Mad Cows and Sick Chickens: 
Using Information Networks to Protect Human Health

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Abstract

Thailand, Indonesia, Malaysia and Vietnam have suffered continuing outbreaks of H5N1 Highly Pathogenic Avian Influenza (HPAI) in poultry. There is need for biosecurity of poultry to prevent infection and enhanced early warning systems to detect new cases are critical. This implies the need to implement surveillance systems and information sharing to reduce the risk of potential outbreaks and human transmission.

In the case of “mad cow” disease, or bovine spongiform encephalopathy, the 2003 discovery of one contaminated cow in each of Canada and the U.S. resulted in their common border being closed. It also closed exports from both countries to Europe, particularly Japan and other Asian countries. The U.S. and Canada finally reached agreement to reopen their border “after a careful and thorough science-based risk assessment” to importation of meat and animals from regions recognized as posing minimal risk of introducing BSE into the U.S. But several subsequent cases, including the second confirmed U.S. case was announced June 24, 2005.

Do these cases signal a flawed prevention system, weak surveillance and tracking, or a dubious policymaking process? This paper will explore the evidence of animal to human contamination risk; the economic impacts of control measures; the need for tracking and animal ID systems; and the challenges of using information systems to prevent contamination of humans by animal-borne diseases.

1. Introduction

Thailand, Indonesia, Malaysia and Vietnam have suffered continuing outbreaks of H5N1 Highly Pathogenic Avian Influenza (HPAI) in poultry, with accompanying human infections and deaths. Extensive surveillance, including viral culture, is being conducted in wholesale and retail poultry markets, in bird parks and in the wild bird population. Yet, there is need for increased bio-security of poultry to prevent infection, as well as the need for enhanced early warning systems to detect new cases. This is particularly important because of the possibility that new strains of the virus could result from mutations, increasing the likelihood of its spread person to person, creating the potential for a world wide flu pandemic.

The case of “mad cow” disease or bovine spongiform encephalopathy (BSE) in Canada and the U.S. continues to evolve. The 2003 discovery of one contaminated cow in each of Canada and the U.S. resulted in their common border being closed to keep the suspected Canadian contamination from spreading to the U.S. where the large livestock herd could lead to huge economic losses if herd destruction became necessary. These cases also closed exports from both countries to Europe, Japan and other Asian countries. The U.S. and Canada finally reached agreement to reopen their border, “after a careful and thorough science-based risk assessment”, to importation of meat and animals from regions recognized as posing minimal risk of introducing BSE into the U.S.

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But one day after the December 29, 2004 announcement to reopen the border effective March 7, 2005, a second potential U.S. case of mad cow was identified, and a third was announced on January 7, 2005. One confirmed case was discovered in Canada on January 11, 2005. On June 24, 2005 the U.S. announced a second case of confirmed BSE contamination. This time, the animal was born and reared in the U.S. as opposed to the earlier one which was traced to a birth herd in Canada and imported into the U.S. at the age of approximately four years.

Do these BSE cases and the continuing HPAI outbreaks signal a flawed prevention system, weak surveillance and tracking or dubious policy making processes? Alternatively, do they demonstrate the viability and strength of information networks designed to prevent transmission of animal diseases to humans via the food supply chain?

2. Reducing Animal to Human Contamination Risks

Avian influenza and BSE in beef represent two different types of contamination risk between animals and humans. In the case of avian influenza, the risk to public health is through mutations allowing human to human spread rather than what has until now been transmission of the flu only from infected birds to humans coming into physical contact with them or their droppings. For BSE, the disease is spread through feeds containing contaminated animal parts. While feeds containing bone meal and other slaughter wastes are now barred from bovine use, they are still allowed for other animals. Hence, illegal feeding to beef or dairy animals could result in new contamination. The lengthy incubation period means that current cases likely result from pre-ban feed use.

2.1 Avian Influenza

Flu experts believe that H5N1 may have affected many more people than officially reported. Challenges in getting accurate test results, lack of lab capacity in affected countries and political sensitivities have kept a broad testing program from being implemented. This step is necessary to accurately determine the number of people infected, ways the virus spreads and whether the virus is getting better at human to human transmission, which could be the first step to a pandemic. Getting international laboratories involved could help avoid mistrust and confusion, but this will have to be done diplomatically to avoid political sensitivities (Enserink/Normile).

Lab experiments suggest that the H5N1 virus can replicate rapidly in domestic ducks without being symptomatic, that newer strains survive longer in the environment than earlier ones, and ducks are shedding larger quantities of it (Normile). Thus controlling the virus could be even more challenging than originally thought. Additional surveillance and studies are needed to determine how widespread the virus is in domestic ducks in Asia, if the virus is moving from ducks to migratory birds and risks the infected ducks pose to humans.

The challenge with HPAI is the relatively rapid and easy mutation common to flu viruses. If the fast mutating virus crossed with an existing human influenza virus, it could provide a vehicle for rapid contagion. This could lead to a pandemic because no existing flu vaccinations would be effective in stopping the spread. The highly pathogenic avian influenza ranks as one of the world’s most contagious agents and its ability to mutate into novel forms where humans have no resistance are two characteristics that make it potentially very dangerous.

A recent development has created even more concern among experts. The U.N. Food and Agricultural Organization confirmed that birds in North Korea are “infected with the H7 bird flu strain that sickened nearly 90 people and killed one in the Netherlands two years ago. It is distinct from the
H5N1 strain that has decimated poultry populations across Asia since December, 2003 and killed at least 50 people in Viet Nam, Thailand and Cambodia” (WHO). However, the H7 virus transmits easily among people while the H5N1 has a mortality rate between 50 and 80%. The concern is that with both of them circulating in Asia simultaneously, a serious threat exists to create an organism with the high mortality involved with H5N1 and the easy transmissibility associated with H7.

Surveillance systems and information sharing are being used to head off a pandemic. “The U.S. Government is conducting surveillance for the virus in Asia, helping laboratories around the globe more quickly to detect the virus and modernizing and expanding production of flu vaccine” (McKay).

Indonesia apparently had success in containing a national outbreak of HPAI through massive poultry vaccinations and thus demonstrated a first step in heading off a long anticipated bird flu driven global pandemic, according to WHO officials. However, there are problems with employing a flu vaccine which may not prevent poultry from contacting the virus, but only lessening its effect. It would slow the spread of the flu, with vaccinated poultry shedding fewer viruses than if unvaccinated, but not likely to exhibit symptoms when infected. Hence, farmers could be exposed to birds they believe to be healthy which are actually carrying the virus. This can allow quiet spread to other flocks unless a vigorous surveillance system is also implemented (Kyne).

2.2 Mad Cow Disease

The brain wasting disease BSE has been largely under control since the outbreak in Britain and a few other European countries approximately ten years ago. During the past year, the United States Department of Agriculture has screened 388,000 of the 455,000 cattle deemed most likely to have the disease. Only the cow discovered in Texas that died in June has been confirmed as having BSE, and the policy guidelines that the U.S. Department of Agriculture uses to keep sick animals out of the food supply worked. Thus, the human risk of contacting BSE from infected beef animals is quite small. However, the fear factor is quite high due to the devastating consequences of the disease which destroys the brain and kills all its victims.

There is still a lack of scientific agreement on how BSE is transmitted, how long it can incubate without symptoms, if it can be cured and what steps should be taken to lessen the risks. Although significant progress is being made, there is still much uncertainty including concern that some people may die from undiagnosed brain diseases which could actually be prion-based illnesses. The concern is that illnesses such as chronic wasting disease in deer and elk may be jumping from animals to humans. The only way to confirm and identify prion disease is to examine brain tissue after death. However, only 66% of suspected cases are autopsied each year in the U.S. (Weintraub and Capell).

The main way in which BSE is dealt with is to try to prevent additional contamination through feed sources and to prevent potentially disease bearing animals from entering the food supply chain. Part of this approach is to forbid downer or sick animals unable to walk on their own from entering the human food chain. The other approach is to prevent certain high risk parts of the animal, including brain and spinal tissues from being used in human food.

The U.S. beef industry has consistently opposed calls to test cattle more aggressively, which has led to long delays in reopening the borders for export to Europe and Asia. The U.S. has also put significant pressure on Asian importers to relax their mandatory testing of all animals at a quite young age before they can enter the food supply chain. The recent confirmation of a second BSE case, in an animal born in the U.S. 12 years ago, raises concern that indeed the disease is circulating within the U.S. animal feed supply chain. There could be additional diseased animals entering the U.S. food supply chain which are not caught because they do not meet the criteria for animals to be tested.
The new U.S. case may lead to increased pressure for the U.S. to accept the Asian rules, or at the minimum increase its own testing regime to include many more animals. While so far only 159 people world wide are known to have died from eating BSE infected meat, the concern is that there may be uncounted cases and the potential for more to develop. However, to the extent that the feeding ban is effective in removing the most likely contamination route, the number of animals entering the food supply chain and born prior to the feed restrictions is decreasing rapidly, therefore decreasing the likelihood of transmission to humans.

3. Disease Outbreak Control Strategies

Control measures for HPAI include surveillance, vaccination to attain strategic control of the disease, flock destruction, movement restriction, wildlife management to eliminate continued cross contamination and prevention of transmission to humans having contact with diseased birds. For BSE, herd destruction has been the primary method of eliminating potentially diseased animals with tracking and electronic identification systems to trace other animals from a herd producing a diseased animal as a second control measure.

These strategies all come with significant economic costs, which must be weighed against health benefits. However, cost-benefit analysis can only go so far, especially when the likelihood of severe consequences as in the case of BSE justify strenuous measures to prevent contamination. Social as well as technical dimensions of risk must be considered in determining viable strategies.

Of course, the first critical step in either the HPAI or BSE cases is surveillance to determine the extent of spread and to head off emerging problems. This requires building networks to rapidly exchange information in today’s global economy. The risk of contamination from human travel, animal and product trade and rapid transportation all necessitate a well functioning surveillance system. This requires that governments cooperate, institutions share knowledge and food industry participants from producers to retailers cooperate with surveillance initiatives.

Vaccination in the case of HPAI can lead to elimination of the disease when used in combination with other strategies. It is not without cost, including the unacceptability of vaccinated meats in some importing countries. A vaccination program may control the problem domestically, but close the borders to exports which can be costly to the industry.

The herd or flock destruction strategy can be effective in eliminating or greatly reducing the chance of further contamination. However, it is very costly strategy when implemented and since it is carried out for public benefit, government compensation is needed to make the program acceptable. Without such compensation, there will be little incentive for those with potential problems to come forward, thus facilitating the spread of the disease without detection.

Restricting movement through various quarantine strategies can also be costly. It may essentially result in a closing of market opportunities either within a country or across borders. Clearly the closing of the U.S. border to Canadian beef imports greatly affected the economic health of the Canadian cattle industry. Very large losses were sustained. Subsequent developments, keeping the borders closed for a lengthy period of time have resulted in increasing slaughter and packing capacity being created in Canada. This will undoubtedly change the structure of the industry from what was developing as an integrated industry under the NAFTA trade agreement.

Wildlife management -- in the case of HPAI, birds and in the case of BSE, elk and deer -- in North America may be necessary in order to prevent continuing contamination by transmission from diseased domestic animals to alternate hosts and back.
Controlling infection of humans from diseased animals, of course, is the primary goal and one for which all strategies aim. Until now there is little evidence that HPAI has transformed into a human transmissible form of the flu which would create the dreaded pandemic that so many experts are concerned about. The main strategy for controlling a pandemic is an avian flu vaccine designed to stop the spread among humans. Vaccines able to potentially head off the spread of avian flu among humans will be stockpiled by the richest countries, leaving the neediest with the least access to the drugs. This may create an ideal situation for a pandemic to rapidly spread throughout the world.

Recent work has shown some ability to control symptoms and reduce fatalities for those infected with BSE. This is a promising development. However, elimination of the potential for the disease to be transmitted to humans by eliminating it from the beef and dairy herds is by far the preferred strategy for such a serious illness. Continued collaboration through information networks to control spread and develop identification systems and tracking approaches that are cost effective to help eliminate potential contamination from infected animals is a critical strategy. The technology for tracking animals from birth to the retail meat product is improving, becoming more cost effective and feasible to use in high speed slaughter facilities prevalent in today’s food system. Yet there is a long way to go to tighten up the information sharing networks to assure no lapses in the system, particularly at the processing level and facilitating trace back through adequate databases to support the information networks. Mad cow disease in the U.S. cost the beef industry between $3.2 and $4.0 billion in losses during 2004, according to an economic impact study commissioned by the Kansas Department of Agriculture. When regulator costs, losses to producers and others in the food chain and consumer reactions after the December 2003 discovery of a mad cow case in Washington State are counted, proceeds from overseas markets accessed by testing every animal slaughtered would have more than paid for the testing for BSE (Hegeman). The cost estimates do not incorporate investment in the processing plants for testing, so the economic trade-offs are not totally covered by the study but the magnitude of the issue is illustrated.

4. Information Networks to Protect Human Health

Surveillance and intervention strategies are only as good as the information networks and their integrity. “The misdiagnosis by U.S. Department of Agriculture’s scientists caused a seven month delay in alerting consumers to the U.S.’s second case of mad cow disease” (Kilman). Apparently, human error including missing paperwork and sloppy handling of the beef cow’s brain sample helped contribute to the misdiagnosis and delays. Scientists in the USDA’s Ames, Iowa laboratory had cleared the animal using a brain tissue test called immunohistochemistry. But questions persisted which eventually lead to re-examination of the sample including a final test by a British laboratory in Weybridge, England, the world’s premier mad cow testing laboratory. Publicity surrounding such errors in information sharing networks designed to prevent possibly catastrophic individual illness could destroy consumer confidence in the beef supply chain should further incidents occur. To date there has been little evidence of consumer backlash or concern in the U.S. or Canada to the very few and isolated cases of mad cow disease diagnosed.

Work in Italy found that losses to consumers due to delayed information ranged from 12 to 54% of total meat expenditures. This initial work provides some insight into theoretical and methodical intricacies in the assessment of economic impacts of food-borne risk communication policies. “The BSE scare, as a case example demonstrates the importance of risk communication in maintaining consumer trust in the food chain” (Mazzocchi, 57).

There is no doubt that increasing premiums will be put on creating vigorous information networks to protect human health in today’s worldwide integrated food marketing system which allows rapid
transmission of animal borne diseases to humans in some cases. Researchers, industry representatives and policy makers will need to work together to develop the best possible networks that are economically efficient and scientifically sound.

**Bibliography**


