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**SYSTEMS FOR THE PREVENTION AND CONTROL  
OF INFECTIOUS DISEASES IN PIGS**

A thesis presented  
in partial fulfilment of the requirements  
for the degree of Doctor of Philosophy  
at Massey University

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*The results of science remain hypotheses that may have been well tested, but not established: not shown to be true. Of course, they may be true. But even if they fail to be true, they are splendid hypotheses, opening the way to still better ones.*

Karl R. Popper, *A World of Propensities*, 1990

## Abstract

An expert system (RestiMATE) was designed that assists veterinary practitioners in assessing the respiratory health status of a pig farm. RestiMATE uses classification rules to identify patterns of environmental risk factors for respiratory diseases and to select optimal management interventions to control and prevent respiratory diseases. The classification rules are based on expert interviews and on empirical data collected in New Zealand. Recursive partitioning and neural network techniques have been applied for rule induction. These methods were compared with logistic regression and appeared to be similarly efficient in terms of classification while providing additional insight into the structure of a data set. Non-parametric analytical methods appear to be particularly suitable when analysing complex data sets and for exploratory data analysis.

EpiMAN-SF is an advanced decision-support system designed to manage and analyse data accumulated during an African swine fever or classical swine fever emergency. EpiMAN-SF offers state-of-the-art technology for managing data related to a swine fever epidemic, including laboratory results. An expert system was developed to support rapid classification of contacts between pig farms in terms of the risk of virus transmission. These classifications are used to set priorities in visiting farms for laboratory investigations. The validation of the expert system showed that its evaluation was more consistent and generally more risk-averse than that of human experts. A stochastic simulation model was developed to investigate the spread of swine fever infection within a farm and a second model (INTERSPREAD-SF) was designed to forecast the dynamics of the epidemic within a region and to evaluate control strategies. INTERSPREAD-SF has been validated using real outbreak data from Germany and was shown to be capable of realistically replicating the behaviour of classical swine fever. However, more research is needed to complete our knowledge about the detailed epidemiological processes during a swine fever epidemic.

A prerequisite for efficient disease control in pig populations is reliable animal identification. A series of trials was conducted in order to compare electronic ear tags and implantable identification chips with visual ear tags. It was shown that the difficulties with respect to implants are loss rates of up to 18.1% within 4 weeks after implantation while electronic ear tags were lost or damaged by processing at the abattoir in up to 23.4% of pigs.

Infectious aerosols were reviewed as an additional aspect of the causative network of infectious diseases in pigs. An air sampling system based on air filtration was developed and applied in combination with polymerase chain reaction assays. Using this technique, *Mycoplasma hyopneumoniae*, the major causative agent of enzootic pneumonia was isolated from air samples for the first time. However, the attempt to isolate classical swine fever virus from the air was unsuccessful, probably due to technical difficulties.

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*Katharina D.C. Stärk*  
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