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ZOONOSES IN THE BEDROOM

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ABSTRACT

In most industrialized countries, pets are becoming an integral part of households, sharing human lifestyles, bedrooms, and beds. The estimated percentage of pet owners who allow dogs and cats on their beds is 14%–62%. However, public health risks, including increased emergence of zoonoses, may be associated with such practices.

As modern society is becoming more urbanized, the presence in our households of traditional pets, or even exotic creatures, is increasing in popularity. Pets have become an integral part of the family and are often considered to be extended family (1). Having pets brings many benefi ts, such as psychological support, friendship, and even good health practices (exercising or reducing stress) (1). However, in many countries, pets have become substitutes for childbearing and child care, sometimes leading to excessive pet care. For example, one of the most recent trends in pet care in Asia is hair dyeing. A recent news story claims, "Dyeing pets is popular in many developed countries like Japan and Korea, but China is quickly catching on" (www.wibw.com/home/headlines/101 783553.html [cited 2010 Nov 29]). Not only are pets present in our daily environment, but they have also conquered our bedrooms. Sharing our resting hours with our pets may be a source of psychological comfort, but because pets can bring a wide range of zoonotic pathogens into our environment, sharing is also associated with risks.

SLEEPING WITH "MAN'S BEST FRIENDS"

In the United States, >60% of households have pets (2); pet ownership increased from 56% in 1988 to 62% in 2008 (www.americanpetproducts.org/press_industrytrends.asp [cited 2010 Jun 23]). Among dog owners, 53% consider their dog to be a member of the family. A surprising 56% of dog owners sleep with their dog next to them; ≈50% of dogs sleep on the bed. Among dogs that sleep with their owners, 62% are small dogs, 41% are medium sized, and 32% are large (http://pets.webmd.com/features/pets-inyour-bed [cited 2010 Jun 23]). In a 2005 survey about dog ownership conducted by the American Kennel Club, 21% of dog owners interviewed said that they slept with their dog regularly; women were more likely than men to allow the practice (25% to 16%) (www.akc.org/pdfs/press_center/press_releases/2006/ValentineSurvey.pdf [cited 2010 Nov 29]). Another 16% said that their dogs snuck into their beds at least once in a while (Sacramento Bee, April 9, 2006, L1–L2). Among cats, 62% slept with their adult owners and another 13% slept with children.

In the United Kingdom, an estimated 6.5 million dogs live in ≈25% of households (3). In a survey of 260 dogowning households in a community in Cheshire, 19% of the dogs were sleeping on the bedroom fl oor and 14% on their owner's bed (3). A survey conducted in 1995 with regard to cats >12 years of age throughout the United Kingdom found that among 1,236 of these older cats, 45% were sleeping regularly on the owner's bed (www.fabcats.org/ behaviour/ understanding/oldcats.html [cited 2010 Jun 23]).

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In the Netherlands, the pet population is ≈2 million dogs and 3 million cats (1). The percentage of households with pets increased from 50% in 1999 to 55% in 2005. A recent study indicated that among 159 households with pets, 50% of pet owners interviewed allowed the pet to lick their face; 60% of pets visited the bedroom; 45% of dogs and 62% of cats were allowed on the bed; and 18% and 30% of the dogs and cats, respectively, were allowed to sleep with the owner in bed (1).

In France, the estimated pet population is ≈8.1 million dogs in 25% of households and ≈9 million cats in 26% of households. The number of dogs increased from ≈4 million in the late 1950s to its current 8.1 million (www.naturanimal. com/chiens/pratique/chiffres-chiens.php [cited 2010 Nov 29]). Le Monde in 2002 reported that ≈45% of cat owners and ≈30% of dog owners slept with their pet (www.lemonde.fr/cgi-bin/ACHATS/acheter.cgi?offre=ARCHIVES&type_item=ART_ARCH_30J&objet_id=785025 [cited 2010 Jun 23]).

Although such trends (Table 1) should be considered with some caution because they were obtained from media sources and may not accurately reflect the true prevalence of this behavior, the zoonotic disease risks associated with such behavior should be evaluated on the basis of the scientific literature. We therefore searched PubMed for any peer-reviewed publication that clearly documented human exposure to zoonotic diseases by sleeping with, sharing a bed with, kissing, or being licked by pets.

BACTERIAL, PARASITIC, AND VIRAL ZOONOSES

Plague

During a 1974 outbreak of plague in New Mexico, USA, 7 cases of bubonic plague were investigated. One patient noticed flea bites the morning after he allowed his flea-infested cat to share his bed (4). Similarly, in a series of 23 cases of plague related to cat exposure, a 9-year-old boy from Arizona had handled and slept with a sick cat (5). Another case, which occurred in 1983 in New Mexico, was likely acquired after indoor/outdoor cats slept with the patient (6). More recently, a 2008 matched case–control study (7) surveyed 9 plague survivors, 12 household members of these survivors, and 30 age- and neighborhood-matched controls about household and individual exposures. Four (44%) survivors and 3 (10%) controls (matched odds ratio 5.7, 95% confidence interval [CI] 1.0–31.6) reported sleeping in the same bed with a pet dog, which remained significantly associated with infection in a multivariate logistic regression model ($p = 0.046$). Such behavior is of concern because dogs may facilitate transfer of infected fleas into the home and, unlike cats, rarely show clinical signs of infection that could serve as a warning.

Chagas Disease

A study in northwest Argentina showed that dogs and cats infected with the Chagas disease agent, Trypanosoma cruzi, increased risk for domestic transmission of T. cruzi to the Chagas disease vector, Triatoma infestans bugs (8). Infection rates were significantly higher when infected dogs shared sleeping areas with humans than when they did not (relative risk 1.79; 95% CI 1.1–2.91).

Cat-Scratch Disease

Cat-scratch disease is mainly transmitted to humans when they are scratched by a cat that harbors Bartonella henselae–infected fleas and flea feces (9). However, a few documented cases have been associated with sleeping or being licked by a household pet. For example, a systemic case of cat-scratch disease with hepatic, splenic, and renal involvement caused by B. henselae was diagnosed by immunofluorescence assay, PCR, computed tomography, and histologic examination. The patient was a 9-year-old aboriginal girl from Taiwan, who had been sleeping with a cat at night (10). In addition, B. hensalae infection was suspected and confirmed by serologic testing of a 50-yearold man from Japan, who had left cervical lymphadenopathy and owned a dog that often licked his face (11). In a

Table 1. Estimated pet dog and cat populations in developed countries and estimated percentage of these pets sleeping on/in owner's bed , 1974–2010

	Dogs		Cats	
Country	Estimated population, millions	% Sleeping on/ in owner's bed	Estimated population, millions	% Sleeping on/ in owner's bed
United States	60	21–33	75	60
United Kingdom	8	14	8	45
France	8	30	9	45
The Netherlands	2	45	3	62

study of risk factors associated with cat-scratch disease in Connecticut, USA, case-patients were more likely than matched controls to have been scratched or bitten by a kitten, licked on the face by a kitten, slept with a kitten, or combed a kitten (12).

Pasteurella spp. and *Capnocytophaga canimorsus* Infections

Several reports describe human infections by Pasteurella spp. that were acquired after close contact with pets, including sharing a bed, being licked by, or kissing the pets. In 1985, a case of meningitis caused by P. multocida in a 60-year-old housewife living in the United Kingdom was reported (13). She admitted to regularly kissing the family dog. P. multocida isolates from buccal and nasal swabs of the dog were identical to isolates from the woman. Two cases of meningitis in newborn children (<1 month of age) have been reported; 1 was associated with a pet cat stealing a baby's pacifi er and using it as a toy, and the other was associated with a pet dog that often licked the baby's face (14). Of 38 reported cases of P. multocida meningitis in infants, 27 (87%) of 31 infants that had been exposed to animals had been exposed directly or indirectly to the animals' oropharyngeal secretions through licking or sniffi ng (14). A case of P. multocida infection of a hip replacement site occurred in a 69-year-old man (15). This man indicated that the dog had shared his bed before and after his operations, sleeping under the covers on the side of the affected leg, as it had done every night for the past 10 years (15).

Being licked by pets is a common source of human infection with P. multocida (16–19), but in a case described by Wade et al. (16), transmission to an infant occurred from another person. After the 2 family dogs had licked the hands of the infant's 2-year-old brother, the older boy allowed the infant to suck on his little fi nger. Heym et al. (18) describe a case in France in which a total knee arthroplasty site became infected with P. multocida after the patient's dog licked a small wound on the third toe of the leg that had been operated on. In another case, P. multocida was cultured from a wound abscess that developed in a 48-year-old obese woman 6 weeks after hysterectomy and panniculectomy for endometrial cancer (20); her cat had licked the wound. In France, meningitis caused by P. multocida developed in a 67-year-old patient with chronic, purulent otorrhea of the right ear. His dog frequently licked the patient's right ear (21), and cultures from the dog's saliva also grew P. multocida. The isolates had identical biochemical patterns, and pulsed-fi eld gel electrophoresis (PFGE) confi rmed genotypic similarities. After digestion of genomic DNA with the infrequently cleaving restriction endonuclease SmaI, banding-pattern analysis showed clonal similarity between the isolates from the patient and the dog. In Japan, paranasal sinusitis caused by P. multocida was diagnosed for a 39-year-old woman with rhinorrhea and headache (22). The patient's cat awakened her every morning by licking her. P. multocida isolates from the woman's nasal discharge and the cat's saliva were similar with respect to biochemical properties, serotype, and drug susceptibility.

Kissing pets can also transmit zoonoses. A study in Japan of 24 pet owners (11 cats and 3 dogs) found no Pasteurella spp. in the oral cavity of the 19 owners who had not kissed their cat, but isolated P. stomatis from the oral cavity of 1 of 2 owners who had kissed their cat and in 2 of 3 dog owners who had kissed their dog (23). Also in Japan, meningitis caused by P. multocida developed in a 44-yearold woman who admitted that she was regularly kissing the dog's face and feeding it by transferring food mouth to mouth (24). As suggested by Kawashima et al. (24), "recent increase in pet ownership is likely to increase human exposure to P. multocida." These authors identifi ed at least 2 other cases of P. multocida meningitis between 2000 and 2010; these cases developed after the patients kissed a pet dog and a pet rabbit.

Capnocytophaga canimorsus infections in humans have been associated with being licked by or sleeping with a dog or cat. In Finland from 1988 through 1994, several cases of C. canimorsus septicemia were identifi ed; 2 cases were associated with sleeping with and/or being licked by a pet (25). For an 81-year-old woman with cellulitis of the right leg and an ulcer between the fourth and fi fth toe, C. canimorsus was isolated from a blood culture. This patient indicated that she slept with her cat in her bed and that the cat licked her feet and toes. A 60-year-old patient with chronic eczema died of septic shock and renal failure and disseminated intravascular coagulation caused by C. canimorsus (25). The ulcerous chronic eczema of his legs was the most probable port of entry for the organism because his dog used to lick his legs. In Kansas, USA, a splenectomized 44-year-old man died after infection with C. canimorsus (26). The man had lived in a trailer and collected scrap metal to sell; he had several cuts and scratches on his forearms and hands. His recently acquired German shepherd puppy reportedly licked the open abrasions on the

man's hands, but no bite was reported. In Australia, septicemia and multiorgan failure developed in a 48-yearold woman after her fox terrier puppy licked a minor burn wound on the top of her left foot (27).

Staphylococcus intermedius Infections

Staphylococcus intermedius is a common commensal bacterium in dogs and cats and has rarely been identifi ed as causing human infection (28). However, in Japan, S. intermedius developed in the mastoid cavity of a 51-year-old woman after mastoidectomy for chronic otitis media with cholesteatoma (28). Her dog had licked her ears, and bacterial strains from the dog's saliva and the patient's otorrhea were confi rmed by PFGE to be identical. Similarly, a 28-year-old woman with a history of endoscopic pituitary adenoma resection reported 3 weeks of foul-smelling nasal discharge (29). Nasal endoscopy indentifi ed a purulent sinus infection caused by methicillin-resistant S. intermedius. Cultures from the patient's pet bulldog also grew S. intermedius strains that were confi rmed by PFGE to be identical to those of the patient. The patient reported having had close physical contact with her dog, including frequent licking of her face, and that the dog had recent bouts of pyoderma requiring treatment with antimicrobial drugs.

Methicillin-Resistant *Stapylococcus aureus* Infections

A 48-year-old man with diabetes and his wife had recurrent methicillin-resistant Staphylococcus aureus (MRSA) infections (30). Culture of nares samples from the family dog grew mupirocin-resistant MRSA that had a PFGE chromosomal pattern identical to the MRSA isolated from the patient's nares and his wife's wound. The couple reported that the dog routinely slept in their bed and frequently licked their faces. Further recurrence of MRSA infection and nasal colonization in the couple was prevented only after successful eradication of MRSA from the dog's nares.

Rabies

In many developing countries, being licked by dogs that are rabid or suspected to be rabid is considered to pose a major risk. A survey of rabies exposure among 296 Norwegian missionaries and foreign aid workers traveling abroad showed that of 48 persons for whom postexposure vaccination was recommended, two thirds had only cared for or been licked by the suspected rabid animal (31). Rabies remains a problem in Southeast Asia, where many backpackers visit each year. In the early 1990s, foreign travelers (74% of whom were European), who had been in Thailand for an average of 17 days, were surveyed about potential rabies exposure during their visits. Among 1,882 travelers, 1.3% had been bitten and 8.9% had been licked by dogs (32). During May–June 2008, another survey of 870 foreign backpackers (median age 25.5 years) in Bangkok, Thailand, found that 3.56% had been licked by a dog (33).

Parasitic Infections

In the United States, the most common parasitic zoonoses associated with dogs are caused by hookworms (Ancylostoma spp.) and roundworms (Toxocara canis) (2). In the Netherlands, prevalent parasitic zoonoses are caused by Toxocara spp., Giardia spp., Cryptosporidium spp., and Toxoplasma spp. (1). Among the ways that toxocariasis can be transmitted to humans, contact with embryonated eggs on a dog's hair coat was recently proposed (34). Similarly, a recent study in the Netherlands identifi ed Toxocara spp. eggs on the fur of 18 dogs (12.2%) and 2 cats (3.4%) and in the feces of 4 dogs and 1 cat (1). That same study found Giardia spp. in the feces of 14 dogs and 3 cats and Cryptosporidium spp. in feces of 8 dogs and 1 cat (1). A case of Cheyletiella blakei infection was reported in a 76-year-old woman with pruritic eruption of vesicles and bullus lesions on her trunk and arms (35). Cheyletiella spp. dermatitis was suspected because of the appearance and distribution of the elementary lesions and because before the eruption, the patient had acquired a cat that sometimes slept in her bed. The diagnosis was confi rmed by a veterinary examination and isolation of C. blakei from the cat's skin. The patient's condition resolved after the cat was treated with ivermectin, the household was disinfected with permethrin, and the patient was treated with benzyl benzoate.

OTHER DANGERS

Another major health hazard can be created by keeping dominant and possessive dogs in a bedroom where young infants are sleeping. An analysis of risk factors associated with nonplay dog bites in Kingston, Jamaica, found that a dog sleeping in a family member's bedroom was a risk factor for biting (relative risk 2.54, 95% CI 1.4–4.54) (36). In a review of fatal dog attacks in the United States during 1989–1994, Sacks et al. (37) reported that

among 109 dog bite–related deaths, 57% were of children <10 years old and 11 were of a sleeping infant.

RECOMMENDATIONS

Zoonotic infections acquired by sleeping with a pet are uncommon. However, severe cases of C. canimorsus infection or plague in humans have been documented. More zoonotic agents that are transmitted by kissing a pet or being licked by a pet have been identifi ed, especially zoonotic pathogens that are commensal in the oral cavity of carnivores, such as Pasteurella spp. and C. canimorsus. Because young children are often at higher risk than adults for exposure to zoonotic pathogens, especially when animals are displayed in public settings, the National Association of State Public Health Veterinarians issued specific recommendations (38). However, the concerns associated with sharing a bed with pets, being licked by pets, or kissing pets were not addressed in these recommendations. Similarly, although the risk for introduction of zoonotic agents by pets in hospitals or nursing homes has been evaluated (39) and recommendations made (40), the recommendations do not specifically address the risk for transmission through being licked by, kissing, or even sleeping with a pet.

Our review suggests that persons, especially young children or immunocompromised persons, should be discouraged from sharing their bed with their pets or regularly kissing their pets. Any area licked by a pet, especially for children or immunocompromised persons or an open wound, should be immediately washed with soap and water. Pets should be kept free of ectoparasites (especially fl eas), routinely dewormed, and regularly examined by a veterinarian. Preventive measures such as anthelmintic drug intervention for puppies within the fi rst few weeks after birth or, even better, for bitches during the last few weeks of pregnancy, could help prevent most cases of human toxocariasis. Similarly, evaluation of patients with recurrent MRSA colonization or infection or Pasteurella spp. infection with no obvious source should prompt queries about any regular contact with pet dogs, particularly in household settings.

CONCLUSION

Although uncommon with healthy pets, the risk for transmission of zoonotic agents by close contact between pets and their owners through bed sharing, kissing or licking is real and has even been documented for lifethreatening infections such as plague (Table 2). Carriage of ectoparasites or internal parasites is certainly of major concern when it comes to this type of behavior. To reduce such risks, pet owners should seek regular veterinary care for their pets.

Dr. Chomel is a professor of zoonoses at the School of Veterinary Medicine, University of California, Davis, with an interest in the epidemiology of zoonotic diseases, especially new and emerging zoonoses.

Dr. Sun is the state public health veterinarian for California and is involved with several national committees concerning zoonotic diseases.

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