

Compendium of Measures to Prevent Disease Associated with Animals in Public Settings, 2023

National Association of State Public Health Veterinarians Animal Contact Compendium Committee

Committee members are listed in the Acknowledgments at the end of the article.

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ABSTRACT

Opportunities for the public to interact with animals in public settings such as petting zoos, fairs, and farm visits can be valuable learning and entertainment experiences. However, zoonotic disease transmission from healthy animals on exhibit and their environments, as well as injuries and other health problems, may result from these interactions if steps are not taken to minimize risks. The 2023 Compendium of Measures to Prevent Disease Associated with Animals in Public Settings provides background about these potential risks and updates recommendations for reducing those risks. Enteric zoonotic disease risks from animal contact in public settings include Shiga toxin-producing *Escherichia coli* infections, cryptosporidiosis, and campylobacteriosis. These infections occur when pathogens are accidentally ingested by individuals following direct contact with animals or contaminated objects. Zoonotic influenza infections can occur in a similar manner or through aerosols generated from infected animals. Other infectious diseases, parasitic infections, bites, and other injuries are also possible hazards in these settings. Inadequate handwashing and facility design flaws are frequent contributors to these risks, especially on farms or temporary exhibits not specifically designed for public use. Venues should provide sufficient handwashing stations and establish clearly defined animal contact areas. Operators should educate visitors about potential disease and injury risks, steps necessary to minimize exposure, and the importance of handwashing after the visit. Additionally, operators and visitors alike should realize that certain individuals are at heightened risk for zoonotic infections. Signs, handouts, and other educational materials are publicly available in a toolkit that accompanies the compendium.

Keywords: zoonosis, petting zoos, animal exhibits, farm visits, public health

Contact with animals in public settings (**Table 1**) provides positive opportunities for entertainment and education. However, an inadequate understanding among animal exhibitors and visitors regarding disease transmission and animal behavior can increase the likelihood of zoonotic disease exposures (**Supplementary Material S1**), injuries, and other health problems.

This compendium, summarized here and available in its entirety at www.nasphv.org, provides general recommendations for minimizing disease and injury associated with public animal contact settings. Managers of venues where animal contact is possible should use the information in this report in consultation with veterinarians and other professionals to evaluate and reduce risks of disease transmission for their specific venues and circumstances.

Background

Infectious diseases associated with animals in public settings

Diseases transmitted by direct or indirect animal contact

One of the most common routes of disease transmission from animals to people is direct physical contact with

the animal. Disease transmission also occurs indirectly from an animal through contact with contaminated surfaces or via contaminated human food and beverages.

Enteric (intestinal) diseases

Enteric bacteria and parasites, particularly *Campylobacter* spp, nontyphoidal *Salmonella enterica*, *Cryptosporidium* spp, non-O157 Shiga-toxigenic *Escherichia coli* (STEC), and STEC O157:H7, pose the most commonly encountered risk for human disease from animals in public settings.¹ Numerous enteric disease outbreaks as well as sporadic (nonoutbreak) cases among visitors to fairs, farms, petting zoos, and other public settings are well documented.¹⁻⁸ Cattle, sheep, or goats^{5,7,9} have typically been identified as infection sources, but other animals have been associated with outbreaks as well (**Table 2**).¹⁰

These animals frequently have no signs of illness but can still shed the organisms in feces.¹¹ Disease transmission at animal exhibits can be influenced by multiple factors. Stress induced by transportation, confinement, and increased handling increases the likelihood of animals shedding pathogens.^{12,13} Young animals, which are frequently included in public settings, have a higher prevalence of shedding enteric pathogens such as STEC than do mature animals.¹⁴

Table 1—Public settings with animals present.

Agricultural fairs
Farms: educational, crop share, or otherwise open to public
Agritourism venues
Livestock birthing exhibits
Petting zoos or animal displays
Schools and childcare facilities
Camps
Zoological institutions
Nature parks
Pet stores
Feed stores
Live animal markets
Animal swap meets
Wildlife or animal photography settings
Circuses and carnivals

Table 2—Animals recognized as sources for enteric disease outbreaks in public settings.

Cattle
Goats
Sheep
Live poultry (chickens, ducks, geese, turkeys)
Rodents
Hedgehogs
Reptiles
Amphibians
Wild animals

Enteric pathogens are primarily transmitted to people by the fecal-oral route. Because animal fur, hair, feathers, scales, skin, and saliva harbor fecal organisms,¹⁵ transmission can occur when people pet, touch, kiss, hold, feed, or are licked by animals and bacteria are ingested. In addition, illness has resulted from fecal contamination of food¹⁶ and beverages¹⁷ at animal contact settings.

Disease transmission can also occur in the absence of direct animal contact when pathogens are present in the environment. This occurs when animals or animal excreta, fur, hair, feathers, scales, or skin is present. Exposure to contaminated materials such as animal bedding, environmental surfaces, clothing, and shoes has been associated with transmission of pathogens and outbreaks of enteric illness.^{2,7,18} Enteric pathogens can persist in contaminated environments for long periods.^{2,11}

While anyone can get sick due to pathogens from animals in public settings, some groups are more likely to become ill or to have severe consequences of infection (**Table 3**). The recommendations that follow are particularly important for these groups.¹⁹

Table 3—Populations with additional risks.

Young children (under 5 y of age) are at greater risk for acquiring enteric pathogens due to their behaviors. Closer physical contact with animals and hand-to-face contact were more common in children than in adults during petting zoo visits.

People with weakened immune systems, such as young children and adults 65 y of age and older, have an increased risk for developing severe illness, compared with healthy individuals outside these groups, when they do become infected.

Despite their more frequent exposure to livestock, **exhibitors and/or employees** have also become infected with enteric pathogens in outbreaks at fairs.

Other animal contact-related human health issues

People in contact with rabid mammals can be exposed to rabies virus via bites or exposures through mucous membranes or open wounds. Multiperson rabies exposures have occurred at public venues such as petting zoos and fairs, among others,^{20,21} and require extensive public health investigations and medical follow-up.

Bacterial infections from animal bites and scratches are common; some might require extensive treatment or hospitalization.^{22,23} Contact with animals in public settings can also result in human skin infection, including ringworm, parapox, and other poxvirus infections.^{24,25} Certain internal animal parasites can infect people who ingest materials or soil contaminated with animal feces,^{26,27} and fleas, ticks, and mites can be acquired by people who interact with animals in public settings.²⁸

Diseases transmitted through droplets or aerosols

Generation of infectious droplets or aerosols and subsequent contamination of the environment are important risks for indirect transmission of disease in public settings. These droplets or aerosols can include infectious agents from animals' respiratory tracts, reproductive fluids, or other sources. Infectious aerosols can also be generated through cleaning procedures (eg, pressure washing) or dust raised in animal environments.

Influenza

Cases of human influenza from variant influenza viruses from pigs have been associated with direct or indirect exposure to swine at agricultural fairs.²⁹ Although pigs with influenza can become ill, pigs that are apparently healthy can carry influenza viruses.³⁰

Swine and poultry species should be kept separated because of the potential for interspecies transmission of influenza viruses, which can result in the formation of novel viruses with the potential to infect and spread in the human population.³¹

Q fever

Q fever (*Coxiella burnetii* infection) is a zoonotic disease that can be acquired through contact with aborted fetuses, newborn animals, reproductive tissues, or fluids associated with animal birthing, most frequently from goats, sheep, and cattle.³² While *C burnetii* infection can cause abortion in animals, it is often subclinical. High numbers of organisms are shed from reproductive tissues and fluids.

Most individuals exposed to *C burnetii* develop an asymptomatic infection, but clinical infections can range from an acute influenza-like illness to life-threatening endocarditis as well as premature birth, stillbirth, and miscarriage in pregnant women.³²

Leptospirosis, listeriosis, brucellosis, and chlamydiosis are other potentially serious zoonotic diseases that can be acquired through contact with newborn animals, fetuses, or reproductive tissues and fluids.³³

Chlamydia psittaci infections

Chlamydia psittaci infections are usually acquired from psittacine birds (eg, parrots) and have caused respiratory disease in people contacting infected birds in public settings.³⁴

Factors influencing the risk of zoonotic disease transmission

Handwashing

Handwashing following contact with animals has been associated with decreased rates of illness

during disease outbreaks associated with touching animals, barriers, and animal environments in public settings.^{4,5,35} Additional factors include feeding animals without washing hands afterward (increased risk), lathering with soap and water (decreased risk), and drying hands on clothing (increased risk).

Facility design

The layout and maintenance of facilities and animal exhibits can increase or decrease the risk for infections.³⁴ Factors that increase this risk include inadequate handwashing facilities, inappropriate flow of visitors, and incomplete separation between animal exhibits and food preparation and consumption areas, as well as other factors.^{6,18,36} Temporary and seasonal animal exhibits and activities are particularly vulnerable to design flaws,^{4,6} as are venues that are not designed for or accustomed to public events, such as working farms.

Food contamination

Contamination of food products, beverages, or food preparation areas by people after animal contact has resulted in disease outbreaks.^{16,17} Inadequate sanitation (eg, of hands, utensils, or equipment) during food preparation or consumption has been associated with illnesses.³⁷

Physical injuries caused by animals in public settings

Injuries associated with animals in public settings include bites, kicks, falls, scratches, stings, crushing of extremities, and being pinned between an animal and a fixed object,³⁸ all of which can result in infection or trauma.

Recommendations for Disease Prevention

Applicable venues

The recommendations in this report were developed for a variety of settings in which contact with animals or their environments is possible (Table 1). Contact with animals in public settings should only occur where measures are in place to reduce the potential for disease transmission or injuries.

Recommendations for local, tribal, state, and federal agencies

Agencies should work to ensure compliance with recommendations at animal contact venues. This includes dissemination of this compendium to organizations involved in managing these settings; tailoring recommendations to specific settings; incorporating them into best practices, protocols, and regulations; and working and communicating with additional stakeholders. Sample supplementary materials are available electronically in the National Association of State Public Health Veterinarians toolkit.³⁹

Agencies should also work to evaluate and improve these recommendations by conducting thorough epidemiologic investigations of outbreaks, reporting them to state public health officials, and including questions about animal contact in public settings on routine disease and outbreak investigation questionnaires.

Recommendations for animal exhibitors and venue operators

Staff and visitor education, attention to hygiene, appropriate facility design, and proper care and monitoring of animals and their enclosures are essential components for reduction of risks associated with animal contact in public settings.

Education

Awareness of zoonotic disease risk is protective against illness in outbreaks.⁴⁰ Therefore, educating visitors to public animal contact venues about the risk for transmission of diseases is of utmost importance. Even in well-designed venues with operators who are aware of the risks for disease, outbreaks and injuries can occur when visitors do not understand the risks and therefore are less likely to apply disease-prevention measures.

Operators and staff

Venue operators and staff should take the following steps for public health and safety:

- Consult with veterinarians, state and local agencies, and cooperative extension personnel on implementing the recommendations in this compendium.
- Become knowledgeable about the risks for disease and injury associated with animals and be able to explain risk-reduction measures to staff members and visitors.
- Be aware of human populations at high risk for disease and injury (Table 3).
- Understand which animals pose a high risk for causing disease and injury within the venue.

Each of the following messaging, facility, and animal aspects should be considered:

- Direct public contact with ill animals is inappropriate.
- Children < 5 years of age (Table 3) should not have direct contact with animals likely to carry zoonotic pathogens (eg, preweaned calves, reptiles, or live poultry).
- Children < 5 years of age should be closely supervised to discourage hand-to-mouth activities and contact with manure and soiled bedding.
- Individuals > 65 years of age and those with weakened immune systems also have a high risk of developing serious illness from contact with animals carrying zoonotic diseases (Table 3).
- Pregnant people are at risk of stillbirth, miscarriage, and preterm delivery from certain pathogens that might be present in animal contact settings.
- Direct contact with venomous or otherwise dangerous animals should be completely prohibited (**Supplementary Material S2**).
- Live animals should not be given as prizes at fairs, carnivals, or other events.
- Ensure that visitors receive educational instructions before entering an exhibit, including the risk of injury or exposure to pathogens that can cause serious illness, along with recommended prevention measures (**Supplementary Figure S1**; **Supplementary Material S2**).
- Provide information in multiple, easy-to-understand formats that are age appropriate and language appropriate.
- Provide information to people arranging school field trips or classroom exhibits so they can educate participants and parents before the visit.

- Encourage compliance by the public with risk reduction recommendations, especially handwashing procedures as visitors exit animal areas (**Supplementary Figure S2; Supplementary Material S3**).
- Comply with local, tribal, territorial, and state requirements for reporting animal bites or other injuries.

Visitors

Visitors to animal exhibits should be presented with effective educational messages aimed at ensuring compliance with the following recommendations:

- Be aware that the risks of and severity of disease associated with animal contact are higher among people of certain age groups and health conditions (Table 3).
- Supervise children properly at all times while in the presence of animals and areas with animal waste; prevent inappropriate contact with animals and sitting or playing on the ground.
- Refrain from eating, drinking, or other hand-to-mouth activities in the presence of animals.
- Practice proper hand hygiene, including washing hands immediately upon exit of the animal area and before any hand-to-mouth activity or eating is done.⁴¹
- Practice proper hand hygiene after any contact with shoes, strollers, or clothing that might have come in contact with animals, their waste, or their bedding.⁴¹
- Report any animal bites or injuries promptly to the venue operator and to authorities.

Facility design and use

Venues should be divided into 3 areas: animal areas (where animal contact is possible or encouraged), transition areas (located at entrances and exits to animal areas), and nonanimal areas (where animals are not permitted, with the exception of service animals; **Figure 1**).

Layout and traffic patterns

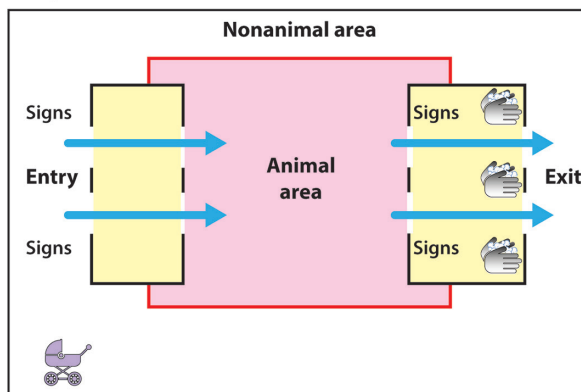
Animal area considerations—The design of facilities and animal pens should minimize the risk associated with animal contact (Figure 1), including limiting direct contact with manure and encouraging handwashing (Supplementary Material S3). This might include double barriers to prevent contact with animals or contaminated surfaces except in specified animal interaction areas.

Temporary exhibits are often prone to design problems.^{4,6} Specific recommendations might be necessary for certain other settings, such as schools and childcare facilities (**Supplementary Material S4**).

Recommendations for animal areas are as follows:

- Do not allow consumption of food or beverages.
- Do not allow toys, pacifiers, spill-proof cups, baby bottles, strollers, or similar items to enter animal areas.
- Individuals utilizing wheelchairs or other mobility devices should consider how these items can be adequately cleaned and disinfected following their visit.
- Prohibit smoking and other tobacco product use.
- Do not allow children to sit or play on the ground or on manure piles. If hands become soiled, supervise handwashing immediately.

Design 1



Design 2

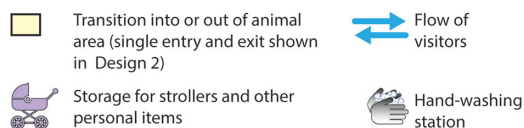
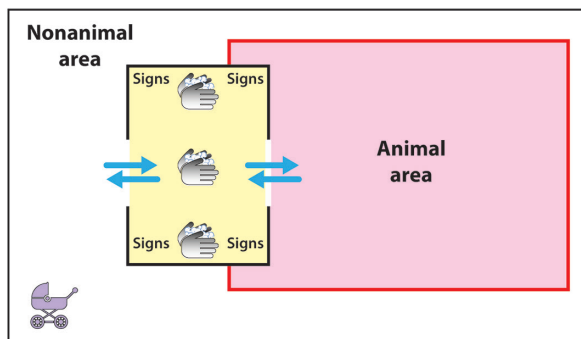


Figure 1—Examples of 2 designs for facilities with animal exhibit areas, including clearly designated animal areas, nonanimal areas, and transition areas with handwashing stations and signs.

- For areas where animal contact is encouraged, a 1-way flow of visitors is recommended, with separate entrance and exit points (Figure 1).
- Control visitor traffic to prevent overcrowding.
- Ensure that animal feed bowls or bins are not accessible to the public.
- Allow the public to feed animals only in circumstances where contact with animals is controlled (eg, with barriers).
- Do not provide animal feed in containers that can be eaten by people (eg, ice cream cones).
- Promptly remove manure and soiled animal bedding from exhibit areas.
- Assign trained staff members to encourage appropriate human-animal interactions, to identify and reduce potential risks for patrons, and to process reports of injuries and exposures.
- Ensure that visitors do not have access to animals that are not part of the defined interaction area, especially in on-farm visit situations.
- Store animal waste and tools for waste removal (eg, shovels and pitchforks) in designated areas restricted from public access.

- Avoid transporting manure and soiled bedding through nonanimal areas or transition areas. If this is unavoidable, take precautions to prevent spillage, or remove manure when the public is not present.
- Where feasible, clean and disinfect the animal area (eg, flooring and railings) as necessary.
- Provide adequate ventilation for animals and people, but avoid creating air movement that distributes dust.
- Minimize the use of animal areas (and those previously used by animals) for public activities. If used, they should be cleaned and disinfected, particularly if food or beverages are served.
- When using animals or animal products for educational purposes, use them only in designated areas, not in school cafeterias or other areas where food and beverages are stored, prepared, served, or consumed.
- When animals are in school or childcare settings, specific areas must be designated for animal contact (Supplementary Material S4). These areas must be thoroughly cleaned after use. Parents and guardians should be informed of the presence of animals as well as the associated benefits and potential risks.
- Immersion exhibits (where members of the public enter into the animal space) present additional opportunities for transmission of infectious agents. Entry into these spaces can lead to increased contamination of clothes, shoes, and other items, therefore increasing risk for disease. Lack of barriers between animals and people also increases the risk for injury. These exhibits heighten the need for supervision and awareness by venue operators and attendees.

Transition area considerations—Establishing transition areas through which visitors pass between animal and nonanimal areas is critical. The transition areas should be designated as clearly as possible, even if they are conceptual rather than physical (Figure 1).

Entrance transition areas should be designed to facilitate education:

- Position staff members, post signs, and otherwise notify visitors that they are entering an animal area and that there are risks associated with animal contact, including who might be at highest risk for illness (Supplementary Figure S1).
- Instruct visitors not to eat, drink, smoke, place their hands in their mouth, or use bottles or pacifiers while in the animal area.
- Establish storage or holding areas for strollers and related items (eg, wagons and diaper bags). Exit transition areas should be designed to facilitate handwashing (Supplementary Material S3):
- Post signs or otherwise instruct visitors to wash their hands when leaving the animal area (Supplementary Figure S2).
- Provide handwashing stations accessible for all visitors, including children and people with disabilities (Figure 1).
- Position staff members near exits to encourage compliance with proper handwashing.

- Post signs or otherwise instruct visitors to exercise proper handwashing when handling shoes, clothing, strollers, wheelchairs, and other mobility devices that might have come in contact with animal bedding or waste.

Nonanimal area considerations—Recommendations for nonanimal areas are as follows:

- Do not permit animals, except for service animals, in nonanimal areas.
- Restrict food and beverage storage, preparation, serving, and consumption to nonanimal areas.
- Provide handwashing facilities and display handwashing signs where food or beverages are served (Supplementary Figure S2; Supplementary Material S3).

Cleaning and disinfection

Cleaning and disinfection practices should be tailored to the specific situation. When a particular organism has been identified, additional guidance regarding specific disinfectants can be consulted.⁴² General recommendations are that all surfaces should be cleaned thoroughly to remove organic matter before disinfection. Disinfectants should be used in accordance with the manufacturer label, including sufficient contact time with surfaces.

Venue operators should strive to develop an integrated pest management program to eliminate or reduce the risk of exposure to pathogens carried by pests such as insects, rodents, and wild birds.

Animal care and management

Selection of animals for use in public settings

The risk for disease or injury from animal contact can be reduced by carefully managing animal use. The following recommendations should be considered for management of animals in contact with the public:

- Direct contact with some animals is inappropriate in public settings, depending on expected audiences. Use of preweaned calves, lambs, goat kids, reptiles, amphibians, and live poultry (including chicks) is not appropriate in nursing homes, schools, daycares, or other venues where groups at high risk for serious infection are expected to be present.
- Animals showing signs of illness are not appropriate for use in public settings.
- Direct contact with species known to serve as reservoirs for rabies virus (eg, bats, raccoons, skunks, foxes, and coyotes) should not be permitted.
- Certain nonhuman primates are of particular concern because of the types of pathogens they can transmit to people, such as B virus.²³
- Because of their strength, unpredictability, or ability to produce venom, certain domestic, exotic, or wild animals should be prohibited from exhibition settings where a reasonable possibility of animal contact exists. Species of primary concern include certain nonhuman primates, certain carnivores (eg, lions, tigers, ocelots, wolves and wolf hybrids, and bears), and venomous species (eg, some reptiles and invertebrates).

Routine animal and veterinary care

Venue operators should retain and use the services of a licensed veterinarian, monitor animals

daily for signs of illness, and ensure that animals receive appropriate veterinary medical care. Ill or injured animals, animals known to be infected with a zoonotic pathogen, and animals from herds with a recent history of abortion, diarrhea, or respiratory disease should not be exhibited. To decrease shedding of pathogens, animals should be housed in a manner to minimize stress, injury, and overcrowding.

Animals should also be current on rabies vaccinations⁴³ and be housed in a manner that reduces potential exposure to wild animals that may serve as rabies virus reservoirs. In animal contact settings, rabies testing should be considered for animals that die suddenly.

While vaccines against certain enteric pathogens (eg, *Salmonella* spp and STEC) are available for specific animal species, insufficient evidence currently exists to support their use to reduce transmission of disease to people in public settings.⁴⁴ Vaccination of animals in public settings should be done in consultation with a licensed veterinarian and tailored to the animal species and nature of public interaction.

Routine screening for zoonotic diseases is not recommended, except for *C psittaci* infection in bird encounter exhibits³⁴ and tuberculosis in elephants⁴⁵ and primates.⁴⁶ Screening tests are available for some enteric pathogens; however, the interpretation of test results can be problematic. Shedding can be intermittent, and negative results do not indicate an animal was not shedding an organism at an earlier time or will not start shedding in the near future. There is no established guidance for management of animals with positive test results; inappropriate interpretation might lead to unnecessary treatments, quarantine, or euthanasia.

Birthing exhibits

It is important for organizers and attendees of animal birthing exhibits to understand that animals such as goats, sheep, and cattle giving birth might shed pathogens such as *C burnetii*, *Brucella* spp, *Leptospira* spp, and *Listeria monocytogenes*. Organizers should take the following steps to reduce the risk of disease transmission:

- Ensure that the public has no contact with newly born animals or birthing byproducts (eg, the placenta).
- Ensure that attendees and staff who are particularly vulnerable to zoonotic diseases (eg, pregnant women, people with cardiac valvular disease and other heart conditions, and people with weakened immune systems) and the parents of small children understand the risks of attending or working at these exhibits.
- Thoroughly clean and disinfect the birthing area after each birth, using appropriate personal protective equipment, safety precautions, and disposal methods for waste products.
- If abortions or stillbirths occur, the exhibit should be closed; operators should work with their veterinarians to determine the cause of abortions or stillbirths.
- Birthing events should be held outdoors or in well-ventilated areas to reduce the risk for human exposure to aerosolized pathogens.⁴⁷

Considerations regarding variant influenza

In response to influenza A variant virus outbreaks associated with swine at agricultural fairs, the following prevention strategies have been recommended⁴⁸:

- All people should take routine preventive actions (eg, appropriate hand hygiene) at fairs to reduce potential influenza virus transmission between pigs and people.
- People at high risk of serious influenza-related complications should avoid exposure to pigs at fairs.
- Shortening the time that animals are on exhibit has been shown to dramatically reduce the risk of influenza transmission in swine, lowering the risk of human illness due to zoonotic influenza.⁴⁹
- Measures should be taken to reduce the presence of pigs with clinical signs of disease at these events.

Potential strategies to mitigate the risk for intraspecies and interspecies transmission of influenza viruses at agricultural fairs include shortening the swine exhibition period,⁴⁹ consulting with a veterinarian to determine whether vaccination of swine against influenza is appropriate, keeping swine and poultry separate,⁵⁰ cleaning and disinfecting sorting boards, and providing for ≥ 7 days between exhibitions.⁴⁸

Summary

Contact and interaction with animals in public settings can be a valuable means of education and entertainment. People who provide these opportunities to the public as well as those attending such venues should be aware of the potential health risks associated with such venues and understand that even apparently healthy animals can transmit pathogens. The recommendations included in this compendium will help venue operators, staff, and attendees reduce the risk for injury and zoonotic disease transmission in these settings.

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