

# Reports of zoonotic disease outbreaks associated with animal exhibits and availability of recommendations for preventing zoonotic disease transmission from animals to people in such settings

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**Objective**—To assess the number of zoonotic disease outbreaks associated with animal exhibits and identify published recommendations for preventing zoonotic disease transmission from animals to people in exhibit settings.

**Design**—Literature review and survey of state public health veterinarians and state epidemiologists.

**Procedure**—MEDLINE and agriculture databases were searched from 1966 through 2000. Retrieved references and additional resources provided by the authors were reviewed. A survey was sent to state public health veterinarians and state epidemiologists to determine whether their states had written recommendations or guidelines for controlling zoonotic diseases in animal exhibition venues, whether their states maintained a listing of animal exhibitors in the state, and whether they had any information on recent outbreaks involving animals in exhibitions.

**Results**—11 published outbreaks were identified. These outbreaks occurred in a variety of settings including petting zoos, farms, and a zoological park. An additional episode involving exposure to a potentially rabid bear required extensive public health resources. A survey of state public health veterinarians identified 16 additional unpublished outbreaks or incidents. Most states did not have written recommendations or guidelines for controlling zoonotic diseases or any means to disseminate educational materials to animal exhibitors.

**Conclusions**—Recent outbreaks of zoonotic diseases associated with contact with animals in exhibition venues highlight concerns for disease transmission to public visitors. Only a handful of states have written guidelines for preventing zoonotic disease transmission in animal exhibition venues, and published recommendations currently available focus on preventing enteric diseases and largely do not address other zoonotic diseases or prevention of bite wounds. (*J Am Vet Med Assoc* 2004;224:1105–1109)

Several recent zoonotic disease outbreaks in humans have been associated with animals in petting zoos, on farms, or in other animal exhibits.<sup>1-10</sup> Such out-

breaks, along with concerns about the potential for bite injuries and other zoonotic diseases (eg, rabies), are providing an impetus to develop rational, standardized guidelines governing animal exhibits that provide contact between animals and people. The National Association of State Public Health Veterinarians (NASPHV) intends to develop and distribute guidelines for the prevention of diseases and injuries resulting from such exhibits. Prior to this, however, it was determined that it would be useful to identify existing guidelines and past outbreaks of zoonotic diseases associated with animal exhibits. The purpose of the study reported here was to obtain information on published and unpublished incidents of zoonotic disease outbreaks associated with animal exhibits and identify published and unpublished recommendations for preventing zoonotic disease transmission from animals to people in such settings.

## Methods

Literature reviews of zoonotic disease outbreaks associated with animal exhibits and guidelines for zoonotic disease prevention were conducted. For these reviews, MEDLINE was searched for articles published between January 1966 and December 2000. Veterinary and animal health databases (VET-CD and BEAST-CD) were also searched, and the LEXIS-NEXIS and MnLINK databases were searched for information on outbreaks published in US newspapers. Search terms included petting zoos, animal exhibits, zoos, outbreaks, zoonoses, and farm visits. Outbreaks of zoonotic disease in animals that were not associated with reports of human illness were excluded, but incidents of animal exposure that resulted in substantial consumption of public health resources (eg, mass rabies prophylaxis following exposure to a rabid animal) were included, even if no human cases of disease were documented. Additional sources identified by members of the Animals in Public Contact subcommittee of the NASPHV were also included.

A survey was developed and e-mailed or faxed to the state public health veterinarian in each state or, in states without a state public health veterinarian, to the state epidemiologist. Survey recipients were asked whether their states had written recommendations or guidelines on controlling the spread of zoonotic diseases from animal exhibits and whether their states maintained a list of petting zoo operators, individuals

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who exhibit animals, and persons who conduct educational field trips that entail animal contact. In addition, information concerning recent outbreaks associated with such settings during 1990 through 2000 was requested. Data collected included date of the incident, county, state, pathogen, demographic information (age and sex of affected individuals), number of cases, number of potentially exposed people, and recommendations to prevent further spread.

## Results

**Outbreaks or incidents involving animal exhibits**—The literature review did not identify any published reports of outbreaks of zoonotic disease associated with animal exhibits between 1966 and 1994, but 11 published reports<sup>1-4,6,8-13</sup> that documented outbreaks of disease in humans traced to transmission of zoonotic pathogens from animals in animal exhibits between 1995 and 2000 were identified (Table 1). An additional report<sup>5</sup> was identified that described an incident in a petting zoo setting that consumed substantial public health resources, even though no human cases of disease were documented.<sup>5</sup> Outbreaks took place in the United Kingdom (n = 6), United States (5), and Canada (1). Pathogens involved in these 12 incidents included *Escherichia coli* O157 (n = 7), *Cryptosporidium parvum* (2), *Salmonella* spp (1), rabies virus (1), and dermatophytes (1). The 10 outbreaks associated with enteric pathogens occurred following visits to educational farms (n = 8), a zoo (1), or a petting zoo at a provincial fair (1). In 6 of these 10 outbreaks, inadequate handwashing facilities were considered to be a contributing factor. For 5 of the 10 outbreaks, case-control studies of contributing factors were performed, and handwashing was found to be protective in 4 of the 5. Risk factors that were identified included biting nails, sucking thumbs, eating or purchasing food near animal areas, and contact with animals or their environment. Common recommendations from investigators included placement of appropriate signs, education of patrons, avoiding contact with sick animals, providing adequate handwashing facilities, ensuring adequate supervision of children, providing separate eating and animal contact areas, establishing animal contact guide-

lines, and providing for appropriate cleaning and disinfection of the animal holding environment and proper manure disposal. In 2 of the 10 outbreaks involving enteric pathogens, appropriate handwashing facilities were available and patrons were notified of possible risks. The incident related to rabies virus involved approximately 150 people who came into contact with a potentially rabid bear cub.<sup>5</sup> The report<sup>13</sup> of dermatophytosis involved owners and family members who showed lambs during the lamb show season.

Several reports<sup>5,7,14-16</sup> of sporadic cases of disease associated with farm animal contact were also identified. However, these were not included since our analysis focused on outbreak situations. In addition, a number of other published articles<sup>17-23</sup> documented evidence of zoonotic diseases among exhibit animals with the potential for transmission to the public or keepers, but were excluded because no human cases were identified. Potential zoonotic agents included pox viruses, hepatitis A virus, *Mycobacterium* spp, *Chlamydophila psittaci*, other bacteria, and enteric parasites. Infections and injuries from bite wounds were also described.

Completed surveys were returned by the state public health veterinarian or state epidemiologist from 45 states. Respondents identified 19 additional outbreaks or other incidents involving animal contact that occurred between 1990 and 2000. Three of these incidents were excluded because they did not involve animal exhibits (ie, outbreaks associated with animal contact at a pet store or during the sale of baby chicks and an attack on zoo personnel). There were 16 incidents that involved public contact with animals during exhibitions or educational visits (Table 2). Pathogens involved in these incidents included rabies virus (n = 3), *E coli* O157:H7 (3), *Campylobacter* spp (3), *Salmonella* spp (3), *Giardia* spp (1), orf virus (1), *C parvum* (1), and multiple enteric pathogens (1). The number of individuals potentially exposed in each incident ranged from 1 to 400 individuals.

Twelve of the 16 outbreaks involved enteric pathogens. The median number of ill persons for these outbreaks was 16, with a range from 1 to 82. Outbreaks occurred between March and November. In 3 of the enteric disease outbreaks, no or inadequate handwash-

Table 1—Characteristics of documented outbreaks of disease in humans traced to transmission of zoonotic pathogens from animals in animal exhibits between 1995 and 2000

Country	Setting	Year*	Pathogen	No. affected†	No. hospitalized	Implicated sources	Reference
United Kingdom	Farm visit	1994	<i>Escherichia coli</i> O157	32	5	Cattle and goats	1
United Kingdom	Farm visit	1995	<i>Cryptosporidium</i> spp	13	2	Environment	3
United Kingdom	Farm visit	1995	<i>Cryptosporidium</i> spp	47	1	Calves	2
United States	Zoo	1996	<i>Salmonella</i> Enteritidis	65	8	Exhibit environment	4
United States	Farm visit	1995	Dermatophytes	15	0	Lambs	13
United Kingdom	Farm visit	1997	<i>E coli</i> O157	5	5	Calves and goats	8
United Kingdom	Farm visit	1997	<i>E coli</i> O157	3	1	Various animals	11
United Kingdom	Farm visit	1997	<i>E coli</i> O157	3	3	Goats and calves	6
Canada	Fair	1999	<i>E coli</i> O157	61	UNK	Goats and sheep	10, 26
United States	Petting zoo	1999	Rabies virus	0‡	0	Potentially rabid bear	5
United States	Farm visit	2000	<i>E coli</i> O157	51	16	Calves	9, 12
United States	Farm visit	2000	<i>E coli</i> O157	5	3	Animals or environment	12

\*Year of incident. †Includes confirmed and suspect cases. ‡No cases were identified; however, an estimated 150 persons were potentially exposed.

UNK = Unknown.

Table 2—Characteristics of unpublished outbreaks of disease in humans traced to transmission of zoonotic pathogens from animals in animal exhibits between 1990 and 2000

State	Setting	Year	Pathogen	No. affected	Source
Alabama	Petting zoo	1994	<i>E coli</i> O157	1	Calf
Indiana	Petting zoo	1997	<i>E coli</i> O157	6	ND
Massachusetts	Farm visit	NS	<i>Salmonella</i> Typhimurium	NS	Raw milk
Michigan	Farm visit	1996	<i>Cryptosporidium</i> spp	82	Calf
Minnesota	County fair	1998	<i>E coli</i> O157	2	ND
Minnesota	Farm educational program	2000	Multiple pathogens	59	Calf
Nebraska	Farm visit	1997	<i>Campylobacter</i> spp	53	Raw milk
New York	Photo shoot	NS	Orf virus	NS	Sheep
New York	County fair	NS	Rabies virus	400*	Goat
Ohio	Petting zoo	1996	<i>Giardia lamblia</i>	12	Rabbits
Ohio	Petting zoo	2000	<i>Salmonella</i> Typhimurium	18	ND
Oklahoma	Farm visit	1992	<i>Campylobacter</i> spp	16	Raw milk
Washington	Science center	1991	<i>Salmonella</i> Typhimurium	5	Multiple animals
Wisconsin	Farm visit	2000	<i>Campylobacter</i> spp	19	Raw milk
Wyoming	Rodeo	1995	Rabies virus	12	Pony
Wyoming	School	NS	Rabies virus	40	Dog

NS = Not specified. ND = Not determined. \*Includes individuals potentially exposed.

ing facilities were available. Six of the 12 outbreaks occurred following farm visits or educational programs involving farm animals. Four of these 6 outbreaks were attributed to raw milk consumption during the visit. Other venues included petting zoos (n = 4), a county fair (1), and an educational science center (1).

**Recommendations**—Four published sets of recommendations for educational farm visits and petting zoos were found.<sup>12,24-26</sup> Three sets of recommendations available from the World Wide Web were also identified.<sup>27-29</sup> Alabama was reported to have written guidelines for pets visiting or residing in school settings.<sup>a</sup>

Published recommendations focused on preventing enteric disease illnesses. Common themes included providing educational information, minimizing risks (especially to children), providing adequate handwashing facilities, discouraging hand-to-mouth activities in animal areas (eg, eating, drinking, smoking, and using pacifiers), and avoiding consumption of unpasteurized milk. Some of the recommendations provided details regarding type of handwashing facilities, layout of access areas for visitors, information to include on signs or pamphlets, and manure management. There were no specific recommendations about the prevention of animal bites or other zoonotic diseases.

Survey respondents indicated that 3 states (Massachusetts, Ohio, and Washington) had recently developed some guidelines for petting zoo exhibitors and other animal exhibition venues. One state was in the process of developing guidelines, and the remaining 41 states had no current standardized recommendations for animal exhibits or petting zoos. Many states without current guidelines indicated that they distributed recently published guidelines from the Centers for Disease Control and Prevention.<sup>12</sup>

Thirty-five of the 45 survey respondents indicated that their states did not have lists of animal exhibitors to facilitate dissemination of developed materials, and 8 respondents did not answer this question or did not know whether there was a list of animal exhibitors available. Only 2 states (Georgia and Utah) had a list, either through licensing or other legislative efforts.

## Discussion

Recent outbreaks of zoonotic diseases associated with contact with animals in farm settings or at petting zoos have highlighted a number of concerns for disease transmission to public visitors. Sporadic cases of zoonotic diseases associated with such venues undoubtedly also occur, but typically cannot be traced to their source. Recent case-control studies<sup>30-34</sup> have documented contact with animals and their environment as common risk factors for sporadic *E coli* O157 infections. Other epidemiologic studies<sup>35-37</sup> involving *C parvum* and *Campylobacter* spp have also identified visiting farms as a risk factor for sporadic infection. Most outbreaks identified by state health officials in the current survey were related to enteric pathogens, but other zoonotic pathogens and bite injuries are also a concern.

In the present study, we found that only a handful of states had written guidelines for preventing zoonotic disease transmission in animal exhibition venues. In addition, published recommendations focused on preventing enteric diseases and largely did not address other zoonotic diseases or prevention of bite wounds. Thus, we believe it would be useful to develop more comprehensive guidelines that address the broad range of potential zoonotic diseases associated with animal exhibits, along with the risk of other injuries, including bite wounds.

If such broad guidelines can be developed, we would suggest that they be distributed as widely as possible, particularly to individuals involved with animal exhibits of any type, such as petting zoos, educational farms, traditional and mobile zoos, nature parks, circuses, and county and state fairs. One problem involved with the dissemination of such materials that we identified in the present study is that most states do not maintain centralized lists of animal exhibitors. Several survey respondents mentioned that they thought that the USDA maintained such lists, and in fact, the Animal and Plant Health Inspection Service does indeed maintain a current list of exhibitors of certain mammals used in public display, as directed by the Animal Welfare Act. This includes public petting zoos,

nativity scenes, camel or elephant rides, carnivals, and circuses. However, USDA guidelines are directed toward animal well-being and welfare and do not specifically address public health issues. In addition, the USDA does not maintain a consistent record of incidents involving the public, such as bites, attacks, or disease outbreaks. Also, the USDA regulations do not include horses, except to monitor for soring in horses used for shows or animals used for food or fiber.

Veterinarians have a critical role in educating the public about animals, their behavior, and the unique interrelationship between humans and animals. In this light, the benefits of animal exhibition must be balanced against public health concerns. Strategies are required to reduce disease transmission, such as provision of adequate handwashing facilities and supervision of animal contact, and procedures are needed for preventing and dealing with bites and other injuries. The NASPHV encourages veterinarians to contact their state department of health to obtain educational materials or to encourage the development of materials that can be widely disseminated. Also, veterinarians should help local animal exhibit operators or organizers of educational farm visits to identify and mitigate potential risks for zoonotic disease transmission, as well as encourage means to ensure animal welfare. The NASPHV is developing guidelines that will provide additional tools to control the risk of injury and disease from animal contact in public settings. The intent of these guidelines is to provide recommendations on a broad range of subjects, including prevention of enteric diseases, other zoonotic diseases, and injuries. Our ultimate goal is to provide a safe learning environment for public visitors to animal exhibits.

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