosh/healthcare/protective-clothing/selection.html]. Accessed May 22, 2026.

150. Habrun C. New Delhi Metallo-B-Lactamase-producing *Escherichia coli* among dogs living at an animal rescue facility - Wisconsin, 2022. Presented at the American Veterinary Medical Association Convention. July 14, 2023, Anaheim, California.

151. McNamara K, Habrun C, Wilson WW, Kollmann L, Stapleton GS, Stanton R, Benedict K, Beaudoin A, Snippes P, Anacker M, Nichols M, Walters M, Mason J, Mueller N. New Delhi metallo-β-lactamase–producing *Escherichia coli* among dogs at an animal rescue facility—Wisconsin, 2022. Antimicrob Steward Healthc Epidemiol. 2023: 3: Supplement S2.

152. Occupational Health and Safety Administration. Respiratory Infection Control: Respirators Versus Surgical Masks [Updated May 2009. Available from: https://www.osha.gov/sites/default/files/publications/OSHA3219.pdf]. Accessed May 22, 2026.

153. Centers for Disease Control and Prevention. Human exposures to marine Brucella isolated from a harbor porpoise - Maine, 2012. MMWR Morb Mortal Wkly Rep. 2012;61(25):461-3.

154. Anderson A, Bijlmer H, Fournier PE, Graves S, Hartzell J, Kersh GJ, 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(RR-03):1-30.

155. Williams CJ, Sillis M, Fearne V, Pezzoli L, Beasley G, Bracebridge S, 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(9):1965-74.

156. Vaughan A, Joyce A, Traub E, Jae M, Beeler E, Paiva E, et al. Serologic Evidence of Highly Pathogenic Avian Influenza A(H5N1) Virus Infection in a Veterinary Professional Exposed to an Infected Domestic Cat - Los Angeles County, California, December 2024-January 2025. MMWR Morb Mortal Wkly Rep. 2026;75(17):215-20.

157. Gibbins JD, Niemeier RT, De Perio MA, Mueller CA. Health hazard evaluation report: Evaluation of zoonotic disease and exposures in persons working with marine mammals. Apr 2013. Report No. 2011-0105-3173. [Available from: https://www.cdc.gov/niosh/hhe/reports/pdfs/2011-0105-3173.pdf]. Accessed May 22, 2026.

158. Occupational Health and Safety Administration. Standard Number 1910.134 - Respiratory protection. [Updated Sept 26, 2019. Available from: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.134]. Accessed May 22, 2026.

159. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Filtering out Confusion: Frequently Asked Questions about Respiratory Protection. [Updated Apr 6, 2018. Available from: https://www.cdc.gov/niosh/docs/2018-129/default.html]. Accessed May 22, 2026.

160. Bemis DA, Craig LE, Dunn JR. Salmonella transmission through splash exposure during a bovine necropsy. Foodborne Pathog Dis. 2007;4(3):387-90.

161. Posthaus H, Bodmer T, Alves L, Oevermann A, Schiller I, Rhodes SG, et al. Accidental infection of veterinary personnel with *Mycobacterium tuberculosis* at necropsy: a case study. Vet Microbiol. 2011;149(3-4):374-80.

162. Miller JM, Astles R, Baszler T, Chapin K, Carey R, Garcia L, et al. Guidelines for safe work practices in human and animal medical diagnostic laboratories. Recommendations of a CDC-convened, Biosafety Blue Ribbon Panel. MMWR Suppl. 2012;61(1):1-102.

163. Christensen L, Rasmussen CS, Benfield T, Franc JM. A Randomized Trial of Instructor-Led Training Versus Video Lesson in Training Health Care Providers in Proper Donning and Doffing of Personal Protective Equipment. Disaster Med Public Health Prep. 2020;14(4):514-20.

164. Centers for Disease Control and Prevention. Sequence for putting on personal protective equipment (PPE) [Available from: https://www.cdc.gov/infection-control/media/pdfs/Toolkits-PPE-Sequence-P.pdf]. Accessed May 22, 2026.

165. Olmsted RN. Prevention by Design: Construction and Renovation of Health Care Facilities for Patient Safety and Infection Prevention. Infect Dis Clin North Am. 2016;30(3):713-28.

166. Emmanuel U, Osondu ED, Kalu KC. Architectural design strategies for infection prevention and control (IPC) in health-care facilities: towards curbing the spread of Covid-19. J Environ Health Sci Eng. 2020 Oct 30;18(2):1699-1707.

167. Association for Professionals in Infection Control and Epidemiology. Infection Prevention Manual for Construction & Renovation. [Updated Sept 2019. Available from: https://apic.org/Resource_/store/books/preview/SLS9808_Preview.pdf]. Accessed May 22, 2026.

168. Portner JA, Johnson JA. Guidelines for reducing pathogens in veterinary hospitals: disinfectant selection, cleaning protocols, and hand hygiene. Compend Contin Educ Vet. 2010;32(5):E1-11; quiz E2.

169. The Facility Guidelines Institute. Guidelines For Design and Construction of Health Care Facilities. 2010. [Available from: https://fgiguidelines.org/wp-content/uploads/2022/03/2010_FGI_Guidelines.pdf]. Accessed May 22, 2026.

170. Health Quality Innovators. Splash Zone [Updated Apr 20, 2023. Available from: https://hqin.org/wp-content/uploads/2023/04/Splash-Zone-Infosheet.pdf]. Accessed May 22, 2026.

171. Philadelphia Department of Public Health, Healthcare-Associated Infections and Antimicrobial Resistance Program. Water Management: Splash Zones and Under Sink Storage [Updated Apr 2025. Available from: https://hip.phila.gov/document/5293/PDPH-WaterManagement-SplashZones-April2025.pdf]. Accessed May 22, 2026.

172. Deyneko A, Cordeiro F, Berlin L, Ben-David D, Perna S, Longtin Y. Impact of sink location on hand hygiene compliance after care of patients with *Clostridium difficile* infection: a cross-sectional study. BMC Infect Dis. 2016;16:203.

173. 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(1):61-4.

174. 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(1):52-7.

175. Dowd K, Taylor M, Toribio JA, Hooker C, Dhand NK. Zoonotic disease risk perceptions and infection control practices of Australian veterinarians: call for change in work culture. Prev Vet Med. 2013;111(1-2):17-24.

176. D'Souza E, Barraclough R, Fishwick D, Curran A. Management of occupational health risks in small-animal veterinary practices. Occup Med (Lond). 2009;59(5):316-22.

177. 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(2):559-65.

178. Occupational Health and Safety Administration. Training Requirements in OSHA Standards. [Available from: https://www.osha.gov/sites/default/files/publications/OSHA2254.pdf]. Accessed May 22, 2026.

179. McLaughlin K DJ, Crowell TL, et al. Engage, educate, escape: The New Jersey Department of Health Project Firstline Escape Room. Health Education Journal. 2024 Mar;83(2):205-14.

180. Project Firstline. The Project Firstline Escape Room and Other IPC Education and Communication Tools [Available from: https://www.naccho.org/uploads/card-images/naccho-general/The-Project-Firstline-Escape-Room-and-Other-IPC-Education-and-Communication-Tools.pdf]. Accessed May 22, 2026.

181. Public Health Ontario. Introduction to Implementing Environmental Cleaning Auditing. [Updated Aug 2023. Available from: https://www.publichealthontario.ca/-/media/Documents/E/2023/ec/environmental-cleaning-intro-auditing.pdf?sc_lang=en]. Accessed May 22, 2026.

182. Forbes NA. An educational intervention, the use of optimal sanitisation and regular measurement of infection control outcomes can greatly reduce contamination levels in the veterinary practice. J Small Anim Pract. 2026.

183. Langdon G, Hoet AE, Stull JW. Fluorescent tagging for environmental surface cleaning surveillance in a veterinary hospital. J Small Anim Pract. 2020;61(2):121-6.

184. Burgess BA. Does environmental microbiological surveillance support infection control in veterinary hospitals? A PRO/CON debate. JAC Antimicrob Resist. 2024;6(4):dlae115.

185. Timofte D, Jepson RE. PRO: Environmental microbiological surveillance does support infection control in veterinary hospitals. JAC Antimicrob Resist. 2024;6(4):dlae113.

186. Allerton F, Weese S. CON: Environmental microbiological surveillance does not support infection control in veterinary hospitals. JAC Antimicrob Resist. 2024;6(4):dlae114.

187. Sax H, Allegranzi B, Chraiti MN, Boyce J, Larson E, Pittet D. The World Health Organization hand hygiene observation method. Am J Infect Control. 2009;37(10):827-34.

188. Greene, LR. Auditing and Feedback of PPE Use [Available from: https://www.cdc.gov/infection-control/media/pdfs/Strive-PPE104-508.pdf]. Accessed May 22, 2026.

189. 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(7):1042-8.

190. Australian Veterinary Association. Guidelines for veterinary personnel biosecurity, January 2017. [Available from: https://www.ava.com.au/wp-content/uploads/Biosecurity-Guidelines-2017-Updated-2025.pdf]. Accessed May 22, 2026.