

# Public Veterinary Medicine: Public Health

## A survey of Tennessee veterinarian and physician attitudes, knowledge, and practices regarding zoonoses prevention among animal owners with HIV infection or AIDS

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**Objective**—To examine the attitudes, knowledge, and practices of Tennessee veterinarians and physicians engaged in clinical practice regarding the risk for and prevention of zoonoses in people with HIV infection or AIDS.

**Design**—Cross-sectional survey.

**Sample**—Licensed Tennessee veterinarians and physicians engaged in clinical practice.

**Procedures**—A survey was mailed in January 2010 to 454 licensed veterinarians and 1,737 licensed physicians.

**Results**—181 of 419 (43.20%) eligible veterinarians and 201 of 1,376 (14.61%) eligible physicians responded to the survey. A majority of both veterinarians (131/179 [73.18%]) and physicians (97/192 [50.52%]) indicated that veterinarians should always or almost always be involved in advising clients with HIV infection or AIDS. The majority of veterinarians (120/173 [69.36%]) indicated they always or almost always discussed with clients the potential risk to immune-compromised persons after diagnosing a zoonosis. A high proportion (88/94 [93.62%]) of physicians indicated they never or rarely initiated discussions about zoonoses with patients with HIV infection or AIDS. All physicians (94/94 [100%]) indicated they never or rarely contacted veterinarians for advice on zoonoses. Similarly, 174 of 180 (96.76%) veterinarians had never or rarely contacted physicians for advice on zoonoses risks. Only 25.97% of veterinarians and 33.33% of physicians were correctly able to identify zoonotic pathogens of greatest concern to people with HIV infection or AIDS.

**Conclusions and Clinical Relevance**—We identified several implications for veterinary medical and medical practice that may reduce zoonoses transmission risks for people with HIV infection or AIDS, including increased communication between veterinarians and physicians, increased communication between people with HIV infection or AIDS and health-care providers, increased availability of client educational materials, and increased participation in zoonoses continuing education opportunities by health-care providers. (*J Am Vet Med Assoc* 2012;240:1432–1440)

At the end of 2008, an estimated 1,178,350 adults and adolescents in the United States were infected with HIV, including 236,400 whose infections had not been diagnosed.<sup>1</sup> In Tennessee alone, in 2009, there were 15,715 individuals with diagnosed HIV infections.<sup>2</sup> Approximate-

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ly 50% of people with HIV infection have pets,<sup>3,4</sup> yet the role of companion animals in the lives of people with HIV infection or AIDS has received little attention in the peer-reviewed literature. Pet ownership has been reported to lessen depression,<sup>5</sup> and cat ownership has been shown to protect against loneliness<sup>6</sup> in men with AIDS. However, animals are involved in the epidemiology of several opportunistic infections of HIV-infected persons and many HIV comorbidities that signal the onset of AIDS.<sup>7</sup> As a result, animal contact may pose particular risks for people with HIV infection or AIDS. Zoonoses of concern for people with HIV infection or AIDS include the following: *Bartonella* spp, *Bordetella bronchiseptica*, *Campylobacter* spp, *Cryptococcus* spp, *Cryptosporidium* spp, dermatophytes, *Giardia* spp, *Listeria monocytogenes*, *Mycobacterium* spp, *Rhodococcus equi*, *Salmonella* spp, and *Toxoplasma gondii*.<sup>7–12</sup>

The degree to which animals may contribute to zoonoses transmission to people with HIV infection or AIDS varies,<sup>7</sup> yet a high proportion of immunocompromised pet owners have been advised to surrender their pets.<sup>13</sup> The prevalence of pet ownership among people with HIV infection or AIDS and the benefits of pet ownership and companionship to this population require that health-care providers offer factual information and appropriate disease prevention strategies. The purpose of the study reported here was to examine the practices, attitudes, and knowledge of Tennessee veterinarians and physicians regarding the risk for and prevention of zoonoses among companion animal owners with HIV infection or AIDS. Similar studies<sup>14,15</sup> have been performed to assess the role of veterinarians and physicians in preventing zoonoses in immunocompromised individuals. However, neither of the previous studies<sup>14,15</sup> focused specifically on zoonoses prevention in people with HIV infection or AIDS.

## Materials and Methods

**Study protocol**—The study was designed as a cross-sectional survey of veterinarians and physicians engaged in clinical practice in Tennessee. For this study, clinical veterinary practice included the following disciplines: equine medicine and surgery, exotic animal medicine and surgery, large animal medicine and surgery, mixed animal practice, shelter medicine, and small animal medicine and surgery. Clinical medical practice included the following specialties: family medicine, hematology and oncology, infectious disease, internal medicine, and pediatrics. Physicians were chosen by specialties most likely to involve treatment of patients with zoonoses and HIV infection or AIDS. Electronic databases of licensed veterinarians and physicians in Tennessee maintained by the Tennessee Department of Health were accessed to identify study participants. Only providers with an active Tennessee veterinary medical or medical license and a practice mailing address in Tennessee were eligible for participation.

Physicians were stratified by specialty, and separate databases for each specialty were created. Veterinarians were not stratified by practice type because this information was not provided in the accessed database. After exclusion of ineligible participants, the total eligible participant population included 1,365 veterinarians, 1,479 family practitioners, 84 hematologists and oncologists, 55 infectious disease specialists, 2,348 internists, and 1,100 pediatricians. Sample size was determined by applying a formula developed by Krejcie and Morgan.<sup>16</sup> Sample populations of veterinarians ( $n = 454$ ), family practitioners (494), internists (784), and pediatricians (366) were chosen by systematic sampling of every third name in each database. Sample populations of hematologists and oncologists ( $n = 56$ ) and infectious disease specialists (37) were chosen by systematic sampling of the first 2 of every 3 names in each database.

Participants received postcard notification of their selection for study participation approximately 1 week prior to the first survey mailing. In January 2010, a veterinarian- or physician-specific survey, a cover letter describing the study, and a preaddressed, postage-paid return envelope coded with a unique, personal identifier were mailed from the University of Tennessee, Knoxville, Tenn, to each study

participant. Participants were sent a reminder postcard 1 week after the survey mailing. Nonresponders were sent a reminder letter and a second copy of the survey 4 weeks after the initial survey mailing. Survey data were disassociated from personal identifiers prior to data analysis. The study was performed pursuant to an approved University of Tennessee Institutional Review Board protocol.

**Survey description**—Questions modified from previous authors<sup>14,15,17</sup> and those developed by the present authors were used to generate veterinarian- and physician-specific survey instruments.<sup>a</sup> Surveys were evaluated by administration to a convenience sample of 5 veterinarians and 5 physicians in other states, which resulted in revisions for clarity. The veterinarian-specific survey consisted of 21 questions, and the physician-specific survey consisted of 20 questions. Final surveys were composed primarily of closed-ended questions rated on a 5-point Likert scale and took approximately 10 minutes to complete. Both surveys contained questions to determine demographic characteristics of respondents, including gender, type of veterinary or medical practice, veterinary or medical school attended, year of graduation, advanced degrees and board certifications earned, and number of days per week involved in direct patient care.

Additionally, both surveys contained a similar set of questions to determine the frequency of communication between veterinarians and physicians regarding zoonoses risks for individuals with HIV infection or AIDS, comfort in advising people with HIV infection or AIDS on zoonoses transmission and risks, the appropriate level of veterinary involvement in advising people with HIV infection or AIDS about zoonoses risks, and the likelihood of zoonoses transmission to people with HIV infection or AIDS following contact with specific animals. To assess knowledge of zoonoses, all respondents were asked to list 2 zoonotic pathogens of greatest concern to people with HIV infection or AIDS. All respondents were also asked whether client or patient zoonoses education materials were available in their practice, whether they had completed continuing education courses on zoonoses during the past 3 years, and whether they had ever visited a website to explore zoonoses risk to people with HIV infection or AIDS.

Questions included only on the veterinarian-specific survey assessed how often respondents encountered zoonoses among patients, how often respondents discussed zoonoses with clients, and whether respondents would offer consultation on zoonoses prevention to clients with HIV infection or AIDS. Veterinarians were also asked whether a client had ever disclosed a diagnosis of HIV infection or AIDS for themselves or a family member.

Physicians were queried on the percentage of patients with HIV infection or AIDS in their total patient population. Additional questions included only on the physician-specific survey assessed how often respondents questioned patients with HIV infection or AIDS about animal contact, how often respondents encountered zoonoses in patients with HIV infection or AIDS, and how often respondents discussed zoonoses with patients with HIV infection or AIDS.

**Statistical analysis**—For similar questions on both surveys, Pearson  $\chi^2$  analysis was performed with standard statistical software<sup>b</sup> to determine whether responses were significantly associated with

occupation (veterinarian vs physician). Values of  $P < 0.05$  were considered significant. For the open-ended question designed to assess knowledge of zoonoses of concern to people with HIV infection

Table 1—Responses of veterinarians (n = 181) in Tennessee to a survey on zoonotic disease prevention in people with HIV infection or AIDS.

Question	Frequency (No. [%])
How often do you encounter zoonotic diseases in your patient population? (n = 181)	
Never	6 (3.31)
Rarely	29 (16.02)
Several times/y	52 (28.73)
Several times/mo	39 (21.55)
Several times/wk	55 (30.39)
After diagnosing a zoonotic disease in a client-owned animal, how often do you discuss with the client the potential risk to any immune-compromised persons having contact with the diseased animal? (n = 173)	
Never	4 (2.31)
Almost never	14 (8.10)
Sometimes	35 (20.23)
Almost always	64 (37.00)
Always	56 (32.37)
How often do you initiate discussions about zoonotic diseases with clients? (n = 178)	
Never	2 (1.12)
Rarely	21 (11.80)
Several times/y	44 (24.72)
Several times/mo	56 (31.46)
Several times/wk	55 (30.90)
How often do clients initiate discussions about zoonotic disease with you? (n = 179)	
Never	6 (3.35)
Rarely	70 (39.11)
Several times/y	65 (36.31)
Several times/mo	33 (18.44)
Several times/wk	5 (2.79)
Has a client ever disclosed their HIV infection or AIDS diagnosis to you? (n = 181)	
No	136 (75.14)
Yes	45 (24.86)
Has a client ever disclosed the HIV infection or AIDS diagnosis of a family member to you? (n = 179)	
No	140 (78.21)
Yes	39 (21.79)
If you knew a client or their family member had an HIV diagnosis, would you offer consultation on zoonotic disease prevention? (n = 177)	
No	17 (9.60)
Yes	160 (90.40)
How comfortable do you feel advising clients with HIV infection or AIDS or those with a person with HIV infection or AIDS in their household specifically on the animal aspects of transmission and the risk for zoonotic diseases? (n = 179)	
Very uncomfortable	13 (7.26)
Uncomfortable	11 (6.15)
Neither uncomfortable nor comfortable	57 (31.84)
Comfortable	74 (41.34)
Very comfortable	24 (13.41)
How often do you contact physicians for advice on the animal aspects of transmission and risk of zoonotic disease with reference to a specific patient with HIV infection or AIDS? (n = 180)	
Never	118 (65.56)
Rarely	56 (31.11)
Several times/y	6 (3.33)
Several times/mo	0 (0.00)
Several times/wk	0 (0.00)
How often do physicians contact you regarding a zoonotic disease with reference to a specific patient with HIV infection or AIDS? (n = 180)	
Never	96 (53.33)
Rarely	77 (42.78)
Several times/y	7 (3.89)
Several times/mo	0 (0.00)
Several times/wk	0 (0.00)

or AIDS, responses were categorized as 2 zoonotic pathogens of concern correctly identified or < 2 zoonotic pathogens of concern correctly identified by a single investigator.

## Results

Three hundred fifty-seven of 2,191 (16.29%) surveys (including 27 veterinarian-specific and 330

physician-specific surveys) were determined to be undeliverable and returned by the US Postal Service. As a result, the final sample population included 427 veterinarians and 1,407 physicians (399 family practitioners, 49 hematologists and oncologists, 27 infectious disease specialists, 613 internists, and 319 pediatricians). Completed surveys were received from 189 veterinarians and 232 physicians. Thirty-nine surveys (including 8 veterinarian-specific and 31 physician-

Table 2—Responses of physicians (n = 201) in Tennessee to a survey on zoonotic disease prevention in people with HIV infection or AIDS.

Question	Frequency (No. [%])
What percentage of your patients has an HIV infection or AIDS diagnosis? (n = 201)	
0%	107 (53.23)
1%–25%	88 (43.78)
26%–50%	4 (19.90)
51%–75%	0 (0.00)
> 76%	2 (1.0)
How often do you ask your patients with HIV infection or AIDS if they own or have contact with animals? (n = 94)	
Never	36 (38.30)
Almost never	31 (32.98)
Sometimes	14 (14.89)
Almost always	9 (9.57)
Always	4 (4.26)
How often do you encounter zoonotic diseases in your patients with HIV infection or AIDS? (n = 94)	
Never	48 (51.06)
Almost never	41 (43.62)
Sometimes	5 (5.32)
Almost always	0 (0.00)
Always	0 (0.00)
How often do you initiate discussions about zoonotic diseases with patients with HIV infection or AIDS? (n = 94)	
Never	51 (54.26)
Rarely	37 (39.36)
Several times/y	5 (5.32)
Several times/mo	1 (1.06)
Several times/wk	0 (0.00)
How often do patients with HIV infection or AIDS initiate discussions about zoonotic diseases with you? (n = 94)	
Never	71 (75.53)
Rarely	22 (23.40)
Several times/y	1 (1.06)
Several times/mo	0 (0.00)
Several times/wk	0 (0.00)
How often do you contact veterinarians for advice on the animal aspects of transmission and risk of zoonotic disease with reference to a specific patient with HIV infection or AIDS? (n = 94)	
Never	84 (89.36)
Rarely	10 (10.64)
Several times/y	0 (0.00)
Several times/mo	0 (0.00)
Several times/wk	0 (0.00)
How often do veterinarians contact you regarding a zoonotic disease with reference to a specific patient with HIV infection or AIDS? (n = 94)	
Never	91 (96.81)
Rarely	3 (3.19)
Several times/y	0 (0.00)
Several times/mo	0 (0.00)
Several times/wk	0 (0.00)
How comfortable do you feel in advising patients with HIV infection or AIDS specifically on animals as potential sources of zoonotic diseases? (n = 193)	
Very uncomfortable	51 (26.42)
Uncomfortable	54 (27.98)
Neither uncomfortable nor comfortable	51 (26.42)
Comfortable	29 (15.03)
Very comfortable	8 (4.15)

specific surveys) were excluded from analysis because respondents reported < 2 d/wk involvement in direct patient care or submitted an incomplete survey. One hundred eighty-one of 419 (43.20%) eligible veterinarians and 201 of 1,376 (14.61%) eligible physicians responded to the survey.

Of the 181 eligible veterinarian respondents, 127 (70.17%) were engaged in small animal practice, 29 (16.02%) were engaged in mixed animal practice, 8 (4.41%) were engaged in equine practice, 8 (4.41%) were engaged in large animal practice, 5 (2.76%) were engaged in small animal and exotic animal practice, 2 (1.10%) were engaged in exotic animal practice, and 1 (0.55%) was engaged in shelter medicine. One (0.55%) respondent did not indicate practice type. Seventy-one (39.23%) respondents were female, 107 (59.12%) were male, and 3 (1.66%) did not indicate gender. Ninety-nine (54.70%) respondents had received their veterinary degree from the University of Tennessee, and 82 (45.30%) had received their veterinary degree from another school, including 3 who had attended a foreign school. Nineteen (10.50%) respondents indicated they had earned an advanced degree, specialty board certification, or both. Frequencies reported for questions included only on the veterinarian-specific survey were summarized (Table 1).

Of the 201 eligible physician respondents, 59 (29.35%) were engaged in family practice and pediatric practice, 55 (27.36%) were engaged in internal medicine practice, 8 (3.98%) were engaged in infectious disease practice, 7 (3.48%) were engaged in hematology and oncology practice and pediatric internal medicine

practice, 2 were engaged in pediatric hematology and oncology practice, and 1 (0.50%) each was engaged in internal medicine and hematology and oncology practice, internal medicine and infectious disease, and pediatric infectious disease. One (0.50%) respondent did not indicate practice type.

Sixty-seven (33.33%) respondents were female, 131 (65.17%) were male, and 3 (1.50%) did not indicate gender. Eighty-eight (43.78%) had received their medical degree from 1 of the 4 Tennessee medical schools, and 108 (53.73%) had received their medical degree from another school, including 18 from foreign institutions. Five (2.49%) respondents did not indicate the institution from which their medical degree was received. One hundred seventy (84.58%) indicated they had earned an advanced degree, specialty board certification, or both. Frequencies reported for questions included only on the physician-specific survey were summarized (Table 2).

Frequencies reported for common questions included on the veterinarian- and physician-specific surveys were summarized (Table 3). Responses of veterinarians and physicians regarding the likelihood of zoonotic disease transmission to people with HIV infection or AIDS having contact with specific animals were summarized (Table 4). All respondents were asked to list 2 zoonotic pathogens of greatest concern for people with HIV infection or AIDS. *Toxoplasma* spp (veterinarians, 47; physicians, 69) and *Salmonella* spp (veterinarians, 42; physicians, 49) were listed most frequently as the pathogens of greatest concern for people with HIV infection or AIDS. Other zoonoses of concern for people with HIV infection or AIDS listed

Table 3—Responses of veterinarians and physicians in Tennessee to a survey on zoonotic disease prevention in people with HIV infection or AIDS.

Species	Veterinarians		Physicians		P value
	Frequency (No. [%])	No. of respondents	Frequency (No. [%])	No. of respondents	
Should veterinarians be involved in advising clients with HIV or or AIDS about zoonotic disease risks?*		179		192	< 0.001
Never	3 (1.68)		3 (1.56)		
Almost never	5 (2.79)		11 (5.73)		
Sometimes	40 (22.35)		81 (42.19)		
Almost always	42 (23.46)		50 (26.04)		
Always	89 (49.72)		47 (24.48)		
Are educational materials about zoonotic diseases available for clients or patients in your practice?*		180		198	< 0.001
No	76 (42.22)		191 (96.46)		
Yes	104 (57.78)		7 (3.54)		
Have you completed continuing education courses on zoonotic diseases during the past 3 years?*		180		201	< 0.001
No	128 (71.11)		191 (95.02)		
Yes	52 (28.89)		10 (4.98)		
Have you ever visited a website to explore zoonotic disease risks to people with HIV infection or AIDS?		181		201	0.310
No	158 (87.29)		182 (90.55)		
Yes	23 (12.71)		19 (9.45)		

\*Value is significantly ( $P < 0.05$ ) different between responses of veterinarians and physicians.

Table 4—Responses of Tennessee veterinarians and physicians regarding the likelihood of zoonoses transmission to people with HIV infection or AIDS following contact with specific animals.

Species	Veterinarians		Physicians		P value
	Frequency (No. [%])	No. of respondents	Frequency (No. [%])	No. of respondents	
Amphibians		150		153	0.059
Seldom	44 (29.33)		63 (41.18)		
Frequent	34 (22.67)		31 (20.26)		
Very likely	57 (38.00)		37 (24.18)		
Near certain	12 (8.00)		17 (11.11)		
Certain	3 (2.00)		5 (3.27)		
Birds		150		154	0.143
Seldom	29 (19.33)		29 (18.83)		
Frequent	35 (23.33)		51 (33.12)		
Very likely	68 (45.33)		53 (34.42)		
Near certain	14 (9.33)		12 (7.79)		
Certain	4 (2.67)		9 (5.84)		
Cats		167		156	0.204
Seldom	53 (31.74)		38 (24.36)		
Frequent	63 (37.72)		56 (35.90)		
Very likely	38 (22.75)		45 (28.85)		
Near certain	11 (6.59)		10 (6.41)		
Certain	2 (1.20)		7 (4.49)		
Dogs*		165		153	0.005
Seldom	66 (40.00)		88 (57.52)		
Frequent	55 (33.33)		31 (20.26)		
Very likely	36 (21.82)		22 (14.38)		
Near certain	7 (4.24)		8 (5.23)		
Certain	1 (0.61)		4 (2.61)		
Farm animals		152		154	0.723
Seldom	55 (36.18)		61 (39.61)		
Frequent	50 (32.89)		44 (28.57)		
Very likely	39 (25.66)		36 (23.38)		
Near certain	6 (3.95)		9 (5.84)		
Certain	2 (1.32)		4 (2.60)		
Kittens (< 6 mo old)		166		154	0.598
Seldom	36 (21.69)		30 (19.48)		
Frequent	65 (39.16)		62 (40.26)		
Very likely	43 (25.90)		44 (28.57)		
Near certain	19 (11.45)		12 (7.79)		
Certain	3 (1.81)		6 (3.90)		
Puppies (< 6 mo old)*		166		150	0.002
Seldom	42 (25.30)		69 (46.00)		
Frequent	61 (36.75)		44 (29.33)		
Very likely	43 (25.90)		24 (16.00)		
Near certain	17 (10.24)		9 (6.00)		
Certain	3 (1.81)		4 (2.67)		
Rabbits		149		150	0.719
Seldom	71 (47.65)		71 (47.33)		
Frequent	47 (31.54)		48 (32.00)		
Very likely	25 (16.78)		23 (15.33)		
Near certain	6 (4.03)		6 (4.00)		
Certain	0 (0)		2 (1.33)		
Reptiles*		152		155	0.010
Seldom	37 (24.34)		59 (38.06)		
Frequent	31 (20.39)		37 (23.87)		
Very likely	56 (36.84)		37 (23.87)		
Near certain	22 (14.47)		12 (7.74)		
Certain	6 (3.95)		10 (6.45)		
Rodents		149		152	0.100
Seldom	51 (34.23)		63 (41.45)		
Frequent	45 (30.20)		36 (23.68)		
Very likely	45 (30.20)		34 (22.37)		
Near certain	5 (3.36)		12 (7.90)		
Certain	3 (3.01)		7 (4.60)		

See Table 3 for key.

included the following: *Bartonella* spp (veterinarians, 11; physicians, 18), *Bordetella bronchiseptica* (veterinarians, 1; physicians, 1), *Campylobacter* spp (veterinarians, 1; physicians, 1), *Cryptococcus* spp (veterinarians, 4; physicians, 3), *Cryptosporidium* spp (veterinarians, 9; physicians, 17), dermatophytes (veterinarians, 27; physicians, 3), *Giardia* spp (veterinarians, 10; physicians, 2), *Listeria monocytogenes* (veterinarians, 0; physicians, 0), *Mycobacterium* spp (veterinarians, 4; physicians, 7), and *Rhodococcus equi* (veterinarians, 0; physicians, 1).

## Discussion

In the present study, 94 of 181 (51.93%) veterinarians had encountered zoonotic diseases in their patient population at least several times per month. The frequency with which veterinarians encounter zoonoses highlights the important role of veterinarians in protecting animal and human health. The public health responsibilities of veterinarians include disease surveillance, zoonotic disease reduction, and community health education. One hundred eleven of 178 (62.36%) veterinarians in the present study indicated they had initiated discussions about zoonoses with clients at least several times a month. Additionally, 120 of 173 (69.36%) veterinarians indicated that they regularly discussed the potential risk to immune-compromised persons with clients after diagnosing a zoonotic disease in their animal. Veterinarians were significantly more likely than physicians to indicate that veterinarians should be involved in advising clients with HIV infection or AIDS about zoonotic disease risks. However, a majority of both veterinarians (131/179 [73.18%]) and physicians (97/192 [50.52%]) indicated that veterinarians should always or almost always be involved in advising people with HIV infection or AIDS who have animal exposure. These data suggest that veterinarians could assume greater roles in zoonoses education and prevention and that these actions would be well received by the medical community. We recommend that veterinarians routinely educate clients on zoonotic risks and ask whether clients are interested in discussing zoonotic risk-reduction practices for immunocompromised persons.

We found that 94 of 201 (46.77%) physician respondents had treated patients with HIV infection or AIDS; however, the majority of respondents had never (48/94 [51.06%]) or almost never (41/94 [43.62%]) encountered zoonotic diseases in their patients with HIV infection or AIDS. The low incidence of zoonotic infections among patients with HIV infection or AIDS treated by the responding physicians is likely attributable to the availability and use of highly active combination antiretroviral treatment since the mid-1990s.<sup>18</sup> In a prospective cohort study<sup>18</sup> of 8,070 HIV-infected individuals, rates of AIDS-defining zoonotic infections, including *Mycobacterium avium* complex, cryptosporidiosis, and toxoplasmosis, decreased 8- to 11-fold to  $\leq 2.5$  cases/1,000 person-years from 1994 to 2007.

In the present study, only 5 (5.32%) physicians reported zoonotic diseases among their patients with HIV infection or AIDS; however, our data suggest that physicians may underdiagnose zoonotic diseases. A high proportion (67/94 [71.3%]) of physicians who treated patients with HIV infection or AIDS indicated

they never or almost never asked their patients if they owned or had contact with animals. A greater percentage (93.62%) of physicians indicated they never or rarely initiated discussions about zoonoses with patients with HIV infection or AIDS. The lack of communication between physicians and patients with HIV infection or AIDS about zoonoses may be attributable to lack of physician comfort in advising patients regarding animals, particularly pets, as potential sources of zoonotic diseases. In the present study, veterinarians were significantly more likely than physicians to have indicated they were comfortable advising people with HIV infection or AIDS on animals as potential sources of zoonotic diseases. Higher comfort among veterinarians may be related to increased zoonotic risk awareness as a result of ongoing animal contact.<sup>14</sup>

Prevention of zoonotic diseases among people with HIV infection or AIDS will require cooperation between people with HIV infection or AIDS, physicians, and veterinarians. Human and animal health are inextricably linked, and collaboration between physicians and veterinarians will improve health outcomes for all species.<sup>17</sup> In the present study, 100% of physicians who treated patients with HIV infection or AIDS indicated they never or rarely contacted veterinarians for advice on zoonoses with reference to a specific patient with HIV infection or AIDS. These data may be influenced by the prevalence of zoonoses in the patient population of physician respondents. Similarly, we found that 174 of 180 (96.76%) veterinarians had never or rarely contacted physicians for advice on zoonotic risks with reference to an individual with HIV infection or AIDS. These data may be influenced by a client's unwillingness to disclose their HIV status or the status of a family member to a veterinarian. Despite the influences mentioned, previous studies<sup>14,15,17</sup> have highlighted the lack of communication regarding zoonoses between physicians and veterinarians. Others<sup>17</sup> have posited that public health agencies may provide the infrastructure necessary to increase collaboration between health-care providers. Factors that preclude physician-veterinarian communication may include lack of genuine patient sharing (veterinarians attend to animal patients, and physicians attend to human patients) and geographic and professional isolation.<sup>14</sup> Additional studies should be conducted to identify methods to mitigate these factors and increase cooperation between veterinarians and physicians.

People with HIV infection or AIDS who are pet owners or have frequent animal contact have a critical role in facilitating communication between their physician and veterinarian. In the present study, 160 of 177 (90.40%) veterinarians indicated that they would offer consultation on zoonotic disease prevention if they were aware of HIV infection or an AIDS diagnosis in a client or client family member. However, only 45 of 181 (24.86%) veterinarians indicated that a client had ever disclosed their HIV infection or AIDS diagnosis. Similarly, only 39 of 179 (21.79%) veterinarians indicated that a client had ever disclosed the HIV infection or AIDS diagnosis of a family member. These findings may be associated with actual prevalence of HIV infection or AIDS among respondent clientele but is more likely associated with HIV- and AIDS-related stigma and failure

of people with HIV infection or AIDS to view veterinarians as a source of zoonotic disease information.<sup>15</sup> Veterinarians have received training on zoonoses, animal-related hazards, and the human-animal bond<sup>11</sup> and may provide a valuable source of information for people with HIV infection or AIDS and for physicians who treat patients with HIV infection or AIDS. Various approaches to encourage people with HIV infection or AIDS to use veterinarians as a resource for zoonoses information have been suggested and include display of educational material and signage in practices, comments in practice newsletters, and affiliation with HIV and AIDS support groups.<sup>15</sup> Additional approaches to encourage people with HIV infection or AIDS to use veterinarians may include providing zoonoses educational material at HIV testing locations and veterinarian participation in HIV and AIDS outreach and education activities.

A large proportion (151/179 [84.36%]) of veterinarians in the present study indicated clients infrequently initiated discussions with them about zoonotic diseases. This finding suggests that the expertise of veterinarians may be unrecognized and underutilized by veterinary consumers, including but not limited to individuals with HIV infection or AIDS. Veterinary clientele and people with HIV infection or AIDS may also be unaware of zoonotic risks. A similarly large proportion (93/94 [98.94%]) of physicians who treated patients with HIV infection or AIDS indicated that patients rarely or never initiated discussions about zoonoses. In the present study, 191 of 198 (96.46%) physicians and 76 of 180 (42.22%) veterinarians indicated they did not have client educational materials on zoonoses available in their practices. Coupled together, these findings suggest an increased need for zoonoses education among the general public. We suggest that veterinarians and physicians make available client educational materials that discuss pathogens transmissible from animals and that offer practical risk-reduction strategies.

In the second portion of the survey, we examined the views and knowledge of veterinarians and physicians regarding the zoonotic risks to people with HIV infection or AIDS. Veterinarians were more likely than physicians to view dogs (and specifically puppies) and reptiles as zoonotic risks for people with HIV infection or AIDS. We did not ask respondents to list the pathogens associated with specific animals. As a result, we were unable to conclude whether our findings represented actual zoonoses knowledge or species biases among respondents. Only 25.97% of veterinarians and 33.33% of physicians were correctly able to identify zoonotic pathogens of greatest concern to people with HIV infection or AIDS. Among veterinarians and physicians, *Toxoplasma* spp and *Salmonella* spp were the 2 most frequently listed pathogens. The frequency of other pathogens listed varied considerably.

Veterinarians were significantly more likely than physicians to have completed continuing education courses on zoonoses during the past 3 years, yet the proportion of veterinarians (52/180 [28.90%]) and physicians (10/201 [4.98%]) who attended such courses was small. Similarly, few veterinarians and physicians indicated that they had ever visited a website to

explore zoonotic risks to people with HIV infection or AIDS. Our survey instruments did not ask respondents to identify specific sites visited. Knowledge deficits regarding zoonotic risks for people with HIV infection or AIDS likely exist among veterinarians and physicians. Additionally, our findings suggest that opportunities to increase zoonoses knowledge are underused by veterinarians and physicians. If these conclusions are valid, these findings represent obstacles to adequate health-care delivery to patients with HIV infection or AIDS. Moreover, these findings may explain why many patients with HIV infection are advised to relinquish their pets. Public health programs and veterinary medical and medical school curricula should place greater emphasis on zoonoses education, especially risks for people with HIV infection or AIDS and other immunocompromised individuals and the benefits of pet ownership for this population.

We achieved 43.20% and 14.61% survey response rates among veterinarians and physicians, respectively. A similar study<sup>15</sup> of veterinarians and physicians in Wisconsin achieved veterinarian and physician response rates of 62.17% and 46.13%, respectively. Another, related study<sup>14</sup> achieved response rates of 56% and 39% for veterinarians and physicians, respectively. Various methodologies for improving response rates in physician surveys have been reported and include financial incentives with questionnaire mailings, use of mixed-mode survey approaches, inclusion of first-class stamps on return envelopes, and use of brief questionnaires.<sup>19</sup> The veterinarian- and physician-specific questionnaires contained 791 and 822 words, respectively. Lower response rates have been reported among physicians when surveys exceeded 1,000 words.<sup>20</sup> However, the length of our questionnaires was well below this threshold. Because of financial constraints, we did not include financial incentives in mailed questionnaires and return envelopes were stamped postage paid. Methods we used to increase response rates included use of prenotification postcards, use of reminder postcards, and use of a second survey mailing for nonresponders. However the relatively low response rate, particularly for physicians, may be a limitation for the results of our study.

Response bias may be another limitation of the present study. Small animal practitioners made up a large proportion (127/181 [70.17%]) of veterinarian respondents. Similarly, family practitioners, pediatricians, and internists made up a large proportion (173/201 [86.07%]) of physician respondents. In a similar study,<sup>15</sup> small animal practitioners encountered or discussed zoonoses more frequently than did veterinarians in general and infectious disease physicians encountered or discussed zoonoses more frequently than did the overall population of physicians. The physician response rate, especially among infectious disease specialists, is a limitation of the present study. We concede that our results may not be generalized to all practicing veterinarians and physicians in Tennessee.

The overall risk of transmission of zoonotic diseases to people with HIV infection or AIDS from contact with pets is low.<sup>4,7</sup> The present study identified several implications for veterinary medical and medical practice



that may further reduce transmission risks, including increased communication between veterinarians and physicians, increased communication between people with HIV infection or AIDS and health-care providers, increased availability of educational materials for patients of physicians and clients of veterinarians, and increased participation in zoonoses continuing education opportunities by health-care providers. These practices, performed collectively, will permit safe, responsible pet ownership by people with HIV infection or AIDS and ensure adequate health-care delivery to this population.

- a. Survey instruments available by request from the corresponding author.
- b. Stata, version 11, StataCorp LP, College Station, Tex.

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