In 2009, the H1N1 pandemic strain of influenza served as a dramatic wake-up call for biosurveillance experts around the world. Despite major advances in domestic and global surveillance capabilities, H1N1 was spreading rapidly across the United States long before a vaccine could be developed, tested, and mass-produced in time to slow the pandemic. Today, the threats posed by the H7N9 influenza virus and the MERS (Middle East Respiratory Syndrome) Coronavirus are a significant concern to global health officials. Although it is far from clear how these two viruses are transmitted, it seems likely that animal-to-human spread could be playing a role in the evolution of one or both of the viruses.

That supposition should not be a surprise to anyone who knows the sheer number of zoonotic threats on a comprehensive list of the newly emerging (or re-emerging) infectious diseases. Given what was observed with the rapid introduction of H1N1 to humans and the subsequent unchecked spread of the disease, a closer and more detailed understanding of the existing strengths and weaknesses of global and domestic surveillance systems may be the key to impeding the spread of these and other emerging zoonotic threats—rabies, for example, is a disease that can easily be transmitted from animals to humans.

**Animal Surveillance Systems in the United States**

Within the United States, surveillance programs for infectious diseases are spread across a diverse array of federal, state, and local agencies. Departments of health usually focus their greatest attention on human diseases; departments of agriculture give primary attention, though, to animals commonly classified as livestock; and departments of natural resources or wildlife are responsible for the tracking and surveillance of non-domesticated and wild animals.

These understandably different priorities lead to some significant intrinsic breaks in continuity. In June 2010, the U.S. Government Accountability Office published an analysis of the federal government’s own biosurveillance systems and found that the diverse array of programs assigned to various departments suffered from a severe lack of overarching leadership and complicated national strategic planning. As a follow-up, the White House published a National Strategy for Biosurveillance in July 2012 and, a few months later (November 2012), a National Biosurveillance Integration Center Strategic Plan for the U.S. Department of Homeland Security (DHS). The implementation of these new strategies is ongoing, so progress in the field of integrated biosurveillance will likely be an area of increasing scrutiny over the coming years.

Even within the animal surveillance system itself, a diverse array of data sources must be more closely aligned to provide an accurate nationwide understanding of zoonotic diseases. The National Animal Health Surveillance System (NAHSS) serves as an integrated framework for the federal and state as well as university and industry-based entities to collect, collate, and review animal health data throughout the United States.
The overarching goal of the NAHSS is multi-pronged. First, the program seeks to serve as an early detection and global surveillance system for both foreign animal and newly emerging diseases. Second, the NAHSS serves as a data collection system for existing "program diseases" and, in that respect, will help researchers understand the current status, the potential impact of various interventions, and/or changes in the dynamics of such diseases. Finally, NAHSS helps to monitor animal systems for diseases of high impact on both production and the nation’s food markets.

Here it should be pointed out that the NAHSS has made significant progress in recent years and, among other things, has standardized the data collection processes used by all 50 states. However, work continues on the development of a U.S. National List of Reportable Animal Diseases, where the goal is to make the National List of Reportable Animal Diseases aligned with the international efforts of the World Organization for Animal Health (OIE).

**The Influence of Pandemic Influenza on Domestic Surveillance**

The growing threat posed by a pandemic influenza, particularly Highly Pathogenic Avian Influenza (HPAI), has driven the enhanced domestic surveillance of non-human animals. The Veterinary Services unit of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service aims to partner with a broad spectrum of state and industry organizations to monitor and test the nation’s domestic poultry and swine populations to ensure that foreign influenza strains are constantly observed. This enhanced surveillance effort has been significant, according to the USDA, which reports that more than a combined 478,000 tests were conducted during the fourth quarter of 2012 and first quarter of 2013.

The USDA also is working actively to prevent the establishment of domestic reservoirs of HPAI. To begin with, the United States does not allow the importation of live birds, eggs, or hatchlings from countries where avian inflenzas, such as the novel H7N9 strain, are prevalent. Products based on those types of poultry may be imported only if they are treated in a manner that would have destroyed the virus. Pet birds also are routinely tested before importation. The USDA's work in this area, combined with heightened border and port security, has been very effective in preventing the introduction of any HPAI strains of particular concern.

Unfortunately, as the 2009-2010 H1N1 pandemic seems to indicate, there is still room for improvement in the U.S. domestic surveillance of influenza, particularly in the swine population. Pigs are often an important intermediary between avian influenza and human-adapted strains. The H1N1 pandemic highlighted this risk. In the case of the 2009-2010 pandemic strain of H1N1, the ancestors of the virus had been tracked in pigs for several years, but a series of non-anticipated evolutionary changes led to the new strain. Preventing new outbreaks is a particularly difficult challenge in an environment in which thousands of novel avian and swine influenza sequences are identified every year.

The constant struggle is not simply to identify new strains of a particular disease in animals, but to determine which of the new strains poses an abnormally high risk to humans and/or other animals. This is an area where considerable work will be needed to reach a point of more effective intervention, if ever such a state could be achieved. Nonetheless, the effort must be made. In May 2009, for example, in its response to the 2009 H1N1 pandemic, the U.S. Centers for Disease Control and Prevention called for "more systematic surveillance of influenza viruses in pigs."

**International Systems of Surveillance: A Complex Network**

Many diseases that threaten U.S. livestock originate overseas, particularly in nations where population densities, agricultural practices, and surveillance mechanisms differ significantly from U.S. domestic standards. Like most other international security measures, the methodical surveillance of diseases of any type is subject to local capabilities – and vulnerable to them as well, if the capabilities are limited. Largely for that reason, standards vary between locations, leaving participants in the international food trade system susceptible to exposure. Recognizing this problem, international agencies have developed rigorous surveillance and response guidelines to detect and at least ameliorate these international food safety vulnerabilities.

Perhaps of greater importance are the international community’s cooperative efforts between and among different agencies. In April 2010, in recognition of the growing threat posed by foodborne diseases, OIE, the Food and Agriculture
Organization (FAO) of the United Nations, and the World Health Organization (WHO) developed a collaborative strategy spelling out their different, but complementary, missions in disease control and prevention. That strategy divides responsibilities among the various agencies' areas of expertise and, where responsibilities overlap, encourages the free exchange of information.

One product of the FAO/OIE/WHO tripartite agreement, the Global Early Warning System (GLEWS), jointly consolidates epidemiological data for use by other international agencies, national authorities, nongovernmental organizations, and the global public. The extensive GLEWS database of disease events tracks the incidences of animal disease, including zoonoses, across the world, maintaining a level of situational awareness on all fronts. With some 70 HPAI incidents monitored by the FAO from July 2009 to January 2012, it is obvious that GLEWS already has improved the interagency mobilization needed to verify instances of various diseases. Although pandemics have certainly threatened both animal and human populations in the past, the FAO also noted that HPAI was the first pandemic to arrive with advance warning – thanks largely to the development and use of improved surveillance methods.

Responding to calls for international emergency responses, in addition to surveillance efforts, the OIE-FAO's Crisis Management Center-Animal Health (CMC-AH) was established to provide additional help to local agencies in the form of technical assistance. The CMC-AH, housed in the FAO's Rome headquarters, uses advanced surveillance technology to facilitate international responses to HPAI and other disease threats. Resource mobilization is needed in some cases, but the CMC-AH acts primarily in an advisory role to local authorities. The international response to HPAI is nearly unprecedented in its scope. Most of the CMC-AH's activation calls to combat the spread of HPAI during the 2006-2008 time frame were issued because the organization was monitoring the disease around the clock in 13 endemic countries.

The cooperation between and among the FAO, OIE, and WHO has provided significant multi-sectorial protection against foodborne diseases. By merging their operational tools, professional expertise, and material resources (when applicable), these international organizations have prevented effort redundancies and multiplied the effectiveness of their surveillance and intervention actions.

As the threat of HPAI looms, the U.S. public health experts involved would be well advised to seek new methods to improve and expand national foodborne disease surveillance and intervention capabilities. The U.S. Department of Health and Human Services, the USDA, and other federal departments also should continue to foster additional collaboration not only among their own agencies but also with international partners. The consolidation of parallel efforts to detect, research, and treat foodborne diseases lends itself to greatly increased national food security actions.

Lessons to Be Learned: Improving Domestic Surveillance

One of the more important lessons to be learned from recent threats to global health is the overarching truth that zoonoses now constitute a major threat to all nations throughout the world. Although recognition of that fact certainly exists in the U.S. animal-surveillance community and among public health officials, many segments of the human public health infrastructure are almost wholly divorced from their animal surveillance counterparts in other agencies. Moreover, many do not participate in the joint information-sharing processes necessary to inform their global partners about the broad spectrum of new potential threats looming just over the horizon.

One model that may serve public health well is the development of fusion center-like collaborations with animal surveillance counterparts. Fusion centers allow for interdisciplinary information sharing and situational awareness, principally in the law enforcement and homeland security sectors, but it was their efforts to obliterate certain silos that produced improved understanding among critical partners.

In summary, the global animal surveillance community has moved into the collaboration business principally due to the necessity produced by divergent national surveillance programs. Domestic surveillance systems would be well served to further improve that same multi-agency integration. Hopefully, recent efforts at the federal level to consolidate surveillance efforts and provide more centralized leadership will eventually lead to adoption of several additional changes in collaboration that are still needed.
Thomas Cotter is a senior policy analyst at the University of Maryland Center for Health and Homeland Security (CHHS). He has a background in international emergency response, recovery, and public health programs with a number of international organizations. In the Philippines, he worked on a World Health Organization team and with the national Department of Health to stop a leptospirosis outbreak following Typhoon Sendong in 2011. He also responded to the Haitian earthquake in 2010, and traveled to Panama to help strengthen healthcare capacity on remote islands. His work in the field led him to develop emergency management and risk mitigation plans for organizations in Tanzania. While earning his Bachelor’s degree, he worked in the Emergency Medical Services in Rhode Island as an emergency medical technician. He earned his Master of Public Health degree from Boston University in International Health, specializing in Complex Humanitarian Emergency Management. He also coordinates the CHHS internship program with the University of Maryland School of Medicine Department of Epidemiology and Public Health.

Earl Stoddard (pictured) is the Public Health Program Manager for the University of Maryland Center for Health and Homeland Security (CHHS). In that post, his responsibilities include overseeing many of the Center’s public health efforts, working with regional partners on public health preparedness efforts, and improving the interface between the public health and emergency management communities. He also assists several local governments, hospitals, and regional organizations in identifying shortfalls, improving planning, and strengthening their collaboration and communications efforts with their partners.