

# Public Veterinary Medicine: Public Health

## A survey of veterinarian involvement in zoonotic disease prevention practices

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**Objective**—To determine the extent to which practicing veterinarians in King County, Washington, engaged in commonly recommended practices for the prevention of zoonotic diseases.

**Design**—Cross-sectional survey.

**Sample Population**—Licensed veterinarians practicing clinical medicine in King County, Washington.

**Procedures**—A survey was sent between September and November 2006 to 454 licensed veterinarians practicing clinical medicine in King County.

**Results**—370 valid responses were received. A high proportion (280/362 [77%]) of respondents agreed that it was very important for veterinarians to educate clients on zoonotic disease prevention, but only 43% (158/367) reported that they had initiated discussions about zoonotic diseases with clients on a daily basis, and only 57% (203/356) indicated that they had client educational materials on zoonotic diseases available in their practices. Thirty-one percent (112/360) of respondents indicated that there were no written infection-control guidelines for staff members in the practice, and 28% (105/371) reported having been infected with a zoonotic disease in practice.

**Conclusions and Clinical Relevance**—Results illustrated that veterinarians recognize their important role in zoonotic disease prevention and suggested that veterinarians would welcome stronger partnerships with public health agencies and other health professionals in this endeavor. Methods to increase veterinarians' involvement in zoonotic disease prevention include discussing zoonotic diseases more frequently with clients, physicians, and public health agencies; encouraging higher risk individuals to discuss zoonotic diseases; having educational materials on zoonotic diseases available for clients; improving infection-control practices; and ensuring that continuing education courses on zoonotic diseases are regularly available. (*J Am Vet Med Assoc* 2008;233:1242–1249)

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Zoonotic diseases are a serious and growing public health concern throughout the world,<sup>1</sup> with most recent emerging and reemerging human infectious diseases involving zoonotic pathogens.<sup>2</sup> Pet animals, particularly exotic pet animals, are an important potential source of zoonotic diseases,<sup>3–6</sup> as are animal-derived pet treats.<sup>7</sup> In general, the number of zoonotic illnesses in the United States is low, and the risk of acquiring zoonotic diseases from pets is outweighed by the emotional and health benefits of pet ownership.<sup>3,8,9</sup> In addition,

most zoonotic diseases can be prevented by taking precautions to minimize the risk of infection.<sup>8</sup> The need for individuals at higher risk of infection, including immunocompromised individuals, young children, pregnant women, and elderly persons, to be aware of preventive precautions is particularly important.<sup>9</sup> Most pet owners, however, are unaware that pets can carry infectious agents transmissible to people and are not familiar with methods to prevent zoonotic diseases.<sup>10</sup>

For this reason, veterinarians in clinical practice have a unique opportunity to become involved in efforts to prevent zoonotic diseases in their clients, their staff members, and themselves. A previous study,<sup>11</sup> however, found that only about a third of veterinarians routinely discussed the potential zoonotic hazards of canine roundworms with their clients, and little is known about the extent to which veterinarians take an active role in the prevention of zoonotic diseases. The

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purpose of the study reported here, therefore, was to determine the extent to which practicing veterinarians in King County, Washington, engaged in commonly recommended practices for the prevention of zoonotic diseases.

## **Materials and Methods**

**Study protocol**—The study was designed as a cross-sectional survey with a target population of all licensed veterinarians practicing clinical medicine in King County, Washington. For purposes of the study, clinical medicine was defined as including small animal medicine, exotic animal medicine, equine medicine, food and large animal medicine, mixed animal medicine, shelter medicine, and specialty medicine. A list of King County veterinary practices and veterinarians working in each veterinary practice was compiled on the basis of a local veterinary association list from 2000 and a thorough search of telephone book and Internet resources performed by the authors. Each veterinary practice that was identified was telephoned to inquire about the names of veterinarians currently working at the practice. Veterinarians who worked at > 1 practice were listed at the practice where they were reported to work most frequently. This yielded a target population of 454 veterinarians working in 204 veterinary practices in September 2006.

A survey, cover letter describing the study, and pre-addressed, postage-paid return envelope were mailed from Public Health—Seattle & King County to each of the 454 veterinarians identified as practicing clinical medicine in King County in September 2006. If the survey was not returned within 1 month, a reminder letter with a second copy of the survey was sent. If the survey was not returned 2 weeks after the second mailing, a telephone call was made urging the veterinarian to complete the survey and providing the veterinarian with the option to complete the survey over the telephone at that time. In addition, in October 2006, a reminder notice was placed in the monthly newsletter of the Seattle–King County Veterinary Medical Association. Survey data were delinked from personal identifiers prior to data analysis. The study protocol was approved by the institutional review boards of the University of Washington and Public Health—Seattle & King County.

**Survey description**—The survey<sup>a</sup> was developed by the authors for the purpose of this study and tested by administering it to a convenience sample of 5 veterinarians practicing clinical medicine in another state, which resulted in minor changes for readability. The final survey consisted of 31 questions, most of which were closed-ended, and took about 10 minutes to complete. The first set of survey questions ascertained demographic characteristics of the respondents, including gender, type of veterinary medical practice, years in clinical practice, average number of days worked per week, number of veterinarians in the practice, veterinary school attended, and any advanced degrees or certifications. Surveys were excluded from the analysis if the veterinarian reported not practicing clinical medicine or practicing < 2 d/wk on average, except that vet-

erinarians' history of infection with a zoonotic disease was analyzed for all respondents regardless of clinical practice status or days practiced per week.

The second set of survey questions determined how often respondents had discussed zoonotic diseases with clients during the past year (including veterinarian-initiated and client-initiated discussions), how often respondents had discussed zoonotic diseases with a physician during the past year, and how often clients had described themselves or a family member as being at higher risk of infection (eg, immunocompromised, pregnant, elderly, or having children < 6 years old) and asked about zoonotic diseases during the past year. This set of questions also determined the likelihood of having a discussion about zoonotic diseases if a client or client's family member was known to be at higher risk of infection and the specific zoonotic diseases discussed with clients. Respondents were also asked whether they had completed continuing education courses on zoonotic diseases during the past 3 years and whether they believed continuing education courses on zoonotic diseases were regularly available.

The third set of survey questions addressed respondents' involvement with local and state public health agencies and included questions about how often they had contacted the local or state public health agency to discuss reportable zoonotic diseases in animals during the past year; a self-assessment of respondents' knowledge of which diseases they were required by state law to report to the Washington State Department of Health<sup>12</sup>; knowledge of who to contact about a suspected case or outbreak of zoonotic disease; and whether and how public health agencies could better assist with issues involving zoonotic diseases. Veterinarians who responded that there were ways public health agencies could better assist with issues involving zoonotic diseases were asked to choose 1 or more ways from a list of 8 examples and to describe any other ways public health agencies could assist.

The fourth set of survey questions addressed the importance of advising clients about zoonotic diseases, the availability of educational materials about zoonotic diseases for clients, the specific diseases covered in educational materials available for clients, whether respondents had ever been infected with a zoonotic disease in practice, and whether respondents had used various infection-control measures in practice. Respondents who indicated that they had been infected with a zoonotic disease were asked to indicate the disease they had been infected with and whether the diagnosis had been medically confirmed.

**Statistical analysis**—Power analysis revealed that a sample size of 209 respondents was sufficient to calculate a proportion of 50% with a 5% margin of error at a confidence level of 95% and that a sample size of 189 respondents was sufficient to calculate a proportion of 30% with a 5% margin of error at a confidence level of 95%.

Two-tailed  $\chi^2$  tests were used to determine whether survey responses were significantly associated with gender (male vs female), type of clinical practice (small animal medicine including exotic animal medicine vs small animal medicine excluding exotic animal medi-

ciné), years in clinical practice (< 5 years vs 6 to 15 years vs > 15 years), and veterinary school the respondent had attended (Washington State University vs any other school). Analyses were performed with standard software.<sup>b</sup> Values of *P* < 0.05 were considered significant. Qualitative data were reviewed and coded by hand to identify common responses. For each question that had missing responses, percentages are reported as a proportion of the total respondents for that question.

## Results

Overall, 376 of the 454 (83%) surveys were returned. Among the 376 respondents, 237 (63%) responded to the first mailed survey, 94 (25%) responded to the second mailed survey, and 45 (12%) responded after the telephone call. Only 1 survey was completed over the telephone. Six surveys were excluded from analyses because respondents were retired or not practicing (*n* = 2) or because respondents practiced < 2 d/wk, on average (4).

Most respondents (336/370 [91%]) practiced small animal medicine (Table 1). One hundred fifty-two (41%) had received their veterinary degree from Washington State University, and 217 (59%) had received their veterinary degree from some other school, including 24 respondents who had attended a foreign school. Overall, 219 (59%) respondents were female and 150 (41%) were male (Table 2). Of the 53 (14%) respondents who possessed advanced degrees or certifications,

Table 1—Practice type of veterinarians in King County, Washington, who responded to a survey on zoonotic disease prevention practices.

Type of veterinary practice	No. (%)
Small animal*	255 (69)
Small animal and exotic†	81 (22)
Equine	14 (4)
Specialty‡	12 (3)
Mixed animal	7 (2)
Large and food animal	1 (0.3)
<b>Total</b>	<b>370 (100)</b>

\*Included individuals who identified themselves as practicing predominantly small animal medicine (excluding exotic animal medicine), predominantly small animal emergency medicine, and shelter medicine. †Included individuals who identified themselves as practicing predominantly small animal medicine (including exotic animal medicine) and predominantly exotic animal medicine. ‡Included specialists in cardiology, dermatology, surgery, or ophthalmology.

12 were board certified in cardiology, surgery, dermatology, or ophthalmology.

**Discussions about zoonotic diseases with clients, physicians, and public health agencies**—One hundred fifty-eight of 367 (43%) respondents reported that they had initiated discussions about zoonotic diseases with clients daily during the past year, and 229 of 368 (62%) respondents reported that clients initiated discussion about zoonotic diseases monthly or less frequently (Table 3). Two hundred eighty-three of 367 (77%) respondents indicated that they were much more likely to discuss zoonotic diseases if they knew that a client or the client's family members were at a higher risk of infection, but only 12 of 368 (3%) respondents indicated that on a daily basis, clients described themselves or their family members as having a higher risk of infection and asked about zoonotic diseases. One hundred seventy-four of 368 (47%) respondents indicated that clients did this only occasionally, and 76 (21%) reported that clients never did this. Two hundred eighty of 362 (77%) respondents said that it was very important to advise clients about zoonotic diseases.

One hundred fifty-six of 367 (43%) respondents indicated that they had discussed zoonotic diseases with physicians at least once during the past year (Table 4). Two hundred nine of 366 (57%) respondents indicated that they had discussed zoonotic diseases with public health agencies at least once during the past year.

**Discussions of specific zoonotic diseases with clients**—In the survey, respondents were given a list of 31 zoonotic disease topics and asked to indicate the topics

Table 3—Frequency of discussions with clients about zoonotic diseases reported by veterinarians in King County, Washington, who responded to a survey on zoonotic disease prevention practices.

Frequency	Veterinarian initiated	Client initiated
Daily	158 (43)	15 (4)
Weekly	122 (33)	124 (34)
Monthly	34 (9)	71 (19)
Occasionally	46 (13)	142 (39)
Never	6 (2)	14 (4)
No client contact*	1 (0.3)	2 (1)
<b>Total</b>	<b>367 (100)</b>	<b>368 (100)</b>

Data are given as number of respondents (%).

\*These respondents indicated that they do not have any client contact in their type of clinical practice.

Table 2—Demographic characteristics of veterinarians in King County, Washington, who responded to a survey on zoonotic disease prevention practices.

Practice type	Gender*		Years in practice			Advanced degree or certification*	
	Male	Female	≤ 5	6–15	> 15	No	Yes
Small animal	91 (36)	163 (64)	58 (23)	91 (36)	106 (42)	230 (91)	24 (9)
Small animal and exotic	36 (44)	45 (56)	21 (26)	31 (38)	29 (36)	66 (82)	15 (18)
Equine	10 (71)	4 (29)	3 (21)	3 (21)	8 (57)	13 (93)	1 (7)
Large and food animal	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)	1 (100)	0 (0)
Mixed animal	4 (57)	3 (43)	3 (43)	1 (14)	3 (43)	6 (86)	1 (14)
Specialty	8 (67)	4 (33)	0 (0)	4 (33)	8 (67)	0 (0)	12 (100)
<b>Total</b>	<b>150 (41)</b>	<b>219 (59)</b>	<b>85 (23)</b>	<b>130 (35)</b>	<b>155 (42)</b>	<b>316 (86)</b>	<b>53 (14)</b>

Data are given as number of respondents (%).

\*Responses were missing for 1 individual.

they had discussed with their clients. The 10 topics most frequently discussed were internal parasitism, external parasitism, dermatophytosis, rabies, giardiasis, leptospirosis, toxoplasmosis, animal bite prevention, feeding raw food diets, and visceral and ocular larval migrans (Table 5). One hundred twenty of 367 (33%) respondents indicated that they never discussed visceral and ocular larval migrans with their clients, and 188 (51%) indicated that they never discussed *Baylisascaris* spp (raccoon roundworm) with their clients. By contrast, 342 (93%) respondents indicated that they discussed internal parasitism in general with their clients. Veterinarians were more likely to initiate discussions about

giardiasis, internal parasitism, leptospirosis, visceral and ocular larval migrans, and rabies, whereas clients were more likely to initiate discussion about avian influenza, feeding raw food diets, West Nile virus, and Lyme disease. Small animal veterinarians who also treated exotic animals initiated discussions about *Baylisascaris* spp ( $P < 0.001$ ), cat scratch disease ( $P = 0.021$ ), hantavirus ( $P = 0.009$ ), lymphocytic choriomeningitis ( $P < 0.001$ ), monkeypox ( $P = 0.001$ ), plague ( $P < 0.001$ ), psittacosis ( $P < 0.001$ ), rat bite fever ( $P = 0.001$ ), Rocky Mountain spotted fever ( $P = 0.015$ ), and tularemia ( $P = 0.007$ ) significantly more frequently than did small animal veterinarians who did not treat exotic animals.

Table 4—Frequency of discussions with physicians and public health agencies about zoonotic diseases reported by veterinarians in King County, Washington, who responded to a survey on zoonotic disease prevention practices.

Frequency	Physicians*	Public health agencies
Several times/wk	9 (2)	0 (0)
Several times/mo	10 (3)	3 (1)
Several times last year	29 (8)	42 (11)
Once or twice	108 (29)	164 (45)
Never	211 (57)	157 (43)
<b>Total</b>	<b>367 (100)</b>	<b>366 (100)</b>

Data are given as number of respondents (%).  
\*Included physicians who were clients of the respondent.

**Client educational materials on zoonotic diseases**—One hundred fifty-three of 356 (43%) respondents indicated that they did not have client educational materials on zoonotic diseases available in their practices. The 5 most common zoonotic diseases included in client educational materials available in practices that had such materials were intestinal parasitism, leptospirosis, rabies, external parasitism, and dermatophytosis.

**Continuing education courses on zoonotic diseases**—Two hundred thirty-one of 365 (63%) respondents indicated that they had attended continuing education courses on zoonotic diseases within the past 3

Table 5—Specific zoonotic diseases or topics discussed with clients, as reported by veterinarians in King County, Washington, who responded to a survey on zoonotic disease prevention practices.

Disease or topic	Never discussed	Ever discussed*		
		Client initiated	Veterinarian initiated	Either initiated
Internal parasitism	25 (7)	7 (2)	257 (70)	78 (21)
Dermatophytosis	30 (8)	43 (12)	131 (36)	163 (44)
External parasitism	30 (8)	15 (4)	170 (46)	152 (41)
Rabies	37 (10)	23 (6)	222 (60)	85 (23)
Giardiasis	46 (13)	10 (3)	261 (71)	50 (14)
Leptospirosis	57 (16)	22 (6)	246 (67)	42 (11)
Toxoplasmosis	63 (17)	45 (12)	182 (50)	77 (21)
Animal bite prevention	67 (18)	48 (13)	136 (37)	116 (32)
Feeding raw foods	68 (19)	88 (24)	127 (35)	84 (23)
Visceral and ocular larval migrans	120 (33)	3 (1)	238 (65)	6 (2)
Salmonellosis	125 (34)	14 (4)	204 (56)	24 (7)
Cat scratch disease	129 (35)	45 (12)	151 (41)	42 (11)
Lyme disease	141 (39)	74 (20)	90 (25)	62 (17)
<i>Escherichia coli</i> infection	143 (39)	27 (7)	147 (40)	50 (14)
Enteric infections in general	144 (39)	10 (3)	159 (43)	54 (15)
<i>Baylisascaris</i> infection	188 (51)	11 (3)	145 (40)	23 (6)
West Nile virus infection	193 (53)	77 (21)	46 (13)	51 (14)
Avian influenza	198 (54)	125 (34)	16 (4)	27 (7)
Cryptosporidiosis	213 (58)	5 (1)	138 (38)	11 (3)
Campylobacteriosis	234 (64)	3 (1)	123 (34)	7 (2)
Rocky Mountain spotted fever	247 (67)	11 (3)	86 (23)	23 (6)
MRSA	264 (72)	30 (8)	51 (14)	22 (6)
Brucellosis	267 (73)	20 (6)	58 (16)	21 (6)
BSE	279 (76)	42 (12)	13 (4)	32 (9)
Hantavirus infection	287 (78)	22 (6)	35 (10)	22 (6)
Psittacosis	298 (81)	6 (2)	47 (13)	16 (4)
Plague	304 (83)	13 (4)	37 (10)	13 (4)
Tularemia	313 (85)	3 (1)	36 (10)	15 (4)
Lymphocytic choriomeningitis	320 (87)	3 (1)	29 (8)	15 (4)
Monkeypox	324 (88)	10 (3)	20 (5)	13 (4)
Rat bite fever	328 (89)	4 (1)	22 (6)	13 (4)

Data are given as number of respondents (%).  
\*For each disease or topic, respondents were asked whether the discussion was usually (ie, > 50% of the time) initiated by the client, usually initiated by the veterinarian, or initiated by the client or veterinarian about equally.  
MRSA = Methicillin-resistant *Staphylococcus aureus* infection. BSE = Bovine spongiform encephalopathy.

years, and 174 (48%) indicated that they believed that continuing education courses on zoonotic diseases were regularly available.

**Infection-control practices**—Two hundred forty-six of 366 (67%) respondents indicated that they always washed their hands between handling individual animals, and only 14 (4%) indicated that they sometimes, seldom, or never washed their hands between handling individual animals. Additionally, 310 of 352 (88%) respondents indicated that examination and treatment tables were always disinfected between patients, and no respondents indicated that tables were seldom or never disinfected between patients. One hundred ninety-three of 364 (53%) respondents indicated that veterinarians or staff members ate or drank in animal handling areas daily, and only 50 (14%) indicated that veterinarians and staff members never ate or drank in animal handling areas. One hundred twelve of 360 (31%) respondents indicated that there were no written infection-control guidelines for staff members in the practice, and an additional 105 (29%) were unsure whether the practice had written infection-control guidelines. Whether veterinarians reported that they or their staff ate or drank daily in animal handling areas was significantly associated with years in clinical practice, with respondents less likely to indicate that there was daily eating or drinking in these areas as number of years in clinical practice increased ( $P = 0.005$ ). Whether the practice had written infection-control guidelines was also significantly associated with years in clinical practice, with respondents less likely to indicate that they were unsure whether there were written infection-control guidelines as number of years in clinical practice increased ( $P < 0.001$ ). No significant differences were identified when comparing infection-control practices between groups when respondents were grouped by gender. However,  $P$  values for whether female respondents were more likely than male respondents to indicate that there was daily eating or drinking in animal handling areas ( $P = 0.050$ ) and for whether female respondents were more likely than male respondents to indicate that the practice had written infection-control guidelines ( $P = 0.053$ ) were close to our cutoff for significance.

**Veterinarian reports of zoonotic disease infections**—One hundred five of 371 (28%) respondents indicated that they had been infected with a zoonotic disease in practice, with 22 respondents indicating that they had had > 1 zoonotic disease. A total of 133 cases of zoonotic disease, of which 70 (53%) were not medically confirmed, were listed by these 105 veterinarians (Table 6). The most common zoonotic disease that was reported was dermatophytosis ( $n = 72$ ), but only 20 of 72 (28%) cases were reportedly medically confirmed. Cat scratch disease and infected dog and cat bite wounds were the next most frequently reported zoonotic diseases. There was a significant ( $P = 0.016$ ) association between whether respondents had ever been infected with a zoonotic disease in practice and years in clinical practice, with respondents more likely to indicate that they had been infected with a zoonotic disease as number of years in clinical practice increased.

Table 6—Zoonotic diseases reported by veterinarians in King County, Washington, who responded to a survey on zoonotic disease prevention practices.

Disease or condition	No. of cases	No. (%) medically confirmed
Dermatophytosis	72	20 (28)
Cat scratch disease	21	15 (71)
Infected dog or cat bite	13	11 (85)
Giardiasis	6	4 (67)
Psittacosis or chlamydiosis*	5	4 (80)
Cryptosporidiosis	3	2 (67)
Flea bite dermatitis	2	0 (0)
Contagious ecthyma (orf)	2	2 (100)
Sarcoptic mange	2	1 (50)
Other†	7	4 (57)
<b>Total</b>	<b>133</b>	<b>63 (47)</b>

\*For 1 case, the source of infection was a goat. †Included 1 case each of brucellosis, needle stick with *Brucella* vaccine, campylobacteriosis, leptospirosis, Q fever, salmonellosis, and toxoplasmosis.

**Contact with public health agencies**—Only 14 of 365 (4%) respondents indicated that they were very knowledgeable about which diseases they were required by state law to report to the Washington State Department of Health, although an additional 125 (34%) indicated that they were mostly knowledgeable. Two hundred ninety of 365 (80%) respondents indicated that they knew how to report a potential case or outbreak of zoonotic disease. Two hundred seventy-one of 364 (74%) respondents indicated that there were ways that public health agencies could better assist with issues involving zoonotic diseases. The 4 ways most commonly listed were providing written information for clients on awareness and prevention of zoonotic diseases, providing written information about local regulations (eg, rabies laws) and notifiable diseases, maintaining a Web site with information for veterinarians on zoonotic diseases, and providing written information for veterinarians on recognition and control of zoonotic diseases.

Many respondents indicated that they believed public health agencies could assist with client education by developing written educational materials about zoonotic diseases and by developing public awareness campaigns or service announcements. Respondents also indicated that it would be helpful for public health agencies to develop a list of individuals to contact at those agencies; send fax or e-mail messages about outbreaks or updated information about zoonotic diseases; and clarify the notifiable disease process by regularly providing forms for reporting, easy access to the list of notifiable diseases, and information about notifiable diseases. Veterinarians further suggested that public health agencies communicate with physicians to increase their knowledge of zoonotic diseases and involvement in the prevention of zoonotic diseases.

## Discussion

In the present study, we found that a high proportion (280/362 [77%]) of veterinarians practicing clinical medicine in King County, Washington, agreed that it was very important for veterinarians to educate clients on prevention of zoonotic diseases; however, only 43% (158/367) of survey respondents reported that they had initiated discussions about zoonotic dis-

eases with clients on a daily basis. Additionally, only 57% (203/356) indicated that they had client educational materials on zoonotic diseases available in their practices. Survey respondents also indicated that when clients themselves initiated discussions about zoonotic diseases, they often asked about conditions such as avian influenza and West Nile virus infection, which are not commonly transmissible from pets, suggesting that client interest in zoonotic diseases was motivated more by media coverage than by a true understanding of the most common conditions. We suggest, therefore, that veterinarians make available attractive, easily read, client educational materials that discuss common zoonotic diseases transmissible from pets and offer practical and effective advice for control. The Companion Animal Parasite Council has developed a brochure of this type,<sup>13</sup> and the CDC maintains a Web site that contains many client educational resources, including brochures and posters.<sup>14</sup>

Education of pet owners at higher risk of infection is essential in preventing zoonotic diseases in these individuals. Individuals at higher risk should be aware of the risks of owning pets and encouraged to discuss zoonotic diseases with their veterinarian and physician. However, only 12 of 368 (3%) respondents in the present study indicated that they had seen on a daily basis clients who described themselves or their family members as having a higher risk of infection and asked about zoonotic diseases. Resources that address zoonotic diseases in higher risk individuals are available,<sup>15</sup> and we recommend that veterinarians specifically ask clients whether they are interested in discussing the risks of pet ownership among individuals who might be at higher risk of being infected with diseases transmitted from pets.

Veterinarians, physicians, and public health agencies have necessary roles to play in the prevention of zoonotic diseases and have contact with the public in different settings and for different reasons. Better communication between veterinarians and physicians needs to be established to help assess the risks of zoonotic disease, properly educate pet owners, and promptly diagnose zoonotic diseases in animals and people. The one-health initiative that has recently been proposed by members of the veterinary and medical professions has recognized that human and animal health are inextricably linked and that cooperation between physicians and veterinarians will promote and improve the health and well-being of all species.<sup>16</sup> In the present study, we found that 43% (156/367) of respondents had discussed zoonotic diseases with a physician at least once during the past year, although some of these physicians were likely clients who had brought their own pets for veterinary care. In addition, 57% (209/366) of respondents indicated that they had discussed zoonotic diseases with a public health agency during the past year. We believe that public health agencies should meet regularly with veterinarians and physicians in the community to discuss ways in which they could better assist with zoonotic disease prevention. Public health agencies could also increase their involvement with both professions by developing educational materials for use by veterinarians and physicians on zoonotic dis-

eases common to the area. Finally, public health agencies might consider developing a secure, online method for veterinarians, physicians, and other public health professionals to share information about zoonotic diseases in the community.

In the present study, only 63% (231/365) of respondents reported that they had attended continuing education courses on zoonotic diseases within the past 3 years, and only 48% (174/365) indicated that they believed continuing education courses on zoonotic disease were regularly available. Continuing education courses on zoonotic diseases could be offered by veterinary associations, including local and national organizations, public health agencies, and companies that produce products to control zoonotic diseases in pets. Annual joint continuing education courses for veterinarians and physicians could provide excellent opportunities to establish communication between these professions. Because they have access to both veterinarians and physicians, public health agencies would be the logical agencies to sponsor such joint educational programs.

Veterinarians have a moral and legal responsibility to provide a safe workplace for their staff.<sup>17</sup> In the present study, 31% (112/360) of respondents indicated that there were no written infection-control guidelines for staff members in the practice, 53% (193/364) indicated that veterinarians or staff members ate or drank in animal handling areas, and only 67% (246/366) always washed their hands between handling individual animals. In addition, 28% (105/371) of respondents reported having been infected with a zoonotic disease in practice. A national survey in 2005 found that 69% of small animal practices had no written infection-control policy.<sup>18</sup> Less frequent practice of infection-control measures was reported by male than female small animal veterinarians, such as hand washing between patients and not eating or drinking in animal handling areas.<sup>18</sup> Our study did not demonstrate any significant gender differences in the practice of infection-control measures. However, *P* values for whether female veterinarians were more likely to report daily eating or drinking in animal handling areas than male veterinarians and for whether female veterinarians were more likely than male veterinarians to indicate that the practice had written infection-control guidelines were close to our cutoff for significance. All veterinary practices should have written infection-control guidelines, and all staff members should be required to read and sign these guidelines. Small animal veterinarians working in practices that did not have a written infection-control policy were significantly more likely to report a lower frequency of practicing infection-control measures.<sup>18</sup> Veterinary practices should train new staff in infection-control procedures and incorporate annual review of the guidelines into staff meetings. The National Association of State Public Health Veterinarians has developed a model infection-control plan that can be customized with information relevant to individual veterinary practices.<sup>19</sup>

To our knowledge, the present study represents the most comprehensive survey of zoonotic disease prevention practices among veterinarians, with previous stud-

ies having been more limited in scope. For example, 2 previous studies<sup>11,20</sup> focused on education of clients regarding the zoonotic potential of canine roundworms, 2 other studies<sup>21,22</sup> dealt specifically with discussion of zoonotic diseases with immunocompromised clients, and 2 studies<sup>18,23</sup> involved infection-control practices in veterinary clinics. Although these studies used different methodologies and had varied sample populations, all of the studies suggest that veterinarians should be more involved in commonly recommended practices for the prevention of zoonotic diseases. With reports of emerging infectious diseases occurring in recent years, preventive practices that control zoonotic diseases, including infection-control practices, education of clients, and collaboration with physicians and public health agencies, should be increasing.

The high response rate in the present study increased the validity and quality of the data, and the involvement of the local public health agency undoubtedly increased the response rate. There was no potential for selection bias because surveys were sent to the entire population of veterinarians practicing clinical medicine in the county, and there was a low potential for measurement bias because researchers who made reminder telephone calls followed a predetermined script, and only 1 survey was completed over the telephone. Although not all respondents answered all questions, the maximum number of missing responses for any individual question was 8, representing only 2% of all respondents. Thus, missing data were unlikely to have substantially changed our results.

Because survey data were delinked from personal identifiers prior to data analysis, it was not possible in the present study to determine the number of veterinarians from each practice who responded to the survey or the total number of practices with responding veterinarians. However, this should not have affected our results because survey responses were analyzed on an individual level. For example, the survey question about written infection-control guidelines allowed for veterinarians to respond that their practice did have guidelines, that their practice did not have guidelines, or that they were unsure whether their practice had guidelines. It was therefore not relevant whether the practice had guidelines but whether the veterinarians knew about any guidelines.

One weakness in the design of survey questions in the present study was that veterinarians were not asked to differentiate between discussion of zoonotic diseases with physicians in reference to a specific client or patient with a possible zoonotic infection and general discussion of zoonotic diseases with physicians who visited the veterinarian as pet-owning clients. Thus, the proportion of veterinarians who responded that they discussed zoonotic diseases with physicians during the past year was likely an overestimate.

Because small animal veterinarians encounter zoonotic diseases more frequently than do veterinarians in general,<sup>21</sup> results of the present study should be generalizable to areas where most veterinarians practice small animal medicine. Although prevalences of zoonotic diseases vary throughout the county, practice habits of veterinarians are less likely to be affected by

regional differences in disease occurrence. How well our results can be generalized will also depend on the extent to which the local or state public health agency is involved with veterinarians. In the area where our survey was performed, the local public health agency employs public health veterinarians and actively participates in education of local clinical veterinarians on public health issues.

In summary, findings of the present study illustrated that veterinarians recognize their important role in zoonotic disease prevention and suggested that veterinarians would welcome stronger partnerships with public health agencies and other health professionals in this endeavor. Ways to reduce zoonotic disease risks include increasing the availability of veterinary continuing education on zoonotic infections; encouraging clients at higher risk to discuss prevention of zoonotic diseases; strengthening collaborative relationships between veterinarians, physicians, and public health agencies; promoting the use of effective standard precautions in veterinary practices through written infection-control plans and ongoing staff training; and encouraging veterinarians to take a proactive role in educating clients on prevention of zoonotic diseases.

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- a. Survey available from the corresponding author.  
b. SPSS, version 12.0, SPSS Inc, Chicago, Ill.
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