



DIRK PFEIFFER

Professor of Veterinary
Epidemiology

*Royal Veterinary College
United Kingdom*

Dirk Pfeiffer graduated in Veterinary Medicine in Germany in 1984. He obtained his PhD in Veterinary Epidemiology from Massey University, Palmerston North, New Zealand in 1994.

He worked as an academic in New Zealand for 9 years and has been holding the Chair in Veterinary Epidemiology at the Royal Veterinary College (RVC) since 1999. Dirk has been involved in epidemiological research since 1985 and worked on animal health issues in developing as well as developed countries. He has published 175 peer-reviewed publications, and currently holds research grants as principal investigator with a total value of about £5Mill. He currently is the Head of Veterinary Epidemiology & Public Health Group within RVC comprising 11 academic staff and about 35 PhD students and research assistants.

Dirk is also Head of the newly designated FAO Reference Centre for Veterinary Epidemiology at the RVC. He teaches epidemiology at undergraduate and postgraduate levels and has designed and taught international training courses in veterinary epidemiology, risk analysis and spatial analysis in Europe, North America, Australasia and Africa. At RVC, he co-directs an MSc in Veterinary Epidemiology as well as one in Veterinary Epidemiology & Public Health by Distance Learning.

He is the lead author of a textbook on spatial epidemiology, author of the chapter on spatial analysis in the key veterinary epidemiology textbook 'Veterinary Epidemiologic Research' and the author of a new textbook 'Introduction to Veterinary Epidemiology'. His particular interest is the epidemiology and control of infectious diseases, and the science-policy interface.

His technical expertise includes field epidemiological and ecological research methods, advanced epidemiological analysis, spatial and temporal analysis of epidemiological data, risk analysis, computer modelling of animal disease and development of animal health surveillance systems. Dirk provides scientific expertise to various national and international organizations including the European Food Safety Authority, the European Commission, the UK Department of Environment, Food and Rural Affairs, the Food and Agriculture Organization of the United Nations, the World Organisation of Animal Health, as well as various national governments.

RISK ASSESSMENT FRAMEWORK FOR H5N1 AVIAN INFLUENZA

in South-East Asia, with Special Reference
to the Human-Livestock-Wildlife Interface

Dirk U. PFEIFFER

Veterinary Epidemiology & Public Health Group, Royal Veterinary College, University of London,
Hawkshead Lane, North Mymms, Hertfordshire, AL9 7TA, United Kingdom

SUMMARY

Risk assessment has been widely used in South-East Asian countries to inform the development of control policies for highly pathogenic avian influenza (HPAI) H5N1. The understanding of the disease's epidemiological parameters can probably now be considered adequate, and broadly effective diagnostics and vaccines have been developed. But the inability to eradicate the infection from the region has led to the realization that the occurrence of HPAI H5N1 is influenced by a complex interaction of environmental, epidemiological and social factors that are spatially heterogeneous and interconnected across the region and beyond. Sustainable and effective control will need to take account of the holistic nature of the system. A major challenge will be to understand the influence of human behaviour and to develop effective mechanisms leading to appropriate behaviour change where necessary.

CONTEXT

Initially large and now small-scale outbreaks of highly pathogenic avian influenza (HPAI) H5N1 have occurred in South-East Asia since late 2003. While some countries, e.g. Thailand, have been able to

eradicate it, others, e.g. Viet Nam, still experience outbreaks on a regular basis. The threat of a global pandemic which justified the major multi-national efforts towards control of HPAI H5N1 in the region is still just as relevant, given the continuing virus spread and the associated risk of genetic change [1]. The current situation is dangerous, in that most stakeholders have become less aware of this still present risk. In addition, the widespread use of vaccination in Viet Nam (and in China) without being able to eradicate the virus due to insufficient vaccination coverage may accelerate the emergence of resistant virus mutations.

RISK MANAGEMENT OF HPAI H5N1

Risk management of infectious diseases such as HPAI H5N1 is ultimately aimed at elimination of infection from a population sub-nationally, nationally, regionally or even globally. Given the presence of the virus in wild waterbird species and domestic poultry in South-East Asia and neighbouring countries which are connected through wild bird migration and poultry-associated trade, elimination from South-East Asia will not be feasible for the foreseeable future with the currently available disease control tools. This reality needs to be recognised and the objectives of risk

management within the region may have to be re-defined in some countries. One objective should be to minimise the risk of genetic change in the virus and if it does indeed occur to detect such changes early. A second objective will be to minimise the risk of human exposure since infection can be fatal. The third objective is to eliminate the virus from defined populations for trade purposes. The fourth objective is to minimise infection risk for domestic poultry to reduce mortality.

The resulting risk management policy needs to be part of an integrated risk governance (or analysis) framework that includes risk assessment, risk communication and surveillance [2, 3]. Given the transboundary nature of the system within which the virus is transmitted, long-term effectiveness of risk management requires a regional approach to the problem. It is also important that the risk management policies are informed by integrated risk assessment taking account of the holistic nature of the underlying system.

RISK ASSESSMENT OF HPAI H5N1

The understanding of the ecological, epidemiological and sociological system within which HPAI H5N1 exists is one of the factors influencing the development of risk management policies. Scientific risk assessments are now widely accepted as the most appropriate tool for synthesizing knowledge about risks such as infectious diseases in a structured way. They also allow expressing the absolute risk in quantitative or qualitative terms and to prioritise different risk pathways which in turn provides guidance for risk mitigation strategies [3].

For HPAI virus (HPAIV) H5N1 in South-East Asia,

structured scientific risk assessments based on the OIE risk analysis framework [3] were conducted in support of national policies, for example in Thailand and Viet Nam. The process was facilitated by a project funded by the UK Department for International Development (DfID) and led to a series of reports tailored to the needs of national policy makers [4, 5]. The risk assessments included a variety of information sources and analytical tools. Data- as well as knowledge-driven modelling approaches were used [6]. The data-driven approaches were based on existing surveillance data, and resulted in identification of many specific but also large numbers of proxy variables for environmental, epidemiological and sociological risk factors [7]. Key outcome of this research was the identification of the importance of rice-paddy production systems with their mix of poultry and ducks connected through live bird markets and free grazing ducks for local maintenance of HPAIV H5N1 [8-11]. Furthermore, cross-border trade played an important role as a source for continued introduction into the region and between countries within the region [1]. Knowledge-based approaches were applied to produce maps of suitability for HPAIV in Asia [12] and to model the infection dynamics [13-15]. The risk assessments were complemented by socio-economic studies which emphasized the importance of economic drivers influencing the occurrence of HPAI H5N1 [16-19].

LESSONS LEARNED

The complexity of systems associated with disease emergence has been recognised for some time now [20-22]. The inability to regionally control HPAI H5N1 in South-East Asia and elsewhere has demonstrated the need for

an interdisciplinary approach towards dealing with infectious disease challenges [23]. Most of the research conducted so far uses a single or multidisciplinary approach, primarily involving the bioscientific disciplines. The resulting very resource-intensive risk management policies have led to a major reduction in HPAI H5N1 outbreak occurrence in SE-Asia control without being able to eradicate HPAIV H5N1 from the region [18, 24-27]. The challenge for now and the future will be to establish more effective and sustainable processes and practices for participatory and cross-sectoral approaches embedded within a sound risk governance framework in SE- Asian countries, and elsewhere [28, 29].

1. Pfeiffer, D.U., et al., Implications of global and regional patterns of highly pathogenic avian influenza virus H5N1 clades for risk management. *Vet.J.*, 2011. 190: p. 309-316.
2. Renn, O., Risk governance - Towards an integrative approach. 2005, The International Risk Governance Council: Geneva, Switzerland. p. 154.
3. Anonymous, Handbook on import risk analysis for animals and animal products: Introduction and qualitative risk analysis. 2nd ed. Vol. 1. 2010, Paris, France: OIE Publications. 88.
4. Kasemsuwan, S., et al., Qualitative risk assessment of the risk of introduction and transmission of H5N1 HPAI virus for 1-km buffer zones surrounding compartmentalised farms in Thailand. Mekong Team Working Paper, ed. Anonymous. Vol. 7. 2009, Rome, Italy. 43.
5. Prakarnkamanant, A., et al., Quantitative risk assessment of HPAI virus H5N1 via cock fighting activities into the 1-km buffer zones surrounding compartmentalised broiler chicken farms in Thailand. Mekong Team Working Paper, ed. Anonymous. Vol. 11. 2011, Rome, Italy. 53.
6. Stevens, K.B. and D.U. Pfeiffer, Spatial modelling of disease using data- and knowledge-driven approaches. *Spat.Spatiotemporal.Epidemiol.*, 2011. 2(3): p. 125-133.
7. Fournie, G., W. de Glanville, and D. Pfeiffer, Epidemiology of highly pathogenic avian influenza virus strain type H5N1, in Health and animal agriculture in developing countries, D. Zilberman, et al., Editors. 2012, Springer Science + Business Media, LLC: New York, USA. p. 161-182.
8. Pfeiffer, D.U., et al., An analysis of the spatial and temporal patterns of highly pathogenic avian influenza occurrence in Vietnam using national surveillance data. *Veterinary Journal*, 2007. 174: p. 302-309.
9. Gilbert, M., et al., Mapping H5N1 highly pathogenic avian influenza risk in Southeast Asia. *Proc.Natl.Acad.Sci.U.S.A.*, 2008. 105(12): p. 4769-4774.
10. Gilbert, M. and D.U. Pfeiffer, Risk factor modelling of the spatio-temporal patterns of highly pathogenic avian influenza (HPAIV) H5N1: A review. *Spat.Spatiotemporal.Epidemiol.*, 2012. 3(3): p. 173-183.
11. Henning, J., D.U. Pfeiffer, and I.T. Vu, Risk factors and characteristics of H5N1 Highly Pathogenic Avian Influenza (HPAI) post-vaccination outbreaks. *Vet.Res.*, 2009. 40(3): p. 15.
12. Stevens, K.B., M. Gilbert, and D.U. Pfeiffer Modelling habitat suitability for occurrence of highly pathogenic avian influenza virus H5N1 in domestic poultry in Asia: a spatial multicriteria decision analysis approach. *Spatial and Spatio-temporal Epidemiology*. DOI: 10.1016/j.sste.2012.11.002.
13. Fournie, G., et al., Impact of the implementation of rest days in live bird markets on the dynamics of H5N1 highly pathogenic avian influenza. *J.R.Soc.Interface*, 2011. 8(61): p. 1079-1089.
14. Walker, P.G., et al., A Bayesian approach to quantifying the effects of mass poultry vaccination upon the spatial and temporal dynamics of H5N1 in Northern Vietnam. *PLoS Comput.Biol.*, 2010. 6(2): p. e1000683.
15. Walker, P., et al., Outbreaks of H5N1 in poultry in Thailand: the relative role of poultry production types in sustaining transmission and the impact of active surveillance in control. *J.R.Soc.Interface*, 2012. 9(73): p. 1836-1845.
16. Heft-Neal, S., et al., Promoting rural livelihoods and public health through contracting: Evidence from Thailand, in Health and animal agriculture in developing countries, D. Zilberman, et al., Editors. 2012, Springer Science + Business Media, LLC: New York, USA. p. 327-351.
17. Ifft, J., D. Roland-Holst, and D. Zilberman, Production and Risk Prevention Response of Free Range Chicken Producers in Viet Nam to Highly Pathogenic Avian Influenza Outbreaks. *American Journal of Agricultural Economics*, 2011. 93(2): p. 490-497.
18. Otte, J., et al., Impacts of avian influenza virus on animal production in developing countries. *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 2008. 3(80): p. 1-18.
19. Ifft, J. and D. Zilberman, The evolution of animal agricultural systems and supply chains: Theory and practice, in Health and animal agriculture in developing countries, D. Zilberman, et al., Editors. 2012, Springer Science + Business Media, LLC: New York, USA. p. 31-56.
20. Daszak, P., A.A. Cunningham, and A.D. Hyatt, Emerging Infectious Diseases of Wildlife-- Threats to Biodiversity and Human Health. *Science*, 2000. 287(5452): p. 443.
21. Wilcox, B. and R. Colwell, Emerging and Reemerging Infectious Diseases: Biocomplexity as an Interdisciplinary Paradigm. *EcoHealth*, 2005. 2(4): p. 244-257.
22. Kapan, D., et al., Avian Influenza (H5N1) and the Evolutionary and Social Ecology of Infectious Disease Emergence. *EcoHealth*, 2006. 3(3): p. 187-194.
23. Pfeiffer, D.U., et al., A one health perspective on HPAI H5N1 in the Greater Mekong Sub-Region. *Comparative Immunology Microbiology and Infectious Diseases*, accepted for publication.
24. Hinrichs, J. and J. Otte, Large-scale vaccination for the control of avian influenza, in Health and animal agriculture in developing countries, D. Zilberman, et al., Editors. 2012, Springer Science + Business Media, LLC: New York, USA. p. 207-231.
25. McLeod, A., et al., Economic and social impacts of avian influenza. 2005, Food and Agriculture Organisation of the United Nations: Rome, Italy. p. 10.
26. Zilberman, D., et al., Conclusion, in Health and animal agriculture in developing countries, D. Zilberman, et al., Editors. 2012, Springer Science + Business Media, LLC: New York, USA. p. 403-407.
27. Haesler, B., et al., The economic value of one health in relation to the mitigation of zoonotic disease risks, in One health: The human-animal-environment interfaces in emerging infectious diseases, J.S. Mackenzie, et al., Editors. 2013, Springer Verlag: Berlin. p. 25.
28. Stirling, A., Opening up the politics of knowledge and power in bioscience. *PLoS.Biol.*, 2012. 10(1): p. e1001233.
29. Renn, O., A. Klinke, and M. van Asselt, Coping with Complexity, Uncertainty and Ambiguity in Risk Governance: A Synthesis. *Ambio*, 2011. 40(2): p. 231-246.