Digital Governance for Animal Health and Biosecurity Applications

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ABSTRACT

This project brings together components of animal disease biology, information technology (IT), public policy and social sciences in research that will provide more effective means of ensuring food, animal, and human health biosecurity against intentional disease introductions.

Since 9/11, policies, protocols and governance in the area of animal health deal primarily with detection and control of disease outbreaks, but must also consider a larger context that includes food security, human health (in the case of zoonotic diseases) and economic stability. Existing regulations, policies, risk assessments, social issues, and the means of governance have to be evaluated with respect to narrow response windows, if fast and effective counter-measures to bioterrorism are to be achieved. This project introduces an interdisciplinary approach to examine the perception of animal health policy and the societal and technical requirements for countering animal and zoonotic disease outbreaks, whether accidental or intentional. Deliverables will include methods and recommendations for a transition into digital governance, with the goal of an effective connection between policy-driven action protocols, and new, innovative information and communication technology tools that can be utilized as preparatory, preventative and effective emergency responses.

INTRODUCTION

As free trade increases, our vulnerability to the introduction of animal and zoonotic diseases (diseases animals and humans share), either accidentally (movement of infected animals) or intentionally (bioterrorism), also increases. The public welfare and economic impacts of some of these diseases are potentially devastating. The USDA suggests that a foot-and-mouth disease (FMD) outbreak in the US could affect 13 million animals (cattle, sheep and pigs) at a cost of $24 billion (U.S. General Accounting Office, July, 2002). Since the U.S. is number one in world trade (>$1 trillion per year), the indirect cost would be catastrophic. The preparation for disease outbreaks such as FMD must, therefore, consider not only the direct costs of detection, control and eradication, but also the time needed for an effective response and the consequences for international trade. And, it is vitally important to understand that the existing set of animal disease and emergency interdiction methods, policies and regulations embody a set of assumptions about how individual actors, especially ranchers, assess risks to animal and public health, to personal economic well being, to existing geographic and regulatory relationships, and how they will act on those risks. These assumptions, however, remain largely unexamined and are not reflected in the policy frameworks used in the analysis of hypothetical disease outbreaks such as the FMD model noted above. Finally, the basis for rapid policy decisions, the capacity of networks to quickly implement changes, and the increasingly central role of IT, are each inherent but poorly-studied characteristics of a digital governance tool for animal health and biosecurity applications. These issues clearly establish the basis for development of a decision support system and the policy study suggested in this proposal.

RESEARCH DIRECTIONS

This research project incorporates two linked tracks. One examines the current policy and regulatory structure designed to guide detection, reporting and control of infected animal populations and the emergency response associated with a disease outbreak (intentional or accidental), and the factors that affect the implementation of this structure. The purpose of this examination is to describe the way information is received, transferred and managed , and the way decisions are made at federal, state and local levels. Particular attention will be given to how these decisions are transmitted for governance, and the efficacy of these protocols at the level of the end-users of the policy, i.e., the producers, consumers and citizens.

The second track involves developing the concept of digital governance as a relational database that can assimilate multiple streams of data into a rapid and relevant decision making tool needed to counter the special circumstances associated with intentional disease introductions.

Texas has been chosen as the primary research site because the state shares some portion of its border with four other states and a foreign country (Mexico). This introduces interesting interstate and international relationships that will make findings more applicable to other locations. Also, the state varies widely in terrain, climate, and in the variety of its livestock production. This variety also makes the results more generally applicable than those from a state more homogeneous in either geography or agricultural features.

We are developing an IT application that automatically queries and interacts with multiple, perhaps disparate systems. Digital governance in the above context involves an integration logic that takes the incoming report (inquiry about an animal condition or a disease description) and, using near real time data (weather, transportation patterns, etc), provides the decision-maker with the needed information. The information may also be presented within the context of policy and interdiction procedures.

A database has been developed that "describes" the state in terms of topographical features (rivers, roads, etc), livestock related enterprises (sale barns, stock yards, veterinary clinics, etc), weather patterns (since 1992), political features (ranches, farms, towns, etc), transportation networks (partially complete), and wildlife (partially complete).

Also, an IT infrastructure has been designed (unpublished data) that establishes an integrated system of relational databases, xml-based content management, and analytical tools (animal disease diagnostics, epidemiological models of disease spread, geocodes of livestock assets such as ranches, sale barns, feed mills, etc.). We will investigate the utility of web services (data mining) and integration logic that will support the development of a decision support system for disease outbreak management. We will use recent information (unpublished data) on an exotic disease (Classical Swine Fever in pigs) to illustrate how a decision maker might use the relational database to manage a disease outbreak. We also plan to investigate further the software needed to allow continuous monitoring of the conditions that might predict an animal disease outbreak.

EXPECTED RESULTS

We will map the current animal disease/biosecurity network in Texas, and the regulatory structures that guide animal disease prevention, response and recovery operations to determine all the stakeholders in the project. Understanding the relationships among agencies and stakeholders that influence information exchange and coordination of activities will help us introduce the concept of a relational database, and how it will contribute to an efficient and rapid response to an animal disease introduction. Education may be a logical outcome as well, since the concept of the relational database depends on the stakeholder; they must be educated to understand that the primary beneficiary of a national and state animal health policy is the producer, not the decision-maker. If the producer does not his or her critical role in policy implementation, then potentially catastrophic disease introductions may go unreported for a significant period of time.

The software needed to integrate the different databases (web services) pertinent to the control and resolution of a major food animal disease outbreak will be developed. Besides the obvious databases (disease diagnostic programs and epidemiologic models to evaluate spread of a disease, geographic location, current and predicted weather, transportation, etc), we also intend to assimilate information that will provide different interdiction and management protocols for specific disease outbreaks based on animals involved, location, season, etc., and the appropriate means available for implementation.

The integration logic being developed will enable data mining and data extraction. Conditional triggers are envisaged that utilize historic (world-wide prevalence and incidence selected diseases) and live data streams to provide the system with both predictive and interpretive results. These results will be the basis for the preparation phase of the system, utilizing a tool that yields a dynamic "criticality spectrum" of risk based on near real-time conditions. An example of "criticality" would be historic data in the system that provides information that pigs in a certain country are currently undergoing a disease outbreak, that our imports of pork products from that country are increasing, and that those products are primarily destined for the increasingly popular ethnic food restaurants that just happen to be located in areas where garbage feeding of pigs is permitted.

As is the case with much policy, the development of the IT system we are proposing will reflect political and administrative considerations as well as scientific ones. Current policy sometimes leaves important details unspecified and assumes that decision-makers will have been able to think through the implications of the directives, particularly to neighboring states or countries. The final element in this study would provide access to multiple policy structures (response plans for neighboring states or the federal government), multiple responders, and would have access to the infrastructure implied by those structures.