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Abstracts for ISVEE XI

R. Sanson

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Control of Foot-and-Mouth Disease in Southeast Asia

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The OIE Southeast Asia Foot and Mouth Disease Campaign (SEAFMDC) coordinate the regional control of foot-and-mouth disease (FMD) in Southeast Asia. The distribution of FMD serotypes from 2001 to 2005 is presented. Serotype O is the most common strain reported with three distinct topo-types—the Southeast Asia, Pan-Asia and the Cathay (pig adapted strain) topo-types. This is followed by serotype A and Asia 1. The risk associated with the spread of FMD virus to animal movement is described. This paper also presents the regional strategy adopted to control this disease through the implementation of progressive zoning in the Malaysia–Thailand–Myanmar Peninsula, Lower and Upper Mekong Zones.

Epidemiological and Economic Modelling of Foreign Animal Disease in Australia

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Preparedness for an incursion of a foreign animal disease is of key importance to government, industry, producers and the Australian community. One component of Australia’s preparedness is pre-emptive evaluation of the likely cost and effectiveness of...
eradication and surveillance strategies. These evaluations will also inform decisions about the allocation of resources during an outbreak. Simulation modelling and economic analysis are tools that can be used to undertake these studies. These tools are particularly useful for investigating diseases of which Australia has little or no contemporary experience.

In this study we review the status of Australian Government epidemiologic simulation modelling and economic modelling, and propose a three-step process for combining these tools to inform decisions about regional outbreak management. Under this process: (1) the DAFF spatial model, AusSpread, is tailored to a regional setting and used to simulate the outbreak; (2) outputs from the simulation are utilised by a dynamic bio-economic partial equilibrium model to estimate impact on Australian livestock industries and consumers; (3) outputs from the partial equilibrium analysis are passed to Ausregion, the DAFF computable general equilibrium model, which estimates indirect impacts across the Australian economy.

The study is in progress. Preliminary results suggest that the three-step process will provide a practical, consistent and transparent basis for evaluating regionally focussed control and eradication strategies.

Management of Emergency Animal Disease in Southeast Asia and Australia

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This paper describes the arrangements for managing emergency animal diseases (EADs) in Australia and Southeast Asia. It sets the scene with a contemporary view of the socio-economic impacts of animal disease. It then outlines the geography, human population, animal production and important animal diseases in Southeast Asia. The paper describes the global strategy against avian influenza which can be considered the global master plan for managing any animal disease with international impacts. This leads to a description of the arrangements for the international coordination of emergency animal disease control under the global alliance of FAO, OIE and WHO. The centrepiece is the global framework for the progressive control of emergency animal diseases (GF-TADs) and its global livestock early warning system. The paper next describes the role of ASEAN in the regional management of EADs in Southeast Asia and the arrangements for EAD management in Australia.

An important conclusion is that the spectacular increase in animal production and consumption of animal products in the developing world, the livestock revolution, has produced hazards for animal and human health. Increased number and density of livestock in intensive pig and poultry husbandry systems have activated the animal, pathogen and environment-related factors that lead to the emergence of new diseases and the re-emergence of old diseases. Unfortunately, the livestock revolution has outstripped the capacities of animal health services in these areas. The challenge now is capacity building in veterinary services and public health as a public good that falls within the Global Public Goods concept of the United Nations Millennium Development Goals.
Contact Network Structure and Risk of Infection

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The transmission dynamics of infectious agents depend on three main elements: (1) the transmissibility of the infectious agent (including factors such as off-host survival); (2) the duration and intensity of infectivity of the host; (3) the network of contacts linking individual host animals (and hence groups, farms, regions and countries). This study investigates the effect of structural features of contact networks on transmission of infection in populations. First, we examined a number of measures of network centrality that may be useful to identify individuals of high risk of infection during outbreaks using susceptible-infectious-recovered models. Centrality describes an individual’s position in a population; numerous parameters are available to assess this attribute. Here we use a number of centrality measures including degree, eigenvector centrality, betweenness and farness. Second, time to infection and outbreak size were examined in both “small-world” and randomly mixing networks. Infection tended to be transmitted more rapidly, but ultimately infected fewer individuals, in the small world network compared to the random network. Hence, models relying on random mixing are likely to underestimate rate of spread, but overestimate outbreak size. Each of the measures of centrality was associated with time to infection and risk of infection in the simulated outbreaks. Importantly, degree (which is the most readily measured) was at least as good as other network parameters in predicting risk of infection. Identification of more central individuals in populations may be used to inform surveillance and infection control strategies.

Choices, Choices: The Application of Multi-Criteria Decision Analysis to Food Safety Decision Making

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A Multi Criteria Decision Analysis (MCDA) methodology is presented as a support tool for decision makers faced with multi-criteria decision problems. These decision problems are typically characterized by the existence of several alternative potential courses of action with varying degrees of strength and weakness when judged against several key criteria. The framework for applying this approach to food safety related issues was developed as an offshoot of another larger project looking at the selection of interventions against Salmonella in pork, prioritized for study primarily because of its importance from a public health and trade perspective (Funk and Gebryes, 2004).
Reference
Funk, J., Gebreyes, W.A., 2004. Risk factors associated with Salmonella prevalence in swine on swine farms. J. Swine Health Product. 12, 246–251.

Searching for the Natural Reservoir of the Sars Virus
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This paper presents an epidemiological perspective to our identification of species of bats as the natural hosts of SARS-like coronaviruses. Earlier evidence of infection with SARS coronavirus in masked palm civets (Paguma larvata) in ‘wet markets’ in southern China was widely interpreted as indicating they were the natural host of SARS. We hypothesized that while the outbreak may have originated from civets in markets, these species were not the natural reservoir of the virus. We prioritized bats for surveillance because of their known association with a broad taxonomic spectrum of viruses and with a number of recently emerged zoonotic viruses in the region. We found serologic and genetic evidence of infection with SARS-like coronaviruses in five species. Positive findings over space and time suggest that the genus Rhinolophus plays an important role in the maintenance of SARS-like coronaviruses in the wild. Prioritization can improve the efficiency of surveillance of uncontrolled wildlife populations.

K-Function Analysis: Recent Developments and Novel Applications
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K-function analysis has been used to detect and describe spatial and space-time clustering of disease in human and veterinary epidemiology. Recent studies of the spatial, spatio-temporal and inhomogeneous K-functions have resulted in new applications in the veterinary field. We have examined the validity of the space-time K-function in situations where there is random and non-random ‘thinning’ of points. This situation would arise if there was underreporting of a disease that is either random, or variable according to geographical location; for example the latter could occur if the level of reporting of a notifiable disease varied by diagnostic centre. These studies showed that the Monte Carlo test for space-time clustering is robust to most types of thinning, both random and non-random (e.g position-dependent), but the diagnostics used to describe the nature and scale of clustering may be biased by these processes. We also report on a novel application of the inhomogeneous K-function for detecting differences in the patterns of brain lesions produced by TSEs: both BSE and different strains of scrapie. When combined with models of the intensity and size of vacuolation this method could be used as an alternative to the
more subjective methods based on lesion-profiling, and contribute to our understanding of
the molecular epidemiology of TSEs in cattle and sheep.

Positioning Risk Assessment Within Modern Food Safety Programmes

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Food safety has undergone a remarkable transition in the last decade or so. There have
been three waves of “scientific” change: more objective specification of good hygienic
practice in the early 1990s, application of HACCP in the mid-1990s and widespread
adoption of risk assessment principles in the late 1990s. At the same time, competent
authorities in many countries have themselves been undergoing considerable change in
terms of their legislative base, structure, policies and inclusion of international norms.
Further, it is now generally accepted that industry has the primary responsibility for food
safety.

Despite these changes and the increasing attention to the provisions and obligations of
the WTO SPS Agreement for food in trade, it is still relatively uncommon to see genuine
application of “production-to-consumption” risk-based approaches to standards devel-
opment. Progress in this area requires a clear understanding of the systematic application of
a risk management framework and acknowledgement of the significant differences
between “science-based” versus “risk-based” food safety standards.

I conclude that risk assessment as a basis for food safety standards is no longer a choice
but a necessity. The ability to conduct a risk assessment should not remain a barrier and
there is a need to simplify current quantitative approaches where applicable. In this context,
the current emphasis on food safety objectives as leading microbiological risk management
strategies may be overdone. The positioning of risk assessment in modern food safety
programmes is still a “work in progress”.

Realising the Potential: Enhancing the Impact of Veterinary Epidemiology in Current
and Emerging Food-Safety Issues

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In food safety, most interest and inference occurs at the level of populations. Despite
this, the methodologies and decision processes in widespread use can be weak in the
application of basic epidemiology. One challenge for epidemiologists is to achieve greater
integration of their knowledge and skill with that of the biotechnologist and to improve the
incorporation of epidemiological principles when policy on food safety is being
formulated. It seems unlikely that more widespread application of sophisticated
quantitative techniques in food safety issues will address this challenge. A more effective
focus is to aim for broad dispersal of key skills into participating disciplines and to extend
knowledge on basic principles to policy settings. Much progress can be made by more
widespread use of probabilistic sampling, by increasing the number of tests for hazards that
undergo objective evaluation, and by providing decision makers with the skill to recognise when information is suitable for a particular use. Greater recognition of “multiple causation” is needed to reduce the fixation on presence or absence of particular hazards. At a societal level, there is a niche to be filled by veterinary epidemiologists who have understanding of the strengths and limitations of biotechnology, the workings of agricultural and food production systems and the nuances of trade. Such individuals can have greater influence on the allocation of resources to public health and on prioritising balance between public health, social needs and economic progress. This presentation will discuss these issues, with reference to important longstanding and emerging issues in food safety.

Antimicrobial Resistance: Association of Trends and Clusters of Resistant S. Typhi-
murium in Contemporaneous Animal and Human Populations

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Antimicrobial resistance has epidemiological characteristics and consequences paralleled in the domain of emerging diseases. Early detection, surveillance and “freedom from” status are important considerations in both areas of epidemiological endeavour. Over a 10-year period, through clinical reporting, Scotland has data on the resistance profiles of enteric pathogens affecting the human population together with a contemporaneous database of similarly typed and profiled animal derived isolates. With a socio-political undercurrent that use of antimicrobials in a veterinary context leads to resistance in pathogens isolated from humans, we investigated over 45,000 isolates collected over a decade to test this hypothesis. As well as analysing temporal trends and spatial clustering at the individual antimicrobial level of resolution, using statistical clustering techniques and the resistance characteristics of S. typhimurium to 10 antimicrobials we identified 12 “profiles” that were chartable in both space and time. Whilst temporal trends for the prevalence of resistance to some individual antimicrobials did appear to vary in both animal and human populations synchronously, there was no evidence either in temporal, spatial or time-space aspects that any of the 12 profiles behaved in a manner that suggested a dependent relationship between animal and human isolates. Importantly, there was no evidence that the emergence of resistance and increase in prevalence in the animal isolates predated the emergence or increase in the human isolates.

Enhancing Disease Monitoring in Shrimp Through a Geographical Information System (GIS) Application

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SEAFDEC Aquaculture Department (AQD) pioneered fish disease work in the Philippines and developed diagnostic tools through research. Its Diagnostic Service Laboratory was established in the late 1970s to serve the budding aquaculture industry. Through the assistance of SEAFDEC AQD, this service has been replicated by both private and government agencies involved in shrimp aquaculture, thus, data on disease occurrence and prevalence are already available in databases in various forms. Laboratory analysis of hatchery-reared shrimp postlarvae has become an important tool for marketing using both physical and health attributes as gauges for acceptance or rejection of specific batches. Through the years, the diagnostic tools have evolved from mere wet mount microscopy to molecular diagnostic techniques by means of polymerase chain reaction (PCR) to detect viruses.

Despite this development, however, disease information is still patchy and difficult to use as decision-support tools because it remains in highly technical and in difficult to visualize information spreadsheets and tables. GIS is a tool that translates complex data in tables and spreadsheets into maps that provide visual displays of information in both spatial and temporal forms. It shows disease trends that are not presently seen and understood by all stakeholders. This paper will highlight the evolution of shrimp health monitoring as a marketing tool in the Philippines and how the application of GIS has helped in understanding disease patterns in the shrimp industry.

**Management Practices Associated with the Incidence Rate of Clinical Mastitis on Canadian Dairy Farms**

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Research and extension programs have stressed certain management practices. However, the level of compliance to these management practices in Canada is undocumented. The goal of this clinical mastitis cohort study is to determine risk factors in mastitis preventive management for pathogen-specific clinical mastitis on Canadian dairy farms. Milk samples of cows with clinical mastitis are being collected from 121 farms from every province of Canada for a time period of 1 year, ending January 2006. In total, approximately 2500 milk samples will be cultured and pathogen-specific incidence rates will be calculated. Questionnaires, which are completely focussed on mastitis preventive management practices will be taken orally on-farm by provincial co-ordinators in the fall of 2005. The questionnaire focusses on milking procedures, management of clinical mastitis, dry cow management, management of subclinical mastitis, milking equipment, cow comfort and hygiene, biosecurity and prevention management, nutrition and mastitis plan review and communication. Associations between management practices and pathogen-specific incidence rates of clinical mastitis will be studied using a Poisson regression model constructed by backward stepwise selection of variables. It is expected that incidence rates of *Escherichia coli* and *Streptococcus uberis* are strongly related to housing, milking machine and nutrition while the incidence rate of *Staphylococcus aureus* is more related to milking procedures, barn type and attitude to mastitis of the farmer. These items will be discussed regarding their causal relationship with clinical mastitis.
Prevalence of and Risk Factors for Post-Operative Colic in Horses after Non-Abdominal Surgery

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A retrospective pilot study conducted to estimate the prevalence of, and identify risk factors for, the development of post-operative (PO) colic in horses undergoing orthopaedic surgery at a single UK equine referral hospital indicated a prevalence of 2.8% (95% CI = 1.6, 4.7) per anaesthetic. The incidence of colic was substantially higher than that reported previously in housed horses suggesting that being hospitalized and/or having surgery increases colic. Morphine was associated with an increased risk of post-operative colic compared to the use of no opioid (OR = 4.1, 95% CI = 1.4, 12.2). Out-of-hours surgeries were also associated with an increased risk of developing post-operative colic (3.0, 95% CI = 1.0, 8.8).

Subsequently, a prospective multi-centre case-control study was conducted to investigate the prevalence of PO colic after non-abdominal surgery at different centres, and to further investigate risk factors for the development of colic. Four equine hospitals were enrolled. Cases of colic were defined as any horse with recognised signs of abdominal pain that occurred within 72 h post-anaesthetic. Controls were randomly selected from all the centres, from all non-abdominal anaesthetics performed during the study period that did not show any signs of colic for 72 h post anaesthesia. The overall prevalence of PO colic was 5.2 (95% CI = 3.8, 6.9) however the range at different clinics was 1.9–7.7. Orthopaedic procedures were more likely to suffer post-operative colic than non-orthopaedic procedures. Other confounding factors were the use of any type of opioid and whether the horse was starved prior to surgery.

Surveillance Data and Control of H5N1 Avian Influenza in Asia

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Control programs for H5N1 avian influenza have been based on less than adequate surveillance data. The combination of widespread infection and disease, large numbers of households rearing poultry and limited capacity to collect and test samples have all compounded to limit the number of flocks that could be monitored.

The high fatality rate in domestic chickens that has limited the utility of serological testing as a means of detecting chicken flocks previously exposed to the virus and sub-clinical infection of domestic waterfowl has also created challenges.

This paper considers the methods that have been used in Asia in an attempt to overcome these problems and explains why vaccination has been used as a key platform in the control program for this disease.
Quantification of the Transmission Characteristics of Avian Influenza (H5N1 and H7N7) in Ducks

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The natural reservoir of influenza A viruses is considered to be in wild aquatic birds. Interspecies transmission events from the natural reservoir to other species are believed to be the sources that spark outbreaks in poultry. Motivated by these observations we study the transmission characteristics of highly pathogenic H5N1 (A/2004/Indonesia) and H7N7 (A/2003/Netherlands) in ducks. To this end we resort to so-called “transmission experiments”. In a transmission experiment, a number of artificially inoculated animals are placed in one cage with a number of contact animals, and the infection chain is monitored by taking blood samples, and samples from the trachea and cloaca. The data are analysed by final size methods and a generalized linear model based on a stochastic SEIR model. Based on the stochastic SEIR model, a systematic comparison will be made of the transmission characteristics (period of latency, infectious period, transmissibility, mortality) of H5N1 and H7N7 in vaccinated and unvaccinated ducks. We will discuss the implications of our results for the risk of interspecies transmission from ducks to poultry.

Multi-Model Investigation of Foot-and-Mouth Disease Spread in Texas

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Simulation models are important for investigating foot-and-mouth disease (FMD) introduction scenarios and testing the potential effectiveness of control programs. To incorporate disease spread via domestic livestock and wildlife populations, a multi-model approach has been used to simulate potential FMD outbreaks in a region of Texas. Within the study region – a 9-county area (24,525 sq.km) of southern Texas, bordering Mexico – the distribution of cattle and feral pigs was estimated based on land use and vegetation characteristics. A geographic automata model of FMD spread between feral pig herds (1 km\textsuperscript{2} grid) was used to initiate the outbreak. During each simulated day of spread, we identified cattle herds (represented as either points or polygons) that may have been infected. We then used, separately, two spread models of FMD in domestic species to simulate an FMD outbreak in cattle herds in the study region. Initial simulations of this multi-model system based on introduction of infection into five randomly selected feral pig herds as input to the two spread models resulted in a typical outbreak that lasted 1–2
months and could affect about 100 cattle herds. The multi-epidemiologic modeling framework is currently being integrated with livestock transportation, carcass disposal and economic models to create a scalable and generic decision support system.

**Epidemiologic Analysis of Risk Factors for Local Disappearances of Native Ranid Frogs in Arizona, USA**

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The objective of this study was to examine factors that may act independently and/or synergistically to contribute to amphibian declines. Epidemiologic case-control methodology was used to subsample and analyze a large database that describes historical and currently known ranid frog localities in the state of Arizona, USA. All eligible sites (n = 324) were evaluated to identify locations where frogs disappeared during the study period (case sites). One hundred five case sites and an equal number of non-disappearance (control) sites were sampled to control for effects of time. Environmental and habitat data gathered during surveys were summarized for all 210 sites using survey-specific results and Geographic Information Systems. Risk factors were evaluated using univariate and multivariable logistic regression analyses to derive prevalence and adjusted odds ratios. Thirty-six percent (117/324) of all classified sites became cases during the study period. Elevation, presence of non-native species (crayfish, non-native fish, and bullfrogs), hydrologic characteristics, aspect, and effects of nearby sites were significantly associated with frog persistence or disappearance. In the final multivariable model, risk for local population disappearance increased with increasing elevation (OR = 2.7 for every 500 m, \( P < 0.01 \)). Sites where disappearances occurred were 4.3 times more likely to have other nearby sites that also experienced disappearances (\( P < 0.01 \)), while having a source population nearby decreased risk of disappearance by 85\% (OR = 0.15, \( P < 0.01 \)). Sites experiencing disappearances were 2.6 times more likely to have crayfish than control sites (\( P = 0.04 \)). Identification of risk factors associated with frog disappearances will help guide future research and conservation efforts.

**Synergies in Microbiological Food Safety and Animal Health Risk Assessment**

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Microbiological risk assessments are generally undertaken according to ‘Codex’ guidelines as adopted by the World Health Organisation and the Food and Agriculture Organisation of the United Nations (WHO/FAO). Animal health risk assessments,
including in particular animal import risk assessments, are generally undertaken using the guidelines of the World Organisation for Animal Health (OIE). Although these systems have some differences in terminology and detail, in fact they abide by the same underlying principles. Thus any risk assessor familiar with one type should have no great difficulty in undertaking a risk assessment of the other type.

Taking as an example Pathogen P, a zoonotic pathogen present in livestock Species S in Country Ci, but not present in Country Cf, the two sets of guidelines will be examined. Two complementary risk assessments will be considered; firstly, the risk of food-born infection with Pathogen P from Species S in the human population in Country Ci; and secondly, the risk of infection of Species S in country Cf due to importation of Species S from Country Ci. Synergies in method, data required, and outcomes will be examined, with respect both to the two sets of guidelines, and the underlying risk assessment principles.