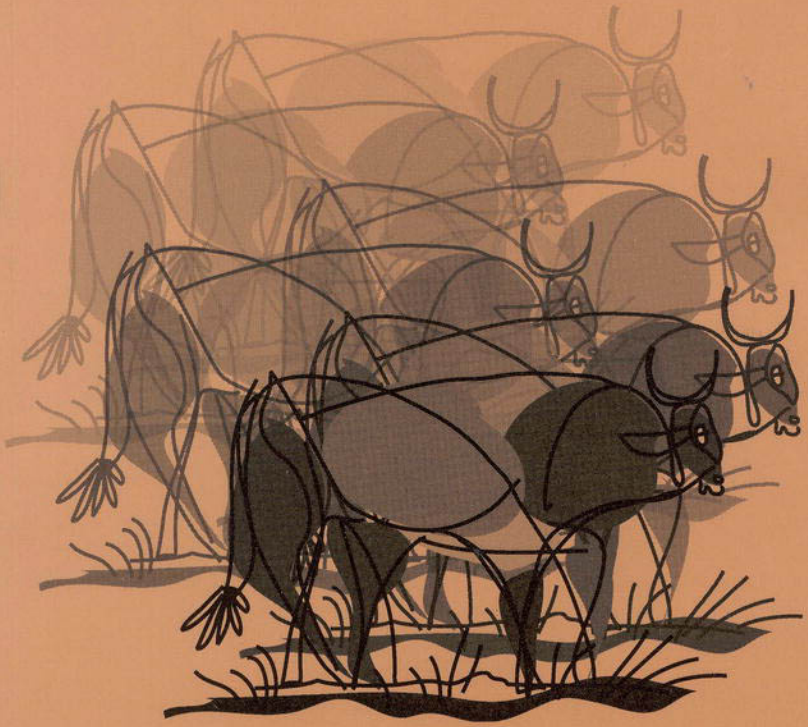
Emerging Animal Diseases

Global Markets, Global Safety

A WORKSHOP SUMMARY



NATIONAL RESEARCH COUNCIL

Emerging Animal Diseases

Global Markets, Global Safety

A WORKSHOP SUMMARY

By
Debra P. Davis

Board on Agriculture and Natural Resources
Division on Earth and Life Studies
National Research Council

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PLANNING GROUP FOR A WORKSHOP ON EMERGING ANIMAL DISEASES

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Preface

The recent appearance of certain animal diseases, both familiar and novel, accidental and deliberate, has put the U.S. veterinary, medical, food, and regulatory systems on notice. Increase in global trade has been identified as a key factor in the appearance, control, and prevention of emerging animal diseases, since the most common source of recent animal disease outbreaks is the importation of pathogens. These concerns have raised questions about our scientific knowledge and nationwide preparedness.

On January 15th, 2002, the National Academies' Board on Agriculture and Natural Resources of the Division on Earth and Life Studies held a workshop on "Emerging Animal Diseases: Global Markets, Global Safety," where leading scientists and policymakers discussed issues such as the potential for animal diseases to reach epidemic proportions, mechanisms in place to prevent and control these diseases in the immediate and long-term, and impacts of diseases on industries, populations, and international trade. This summary describes the issues presented and discussed by the workshop participants.

The workshop's original stated task was to discuss the realm of potentially threatening animal diseases, current strategies to prevent their introduction and spread in the United States, as well as future needs for protection. Major objectives of the workshop include: (1) elucidating information on the U.S. position with regard to potentially threatening animal diseases; (2) identifying critical problems, barriers, and data gaps; and (3) defining potential future National Academies' activities. Planning for the workshop was begun prior to the tragic events of September 11th, and the subsequent deliberately introduced outbreak of anthrax. In responding to changing public health and safety concerns, the workshop agenda was modified to encompass both intentional and accidental introductions. The workshop was designed to explore the following topics:

- The British battle against foot-and-mouth disease
- Global security in a global economy
- Animal pathogens: What should we be looking for?
- Detection and prediction: How will we know it's a problem?
- Disease diagnostics: How can we identify it—quickly, cheaply, and accurately?
- Treatment and eradication: How do we get rid of it?

A steering group assisted NRC staff in planning the workshop, and consisted of Barbara P. Glenn (chair), Federation of Animal Science Societies; Dale E. Bauman, Cornell University; Lonnie J. King, Michigan State University; Whitney Macmillan, Cargill, Inc. (Retired); Gary D. Osweiler, Iowa Sate University; and Nancy J. Rachman, Novigen Sciences, Inc. The planning group suggested topics and speakers and provided comments on the drafts of the workshop agenda; they did not participate in the preparation of the workshop summary.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with the procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the workshop charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report: Bernadette Dunham of the American Veterinary Medical Association, Washington, DC; Mo Salman of Colorado State University, Ft. Collins, Colorado; and James Schaub of the U.S. Department of Agriculture, Washington, DC.

Although the reviewers listed above have provided many constructive comments and suggestions, they did not see the final draft of the report before its release. The review of this report was overseen by John Shadduck of Optibrand, Ft. Collins, Colorado. Appointed by the National Research Council, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content rests entirely with the author and the institution.

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1

Introduction

Recent outbreaks of foot-and-mouth disease (FMD) and bovine spongiform encephalopathy (BSE) in Europe and Japan set off alarm bells in the United States and other nations, prompting a flurry of new regulations, border controls, inspections, and other activities to prevent incursions of the diseases. The terrorist attacks last fall in New York City and Washington, DC, added a new note of urgency to the alarm. Concerned about additional acts of terror or sabotage in various sectors of the economy, including agriculture, U.S. government and industry officials have begun to reevaluate emergency management plans in response to these threats and to shift the focus of research and planning. More than 200 representatives of government, industry, academia, and nongovernmental organizations gathered at a one-day workshop in Washington, DC, on January 15, 2002, to assess what the United States is doing about emerging animal diseases and related issues and to explore what still needs to be done. An additional 152 computers tapped into the proceedings via the Internet.

The workshop was organized with an opening keynote address, followed by one or more presentations on each topic, with panel discussions and audience questions interspersed with each presentation session. The workshop summary extracts the key technical issues from the presentations and discussions, rather than presenting each session and panel discussion separately. Many issues were touched upon repeatedly by several speakers in different sessions, and this format is intended to allow readers who did not attend the workshop to have a good understanding of the discussions in the context of the entire workshop.

The objective of the workshop was to illuminate issues, not to resolve them. By its nature, any single workshop is necessarily incomplete, and a workshop summary can report only on what was said. All the information reported in the text emerged from presentations and discussions during the workshop. The summary of the workshop is intended to reflect the variety of opinions expressed by the speakers. All of the contributors have reviewed the document and affirmed that the report accurately reflects the events and discussions at the workshop.

WELCOME ADDRESS

Concern about animal health has been building for decades and is now at a historic high, particularly in developed countries, Dr. Harley W. Moon of Iowa State University's College of Veterinary Medicine told the gathering. The recognition of the emergence of antimicrobial resistance in farm animals led to increased food safety concern and was followed by a focus on food-borne illness. This issue peaked as the BSE epidemic had international impact in the 1980s and 1990s, and culminated with the 2001 outbreak of FMD in Great Britain. "Then, with the events of last fall, the issue of terrorism changed from a theoretical abstract possibility to a real-time threat. These decades of increasing concern certainly indicate that it is time to look at needs and opportunities to make further progress addressing these issues in animal health."

KEYNOTE ADDRESS

Deputy Secretary James R. Moseley of the U.S. Department of Agriculture (USDA) underscored the impact of the events of September 11th, saying that it added "a new dimension on work long underway in animal disease." Animal disease and food safety systems now require consideration of both intentional and accidental incidents, and these issues were raised to the highest priority of both the USDA and the Office of Homeland Security.

"The continued safety and integrity of our food and agriculture production systems have now become the highest priority," said Moseley. The department is now much more alert to the possibility of intentional introduction of animal diseases and threats to the safety of the food supply. USDA is beefing up security at research facilities and laboratories, particularly the federal government's five biosecurity level-3 labs. This includes more restrictions on access to anthrax and other biologic pathogens and closer scrutiny at ports of entry and food processing plants.

Building on the joint U.S. and British efforts to combat the U.K. FMD epidemic last spring and summer that "placed attention on the core infrastructure

of our systems and our programs," Moseley emphasized international, interagency, and public cooperation in food safety and biosecurity systems. This outbreak also pointed out the importance of animal disease to market stability, and Moseley cited the recent BSE risk assessment (*Evaluation of the Potential for BSE in the United State*s, Harvard Center for Risk Analysis, Harvard School of Public Health, November 2001) as an example of a useful tool to explore the potential health and economic impacts of animal diseases.

Deputy Secretary Moseley underscored the importance of preparedness and emphasized the need for a rapid, coordinated, and flexible response system, stating, "We have to be able to skate to where the puck will be." Other key components of an enhanced animal disease control system are monitoring and surveillance, especially at international borders; epidemiology; physical security of researchers and laboratory facilities; control of biohazardous and biologic agents; and primary research on potential animal pathogens. An especially important factor in protecting U.S. agriculture and the U.S. food supply is cooperation of the public and private sector, on a national and international basis. Moseley also called upon the scientific community to continue its creative thinking and research and to build upon the tragic events of the past with new and innovative animal disease control mechanisms.

PROGRAM OVERVIEW

Dr. Corrie C. Brown of the University of Georgia's College of Veterinary Medicine drew from an earlier National Academies' conference on emerging human diseases, citing some of the same key factors that contribute to the emergence of diseases: movement of animals and people, disruption of the environment, the crossing of species boundaries, and lifestyle or husbandry changes. These changes are "continuing to occur at an ever-increasing rate" and their impacts are intensified when combined with the phenomenon of globalization and international trade, she said. "So, we are going to see more and more emerging diseases. If you put that then into the framework of globalization, … the interconnectedness of all people, economies, and countries, it is estimated that globalization will have a larger impact on society today than the industrial revolution had on society 150 years ago."

2

FMD and BSE in the United Kingdom

In the last two decades, two major animal disease outbreaks have emerged in the United Kingdom. The outbreak of BSE, or "mad cow disease," which began in the United Kingdom in 1986, has infected about 200 thousand cattle and has led to the preemptive slaughter and destruction of 4.5 million. The foot-and-mouth disease (FMD) epidemic in the United Kingdom last year led to the eradication of 4 million livestock. While FMD is extremely contagious and harmful to livestock, there is little risk to human health. However, exposure to BSE has been linked to a growing number of cases of variant Creutzfeldt-Jakob Disease (vCJD) in humans (See Box 2-1 for a description of FMD and BSE).

MANAGEMENT OF THE U.K. FMD OUTBREAK

Given the global nature of animal disease and food safety in the twenty-first century, Professor David King, the Chief Scientific Adviser to the British Government and Head of the Office of Science and Technology, was called upon to share insights gained from the recent British FMD outbreak. King began by describing foot-and-mouth disease as a highly infectious, viral disease that causes fever and vesicles around the mouth and the feet in cloven-hoofed animals. It is an unpleasant and painful disease, can be sometimes fatal to young animals, and has serious impact on productivity. Although it is possible to keep foot-and-mouth disease out of a country with tight import controls, King noted

BOX 2-1
How Do Foot-And-Mouth Disease (FMD) and Bovine Spongiform Encephalopathy (BSE) Differ?

FMD and BSE are similar in that they both affect livestock. Otherwise, there are major differences between the two animal diseases.

FMD is a highly contagious viral disease that primarily afflicts cloven-hoofed animals (i.e., cattle, pigs, sheep, goats, and deer). Wild ungulates such as buffalo, antelope, and warthogs are also susceptible to the disease. FMD can be debilitating to infected animals, causing losses in meat and milk production. It also can be fatal to young animals.

The principal symptoms of FMD are fever and blisters in the mouth and on the feet, resulting in salivation and lameness. Symptoms are similar in all species, although the severity may vary considerably.

Mortality rates from contracting FMD are generally low. However, an outbreak of the disease can have grave economic consequences for the meat and dairy industry in countries where it occurs. This is primarily due to the imposition of international trade restrictions on affected countries, which often go to great lengths, investing large sums in eradication campaigns, to recover their FMD-free status and resume trade.

FMD is not a public health concern because humans rarely contract the disease, and it causes few or mild symptoms when it occurs in humans. FMD is not a food safety issue because affected animals are easily identified and removed from the food chain, and, additionally, the virus is killed by cooking.

BSE, or "mad cow disease," on the other hand, has been linked to a fatal brain disease in humans called Creutzfeldt-Jakob disease (CJD). BSE is also a food safety issue in that it appears to result from the consumption of beef products contaminated by central nervous system tissue from infected cattle.

The vast majority of cases of BSE have occurred in the United Kingdom, where, up until 1988, the rendered carcasses of livestock were fed to ruminants and other animals as a protein-rich nutritional supplement. Recognizing that this was a source of infection, the United Kingdom imposed a ban on ruminant protein feed in 1988. Unfortunately the disease had already reached epidemic levels in the United Kingdom and had spread to other countries that imported livestock food supplements or live animals. The incidence of new cases in the United Kingdom has been decreasing in recent years.

BSE, which is also fatal to cattle, has not occurred in the United States or other countries that have historically imported little or no live cattle, beef products, or nutritional supplements from the United Kingdom.

Sources: The Centers for Disease Control and Prevention (CDC) and the Advanced Veterinary Information System (AVIS) Consortium.

that 35 countries have declared outbreaks of foot-and-mouth disease around the world over the last couple of years. An outbreak can have significant impact on international trade for up to two years after the country is declared disease free, based on the disease-free standards set by the Office of International Epizootics (OIE), the "World Health Organization" of animal diseases.

By the time the first case of FMD was reported to British public officials

on February 20, 2001, the disease had already had more than three weeks to spread. This time lapse was crucial because, as King noted, each affected farm was a "viral factory," and the disease was spreading rapidly and would soon be out of control. Contributing to this was the incubation period, during which the infected animals can transmit the disease but do not display signs and symptoms.

Based on the results of mathematical models used to simulate the outbreak, officials estimated that the number of new cases was doubling every nine days. These models, created by four independent modeling teams, incorporated available biological evidence and played an important role in fighting the outbreak. This highlighted the need for good scientific information to feed into models on animal transport and trade; epidemiology through surveillance and reporting; the mechanisms for transmittal and establishment of the disease; and a good, current animal census. Both stochastic models, which are both time-and resource-consumptive, and deterministic models, which are less detailed but more efficient, were used. Once there was agreement between the two stochastic models on a particular scenario, the deterministic models could then run several different intervention scenarios much more quickly.

Multiple scenarios for different intervention strategies were created using the models, attempting to balance the fastest possible resolution of the outbreak, with the minimization of the number of culled animals. Because the models were so precise and vivid, they were comprehensible by both policymakers and the public and helped garner support for the intervention strategies to which the models pointed. King credited the modelers with the ultimate success of the eradication program, by producing what turned out to be very accurate models predicting the impact of various intervention strategies in a very short period of time (See Figure 1). Given the crucial role of the models in battling the epidemic, King suggested that epidemiological modeling should be included as part of veterinary training, so that veterinarians have "a full understanding of what these models can do and what they incorporate."

Through an emergency interagency advisory group and with the input of scientists, veterinarians, and modelers, U.K. officials decided that an aggressive approach to controlling the disease was the required intervention strategy: the destruction of all livestock on infected farms within 24 hours of detection by veterinarians, followed by the culling of livestock on all adjacent properties within 48 hours. Since rapid action was paramount, officials "slaughtered on suspicion"—taking action immediately following the diagnosis by two veterinarians knowledgeable about the disease, rather than waiting for the more definitive results of lab tests. Officials also imposed tight restrictions on the movement of people, animals, and farm equipment after determining that the virus (Type O of FMD) was being spread primarily by such movements, rather than through aerosol transmission.

Although, in the end, the culling strategy led to the destruction of 4 million

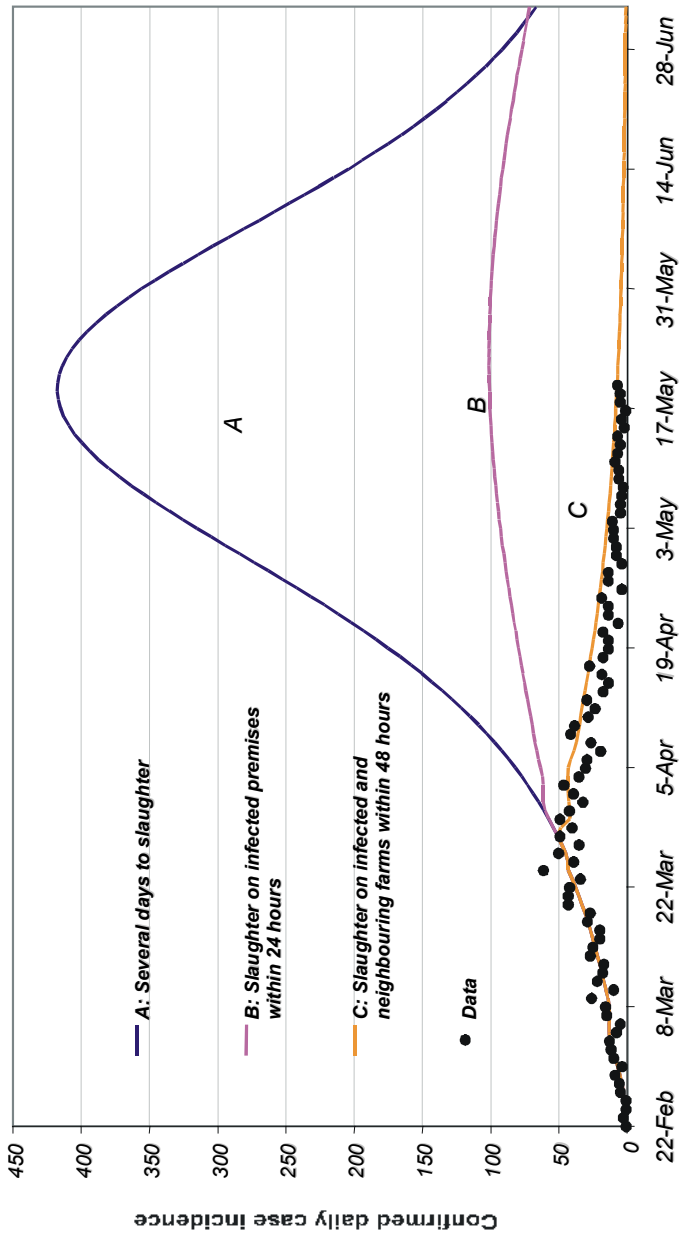

FIGURE 2-1 Model predictions for three scenarios (A, B, and C) of time from infection to control intervention, compared to data collected during the outbreak (Ferguson, Donnelly, and Anderson).

cattle and sheep, the models predicted that the toll would have been far greater with a less aggressive strategy. The models also predicted that the toll could have been cut in half if the outbreak had been recognized a few weeks earlier. This highlighted the importance of early reporting and quick response in stamping out the disease very rapidly. King recommended to policymakers dealing with future outbreaks, "There should be a strategy in place so that, as soon as this happens, you know what you are going to do."

One important aspect of managing the outbreak was keeping the media and the general public informed. "It was quite clear that since we had a massive logistical problem and a very large media interest, apparently not only in the United Kingdom, that we would have to present what we were doing openly and transparently to the media, and from the 24th of March onwards, I went on television and radio on a regular basis to inform the country as to how things were proceeding and why we were doing what we were doing," King said.

Since the disease was, for the most part, not fatal to livestock and presented no harm to human health, the aggressive culling policy and the related decision not to use vaccination as a control method were significant concerns of the public. King explained that there were enormous economic incentives behind the policies: Under the guidelines of the OIE, a country has to be completely free of FMD for a year in order to resume trade in livestock, beef, and related products. Since "there is no internationally recognized test to distinguish between infected and vaccinated animals," the OIE imposes additional trade restrictions on vaccinating countries. If the United Kingdom had decided to eradicate the disease by using vaccination, it would be necessary to wait an additional year before resuming trade, resulting in a two-year trade ban. In addition, all vaccinated animals would ultimately have to be culled if the United Kingdom were to have its FMD-free status restored because they could not be differentiated from infected animals, and, therefore, could not be traded. This would result in the slaughter of a greater number of animals than required by the non-vaccination strategy and was therefore not pursued. In addition, vaccination gives immunity to an animal within four to ten days. If, however, an animal is incubating the disease when it is vaccinated, it will continue to develop the disease and will become infectious. King said that a faster, smarter vaccine, one that could stop the disease in its tracks and produce a marker protein enabling diagnosticians to tell whether an animal has been infected or vaccinated, would have been invaluable. "If we had had those available, I believe the situation would have been very different," he said. Scientists are working to meet this challenge, but one "was not available to us," he said.

Diagnostic tests, however, could also have been very valuable during herd screening and case identification, if there were a fast and reliable protocol such as a polymerase chain reaction-based technique that could be used in the field. Because of the time required to obtain results, serology (testing the blood samples to determine whether animals were infected with the pathogen) did not

play a large role during the "slaughter on suspicion" phase of the outbreak control policy, which instead relied on two veterinarians' professional diagnosis. It was, however, a component to successfully resolving the FMD outbreak, used in combination with the declaration of infected areas as FMD zones, where full FMD controls were applied. All animal movement throughout the country was restricted, and then serologic testing of animals was used to determine when a region, and ultimately the country, could be declared FMD free. This would then allow the country to move towards applying to the OIE for FMD-free status.

Within three weeks of implementation of the strategy, the outbreak was leveling out, and by mid-May, the disease was under control, slightly ahead of the schedule the models predicted. On January 14, 2002, the United Kingdom was declared FMD-free.

IMPACTS ON THE FARMING COMMUNITY

Thomas McManus, an Irish cattle farmer, described the personal devastation that resulted from the BSE and FMD outbreaks. The first case of BSE was diagnosed in Ireland in 1989 and, by 1996, the disease in the United Kingdom and Ireland had spiraled out of control. In March 1996, the government announced that there was a link between BSE and vCJD, which led to the collapse of the beef market. McManus said his cattle fell from a value of £600 a head to zero, since they could no longer be sold on the market. The government bought all his cattle over the age of 30 months "to take them out of the food chain," but at a price that was only two-thirds of the previous market value.

McManus said his losses were further compounded in February 2001, when the first case of FMD was reported in the United Kingdom. The FMD outbreak led to a ban on beef exports and stringent restrictions on the movement of people, animals, and farm equipment. McManus said he and other Irish farmers suffered large financial losses that they never recouped because the loss of their export market has kept the price of beef about 30 percent below pre-BSE levels. He said his farm has not been profitable for the past six years. "The farm wasn't fit to support me, so I had to find an alternative job."

McManus noted that his father and grandfather were also farmers, and, prior to the epidemics, he was able to make a good living from the farm. His sons, however, have declined to take over the farm because "there is no money in it." He said many other Irish farmers have found themselves in the same predicament. Many have left farming or have suffered bouts of depression, some resulting in suicide. "I had never seen a case of BSE, and yet I have suffered severe losses," McManus said, noting that he and other farmers have watched their businesses of many years fail through no fault of their own. He highlighted the importance of rapid response by the government to prevent disasters of

epidemic proportions. "I don't think you can put the blame anywhere but on the government for not being fast enough and not doing things in time," he said. "And a word of caution I would say to you that are going to make a report to the government: A stitch in time saves nine."

3

Potential Threats to Animal Health and Food Safety

The recent outbreak of foot-and-mouth disease (FMD) and the appearance of bovine spongiform encephalopathy (BSE) in the United Kingdom have increased awareness and concern about the potentially devastating impacts of these and other animal diseases. Building on the presentations of Moseley and King, several speakers described measures the United States is taking to prevent outbreaks of FMD, BSE, and other diseases and to deter sabotage within the agricultural system, as well as describing ongoing areas of concern and vulnerability. U.S. government officials discussed a range of additional threats to animal health and food safety, including diseases such as classical swine fever and highly pathogenic avian influenza.

EMERGING THREATS

In addition to the diseases mentioned above, participants expressed concern about several others that could emerge or re-emerge in the United States. These include classical swine fever, considered a very high-risk disease because of its presence south of the United States and in the Caribbean, according to Dr. Caird Rexroad, Associate Deputy Administrator of the U.S. Department of Agriculture's Agricultural Research Service. Rexroad said researchers are also concerned about the re-emergence of the Texas cattle fever

tick, which was eradicated from the United States, but has since developed a resistance to classic methods of control.

New strains of existing diseases, such as highly pathogenic avian influenza and Newcastle disease that could be brought into the United States via imported or migratory birds, and previously unknown diseases like chronic wasting disease also present a growing threat and challenges in terms of new treatment methods. "In the extreme, we have to worry about recombinant organisms … how organisms might be put together or modified to attack, and we hope that extreme scenario is not the one, but it can't be dismissed," Rexroad added.

Other speakers discussed how ticks could be used as an agent for the spread of certain diseases such as Texas cattle fever, caused by *Babesia bovis,* and heartwater, caused by *Cowdria ruminantium*. Heartwater disease could be spread to deer by the *Amblyomma* ticks; from there it would "spread geometrically, and it would be really difficult to eradicate," Brown said.

In areas with disease-spreading tick populations, one could achieve the same results by simply introducing the disease, without having to bring in the ticks, added Dr. Gary Weber, Executive Director of Regulatory Affairs, National Cattlemen's Beef Association. Another factor, just as important as the disease and the vector, is the development of resistance to insecticides used to control ticks and other vectors. In combination, these factors can complicate control efforts, Weber said.

IMPLICATIONS OF SEPTEMBER 11 TERRORIST ATTACKS

Animal health issues are very closely linked to food safety and security, Dr. Robert Brackett, Director of Food Safety in the Federal Drug Administration's (FDA) Center for Food Safety and Applied Nutrition, told the gathering. To illustrate his point, he displayed a list of bacterial and viral risk agents associated with animals (See Box 3-1). The list, published by the Centers for Disease Control and Prevention (CDC), include bacteria, such as the anthrax pathogen, and viruses, such as the one that causes yellow fever, that could be used for bioterrorism.

Brackett said the agency's traditional approach to inspections of food imports was based largely on volume, i.e., the largest exporters to the United States, such as Canada and Mexico, would have more of their products scrutinized. Now the agency is rethinking that strategy, considering whether to target certain countries or products. The scope of surveillance has also been broadened, with more focus on intentional biologic, chemical, and radiologic threats, he said.

In addition, the FDA no longer assumes that industry and individual producers are concerned only with unintentional contaminants in foods, Brackett

BOX 3-1
Bacterial and Viral Threat Agents Associated with Animals

Category A Diseases/Agents
High-priority agents include organisms that pose a risk to national security because they can be easily disseminated or transmitted from person to person, cause high mortality and have the potential for major public health impact, might cause public panic and social disruption, and require special action for public health preparedness.

Category B Diseases/Agents
Second highest priority agents include those that are moderately easy to disseminate, cause moderate morbidity and low mortality, and require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance.

Category C Diseases/Agents
Third highest priority agents include emerging pathogens that could be engineered for mass dissemination in the future because of availability, ease of production and dissemination, and potential for high morbidity and mortality and major health impact.

Category A Bacterial Agents
Bacillus anthracis (Anthrax)
Yersinia pestis (Plague)
Francisella tularensis (Tularemia)

Category B Bacterial Agents
Coxiella burnetti (Q Fever)
Brucella species (Brucellosis)
Bukholderia mallei (Glanders)
Clostridium perfringens Epsilon Toxin
Staphylococcus aureus Enterotoxin B

Category C Bacterial Agents
Multidrug-Resistant Tuberculosis

Category A Viral Agents
Viral hemorrhagic fever
Lassa fever
Rift Valley fever
Ebola hemorrhagic fever
Marburg hemorrhagic fever

Category C Viral Agents
Hantavirus
Nipah virus (encephalitis)
Yellow fever

said. There is more awareness of the possibility of tampering or the premeditated manufacture of harmful products, including the pirating of existing products. Concerns about terrorism have also prompted the agency to issue guidance to food producers and processors to help them identify their risks and to establish new relationships with intelligence and law enforcement agencies to enhance intelligence gathering.

4

U.S. Vulnerability and Response Capabilities

The importance of preparedness and the need for stronger biosecurity measures to reduce potential threats to animal health and food safety were recurrent themes at the workshop. Several speakers noted that foot-and-mouth disease (FMD) exists in many countries, and, therefore, the FMD virus has probably been brought into the United States unintentionally numerous times each year, although so far it has failed to produce detectible infections or take hold in the agricultural industry. Some expressed the view that the risk of accidental or intentional introduction of both FMD and BSE, or "mad cow disease," remains high.

PREPAREDNESS

"Emerging diseases are the norm and not the exception," and being prepared is crucial in dealing with new diseases when they happen, said Dr. William Hueston, Director of the Center for Animal Health and Food Safety at the University of Minnesota. "So, where should we look? How should we be prepared? We should be looking for new diseases to emerge where the pressure for change is the greatest," he told the gathering.

Reiterating a point made by several other speakers, Hueston said FMD

and "a whole range of other disease agents enter the United States multiple times each year." Arrival of the agent does not automatically mean emergence of the disease, since this is contingent on interactions among the agent, host, and the environment. "Because agents, host characteristics, and the environment are constantly changing, there are always new opportunities for diseases to emerge," he said.

Hueston also described key trends in demographics, agriculture, and the environment that can help one predict where and when diseases are likely to emerge or re-emerge. Population growth in cities and suburbs is causing increasing encroachment of suburban areas on "what heretofore have been wilderness or wildlife areas," he said, noting that this has led to more interactions between humans and wildlife. He cited as an example problems caused by the overabundance of deer in the suburbs of Washington, DC, and many other cities. Hueston said that it is within these "ecoclines," or locations where ecosystems meet, that new diseases are most likely to emerge. He recommended expanded surveillance in these areas, especially where humans, domestic animals, and wildlife interface. He also argued for more integration of the animal health and human health infrastructures. "Remember, diseases work both ways, from humans to animals and from animals to humans, and I think it is a dynamic interface."

Diseases are also likely to emerge in high-population agricultural areas with large animal populations, where demographics are changing the most, and where there is pressure to intensify production. Environmental changes caused by changing weather patterns and human interventions, such as the draining of wetlands, construction, and landscaping, also increase our vulnerability to new diseases. "As the environment changes, it creates new ecologic niches," he noted.

On the issue of public policy, Hueston noted what he referred to as the "conundrum of prevention": As countries attain a higher health status, they tend to reduce their investment in animal health infrastructure. This is because governments get credit for solving problems, but not for preventing them. "If we are successful in preventing a disease, we will be condemned for having wasted money for something that never occurred. If, on the other hand, we fail to prevent disease, then we will be condemned for not taking more aggressive actions and spending more money."

Hueston concluded that "anticipating and responding to the next major animal disease threats is going to require an integrated and coordinated interdisciplinary approach." Hueston added that this approach would require flexibility and broader use of resources in public and animal health, civilian agencies, and the military.

FOOD SAFETY CONCERNS

The Food and Drug Administration's (FDA) regulation of BSE is "probably the most visible issue that we have in the area of animal feeds" because of its potential for adverse effects in humans, as well as animals, Dr. Stephen P. Sundlof, Director of the FDA's Center for Veterinary Medicine, told the gathering. One key measure against BSE is an FDA rule that prohibits the feeding of most mammalian proteins to cattle and other ruminants. "What we learned from the United Kingdom experience was that BSE is spread almost exclusively through feed and that, by establishing a rule that would prevent any infectious or potentially infectious materials from being fed to ruminants, we have a single point of transmission or a choke point on which to stop the disease, should it enter the country," Sundlof said.

Enforcement of this ban is "absolutely critical" in keeping BSE out of the United States, and therefore the FDA has stepped up its inspection of feed mills, renderers, transporters, and protein blenders that handle prohibited material, he added. The FDA also works closely with the USDA and the customs service to keep infectious materials from entering or getting beyond U.S. ports. These controls have been very effective, he said, as not a single case of BSE has been diagnosed in the United States. It is also the responsibility of U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Agency (APHIS) to provide the domestic surveillance and monitoring, should BSE enter the United States, Sundlof said.

Salmonella in animal feeds is another concern because feed can be a vehicle for transmitting *Salmonella* not only to animals, but also to humans, Sundlof said. He added that the FDA is working to define what the S*almonella* standard should be in animal feeds and to inform livestock producers and feed manufacturers about the issue. If educational efforts are not sufficient to control the pathogen, the agency may have to take stronger regulatory measures.

Another prominent issue that the FDA is studying is antimicrobial resistance resulting from the use of antibiotic drugs in food animals. Preliminary research using *Enterococcus* as a marker indicates that the problem is linked more to the production environment than to feed. Still, "we are finding bacterial loads in virtually all animal feeds," he said. "It is more heavily associated with those animal feeds that contain meat and meat by-products than it is for those that are purely vegetable in origin."

JURISDICTIONAL ISSUES

In addressing how the various agencies with responsibilities for animal Because of the time required to obtain results, serology (testing the blood

health and food safety, particularly those with overlapping duties, are working together, speakers said that interagency collaboration and communication have improved recently, driven by the new sense of urgency in this area.

Brackett said the FDA and USDA's Food Safety Inspection Service have some areas of overlapping jurisdiction. Problems arise not so much from turf battles as "just a failure to communicate," he said, noting that the current systems of communications are "probably better than they have ever been," due in large part to the need to work together on public health and animal health issues such as BSE.

Rexroad said collaboration between the Agricultural Research Service (ARS) and APHIS in emergency management "has been quite good." The ARS will provide APHIS with facilities and scientists whenever there is an outbreak, he said, and the two agencies work together on the development and validation of assays. The National Animal Health Emergency Management System, though formally managed by APHIS, is really a collaborative function involving various federal, state, and commodity groups, he added.

AUSTRALIA: CASE STUDY IN DISEASE CONTROL, COOPERATION

Australia remained free of BSE and FMD in 2001 and has been successful in keeping other diseases under control, Dr. Philip Corrigan of the Australian Embassy told the gathering. Australia's success in building a multipronged, multi-stakeholder system for disease management has been achieved with great effort, much planning, and at tremendous cost, he said. Corrigan added that the nation is "totally reliant on exports" of livestock and other products and thus is highly motivated to protect the agricultural industry from diseases.

One of the key features of Australia's system is the close collaboration between government and industry in disease management, Corrigan said. An industry council works closely with the federal and state governments in deciding on priorities for disease control and on funding for eradication and control programs. This collaboration even extends to cost-sharing. "There is a formal cost-sharing agreement for 12 designated foreign diseases, and the cost-sharing arrangement is enshrined in legislation," he said, noting that it includes FMD and classical swine fever. An agreement on BSE is now being negotiated.

Another feature of the Australian system is its linkage of foreign disease management and emergency management. "The introduction or

identification of a foreign disease in Australia would be treated like a flood disaster, a drought disaster, a natural disaster in terms of mitigation and management," which means that the State Emergency Service (similar to the Federal Emergency Management Agency in the United States) intervenes and assists with veterinary and other services. Australia also has produced a detailed manual on disease management, called the AUSVET Plan, which provides guidance on the epidemiology of various diseases, diagnostic and control procedures, training resources, and the like for various sectors. Australia is also an active participant in multilateral organizations such as the Office of International Epizootics and the World Trade Organization.

5

Detection, Data Collection, and Reporting

Speakers noted that many types of systems are in place for early detection of emerging diseases, but these systems are, for the most part, not integrated or coordinated. Moreover, weaknesses in monitoring at the farm level make the system vulnerable to failure, they said.

ROLE OF SURVEILLANCE IN EARLY DETECTION

A large number and variety of surveillance and monitoring systems are in place at the federal, state, and local levels, but "the effort to integrate them is sorely needed," said Dr. Nora E. Wineland of the U.S. Department of Agriculture's (USDA) Centers for Epidemiology and Animal Health. The chief barrier to integrating the various systems is a lack of resources, she said. Wineland described some of the many surveillance systems, pointing out the wide range of existing programs: active and passive, mandatory and voluntary, government and industry, formal and informal.

The first level of surveillance is at the farm or production level, where producers are the "first set of eyes and ears out there for the unusual event." Producers can use networking (e.g., online listserves) to discuss any health issues that come up, or they can participate in federal or industry monitoring programs, she said. The next level of surveillance is the local veterinary practitioner, which is missing in cases where producers do not use the services of a veterinarian

routinely. In addition to advising producers, veterinarians can also participate in listserves and report diseases to state and federal officials. An additional emerging problem is the need for education at all levels on proper vigilance and reporting.

There are various surveillance programs at the state level, including the National Animal Health Reporting System (NAHRS), she noted. State veterinary diagnostic labs report on diseases they find, and state veterinarians also use telephone or online networks "to report the information they are seeing and talk about it and come up with recommendations for additional testing needs."

Federal monitoring programs are both voluntary and mandatory, she said. Voluntary programs include the National Animal Health Monitoring System (NAHMS), which collects information on farm management, production, and diseases in order to create baseline data.

Monitoring is also done at feedlots and slaughter plants, where samples are taken and information on partial or whole condemnations is recorded. As an Office of International Epizootics member country, the United States participates in international awareness activities and information exchanges with experts in other countries and key trading partners. "That allows our vigilance at the border—be that air, sea, or land—to be appropriately enhanced based on what is going on around the world," Wineland said.

Dr. Joan Arnoldi, Director of the Animal Industry Division, Michigan Department of Agriculture, said that the first line of defense in detecting and reporting emerging diseases—the farm owner and worker, local veterinary practitioner, and state laboratory technician—is also the "weakest link, and perhaps the most difficult to deal with." Arnoldi stressed that more effort and resources should be directed to this first line of defense.

Arnoldi described two scenarios that illustrate the potential extremes of responding to an outbreak: In the first scenario, it takes weeks for a problem to come to the attention of officials with the expertise and authority to take action. The second is a best-case scenario where controls are put in place within 24 hours. The difference in response hinges on whether the first line of defense, which could be a minimum-wage worker, an absentee owner, or an overworked practitioner, has the adequate background, training, or awareness to recognize and report a problem. "The further up the chain or away from the disease problem you go, the more sophisticated the system becomes, whether you are speaking of molecular techniques in the lab or the very complex integrated control systems. The usefulness of these sophisticated systems may be dependent upon those unsophisticated and variable beginnings," Arnoldi said.

Some of the barriers that states and localities face include declining resources, fewer staff, and insufficient training. "We have a lack of interest by local political bodies. We have a lack of good coordination of the resources that are available at times and poor or little rapport with producers, who view us as regulators or the government, neither of which are very popular in the

countryside," she said. On the positive side, she noted that state and federal staff are "pretty good at applied epidemiology," and states have broad quarantine authority and therefore are able to "stop movements, to gain immediate control over something we think is a foreign animal disease or something that appears to be spreading very rapidly."

Arnoldi and Wineland said there is a need for a better animal identification and trace-back system, without which we cannot determine the origins of diseases. "We don't really know, number one, where our producers are, how many there are, and where the animals are. We don't know how they are identified, if they are identified in most instances, and we don't have a good trace-back system in this country," Arnoldi said. Concurring, Dr. Quentin Tonelli of IDEXX Laboratories, Inc., said the lack of such systems in the United States "will limit our ability to export to countries who have spent a lot of time and effort to eradicate many diseases." Dr. David Swayne, Director of the USDA's Southeast Poultry Research Laboratory noted that having specific information about farms, such as location, animal populations, and types of operation, in the public domain raises fears among producers that the information will be misused by various groups, including those seeking to sue over food-related problems.

Wineland noted that the USDA's National Agricultural Statistics Service collects such data on producers and is the only federal agency with statutory protection to provide confidentiality to information from producers. She said the NAHMS national studies has the same statutory protection, which is crucial in assuaging the fears of producers when asked for sensitive information.

SURVEILLANCE AND REPORTING OF WEST NILE VIRUS

Dr. Michael Bunning of the Centers for Disease Control and Prevention (CDC) described a surveillance system the CDC is using to track the spread of the West Nile virus in the United States. West Nile is an arboviral disease that is transmitted between birds and mosquitoes and is spread to mammals by infected mosquitoes. It was first discovered in the United States in 1999. Bunning said the West Nile tracking system is designed to function as an early warning system that "would identify emerging, re-emerging disease patterns or situations as quickly as possible, in real time."

As soon as a state or county has made a positive diagnosis, they will share that information with neighboring states and counties, and, 24 hours later, the information is made public by being published on the Internet. Anyone can then access up-to-date tallies of infections in humans, horses, sentinel chickens, birds, and mosquitoes on a U.S. Geological Survey website. The data is not comprehensive because not all states are testing or testing extensively for the disease, and data on pets and zoo animals is not yet collected consistently, he

said.

Bunning noted that surveillance and surveillance analysis could be better centralized. Various agencies could continue to collect the data, which would be funneled into one agency and put under a manageable scheme. When a veterinarian "is sitting out there at his desk and he wants to know something about foot-and-mouth, he doesn't have to go to 27 different sites and miss the very site he wants. There ought to be a way to do it, and we have the technology," he noted.

6

Critical Role of Science and Research

Several speakers addressed the importance of developing new methods of testing that would enable technicians to quickly and accurately detect the presence of pathogens in blood and tissue samples and also to distinguish between animals that are infected and those that have been vaccinated. The polymerase chain reaction (PCR) technique, which is still being developed and refined for various applications, figured prominently in the discussions. PCR is a technique of molecular genetics in which DNA is replicated and amplified, thus enabling genetic analysis and identification.

DIAGNOSIS AND TREATMENT

Caird Rexroad said the Agricultural Research Service (ARS) is focusing much of its current research efforts on PCR and other nucleic acid-based detection systems. Using PCR, one can "in a matter of less than an hour or two see the presence of foot-and-mouth virus in the samples." The ARS is in the process of validating this method by conducting field tests, he said, noting that PCR tests can be used in the field in the case of outbreaks, as well as onsite at ports of entry.

Similarly, Quentin Tonelli highlighted the positive features of PCR and associated techniques. "Real-time PCR offers high sensitivity, and, more important than that, you have eliminated the need to culture the organism and,

hence, it is not biohazardous." Additional benefits include the ability to test samples at dispersed sites and to run multiple samples by using automation.

Dr. Bruce Akey, Chief of the Office of Laboratory Services, Virginia Department of Agriculture and Consumer Services, noted that PCR is one important answer to the need for quick, accurate, and affordable diagnostic tests. Rapid or real-time PCR diagnostics are already being validated at USDA's Plum Island Animal Disease Center for doing foreign animal disease work, he said.

Akey addressed the need for accurate tests. "It is not good having a fast test, or even a cheap test, if the results don't tell you anything." Tests should be validated to international standards (i.e., OIE standards), yet many of the tests, especially molecular diagnostics, that have been developed in-house in state and university labs have never been subjected to such validation, he said. The related issue of standardization of protocols is also critical, he said.

NEW VACCINES

Rexroad addressed the need for new vaccines "that we could produce in this country, that don't entail the use of a live virus, perhaps peptide vaccines or something that is based on DNA." Other priorities for research include vaccines that (1) can quickly induce an immune state and prevent a carrier state, (2) have a long-lasting immune response, (3) can be produced in large quantities to meet demand in the event of an outbreak, and (4) are affordable. He said the ARS is working on viral-vectored foot-and-mouth disease (FMD) vaccines and is in the process of testing peptide vaccines.

Genomics plays a strong role in the development of new vaccines "in terms of understanding the immune response of the animal to a particular immunogen, but also how you can make a practical vaccine," he said. Rexroad noted that genomics is now a focus of research at the Plum Island facility, where "genomics is playing a major role in terms of trying to understand the organisms, [and in] identifying the organisms that are likely to have a role in the emergence of new diseases in this country."

CONFIDENTIALITY

Akey also stressed the importance of confidentiality in the handling of samples and test results, noting that producers are often reluctant to participate, fearing that they may face negative publicity or liability for a pathogen that is later traced back to their operation. Each state has its own Freedom of Information Act (FOIA) requirements, and, in Virginia's case, labs are completely open to FOIA requests. "That scares off producers who don't want to bring something into the state laboratory if they have a suspicion that it might

be something they wouldn't want to see in the media or that, down the road, some disgruntled buyer of their product could come back and get their entire history of testing results from those laboratories." One way to deal with this problem, he said, is for states to amend their regulations to give state veterinarians discretionary authority in FOIA decisions, rather than going after exemptions to the statute which "generally, in most states, is political suicide."

COLLABORATION

Akey made a case for more collaboration between the federal government and the states in the area of research and for more federal support for the transfer of new technologies to state veterinary diagnostic laboratories. States are not asked for input in determining research priorities of the USDA's Agricultural Research Service, and, as a result, state diagnosticians are unaware of much of the publicly funded research taking place at the ARS and in universities. "We don't often find out until that technology has been leased to a private company," at which point exclusive licensing agreements and high royalty payments often present insurmountable barriers to acquisition by the state. Having the latest diagnostic technologies available in a single laboratory does not provide adequate protection in an epidemic, when a large number of tests would have to be processed, he said. Brown added, "There is tremendous scientific and technical expertise in our state laboratories that is crying to participate in test development and validation. More federal partnering with state laboratories could provide tremendous synergy." In addition to new diagnostic technologies, states also need funding and support to upgrade their physical facilities and hire additional staff with specialized training in molecular biology, epidemiology, and quality assurance, Akey said.

A National Animal Health Laboratory Network (NAHLN), similar to the Laboratory Response Network sponsored by CDC for public health, would also be useful to provide early detection and response to bioterrorism, emerging diseases, and emergency disease situations. The NAHLN would ensure that each state's veterinary diagnostic laboratory had the equipment and expertise needed, performed testing according to standardized protocols, and were part of a secure, rapid-response communications network.

Weber of the National Cattlemen's Beef Association also addressed the need for additional federal funding of programs that support animal health and food safety. Weber reviewed recent budgets for the USDA and pointed out that funding for the ARS and for the Animal and Plant Health Inspection Agency (APHIS), which he described as the agencies responsible for providing a partnership framework between state animal health officials and industry, working together to prevent the introduction of foreign animal diseases and to

work to eradicate those that we have, is far down on the list of budget outlays. He noted that over the last several years there has been a net loss in funding for such programs, resulting in a loss of intellectual and human capital for the industry and the veterinary medical infrastructure. "This is our greatest threat to the health of our cattle and livestock herds in the United States," he said.

Weber stressed the need for a strong infrastructure at the local, state, and federal levels to prevent foreign animal diseases such as BSE (bovine spongiform encephalopathy) and FMD from occurring in the United States. There are about 100 million head of cattle in the United States, and the risks to industry of such an outbreak would be unacceptable, he said. "Obviously, we believe that the most significant allocation of resources has to be on prevention in the first place. The old saying is 'an ounce of prevention is worth a pound of cure,' and so we are extremely aggressive in asking government to protect our borders."

Industry could be a very important partner to government agencies and labs in the case of an outbreak or terrorist attack, said Tonelli. Industry has the ability to develop and provide a large number of tests on fairly short notice, with standardized test formats to ensure consistent product performance, he said. Industry can also provide product training and technical support, he added. Tonelli suggested a number of strategies to enhance commercial development of diagnostics, particularly in emergency situations: (1) a mechanism for disease screening at regional sites, (2) creation of a special designation for screening positives that does not "confer any economic impact" until the test is confirmed, (3) establishment of a mechanism to drive consensus on what the test needs are, (4) quicker regulatory approval and/or permission to bring materials into the United States in special circumstances, (5) enhanced collaboration between government laboratories and industry worldwide, and (6) broader industry participation in emerging disease committees.

7

Role of Communication and Education

Several speakers addressed the importance of making the general public and legislators aware of the dangers of emerging animal diseases and of the need for additional funding to improve the animal health infrastructure. Some also discussed the role of formal education and training in preparing those who work in the field of animal health to meet today's needs.

COMMUNICATION

There is no better time than now, while concerns about foot-and-mouth disease (FMD), bovine spongiform encephalopathy (BSE), and bioterrorism are still fresh in the public consciousness, to communicate to the general public and legislators the changes that are needed in the animal health infrastructure to bolster our ability to respond to emerging animal diseases, according to several speakers. William Hueston stressed the importance of seizing this "teachable moment" or window of opportunity to "rapidly make changes or solidify the system."

Hueston argued that not enough attention is being paid to the importance of risk communication. "In the absence of accurate information and credible spokespersons, the general public will fill in their concerns with perception. My experience says that 99 percent of the time the perceptions are worse than the reality," he said. Often, government agencies are constrained by political

considerations, so independent sources such as universities could assist by issuing complementary reports.

Corrie Brown noted that veterinarians could be a "tremendous conduit of information to the public" because they have broad-based biomedical training and, according to a recent large market survey, are highly trusted members of the community, ranking just below clergy in this characteristic.

EDUCATION

Dr. Peter Eyre, Dean of the Virginia-Maryland Regional College of Veterinary Medicine, stressed the need for specialized training in veterinary schools. "Why—since the general public, the profession, the industries are looking for specialized veterinarians—are the schools of veterinary medicine still producing only generalists?" he asked. Eyre described a core elective tracking curriculum at his college that provides a common foundation to all students, but then allows individual students to focus on areas such as epidemiology and public health, food animal, or small animal practice. The curriculum includes independent research and externships, which give students valuable experience in industry and government. "We discovered that it was extremely well received and, statistically, approximately 50 percent of the graduates who go through these government and corporate programs go directly into a government or corporate job," he said.

Brown noted that many students entering veterinary medical colleges are unaware of the wide range of jobs available to them in industry and government. Moreover, many colleges are not doing a good job of educating students "about the importance of public and corporate veterinary medicine, about global veterinary medicine," she said. She noted that several programs are being implemented to address this problem, including a stand-alone Internet course on foreign animal diseases funded by a U.S. Department of Agriculture grant. The goal is to "create a cadre of veterinarians, hopefully at each of the veterinary schools, that will then help to change the culture within the school so that students then begin to think outside the halls of the school, outside of the county, outside of the state, outside of the country." There needs to be a major shift in education, she added. "I go back to the saying that they use in many medical schools, 'when you hear hoof beats on the covered bridge, don't think about the zebra….' Now, in this whole new world order, we have to teach students and practitioners that they have to think about the zebra."

8

Summary

Speakers noted that recent actions taken by the United States to control emerging diseases, including new regulations, tightened border controls, and increased inspections, have had positive results, particularly in keeping out BSE, or "mad cow disease." However, they noted that in this age of globalization and constant changes in demographics and the environment, the nation remains vulnerable to outbreaks of animal diseases, which could occur at any time. Thus, proper planning and preparation are crucial, they stressed.

Some of the key areas as noted by speakers where more attention needs to be focused include:

- *Surveillance and monitoring* A multitude of surveillance and monitoring systems for tracking animal diseases exist, but these systems could be better coordinated and more functional. In addition, strategies that encourage the participation of producers should be developed, so that diseases and pathogens can be more easily tracked to their source.
- *Research and development* Much progress already is being made, but more is needed, in research and development of diagnostic tools that are portable, quick, accurate, and flexible, as well as "smart vaccines" that can stop diseases in their tracks and enable us to distinguish between an animal that is infected versus one that has been vaccinated.
- *Awareness* The general public may not recognize the value of agriculture and the tremendous economic impact that a foreign disease

incursion could have on the nation. The individuals on the first line of defense—the producers, veterinarians, and processors—have inadequate training in recognition of many diseases. An educational campaign to increase awareness and to train the first line of defense could have far-reaching impacts.

- *Laboratory infrastructure* There was concern about the ability of state and federal laboratories to run a large number of tests in the event of an outbreak such as the one that occurred in the United Kingdom. Additionally, state diagnostic laboratories may benefit from improved information and partnering during technology development.
- *Confidentiality* It is possible that the handling of FOIA (Freedom of Information Act) requests will need to be reevaluated in light of producers' fears about disclosures that could cause them to be targeted by regulators, extremist groups, or disgruntled consumers.
- *Coordination and communication* For all of these issues, stronger communication, collaboration, and cooperation is encouraged, with involvement of all stakeholders—federal and state agencies, academics, and industry. Only with the synergy provided through collaboration can the significant gaps in the system be effectively addressed.

APPENDIX A

Workshop Agenda

A NATIONAL RESEARCH COUNCIL PUBLIC WORKSHOP
EMERGING ANIMAL DISEASES:
GLOBAL MARKETS, GLOBAL SAFETY

January 14–15, 2002

The National Academies
2101 Constitution Avenue N.W.
Washington, DC 20418

Reception
The Great Hall
January 14, 2002
7:00–9:30 pm

Welcome
Dr. Bruce M. Alberts, President, National Academy of Sciences

Opening Remarks
Dr. John Marburger, Director, White House Office of Science and Technology Policy

Guest of Honor
Dr. David King, F.R.S., Chief Scientific Advisor, U.K. Government and Head, British Office of Science and Technology
Biosecurity: Lessons Learned from a Disease Crisis in Animal Agriculture

Workshop
Auditorium
January 15, 2002
8:30 am–5:00 pm

8:30–8:35 am	**Welcome** ***Dr. Harley W. Moon*****,** Frank K. Ramsey Endowed Chair in Veterinary Medicine, College of Veterinary Medicine, Iowa State University
8:35–8:50 am	**Keynote Address** ***Deputy Secretary James R. Moseley***, U.S. Department of Agriculture
8:50–9:00 am	**Overview of Workshop** ***Dr. Corrie Brown***, University of Georgia
9:00–10:00 am	**The British Battle Against Foot-and-Mouth Disease** ***Professor David King***, Chief Scientific Adviser to the British Government and Head of the Office of Science and Technology
10:00–10:15 am	BREAK
10:15–11:35 am	**Global Security in a Global Economy** **Session 1 Moderator: *Dr. Corrie Brown***, University of Georgia ***Dr. Robert Brackett***, Director of Food Safety, DHHS/FDA/CFSAN Current U.S. Programs on Food Safety and Bioterrorism

Dr. Caird E. Rexroad, Associate Deputy Administrator, USDA/ARS
Current and Changes in Research Priorities
Dr. Philip Corrigan, Embassy of Australia
International Perspective
Dr. Gary Weber, National Cattlemen's Beef Association
Industry Perspective
Mr. Thomas McManus
Perspective of an Irish Farmer

11:35 am–12:00 pm **Panel Discussion and Audience Questions**

12:00–1:00 pm LUNCH

1:00–2:00 pm **Session 2 Moderator:** ***Dr. David E. Swayne***, Director, Southeast Poultry Research Laboratory, USDA/ARS

Animal Pathogens: What Should We Be Looking For?
Dr. Stephen F. Sundlof, Director, Center for Veterinary Medicine, DHHS/FDA
Issues of Feedborne Pathogens
Dr. William Hueston, Director, Center for Animal Health and Food Safety, University of Minnesota
Emerging Trends/Issues

Detection and Prediction: How Will We Know It's A Problem?
Dr. Nora E. Wineland, Center Leader, Center for Animal Health Monitoring, USDA/APHIS/VS/CEAH
Current Animal Disease Surveillance, Monitoring, Reporting
Dr. Mike L. Bunning, DHHS/CDC
Public Health Surveillance—Models, Lessons Learned

2:00–2:15 pm **Panel Discussion and Audience Questions**

2:15–2:30 pm BREAK

2:30–3:30 pm **Session 3 Moderator:** ***Dr. David E. Swayne*****,** Director, Southeast Poultry Research Laboratory, USDA/ARS

Disease Diagnostics: How Can We Identify It—Quickly, Cheaply, and Accurately?

Dr. Quentin Tonelli, IDEXX Laboratories, Inc.
Industry Perspective
Dr. Bruce Akey, Chief, Office of Laboratory Services, Virginia Department of Agriculture and Consumer Services
Breakthroughs and Barriers

Treatment and Eradication: How Do We Get Rid of It?
Dr. Joan Arnoldi, Director, Animal Industry Division, Michigan Department of Agriculture
On-site Control Programs
Dr. Peter Eyre, Dean, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech and University of Maryland
Veterinary Education and Outreach

3:30–3:45 pm **Session 3: Panel Discussion and Audience Questions**

3:45–4:45 pm **Opportunities and Obstacles: Identifying Next Steps for Progress**
Panel Discussion and Audience Questions
Moderator: ***Dr. David E. Swayne***, Director, Southeast Poultry Research Laboratory, USDA/ARS

4:45–5:00 pm **Summary and Final Thoughts**
Dr. Corrie Brown, University of Georgia

5:00 pm **Adjourn**

APPENDIX B

Speaker Biographies

Bruce L. Akey is currently the Chief, Office of Laboratory Services in the Division of Animal Industry Services of the Virginia Department of Agriculture and Consumer Services and is the Director of the Virginia Animal Health Laboratory System. He is a past President of the AAVLD and currently Chair of the AAVLD Government Relations Committee, Co-Chair of the Joint AAVLD/USAHA Animal Health Information Systems Committee, and Co-Chair of the National Animal Health Reporting System Steering Committee.

Joan M. Arnoldi is Michigan's State Veterinarian and Director of the Michigan Department of Agriculture's Animal Industry Division. Her interests are in developing and implementing policies, standards, and programs designed to help ensure a strong, vigorous, and economically stable livestock industry by the control of intrastate and interstate movement of animals and animal products, with particular emphasis on those animal diseases having potentially harmful effects on human health.

Robert E. Brackett is the Director of Food Safety in FDA's Center for Food Safety and Applied Nutrition. His research interests have focused on the effects of processing and packaging on the growth and survival of foodborne pathogens

in foods, methods for detection and enumeration of foodborne pathogenic bacteria, and the detoxification of aflatoxins.

Corrie C. Brown is a Professor and Coordinator of International Activities in the College of Veterinary Medicine, University of Georgia. Her research interests include emerging diseases and the pathogenesis of infectious disease in food-producing animals, through the use of immunohistochemistry and in situ hybridization.

Michael L. Bunning, LTC, Biomedical Science Corps, United States Air Force, is currently serving as the Department of Defense liaison to the Centers for Disease Control and Prevention. His scientific interests include epidemiology and complex humanitarian disasters.

Philip Corrigan is the Veterinary Counselor at the Embassy of Australia in Washington, representing the Australian Federal Department of Agriculture in the Americas. He has wide experience in food animal veterinary practice, management of national animal health programs, and in the facilitation of international trade in agricultural products, particularly dealing with export/import, World Trade Organization, and sanitary and phytosanitary issues.

Peter Eyre is the Dean of Virginia-Maryland Regional College of Veterinary Medicine. He frequently speaks at professional veterinary association meetings and universities around the nation concerning curricular reforms that promote the economic well-being of the profession of veterinary medicine.

William D. Hueston is the Director for the Center for Animal Health and Food Safety, an interdisciplinary initiative linking the College of Veterinary Medicine; School of Public Health; and College of Agriculture, Food, and Environmental Sciences at the University of Minnesota. His expertise is in epidemiology and animal health, especially domestic and foreign animal disease control and monitoring, and in food safety risk analysis.

David King is the Chief Scientific Advisor to the British Government and Head of the U.K. Office of Science and Technology. He was instrumental in controlling the foot-and-mouth disease outbreak in February 2001, and has also worked on issues including climate change, energy research, and BSE. He oversees science advice across the British government, as well as provides of scientific counsel to the Prime Minister.

Thomas McManus is a cattle farmer from Belleek, Co. Fermanagh, Northern Ireland. He owns 42 hectares in Northern Ireland and 30 hectares in Southern

Ireland, and the recent animal disease outbreaks have had significant impact on his farms and livelihood.

Harley W. Moon is the current Chair of the Board on Agriculture and Natural Resources, as well as the F. K. Ramsey Chair in the Veterinary Medical Research Institute of Iowa State University. He has been a member of the National Academy of Science since 1991 and has served on several NRC committees. Dr. Moon's research interests include vaccines for preventing *E. coli* infection in farm animals and livestock disease eradication, and he is widely recognized for his contributions to understanding intestinal infections in humans and animals. Prior to his current position, Dr. Moon was Director of USDA's Plum Island Animal Disease Center.

Jim Moseley is the Deputy Secretary of the U.S. Department of Agriculture. He oversees the day-to-day activities of the Department, including the management of traditional farm programs, private lands conservation, domestic food assistance, agriculture research and education, agricultural marketing, international trade, meat and poultry inspection, forestry, and rural development programs. Prior to this appointment, Moseley, an Indiana farmer with 32 years of hands-on farm experience, was the owner of Ag Ridge Farms, which specializes in grains, and managing partner of Infinity Pork, LLC, which raises hogs.

Caird E. Rexroad is Associate Deputy Administrator of the Agricultural Research Service, the intramural research agency of the USDA, and has responsibility for livestock programs, animal health, food safety, and human nutrition. He was trained as a reproductive physiologist and has conducted research on genetic modification of livestock, including on genes to enhance disease resistance.

Stephen F. Sundlof is Director of FDA's Center for Veterinary Medicine. His research interests include drug residues and food safety. He presently serves as chairman of the WHO/FAO Codex Alimentarius Committee on Residues of Veterinary Drugs in Foods.

David E. Swayne is the Director of USDA/ARS/Southeast Poultry Research Laboratory. This facility provides research solutions to emerging and exotic viral diseases of poultry. Dr. Swayne's personal research interests include pathobiology and control of avian influenza, West Nile fever, and avian pneumovirus in domestic poultry

Quentin Tonelli is the Corporate Vice President and General Manger of the Production Animal Business Group at IDEXX Laboratories. Dr. Tonelli's research interests include the development of infectious disease diagnostics for poultry and livestock, and he has done extensive work on hepatitis and AIDS diagnostics.

Gary Weber is currently the Executive Director for Regulatory Affairs, Center for Public Policy, National Cattlemen's Beef Association. His role is to provide leadership and guidance on matters relating to the federal regulation of the beef industry.

Nora E. Wineland is the National Animal Health Monitoring System program leader at the United States Drug Administration. She has been with the APHIS Veterinary Services' Centers for Epidemiology and Animal Health since 1987 in several capacities, beginning her career with USDA as an APHIS field veterinary medical officer in Ohio.

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