



CLINICAL REPORT

Exposure to Nontraditional Pets at Home and to Animals in Public Settings: Risks to Children

Guidance for the Clinician in Rendering
Pediatric Care

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ABSTRACT

Exposure to animals can provide many benefits during the growth and development of children. However, there are potential risks associated with animal exposures, including exposure to nontraditional pets in the home and animals in public settings. Educational materials, regulations, and guidelines have been developed to minimize these risks. Pediatricians, veterinarians, and other health care professionals can provide advice on selection of appropriate pets as well as prevention of disease transmission from nontraditional pets and when children contact animals in public settings. *Pediatrics* 2008;122:876–886

INTRODUCTION

The majority of households in the United States own 1 or more pets. In national surveys conducted by the American Pet Products Manufacturers Association, the percentage of US households that have 1 or more pets increased from 56% in 1998 to 63% (71.1 million homes) in 2007.¹ Dogs are owned by 44.8 million households, cats are owned by 38.4 million, freshwater fish are owned by 14.2 million, birds are owned by 6.4 million, small animals are owned by 6.0 million, horses are owned by 4.3 million, and saltwater fish are owned by 0.8 million. Total US pet industry expenditure in 2007 is estimated at \$40.8 billion.¹ In recent years, the number of families that have chosen nontraditional pets has increased.¹

Many pet owners and people in the process of choosing a pet often are unaware of the potential risks posed by certain animals, especially nontraditional pets. These risks are associated with changes in physical and behavioral characteristics as young animals reach maturity. Pediatricians, veterinarians, and other health care professionals are in a unique position to offer advice on proper pet selection, to provide information about safe pet ownership and responsibility, and to minimize risks to infants and children.

In addition to exposure to animals in their homes, children may come in contact with animals in a variety of public settings.² Although there are many benefits to experiences with animals outside the home, contact with animals in public settings also can be associated with significant risks to children, including infections and injuries. These potential risks are enhanced when there is an inadequate understanding of disease transmission, methods of preventing transmission, animal behavior, or appropriate facilities for animals.

This report deals with the potential exposure of infants, children, and adolescents to nontraditional pets in the home and to animals in public settings. The objectives of this report are to (1) summarize information regarding emerging and reemerging infectious diseases, injuries, and allergies associated with exposure to nontraditional pets in the home and to animals in a variety of public settings, (2) outline regulations and recommendations applicable to these exposures, and (3) define measures to minimize or prevent illness and injury in children from exposure to these animals and cite resources for additional information for health care professionals and families.

METHODS

To identify original research publications and review articles dealing with infections, injury, and allergies in children resulting from nontraditional pets, including exotic animals, in the home and from animals in public settings, a search of the National Library of Medicine's Medline database was performed by using PubMed, and the Cochrane Library was searched for articles published between 1975 and 2007. The terms "nontraditional pets," "exotic animals," "farm

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The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

Key Words

nontraditional pets, exotic animals, farm animals, pets, reptiles, rodents, indigenous wildlife

Abbreviations

FDA—Food and Drug Administration
AVMA—American Veterinary Medical Association
NASPHV—National Association of State and Public Health Veterinarians
CSTE—Council of State and Territorial Epidemiologists
CDC—Centers for Disease Control and Prevention

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TABLE 1 Animals That Are Considered Nontraditional Pets and/or Animals That May Be Encountered in Public Settings

Categories	Examples
Amphibians	Frogs, toads, newts, salamanders
Fish	Many types
Mammals: wildlife	Raccoons, skunks, foxes, coyotes, civet cats, tigers, lions, bears, nonhuman primates
Domesticated livestock	Cattle, pigs, goats, sheep
Equines	Horses, mules, donkeys, zebras
Weasels	Ferrets, minks, sables, skunks
Lagomorphs	Rabbits, hares, pikas
Rodents	Mice, rats, hamsters, gerbils, guinea pigs, chinchillas, gophers, lemmings, squirrels, chipmunks, prairie dogs, hedgehogs
Feral animals	Cats, dogs, horses, swine
Reptiles	Turtles, lizards, iguanas, snakes, alligators

animals," "pets," "wildlife hybrids," "indigenous wildlife," "reptiles," and "rodents" were selected as Medical Subject Headings (MeSH), and text words were combined in the search strategy. In addition, the "related links" option on PubMed was used. References in all relevant published articles, including reviews, letters, commentaries, and Web sites, also were reviewed to identify original research.

Studies were assessed as to whether they should be included in this review on the basis of their reporting or summarizing original data that examined infections or injuries in children resulting from nontraditional pets in the home or animals in public settings. Previously published recommendations to prevent infections and injuries were reviewed.

For the purpose of this report, nontraditional pets include exotic animals, defined either as imported, non-native species or species that originally were nonnative but now are bred in the United States; indigenous wildlife; and wildlife hybrids (wildlife crossbred with domestic animals producing offspring known as hybrids). The definition of nontraditional pets includes reptiles and certain species of mammals.

NONTRADITIONAL PETS

Nontraditional pets are increasing in popularity among a pet-loving public as lifestyle choices of owners dictate the need for smaller or more unusual pets. Table 1 provides examples of animals that are considered nontraditional pets as well as animals to which children may be exposed in public settings.

Since 1992, the number of exotic animals available in the United States has increased 75%.¹ In 2005, 87 991 mammals (including 29 species of rodents), 1.3 million reptiles, and 203 million fish were imported legally into the United States. The US Fish and Wildlife Service estimates that in 2002, 365 000 birds were imported legally. Reptiles are now in 4.4 million homes.¹ In addition, there is a worldwide illegal trade of exotic animals, estimated at \$6 to \$10 billion dollars annually,³⁻⁵ only exceeded by the trafficking of arms and drugs. This illegal trade subverts rules established by regulatory agencies to reduce introduction of disease and poten-

tially dangerous animals through importation restriction, inspection, and/or quarantine.⁵

A number of public health concerns are related to human contact with nontraditional pets and, specifically, to exotic animals. Most imported nonnative species are caught in the wild rather than bred in captivity. Health screening often is not performed before shipment of these animals to the United States, and there is mixing of animal species in holding locations, including animals that might be ill or incubating illness or carriers of potential pathogens. In addition, the significant wildlife black market, through which a large number of exotic animals enter the United States, compounds the risks of introduction of zoonoses.⁶

Despite the popularity of nontraditional pets, after making the initial decision to acquire a nontraditional pet, owners may discover that they are unable to provide the animal with the environment or nutrition required for a healthy life and often subsequently abandon or release the animal into the wild, which poses risks for zoonotic disease and injury to people and other animals.

ZOOSES ASSOCIATED WITH NONTRADITIONAL PETS

Zoonotic diseases or zoonoses are infections transmitted between other vertebrate animals and humans. Most emerging infectious diseases in humans are zoonotic in origin.⁶⁻⁹ A list of 1415 human pathogens demonstrates that 61% are known to be zoonotic, and pathogens with multiple host species are twice as likely to be associated with an emerging infectious disease.⁸ From 1980 to 2003, more than 35 new infectious diseases have emerged in humans, many of which are zoonoses.⁹ The leading causes of their emergence are human behavior (travel and leisure activities, preferences for pet ownership) and modifications of natural habitats, including expansion of human populations and encroachment on wildlife habitats, changes in food-production processes, changes in agricultural practices, and global trade in wildlife.^{5,6,9} Domestic animals and humans may acquire zoonotic pathogens from nontraditional pets. Wild animals also can serve as reservoirs for transmission of zoonotic agents to domesticated animals and to humans.⁷ An outbreak of tularemia in US wild-caught prairie dogs held in a commercial facility in Texas led to human transmission.¹⁰ Some of the infected animals were distributed to a pet shop in Texas and were exported as far away as the Czech Republic.

Exotic animals imported to the United States have been associated with introduction of infectious agents otherwise not present in the United States. Contact between animals from different areas of the world can lead to the appearance of disease in a new species and establishment of a pathogen in a new geographic area. An example occurred in 2003 when human monkeypox was introduced into the United States. Investigators determined that the source of monkeypox was importation of African Gambian rats, which, in turn, ultimately infected prairie dogs being sold as pets, which infected humans in close contact with the prairie dogs.¹¹ In this case, prompt recognition and public health efforts controlled this outbreak and may have been respon-

sible for preventing establishment of monkeypox in North America.

Zoonotic transmission of infections by household pets or animals with which children come in contact in their homes or public settings is a common event. Infections can be caused by bacteria, viruses, fungi, and parasites. Transmission may be direct or indirect through contact, aerosols, bites or scratches, contamination of the environment, food or water, or disease-carrying vectors. Animals may become ill or, more commonly, are asymptomatic carriers of specific organisms and may contaminate the environment to which children are exposed. Infants and children younger than 5 years are at the greatest risk, in part because they have less-than-optimal hygiene practices, attraction to or curiosity about animals, and developing immune systems¹² but also because these infections tend to be more severe in infants and young children. People of all ages with primary or secondary immunodeficiencies are at risk of more severe disease, as are pregnant women and elderly people.¹³

Reptiles

Among nontraditional pets, reptiles pose a particular risk because of high carriage rates of *Salmonella* species, the intermittent shedding of *Salmonella* organisms in their feces, and persistence of *Salmonella* organisms in the environment.^{12,14–16} The US Food and Drug Administration (FDA) ban on commercial distribution of turtles with shells less than 4 inches long in 1975 resulted in an important and sustained reduction of human *Salmonella* infections as a result of prevention of transmission of *Salmonella* from these reptiles, although illegal distribution of small turtles with subsequent disease in humans continues to occur.^{17,18} Amphibians also can serve as a source of salmonellosis in households.¹² Six percent of all sporadic *Salmonella* infections in the United States (11% among people younger than 21 years)—approximately 74 000 cases annually—are the result of direct or indirect contact with reptiles or amphibians.¹²

Rodents

Multistate outbreaks of salmonellosis attributable to contact with hamsters¹⁹ and other rodents²⁰ purchased from retail pet stores have been described. Hamsters also have been associated with outbreaks of disease attributable to lymphocytic choriomeningitis virus.²¹ Hedgehogs, originally from Europe, Asia, and Africa and now estimated to be in approximately 40 000 US households, have proven to be an important source of *Salmonella* serotype Tilene in the United States.²² Other *Salmonella* serotypes as well as *Yersinia pseudotuberculosis*, *Mycobacterium marinum*, and rabies also have been shown to be zoonotic diseases carried by hedgehogs.

The natural reservoir of plague is wild rodents, with humans becoming infected through bites of infected rodent fleas and through handling infected animals, especially rodents, lagomorphs, and domestic cats.^{23,24} In parts of the United States where plague is endemic, people with rodent-seeking animals can be exposed to

Yersinia pestis through direct contact with plague-infected pets or their fleas.²⁴ People who live in areas where plague is endemic should follow a flea-control program designed by their veterinarians to keep their cats and dogs free from fleas.

Skin infections also can be acquired from nontraditional pets and include ringworm, monkeypox, orf, cutaneous anthrax, tularemia, erysipeloid, ectoparasites, and endoparasites.^{25–30} Hedgehogs pose a significant risk, because their spines readily penetrate skin and can be the source of *M marinum* and *Y pseudotuberculosis* infections.²²

Nonhuman Primates

Herpes B virus (cercopithecine herpesvirus 1) is a zoonotic agent that can be found in macaque monkeys that are kept as pets or displayed in public exhibits. The virus is endemic in macaque monkeys, which may remain asymptomatic or may develop mild oral lesions. Herpes B virus infections in humans have been reported after animal bites, scratches, or percutaneous inoculation with infected material or splashes to mucous membranes. Human infections most often result in fatal meningoencephalitis.³¹

Fish

Mycobacterial infections are among the major zoonoses that can be transmitted by aquarium fish,³² but other organisms have been reported after exposure to aquarium water, usually sporadically or in immunocompromised people. These organisms include *Aeromonas* species, *Vibrio* species, *Edwardsiella* species, *Salmonella* species, *Streptococcus iniae*, and *Erysipelothrix rhusiopathiae*.³³

Other Sources of Infection

Infection attributable to *Salmonella* species can be acquired from other sources. Outbreaks of *Salmonella* species infections in people who have been in contact with chicks and other baby poultry purchased at agricultural feed stores have been reported.³⁴ Parents who purchase these birds for their children generally are not aware that *Salmonella* infections can be transmitted from poultry to humans. In addition to direct exposure to animals, exposure to animal-derived pet food treats and pet food has resulted in human infections attributable to *Salmonella*.^{35,36} Animals may become colonized with *Salmonella* after ingesting contaminated pet food treats or raw meats. These animals may remain asymptomatic and become unrecognized sources of contamination in the household. Handling of pet food treats by humans may result in infection.³⁶ In the United States, pet treats are regulated by the FDA. *Salmonella*-contaminated pet treats are considered adulterated under the Federal Food, Drug, and Cosmetic Act (21 USC §301–399). The American Pet Products Manufacturers Association published guidelines to educate its members about risks of contamination of pet treats.³⁷ In 2004, the FDA initiated annual nationwide testing of pet treats for *Salmonella* species.

TABLE 2 Potential Exposures of Children to Animals in Public Settings

Area	Animal Involved	Organism
Metropolitan zoo	Elephants, giraffes, rhinoceroses, buffaloes	<i>M tuberculosis</i> ^{56,57}
County or state agricultural fairs	Komodo dragons	<i>Salmonella</i> serotype <i>enteritidis</i> ¹⁵
	Cattle, calves	<i>E coli</i> O157:H7 ^{38,45,51,64}
	Cattle	<i>Campylobacter</i> species ⁵⁰
	Reptiles	<i>Salmonella</i> species ¹⁴
Farm tours or visits	Goats	Rabies ^{62,64}
	Cattle, calves	<i>E coli</i> O157 ^{38-40,43,44,46,47,52,62}
	Raw milk	<i>Campylobacter</i> species, <i>Salmonella</i> species ⁶⁴
	Calves	<i>Cryptosporidium</i> species, <i>E coli</i> O157:H7, <i>Salmonella</i> species, <i>Campylobacter</i> species ⁴⁸
Livestock exhibits	Sheep, goats, calves	<i>Cryptosporidium</i> species ^{38,53-55,64}
	Sheep	Orf ²⁵
Pet stores	Cattle	<i>E coli</i> O157 ⁴⁵
	Hamsters, mice, rats	<i>Salmonella</i> species ²⁰
	Kittens	Rabies ⁶¹
	Hamsters	Tularemia, ¹⁰ lymphocytic choriomeningitis ²¹
Petting zoos	Prairie dogs	Monkeypox ¹¹
	Cattle, sheep, goats	<i>E coli</i> O157 ^{38,42,49,64}
	Rabbits	<i>Giardia</i> species ⁶⁴
	Bear cubs	Rabies ⁶³
Rodeo events	Ponies	Rabies ⁶⁰
Fish tanks	Fish	<i>Mycobacterium</i> species, ³² <i>Salmonella</i> species ³³
Agricultural feed store	Baby poultry (chicks, ducklings, goslings, turkeys)	<i>Salmonella</i> species ³⁴

DISEASES ASSOCIATED WITH ANIMALS IN PUBLIC SETTINGS

Infants and children can come in contact with numerous different animal species (Table 1) in a number of public settings (Table 2), potentially resulting in millions of human-animal interactions annually. Public animal exhibits can be permanent, such as zoos and science museums; temporary, such as in shopping malls, schools, or community events; or recurring, such as agricultural fairs and petting zoos.³⁸ Petting zoos are common at agricultural fairs, animal parks, and other public events. Although numerous positive benefits of human-animal contacts exist, including opportunities for education and entertainment, infectious diseases, injuries, and other health problems associated with these venues are well documented. Infections with enteric bacteria and parasites pose the highest risk of human disease from animals in public settings. Although ruminant livestock (cattle, sheep, and goats) are the major source of infection, poultry, rodents, and other domestic and wild animals are also potential sources.²

From 1991 to 2005, more than 55 outbreaks of human disease, the most common of which were enteric, involved animals in public settings.³ Serious infections with *Escherichia coli* O157:H7 have been associated with multiple animals in public settings.³⁹⁻⁵² The primary reservoir of *E coli* O157:H7 is ruminant livestock, which are colonized asymptotically. In many studies, the primary route of transmission has been foodborne,⁴⁶ but person-to-person spread, direct animal contact, and contact with environmental items contaminated by animals are common.⁴¹ In 2004 and 2005, there were 3 *E coli* O157:H7 outbreaks, accounting for 173 cases from 3 states associated with direct and indirect animal

contact at petting zoos.⁴² Outbreaks¹⁴ and sporadic cases of salmonellosis and outbreaks of cryptosporidiosis⁵³⁻⁵⁵ have been described after visits to farms at which visitors had either direct or indirect contact with animals. Additional illnesses include salmonellosis, campylobacteriosis, tuberculosis, rabies, orf virus infection, giardiasis, tularemia, ringworm, and infected bites or wounds.^{10,15,25,48,50,56,57} Direct contact with animals (especially young animals), contamination of the environment or food or water sources, inadequate hand-washing facilities or lack of education about hand hygiene, and inappropriate layout and maintenance of facilities at animal exhibits have been implicated as sources of or reasons for infection in these public settings.² As an example, in a study of observations of practices at petting zoos in Canada, hand-hygiene facilities were provided but often not used, items that would come into contact with mouths of infants and children (pacifiers, infant bottles, sippy cups) were carried into the petting zoos, and education about hygiene was lacking.⁵⁸ The recommendation to wash hands immediately after leaving an animal exhibit is the single most important prevention step to reduce the risk of disease transmission, even if an animal is not touched.

RABIES

Rabies is a fatal viral zoonosis and a serious public health problem.^{59,60} Although human rabies deaths caused by animal contact in public exhibits have not been reported, exposure to rabid mammals at pet stores,⁶¹ county fairs,⁶² petting zoos,^{63,64} and rodeo events⁶⁴ have required extensive public health investigations and med-

ical follow-up. For example, raccoon-variant rabies in pet rabbits and a guinea pig have led to postexposure prophylaxis of adults and children.⁶⁵ Prevention of rabies in domestic cats, dogs, and ferrets can be achieved by regular rabies immunization and reimmunization.^{59,60} Control of rabies among wildlife reservoirs is difficult, and use of licensed oral vaccines for mass immunization of free-ranging wildlife depends on the circumstances surrounding each animal rabies outbreak and is restricted to use in state and federal rabies-control programs.⁵⁹ No parenteral rabies vaccine is licensed for use in wild animals or hybrids. Because of the risk of rabies in wild animals (especially raccoons, skunks, coyotes, foxes, and bats), the American Veterinary Medical Association (AVMA), National Association of State and Public Health Veterinarians (NASPHV), and Council of State and Territorial Epidemiologists (CSTE) recommend enactment and enforcement of state laws that prohibit importation, distribution, and/or relocation of these animals. The AVMA has recommended that wild animals or hybrids not be kept as pets (www.avma.org/careforanimals/animatedjourneys/petselection/consider.asp).

INJURIES AND ALLERGIES

Infants and children younger than 5 years are at increased risk of injuries associated with animal interactions because of their size and behavior. Bites, scratches, kicks, falls, and crush injuries of hands or feet or from being pinned between an animal and a fixed object can occur at home or during exposure to animals in a public setting. Serious and fatal injuries can be caused by a large animal or an animal with aggressive behavior. Some nontraditional pets are chosen when they are young and small without consideration that they may grow into dangerous, aggressive adults. For example, iguanas sold shortly after birth measure less than 8 inches but grow to several feet in 2 to 3 years, and baby chicks become full-grown chickens and have a life span of up to 20 years.

An estimated 4 to 5 million animal bites occur in the United States annually. Although approximately 90% of bites are from dogs or cats, severe and fatal bites can occur from large or aggressive nontraditional pets. Animal bites or scratches often become infected. Infectious organisms, depending on the biting animal, include *Pasteurella multocida*, *Francisella tularensis*, *Capnocytophaga canimorsus*, *Streptobacillus moniliformis*, *Spirillum minor*, *Bartonella henselae*, leptospires, and herpes B virus. Tularemia occurred in a 3-year-old child who was bitten by an infected hamster that was purchased at a pet store.³⁰ Reptiles can produce injuries by bites, with claws, or with tails. Severe hand injury²⁹ and cellulitis²⁶ have been reported after green iguana bites. Unprovoked attacks by ferrets on children, particularly infants sleeping or lying down, can be severe, with mutilation of the ears or nose.^{66,67} Attacks on sleeping infants are similar to those inflicted by rats.⁶⁸

Although the frequency is not known, the potential for having an allergy to nontraditional pets is likely to be significant. The American Academy of Allergy Asthma & Immunology estimates that approximately 15% of the

population experiences allergies to dogs and cats.⁶⁹ Allergy to animals usually is attributable to sensitization to their dander, scales, fur, feathers, body waste, or saliva. Flea bites also can lead to allergic manifestations. Hives have been described in people who have contact with hedgehogs.⁷⁰ Although scaly animals are not as likely to be as allergenic as furry animals, there are case reports of allergic rhinitis, asthma, and contact hypersensitivity reactions to iguanas. In 1 case, a person with respiratory allergic symptoms was found to be allergic to iguana scales.²⁸ In addition, an iguana bite-induced hypersensitivity reaction has been reported.²⁹

REPORTABLE DISEASES ACQUIRED FROM NONTRADITIONAL PETS AND ANIMALS IN PUBLIC SETTINGS

Many national and state-notifiable diseases can be transmitted from animals. Public health officials at state health departments and personnel from the Centers for Disease Control and Prevention (CDC) collaborate in determining which infectious diseases should be notifiable nationally; states determine which diseases are reportable within their borders. A disease may be added to the national or state list as a new pathogen emerges, or a disease may be removed from the list as disease incidence decreases. Because disease reporting varies according to state, specific requirements should be obtained from the appropriate state health department. Provisional data are published weekly in the *Morbidity and Mortality Weekly Report*, and final data are published each year by the CDC in the annual "Summary of Notifiable Diseases," which can be found online (www.cdc.gov/ncphi/diss/nndss/phs/infdis.htm). These data are necessary for the study of epidemiologic trends and development of disease-prevention policies. Physicians and other health care professionals should report suspected cases of human illness to local and state health departments as soon as possible, especially when the patient has a history of visiting an animal exhibit during the incubation period.

IMPORTATION LAWS AND REGULATIONS REGARDING EXOTIC ANIMALS

Addressing importation and regulation of animals in the United States is complex. No single federal agency has the authority to limit importation, interstate distribution, movement, sale, or ownership of exotic animals in the United States. Federal agencies that do have regulatory authority over some aspects of the exotic-animal trade as it relates to their individual mission include the CDC, the Animal and Plant Health Inspection Service of the US Department of Agriculture, the FDA, and the US Fish and Wildlife Service. There also is a patchwork of state bans, permits, and tracking systems for exotic animals. Agencies responsible for enforcing regulations vary among states.

Among the federal agencies, the CDC is responsible for regulations regarding importation of dogs and cats; nonhuman primates, small turtles, terrapins, and tortoises; African rodents; civets; and birds from countries with H5NI influenza. In addition, CDC regulations in-

clude etiologic agents, hosts, and vectors, under which importation of bats is regulated. The US Fish and Wildlife Service requires permits to import fish, reptiles, spiders, wild birds, rabbits, bears, wild members of the cat family, and other wild or endangered animals. The FDA regulates interstate transactions involving turtles, molluscan shellfish, psittacine birds, prairie dogs, and African rodents. Many states also have laws that make it illegal to own or keep certain wild animals or a variety of exotic pets, including nonhuman primates.

The Animal Welfare Act (7 USC §2131-216) covers the sale and exhibition of wild/exotic animals and the wholesale distribution of pet animals. Wholesale breeders, dealers, exhibitors, and research laboratories are covered by this act. Birds, rats, and mice are exempted; dogs, cats, and other animals have limited coverage; and cold-blooded species such as reptiles are not regulated under this act. Small retail breeders and pet shops that sell only domestic pet animals are not regulated under this act; these animals usually are covered by local (state, county) anticruelty laws and, in some instances, by local animal regulations or public health laws. The US Department of Agriculture has issued a position statement on risks of ownership of large, wild, and exotic cats (www.aphis.usda.gov/animal_welfare/downloads/big_cat/position.pdf).

CDC efforts are underway to galvanize partner agencies into further actions to enhance protection of humans from zoonotic diseases. A meeting of stakeholder organizations was held at the CDC in 2006, a summary of which was published in the *Federal Register*.⁷¹ The AVMA, CSTE, and NASPHV have each issued position statements calling for a coordinated federal approach to better control of infectious disease risks associated with the exotic-animal trade (these publications are available through the Web sites of the respective organizations). Uniform importation laws, better quarantine and surveillance methods for animals coming into the country, and prevention of illegal wildlife trade are necessary components of an overall plan to protect the public.

PREVENTION MEASURES AND THE ROLE OF PEDIATRICIANS AND VETERINARIANS

Pediatricians and veterinarians play an important role in guiding parents and their children about mitigation of risks associated with ownership of nontraditional pets or contact with animals in public settings. Parents and pet owners typically lack knowledge about the multiple modes of transmission of zoonotic infectious diseases from pets. Although pediatricians recognize the importance of anticipatory guidance about pet-related hazards, only 5% reported that they regularly educated patients or families about pet-associated salmonellosis or toxoplasmosis.⁷²

Pediatricians and veterinarians together can remind parents, children, and pet owners about the importance of measures to avoid illness. Simple and effective advice includes frequent hand-washing and avoiding direct contact with animals and their environments. This is particularly important with animals from which transmission of enteric pathogens is a risk, including young ruminants, young poultry, reptiles, rodents, amphibians,

and animals that are ill. Young children always should be supervised closely when in contact with animals in public settings. The NASPHV has developed an excellent compendium with standardized recommendations for use by public health officials, veterinarians, animal venue operators, animal exhibitors, and others who are concerned with disease control and minimizing risks associated with animals in public settings.²

To reduce the possibility of injury, health care professionals should remind pet owners about matching the size and temperament of a pet to the age and behavior of their infant or child, providing close supervision of younger children, and educating all children about appropriate human-animal interactions.

The decision to obtain a nontraditional pet by parents with children in the household is often not discussed with a physician or veterinarian. However, as trusted sources of health care information, pediatricians and veterinarians are in a unique position to offer information and advice to families considering the purchase of a nontraditional pet or to families who already have a nontraditional pet in the household. Informational brochures and posters available for display in physician and veterinarian offices could allow for parent education without significantly increasing time of a visit. Parents can be made aware of Web sites that provide guidelines for safe pet selection and appropriate handling of pets. Proper pet health maintenance, immunization, flea and tick control, deworming, and diet and activity can minimize the risk of infection or injury and ensure the health of the pet. Referral to a veterinarian also can be helpful when parents are contemplating purchase of a nontraditional animal. Veterinarians can provide information about appropriate pet selection, the size of an animal when it attains adulthood, the temperament and husbandry needs of an animal, and suitability as a pet.

A history of contact with pets in the home or animals in public settings should be part of every well-child evaluation and especially should be part of an evaluation of a suspected infectious disease. A history of nontraditional pets in the home or contact with animals in public settings can lead to specific testing and additional management recommendations and occasionally will result in early identification of an unusual infection from another part of the world.

AVAILABLE RECOMMENDATIONS AND GUIDELINES

Recommendations from several organizations dealing with nontraditional pets and animals in public settings have been developed and are summarized in Table 3. In addition, Table 4 provides Web-site addresses for health care professionals and parents at which information for prevention of human disease from nontraditional pets and animals in public settings can be found. Recommendations for prevention of enteric disease transmission from animal contact in public settings resulted from outbreaks of *E coli* O157:H7 at farms open to the public at which animal contact and inadequate hand hygiene occurred.⁴⁰ The NASPHV and CDC have established recommendations to prevent disease outbreaks associated with animals in public settings.² The CDC has issued

TABLE 3 Guidelines for Prevention of Human Diseases From Nontraditional Pets at Home and Exposure to Animals in Public Settings

General

- Wash hands immediately after contact with animals, animal products, or their environment
- Supervise hand-washing for children younger than 5 y
- Wash hands after handling animal-derived pet treats
- Never bring wild animals home, and never adopt wild animals as pets
- Teach children never to handle unfamiliar, wild, or domestic animals even if the animals appear friendly
- Avoid rough play with animals to prevent scratches or bites
- Children should not be allowed to kiss pets or put their hands or other objects into their mouths after handling animals
- Do not permit nontraditional pets to roam or fly freely in the house or allow nontraditional or domestic pets to have contact with wild animals
- Do not permit animals in areas where food or drink are prepared or consumed
- Administer rabies vaccine to mammals as appropriate
- Keep animals clean and free of intestinal parasites, fleas, ticks, mites, and lice
- People at increased risk of infection or serious complications of salmonellosis (eg, children younger than 5 y, older adults, and immunocompromised hosts) should avoid contact with animal-derived pet treats

Animals visiting schools and child-care facilities

- Designate specific areas for animal contact
- Display animals in enclosed cages or under appropriate restraint
- Do not allow food in animal-contact areas
- Always supervise children, especially those younger than 5 y, during interaction with animals
- Obtain a certificate of veterinary inspection for visiting animals and/or proof of rabies immunization according to local or state requirements
- Properly clean and disinfect all areas where animals have been present
- Consult with parents or guardians to determine special considerations needed for children who are immunocompromised or who have allergies or asthma
- Animals not recommended in schools, child-care settings, and hospitals include nonhuman primates, inherently dangerous animals (lions, tigers, cougars, bears, wolf-dog hybrids), mammals at high risk of transmitting rabies (bats, raccoons, skunks, foxes, and coyotes), aggressive animals or animals with unpredictable behavior, stray animals with unknown health history, reptiles, and amphibians
- Ensure that people who provide animals for educational purposes are knowledgeable regarding animal handling and zoonotic disease issues

Public settings

- Venue operators must know about risks of disease and injury
- Venue operators and staff must maintain a safe environment
- Venue operators and staff must educate visitors about the risk of disease and injury and provide appropriate preventive measures

Animal specific

- Children younger than 5 y and immunocompromised people should avoid contact in public settings with reptiles, amphibians, rodents, ferrets, baby poultry (chicks, ducklings), and any items that have been in contact with these animals or their environments
- Reptiles, amphibians, rodents, ferrets, and baby poultry (chicks, ducklings) should be kept out of households that contain children younger than 5 y, immunocompromised people, or people with sickle cell disease and should not be allowed in child-care centers
- Reptiles, amphibians, rodents, and baby poultry should not be permitted to roam freely throughout a home or living area and should not be permitted in kitchens or other food-preparation areas
- Disposable gloves should be used when cleaning fish aquariums, and aquarium water should not be disposed in sinks used for food preparation or for obtaining drinking water
- Mammals at high risk of transmitting rabies (bats, raccoons, skunks, foxes, and coyotes) should not be touched by children

recommendations for preventing transmission of *Salmonella* organisms from reptiles to humans¹⁸ and information regarding health risks from *Salmonella* species posed by contact with baby poultry.³⁴ Guidelines for prevention of zoonoses in immunosuppressed people also are available.^{13,73}

The AVMA supports the view that exotic animals, wildlife, and wildlife-domestic animal hybrids do not make good pets. These animals are dangerous and are a hazard to human health, other animals, and the environment. The AVMA also recommends that ferret owners have knowledge about the species and stress that no one who is incapable of removing himself or herself from the bite of a ferret should be left unattended with a ferret. Measures to control and prevent psittacosis in humans and birds were published by a committee formed by the NASPHV and were endorsed by the AVMA,⁷⁴ the CSTE, and the Association of Avian Veterinarians.

Guidelines for animals that might have contact with children in a child-care setting have been published by

the National Resource Center for Health and Safety in Child Care and Early Education.⁷⁵ These guidelines state that any pet or animal present at the facility, indoors or outdoors, should be in good health; show no evidence of carrying any disease; be fully immunized; and be maintained on a flea-, tick-, and worm-control program. A current (time-specified) certificate from a veterinarian should be on file in the facility and state that the specific pet meets these conditions. All contact between animals and children should be supervised by a caregiver who is close enough to remove the child immediately if the animal shows signs of distress or the child shows signs of treating the animal inappropriately. The caregiver should instruct children on safe procedures to follow when in close proximity to these animals (eg, not to provoke or startle animals or touch them when they are near their food). Potentially aggressive animals should not be in the same physical space with children. The facility should not keep or bring in turtles, iguanas, lizards, or other reptiles; ferrets; psittacine birds; or any wild or dangerous animals. Recommendations for hand-

TABLE 4 Web Sites With Information on Prevention of Human Diseases Transmitted From Nontraditional Pets and Wild Animals

Health care professionals	
CDC Health Pets Healthy People site for resources and recommendations related to animal contact	www.cdc.gov/healthypets/health_prof.htm
FDA tips on keeping pets and people healthy	www.fda.gov/fdac/features/2004/104_pets.html
CDC and Healthcare Infection Control Practices Advisory Committee guidelines for infection control in health care facilities	www.cdc.gov/ncidod/dhqp/pdf/guidelines/Enviro_guide_03.pdf
Guidelines for veterinarians for prevention of zoonotic transmission of ascarids and hookworms of dogs and cats	www.cdc.gov/ncidod/dpd/parasites/ascaris/prevention.htm
Educational materials for physician offices/parents	
CDC search engine for diseases associated with specific animals	www.cdc.gov/healthypets/browse_by_animal.htm
Department of Public Health, Commonwealth of Massachusetts recommendations for petting zoos, petting farms, animal farms, and other events and exhibits where contact between animals and people is permitted	www.mass.gov/dph/cdc/epii/rabies/petzoo.htm
NASPHV report of standardized recommendations for public health officials, veterinarians, animal venue operators, animal exhibitors, visitors to animal venues and exhibits, and others concerned with disease control and with minimizing risks associated with animals in public settings	www.nasphv.org/documentsCompendia.html and www.cdc.gov/mmwr/preview/mmwrhtml/rr5605a1.htm
NASPHV safety at animal exhibits and hand-washing posters	www.nasphv.org/documentscompendiaAnimals.html
CDC information on health risks posed by contact with baby poultry	www.cdc.gov/healthypets/easter_chicks.htm
Guidance for pet selection	
CDC information about health-related risks of owning and caring for animals	www.cdc.gov/healthypets
Guidance for minimizing risk of disease transmission	
CDC Pet-Script: guidelines for staying healthy while enjoying your pet and for animal-specific diseases	www.cdc.gov/healthypets/petscription_gen.htm
CDC regulations for importation of pets, other animals, and animal products into the United States	www.cdc.gov/ncidod/dq/animal/index.htm
NASPHV recommendations on hand-washing, venue design, animal care and management, and risk communications regarding disease and injury prevention associated with animals in public settings	www.nasphv.org/documentsCompendia.html and www.nasphv.org/Documents/AnimalsInPublicSettings.pdf
Association of Zoos & Aquariums guide to accreditation of zoological parks and aquariums	www.aza.org/Accreditation/Documents/AccredGuide.pdf and www.aza.org/Accreditation/Documents/AccredStandPol.pdf

washing by staff, volunteers, and children as well as maintenance of animals housed on the premises are provided in the guidelines.⁷⁵ In addition to exposures to animals within a center, child-care and school field trips can result in disease. A field trip to a petting zoo at which hand-hygiene facilities were not adequate resulted in 44 cases of *E coli* O157:H7 infection in British Columbia.⁷⁶ Guidelines for infection control in health care facilities are not part of this document but are available (www.cdc.gov/ncidod/dhqp/pdf/guidelines/Enviro_guide_03.pdf).

FUTURE

In 2006, the CDC hosted a meeting dealing with infectious disease risks associated with exotic-animal importation and trade. The CSTE, NASPHV, and AVMA—3 organizations involved in the issue of infectious disease risks associated with the exotic-animal trade—presented policy statements of their organizations or calls to action. There was a consensus that rules and regulations need to be strengthened and standardized to reduce risks associated with exotic pets and that federal and state efforts are needed to eliminate illegal wildlife trade. In addition, the Zoonoses Education Coalition organized by the CDC aims to increase partnerships between government and industry. An effort is underway by a number of regulatory and public health agencies and veterinary organizations to address issues raised by legal and illegal importation of exotic animals and to develop a comprehensive set of regulations to protect the public (J. McQuiston, DVM

[veterinary epidemiologist, Viral and Rickettsial Zoonoses Branch, National Center for Zoonotic, Vector-Borne, and Enteric Diseases, CDC], verbal personal communication, August 2007).

SUMMARY

Most nontraditional pets pose a risk to the health of young children, and their acquisition and ownership should be discouraged in households with young children. Exposures to animals in public settings also pose specific risks. Parents need to be educated about the increased risks of exposure to nontraditional pets and animals in public settings for infants and for children younger than 5 years and for immunosuppressed people of all ages and should be made aware of the general recommendations for reduction of risks of infection, injury, and allergy. Resources are available for physicians, veterinarians, and parents, and recommendations, including specific guidelines for reducing the risk of *Salmonella* infection from reptiles, are offered by a number of organizations. In addition, physicians and veterinarians are encouraged to work together to educate one another and to communicate a common message to pet owners regarding the benefits and risks of pet ownership and of contact with animals outside the home. Joint training seminars and joint sponsorship of health-communication campaigns in pediatrician and veterinarian offices would greatly increase awareness in pet owners. The “One Medicine” initiative supported by the AVMA

to increase veterinary collaboration with counterparts in human medicine is an excellent step forward to benefit clinical medicine and public health and will build and reinforce partnerships between the 2 professions to reduce human illness and injury related to contact with animals.⁷⁷

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