

Perspectives in Professional Education

Veterinary student and veterinarian attitudes toward veterinary public health and epidemiology

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Objective—To identify predictors of veterinary students and veterinarians having an interest in veterinary public health and epidemiology (PH&E).

Design—Cross-sectional study.

Sample Population—Veterinary students enrolled in the College of Veterinary Medicine and Biomedical Sciences at Texas A&M University and veterinarians with membership in a Texas veterinary professional organization.

Procedures—2 questionnaires were designed and administered to investigate hypothesized predictors of PH&E interests among veterinary students and veterinarians. Descriptive statistics were calculated for all variables from both questionnaires. Prevalence ratios, 95% confidence intervals, and χ^2 tests were used to evaluate bivariate associations between variables and an interest in PH&E. Multivariable logistic regression was used to adjust for the effects of multiple variables on the outcome.

Results—70% (215/305) of students believed that a course in PH&E was necessary, and 46% (140/304) believed that more courses in PH&E would improve the veterinary curriculum. Ninety-nine percent (299/303) of veterinarians believed that a course in PH&E was necessary in the curriculum. Ninety-two percent (272/297) of veterinarians agreed that knowledge related to PH&E was important to perform the functions of their job. History of raising animals and membership in 4-H or Future Farmers of America were significant predictors of veterinary students having an interest in PH&E. Being male and growing up in a rural environment were not significant predictors.

Conclusions and Clinical Relevance—Most veterinary students and veterinarians agreed that knowledge of PH&E is important. Variables identified as associated with an interest in PH&E may be useful for designing mitigation strategies to increase the number of veterinarians entering public health careers. (*J Am Vet Med Assoc* 2008;233:240–247)

Recent world events that have included devastating outbreaks of foreign animal diseases,^{1,2} bioterrorism,^{3,4} and natural disasters⁵ have brought to the forefront the importance of PH&E principles when dealing with emergency response and recovery from man-made and natural disasters. Veterinarians have the unique ability to bridge the fields of human and veterinary medicine and agriculture because of their training and expertise in comparative medicine. The veterinary profession has the opportunity and obligation to perform critical roles in protecting the health of humans and other animals.^{2–4,6–9}

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Supported by a grant from the Master Teaching Panel, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University.

The author thanks Ashley Berry and Brenda Jacklitsch for technical assistance and Dr. James Wright for assistance in the development of questionnaires.

ABBREVIATIONS

ACVPM	American College of Veterinary Preventive Medicine
CI	Confidence interval
FFA	Future Farmers of America
PH&E	Public health and epidemiology
PR	Prevalence ratio

A demand exists for veterinarians with an interest in PH&E to fill positions in public health practice.^{5,10–16} These positions include specializations such as bioterrorism and emergency preparedness, environmental health, food safety and security, regulatory medicine, diagnostic laboratory medicine, and biomedical research.^{5,6} The demand is expected to grow as more public practitioners approach retirement age.¹³ However, most commonly, students enter veterinary school with the desire and expectation to practice companion animal medicine^{12,17} rather than pursue a career in veterinary public health. The changing demographics of the population of veterinary students from predominantly

male with a rural upbringing to predominantly female with suburban upbringing have been considered an important factor in the decreasing percentage of students choosing careers outside of small animal practice.^{18–21} The most common career for female veterinarians is small animal practice,²² and males are more likely than females to choose a career related to food animal production.^{17,22} Quantitative data are necessary to ensure that antiquated gender roles^{17,19} and the anecdotal perception that people from urbanized locales are less likely to develop interests in public health and population medicine are not used to bias future admission policies of veterinary colleges. The magnitude of the problem must first be measured and predictors of an interest in public health should be identified before implementing procedures to address the demand for veterinarians in public practice. Changes to veterinary curricula and the amount of student debt^{22,23} have also changed over time, and the use of historical information for comparisons is not optimal for identifying appropriate mitigation strategies. The shift in career choices to companion animal practice may simply be related to market forces⁵ rather than an underlying change in the interest in public health.

Veterinary students with an interest in public health have expressed concern regarding the general lack of curricular support for developing careers in this field,^{24,25} and the ACVPM has developed a model curriculum for teaching veterinary PH&E.²⁶ Anecdotally, however, faculty who teach PH&E generally believe that few students demonstrate a strong interest in the subject matter. Identification of attitudes of private practitioners toward PH&E and development of methods to foster student interest in topics related to PH&E may be important to address the critical shortage of veterinarians appropriately trained in public health practice. The objectives of the study reported here were to identify predictors of veterinary students and veterinarians having an interest in veterinary PH&E and to determine attitudes of veterinarians toward PH&E.

Materials and Methods

Study design—A cross-sectional study design was used. All 508 veterinary students enrolled at Texas A&M University College of Veterinary Medicine and Biomedical Sciences during the spring semester of 2006 were eligible to participate. The sampling frame for veterinarians consisted of a list of veterinarians with active membership in a statewide professional organization during 2006. The list contained contact information for 3,250 veterinarians. A simple random sample of veterinarians was selected from the list on the basis of a 21% probability of selection, for a total of 683 veterinarians. An approximately equal number of veterinary student and veterinarian respondents was desired.

Questionnaire development—Two questionnaires were developed to investigate predictors of interest in PH&E: one for veterinary students and the other for veterinarians. Questionnaires included open- and closed-ended questions. Closed-ended questions included those that required participants to indicate their

responses according to a Likert scale (ie, strongly agree, agree, unsure, disagree, and strongly disagree).

The questionnaire for veterinary students consisted of 20 questions regarding personal information and veterinary school topics. Personal information included student demographics, experience with animals and agriculture, and education history. Veterinary school questions were related to personal interests in veterinary medicine and PH&E and general questions related to the veterinary curriculum. The questionnaire for veterinarians consisted of 31 questions regarding general information and PH&E topics. Requested personal information included veterinarian demographics, education, and description of current job. Public health and epidemiology topics included assessment of the veterinary curriculum, experience with public health while in practice, and attitudes toward PH&E issues.

The veterinary student questionnaire was administered confidentially via a secure Internet delivery system. The questionnaire was made available on January 24, 2006, and the link remained active until February 22, 2006. All veterinary students had access to the questionnaire, and college-level network identification was used to limit questionnaire completion to 1 event/student. Network identifications were not recorded in the online database. A digital music player, veterinary medical reference book, and bookstore gift card were used as incentives to increase participation. Students that voluntarily provided a mailbox number were eligible to receive 1 of the 3 prizes in a random selection process. Questionnaires for veterinarians were produced in booklet form. The first page of the booklet was a signed introductory letter that described the purpose of the questionnaire. Included in questionnaire packets was a first-class, stamped, self-addressed return envelope. First-class mail was used to send questionnaire packets to the 683 randomly selected veterinarians on June 1, 2006.

Statistical analysis—Separate data sets were created for responses to the veterinary student and veterinarian questionnaires. Descriptive statistics were calculated for all variables from both questionnaires. Summaries of continuous data are reported as mean \pm SD or median and range.

Dichotomous (yes or no) outcome variables derived from responses to the veterinary student questionnaire included the following: whether a course related to public health was considered necessary for their veterinary career choice, whether a course in public health was listed as 1 of the 3 courses that will help most for their current career choice, whether they would like more courses in PH&E offered in the veterinary curriculum, and whether a course in public health was listed as 1 of the 3 courses they expected to help their career the least. A composite outcome variable, interest in public health (yes or no), was created on the basis of classification according to the first 3 of the aforementioned variables, with a positive classification for ≥ 1 variable indicating a positive composite outcome and negative classifications for all 3 variables indicating a negative composite outcome. Potential predictor variables that were investigated for associations with the outcome variables were gender, age, year

of veterinary education, hometown classification (rural, suburban, or urban), size of high school graduating class, membership in 4-H or FFA organizations, family ownership of a farm or ranch, animal ownership history, undergraduate educational history, and graduate educational history.

Dichotomous (yes or no) outcome variables derived from responses to the veterinarian questionnaire included the following: whether veterinarians considered a course related to public health to be necessary in the veterinary curriculum on the basis of their career experiences, whether a course in public health was listed as 1 of the 3 courses that helped their career the most, and whether a course in public health was listed as 1 of the 3 courses that helped their career the least. Potential predictor variables that were investigated for associations with these outcome variables were gender, years since graduation from veterinary college, practice location (rural, suburban, or urban), practice type, and graduate educational history.

Separate sets of analyses were performed for each set of data. Quantitative variables were categorized via percentiles to evaluate significant associations and to determine the shape of the relationships between predictors and outcomes. Bivariate (crude) PRs, 95% CIs, and *P* values via χ^2 or Fisher exact tests were estimated by use of available software^a for all combinations of predictors and outcomes. Multivariable logistic regression was used to investigate associations between multiple predictors and each outcome. All variables identified as significant at $P \leq 0.20$ in the bivariate analyses were included in the multivariable models as the starting point for model building. Backward stepwise analysis based on likelihood ratio tests was used to determine the final main effects model. The main effect terms remaining in the model were evaluated for effect modification by adding all possible 2-way interactions between main effects individually and testing for significance by use of Wald tests. The fit of the final multivariable model was assessed via the Hosmer-Lemeshow test. Regression analyses were performed by use of commercially available software.^b

In addition, responses to questions that appeared on both the student and veterinarian questionnaires were compared. Bivariate PRs, 95% CIs, and *P* values for χ^2 or Fisher exact tests were estimated by use of available software^a for all combinations of predictors and outcomes. Values of $P < 0.05$ were considered significant for all analyses.

Results

Descriptive analysis—Three hundred ten of 508 veterinary students enrolled during January 2006 completed the online questionnaire, for an overall response proportion of 61%. The response was 64% (82/128), 68% (85/126), 53% (68/129), and 60% (75/125) for first- through fourth-year students, respectively. Mean \pm SD age of respondents was 25.6 ± 4.1 years. Seventy-nine percent (244/308) of responding students were female, and 10% (30/306) reported having an advanced degree at the time of the study. Twenty-five percent (78/309), 51% (157/309), and 24% (74/309) reported that their home was located in a rural, subur-

ban, or urban environment, respectively. Twenty-seven percent (85/308) reported that they had participated in 4-H or FFA, and 42% (128/308) reported having a relative that owned a family farm. Fifty-one percent (156/305) reported that they were interested in a career working exclusively with companion, wild, or exotic animals. Of respondents, 2.6% (8/305) reported having a career interest that involved public health or epidemiology. Seventy percent (215/305) of respondents believed that a course in PH&E was necessary for their veterinary career choice, and 15% (47/305) believed a course was unnecessary; the remainder reported that they were uncertain. Forty-six percent (140/304) believed that more courses in PH&E would improve the curriculum. Eighty-two percent (67/82), 64% (54/85), 79% (54/68), and 77% (58/75) of students within first through fourth years, respectively, were classified as having an interest in public health on the basis of the composite variable that was derived from responses to 3 questions.

Three hundred three of the 683 veterinarians to which questionnaires were mailed responded for an overall response proportion of 44%. Forty-one percent (124/301) of responding veterinarians were female; 17% (52/303) reported having an advanced degree at the time of the study. Twenty-six percent (76/291), 48% (140/291), and 26% (75/291) reported that their practice was located in a rural, suburban, or urban environment, respectively. Sixty-six percent (199/303) reported that their practice exclusively treated small animals. Mean number of years since graduation for respondents was 21 ± 14 years. Of respondents, 2.3% (7/303) reported having a career in public health. Ninety-nine percent (299/303) of responding veterinarians believed that a course in PH&E was necessary in the veterinary curriculum, on the basis of their career experiences. Fifteen percent (45/303), 35% (107/303), 59% (180/303), and 50% (150/303) of responding veterinarians believed that PH&E should be taught during first through fourth year, respectively, in the veterinary curriculum (the selection of more than 1 year for instruction was possible).

In general, most veterinarians agreed that concepts related to PH&E are important for the practice of veterinary medicine (Table 1). Seventy-two percent (211/292) of responding veterinarians believed that PH&E concepts were equally important in small and large animal practice. Twenty-two percent (63/292) reported that PH&E concepts were more important in large animal versus small animal practice, and 6.2% (18/292) believed the opposite. Ninety-three percent (283/303) of responding veterinarians reported reading at least 1 scientific article/mo, and the mean number of articles read per month was 7.2 ± 11.6 .

Seventy-seven percent (232/303) of responding veterinarians reported having interacted with the Texas Animal Health Commission, which is the legislative agency responsible for making and enforcing regulations to prevent, control, and eradicate infectious animal diseases that affect livestock in Texas. Of those that reported interactions, 151 (65%), 109 (47%), 84 (36%), and 194 (84%) had interactions related to rabies, brucellosis, tuberculosis, and health certificates and animal movements, respectively. Twenty-eight percent (84/303)

of responding veterinarians had suspected a foreign animal disease or parasite at some point since graduation from veterinary college. Of those that had ever suspected a foreign animal disease or parasite, the median number of instances was 2 (range, 1 to 20), with a mean of 0.25 (range, 0.02 to 5) instances/y of practice.

Eighty-three percent (252/303) of responding veterinarians reported prior interaction with the Department of State Health Services, which is the Texas agency charged with the protection of public health. Of those responding veterinarians reporting interactions, 178 (71%), 138 (55%), 79 (31%), and 164 (65%) had interactions related to rabies, dog bites, skunk contacts, and international health certificates for animals, respectively. Eighty-two percent (249/303) of veterinarians had referred clients to a physician because of a suspected zoonotic disease in an animal. Of those that reported having made such a referral, the median number of referrals per practitioner was 6 (range, 1 to 500), with a mean of 1.2 (range, 0.03 to 31) referrals/y of practice.

Seventy-three percent (221/303) of responding veterinarians reported having had clients referred to them by physicians because of suspected animal involvement in a human disease. Of those that reported having had such referrals, the median number of referrals was 5 (range, 1 to 500), with a mean of 0.8 (range, 0.02 to 31) referrals/y of practice.

Predictors of interest in PH&E—History of raising animals and membership in 4-H or FFA were significant predictors of veterinary students having an interest in PH&E (Table 2). Second-year veterinary students were less likely to report an interest in PH&E. Gender and self-reported classification of hometown were not associated with an interest in PH&E. The final multivariable logistic regression model included the variables second-year veterinary student and a reported history of cattle ownership and was a good fit to the data, as indicated by the results of the Hosmer-Lemeshow test ($\chi^2 = 0.029$; $P = 0.986$). Second-year veterinary students

Table 1—Number (%) of respondents with particular attitudes toward select PH&E topics as reported by 303 veterinarians surveyed in Texas during 2006.

Statement (No. of respondents)	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
Practicing veterinarians should have a firm understanding of basic epidemiologic measures (299)	79 (26)	194 (65)	17 (5.7)	8 (2.7)	1 (0.3)
Practicing veterinarians should have a basic understanding of statistics (298)	39 (13)	179 (60)	56 (19)	20 (6.7)	4 (1.3)
Practicing veterinarians should accept conclusions from scientific articles because peer-review ensures validity (297)	7 (2.4)	71 (24)	73 (25)	124 (42)	22 (7.4)
Practicing veterinarians should change standard of care on the basis of published articles (297)	4 (1.3)	65 (22)	100 (34)	117 (39)	11 (3.7)
Practicing veterinarians should consider sources of bias when interpreting results of published articles (298)	107 (36)	180 (60)	6 (2)	4 (1.3)	1 (0.3)
Practicing veterinarians should have a good understanding of diagnostic test characteristics (298)	92 (31)	197 (66)	6 (2)	3 (1)	0
Practicing veterinarians should consider other causes of disease in addition to etiologic agents when discussing prevention (298)	129 (43)	165 (55)	4 (1.3)	0	0
Practicing veterinarians should consider the possibility of antibiotic resistance when prescribing antimicrobial agents (297)	116 (39)	170 (57)	5 (1.7)	5 (1.7)	1 (0.3)
Practicing veterinarians should have a basic understanding of meat and milk hygiene (295)	56 (19)	182 (62)	35 (12)	21 (7.1)	1 (0.3)
I feel that knowledge in PH&E is important to perform the functions of my job (297)	57 (19)	215 (72)	11 (3.7)	11 (3.7)	3 (1)
I feel that there is a need for courses in PH&E in the veterinary curriculum (297)	112 (38)	169 (57)	12 (4.0)	4 (1.3)	0

Table 2—Associations between select factors and an interest in PH&E as determined from responses to a questionnaire administered to veterinary students in Texas, 2006.

Factor	Proportion of students interested in PH with factor	Proportion of students interested in PH without factor	PR	95% CI	P value*
Female	0.77 (187/244)	0.70 (45/64)	1.09	0.92–1.30	0.296
Rural hometown	0.76 (59/78)	0.75 (174/231)	1.00	0.87–1.16	0.955
Second-year student	0.64 (54/85)	0.80 (179/225)	0.80	0.67–0.95	0.004
Any family farm	0.80 (103/128)	0.72 (129/180)	1.12	0.99–1.27	0.077
4-H or FFA membership	0.84 (71/85)	0.73 (162/223)	1.15	1.02–1.30	0.047
Dog ownership	0.76 (220/288)	0.62 (13/21)	1.23	0.88–1.74	0.137
Horse ownership	0.84 (93/111)	0.71 (140/198)	1.18	1.05–1.34	0.010
Poultry ownership	0.87 (45/52)	0.73 (188/257)	1.18	1.04–1.35	0.041
Cattle ownership	0.89 (65/73)	0.71 (168/236)	1.25	1.12–1.40	0.002
Swine ownership	0.93 (37/40)	0.73 (196/269)	1.27	1.13–1.42	0.007
Bird ownership	0.80 (95/119)	0.73 (138/190)	1.10	0.97–1.25	0.153
Small ruminant ownership	0.87 (39/45)	0.73 (194/264)	1.18	1.03–1.35	0.058
Any farm-animal ownership	0.85 (122/143)	0.67 (111/166)	1.28	1.12–1.45	< 0.001

Values in parentheses represent number with the factor and an interest in PH (numerator) and total number of respondents with the factor (denominator).
*Calculated on the basis of uncorrected Pearson χ^2 tests; values of $P < 0.05$ were considered significant.

were 0.43 times as likely to report a public health interest, compared with students of other classes (95% CI, 0.25 to 0.76; $P = 0.004$). Students reporting prior cattle ownership were 3.5 times as likely to report a public health interest, compared with students with no prior cattle ownership (95% CI, 1.58 to 7.80; $P = 0.002$). No other variables were significant in the multivariable model.

Only 8 (2.6%) veterinary students reported that PH&E was 1 of the 3 courses that would help most for their projected career, and this outcome was not statistically modeled for this reason. Students from a suburban hometown were less likely to report that PH&E was 1 of the 3 courses least likely to help with their projected career (Table 3). The analysis excluded first-year students because they had not yet taken a course in PH&E. No variables, when combined in the multivariable logistic model, were significantly associated with veterinary students reporting that PH&E was 1 of the 3 courses least likely to help with their projected career.

Only 13 (4.3%) veterinarians reported that PH&E was 1 of the 3 courses that helped most for their career, and this outcome was not statistically modeled for this reason. Because 99% (299/303) of the responding veterinarians reported that a course in PH&E was necessary in the curriculum, this outcome was not statistically modeled. No variables were significantly associated with veterinarians reporting that PH&E was 1 of the 3 courses that helped the least in their career.

When veterinary student responses were compared with veterinarian responses, the proportion of students that reported an interest in strictly small animal or exotic animal medicine (51%; 156/305) was significantly ($P < 0.001$) less than the proportion of veterinarians that reported that their practice was exclusively small animal (66%; 199/303). The proportion of female veterinarian respondents was significantly ($P < 0.001$) lower, compared with the proportion of female student respondents (Table 4). Self-reported hometown classifications (rural, suburban, or urban) of students were not significantly different from those of practice locations of veterinarians. Veterinarians were significantly ($P < 0.001$) more likely to report that a course in PH&E was necessary for their veterinary careers than were students.

Discussion

The present perceived shortage of veterinarians appropriately trained to address needs in public health practice is projected to increase in the near future. It is important for veterinarians to take leadership roles in public health and emergency response to natural and man-made disasters. Increased pressure has been placed on the veterinary profession to train veterinarians for these roles. This shortage could be addressed through the recruitment of veterinarians from other practice fields into the field of PH&E. Another solution would be to implement veterinary curricular changes to

Table 3—Associations between select factors and students' belief that a course in PH&E was 1 of 3 courses least likely to help with their projected career among second- to fourth-year veterinary students, determined from responses to a questionnaire administered in Texas, 2006.

Factor	Proportion of students with belief and factor	Proportion of students with belief and without factor	PR	95% CI	P value*
Female	0.26 (44/167)	0.38 (18/48)	0.70	0.45–1.10	0.133
Second-year student	0.37 (29/79)	0.24 (33/137)	1.52	1.01–2.31	0.483
Rural hometown	0.31 (17/54)	0.28 (45/162)	1.13	0.71–1.80	0.602
Suburban hometown	0.22 (24/108)	0.35 (38/108)	0.63	0.41–0.98	0.035
Urban hometown	0.39 (21/54)	0.25 (41/162)	1.54	1.00–2.35	0.056
4-H or FFA membership	0.36 (19/53)	0.26 (43/163)	1.36	0.87–2.11	0.186

Values in parentheses represent number with the factor and the belief (numerator) and total number of respondents with the factor (denominator).
See Table 2 for remainder of key.

Table 4—Comparison of the distribution of select factors between veterinary students and practicing veterinarians on the basis of responses to questionnaires on attitudes toward PH&E in Texas, 2006.

Variable	Proportion of students with variable	Proportion of veterinarians with variable	PR	95% CI	P value*
Female	0.79 (244/308)	0.41 (124/301)	1.92	1.66–2.23	< 0.001
Rural	0.25 (78/309)	0.26 (76/291)	1.00	0.76–1.32	0.806
Suburban	0.51 (157/309)	0.48 (140/291)	1.10	0.93–1.29	0.509
Urban	0.24 (74/309)	0.26 (75/291)	0.96	0.73–1.28	0.605
Advanced degree	0.10 (30/306)	0.17 (52/303)	0.57	0.38–0.87	0.008
PH&E course helped most	0.03 (8/304)	0.05 (13/276)	0.56	0.24–1.33	0.181
PH&E course helped least	0.21 (62/292)	0.23 (58/252)	0.92	0.67–1.27	0.617
Course in PH&E necessary	0.82 (215/262)	0.99 (299/303)	0.83	0.78–0.88	< 0.001

Values in parentheses represent number with the factor (numerator) and total number of respondents (denominator).
See Table 2 for remainder of key.

foster interest in careers related to PH&E. The shortage could also be dealt with through the recruitment and enrollment of veterinary students predicted to have a higher likelihood of entering the field of public health practice, compared with other potential students.

Only 2.6% of veterinary students that responded to the questionnaire reported an interest in a career in an epidemiology- or public health-related field, which is consistent with the general perception that the majority of students do not have a strong interest in such careers. However, the proportion of students that reported an interest in strictly small animal or exotic animal medicine was less than the proportion of veterinarians that reported their practice exclusively treated small animals. Therefore, the interests of veterinary students may not be as focused on companion animal medicine as generally believed. It has also been reported²⁷ that 20% of students will change their career focus during their veterinary education. Most (70%) students believed that a course in PH&E was necessary, despite the low proportion of students that expected to pursue a career directly related to this field. Many (46%) students also believed that more courses related to PH&E would improve the curriculum. These results suggested that there are opportunities to encourage and foster an interest in PH&E through adjustments in the veterinary curriculum. Such courses would be necessary to prepare students for careers in public health practice.

Courses in veterinary PH&E are typically administered by university faculty members that are removed from the day-to-day realities of the practicing veterinarian. Veterinary curricula could therefore be improved through incorporation of the experiences of private practitioners related to PH&E. Improved delivery of the material in a clinically relevant manner may help foster interests in students and motivate other students that might consider such a career in the future. Most responding veterinarians believed that knowledge related to PH&E was important to perform the functions of their job. Also, most responding veterinarians had interactions with state regulatory agencies related to public health issues, including rabies, dog bites, and animal movements. Veterinary practitioners often interacted with physicians when zoonotic diseases were suspected. Approximately 1 in 4 veterinarians reported having been suspicious of a foreign animal disease or parasite at some time during their veterinary career. This proportion does not seem very high, but considering that true incursions are extremely rare (eg, screw worm or Venezuelan equine encephalitis), it suggests vigilance on the part of the veterinary practitioner. Public health and epidemiology topics are considered to be important as reported by practicing veterinarians, even though students and veterinarians are unlikely to list a PH&E course as being one of the most important subjects within the curriculum.

Students selected for enrollment into professional veterinary curricula could also be selected on the basis of factors that would predispose them to having, and possibly maintaining, an interest in PH&E. Contrary to what might have been expected on the basis of other studies^{17,28} in which predictors of careers in food animal production were investigated, the variables gender

and rural upbringing were not associated with students in the present study having an interest in PH&E. The changing demographics of the veterinary profession may be unrelated to any perceived change in the interest level of students in careers related to PH&E. All but 1 veterinary student reported ownership of ≥ 1 animal prior to entry into veterinary school. Despite the high proportion of pet-owning students, ownership of several species in particular was a better predictor of an interest in PH&E. Students with prior ownership of farm animals were more likely to have a reported interest, and results of multivariable modeling suggested that in this population of students, raising cattle was the best predictor of an interest in PH&E.

Results of the study reported here also suggested that interest in PH&E may change during the course of the veterinary curriculum. Second-year students were less likely to report an interest in PH&E and more likely to report that such a course was least likely to help in their projected career. However, the questionnaire was administered at the beginning of spring semester during which second-year students were taking the required course in PH&E. An examination was scheduled during the time at which the questionnaire was accessible online, and it is possible that the proximity of the examination affected students' responses. The apparent lower interest within second-year students could also represent a cohort effect that resulted from an inherent difference in that class, compared with the other 3 years of students.

Most responding veterinarians reported that a course in PH&E was necessary in the veterinary curriculum; therefore, it was not possible to determine predictors of this outcome. No measured factors were significantly associated with veterinarians reporting that a course in PH&E was least helpful for their chosen career. The proportion of females among veterinarian respondents was fewer than the proportion among students, and this difference reflected the changing demographics of veterinary medicine,²⁹ as the mean number of years since graduation of respondents was 21 years. However, the student demographics as related to hometown classification (rural, suburban, or urban) were not different than self-reported practice locations of veterinarians. It has been suggested that a shortage of veterinarians in rural communities exists,²⁰ but results of the present study indicated that the proportions of students from the various hometown classifications might be equal to the veterinary needs of those locales. The factors associated with a shortage in rural communities may be related to recruitment and retention of veterinarians rather than changing demographics of veterinary students.

Veterinarians were more likely to report that a course in PH&E was necessary for their veterinary careers than were students. This may be an indication that true differences exist in the degree of interest of current versus past students, or the disparity may be attributable to unmeasured factors. If this is a true effect, then it does not appear to be easily explained by gender or a general rural upbringing but may be explained by changing attitudes. Public health and epidemiology is a population-level concept, and veterinary

students need to become comfortable with animal-level medicine before addressing population medicine. With experience in practice, most veterinarians become comfortable with routine medical problems and can therefore devote more consideration to other issues. The hypothesis of changing attitudes with time is also supported by data that indicated the proportions of veterinarians and students who reported that a course in PH&E helped the most or the least were not significantly different.

The results of all epidemiologic studies must be interpreted in conjunction with possible sources of bias and limitations inherent to the study design. The present study used a cross-sectional design, and it was not possible to measure changes in attitudes with time. Many of the evaluated predictors, however, were fixed characteristics (eg, gender) or were factors related to specific time periods that preceded completion of questionnaires (eg, hometown and animal ownership history). The predictors should be valid for the attitudes at the time of questionnaire administration, but it is impossible to know the manner in which these attitudes and the effects of the predictors may change with time. The 3 general sources of systematic error (selection, information, and confounding bias) may have also influenced results of the present study. Selection bias is an important consideration for questionnaire studies and occurs when responders are systematically different than nonresponders. A high response proportion is considered important to minimize nonresponder bias³⁰; however, nonresponder bias can also occur with high response proportions.³¹ Information bias can occur when questions are unclear and the probability of collecting the true information varies on the basis of comparison groups. In the present study, the questions were phrased similarly on student and veterinarian questionnaires and only basic information was collected related to predictors; few complicated questions were included on either questionnaire. Confounding is another potential source of bias in study results. Multivariable models were built in attempt to control for the effects of multiple variables and for the reporting of adjusted measures of association. Because information regarding predictors of an interest in PH&E is limited, it is unknown whether important factors differed between comparison groups.

Despite the limitations of the study reported here, the findings could be used to design mitigation strategies to address the limited number of veterinarians entering career fields related to public health practice. There appears to be a sufficient number of students with some interest in PH&E enrolled in veterinary school. However, schools could make an effort to recruit more students with experience working with food animals if the number of interested students appears to decline. Another strategy may be development of educational opportunities to encourage interests in PH&E. Such opportunities could include the development of related elective courses, a PH&E track, and increased opportunities for summer internships and public health externships. Careers that deal with response to natural and man-made disasters require expertise in public health and epidemiologic principles.

Veterinarians are uniquely qualified to perform these roles, but training in these principles is required to provide the necessary skills. The veterinary profession has the opportunity and obligation to assume critical leadership roles for the protection of human and animal health.

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- a. Epi Info, version 6.04, CDC, Atlanta, Ga.
 - b. SPSS for Windows, version 15.0, SPSS Inc, Chicago, Ill.
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