

**Recommendations and Reports**

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Compendium of Measures to Prevent Disease Associated with Animals in Public Settings, 2007

National Association of State Public Health Veterinarians, Inc. (NASPHV)

Prepared by NASPHV

Summary

This report has been endorsed by CDC, the Council of State and Territorial Epidemiologists, and the American Veterinary Medical Association. The material in this report originated in the Coordinating Center for Infectious Diseases, Mitch Cohen MD, Director; and the Division of Foodborne, Bacterial, and Mycotic Diseases, David Warnock PhD, Director.

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Certain venues encourage or permit the public to contact animals, resulting in millions of human-animal interactions each year. These settings include county or state fairs, petting zoos, animal swap meets, pet stores, zoologic institutions, circuses, carnivals, farm tours, livestock-birthing exhibits, educational exhibits at schools, and wildlife photo opportunities. Although multiple benefits of human-animal contact exist, infectious diseases, rabies exposures, injuries, and other human health problems associated with these settings are possible. Infectious disease outbreaks reported during the previous decade have been caused by Escherichia coli O157:H7, Salmonella, Cryptosporidium, Coxiella burnetii, Mycobacterium tuberculosis, ringworm, and other pathogens. Such incidents have substantial medical, public health, legal, and economic effects.

This report provides recommendations for public health officials, veterinarians, animal venue staff, animal exhibitors, visitors to animal venues, physicians, and others concerned with minimizing risks associated with animals in public settings. The recommendation to wash hands is the single most important prevention step for reducing the risk for disease transmission. Other critical recommendations are that venues not allow food in animal areas, venues include transition areas between animal areas and nonanimal areas, visitors be educated about disease risk and prevention procedures, and animals be properly cared for and managed.

Introduction

Contact with animals in public settings (e.g., fairs, farm tours, petting zoos, and schools) provides opportunities for entertainment and education. However, inadequate understanding of disease transmission and animal behavior can increase the likelihood of infectious diseases, rabies exposures, injuries, and other health problems among visitors, especially children, in these settings. Zoonotic diseases (i.e., zoonoses) are diseases transmitted from animals to humans. Of particular concern are instances in which large numbers of persons become ill. Since 1991, approximately 50 human infectious disease outbreaks involving animals in public settings have been reported to CDC (1). During the preceding 10 years, an increasing number of enteric disease outbreaks associated with animals in public settings (e.g., fairs and petting zoos) have been reported (1).

The National Association of State Public Health Veterinarians (NASPHV) understands the positive benefits of human-animal contact. Although eliminating all risk from animal contacts is not possible, this report provides recommendations for minimizing disease and injury.

NASPHV recommends that local and state public health, agricultural, environmental, and wildlife agencies use these recommendations to establish their own guidelines or regulations for reducing the risk for disease from human-animal contact in public settings. Multiple venues exist where public contact with animals is permitted (e.g., animal displays, petting zoos, animal swap meets, pet stores, zoological institutions, nature parks, circuses, carnivals, farm tours, livestock-birthing exhibits, county or state fairs, schools, and wildlife photo opportunities). Persons responsible for managing these venues should use the information in this report to reduce risk for disease transmission.

Guidelines to reduce risks for disease from animals in health-care and veterinary facilities and from service animals (e.g., guide dogs) have been developed (2--5). These settings are not specifically addressed in this report, although the general principles and recommendations are applicable to these settings.

Methods

NASPHV periodically reviews the "Compendium of Measures to Prevent Disease Associated with Animal in Public Settings". This includes reviewing recent literature; updating reported outbreaks, diseases, or injuries attributed to human-animal interactions in a public setting; and soliciting comments or suggestions from the NASPHV membership and questions posed by the public. During November 27--29, 2006, NASPHV members and external expert consultants met at CDC in Atlanta, Georgia. The first day of the meeting was dedicated to reviewing scientific information regarding recent outbreaks, associated risk factors, pathogen biology, and interventional studies. A moderated discussion of each section of the recommendations was conducted. The committee reviewed scientific evidence and expert opinion in revising the document. A committee consensus was needed to add or modify existing language or recommendations.

Enteric (Intestinal) Diseases

Infections with enteric bacteria and parasites pose the highest risk for human disease from animals in public settings (6). Healthy animals can harbor human enteric pathogens. Many of these organisms have a low infectious dose (7--9). Because of the popularity of animal venues, a substantial number of persons might be exposed. Illness and outbreaks of enteric diseases among visitors to fairs, farms, and petting zoos are well documented. Pathogens responsible for outbreaks include *Escherichia coli* O157:H7 and other Shiga toxin-producing *E. coli* (STEC), *Campylobacter*, *Salmonella*, and *Cryptosporidium* (10--22). Although reports often document cattle, sheep, or goats as sources for infection, poultry (23--26), rodents (25--27), and other domestic and wild animals also are potential sources.

The primary mode of transmission for enteric pathogens is fecal-oral. Because animal fur, hair, skin, and saliva (28) can become contaminated with fecal organisms, transmission can occur when persons pet, touch, feed, or are licked by animals. Transmission has occurred from fecal contamination of food, including raw milk (29--31), sticky foods (e.g., cotton candy [32]), and water (33--35). Illness also has been associated with contaminated clothing and shoes (11,17), animal bedding, flooring, barriers, and other environmental surfaces (15,17,25,36--38).

Animals carrying enteric organisms pathogenic to humans (e.g., STEC, *Salmonella*, and *Campylobacter*) frequently exhibit no signs of illness and can shed these pathogens intermittently. Removing ill animals (especially those with diarrhea) is necessary but not sufficient to protect animal and human health. Animals that appear to be healthy often shed pathogens that contaminate the environment (39). Some pathogens live for months or years in the environment (40--44). Because of intermittent shedding and limitations of laboratory tests, culturing fecal specimens or attempting to identify, screen, and remove infected animals might reduce, but will not eliminate, the risk for transmission. Antimicrobial treatment of animals cannot reliably eliminate infection and shedding of enteric pathogens or prevent reinfection.

Multiple factors increase the probability of disease transmission at animal exhibits. Animals are more likely to shed pathogens because of stress induced by prolonged transportation, confinement, crowding, and increased handling by persons (45--51). Commingling increases the probability that animals shedding organisms will infect other animals (52). The prevalence of certain enteric pathogens is often higher in young animals (53--55), which are frequently used in petting

zoos and educational programs. Shedding of STEC and *Salmonella* is highest in the summer and fall when substantial numbers of traveling animal exhibits, agricultural fairs, and petting zoos are scheduled (50,55,56).

The risk for infections is increased by certain human factors and behaviors, especially in children. These factors include lack of awareness of the risk for disease, inadequate hand washing, lack of close supervision, and hand-to-mouth activities (e.g., use of pacifiers, thumb-sucking, and eating) (57). Children are particularly attracted to animal venues and have increased risk for serious infections.

The layout and maintenance of facilities and animal exhibits also can affect the risk for infection (58). Risk factors include inadequate hand-washing facilities (59), structural deficiencies associated with temporary food-service facilities (12,14,17), inappropriate flow of visitors, and incomplete separation between animal exhibits and food preparation and consumption areas (60). Other factors include contaminated or inadequately maintained drinking water and sewage- or manure-disposal systems (33--35,38).

Lessons from Outbreaks

In 2000, two *E. coli* O157:H7 outbreaks in Pennsylvania and Washington prompted CDC to establish recommendations for enteric disease prevention associated with farm animal contact. Risk factors identified in both outbreaks were direct animal contact and inadequate hand washing (60,61). In the Pennsylvania outbreak, 51 persons (median age: 4 years) became ill within 10 days after visiting a dairy farm. Eight (16%) of these patients acquired hemolytic uremic syndrome (HUS), a potentially fatal consequence of STEC infection. The same strain of *E. coli* O157:H7 was isolated from cattle, patients, and the farm environment. In addition to the reported cases, an increased number of diarrhea cases in the community were attributed to visiting the farm. An assessment of the farm environment determined that no areas existed for eating and drinking separate from the animal contact areas, and the limited hand-washing facilities were not configured for children (60).

The protective effect of hand washing and the persistence of organisms in the environment were demonstrated in an outbreak of *Salmonella* infections at a Colorado zoo in 1996. A total of 65 cases (most among children) were associated with touching a wooden barrier around a temporary Komodo dragon exhibit. Children who were not ill were substantially more likely to have washed their hands after visiting the exhibit. *Salmonella* was isolated from 39 patients, a Komodo dragon, and the wooden barrier (17).

In 2005, an *E. coli* O157:H7 outbreak among 63 patients, including seven who had HUS, were associated with multiple fairs in Florida. Both direct animal contact and contact with sawdust or shavings were associated with illness (12). Persons who reported feeding animals were at increased risk. Among persons who washed their hands after leaving the animal area, using soap and water was protective for those who created a lather (62). Drying hands on clothes increased the risk for illness. Persons were less likely to become ill if they reported washing their hands before eating or drinking or were aware of the risk for illness before visiting the fair.

During 2000--2001 at a Minnesota children's farm day camp, washing hands with soap after touching a calf and washing hands before going home were protective factors in two outbreaks involving multiple enteric organisms. A total of 84 illnesses were documented among attendees. Implicated organisms for the human infections were *E. coli* O157:H7, *Cryptosporidium parvum*, non-O157 STEC, *Salmonella enterica* serotype Typhimurium, and *Campylobacter jejuni*. These organisms and *Giardia* were isolated from calves. Risk factors for children included caring for an ill calf and getting visible manure on their hands (20).

Enteric pathogens can contaminate the environment and persist in animal housing areas for long periods. For example, *E. coli* O157:H7 can survive in soil for months (38,40,42,63). Prolonged environmental persistence of pathogens was documented in an Ohio outbreak in 2001 of *E. coli* O157:H7 infections in which 23 persons became ill at a fair after handling sawdust, attending a dance, or eating and drinking in a barn where animals were exhibited during the previous week (38). Fourteen weeks after the fair, *E. coli* O157:H7 was isolated from multiple environmental sources within the barn, including sawdust on the floor and dust on the rafters. Forty-two weeks after the fair, *E. coli* O157:H7 was recovered from sawdust on the floor. In 2004, an outbreak of *E. coli* O157:H7 infection was associated with attendance at the North Carolina State Fair goat and sheep petting zoo (12). Health officials identified 108 patients, including 15 who had HUS. The outbreak strain was isolated from the animal bedding 10 days after the fair was over, and from the soil 5 months after

the animal bedding and topsoil were removed (58). In 2003, a total of 25 persons acquired *E. coli* O157:H7 at a Texas agricultural fair. The strain isolated from patients also was found in environmental samples 46 days after the fair ended (15).

Transmission can occur even in the absence of direct animal contact if the pathogen is disseminated in the environment. In an Oregon county fair outbreak, 60 cases occurred, mostly among children (25). Illness was associated with visiting an exhibition hall that housed goats, sheep, pigs, rabbits, and poultry; however, illness was not associated with touching animals or their pens, eating, or inadequate hand washing. The same organism was recovered from ill persons and the building. Transmission of *E. coli* O157:H7 from contaminated dust was implicated in two outbreaks in Ohio and Oregon (25,38).

Improper facility design and inadequate maintenance might increase risk, as illustrated by one of the largest waterborne outbreaks in the United States (34,35). In 1999, approximately 800 suspected cases of *E. coli* O157:H7 and *Campylobacter* infection were identified among attendees of a New York county fair where the water and sewage systems had deficiencies. Temporary facilities are particularly vulnerable to design flaws (12,17). Such venues include those that add an animal display or petting zoo for the purpose of attracting children to zoos, festivals, roadside attractions, farm stands, pick-your-own-produce farms, and Christmas tree lots. In 2005, an *E. coli* O157:H7 outbreak in Arizona was associated with a temporary petting zoo at a municipal zoo (12). Child care and school field trips to a pumpkin patch with a petting zoo resulted in 44 cases of *E. coli* O157:H7 infection in British Columbia (14). The same strain of *E. coli* was found both in children and in a petting zoo goat. Running water and signage recommending hand washing were not available, and alcohol hand sanitizers were at a height that was unreachable for some children. A total of 163 persons became ill with STEC O111:H8 and/or *Cryptosporidium* at a New York farm stand that sold unpasteurized apple cider and had a petting zoo with three calves (64).

Several outbreaks have occurred because of failure to understand and properly implement disease-prevention recommendations. Following a Minnesota outbreak of cryptosporidiosis with 31 ill students at a school farm program, specific recommendations provided to teachers were inadequately implemented (18). A subsequent outbreak occurred with 37 illnesses. Hand-washing procedures were inadequate (e.g., only water available, crowding at sink, and drying hands on clothes). Coveralls and boots were dirty, cleaned infrequently, and removed after hand-washing. In addition, inadequate hand washing and cleaning of contact surfaces resulted in an outbreak of salmonellosis associated with dissection of owl pellets in elementary schools (65).

Sporadic Infections

Although not identified as part of recognized outbreaks, sporadic infections have been associated with animal environments. A study of sporadic *E. coli* O157:H7 infections in the United States determined that patients, especially children, were more likely than healthy persons to have visited a farm with cows (66). Additional studies also documented an association between *E. coli* O157:H7 infection and visiting a farm (67) or living in a rural area (68). Studies of human cryptosporidiosis have documented contact with cattle or visiting farms as risk factors for infection (69--71). A case-control study identified multiple factors, including raw milk consumption and contact with farm animals, associated with *Campylobacter* infection (72). In other studies, farm residents were at a lower risk for infection with *Cryptosporidium* (71) and *E. coli* O157:H7 (73) than farm visitors, presumably because the residents had acquired immunity as a result of their early and frequent exposure to these organisms. However, livestock exhibitors became infected with *E. coli* O157:H7 in at least one fair outbreak (15).

Additional Health Concerns

Although enteric diseases are the most commonly reported illnesses associated with animals in public settings, other health risks are of concern. For example, allergies can be associated with animal dander, scales, fur, feathers, body wastes (e.g., urine), and saliva (74--76). Additional health concerns addressed in this report include injuries, rabies exposures, and other infections.

Injuries

Injuries associated with animals in public settings include bites, kicks, falls, scratches, stings, crushing of the hands or feet, and being pinned between the animal and a fixed object. These injuries have been associated with big cats (e.g., tigers), monkeys, and other domestic and zoo animals. The settings have included public stables, petting zoos, traveling photo opportunities, schools, children's parties, and animal rides (M. Eidson, DVM, New York State Department of Health, personal communication, 2003; J.B. Bender, DVM, University of Minnesota, personal communication, 2003; M.T. Jay-Russell, DVM, California Department of Health, personal communication, 2003; G.L. Swinger, DVM, Tennessee Department of Health, personal communication, 2003). For example, a Kansas teenager was killed while posing for a photograph with a tiger being restrained by its handler at an animal sanctuary (77).

Rabies Exposures

Contact with rabid mammals can expose persons to rabies virus through bites or contamination of mucous membranes, scratches, or other wounds with infected saliva or nervous tissue. Although no human rabies deaths caused by animal contact in public exhibits have been recorded, multiple rabies exposures have occurred, requiring extensive public health investigation and medical follow-up. For example, thousands of persons have received rabies postexposure prophylaxis (PEP) after being exposed to rabid or potentially rabid animals (including cats, goats, bears, sheep, ponies, and dogs) at a variety of venues: a pet store in New Hampshire (78), a county fair in New York State (79), petting zoos in Iowa (80,81) and Texas (J. Wright, Texas Department of Health, personal communication, 2004), and school and rodeo events in Wyoming (59). Substantial public health and medical care challenges associated with potential mass rabies exposures include difficulty in identifying and contacting persons, correctly assessing exposure risks, and providing timely medical prophylaxis. Prompt assessment and treatment are critical to prevent this disease, which is usually fatal.

Other Infections

Multiple bacterial, viral, fungal, and parasitic agents have been associated with animal contact. These organisms are transmitted through various modes. Infections from animal bites are common and frequently require extensive treatment or hospitalization. Bacterial pathogens associated with animal bites include *Pasteurella*, *Francisella tularensis* (82), *Staphylococcus*, *Streptococcus*, *Capnocytophaga canimorsus*, *Bartonella henselae* (cat-scratch disease), and *Streptobacillus moniliformis* (rat-bite fever). Certain monkey species (especially macaques) kept as pets or used in public exhibits can be infected with herpes B virus, either asymptotically or with mild oral lesions. Human exposure through monkey bites or bodily fluids can result in a fatal meningoencephalitis (83,84).

Skin contact with animals in public settings is also a public health concern. In 1995, a total of 15 cases of ringworm (club lamb fungus) caused by *Trichophyton* species and *Microsporium gypseum* were documented among owners and family members who exhibited lambs in Georgia during a show season (85). Ringworm in 23 persons and multiple animal species was traced to a *Microsporium canis* infection in a hand-reared zoo tiger cub (86). Orf virus infection (contagious ecthyma or sore mouth) has occurred following contact with sheep at a public setting (E. Lederman, CDC, personal communication, 2006). In addition, orf virus infection has been described in goats and sheep at a children's petting zoo (87) and in a lamb used for an Easter photo opportunity (M. Eidson, New York State Department of Health, personal communication, 2003). After handling various species of infected exotic animals, a zoo attendant experienced an extensive papular skin rash from a cowpox-like virus (88). In 2003, multiple cases of monkeypox occurred among persons who had contact with infected prairie dogs either at a child care center (89,90) or a pet store (J.J. Kazmierczak, Wisconsin Department of Health and Family Services, personal communication, 2004).

Ecto- and endoparasites pose concerns when humans and exhibit animals interact. *Sarcoptes scabiei* is a skin mite that infests humans and animals, including swine, dogs, cats, foxes, cattle, and coyotes (91, 92). Although human infestation from animal sources is usually self-limiting, skin irritation and itching might occur for multiple days and can be difficult to diagnose (92,93). Animal flea bites to humans increase the risk for infection or allergic reaction. In addition, fleas can carry a tapeworm species that can infect children who unintentionally swallow the flea (94,95). Animal parasites also can infect humans who ingest soil or other materials contaminated with animal feces. Parasite control through veterinary care and proper husbandry combined with hand washing reduces the risks associated with ecto- and endoparasites (96).

Tuberculosis (TB) is another disease of concern in certain animal settings. In 1996, a total of 12 circus elephant handlers

at an exotic animal farm in Illinois were infected with *Mycobacterium tuberculosis*, and one handler had signs consistent with active disease after three elephants died of TB. Medical history and testing of the handlers indicated that the elephants had been a probable source of exposure for most of the human infections (97). During 1989–1991 at a zoo in Louisiana, seven animal handlers who were previously negative for TB tested positive after a *Mycobacterium bovis* outbreak in rhinoceroses and monkeys (98). In 2003, the U.S. Department of Agriculture (USDA) developed guidelines regarding removal of TB-infected animals from public contact as a result of concerns over the risk for exposure to the public (99).

Zoonotic pathogens also can be transmitted by direct or indirect contact with reproductive fluids, aborted fetuses, or newborns from infected dams. Live-birthing exhibits, usually involving livestock (e.g., cattle, pigs, goats, or sheep), are popular at agricultural fairs. Although the public usually does not have direct contact with animals during birthing, newborns and their dams are frequently available for petting afterwards. Q fever (*Coxiella burnetii*), leptospirosis, listeriosis, brucellosis, and chlamydiosis are serious zoonoses that can be acquired through contact with reproductive materials (100).

Coxiella burnetii is a rickettsial organism that most frequently infects cattle, sheep, and goats. The disease can cause abortion in animals, but more frequently the infection is asymptomatic. During birthing, infected animals shed substantial numbers of organisms that might become aerosolized. Most persons exposed to *C. burnetii* develop an asymptomatic infection, but clinical illness can range from an acute influenza-like illness to life-threatening endocarditis. A Q fever outbreak involving 95 confirmed patients and 41 hospitalizations was linked to goats and sheep giving birth at petting zoos in indoor shopping malls (101). Indoor-birthing exhibits might pose an increased risk for Q fever transmission attributed to inadequate ventilation.

Chlamydophila psittaci infections cause respiratory disease (commonly called psittacosis) and are usually acquired from psittacine birds (102). For example, an outbreak of *C. psittaci* pneumonia occurred among the staff at the Copenhagen, Zoological Garden (103). On rare occasions, chlamydial infections acquired from sheep, goats, and birds result in reproductive problems in humans (102,104,105).

Recommendations

Guidelines from multiple organizations contributed to the recommendations in this report (106--108). No federal laws in the United States address the risk for transmission of pathogens at venues where the public has contact with animals. Certain states have specific legislation for venues where animals are present in public settings (59,61,109--111). In 2005, after a state fair outbreak, North Carolina passed a law requiring agricultural fairs to obtain a permit from the Department of Agriculture for all animal exhibits open to the public (<http://www.ncleg.net/Sessions/2005/Bills/Senate/html/S268v4.html>).

Certain federal agencies and associations in the United States have developed standards, recommendations, and guidelines for venues where animals are present in public settings. The Association of Zoos and Aquariums has accreditation standards for reducing risk for animal contact with the public in zoologic parks (112). In accordance with the Animal Welfare Act, USDA licenses and inspects certain animal exhibits for humane treatment of animals; however, the act is not intended for human health protection. In 2001, CDC issued guidelines to reduce the risk for infection with enteric pathogens from farm visits (61). CDC also has issued recommendations for preventing transmission of *Salmonella* from reptiles to humans (113). The Association for Professionals in Infection Control and Epidemiology (APIC) developed guidelines to address risks associated with the use of service animals in health-care settings (2).

Recommendations for Local, State, and Federal Agencies

Communication and cooperation among human and animal health agencies should be enhanced and include cooperative extension offices. Additional research should be conducted into the risk factors and effective prevention and control methods for health issues associated with animal contact. To improve use of these recommendations, agencies should:

- Disseminate this report to venue operators. Most states do not have a complete list of animal contact venues (59). States should strive to develop a complete list to facilitate dissemination of recommendations.
- Disseminate educational and training materials to venue operators and other interested persons. Material formats could include PowerPoint slide presentations, videos, and written guidelines (109,110,114).

- Encourage or require oversight to ensure compliance with recommendations at animal contact venues.

To evaluate and improve these recommendations, surveillance for health issues associated with animal contact should be enhanced. Agencies should:

- Conduct thorough epidemiologic investigations of outbreaks.
- Include questions about exposure to animals and their environment on disease report forms and outbreak investigation questionnaires.
- Follow appropriate protocols for sampling of humans, animals, and the environment and for testing and subtyping of isolates.
- Report outbreaks to state health departments and CDC.

Recommendations for Education

Education is essential to reduce risks associated with animal contact in public settings. Experience from outbreaks suggests that visitors knowledgeable about potential risks are less likely to become ill (12). Even in well-designed venues with operators who are aware of the risks for disease, outbreaks can occur when visitors do not understand and apply disease-prevention recommendations.

Venue operators should:

- Know the risks for disease and injury associated with animals and be able to explain risk-reduction measures to staff and visitors.
- Be familiar with and implement the recommendations contained in this report.
- Consult with state and local agencies and county extension agents on implementation of the recommendations.
- Develop or obtain training and education materials and train staff.
- Assure that visitors receive educational messages before they enter the exhibit, including information that animals can cause injuries or carry organisms that can cause serious illness ([Appendix A](#) and [B](#)).
- Provide information in a simple and easy-to-understand format that is age- and language-appropriate.
- Provide information in multiple formats (e.g., signs, stickers, handouts, and verbal information).
- Provide information to persons arranging school field trips or classroom exhibits so they can educate participants before the visit.

Venue staff should:

- Know the risks for disease and injury associated with animals and be able to explain risk-reduction recommendations to visitors.
- Assure that visitors receive educational messages.
- Encourage compliance by the public with risk-reduction recommendations, especially compliance with hand-washing procedures ([Appendix C](#)) as the visitors exit animal areas.
- Comply with local and state requirements for reporting animal bites, scratches, or other injuries.

Recommendations for Managing Public and Animal Contact

The recommendations in this report were developed for settings in which direct animal contact is encouraged (e.g., petting zoos) and in which animal contact is possible (e.g., county fairs). They should be tailored to specific settings and incorporated into guidelines and regulations developed at the state or local level. The public's contact with animals should occur in settings where measures are in place to reduce the potential for injuries or disease transmission and to increase the probability that incidents or problems identified with animal contact settings will be reported, documented, and handled appropriately.

The design of facilities and animal pens ([Figure](#)) should minimize the risk associated with animal contact, including contact with manure, and should encourage hand washing ([Appendix C](#)). The design of facilities or contact settings might

include double barriers to prevent contact with animals or contaminated surfaces except for specified interaction areas. Temporary exhibits should be carefully planned, designed, and managed to avoid problems identified from previous outbreaks. Common problems include inadequate barriers, floor surfaces that are difficult to keep clean, insufficient plumbing, and inadequate hand-washing facilities (12,17,34,35). Specific guidelines might be necessary for certain settings (i.e., schools [[Appendix D](#)]).

Recommendations for cleaning procedures also should be tailored to the specific situation. All surfaces should be cleaned thoroughly to remove organic matter before disinfection. A 1:32 dilution of household bleach (e.g., half a cup of bleach per gallon of water) is needed for basic disinfection. Quaternary ammonium compounds (e.g., Roccal[®] or Zephiran[®]) also can be used per the manufacturer label. For disinfection when a particular organism has been identified, additional guidance is available at <http://www.cfsph.iastate.edu/BRM/resources/disinfectants/Disinfection101Feb2005.pdf>. All compounds require a contact time of ≥ 10 minutes.

The venue should be divided into three types of areas: nonanimal areas (areas in which animals are not permitted, with the exception of service animals), transition areas (located at both entrances and exits to animal areas), and animal areas (where animal contact is possible or encouraged) ([Figure](#)).

Nonanimal Areas

Nonanimal areas are those in which animals are not permitted.

- Do not permit animals, except service animals, in nonanimal areas.
- Prepare, serve, and consume food and beverages only in nonanimal areas.
- Provide hand-washing facilities and display hand-washing signs where food or beverages are served ([Appendix C](#)).

Transition Areas Between Nonanimal and Animal Areas

Establishing transition areas through which visitors pass when entering and exiting animal areas is critical. One-way visitor flow is preferred with separate entrance and exit points. The transition areas should be designated as clearly as possible, even if they must be conceptual rather than physical ([Figure](#)).

Entrance transition areas should be designed to facilitate education.

- Post signs or otherwise notify visitors that they are entering an animal area.
- Instruct visitors not to eat, drink, smoke, place their hands in their mouth, or use bottles or pacifiers while in the animal area.
- Exclude strollers, food, and beverages (establish storage or holding areas for these items).
- Control visitor traffic to avoid overcrowding.

Exit transition areas should be designed to facilitate hand washing.

- Post signs or otherwise instruct visitors to wash their hands.
- Provide accessible hand-washing stations for all visitors, including children and persons with disabilities ([Figure](#)).
- Position venue staff near exits to encourage compliance with hand washing.

Animal Areas

- Provide adequate ventilation for both animals (115) and humans.
- Exclude food and beverages. Animal feed and water should not be accessible to the public.
- Exclude toys, pacifiers, spill-proof cups, baby bottles, and strollers.
- Prohibit smoking.
- Promptly remove manure and soiled animal bedding from animal areas.
- Store animal waste and specific tools for waste removal (e.g., 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.

- Where feasible, disinfect animal areas (e.g., flooring and railings) at least once daily.
- Supervise children closely to discourage hand-to-mouth activities (e.g., thumb-sucking), contact with manure, and contact with soiled bedding. If hands become soiled, supervise hand washing.
- Assign trained staff to encourage appropriate human-animal interactions, to identify and remove potential risks for patrons (e.g., by promptly cleaning up wastes), and to process reports of injuries and exposures.
- Allow feeding only when contact with animals is controlled (e.g., with barriers).
- Do not provide animal feed in containers that can be eaten by persons (e.g., ice cream cones) to prevent children from eating food that has come into contact with animals.
- Use animals or animal products (e.g., animal pelts, animal waste, and owl pellets) (65) for educational purposes only in designated animal areas ([Figure](#)). Animals and animal products should not be brought into school cafeterias and other food-consumption areas.
- Do not use animal areas for public (nonanimal) activities. Zoonotic pathogens can contaminate the environment for substantial periods of time (38). If animal areas must be used for public events (e.g., weddings and dances), these areas should be cleaned and disinfected, particularly if food and beverages are served. Materials with smooth, impervious surfaces (e.g., steel, plastic, and sealed concrete) are easier to clean than other materials (e.g., wood or dirt floors). Remove organic material (e.g., bedding, feed, and manure) before using disinfectants.
- For animals in school classrooms, specific areas must be designated for animal contact ([Appendix D](#)). Designated animal areas must be thoroughly cleaned after use. Parents should be informed of the benefits and potential risks associated with animals in school classrooms.

Animal Care and Management

The risk for disease or injuries from animal contacts can be reduced by carefully managing the specific animals used for such contacts. These recommendations should be considered for management of animals in contact with the public.

- **Animal care:** Monitor animals daily for signs of illness, and ensure that animals receive appropriate veterinary care. Ill animals, animals known to be infected with a pathogen, and animals from herds with a recent history of abortion or diarrhea should not be exhibited. Animals should be housed to minimize stress and overcrowding, which can increase shedding of pathogens.
- **Veterinary care:** Retain and use the services of a licensed veterinarian. Vaccination, preventive care, and parasite control appropriate for the species should be provided. Certificates of veterinary inspection from an accredited veterinarian should be up-to-date according to local or state requirements for animals in public settings. A herd or flock inspection is a critical component of the health certificate process. Routine screening for diseases is not recommended, except for TB in elephants (97-99) and primates, and for Q fever in ruminants in birthing exhibits (116,117).
- **Rabies:** All animals should be housed to reduce potential exposures from wild animal rabies reservoirs. Mammals should also be up-to-date on their rabies vaccinations (118). These steps are particularly critical in areas where rabies is endemic and in venues where animal contact is encouraged (e.g., petting zoos). Because of the extended incubation period for rabies, unvaccinated mammals should be vaccinated at least 1 month before they have contact with the public. If no licensed rabies vaccine exists for a particular species used in a setting where public contact occurs (e.g., goats, swine, llamas, and camels), consultation with a veterinarian is recommended regarding the off-label use of rabies vaccine. Use of off-label vaccine cannot provide the same level of assurance as vaccines labeled for use in particular species; however, off-label use of vaccine might provide protection for certain animals and thus decrease the probability of rabies transmission. Vaccinating slaughter-class animals before displaying them at fairs might not be feasible because of the vaccine withdrawal period that occurs as a result of antibiotics used as preservatives in certain vaccines. Mammals that are too young to be vaccinated should be used only if additional restrictive measures are available to reduce risks. These measures can include using only animals that were born to vaccinated mothers and housed to avoid rabies exposure.
- **Dangerous animals:** Because of their strength, unpredictability, venom, or the pathogens that they might carry, prohibit certain domestic, exotic, or wild animals in exhibit settings where a reasonable possibility of animal contact exists. Species of primary concern include nonhuman primates (e.g., monkeys and apes) and certain carnivores (e.g., lions, tigers, ocelots, wolves/wolf-hybrids, and bears). In addition, rabies-reservoir species (e.g., bats, raccoons, skunks, foxes, and coyotes) should not be used for direct contact.
- **Animal births:** Ensure that the public has no contact with animal birthing by-products. In live-birth exhibits,

the environment should be thoroughly cleaned after each birth, and all waste products should be properly discarded. Holding such events outside is preferable. If held indoors, ventilation should be maximized.

Additional Recommendations

- **Populations at high risk:** Children aged <5 years are at particularly high risk for serious infections. Other groups at increased risk include persons with waning immunity (e.g., older adults) and persons who are mentally impaired, pregnant, or immunocompromised (e.g., persons with human immunodeficiency virus/acquired immunodeficiency syndrome, without a functioning spleen, or on immunosuppressive therapy). Persons at high risk should take precautions at any animal exhibit. In addition to thorough and frequent hand washing, heightened precautions could include avoiding contact with animals and their environment (e.g., pens, bedding, and manure). Animals of particular concern for transmitting enteric diseases include young ruminants, young poultry, reptiles, amphibians, and ill animals.
- **Consumption of unpasteurized products:** Prohibit the consumption of unpasteurized dairy products (e.g., milk, cheese, and yogurt) and unpasteurized apple cider or juices.
- **Drinking water:** Local public health authorities should inspect drinking water systems before use. Only potable water should be used for consumption by animals and humans. Back-flow prevention devices should be installed between outlets in livestock areas and water lines supplying other uses on the grounds. If the water supply is from a well, adequate distance should be maintained from possible sources of contamination (e.g., animal-holding areas and manure piles). Maps of the water distribution system should be available for use in identifying potential or actual problems. The use of outdoor hoses should be minimized, and hoses should not be left on the ground. Hoses that are accessible to the public should be labeled "water not for human consumption." Operators and managers of these settings in which treated municipal water is not available should consider alternative methods for disinfection of their water supply or should consider methods to disinfect their water supply.

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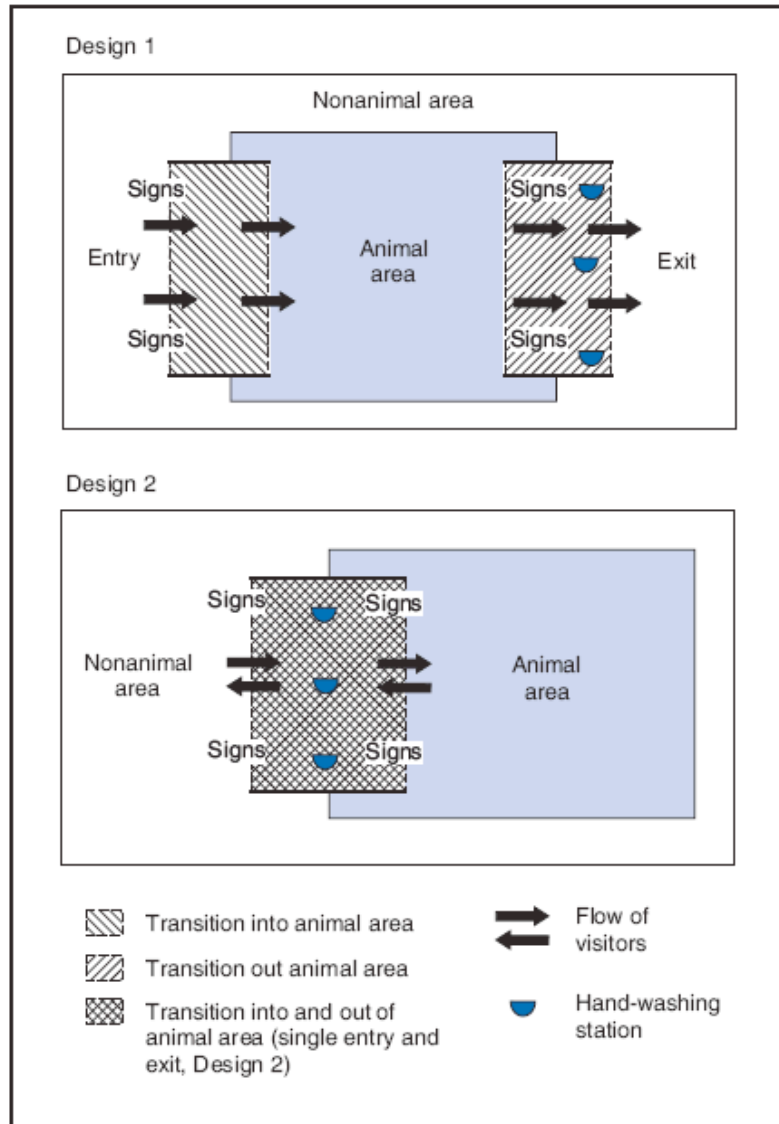
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Figure

FIGURE. Examples of designs for animal contact settings, including clearly designated animal areas, nonanimal areas, and transition areas with hand-washing stations and signage



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