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Assessing Bioterrorism Preparedness and Response of Rural Veterinarians: Experiences and Training Needs

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ABSTRACT

Veterinarians play a unique role in emergency preparedness and response, and federal agencies and academic institutions therefore allocate considerable resources to provide training to enhance their readiness. However, the level of preparedness of veterinarians in many rural regions is yet to be improved. This article reports an assessment of the bioterrorism preparedness, specifically the experience and training needs, of rural veterinarians in North Texas. The study employed a cross-sectional design with a study population that included all veterinarians ($N=352$) in the 37 counties within Texas Department of State Health Services Regions 2 and 3. Data on veterinarians practicing or residing in the target region were obtained from the Texas State Board of Veterinary Medical Examiners. The response rate was 35% ($n=121$). Results indicate that chemical exposure was the condition most frequently seen and treated, followed by botulism and anthrax. The majority (80%) of respondents indicated that they had not previously participated in training related to bioterrorism preparedness, and many (41%) also indicated a willingness to participate in a state health department–initiated bioterrorism response plan. However, only 18% were confident in their ability to diagnose and treat bioterrorism cases. These results suggest that many North Texas veterinarians practicing in rural regions could benefit from additional training in bioterrorism preparedness and response. An area in particular need of further training is the diagnosis and treatment of Category A agents. Federal, state, and local health agencies are urged to increase training opportunities and to make additional efforts to involve veterinarians in bioterrorism preparedness and response.

Key words: veterinary, bioterrorism, emergency preparedness, survey study

INTRODUCTION

Public health and emergency preparedness in the United States have been challenged by several unfortunate events in recent years, including the September 11, 2001, attacks; the subsequent anthrax bioterrorism events in October 2001; and the 2005 hurricane events along the Gulf of Mexico. While the majority of emergency training may use case scenarios that focus on humans, veterinarians also need training, particularly those residing in rural areas. Although rural areas generally have fewer human inhabitants, they include large livestock populations and crop resources and may be at least as vulnerable as urban regions to deliberate acts of destruction.[1,2] Biological weapons in the form of emergent animal diseases could be used against the livestock or poultry industries in the United States and could cause devastating effects to the food supply and economy.[2,3] Veterinarians would be very much involved in the response to such an attack, including the recognition and diagnosis of the disease and the implementation of control measures to limit its spread and mitigate the impact of the event. They would also be involved, should the needs arise, in assessing the extent of injury and loss of animal life.

Veterinarians are very important to public-health surveillance,[2,4,5] specifically to the ability to diagnose and treat cases of zoonotic disease.[a] In the event of an intentional release of biological agents, animals may serve as sentinels, presenting clinically before signs and symptoms become evident in humans. Additionally, a biological agent might be deliberately selected as a weapon because of its zoonotic nature.[4] Of the more than 1,700 identified pathogens affecting humans, 49% are known to be zoonotic, and 73% of the 156 pathogens considered "emerging" are known to infect both humans and animals.[6,7] Therefore, clinical veterinarians, public-health and regulatory veterinarians, and veterinary diagnostic laboratories constitute an important first line of response to biological agents with a potential public-health impact.

Several groups have called for action on many fronts, including addressing how veterinary education must change to meet new professional challenges.[8] Even prior to the 9/11 attacks and the anthrax bioterrorism events of October 2001, it was recognized that there were not enough veterinarians engaged in population-health and public-health practice.[9] In January 2000, the National Animal Health Emergency Management System (NAHEMS) published the Standards for State Animal Health Emergency Management Systems to assist state-level animal-health officials and emergency managers in determining what is needed for a successful response to an animal-health emergency.[10] In November 2002, the Association of American Veterinary Medical Colleges (AAVMC) concluded that changes were necessary to keep pace with new threats, including bioterrorism.[11] Several subsequent National Research Council (NRC) reports have addressed

the future of veterinary medicine.[12–15] In November 2005, the Executive Board of the American Veterinary Medical Association (AVMA) recommended specific actions through *Research for Healthy Animals 2010*, including enhancing the size and diversity of the veterinary workforce and training more veterinarians for careers in public health.[16]

With the ever-expanding range of material included in veterinary curricula, there is limited opportunity to address public health and bioterrorism during the four years of veterinary education. One study found that only 17% of veterinary schools in the United States require clinical-year rotations in public health, preventive medicine, or population medicine. The study calls for greater collaboration between veterinary schools, schools of public health, and the professional public-health community.[17] Other studies recommend providing additional bioterrorism preparedness training, both within DVM curricula and through continuing-education opportunities,[18] with emphasis in such areas as identification of emergent animal diseases, threat assessment for Category A agents, policy making, and education and public information campaigns.[4]

Post-graduate programs for veterinarians may provide the opportunity to focus specifically on bioterrorism and/or public health, as in traditional Master of Public Health degree programs and more recently developed programs in homeland security and bio-security. Residency programs and other experiential learning opportunities have also integrated preparedness in training initiatives for health professionals, including veterinarians. For instance, the Epidemic Intelligence Service and the Preventive Medicine Residency and Fellowship at the Centers for Disease Control and Prevention (CDC) provide training in applied epidemiology, biostatistics, outbreak response, surveillance, emergency preparedness and response, scientific communication, community intervention, and program evaluation to a variety of professionals, including veterinarians.[19,b]

Reaching practicing veterinarians, especially in remote or rural areas, requires innovative approaches to delivering continuing education or creating on-the-job opportunities to get involved in preparedness and response activities.[c] The Center for Food Security and Public Health (CFSPH) at Iowa State University is one program aimed at increasing veterinary practitioners' awareness of bioterrorism, biosecurity, and food safety. The CFSPH is partially funded by the CDC and the US Department of Agriculture (USDA). From 2003 through 2005, 330 veterinarians were trained in train-the-trainer sessions, and those veterinarians then delivered more than 870 presentations to a total of 35,000 individuals.[20] Similarly, North Carolina, in response to the devastation resulting from Hurricane Floyd in 1999, developed the North Carolina State Animal Response Team (SART).[d] This pioneer public–private partnership uses human emergency-management procedures as a model for responding to disasters involving animals. This model has been adapted by other states under various names and organizational structures, and the formation of a national alliance of all state programs is currently being explored.[21] Recognizing that events occur and are responded to locally, many local jurisdictions are also forming response teams, including animal response teams. The sustained success of such programs, however, depends on continued funding, which is not always possible given the cyclical, short-term nature of many funding sources.

Despite these initiatives and other efforts by academic institutions, professional organizations, and federal agencies, the preparedness level of first responders is still a subject of concern, particularly in rural areas.[22] Studies involving physicians and physician assistants in rural Texas have concluded that health care providers need additional training[23–25] and that poor communication or the lack of an existing emergency plan can undermine a quick and effective response in rural areas.[26–29] Similarly, the level of emergency preparedness of veterinarians has traditionally been a concern in many states.[26,27] A recent study conducted among veterinarians in Hawaii reported that fewer than 20% of participants felt they were prepared to recognize a bioterrorism event in human populations and respond effectively to a bioterrorist attack.[18]

Because of the unique importance of veterinarians in public-health preparedness and response, there is a need to better understand their bioterrorism preparedness and training needs. The purpose of the present study was to assess the bioterrorism-related experience, confidence, and training needs of veterinarians in North Texas. The study focused on the diagnosis and treatment of chemical, biological, radiological, nuclear, and explosive (CBRNE) agents that could be used in a bioterrorist attack. The results of this study may be instrumental in recommending policies and developing effective interventions for bioterrorism preparedness and response.

MATERIALS AND METHODS

Study Design

This study used a cross-sectional survey design with a study population that included all practicing veterinarians in the 37 counties in Texas Public Health Regions 2 and 3 that do not have a county health department. These North Texas regions are mostly rural, and because they do not have a county health department they are referred to in the state health department's communications as "non-participating counties." The study protocols were approved by the institutional review boards (IRBs) of the University of Maryland College Park and University of North Texas Health Science Center.

Statewide data on demographics, license numbers, education, and practice information of veterinarians in these counties were retrieved from a Microsoft Excel spreadsheet obtained from the Texas State Board of Veterinary Medical Examiners. This document was then imported into Microsoft Access[e] and queried to identify those veterinarians in the geographical area of interest ($N = 352$). Each veterinarian served as an individual unit of analysis.

Registered veterinarians in North Texas who practiced or resided in one of the 37 identified non-participating counties were selected for the study population.

Survey Instrument

Data were collected using a survey instrument developed by the investigators and previously validated and employed in similar studies assessing other health professionals.[23–25] The survey consisted of 12 items measuring experience,

confidence, and training needs; responses were given on Likert-type and categorical scales.

The experience-related section addressed issues pertaining to previous experience with having seen or treated cases caused by CBRNE agents, such as anthrax, smallpox, botulism, plague, and chemical and radiological exposure. Smallpox, although eradicated in the late 1970s and not a zoonosis, was included because it is listed as a CDC Category A bioterrorism agent. This section also included topics such as participation in bioterrorism preparedness and response training, willingness and availability to collaborate with the state health department in the event of an emergency, and confidence in one's ability to diagnose and treat bioterrorism-related cases.

Data Collection and Methods

A survey package approved by the relevant IRBs and consisting of a cover letter, the survey, and a stamped return envelope was mailed to all eligible veterinarians. Participants were assured of anonymity and were invited to respond to the survey either by submitting the completed hard copy by fax or mail or by completing an online version located on a secure Web site. The survey instrument is available from the authors upon request.

The Web-based survey used ColdFusion Server,[f] which permits access to the electronic survey after verifying the respondent's unique identification. Surveys completed electronically were automatically imported into the database, while surveys completed and returned via fax or mail were entered manually by one individual and subsequently reviewed for inconsistencies by a second individual.

A second survey package, identical to the first, was mailed out approximately three weeks after the initial mailing to non-respondents.

Data Analysis

Data were analyzed with the aid of SPSS 11.5.[g] Basic descriptive statistics were performed to determine the distribution of responses. Demographic variables included gender, race/ethnicity (white vs. non-white), and county of practice or residence. Response variables included assessment of confidence, experience, and training needs. Both independent samples *t*-tests and chi-square tests were employed to explore statistically significant differences in demographic characteristics (e.g., gender and race) between those who responded to the survey and those who did not respond.

RESULTS

In total, 352 survey packets were mailed to eligible veterinarians; only two were returned as undeliverable because of outdated addresses. The final response rate for the 350 individuals who received the survey was 34.57% ($n=121$); of the 121 surveys returned, 55.4% ($n=67$) were received after the second mailing. Table 1 summarizes the characteristics of the study population. Note that it is possible to compute a 95% confidence interval around the 35% response rate; in this case the 95% C.I. ranges from 30% to 40%. Because our study population was relatively large ($N=352$), the response rate (35%), being close to 50%, produced an acceptable confidence interval. Therefore, we can infer that values in the wider population of veterinarians are close to those we observed.

The majority of respondents were white ($n=112$, 92.6%) and male ($n=88$, 72.7%). Independent samples *t*-test and chi-square test results for demographic characteristics by response status revealed no significant differences ($p>0.2$) in gender or race by response status. The respondents represented 30 of the 37 non-participating counties included in the study. Responses to questions of particular interest are detailed below.

Experience

Chemical exposure was reported as the condition most frequently seen ($n=34$, 28.1%) and most frequently treated ($n=26$, 21.5%), followed by botulism (seen: $n=30$, 24.8%; treated: $n=18$, 14.9%), anthrax (seen: $n=19$, 15.7%; treated: $n=5$, 4.1%), and other CBRNE agents (see list in Table 2).

More than 80% of respondents ($n=98$) indicated that they had not previously participated in bioterrorism preparedness and response training. Of those who had participated in training ($n=16$, 16.3%), the majority had done so after September 11, 2001 ($n=13$, 81.2%).

Overall, respondents who had participated in training indicated that the training was more likely to include discussion of emergency preparedness and risk

Table 1: Characteristics of study population and respondents

	Population *N* (%)	Respondents *n* (%)	Non-Respondents *n* (%)
Gender			
Female	89 (25.3)	33 (27.3)	56 (24.2)
Male	263 (74.7)	88 (72.2)	175 (75.8)
Race/Ethnicity			
White	332 (94.3)	112 (92.6)	220 (95.2)
Non-white	0 (0)	0 (0)	0 (0)
No response	20 (5.7)	9 (7.4)	11 (4.8)

Table 2: Experience with CBRNE agents

	Seen		Treated	
	Yes	No	Yes	No
	n (%)	*n* (%)	*n* (%)	*n* (%)
Anthrax	19 (15.7)	102 (84.3)	5 (4.1)	116 (95.9)
Botulism	30 (24.8)	91 (75.2)	18 (14.9)	103 (85.1)
Smallpox	2 (1.7)	119 (98.3)	0 (0)	121 (100)
Plague	3 (2.5)	118 (97.5)	0 (0)	121 (100)
Chemical exposure	34 (28.1)	87 (71.9)	26 (21.5)	95 (78.5)
Radiological exposure	4 (3.3)	117 (96.7)	1 (0.8)	120 (99.2)

Table 3: Participation in bioterrorism-related training, by training type

Bioterrorism Event	Diagnosis	Treatment	Emergency Preparedness	Risk Communication
	n (%)	*n* (%)	*n* (%)	*n* (%)
Anthrax	7 (43.8)	6 (37.5)	11 (68.8)	7 (43.8)
Botulism	6 (37.5)	5 (31.3)	8 (50.0)	6 (37.5)
Smallpox	6 (37.5)	5 (31.3)	10 (62.5)	7 (43.8)
Plague	6 (37.5)	6 (37.5)	10 (62.5)	7 (43.8)
Chemical exposure	5 (31.3)	5 (31.3)	10 (62.5)	6 (37.5)
Radiological exposure	4 (25.0)	4 (25.0)	7 (43.8)	5 (31.3)

communication than to address diagnosis and treatment (see Table 3).

Willingness and Level of Confidence

Despite many respondents' lack of training, more than one-third ($n = 46$, 38%) of them indicated that they would be willing and available to collaborate with the state health department in the diagnosis and treatment of a bioterrorism case. Many respondents also expressed a willingness to participate in a state health department bioterrorism response plan ($n = 49$, 40.5%). However, only 22 respondents (18.2%) were confident in their ability to diagnose and treat a case of intentional exposure to a CBRNE agent. Almost twice as many respondents ($n = 43$, 35.5%) answered that they were, to some degree, *not* confident in their ability to diagnose and treat such a case.

Preferred Future Training

When asked if they would like to receive additional information and/or materials relating to bioterrorism, more than two-thirds of respondents ($n = 81$, 66.9%) replied in the affirmative. An equal expressed interest in being informed of future training opportunities in bioterrorism preparedness and response. Of those interested in future training opportunities, many respondents preferred self-paced training in the form of a CD-ROM ($n = 32$, 39.5%), Internet-based training ($n = 30$, 37.0%), or audiovisual materials ($n = 27$, 33.3%). Many respondents indicated a preference for small-group workshops over large-group presentations when asked about their preference for instructor-led training.

DISCUSSION

Based on the results of the present study, North Texas veterinarians are in need of more training opportunities that address issues of bioterrorism and emergency preparedness. While the importance of veterinarians' role in bioterrorism preparedness and response has been demonstrated, the fact that many training modules focus on human health may deter veterinarians from participating, even if they are very motivated to take part. More effort should be made to target these health professionals and stress the many ways in which they can contribute to preparing for and responding to bioterrorism and emergency events.

As expected, many of the veterinarians reported seeing and treating cases of anthrax and botulism, which are often endemic in rural areas with grazing livestock. However, limited experience was reported with other bioterrorism-related agents and with radiological exposure. This issue should be addressed in future training to ensure familiarity with these agents, especially because all Category A bioterrorism agents except smallpox are zoonotic. A Category A agent has a high potential to cause large numbers of human casualties, can be manufactured and disseminated on a large scale, and requires significant public-health preparation for response.[4]

Like the physicians and physician assistants in the same region surveyed for our previous studies,[23,25] many veterinarians (>80%) reported not being completely confident in the diagnosis and treatment of public-health emergency cases. Therefore, as recommended elsewhere,[8,17,18] more continuing education in preparedness and response should be delivered that addresses the diagnosis and treatment of bioterrorism-related cases and emergent animal diseases. In addition, many veterinarians indicated a preference for self-paced training. Health planners should capitalize on these reported interests and training preferences to enhance the preparedness competencies of this group. Relative to our previous studies with health providers[23,25] in the same region, the present study had a higher response rate, and more respondents expressed interest in obtaining training materials.

The results of this study also confirm and validate concerns within the veterinary profession about the need for additional training in public health and biodefense. This issue is currently being addressed. In early 2007, the Veterinary Public Health Workforce Expansion Act (VPHWEA) was introduced into Congress.[h] The VPHWEA would establish a competitive grants program to increase the capacity of veterinary medical colleges and expand the workforce of veterinarians engaged in public-health practice. Even if the VPHWEA is passed and funds are appropriated, the impact of that bill and of other long-term efforts on veterinarians' involvement in public health and bioterrorism will be difficult to assess until sufficient time has passed for the present generation of pre-veterinary and veterinary students to enter the profession.

Recent long-term efforts to address recommendations to enhance preparedness training programs include the creation of several combined degree programs in veterinary medicine and public health, as at Tufts Cummings School of Veterinary Medicine in collaboration with the school of medicine.[i] Several schools of public health, including the Ohio State University and University of Minnesota School of Public Health, also offer combined veterinary and public health programs.[j]

Other similar training programs exist that may not have veterinarians as the primary target audience but do have programs relevant to veterinary practitioners and bio- or agro-terrorism. The Federal Emergency Management Agency's Center for Domestic Preparedness (CDP), located in Anniston, Alabama, is the United States Department of Homeland Security's only federally chartered Weapons of Mass Destruction training center, and includes the only hospital facility in the United States dedicated to training hospital and health care professionals in disaster preparedness and response. Among the many training programs offered by the CDP are courses on agriculture emergency responder training. The National Center for Biomedical Research and Training, Academy of Counter-Terrorist Education, at Louisiana State University offers a course in preparedness for and response to agricultural terrorism for first responders, including veterinarians.[k] The course is funded in part by the US Department of Homeland Security and by state and local governments, and it is offered free to participants throughout the United States, including those in rural areas.

Other opportunities for veterinarians to become involved in preparedness and response include participating as a member of a Veterinary Medical Assistance Team (VMAT), a team within the National Response Plan that can be deployed in the event that a state or federal disaster is declared.[l] The mission of the VMAT is to assist with animal care and animal-related issues and to provide advice on public health during a disaster, following a request from an appropriate agency. Four VMAT teams are currently available for deployment, and VMAT teams have responded to numerous events, including the 9/11 attacks and Hurricane Katrina. Both the state animal response teams and the VMAT are established to respond to known emergencies. However, although they provide field experience to participants, they do not address training for the practitioner who may be the first to be presented with a case resulting from a bioterrorism event.

The results of the present study indicate that, despite the existing training activities described above, training in bioterrorism recognition and response is still necessary in rural veterinary practice. A review of all existing opportunities for veterinarians to get involved in preparedness and response activities is beyond the scope of this article. However, this discussion does attempt to illustrate how the bioterrorism training needs of veterinarians are being addressed, as well as the need to make these training activities sustainable.

LIMITATIONS

First, because the present study was exploratory in nature, the survey items were limited in scope. A more comprehensive instrument might include, for example, additional demographic questions on education, professional practice, and personal characteristics; similarly, follow-up questions on specific agents would have provided more accurate information about participants' experience and training needs. Our results suggest that the practitioners we surveyed have most experience with chemical exposures, yet many did not provide information on the specific types of chemicals involved. The survey also failed to include tularaemia, an important zoonosis and a CDC Class A agent of bio-threat concern. This agent should be included in future surveys of this particular health profession.

Second, given that the study captured only one-third of the potential study population (34.5%), the results must be generalized with caution.

Third, some participants did not respond to several questions. For instance, rather than selecting an answer choice, nearly half of the respondents chose not to answer the questions regarding their willingness and availability to participate in a state health department's event response ($n=54$, 44.6%) and to assist in the diagnosis and treatment of bioterrorism-related cases ($n=55$, 45.5%). Similar results were seen when respondents were asked about their confidence in their ability to diagnosis and treat a bioterrorism case: 46.3% of respondents ($n=56$) did not responding to this question. Lack of knowledge of what these choices entail may underlie the non-response, but further investigation should be made to determine why so many veterinarians chose not to answer these questions. The respondents did proceed with the survey, however, and,

when asked if they would like to receive more information on these issues, more than 66% ($n = 81$) selected "yes," with equivalent results when respondents were asked if they would like to be informed of future training opportunities.

Finally, it should be noted that although the study focused on veterinarians in non-urban settings, the results may also prove beneficial for those practicing in urban areas. Additional studies should explore this issue.

CONCLUSIONS

Despite reporting limited experience with CBRNE events and a low rate of participation in bioterrorism and emergency preparedness training, North Texas veterinarians expressed a need to receive further information on the topic. Additionally, while most veterinarians expressed a lack of confidence in their ability to diagnose and treat bioterrorism-related cases, survey results showed a general willingness to participate in a state health department bioterrorism response plan. Many respondents did express an interest in receiving additional training and said they preferred self-paced training, such as CD-ROM, Internet-based, or audiovisual material, as well as preferring small-group workshops over large-group presentations. Despite the limitations discussed above, the findings of this study point to the challenges and opportunities involved in developing coordinated strategies to strengthen preparedness and response strategies at the local and state levels, particularly in non-urban jurisdictions.

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NOTES

a Although this study focused on bioterrorism-related events against humans, an act of bioterrorism using a zoonotic agent may also affect animals. Affected animals may be the first indication of a bioterrorism attack, and veterinarians must be trained to identify and report such cases. Agro-terrorism applies to terrorism directed at animals or crops and is generally not intended against humans, although the effects (panic, disruption) would be considerable.

b For information on the CDC Preventive Medicine Residency and Fellowship see <http://www.cdc.gov/epo/dapht/pmr/pmr.htm>.

c Center for Food Security and Public Health, Iowa State University <http://www.cfsph.iastate.edu/>.

d North Carolina State Animal Response Team <http://nc.sartusa.org/>.

e Microsoft Corp., Redland, WA 98052-6399 <http://www.microsoft.com/>.

f Adobe Systems Inc., San Jose, CA 95110-2704 <http://www.adobe.com/>

g SPSS, Inc., Chicago, IL 60606 <http://www.spss.com/>.

h See Office of Legislative Policy and Analysis, Legislative Updates, 109th Congress <http://olpa.od.nih.gov/legislation/109/pendinglegislation/veterinaryact.asp>.

i For more information on the Tufts program see <http://www.tufts.edu/vet/dvm/dvmmph.html>.

j For information on the Ohio State University program see <http://vet.osu.edu/vetpublichealth.htm>; for the University of Minnesota, see <http://www.sph.umn.edu/education/vph/home.html>.

k For more information on the Louisiana State University program see <http://www.eden.lsu.edu/LearningOps/othersources/lsu_ncbrt_agbio.aspx>.

l For more information on the VMAT program see <http://www.vmat.org/>.

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