Animal Health at the Crossroads
Preventing, Detecting, and Diagnosing Animal Diseases

The confirmed case of “mad cow” disease (BSE) in June 2005 illustrates the economic impact of disease outbreaks, as additional countries closed their markets to U.S. beef and beef products. Emerging diseases also threaten public health—11 out of 12 of the major global disease outbreaks over the last decade were from zoonotic agents (that spread from animals to humans). In general, the U.S. animal health framework has been slow to take advantage of state-of-the-art technologies being used now to protect public health; better diagnostic tests for identifying all animal diseases should be made a priority. The report also recommends that a coordinating mechanism be established to enhance partnerships among local, state, and federal agencies, and the private sector.

Safeguarding animal health is of paramount importance to the U.S. economy, public health, and food supply. There are a number of animal diseases of concern that affect the adequacy of the food supply for a growing world population and have huge implications for global trade and commerce (see Box 1, p. 2). Since many animal disease agents are zoonotic, they carry the potential to affect public health on a global scale. Additionally, the impact of an intentional use of animal disease agents to cause illness, loss of life, and economic damage could be enormous.

In recognition of the changing influences on animal health, the National Academies developed a concept for a three-phase analysis of the U.S. system for dealing with animal diseases. This report, which embodies the first phase of the study, presents an overview of the animal health framework and examines its overall role in the prevention, detection, and diagnosis of animal diseases. It examines how well the current framework has responded to different animal disease scenarios and how the framework could be improved. A proposed second phase of the study will focus on surveillance and monitoring capabilities, and a third phase will focus on response and recovery from an animal disease epidemic.

Coordination of Framework Components

The animal health framework is large; it includes people who handle animals on a daily basis, veterinarians and other animal health professionals, numerous offices in more than 10 federal agencies, several international organizations, and many supporting institutions. Because of the very large number of actors responsible in some way for safeguarding animal health, it is not surprising that effective coordination is a major challenge.

There are both overlaps and gaps in current programs that point to a need for a strategic focal point to enhance partnerships and to integrate all stakeholders into a cohesive whole. While there are several possible models for improved coordination, the report does not recommend options for a specific system-wide mechanism, in part because it has only examined the animal health framework from the partial perspective of prevention, detection, and diagnosis.

Recommendation: The nation should establish a high-level, centralized, authoritative, and accountable
coordinating mechanism or focal point for engaging and enhancing partnerships among local, state, and federal agencies as well as the private sector.

**Technological Tools for Preventing, Detecting, and Diagnosing Animal Diseases**

The current U.S. animal health framework has been slow to evaluate, validate, and implement new scientific tools and technologies that could significantly enhance animal disease prevention, detection, and diagnostic capabilities for the United States. Technological advances that are now available to the framework include immune system modulators; animal-embedded chips to monitor temperature and other physiological indices; vaccines as prevention strategies, and a range of rapid, automated, sensitive, and portable sampling and assay systems for early warning and diagnosis.

**Recommendation:** Agencies and institutions—including the U.S. Department of Agriculture (USDA) and the Department of Homeland Security (DHS)—responsible for protecting animal industries, wildlife, and associated economies should encourage and support rapid development, validation, and adoption of new technologies and scientific tools for the detection, diagnosis, and prevention of animal diseases and zoonoses.

**Scientific Preparedness for Diagnostics**

Laboratory diagnosis of animal diseases in the United States involves federal, state, university, and commercial entities. However, the current network lacks surge capacity and is not prepared for disease agents and toxins outside a relatively narrow list of diseases. The system also needs better integration with the public health diagnostic and surveillance system to strengthen the ability to diagnose and rapidly detect most zoonotic and bioterrorism agents. Currently, there are not enough strategically located facilities in the United States to do research on agents that require high levels of containment (containment levels are classified as Biosafety Levels 1 through 4, with 4 being the most restrictive). Additional Biosafety Level 3 facilities are needed for research and surge capacity in case of outbreaks.

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<th>Box 1. Animal Diseases of Concern</th>
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<td><strong>Exotic Newcastle Disease</strong>—Most infectious and fatal disease of poultry worldwide. In California in 1971, 11.9 million commercial birds were destroyed to stop the disease. In 2002-2003, outbreak in California, Nevada, Arizona, Texas, led to destruction of 3.21 million poultry, at a cost of $160 million in federal control efforts.</td>
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<td><strong>Foot-and-Mouth Disease</strong>—Contagious disease of cattle, swine, and cloven-hoofed species such as deer, sheep and goats. No incursions in the U.S. since 1929. In the U.K. in 2001, an epidemic that lasted 214 days led to the destruction of 6.5 million animals.</td>
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<td><strong>Monkeypox</strong>—A rare viral disease affecting monkeys, rats, mice, and rabbits, and causing a rash and fever in humans. In 2003, 70 human cases found in six states; the source of infection was traced to Prairie dogs kept as pets that had been in contact with rats shipped into the U.S. from Ghana.</td>
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<td><strong>Severe Acute Respiratory Syndrome (SARS)</strong>—The World Health Organization (WHO) estimates that a total of 8,098 people worldwide became sick, and 774 died, when infected with a novel, contagious coronavirus (similar to a virus found in civets, a type of cat) in 2003.</td>
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<td><strong>Bovine Spongiform Encephalopathy (BSE or Mad Cow disease)</strong>—Disease affecting the nervous system of cattle. Not contagious, but is transmitted through ingestion of feed contaminated by an aberrant protein called a prion. In 2003 a single case was found in Washington State, leading other countries to stop imports of U.S. beef. A second case was found in Texas in 2005. BSE is linked to variant Creutzfeldt-Jakob disease (vCJD) known to have caused 147 human deaths in the United Kingdom as of December 2004.</td>
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<td><strong>Avian Influenza</strong>—As of January 2005, the H5N1 avian influenza virus killed 34 of 47 infected humans and resulted in the death and depopulation of over 100 million birds, primarily commercial poultry, as well as uncounted numbers of wild birds.</td>
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<td><strong>Chronic Wasting Disease</strong>—A prion disease affecting cervids (deer, elk) is a major problem in some U.S. western and midwestern states where farmed and wild cervids are infected. There is no conclusive evidence to date that a CWD prion has caused disease in domestic animals or people.</td>
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<td><strong>West Nile Virus</strong>—Poorly understood disease affecting birds, horses, and humans. In 2002 and 2003, WNV infected 15,300 and 5,200 horses in North America, respectively. Human cases lead to flu-like signs or no symptoms; rare instances of encephalitis and death.</td>
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**Recommendation:** The animal health laboratory network should be expanded and strengthened to ensure sufficient capability and capacity for both routine and emergency diagnostic needs, and to ensure a robust linkage of all components (federal, state, university, and commercial laboratories) involved in the diagnosis of animal and zoonotic diseases.

**Recommendation:** To strengthen the animal health and zoonotic disease research infrastructure, the report recommends that competitive grants be made available to scientists to upgrade equipment for animal disease research and that the nation construct and maintain government and university Biosafety Level 3 (BSL-3 and BSL-3 Ag) facilities for livestock (including large animals), poultry, and wildlife.

**Animal Health Research**

Early recognition of emerging diseases requires a fundamental knowledge of the epidemiology of the disease, which includes an understanding of the agents and hosts in their natural environment. Many individual researchers address various diseases relatively independently and usually with a focus on a single host species or mouse model. As a result, medical scientists may be unaware of key research done in other species by veterinary scientists studying a similar, closely related or even unique animal pathogen. For example, the animal reservoir and susceptible species for SARS remain undefined and integrated, and collaborative research efforts to study the responses to SARS in infected humans and diverse animal hosts have not been instituted in the United States.

**Recommendation:** Federal agencies involved in biomedical research (both human and veterinary) should establish a method to jointly fund new, competitive, comprehensive, and integrated animal health research programs; ensure that veterinary and medical scientists can work as collaborators; and enhance research, both domestically and internationally, on the detection, diagnosis, and prevention of animal and zoonotic disease encompassing both animal and human hosts.

**International Interdependence and Collaboration**

Globalization, population growth, and expansion of human activity into previously unoccupied habitats have essentially connected the United States to potential zoonotic and non-zoonotic pathogens residing throughout the world. This necessitates coordinated international collaboration efforts directed at identifying potential risks worldwide, including regulatory mechanisms that minimize the threat of introducing emerging infectious agents into the United States or other unaffected countries. The current system has been more ad hoc than strategic.

**Recommendation:** The United States should commit resources and develop new shared leadership roles with other countries and international organizations in creating global systems for preventing, detecting, and diagnosing known and emerging diseases, disease agents, and disease threats as they relate to animal and public health.

**Importation, Sale, and Transport of Animals**

The monkeypox outbreak of 2003 revealed a lack of coordinated federal oversight of the animal-centered aspects of diseases transmitted by exotic animals. Import and movement of exotic animals was, and still is, largely uncontrolled. Tracking of these animals in the United States is inconsistent and ineffective, and there is a disturbing lack of standardized testing of the health status of exotic animals at the point of origin and in companion animal shops, trade fairs, and other venues. Considering that the emergence of new disease agents occurs most frequently at species interfaces, monkeypox is not likely to be the last zoonotic agent to emerge from an exotic animal in the United States.

**Recommendation:** Integrated and standardized regulations should be developed and implemented nationally to address the import, sale, movement, and health of exotic, non-domesticated, and wild-caught animals.

**Addressing Future Animal Disease Risks**

There has been increased recognition and use of well-structured and scientifically based mathematical, epidemiological, and risk analysis models and tools to define acceptable risks and mitigation strategies that can assist in policy and science-based decision-making. Efforts to develop scientific data on disease transmission, effectiveness of control programs, economic evaluation, and quantitative assessment of all factors involved in making policies and regulations should be a priority of the animal health infrastructure, working in collaboration with academia, industry, and global trade partners.

**Recommendation:** The USDA, DHS, Department of Health and Human Services, and state animal and public health agencies and laboratories should improve, expand, and formalize the use of predictive, risk-based tools and models to develop prevention, detection,
diagnostic, and biosecurity systems and strategies for indigenous, exotic, and emerging animal diseases.

**Education and Training**

There are insufficient graduates to meet the needs in a number of major and distinct fields of veterinary medicine dealing with various species of food-animals, rural practice (mixed domestic animals), ecosystem health (including wildlife disease and conservation biology), public health, the many dimensions of the food system, and biomedical science. Too few veterinary students are choosing to specialize in basic biomedical science or pathology.

Strong and well-functioning front-line detection is provided by animal handlers and personnel working with animals on a day-to-day basis who need education and training that includes awareness and recognition of clinical signs, as well as an elementary understanding of disease transmission and prevention. Responsibility for implementing the educational plan would fall on those at the local level.

**Recommendation:** Industry, producers, the American Veterinary Medical Association (AVMA), government agencies, and colleges of veterinary medicine should build veterinary capacity through both recruitment and preparation of additional veterinary graduates into careers in public health, food systems, biomedical research, diagnostic laboratory investigation, pathology, epidemiology, ecosystem health, and food animal practice.

**Recommendation:** The USDA, state animal health agencies, the AVMA, and colleges and schools of veterinary medicine and departments of animal science should develop a national animal health education plan focusing on education and training of individuals from all sectors involved in disease prevention and early detection through day-to-day oversight of animals.

**Public Awareness**

Increased public awareness is critical in supporting and implementing transformations needed to strengthen the framework against animal disease risks. The lack of cohesive national advocacy for animal health issues generally creates a much more difficult environment in which to increase attention and investment in the framework for preventing, detecting, and diagnosing animal diseases, which may directly impact human health.

**Recommendation:** The government, private sector, and professional and industry associations should collectively educate and raise the level of awareness of the general public about the importance of public and private investment to strengthen the animal health framework.

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This brief was prepared by the National Research Council based on the committee’s report. For more information, contact the Board on Agriculture and Natural Resources at http://dels.nas.edu/banr or 202-334-3062. Copies of Animal Health at the Crossroads are available from the National Academies Press, 500 Fifth Street, NW, Washington, DC 20001; 800-624-6242; www.nap.edu.

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