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Review of Air Dispersion Modelling Approaches to Assess the Risk of Wind-Borne Spread of Foot-and-Mouth Disease Virus

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ABSTRACT

Foot-and-mouth disease virus (FMDV) is one of the most economically serious veterinary pathogens due to its negative effects on livestock and its highly infectious nature via a variety of transmission paths through oral and inhalation routes. Measures to enhance outbreak management can be designed according to analytical results predicted by mathematical models for wind-borne dispersion, an important path of virus transmission. Accurate atmospheric dispersion models are useful tools for properly determining risk management plans, while inaccurate models may conversely lead to accidental loss in two possible ways. Overly strict measures, e.g., slaughter for too wide an area, can cause severe economic difficulties, including irreversible loss of business operations for a number of farms. On the contrary, inestimable loss potentially caused by lax controls is a persistent threat. In this paper, available modelling procedures for forecasting the spread of FMDV, which have been used since the 1970s, each having its advantages and limitations, are reviewed for the purpose of ensuring suitable application in various conditions of any future emergency cases.

KEYWORDS

Foot-and-Mouth Disease Virus (FMDV); Atmospheric Dispersion Model; Gaussian; Lagrangian; Viral Production Model

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References

- [1] G. Davies, "Foot and Mouth Disease," *Research in Veterinary Science*, Vol. 73, 2002, pp. 195-199. Hdoi:10.1016/S0034-5288(02)00105-4
- [2] E. Domingo, C. Escarmis, E. Baranowski, C. M. Ruiz- Jarabo, E. Carrillo, J. I. Núñez and F. Sobrino, "Evolution of Foot-and-Mouth Disease Virus," *Virus Research*, Vol. 91, No. 1, 2003, pp. 47-63. Hdoi:10.1016/S0168-1702(02)00259-9
- [3] E. Maradei, "Characterization of Foot-and-Mouth Disease Virus from Outbreaks in Ecuador during 2009-2010 and Cross-Protection Studies with the Vaccine Strain in Use in the Region," *Vaccine*, Vol. 29, No. 46, 2011, pp. 8230- 8240. Hdoi:10.1016/j.vaccine.2011.08.120
- [4] J. N. Cooke and K. M. Westover, "Serotype-Specific Differences in Antigenic Regions of Foot-and-Mouth Disease Virus (FMDV): A Comprehensive Statistical Analysis," *Infection, Genetics and Evolution*, Vol. 8, No. 6, 2008, pp. 855-863. Hdoi:10.1016/j.meegid.2008.08.004
- [5] P. V. Barnett, R. J. Statham, W. Vosloo and D. T. Haydon, "Foot-and-Mouth Disease Vaccine Potency Testing: Determination and Statistical Validation of a Model Using a Serological Approach," *Vaccine*, Vol. 21, No. 23, 2003, pp. 3240-3248. doi:10.1016/S0264-410X(03)00219-6
- [6] N. Longjam, R. Deb, A. K. Sarmah, T. Tayo, V. B. Awachat and V. K. Saxena, "A Brief Review on

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- [7] R. P. Kitching, "A Recent History of Foot-and-Mouth Disease," *Journal of Comparative Pathology*, Vol. 118, 1998, pp. 89-108. Hdoi:10.1016/S0021-9975(98)80002-9
- [8] D. Mayer, "A Lagrangian Particle Model to Predict the Airborne Spread of Foot-and-Mouth Disease Virus," *Atmospheric Environment*, Vol. 42, No. 3, 2008, pp. 466-479.
- [9] I. Traulsen and J. Krieter, "Assessing Airborne Transmission of Foot and Mouth Disease Using Fuzzy Logic," *Expert Systems with Applications*, Vol. 39, No. 5, 2012, pp. 5071-5077. Hdoi:10.1016/j.eswa.2011.11.032
- [10] D. Sharp, "Foot-and-Mouth Epidemic: The Choices," *The Lancet*, Vol. 357, No. 9258, 2001, p. 738. Hdoi:10.1016/S0140-6736(00)04181-7
- [11] H. J. Pharo, "Foot-and-Mouth Disease: An Assessment of the Risks Facing New Zealand," *New Zealand Veterinary Journal*, Vol. 50, No. 2, 2002, pp. 46-55. doi:10.1080/00480169.2002.36250
- [12] P. V. Barnett and H. Carabin, "A Review of Emergency Foot-and-Mouth Disease (FMD) Vaccines," *Vaccine*, Vol. 20, No. 11, 2002, pp. 1505-1514. doi:10.1016/S0264-410X(01)00503-5
- [13] S. Alexandersen, Z. Zhang, A. I. Donaldson and A. J. M. Garland, "The Pathogenesis and Diagnosis of Foot-and-Mouth Disease," *Journal of Comparative Pathology*, Vol. 129, 2003, pp. 1-36. Hdoi:10.1016/S0021-9975(03)00041-0
- [14] S. Robert and J. Gloster, "Foot-and-Mouth Disease: A Review of Intranasal Infection of Cattle, Sheep and Pigs," *The Veterinary Journal*, Vol. 177, No. 2, 2008, pp. 159-168. Hdoi:10.1016/j.tvjl.2007.03.009
- [15] J. Gloster, A. Jones, A. Redington, L. Burgin, J. H. Sørensen, R. Turner, M. Dillon, P. Hullinger, M. Simpson, P. Astrup, G. Garner, P. Stewart, R. D'Amours, R. Sellers and D. Paton, "Airborne Spread of Foot-and-Mouth Disease—Model Intercomparison," *The Veterinary Journal*, Vol. 183, No. 3, 2010, pp. 278-286. doi:10.1016/j.tvjl.2008.11.011
- [16] M. G. Garner, G. D. Hess and X. Yang, "An Integrated Modelling Approach to Assess the Risk of Wind-Borne Spread of Foot-and-Mouth Disease Virus from Infected Premises," *Environmental Modelling & Assessment*, Vol. 11, No. 3, 2006, pp. 195-207. doi:10.1007/s10666-005-9023-5
- [17] J. Gloster, L. P. Smith, W. H. G. Rees, J. D. Gillett, A. I. Donaldson, J. G. Loxam, R. F. Sellers and F. B. Smith, "Forecasting the Airborne Spread of Foot-and-Mouth Disease and Newcastle Disease," *Philosophical Transactions of the Royal Society of London*, Vol. 302, No. 1111, 1983, pp. 535-541. Hdoi:10.1098/rstb.1983.0073
- [18] W. M. Miller, "A State-Transition Model of Epidemic Foot-and-Mouth Disease," *New Techniques in Veterinary Epidemiology and Economics*, ISVEE 1, 1976, pp. 56-72.
- [19] J. Gloster, I. Esteves and S. Alexandersen, "Moving towards a Better Understanding of Airborne Transmission of FMD," *Proceedings of the Session of the Research Group of the Standing Technical Committee of the European Commission for the Control of Foot-and-mouth Disease*, Rome, 11-15 October 2004, pp. 227-231.
- [20] B. Durand and O. Mahul, "An Extended State-Transition Model for Foot-and-Mouth Disease Epidemics in France," *Preventive Veterinary Medicine*, Vol. 47, No. 1-2, 2000, pp. 121-139. Hdoi:10.1016/S0167-5877(00)00158-6
- [21] T. Kostova-Vassilevska, "On the Use of Models to Assess Foot-and-Mouth Disease Transmission and Control," *US Department of Homeland Security Advanced Scientific Computing Program*, Lawrence Livermore National Laboratory University of California, Livermore, California, 2004. https://people.lfml.gov/~unwen/DHS_09/literature/DHS%20report%20FMD%20models.pdf
- [22] R. M. Cannon and M. G. Garner, "Assessing the Risk of Wind-Borne Spread of Foot-and-Mouth Disease in Australia," *Environment International*, Vol. 25, No. 6, 1999, pp. 713-723. Hdoi:10.1016/S0160-4120(99)00049-5
- [23] CFSPH, "Foot and Mouth Disease: Fiebre Aftosa," *The Center for Food Security and Public Health*, Iowa State University, Iowa, 2007. http://www.cfsph.iastate.edu/Factsheets/pdfs/foot_and_mouth_disease.pdf
- [24] T. Mikkelsen, S. Alexandersen, P. Astrup, H. J. Champion, A. I. Donaldson, F. N. Dunkerley, J. Gloster,

J. H. Sørensen and S. Thykier-Nielsen, " Investigation of Airborne Foot-and-Mouth Disease Virus Transmission during Low-Wind Conditions in the Early Phase of the UK 2001 Epidemic," Atmospheric Chemistry and Physics, Vol. 3, No. 1, 2003, pp. 677-703. doi: 10.5194/acpd-3-677-2003H

- [25] F. Moutou and B. Durand, " Modelling the Spread of Foot-and-Mouth Disease Virus," Veterinary Research, Vol. 25, 1994, pp. 279-285.
- [26] NSW EPA, " Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales," Department of Environment and Conservation, Sydney, 2005. <http://www.environment.nsw.gov.au/resources/legislation/ammodelling05361.pdf>
- [27] M. Caputo, M. Gimenez and M. Schlamp, " Intercomparison of Atmospheric Dispersion Models," Atmospheric Environment, Vol. 37, No. 18, 2003, pp. 2435-2449. doi: 10.1016/S1352-2310(03)00201-2
- [28] C. H. Bosanquet and J. L. Pearson, " The Spread of Smoke and Gases from Chimneys," Transactions of the Faraday Society, Vol. 32, 1936, pp. 1249-1263. doi: 10.1039/tf9363201249
- [29] B. Sportisse, " Box Models versus Eulerian Models in Air Pollution Modeling," Atmospheric Environment, Vol. 35, No. 1, 2001, pp. 173-178. doi: 10.1016/S1352-2310(00)00265-X
- [30] M. Mohan, T. S. Panwar and M. P. Singh, " Development of Dense Gas Dispersion Model for Emergency Preparedness," Atmospheric Environment, Vol. 29, No. 16, 1995, pp. 2075-2087. Hdoi: 10.1016/1352-2310(94)00244-F
- [31] S. P. Arya, " Air Pollution Meteorology and Dispersion," Oxford University Press, Oxford, 1999.
- [32] G. F. Mackereth and M. A. B. Stone, " Veterinary Intelligence in Response to a Foot-and-Mouth Disease Hoax on Waiheke Island, New Zealand," Proceedings of the 11th International Symposium on Veterinary Epidemiology and Economics, 2006. <http://www.sciquest.org.nz/node/63926>
- [33] A. K. Luhar and R. E. Britter, " A Random Walk Model for Dispersion in Inhomogeneous Turbulence in