AGRICULTURAL BIOSECURITY AND LAND-GRANT UNIVERSITIES IN THE 21ST CENTURY

BY ALAN RUDOLPH, PHD, MBA

INTRODUCTION

The agricultural industry has experienced significant losses and economic consequences, estimated in the billions of dollars, from infectious disease outbreaks in animals and plants caused by pathogens. The 2014-2015 highly pathogenic avian influenza (HPAI) outbreak, the largest poultry disease outbreak in U.S. history, is one example of the impact of these outbreaks. The 2014-15 HPAI outbreak is estimated to have resulted in the loss of 12% of the U.S. layer population, with resulting billions of dollars in recovery and restoration costs. These costs also include lost jobs and economic hardship for farmers who suffered through the destruction of millions of birds during the outbreak. Provisions from the government only partially compensated for the full economic impact that this event had on the industry, producers, their families and their communities. Other examples include the African Swine Fever outbreak that has recently devastated pork production in China and which is a credible threat to U.S. producers, and the invasive Asian longhorn cattle tick that has been detected in at least nine mid-Atlantic states and is able to transmit disease to both cattle and humans. The increasing frequency of occurrence of known diseases, as well as threats from emerging infectious diseases that could dramatically threaten our country, demands increased attention to enhanced agricultural biodefense.

Although awareness and planning to improve response to infectious disease outbreaks has increased, gaps remain. These gaps have been echoed by numerous academy and government-sponsored reviews of liabilities in the agricultural sector to infectious disease. *Despite best efforts, a lack of coordination linking research and technology development across human and animal investments in biosecurity to agile countermeasures still exists, and coordination of effective networks of response remains challenging.*

NEW POLICIES AND INVESTMENTS IN THE UNITED STATES FOR AGRICULTURAL BIOSECURITY

In 2017, the Bipartisan Commission on Biodefense (formerly the Blue Ribbon Study Panel on Biodefense) released a seminal report focused on disease threats and made recommendations to increase regional stockpiling of response countermeasures that included rapid diagnostics, vaccines and therapeutics.[i] The Commission report also included a recommendation to build better interagency networks for situational awareness, surveillance and laboratory response and to further their cooperation to deliver solutions for this increasingly costly and threatening problem.

Aligned with many of the recommendations of this Commission report, in September 2018 the White House issued a National Biodefense Strategy and created a new interagency authority intended to bring consolidation and more cooperation to a long-standing and increasing threat from infectious disease outbreaks.[ii] The protection of the U.S. agricultural base is a major element of the White House plan, and highlights the U.S.' growing appreciation of the vulnerabilities of the agricultural industry, and aids the Nation as it "prevents, prepares for, responds to, recovers from and mitigates risk from … biological threats" [ii] including those that directly impact the agricultural sectors of the Nation.

AGRICULTURAL ADVANCED DEVELOPMENT AND MANUFACTURING, AND COUNTERMEASURES

In 2004, a significant investment in biodefense was made by the National Institute of Health (NIH) into land-grant universities to study infectious diseases, which resulted in the construction of new biocontainment facilities intended for research and development, clinical diagnosis and treatment of both animals and humans, and biomanufacturing of countermeasures to reduce the impact of disease outbreak by natural or nefarious means. National investments in these assets at land-grant universities provides a foundation of both physical infrastructure, such as Current Good Manufacturing Practices (CGMP) Food and Drug Administration (FDA)-approved biomanufacturing and Advanced Development and Manufacturing (ADM) facilities, and a trained workforce to translate discoveries into startups and scale-up industry opportunities. Assets in these ADM resources include extensive BSL2 and BSL3 facilities that encompass capabilities for animal/plant/human pathogens, select agents and Center for Disease Control (CDC) Tier 1 classified agents. Capabilities extend from basic research programs to manufacturing operations capable of creating CGMP-compliant diagnostic, therapeutic and vaccine products under high-containment operations. These ADM facilities and assets provide a robust framework for the development and production of agricultural medical countermeasures (MCM), including vaccines, biologics and therapeutics, in support of the creation of a national agricultural vaccine stockpile and response strategy.

The need for an MCM stockpile and production capacity is highlighted by the Bipartisan Commission on Biodefense report, stating that "…the bigger challenges [associated with agricultural biosecurity] seem to rest with other elements of the system: we have minimal MCM stockpiles… [and] we lack the capability to produce MCM on demand." [i] The establishment of a network of agriculture ADM facilities that could facilitate regional stockpiles for agricultural MCMs would support both national and regional resilience.

PEN-SIDE/RAPID DIAGNOSTICS

Pen-side diagnostics and surveillance tools are another critical element in the landscape of agricultural biosecurity. The development, testing and deployment of new and innovative tools could enable early detection of agricultural threats, minimizing the spread of disease and thereby mitigating unnecessary animal morbidity and mortality. Need exists in the development of new diagnostics for both plant and animal diseases that will allow rapid and accurate detection, in the ability to rapidly produce and/or stockpile diagnostics for deployment in infectious outbreaks, and in the communication, training and education associated with the use of these new tools.

THE ROLE OF LAND-GRANT UNIVERSITIES IN AGRICULTURAL BIOSECURITY

Since their inauguration, land-grant universities have established systems to train and inform farmers, ranchers and producers to recognize and manage pests and disease. These institutions have deep roots in ecosystem management and zoonotic disease transmission in a one-health framework of environment, plants, animal and human interactions, with strengths in ecosystem and natural resource management, and the zoonotic interplay of microbes, pests, reservoirs, plants, animals and human hosts. Land-grant universities have historically played a significant role in providing support and engagement, building on their knowledge and innovations to recover from—and enhance resiliency from—these threats that include historic outbreaks, such as foot and mouth disease and the more recent avian influenza and prion disease outbreaks.

Land-grant universities have historic tech transfer and communication networks that include extension agents in most countries across the U.S., leading to increased adoption of global solutions. The connectivity of these networks to state assets and rural stakeholders will be critical to effective responses. Land-grant university campuses are integrated with federal laboratories, including United States Department of Agriculture (USDA) and CDC, which can be leveraged to create new agile tactical science networks. With these collective assets and the knowledge base, combined with the trust and network inherent to the extension network, land-grant universities are uniquely positioned to provide leadership and framework to support, enhance and expand ongoing agricultural biosecurity efforts. In their biodefense program efforts, land-grant universities engage state veterinarians and USDA representatives through participation in surveillance and response diagnostic networks (including the National Animal Health Laboratory Network and National Plant Diagnostic Network) and through cooperative extension programs such as the Extension Disaster Education Network. These programs are actively engaged with ranchers, farmers, producers, and public and animal health officials in an all hazards approach to first response, including infectious disease outbreaks. These universities also work closely with USDA researchers, USDA Animal and Plant Health Inspection Service (APHIS) inspectors, and response units to serve the public investors and stakeholders (producers, breeders, agricultural communities, agricultural industries and our citizens) for whom these land grant institutions were founded to serve. These universities boast training programs that educate many students in rural agricultural practices and rural veterinary medicine, and we are poised to continue to prepare a well-equipped workforce, provide on-the-ground expertise and collaborations with local stakeholders, and continue to improve the economic well-being of our citizens.

COALITION FOR EPI RESPONSE ENGAGEMENT AND SCIENCE

In 2019 the Coalition for Epi Response Engagement and Science (CERES) was established by Colorado State University (CSU), Kansas State University (KSU), Iowa State University (ISU), Texas A&M University (TAMU), University of California – Davis (UCD), University of Nebraska - Lincoln (UNL), and University of Nebraska Medical Center with a mission to protect and defend our agricultural industry against global health threats, and to provide innovation for food security, now and into the future. The coalition is aligned around three thematic pillars: (1) Diagnostics and surveillance: Rapid detection of high-consequence threats, (2) countermeasures and manufacturing: Agile countermeasures and production to thwart regional and national outbreaks, and (3) outreach and engagement: Work with urban and rural communities and stakeholders to affect the adoption of better biosecurity practices and innovation. This summer, CERES convened a meeting of more than 70 consortium partners, experts, policymakers and stakeholders in agricultural biosecurity to discuss gaps and opportunities in our Nation's biodefense. Additionally, the consortium institutions have recently invested in five cross-institutional collaborative research projects addressing the three thematic pillars. These efforts seek to link research and technology development and coordinate networks critical to effective response to an agricultural biosecurity event.

Through education, workforce development, research, technology transfer and extension, land-grant universities are uniquely positioned to provide leadership and innovation to national and global agricultural biosecurity efforts, both now and well into the future.

[i] https://www.biodefensestudy.org/a-national-blueprint-for-biodefense
[ii] https://www.whitehouse.gov/wp-content/uploads/2018/09/National-Biodefense-Strategy.pdf