GLOBAL RISK FORUM GRF DAVOS GRF planet @risk http://www.planet-risk.org

What Can Be Done to Manage Catastrophic Human Disease Threats from Farmed Animals?[1]

DANIELS, Peter[a]

[a] CSIRO Australian Animal Health Laboratory, Geelong, Australia. E-mail: peter.daniels@csiro.au

Abstract – Society might expect that animals farmed to meet the food security needs of people globally won't pose a serious public health threat. Experience indicates the situation is otherwise. The Nipah virus outbreak in Malaysia was incomprehensible at the time. Farm workers became sick and died with a case fatality rate of 50% from a disease caught from the pigs on farms; a risk unheard of previously. Fortunately Nipah was not contagious among people. Analyses of pandemic H1N1 2009 influenza in people indicate that it too arose in intensively farmed animals, and it did spread quickly among people globally. Fortunately infections were not usually lethal. The bird flus, H5N1 and H7N9, have high human case fatality rates but are not contagious. None-theless, intensively farmed animals are building up quite a record as a source of undesirable human diseases. The emergence of the next outbreak is unpredictable, as are its essential characteristics: pathogenicity and transmissibility. The animal health sector should deliver systems of diagnosis, surveillance and control of infections in animal populations. Farming businesses should recognize and understand responsibilities to monitor and know the infection status of their animal populations with respect to disease threats to food security, farming profitability and human health. This would be good risk management. However routine surveillance of farmed animal populations for any such infections does not occur. Usually investigations start in response to outbreaks. Real time monitoring is not part of the farming business model. The technical capacity exists and is getting cheaper but there is perceived to be an unwillingness to undertake comprehensive surveillance. A better understanding throughout the whole of society – political, scientific and popular – is needed. Farmers, traders, industry managers, regulators, consumers all have to want to manage the threat of infections on farms, to value it and to pay for it.

Keywords – *pandemic threats, surveillance, human behaviour, business model change, One Health, food security*

1. The risk to be managed

Animal production systems have changed from pastoralism and village based agriculture to intensive systems based on confinement of animals for either all or part of their life cycle. Although much of this intensification may have been profit driven its success, in simple terms, has been based on the fact that an increasing human population with an increasing level of affluence has provided a market for the produce. The projected population trends globally, together with the increasing level of income for a significantly large proportion of that projected population, will create an increasing demand for human foods of animal origin. This demand will likely be met only through the continuing existence of the intensive animal industries in some form.

Such farming systems create demands for animal feedstuffs, potentially competing with the utilization of arable land, and produce effluent of various types, each with potential environmental consequences. These issues are debated publically, and solutions actively sought. Increasingly ethical issues are also being identified and debated, so it seems a little strange that one very practical consideration which arguably has ethical aspects has not been given much consideration. Increasingly intensively farmed animals are being identified as a source of human exposure for emerging infectious diseases (EIDs) dangerous to people, and with pandemic potential.

The Nipah virus outbreak in Malaysia (Chua et al, 2000) was unfortunately an indicator of future EID events.

[1]This article is based on a presentation given during the 2nd GRF Davos One Health Summit 2013, held 17-20 November 2013 in Davos, Switzerland (http://onehealth.grforum.org/home/)

Pig farm workers became sick and died with a case fatality ratio of 40% from a disease caught from the pigs on farms; a risk unheard of previously. Intensive farming of pigs had become a very profitable animal industry because of the market for pork in Malaysia and neighbouring countries. Without effective regulation establishment of such farming operations was a business option for many previously small holder farmers. Although the level of sophistication of the farming enterprises varied capital investments were usually kept to the minimum needed to achieve production targets. In some districts the pig population was quite dense, both on individual farms and across neighbourhoods. Conditions were ripe for the rapid transmission of a new infectious agent in a naïve population should one be introduced. It is well known that this did occur with Nipah virus, from a reservoir in Pteropid fruit bats. However the wildlife reservoir was incidental to the outbreak of human disease, in which people were infected through contact with farmed pigs, the amplifier host, and the control of the outbreak depended on detecting and eliminating the infection in pigs.

If that outbreak had been a unique event, never likely to recur, it would not matter that intensive farming practices of pigs around the world haven't changed much. However it is certain that the essential features of the pre-Nipah Malaysian pig industry, especially from a disease emergence and control perspective, are replicated on most continents and particularly in countries with emerging economies where capital resources and managerial skills are also in a development phase. Hence it is appropriate to consider whether intensively farmed pigs, and other production animal species, are giving rise to other infections that may have zoonotic EID implications, or even pandemic potential. Nipah virus is classified in a genus of viruses, the henipaviruses, for which the highest levels of biocontainment are recommended. Fortunately Nipah was not contagious among people and so it did not spread globally. Had it done so the world would have faced a situation where a disease with a 40% case fatality, and for which no vaccine or treatment was available, was spreading in a manner as seen with SARS, influenza and other common infections.

The filoviruses, such as strains of Ebola virus, are another group of viruses recommended to be worked with only under the highest levels of biocontainment. One strain, Ebola Reston, hasn't proved lethal for people but none-the-less in high containment laboratories internationally it is handled with the same level of caution as other Ebola strains. Hence it should be of great interest that Ebola Reston has been detected in the developing intensive pig farming industry in the Philippines ((FAO 2008). The detection was serendipitous, coming about only through the investigation of an infectious porcine disease causing production losses. In experimental studies the Philippine porcine Ebola Reston strain does not cause clinical signs in pigs, and so could be transmitted among pigs undetected without active surveillance. It is not clear whether the infection has been eradicated. Nor is it known whether mutations in that virus could occur that would make it pathogenic to either pigs or people. Certainly it is considered to be infectious to people with close exposure to infected pigs (WHO 2009), but without causing disease in its present form.

The focus is not only on pig farms. Currently there are two avian influenza virus strains causing a high proportion of fatalities in human cases, particularly in a number of Asian countries: highly pathogenic avian influenza H5N1 (with infected countries widely distributed internationally) and avian influenza A(H7N9) (confined to China). As of 10 December 2013 there has been 648 human cases of H5N1disease with 384 deaths – 60% fatalities (WHO, 2013a), while as of 25 October 2013 137 human cases of human infection with H7N9, with 45 deaths – 33% fatalities, had been reported (WHO, 2013b). Both these avian influenza strains are considered by WHO and the international public health community as having pandemic potential, but at present are not highly contagious among people in their current forms. Although avian influenza viruses have a reservoir in wild waterfowl the current zoonotic infections of concern are propagated in domestic poultry, with such poultry identified by epidemiological studies as the source of most human infections.

Importantly, influenza in some form is considered as a likely cause of pandemic human infection with catastrophic human health consequences. The most recent human pandemic was with an influenza virus, the pandemic H1N1 2009 influenza which did spread quickly among people globally. Fortunately human infections with pandemic H1N1 2009 influenza were not usually lethal. The causative virus is considered to have evolved in intensively farmed animals (Novel Swine-Origin Influenza A (H1N1) Virus Investigation Team, 2009). Other reassortant influenza viruses are continuously being discovered in pig populations (Vincent et al, 2013) with transmission to people in close contact with infected pigs being recorded.

2. The problem

The question clearly arises whether the people of the world can keep relying on good fortune that dangerous zoonotic infections with pandemic potential don't become pandemic because they are not contagious. There seems to be no scientific basis for assuming that such will always be the case. Given these considerations, that human diseases with high levels of case fatality have arisen in intensively farmed animals and in some cases continue to be maintained in such animals with ongoing infection of people, it is reasonable to consider what is being done to manage the risk. This is particularly so as new examples of similar infections which also are potentially pathogenic for people continue to be detected. As has been noted (Chatham House, 2010): *Often identification of an infectious agent occurs in humans after human-to-human spread has begun, rather than in the animal from which it comes, and opportunities for control in animals and prevention of human infection are lost.*

Ideally those responsible for animal health, including both large and small farming businesses and national animal health agencies, should identify public health risks before they cause a public health problem. Where animals are farmed to meet the needs of society, an informed society will have a legitimate expectation that the husbandry of these animals will not result in a health threat to people (Daniels et al, 2012).

If such expectations are to be met managers of intensively farmed animals will have to know the infection status of their enterprise, just as they know any other production related information. Surveillance for infections will be conducted differently from present practices as described by the Chatham House (2010) statement.

However surveillance costs money, and, importantly, is best conducted where there is an agreed, effective, scientifically rational and financially proportionate response to the findings. At present there is no financial or other driver for more comprehensive surveillance, limited scientific basis for recognizing actual zoonotic threats or agents with actual pandemic potential, and no agreed strategy for remedial action that protects the public, does not disrupt food security or the financial viability of the farming business, and that will not cause unwarranted levels of public concern leading to loss of markets for farm produce. A recent World Bank paper has explored these aspects in more detail (World Bank, 2010). It may be perceived that there is an unwillingness to invest more in surveillance. However there should be no insurmountable challenges in the ability to do surveillance in countries that are able to engage in the commercial activity of intensification of animal husbandry.

3. Aspects of the solution

A prerequisite for surveillance for the better identification and management of public health threats arising in farmed animals is a process of consultation among those likely to respond to findings as well as those likely to be involved in the implementation of the activity: farming businesses, veterinary and public health authorities and international agencies, and a well informed public. Key issues to recognize, and then to address, include the following.

1. *Apportioning and recovering the cost of surveillance*
   Who will carry the cost of this surveillance, and any response to the findings? Ultimately it could be the consumer, but what will be the mechanism by which the producer can recoup the costs in a price sensitive market? If the consumer is to be sufficiently well informed to want to pay a small margin for a safer product we might expect that the issues will have to be publicly debated, as are other animal production issues such as animal welfare, antibiotic sensitivity and the putative health benefits of different types of foods. Science can deliver more cost effective ways of conducting surveillance. New detection technologies and agent characterization approaches potentially revolutionize the practicalities of sampling and testing farmed animals and/or their immediate environment for the detection of infectious agents. There is much applied scientific work to be done in developing and validating novel sampling and testing strategies.
   Surveillance for infectious disease agents has a number of potential benefits, such as the detection as well of production limiting infections that detract from farm profitability (OFFLU, 2013). It could be expected that the availability of such information should lead to more profitable farm management which would be an incentive for farmer participation.
2. *A scientifically rational analysis of the risk posed by detected infections*
   Another issue is whether the scientific basis for concerns about particular infectious agents, and particularly for the responses, is sufficiently well developed. Even with presently known zoonotic agents some strains cause disease in either animals or people, while others do not. Can the public health threat associated with each detected agent or strain of an agent be objectively defined, including whether the finding constitutes a pandemic threat? Again this is an area of active scientific study with the potential outcome of improved surveillance strategies.
3. *Proportionate, predetermined and agreed responses to findings based on analysed risks*
   The response to detections of agents considered dangerous would currently involve quarantine of premises with disruption to business, or even destocking of the affected enterprise. Agreement is needed in advance upon which findings will be associated with specified levels of response, and how the cost of the response will be met. Otherwise the risk of disruption to business continuity through ill conceived or “knee jerk” reactions by regulatory authorities will be sufficient to preclude farmer cooperation. Regulation can be expected to have a role in the process, but with regulations that are scientifically based and “socialized” through being the outcome of a processes of public-private industry consultation.
4. *An informed public*
   Public perceptions are particularly important in managing infections in the human food chain. Strategies of communication will have to ensure the public that EID risks to their health and safety are well managed, so that every report in the press of an infected farm is not taken to indicate that a whole commodity may have public health risks.

4. Added value of the One Health approach

Managing the risk of EIDs and pandemic infections requires a comprehensive, whole of society approach. Science can help identify potential threats and the risks they pose. However the management of these will always have a public component, for lack of transparency leads to ill-founded concerns. The costs of having a more safely managed supply chain for human food will have to be understood so that they can be rationally apportioned. Communications with the farming and food supply industries will have to include assurances that surveillance and response activities are scientifically based and proportionate to the risks, and that public concerns will be met. These are enormous challenges, and it is hard to see how they can be met other than by a One Health approach. A comprehensive approach that recognizes and is based on the interconnectedness of all these factors is, in fact, a One Health approach.

5. Conclusions

The frequency of detection of new zoonotic diseases that are lethal in a high proportion of human cases and that have arisen or have been amplified in intensively farmed animals prior to transmission to humans is a clear indication of the need for a new way of managing such farming businesses. It should be incomprehensible to society that such businesses could be conducted without knowing their status with respect to infections lethal to humans or potentially pandemic in the human population.

Surveillance of farmed animals for threats to human health must become a normal component of the farming business model. There is a challenge to animal health science to develop strategies to apply new detection technologies in a cost effective manner. However surveillance implies a response. A balanced response will require an informed public which understands the risks and the proposed mitigation steps, and a farming industry which feels confident that the measures in place under the auspices of both public and animal health authorities are science based, well thought through, appropriately costed and effectively manage real risks rather than apprehensions.

References

Chatham House (2010): Shifting from Emergency Response to Prevention of Pandemic Disease Threats at Source. Meeting Report, Chatham House, London, April 2010. http://www.chathamhouse.org/publications/papers/view/109284 (18 Dec 2013)

Chua, K.B., Bellini, W.J., Rota, P.A., Harcourt, B.H., Tamin, A., Lam, S.K., Ksiazek, T.G., Rollin, P.E., Zaki, S.R., Shieh, W.J., Goldsmith, C.S., Gubler, D., Roehrig, J.T., Eaton, B.T., Gould, A.R., Olson, J., Field, H., Daniels, P., Ling, A.E., Peters, C.J., Anderson, L.J. and Mahy, B.J. (2000): Nipah virus: A recently emergent deadly Paramyxovirus. Science, 288, 1432–1435.

Daniels, P., Morrissy, C., Poermadjaja, B., Selleck, S., Stratton, J., Allen, J., Padungtod, P., Colling, A., Long, N.T., Wong, F., Wiyono, A., Abila, R. and Kalpravidh, W. (2012): Diagnostic Capacity for Regional Emergency Infectious Disease Preparedness. In Adams, L.B., Gray, G.D. and Murray, G. (ed.) Animal biosecurity in the Mekong: future directions for research and development. pp 83 – 86, Australian Center for International Agricultural Research, Canberra.

FAO (2008): Ebola-Reston virus in pigs. Situation in the Philippines. http://www.fao.org/ag/againfo/programmes/en/empres/ebola_111208.html (18 Dec 2013)

Li, K.S., Wang, J., Smith, G.J.D. et al. (2004): Genesis of a highly pathogenic and potentially pandemic H5N1 influenza virus in Eastern Asia.Nature 430: 209-13

Novel Swine-Origin Influenza A (H1N1) Virus Investigation Team (2009): Emergence of a Novel Swine-Origin Influenza A (H1N1) Virus in Humans. New England Journal of Medicine; 360:2605-2615

OFFLU (2013): OFFLU Strategy document for surveillance and monitoring of influenzas in animals, May 2013. http://www.offlu.net/fileadmin/home/en/publications/pdf/OFFLUsurveillance.pdf (18 Dec 2013)

Vincent, A., Awada, L., Brown, I., Chen, H., Claes, F., Dauphin, G., Donis, R., Culhane, M., Hamilton, K., Lewis, N., Mumford, E., Nguyen, T., Parchariyanon, S., Pasick, J., Pavade, G., Pereda, A., Peiris, M., Saito, T., Swenson, S., Van Reeth, K., Webby, R., Wong, F. and Ciacci-Zanella, J. (2013): Review of Influenza A Virus in Swine Worldwide: A Call for Increased Surveillance and Research. Zoonoses and Public Health. Article first published online: 5 APR 2013 DOI: 10.1111/zph.12049http://onlinelibrary.wiley.com/doi/10.1111/zph.12049/abstract (18 Dec 2013)

WHO (2009): Ebola Reston in pigs and humans in the Philippines, http://www.who.int/csr/don/2009_02_03/en/index.html (18 Dec 2013)

WHO (2013a): Cumulative number of confirmed human cases of avian influenza A(H5N1) reported to WHO, 10 December 2013. http://www.who.int/influenza/human_animal_interface/H5N1_cumulative_table_archives/en/index.html (18 Dec 2013)

WHO (2013b): Number of confirmed human cases of avian influenza A(H7N9) reported to WHO, Report 10, 25 October 2013. http://www.who.int/influenza/human_animal_interface/influenza_h7n9/10u_ReportWebH7N9Number.pdf (18 Dec 2013)

World Bank (2010): People, pathogens, and our planet: Volume one: towards a one health approach for controlling zoonotic diseases. Washington D.C. - The Worldbank. http://documents.worldbank.org/curated/en/2010/01/12166149/people-pathogens-planet-volume-one-towards-one-health-approach-controlling-zoonotic-diseases (18 Dec 2013)

Citation

Daniels, P. (2014): What Can Be Done to Manage Catastrophic Human Disease Threats from Farmed Animals?. In: Planet@Risk, 2(3), Special Issue on One Health (Part I/II): 146-149 , Davos: Global Risk Forum GRF Davos.