Bio- and Agroterror: The Role of the Veterinary Academy

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With the events of September 11, 2001, and the anthrax attacks that followed, a somber realization is emerging that we have entered an era of international terrorism that, for years to come, will threaten the quality of life worldwide. This new form of attack, known as "asymmetric warfare," is predicted to supplant traditional military endeavors and is aimed at provoking economic, social, and political chaos and destabilization and, ultimately, at undermining confidence in government. Targets of these so-called asymmetric threats may not be restricted to human beings, but increasingly may include any arena in which destruction or damage could undermine economic, social, environmental, or political values.[1] Among the arsenals available to achieve these goals is intentional dissemination of harmful biological organisms, including many agents aimed at causing human illness or contaminating the food supply (bioterror) and also many agricultural diseases (agroterror). The resulting economic devastation and collapse of animal industries would initiate a cascade of events through multiple sectors of the economy. It will be of paramount importance to the well-being of society that new visionary curricula be developed to prepare veterinarians for these new challenges, which are now a reality for our profession.

Bioterror is the use of biological agents to harm humans or animals, and agroterror is the intentional introduction, or threat of introduction, of chemical, biological, radiological, or nuclear agents into animal or plant populations with the intention of producing a negatively economic impact. Although animal agroterror is very obviously the province of veterinarians, bioterror also has significant relevance to our profession in that most bioterror agents of humans are zoonotic. Of the six major human bioterror threats identified by the Centers for Disease Control and Prevention—smallpox, plague, tularemia, anthrax, botulism, and hemorrhagic fevers—all but the smallpox virus are agents with which veterinarians are already familiar. In the context of this article, the term "agroterror" will refer to the use of biological agents in animal populations.

Although we are just beginning to appreciate the potential for agroterror and the willful introduction of disease into animal populations, biological warfare targeting animals is not new.[2] In 1915 and 1916, horses and mules in Maryland, Virginia, and New York were the targets of biological warfare using glanders and anthrax manufactured in Germany. It has been strongly suggested that Rhodesian security forces infected cattle with anthrax during the Zimbabwe war for independence in 1978–1980, and that the Soviet military used glanders against horses in Afghanistan between 1982 and 1984.[2] In addition, there is documented evidence that foot-and-mouth disease, classical swine fever (hog cholera), African swine fever, rinderpest, sheep and goat pox viruses, and *Chlamydia psittaci* have been prepared specifically for agroterror. Numerous other agents that have been mentioned as making excellent weapons could affect a wide range of species, either as the primary target or through collateral exposure, including captive exotic animals, companion animals, wild animals, food animals, and endangered species. Access to these organisms is straightforward, as they can be obtained from infected animals in many parts of the world, and agent dissemination is simple and could take place in a variety of venues.

The advent of asymmetric threats has colored the landscape of both international and domestic activities and has profound implications for veterinary medicine and veterinary medical education. A new and major question facing veterinary education, and specifically facing the administrations, faculty, and curriculum committees of colleges and schools of veterinary medicine, is *How can the veterinary academy meet the new needs for veterinary education necessary to protect our animal populations and society from these new ills?*

OUR PROFESSION IS FOUNDED ON SERVICE TO SOCIETY

> Being admitted to the profession of veterinary medicine, I solemnly swear to use my scientific knowledge and skills for the benefit of society through the protection of animal health, the relief of animal suffering, the conservation of livestock resources, the promotion of public health and the advancement of medical knowledge.

In view of the events of September 2001, the veterinarian's oath assumes greater significance and meaning in the context of veterinary education than ever before. The oath clearly delineates the important contributions each veterinarian has agreed to make to public health, livestock conservation, and advancing medical knowledge, all key elements in responding to recent events and preparing for the future. To ignore the new challenges facing the profession would be not only to neglect the tremendous opportunities for our profession but also to abandon our greater commitment to animals and society.

The many challenges facing the veterinary profession and veterinary education have been addressed through numerous forums in recent years. Two large market surveys targeted problems of stagnant income for the veterinary profession.[3–4] One of these, the KPMG study,[4] however, indicated that there were tremendous growth opportunities, citing a global demand for all nontraditional and private practice opportunities. Some of the key areas highlighted for development include public health, food safety, environmental health, and internationalization. It is these new areas of growth for the profession that are at the core of creating professionals who can effectively address these new needs of society, including dealing with the specters of bio- and agroterrorism. However, the KPMG study also revealed

that skills, knowledge, aptitudes, and attitudes within the profession were insufficient and inadequate to meet the needs in these new growth areas. Specifically, the study stated that "veterinarians' self perception of their abilities and their perception of what they can contribute to society potentially limit the professional and economic growth of the veterinary medical profession."[4] It is of paramount importance that we induce a major cultural shift in our educational process to allow students to assume roles in these expanding areas, effectively facilitating the growth of our profession and increasing our service to society.[5]

EXPANDING ROLES FOR VETERINARIANS IN RESPONDING TO BIO- AND AGROTERRORISM

Veterinarians can and should be major players in the evolving response to asymmetric warfare involving biological threats. Following are some opportunities and key roles for our profession that deserve renewed consideration in curricular development.

Maintaining the Value of Agriculture

The primary responsibility of the food animal clinician is to preserve the health and economic value of our livestock and poultry. Agriculture is the largest single industry in the American investment portfolio, accounting for 13% of the gross domestic product and 17% of all jobs. Cash receipts from livestock and poultry total approximately $200 billion per year, and about 20% of all livestock and poultry products are destined for export. Agriculture is one of the few industries for which we export more than we import, making it very important in maintaining our balance of trade.[6] Our ability to export animals and animal products is predicated on our, and their, freedom from animal disease. Should a disease be introduced that would make our animal products unpalatable for our trading partners, exports would cease immediately, and the collapse of the domestic sector would follow shortly, with economic reverberations felt in every citizen's pocket. Introduction of a disease in one animal industry may also have severe economic consequences for other seemingly unrelated industries. For example, some believe that outbreaks of foot-and-mouth disease (FMD), although it does not affect horses, can be expected to result in losses for the equine industry.[7] As experienced by the British horse industry during the recent FMD epidemic in the United Kingdom,[8, 9] effects of FMD restrictions can be felt in many aspects of the horse industry, including racing, feed supply and movement, availability of veterinarians, and movement of horses and materials nationally and internationally. Keeping our national herds free of these economically devastating diseases will require a cadre of well-prepared veterinarians to maintain continued vigilance and constant surveillance to detect the entry of new diseases.

Public Health and Communicating Risk

As veterinarians, we receive excellent education for a variety of species in the pathogenesis of many infectious diseases, including zoonotic diseases. Because so many potential bioterror diseases involve a zoonotic agent, veterinarians are well equipped to deal with many aspects of bioterror. The unique qualifications of veterinarians to serve in public health have long been recognized, as indicated by the majority of state governments' maintaining a position in public health specifically for a veterinarian. Our profession is also central in food safety, a potentially high risk arena for bioterror threats. In addition, veterinarians can continue to be necessary and appropriate conduits of information on bioterror and agroterror to the general public. Veterinarians are accustomed to dealing with zoonotic disease and understand biosecurity precautions. They can be a voice of reason in communicating risk and adequate caution to the general public and can be critical representatives in planning efforts to respond to threats effectively. Veterinarians provide critical expertise and perspectives in affecting political change by serving on government panels and advisory committees.

Diagnostic Activities

The diagnostic capabilities and acumen of veterinarians could be very valuable in the event of a bioterror incident. Whereas very few physicians in North America have ever seen cases of anthrax, plague, or tularemia, these are diseases that are diagnosed with some regularity in veterinary medicine. In fact, most veterinary diagnostic laboratories are capable of making these diagnoses. A recent survey conducted by the American Association of Veterinary Laboratory Diagnosticians reveals that 97% of veterinary laboratories are prepared to diagnose *Bacillus anthracis*, 100% to diagnose *Francisella tularensis*, 90% to identify *Yersinia pestis*, and 61% to diagnose *Clostridium botulinum*.[10] Surely these laboratories and the veterinary expertise they provide would prove useful in the event of a bioterror episode.

Research

A degree in veterinary medicine confers a tremendous understanding of comparative biology. Veterinarians are well positioned to undertake research in disease development, pathogenesis, diagnosis, and control. With a broad-based exposure to and study of microbiology, anatomy, physiology, and epidemiology, veterinarians are able to envision a big picture, and they make outstanding team members and leaders in multidisciplinary research.

Protecting Captive Species and Wildlife

Wildlife, including endangered species, are at high risk of being affected when a bioterror or agroterror threat is made on the United States. In addition, captive animal populations will likely be significantly affected. Veterinarians will play a critical role in supplying expertise on how to control bioterror or agroterror when wildlife or captive populations are threatened. Like all veterinarians in clinical practice, the zoo or wildlife veterinarian is part of the first line of defense in recognizing new or unusual diseases, since the zoo animals or wildlife may act as sentinels for newly introduced diseases. The initial alarm for West Nile virus, sounded by a veterinary pathologist at the Bronx Zoo in the fall of 1999 when West Nile virus entered the United States, is an excellent example.

Surveillance in Companion Animal Practice

Although small animal or companion animal practices might not be considered the usual venue for introducing an agent of agroterror, small animal practitioners can be instrumental in protecting our greater animal populations. The most recent introduction of *Cochliomyia hominovorax,* or screwworm, was discovered on a cat by an alert small animal practitioner. It was an exotics animal clinician at the University of Florida who detected the incursion of foreign ticks into the United States while examining a diseased reptile. The ticks were subsequently identified as *Amblyomma*

spp., very capable vectors of heartwater, a foreign animal disease that could devastate our livestock and deer populations. Companion animal veterinarians should be aware of the exotic diseases that can affect their clients' pets, including, for example, exotic Newcastle disease in pet birds or spongiform encephalopathy in cats. By virtue of their close communication with so much of the public through personal contact with owners of small and exotic animals, small animal veterinarians also can play a key role in educating society about animal diseases in general. Clients want to know the risk to their cat, dog, or guinea pig of such agents as anthrax, tularemia, FMD, or BSE. They also want to be educated by their veterinarian about the big picture of animal health. What, for example, are the issues of BSE and FMD? How could the United States acquire FMD or BSE? How will these diseases affect us? The public views veterinarians as caretakers of animal health and well-being, regardless of species, and does not see the profession as divided into separate disciplines narrowly focused on small, large, or exotic animals. It sees the veterinarian as a professional who is well educated in broad aspects of veterinary medicine and who has chosen the profession because he or she is committed to protecting all species of animals. It is critical, therefore, that small animal veterinarians be educated broadly about agents and related issues of agroterrorism and bioterrorism and about how veterinarians should serve society in this regard.

PREPARING THE VETERINARY ACADEMY FOR BIO- AND AGROTERROR

Even prior to the heightened awareness of bio- and agroterror, there was considerable consternation regarding veterinarians' preparation to function in a global environment[11, 12] and how veterinary education has been lagging behind in the area of globalization.[13] Certainly the global nature of disease has been highlighted as a result of recent events, as well as the need for veterinarians to understand the potential global ramifications of agroterror. In preparing veterinarians to meet today's challenges, it is essential that they receive a global education, including economics (markets, trade, international implications, etc.), politics of animal health, worldwide ecological health, and cross-cultural awareness. In the new era of agroterror, each veterinarian has a new and expanded responsibility as a watchdog for exotic diseases and potential terrorist activity. Consequently, it is more important than ever before that veterinarians understand the global implications of animal health. Curriculum committees must empower themselves to take an active role in monitoring educational content to ensure that these issues of international animal and human health are covered adequately at each college.

College administrators must take an active leadership role in addressing these critically important new challenges for the profession by considering the long-term outlook for global animal health when creating new positions and by evaluating how the repertoire of faculty positions is qualified to provide the broad comparative education in veterinary medicine necessary to address the expanding needs of society. Recruitment and retention of quality faculty capable of contributing new and productive solutions to problems of agroterror will be of paramount importance in addressing these needs. The tendency of the promotion and tenure system is to select individuals who are very narrowly focused in specific and fundable areas. Global and societal perspectives of veterinary medicine within veterinary curricula must be improved by developing mechanisms within each college or school by which faculty can be formally recognized and rewarded for addressing the big picture and the broad view of veterinary education. Such efforts would help counter the disciplinary introversion that has been identified as a problem of research universities, where excessive emphasis is placed on garnering large-scale funding for narrowly defined areas.[14] Our roles in extension and in providing broad-based education have become subsidiary to income generation. Deans are instrumental in creating and fostering, within the college or school, the environment and culture necessary for the internationalization of veterinary medicine.[13] In the new era of agroterror and asymmetric warfare affecting veterinary medicine, it will become increasingly important for administrations to address societal concerns with greater diligence and responsibility.

At the same time that we tackle the dual issues of curriculum and faculty contributions, we need to examine the environment in which students are brought into the profession. Data collected in one of the large market surveys demonstrate that self-esteem drops between the first and fourth years of veterinary school, with new graduates scoring lower than freshmen.[3] If we intend to prepare new graduates to deal with the future, we will have to supply them with the confidence and belief that they can undertake adventures in these new areas. In public opinion polls, veterinarians rate very favorably in public opinion in comparison to many other professionals. Specifically, compassion and trustworthiness are often cited in the perception of the veterinary professional.[4] We must take advantage of these attributes in responding positively and rationally to help guide policy makers and the public in their responses to bio- and agroterror. In order to ensure that this happens, however, we need to instill in our graduates the confidence and knowledge necessary to assume the task.

Veterinary organizations and associations must also contribute significantly and effectively to efforts aimed at protecting animals and society from agroterror by helping to ensure that colleges and schools are providing the necessary education. The American Veterinary Medical Association (AVMA) will have to assume a key leadership position through its Council on Education (COE), which must be willing and able to implement minimal curricular requirements necessary to prepare graduates in this area. At the very least, every college of veterinary medicine should dispense information to every student on the global environment of agriculture, zoonotic diseases used in bioterror, and foreign animal diseases. As the President of the AVMA recently stated, "This new century has brought an increased emphasis on the global community–a community that is looking to the AVMA to play a leadership role in veterinary medical education, food safety, disaster preparedness, and other critical issues."[15]

The USDA and state departments of agriculture play critical roles in protecting the country from foreign animal diseases and agroterrorism, in part by placing in the "first line of defense" accredited veterinarians who have received the education and training necessary to recognize and control these diseases. Unfortunately, for various reasons, fewer and fewer veterinarians have such an education. As a conse-

quence, intensive educational initiatives are being called for to address this serious vulnerability in our national veterinary preparedness.[7] State and federal governments should identify means of supporting and encouraging colleges and schools to develop new educational initiatives to address the issues of bio- and agroterror.

SUMMARY

Recent national and international events have highlighted challenges facing society in the new era of asymmetric warfare. There is a critical need to upgrade and strengthen veterinary medical education to address these challenges and to ensure that our profession is prepared to protect animal health and serve society in this evolving environment. Faculty, administration, and curriculum committees must come together to create the learning environment and curricula that will meet the challenges of the new era of agroterror. ■

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