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Animal Diseases and Human Health: Using Information Networks to Guide International Policy

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Abstract

Zoonotic diseases transmissible from animals to humans are of increasing concern in today's global economy. For example, avian influenza (AI) is an omnipresent human flu pandemic threat calling for surveillance and bio-security as first lines of defense. Bovine spongiform encephalopathy (BSE) which affects beef and dairy animals did threaten a global human Crutzfeld-Jacob disease epidemic which is now seen as largely past. But since there are only post-mortem tests for BSE, effective and continued risk communication is critical to containing the potential of a future global epidemic.

1. Socio-economic Impacts

The socio-economic impacts of animal diseases are serious to various stakeholders (Morgan, 2007). Animal diseases, as well as badly planned disease control programs, cause problems for food sources, citizens' livelihoods, and economies of the countries involved. Cost effective disease control is needed to protect livelihoods while eradicating the disease, and policy makers need to understand the socio-economic impact of cross-boundary animal diseases.

Most market uncertainties for meat relate to potential impact of future disease outbreaks and consumer responses (Armbruster, 2005). Disease issues are global. The U.K. suffered a serious foot and mouth disease economic impact in 2001 and Japan experienced one in 2001, as well as industry losses because of BSE in North America in 2004-2005. North America suffered trade losses to BSE in 2004-2005, Brazil from foot and mouth disease in 2006, Argentina from foot and mouth disease in 1992 and 2006, Uruguay from foot and mouth disease in 1992 and Southeast Asia from avian influenza in 2004-2005. In total, these losses amounted to billions of dollars in lost economic activity and trade income.

2. Policy Issues

Policy issues of concern in relation to avian influenza pandemic threats include: controlling risk of AI transmission through genetic stock, spent hens and illegal cross-border trade; identifying appropriate policies and mechanisms to control AI; and ensuring social responsibility in the private-sector. Country specific market characteristics and disease control measures affect the extent of market impacts in terms of consumer responses, location and duration of the disease outbreaks and the market structure of affected countries (Morgan, 2007). Critical questions are what is the role of markets in disease transmission and what are policy strategies to mitigate market shocks. Emerging policy issues indicate that careful risk management and communication are of major importance. Control measures need to be well-targeted and rapidly implemented. And it is important that longer term preparedness be undertaken to deal with short-term emergencies.

The Committee on World Food Security points out that policies may be needed to restructure the sector to take into account the location and market networks of producers, not just the size of production units. Other medium term control and prevention measures and opportunities need to be explored, such as

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making small poultry keepers more bio-secure. Culling requires certain levels of veterinary coordination and cooperation, lacking in some rural areas. Hence, culling is of limited efficacy. An important step is development of an appropriate Highly Pathogenic Avian Influenza (HPAI) vaccine for backyard poultry production. Curtailing small poultry keeping in urban and peri-urban areas must be accompanied by complimentary measures for generating savings and alternative livelihoods for households.

Given that animal diseases can threaten collective international security, and with the potential for rapid development of such pandemics, strong action is required. Computational modeling researchers are working hard to devise policy strategies to stop a pandemic or mitigate its impact Burke, 2005). Models show that it may be possible to identify a human outbreak at the earliest stage, when fewer than 100 cases exist, and deploy international resources such as a WHO stockpile of anti-viral drugs to rapidly quench it. This would be a tipping point strategy that would be highly cost effective. More reactive strategies in which, for example, a country protects its own borders in the face of a growing global pandemic will have limited success.

Epidemics are global in nature and demand a concerted international response if they are to be thwarted. This means that the focus needs to be upstream on the earliest events emphasizing prediction and prevention before a pandemic begins. Surveillance and response, the hallmarks of traditional epidemiology must be part of, but cannot be our only policy strategy for the future. Leadership in the International Partnership of Avian and Pandemic Influenza requires visionary steps.

Collaboration through information networks to guide international policy and protect human health is critical in a global economy. Controlling the spread of disease, developing identification systems and tracking approaches to trace animal diseases to the source of outbreak and strengthening information sharing networks are all important strategies for controlling animal diseases. Information networks to protect human health rely on good information of highest integrity. Errors can destroy consumer confidence. Risk communication to maintain consumer trust is critical. Vigorous information networks among scientists require that all work together to be effective.

3. Networking to Share Scientific Data

Foresight programs instituted by governments and international agencies need to envision how threats of infectious diseases will likely evolve in the future, so that they can identify effective science and technology strategies to meet the challenge. The U.K.'s Foresight Program recently highlighted the importance of fostering interdisciplinary approaches to infectious diseases research that transcend traditional intellectual boundaries (King, 2007). It also identified a number of key choices for policy makers. Among the most important are more extensive international coordination through building on the work of the World Health Organization, the World Organization for Animal Health and the U.N. Food and Agriculture Organization and other agencies. This requires that data and biological material be rapidly collected and openly shared.

According to King, surveillance of infectious diseases has become a collective responsibility and requires collective investment. Extreme disparity and detection in disease management capabilities between nations currently seriously hinders ability to tackle infectious disease problems quickly. A system of regional reference and coordination centers to form a network of high quality laboratories linked to one another, to existing facilities and to appropriate partners in developed countries is necessary. This will allow bringing together physical and human resources to support infectious disease detection, identification and monitoring, as well as development of suitable technologies and appropriate training programs.

Recent developments in networking and sharing scientific data through global reference centers allow testing samples from various areas of the world experiencing disease outbreaks and involve a number of scientific resources. GenBank is a global public database depository of genome sequences. The GenBank network could cover a range of diseases of humans, animals and plants. Benefits would extend not just nationally or regionally but globally. The Organization for Animal Diseases (OIE) maintains a global network of reference labs. FAO also maintains reference labs. These allow samples of diseases such as H5N1 from countries to be accurately analyzed in top scientific laboratories and made available to researchers throughout the world. GenBank allows the entire world to see the information.

ProMED is an email list for emerging infectious diseases which scientists use to share information. The most recent development is a Global Initiative on Sharing Avian Influenza Data (GISAID). It plans to set up a system for sharing research results, but some scientists worry about being scooped in publishing articles if they participate. GISAID's charter is still being dealt with specialists in intellectual property and bio-informatics working out the details. At this time it is unclear exactly how it will work, but momentum for sharing is clearly building (Enserink, 2006).

4. Challenges

New influenza virus types need to be dealt with while they are still diseases of birds, rather than humans. This means they must be detected at the point they originate and that a global pathogen surveillance system is necessary. The public health agencies of China, Viet Nam and other nations in tropical and subtropical Asia must provide the first lines of defense against influenza. This requires multi-lateral support and encouragement. The "countries where flu viruses originate need the courage to recognize that reporting a new disease does not reveal weakness, but rather demonstrates a strength of their health systems (Zimmerman, 2007).

There are two challenges to sharing information about viruses, such as the H5N1 avian influenza virus. The WHO Global Influenza Surveillance Network has long collected seasonal flu viruses which they use to provide seed viruses to drug companies. These companies then produce vaccines used in advance countries in temperate zones to fight seasonal flu. However, developing countries are excluded from the benefits of these systems even though they provide the starting virus materials from which the intellectual property involved in the vaccines is developed. In January 2007 Indonesia, which had at least 63 human H5N1 fatalities ceased sharing sample viruses with WHO. They feared that the country would not be able to afford a vaccine or get a share of limited supplies in the event of a pandemic. Indonesia subsequently agreed to again provide samples to WHO reference labs for monitoring possible mutations more easily transmitted among humans. In exchange WHO will request Indonesia's authorization before sharing any samples beyond its labs (Normile, 2007).

Others argued that barriers to collaboration and information sharing are also a problem with copyrighted articles about avian flu and pandemic flu preparedness contained in medical and scientific publications. This requires professionals and the public to pay high fees or wait for lengthy periods for interlibrary loans of scientific journals which are readily available on-line and could easily be shared with a broad audience. Some journals occasionally make relevant articles available for free upon initial publication or at other times and others can be found on various blogs or web-sites. But this information is often difficult to access, if one is not affiliated with large academic institutions, corporations or government organizations that can afford to subscribe to certain scientific journals and databases (Berger, 2007).

The more that is done to reduce barriers in information sharing and collaboration, the better collectively the world will be prepared for a possible flu pandemic and other potential health emergencies. Enhanced access to scientific journals can facilitate planning and preparedness efforts based on most recent and authoritative scientific knowledge and insights. It can help broaden involvement and discussions about scientific medical regulatory and ethical questions that remain to be resolved. Publishers have the opportunity to make sure important information about a public health risk reaches professionals and the public in a timely way. Berger suggests that providing unrestricted access to relevant articles, letters and correspondence about avian influenza and pandemic flu preparedness is the place to start.

In the case of access to genetic data about H5N1, a password protected influenza sequence database (ISD) at Los Alamos National Laboratory in New Mexico, USA, has provided about 15 flu laboratories access to key information. Under the auspices of the WHO, criticism of that closed system sparked the creation of GISAID announced in August 2006. Now a new database housed at the Swiss Institute of Bio-Informatics in Geneva opened in March, 2007 to implement the concept. "Anyone can get access to the new database, provided they register, log in, and accept an agreement limiting their use of the data" (Enserink, 2007a). Those who provide data will have 6 months to obtain patents and publish in scientific journals. Information will then be entered into three large public databases for widespread sharing.

Most recently, in response to Indonesia's rebellion against sharing viruses under the WHO Global Influenza Surveillance Network, the World Health Assembly meeting of member states in Geneva, drafted a resolution that calls on WHO members to continue sharing viruses. In exchange, WHO will take a range of measures to ensure access by developing countries to the vaccines created from their own materials and to guarantee fair and equitable distribution if a pandemic occurs. WHO is also charged with insuring increased participation of scientists from developing countries in flu research and wider recognition of their role (Enserink, 2007b).

In another development, "Nations on both sides of the Pacific have established a distributed computer grid to improve research collaborations on avian influenza. The flu project …"will be managed by the Pacific Rim Applications and Grid Middleware Assembly Project (PRAGMA) based at the San Diego Supercomputer Centre (SDSC). Scientists in the U.S., Japan, China, South Korea, and Malaysia will be able to remotely operate lab equipment and share access to databases (Busse, 2007)."

Even the private-sector is getting involved. International Business Machines Corporation

((IBM) will make advanced software technologies available to public health organizations and scientists around the world to help them more accurately predict potential spread of avian flu and other infectious diseases. By using super computers to model influenza viruses, it hopes to predict mutations. This could accelerate development of vaccines, possibly before deadly strains become widespread. IBM will collaborate with the Scripps Research Institute, a biomedical research organization in La Jolla, California (McKay, 2007).

5. Implications

It is clear that information sharing is at the heart of any ability to rapidly develop vaccines to head off pandemic flu caused by outbreaks of animal disease which may mutate into human disease and become readily transmissible causing a global pandemic.

Scientists are learning to work together and have created a number of scientific systems to share viruses so that they have their common material upon to do research and can learn from each other to make more rapid progress. However, barriers continue to exist and political institutions must evolve to address them. The WHO and other international organizations are at the center of capacity to create such networks. Scientists, policy makers and the private-sector will need to collaborate on such an important task.

Signs of progress are encouraging, but continued vigilance and improvements will be necessary.

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