

## **Report of Workshop on the Use of Disease Models in Development of FMD Policy**



**Part of the QUADS Emergency Management Working Group**

**Canberra, Australia, March 8–10, 2005.**

## 1. **Background**

Models are a representation of reality that can help test hypotheses and answer questions. Simulation models have been developed to evaluate the consequences of foot-and-mouth disease (FMD) and the effect of various control strategies. Disease models were used during the 2001 FMD UK outbreak to guide and support decisions.

Significant recommendations were made following the UK epidemic on the proper uses of disease models. In addition, many countries have developed simulation models to prepare against such outbreaks. Models need to be used carefully by people with knowledge of underlying assumptions and limitations of the models. Proper representation of results to policy-makers and decision-makers is critical to the success or failure of the uses of these models.

The Quads countries, through the Animal Health- Emergency Management Group, at their meeting in Vancouver, Canada in 2004, in response to a paper tabled by Canada, agreed to hold a workshop on the role of modelling to support decision-making in an disease emergency (with specific emphasis on FMD). Australia offered to host this workshop and a steering group with representation from Australia, Canada, New Zealand and the USA was nominated.

The aim of the workshop was to present policy-makers with the models developed or under development in the QUADS countries and review the current status of FMD policy in the various countries. It is believed that modellers and policy-makers should work together to develop the most efficient methods of controls for FMD outbreaks. The Workshop was intended to identify actions/activities to promote better understanding of the role of modelling in policy development, and opportunities for collaboration by QUADS countries.

### Organizing committee:

Australia: Dr Graeme Garner  
Canada: Dr Caroline Dubé  
New Zealand: Dr Dorothy Geale  
United States: Dr Claudia Cartwright

### Objectives:

The aim of the workshop was to increase collaboration between modelling groups and policy-makers among the QUADS member countries, and to develop a consensus on the uses of models in disease control amongst QUADS country CVOs.

The workshop was intended to ensure that participants gained:

1. An understanding of the various models that are being developed by QUADS countries, their applications and their limitations
2. Explored the current status of FMD policy development in QUADS countries, and the UK
3. Developed a clearer understanding of how, where, when and why disease models are used
4. Developed a better understanding of the strengths and weaknesses of models with respect to supporting policy development and decision-making on disease management
5. Agreed a set of actions to promote better understanding of the role of modelling
6. Agreed on a process to update members on progress and identified opportunities for information exchange and/or future collaboration in this area

The output of the workshop would be a report to the QUADS Animal Health Committee.

## 2. *Participants*

The workshop included several groups:

- Modellers: people working in government or tasked by government to use disease simulations models to influence disease response strategies.
- Policy-makers: this will include the people asking the “What if?” questions to develop the strategy for dealing with FMD.

### **Facilitator:**

Dr Rob Brennan (Rob Brennan Facilitation and Training Services)

### **Invited speakers:**

Dr John Wilesmith, DEFRA, UK  
Dr Nick Taylor, University of Reading, UK

### **Australia:**

DAFF

Dr Gardner Murray Australian Chief Veterinary Officer  
Dr Bob Biddle Deputy CVO  
Dr Graeme Garner – Manager Epidemiology and Modeling Section  
Dr Peter, Dr Jenny Hutchinson, Dr Iain East – Epidemiology/modelling Section  
Dr Mike Nunn – Scientific Adviser, OCVO  
Dr Chris Bunn – Manager, Disease Preparedness and International  
Greg Flaherty, Tony Callan – Emergency Management Response Unit

DAFF/ AB-CRC modelling project

Dr Sam Beckett (DAFF),  
Dr Jenny-Ann Toribio (University of Sydney),  
Sam Hamilton (PhD student) –

CSIRO-Australian Animal Health Laboratory

Dr Laurie Gleeson

Animal Health Australia

Peter Morecombe

Rob Keogh

Peta Hitchens

Department of Prime Minister and Cabinet

Dr Rob Floyd

### **Canada:**

CFIA

Dr Carolyn Inch – National Manager, Disease Control Section, CFIA  
Dr Gilles Dulac – Senior Staff Veterinarian Foreign Animal Disease Unit, CFIA  
Dr Caroline Dubé – Epidemiologist, Modelling, Disease Control Section, CFIA

Canadian Meteorological Centre

Mr Michel Jean – Environment Canada, Chief Emergency Response, Canadian Meteorological Centre.

### **USA:**

USDA-APHIS

Dr Larry Granger – Associate Deputy Administrator for Emergency Management and Laboratories, USDA-APHIS

Dr Barbara Corso – Epidemiologist, Centres for Epidemiology and Animal Health, USDA-APHIS

Dr Mark Teachman – Senior Staff Veterinarian, Emergency Programs, USDA-APHIS

Department of Homeland Security  
Dr Tom McGinn Veterinarian

***New Zealand:***

MAF

Dr Dorothy Geale – Senior Adviser, Animals, Surveillance and Incursion Response, MAF

Dr Andre van Halderen, Senior Adviser, Surveillance & Incursion Response MAF

Mr Colin Holden, Senior Policy Analyst, Biosecurity Policy, MAF

Ms Sue Keenan, Senior Policy Analyst, Biosecurity Policy, MAF

Dr Matthew Stone, Team Leader, National Centre for Disease Investigation, MAF

AgriQuality

Dr Robert Sanson

Massey University

Dr Mark Stevenson

### 3. Agenda

#### Day 1

##### **AM: Disease models in each country.**

- 8:00 – 8:10 Welcome and introduction – *Dr Gardner Murray, Chief Veterinary Officer, AFFA.*
- 8:10 – 8:30 Introduction to meeting by facilitator (*Rob Brennan*) and introduction of participants
- 8:30 – 9:15 Overview of disease modelling – *Mr Nick Taylor, The University of Reading.*
- 9:15 – 10:00 Australian model – *Dr Graeme Garner, AFFA*
- 10:00 – 10:15 Break
- 10:15 – 11:00 North American model – *Dr Caroline Dubé, CFIA*
- 11:00 – 11:45 New Zealand model - *Dr Graham Mackereth, MAF*
- 11:45 – 12:30 Key questions for which we need answers (Syndicate Groups)
- 12:30 – 13:30 Lunch
- Model demonstration Australia

##### **PM: The UK experience of models during the 2001 FMD outbreak**

- 13:30 – 14:30 Review of models used in the UK – *Mr Nick Taylor, The University of Reading.*
- 14:30 – 14:45 Break
- 14:45 – 15:15 Political reality of model use in the 2001 UK outbreak – *Dr John Wilesmith, DEFRA*
- 15:15 – 16:30 Dealing with multiple models and modellers: Lessons learned, pitfalls, and communication issues (Syndicate groups)

## Day 2

### **AM: Validation of models for disease control policy**

- 8:00 – 8:15 Review of items from previous day - facilitator (*Rob Brennan*).
- 8:15 – 8:30 Introduction to verification and validation of simulation models – *Dr Sam Beckett, DAFF*
- 9:15 – 9:45 Validation of Interspread Plus – *Dr Mark Stevenson, Massey University*
- 9:45 – 10:00 Validation of the North American Model – *Dr Caroline Dubé, CFIA*
- 10:00 – 10:15 Break
- 10:15 – 12:30 Generating joint confidence in models: presenting limitations and strengths of models to decision makers (Syndicate Groups)
- 12:30 – 13:30 Lunch
- Model demonstration North America

### **PM: Modelling in policy development: Key drivers**

- 13:30 – 13:45 Australia strategy in policy development, – *Dr Chris Bunn, AFFA*.
- 13:45 – 14:00 New Zealand strategy in policy development, – *Dr Dorothy Geale, MAF*.
- 14:00 – 15:00 North American strategy on the use of models in policy development – *Dr Gilles Dulac, CFIA* and *Dr Larry Granger, USDA-APHIS*.
- 15:00 – 15:15 Break
- 15:15 – 17:00 Identifying key drivers (Syndicate Groups)

### Day 3

#### **AM: Other epidemiological tools that can be used in disease control when simulation modelling is neither possible nor desired**

- 8:30 – 8:45 Review of previous day.
- 8:45 – 9:30 New Zealand presentation on uncertainty in decision making in the early stages of an epidemic. - *Dr Graham Mackereth, MAF*
- 9:30 – 10:15 Australia presentation on other epidemiological tools available – *Dr Peter Black and Dr Graeme Garner, AFFA.*
- 10:15 – 10:30 Break
- 10:30 – 12:30 Discussion: Integration of other epidemiological tools along with modelling. When to use simulation models? (Syndicate groups)
- 12:30 – 13:30 Lunch
- Model demonstration New Zealand

#### **PM: Using models in FMD preparedness – what next?**

- 13:30 – 14:00 Current and future role or use of models in the UK – *John Wilesmith, DEFRA*
- 14:00 – 15:00 “Who”, “When” and “How” to use disease simulation models. (Syndicate Groups)
- Future Collaboration (Syndicate Groups)
- 15:00 – 15:15 Break
- 15:15 – 16:30 Wrap-up of meeting with recommendations, agreements and agreements to differ (with reasons) on the uses of models in disease control amongst QUADS countries, to report to CVOs.
- 16:30 Close

## 4. **Report of the Workshop**

### **Day 1, Morning Session**

Dr Gardner Murray, Australian Chief Veterinary Officer welcomed participants and opened the workshop. Dr Murray Exotic emphasised that diseases like FMD continue to be a serious threat to countries like Australia, New Zealand, Canada and USA. Preparedness for an incursion of FMD is of key importance to government, industry, producers and the Australian community. While modelling can be used to inform policy development, recent experience has shown that, models need to be used appropriately, and if the findings are not communicated effectively, they may also confuse the issues in the minds of policy makers and the public. He also stressed the importance of linking modeling with economic analysis.

Rob Brennan sought to clarify participants' expectations and to confirm the objectives of the workshop.

Dr Nick Taylor from the UK began the formal presentations by providing an overview of disease modeling. NB Copies of all presentations are included in separate files

Dr Graeme Garner then gave a presentation of the Australian FMD model. Several questions were raised at the end of the presentation:

*John Wilesmith:* Have you decided what outputs you will show to Gardner (decision makers) in the face of an outbreak? GG: Not to Gardner directly, but this has been discussed at training workshops. There has been a problem with the policy makers articulating what sort of information that they want. There is a need to simplify the outputs and explain their implications.

*Caroline Inch:* Were you varying the movement controls? GG: It is a variable and can be set. CI: How to investigate effectiveness of movement controls e.g. amount of compliance with the controls...GG: Hard to directly estimate but they can be adjusted to deal with various levels of compliance. John Wilesmith: estimates 80-90%; actually one worry is animals breaking out/in themselves!

*Matthew Stone:* How does compliance vary with resource constraints. GG: Compliance with ovine Johne's disease (OJD) is not good because it is unpopular with producers but we would expect compliance to be better with FMD. There is a good level of education/awareness in producers.

Dr Caroline Dube gave a presentation on the North American model. A copy of the presentation is attached. Discussions included the following issues:

*Rob Brennan:* Tri-partite? CD: Canada, US and Mexico

*Tom McGinn:* is there an economic component as well? CD: Yes – there is a record of direct costs and the outputs of our model will be used in economic models.

*Tom McGinn:* Distances – How far can the spread distance be set in the model? CD: As far as you want.

*John Wilesmith:* What about welfare slaughters? A major cost, is it included? Barbara Corso: Not at present. Dorothy Geale: It could be included fairly easily in NA model? And in Australia? GG: Could be, very easily, although is not at present. NZ: It could be incorporated into the NZ model as a special case of slaughter.

*Chris Bunn:* Is the probability for airborne spread based on wind parameters only? What about the effects of temperature and relative humidity? CD: a lot of research will be done in advance; it will be either a feature of a simulation or not....

*Sam Beckett:* is the wind speed and direction fixed for the duration of the epidemic?? CD: yes at present, although zones could be developed.

*Rob Floyd:* What are direct costs? CD and BC: Government costs - slaughter, vaccination, appraisal, compensation (not production costs to farmers etc.)

*Sam Beckett:* What will the further economic analyses involve? Barbara Corso: The economic planners want details of area and when it entered. We can supply the names of planners with macro-economic models.

A joint presentation on the New Zealand InterSpread model was then given by Matthew Stone, Robert Sanson and Mark Stevenson. The following issues were raised in discussions:

*Caroline Dube:* How long do the simulations take? MS: Using points – 130 000 farms in the UK; 5 iterations takes 4-6 hours. It's now on a Linux platform and it's a lot quicker.

*John Wilesmith:* The writing out of output files makes a big difference; he is sick of making comparisons with milliseconds and thinks that the outputs are the important things; mapping the outputs is incredibly slow. Graeme Garner commented that displaying the mapped outputs on the screen day-by-day for the epidemic slows things down dramatically. The solution is turn this function off unless required.

*Michel Jean:* Is the model it linked to real-time meteorological information? Robert Sanson: there's a network of weather stations, but if they are in an area sparse, we will roll in mobile weather stations. This is not part of InterSpread as such.

*Michel-Jean:* have you considered using neural network approaches? Mark S: social network approaches.

*Dorothy Geale:* Can we as modelers not include the knowledge developments in the social network fields to assist with developing the models? Robert Sanson: potential is there. Talked then about the multiple production systems allowed in Interspread (5 production types and 6 species of animal), plus giving a high degree of heterogeneity that can be accommodated. The model can also define movement into several different classes.

*Peter Black:* social networks – language issue here – complex system science and we need to look at other disciplines and could pick up a level of knowledge that we are not familiar with and that could be of value. The term used in other disciplines to identify the critical points in these network maps is “critical hubs”.

Caroline Dube: have discussed connectivity – computer networks, but assessments have been static and have not incorporated quality of contacts.

*John Wilesmith:* network analyses mostly based on web networks. Animal licensing database in UK has launched a wide range of projects and there are lots of datasets

Following the session on models in the Quads countries, participants then divided up into six break-out groups to consider the topic **‘What are the key questions for which we need answers?’** A summary of the findings follows.

Team 1 (Mike Nunn): What is the objective of the meeting? One model across all countries? Increasing collaboration? Shared experiences? How one should use model with policy people. What data are needed to run models so data collected in peace time. Different stakeholders (politicians, media etc) have different expectations of models, especially in outbreak. Cultural difference between modelers and policy people and also cultural differences between different stakeholders and their different needs and perceptions. Data issues – availability, privacy, legal

Team 2 (Michel Jean): Lexicons – people use different terminologies for the same thing, and same terminology for different things. No consideration for bioterrorism scenario this morning and the particular problems it may present such as multi-focal point epidemics. Are there special considerations that must be taken into account. Spatial!!! Politician would say why use four different models to do the same thing? Inherent richness in this diverse approach. Each has strengths and weaknesses. No best model. How do we present the information to policy makers. Sometimes the politicians do not know what they are looking for. Must be education process but not during a crisis. Has to be a product that could help decision maker to identify gaps – for research purposes or tactical responses.

Team 3 (Caroline Inch): Concerned that assumptions have not been so well defined and that different assumptions can make a huge difference. The assumptions drive the model but may not be correct. Eg North American assumption about larger farm being most likely to be infected – not true in Australia? Need for clear documentation of assumptions for each parameter and of models! A lot of thinking based on models is economic-based but cost-benefit itself is value-laden – what is a cost? What is a benefit. Also didn't think we had defined when models should be used – for different purposes (e.g for preparation? In the face of an outbreak?) Michel Jean notes that there is no social consideration built in to these models – are there ways to build this into the model. We need to define when the models will be used.

Team 4 (Matthew Stone): There is broad agreement between the models when assessing FMD ( an FMD spread model). Heartening that there is consensus about the core components about the models. Difference: 1 - approach to contact structure – needs to be further research; 2 – approach to resourcing or resource constraints. There are divergent approaches to how resources are modeled. In NZ this is a key expectation of what modeling can deliver. Purpose of modeling in peace-time versus wartime. Considering the outputs of models – the decision criteria. Social and political criteria will play a role and will need to be considered. Have seen some attempt to take model output and turn it into economic criteria with economic modeling but there will be other criteria that we will not properly understand so need to engage with decision makers to find out what is considered important so can present appropriate outputs. Considering control strategies. Can modeling deliver info about alternative control strategies – movement control alone, zoning others? Do the decisions makers want the option that produces properties infected or lowest cost or least no of animals slaughtered? May need to explain to decision makers that some of these options are mutually exclusive.

Team 5 (Dorothy Geale): The money. How long are we out of market share. Request for examples of how models have already been used in outbreaks? And how can that help us. Do politicians need this for their decision making? Politicians don't want support for decision making, they want the right answer. Basic distrust of politicians scientists modelers. Suggestion to go with a range of results – worst best case scenario

Team 6 (Mark Teachman): Need to start using the models – not keep waiting for 'the best'. All these models have some value during an event; different aspects can be usefully predictive, particularly with resources. Talked about the assumptions – need good understanding and need to be documented. As do scenario banking, need to make sure assumptions are documented. Future: putting them into gaming environments, so that countries that don't have a lot of experience can get it virtually. Learning by doing, education. Tom McGinn: all models should be applied to the same scenario to find gaps! Meteorological perspective: when hurricane comes, there are multiple models run and what you see on the evening news is an average of multiple models. Maybe the

same approach should be used here. Collaborative approach. Michel Jean: decision makers need to know not just the average but also the uncertainty to assist the risk management.

Rob Brennan summarized the key points from the morning's discussions:

- We need to standardize the lexicon so that we all use the same terminology
- We need to clarify stakeholder's expectations
- Marketing the use of/presenting the models (includes the lexicon)
- Gathering and using the data
- Refining models (includes collaborative approach; drawing on the four different aspects. There is a balance/tension in the richness of multiple models)
- Using models (use them now but continue to refine them).

A modified set of objectives for the workshop were identified (Appendix 1)

### **Day 1, afternoon Session**

This session covered experience with the use of disease models in the 2001 UK FMD epidemic.

Dr Nick Taylor reviewed the models used in the UK. The following issues were discussed:

*Rob Floyd:* What of the 'conflict' or disagreement between the two science groups with no mechanism to resolve it – has this been managed? Was the public aware of the disagreements? JW to answer later. Roy Anderson claims he gave the government several control options and they chose contiguous culling.

*Michel Jean:* From a modeling perspective, when you look at scenarios, they are based on the data one has. Analysis is done retrospectively with 20/20 hindsight, but what of the reasons for making the decisions. i.e. seemed like the right decision at the time. Was the analysis done prospectively? Matthew Stone: should be aware that the constraints on the model that will be placed on it by the assumptions (eg contiguous cull and spread of disease assumptions). There is a circular argument between model assumptions and model answers, but these should be discerned easily.

*Nick Taylor:* We don't have 20:20 hindsight, because not all the information is available. Not all links and contacts are known. We should be more aware of the limitations of the models and not be afraid to say we don't know or we need to wait.

*Barbara Corso:* The caveats are published in papers but the readers gloss over them – in the face of an outbreak, how do you bring out the caveats to the decision makers when not in that formal publishing environment. (JW to answer later).

*Dorothy Geale:* Reason for the 20 days and 6 days standstills? John Wilesmith: These were based on the attributes of the 2001 strains of FMD. From an economic point of view – 6 day better; from an epidemiology viewpoint, 13 days would have been better. Iain East: 6 days allows one to go to the weekly markets!! JW: no comment!

*Tom McGinn:* Testing of dangerous contacts to confirm infection – but only in May were dangerous contact (DC) sheep tested – but by the nature of a DC, many wouldn't even have developed antibodies by that stage.

*Nick Taylor:* Referred to a paper about the Scottish outbreak with late contiguous culling – none of the sheep showed clinical signs.

*Matthew Stone:* Discussing model fitting and contact patterns – InterSpread takes data up to the point that the simulation starts – how were modelers satisfying themselves that the fitting that was going on was valid?

*Laurie Gleeson:* In the UK, decision makers lost faith in their technical people. Will modelling help prevent this?

Dr John Wilesmith presented a talk on the political reality of model use in the 2001 outbreak. After the presentation, the following issues were raised.

A quote from Yogi Berra: “Predictions are very difficult; particularly when they are about the future”

*Graeme Garner:* When applying InterSpread in the different areas, were you using the same set of parameters? *JW:* Yes. The difficulty was defining the area. The model does OK with an uncontrolled epidemic but the ability to predict is reduced when controls are put in place.

*Comment from NZ.* Tension in the government – Chief Scientific Advisors. *JW:* some discussion of the situation. The CSA (Chief Scientific Advisor) was the head of the Office of Science and Technology and had direct contact with the Prime Minister.

*NZ-* Did the CSA have a defined role in the original contingency plan? *JW:* No.

Where did the 24/48 rule come in? *JW:* Don’t know – made up on the spot. Arbitrary. *JW* – where does the clock start? From finding it? From confirming it?

*Michel Jean:* Did the CSA become involved in the technical work. *JW:* Yes, he’s a chemist. He was remote. He didn’t take any advice from the Wilesmith camp. Rob Brennan: insert Murphy’s law into models. If something can go wrong, it will.

*Michel Jean:* Did the CSA lose his independence by getting involved in the technical work? *JW:* No, he listened to the science group but didn’t necessarily take their advice.

*Greg Flaherty:* COBR – do you think the CSA got foothold by lack of DEFRA input to COBR? *JW:* No. COBR is the emergency cabinet. Ministers can be called to book if they do not provide enough resources. *GF:* could DEFRA have come in more forcefully to prevent the railroading? *JW:* they tried to, but were not successful. It was hard to convince people that FMD was a serious matter, the ministers did not understand. Note that the importance of FMD to society was just not there in the public eye anymore.

*Greg Flaherty:* Is COBR chaired by a minister? *JW:* Yes, theoretically by the PM or the home office guy.

*Tony Callan:* Could you rank the public perception of the people involved in terms of trust? *JW:* the public was predominantly influenced by the press. Post-BSE, the press have portrayed to the public a massive cock-up. The public is anti-DEFRA and not too happy with the scientists, including the external scientists.

*Matthew Stone:* We heard this morning about the link between EpiMan and InterSpread – tell us about the databases and data capture mechanisms that were capturing data and providing input to IS. *JW:* telephone reports very important. Lots of information about suspects over phone. Field staff have to get everything confirmed by officers in HQ. Other routine data is the disease control system set up. Event recording system. Had loaded up demographic data – census data. Contains all the events – date of report, confirmation, slaughter etc. Then some bits of info from phone or paper that would supplement this. Eg checking out of clinical information. Putting into ‘Exotic

disease control system'. Now put on hold and starting again with new disease control system used everyday.

*Chris Bunn*: Ever seriously asked to consider if vaccine had been used what the results would be.

*JW*: Yes, looked at the vaccinations strategies as defined by the policy people. Also looked at Cumbria, Devon at the end of the epidemic when cattle were to be put out and might come into contact with sheep. Science group advised vaccination of all cattle without any modeling... did not happen, had been recommended without stakeholder consultation and the proposal was criticized by the farming community.

Another break-out session was held, looking at the topic: **Dealing with multiple models and modellers: lessons learned, pitfalls and communication issues**. A summary of the findings follows.

#### Group 1

- External modelers should be included in peace time or at least plans should be developed on how to use them/deal with them.
- Internal scientific advice is not the only advice that will be offered during an outbreak. Plan how to use/deal with external advice
- Terms of reference need to be established for scientific advisory groups – NZ already does this. They have already experienced conflict between departmental staff and external experts

#### Group 2

- Lessons reflect the pitfalls; communications are a critical part of a number of lessons.
- Identify stakeholders in advance.
- Establish a process by which we can feed the technical information to policy makers.
- Building on real outbreak experiences.
- Building credibility for scientific group with agricultural minister's office. Communication up the chain.
- Build peer review into the system. During the event, know what role of peer review group is and who they should be linked to.
- Role of spending time collaborating and validating and communicating outcomes of that to stakeholders.

#### Group 3

- 'Nature loves a vacuum' – if you are not out there speaking, other's will speak for you – once you've lost that power you'll never get it back. Proactive stakeholder engagement is a key feature – prevent vacuum developing.
- We need to engage stakeholders before the epidemic ever starts.
- We need to recognize the differences between different countries and their different animal systems.

#### Group 4

- We need to decide how to set up external advisors and how to set up rules of conduct for such groups.
- Realise the differences among countries when learning from other country's experiences.
- Be aware of world situation and mindset of public.

#### Group 5

- In the COBR equivalent – there's a hierarchy of ministries but have to be aware of where agriculture fits on pecking order – risk getting swamped.

#### Group 6

- Communication: show transparency. Modelling may not have been wrong but not well communicated. In addition, decision making is not always transparent

## Day 2, morning session

The second day began with a review of items from the previous day. Rob Brennan summed up some of the key findings and lessons learned

### 1. Stakeholders expectations:

Who are the stakeholders? What do they want?

- the magic answers
- large scale economic effects
- bioterrorism contingency plans
- control strategies (innovation)
- economic/social/ecological - political

### 2. Engage with stakeholders

- build credibility proactively
- one voice
- rebuild trust in scientists
- show effectively what models can do for policy decisions
- present story simply (cartoon)

### 3. Draw on outside opinions

- set up external advisory group
- understand power relationships – network
- develop stakeholder communication strategies – use professional communicators
- fill the vacuum

### 4. Manage the data

- gather in 'peace-time'

### 5. Use models in collaboration

- know the assumptions used – document
- know the specific purposes
- know the strengths and weaknesses
- QUADS models on same scenarios – validate
- For learning by doing
- For educating proactively – gaming
- Identify gaps

There were several additional comments:

*Matthew Stone:* We need to establish a Technical Group under QUADS; look to future and have a more cohesive integrated technical input developed in peace-time for wartime use. Building on this workshop. We need to aim for having all three models available with disease profiles and country models in a standard format.

*John Wilesmith:* Integration of epidemiological advice into policy is difficult. Don't expect too much from this - how do we make an impact on policy?

Day 2 proper then commenced with a session on verification and validation. Dr Sam Becket gave a presentation on introduction to verification and validation of simulation models. Several issues were raised in discussions:

*Matthew Stone:* Re- sensitivity analysis – how much should/do you vary the parameters during your sensitivity analysis? For Interspread – input parameters – wasn't until input parameters

changed a lot movement ones that model began fitting. SB: Systematically looked at all the input variables, and varied them by 10%, 20%, 30% up to 100% difference ie doubling them. We also varied the spread rate data. The parameters that you are intuitively worried about tend to be the key drivers.

*Robert Sanson:* So as a result of that, did you eliminate any parameters from the model? GG: No... Some found to be very important, and many are linked. Critical ones were time to detection and spread rate. SB: stratified the assessment of the sensitivities across resource rates with high and low resource levels.

*Robert Sanson:* You found that a really small number of iterations gave you a stable mean and median – how many? SB: 10- 50 and they yielded very symmetrical distributions.

Dr Mark Stevenson gave a presentation on validation of InterSpread Plus. A number of points were discussed;

*Matthew Stone:* Elegant piece of work to validate model outputs. Interested in work validating model input parameters used. Note that there was a lot of less-than-transparent model fitting going in. Now that there's a clean input data set, has there been any validation of those input parameters? MS: would be the subject of a good PhD!

*Dorothy Geale:* The approach of using the 7 April – was that the earliest you felt comfortable looking at the data and making predictions? 45 days post? MS: Yes. It wasn't until late March that we had a true indication of the proper distribution. John W: took quite a while to get the population data. DG: what confidence do you have in the status of the true positive and negatives? MS: well, they were listed as IPs or not in the database. DG: Were the positives confirmed by laboratory results. MS: No. DG Is there an optimal size for sub-regions? How small would the scale go – could the model be put out in the regional offices? JW/MS: would be difficult. MS: optimal size of consideration would depend on the nature of the epidemic. Particularly with the seeded epidemics. MS: would need to know how the input parameters varied between clusters. JW: we have modeled the clusters

*Peter Black:* the sub-regional models – the quality of the data might be quite variable – and amount of variation at a sub-regional level might be much higher. MS: Yes. JW: The focus was whether the model could be used for predictive vaccination (?)

*Caroline Dube:* Anyone looking at the UK data with InterSpread Plus? MS: More for that PhD! Iain East: Did you look at separately predicting new grid squares that had not had disease previously (incidence) as I suspects the sensitivity would be less for those. MS: Good question!

*Sam Beckett:* Have you looked at analyzing distance between points rather than just within a square?? Lot of work, admittedly. So looking at how close points are. JW: note that one of the questions was whether one could use the model for predictive vaccination. SB: When talking about choice of optimal size for models – is the size as relevant or the heterogeneity? That is, is it a homogenous area or area itself? MS: depends what you want to do – does it make sense to apply the same set of parameters to the area. GG: if you know in advance that things are very different across the country, then makes sense to parameterise/prepare in advance.

*Rob Floyd:* Opinion as to whether your model is suited for a spatial pattern of different sized properties? That is, can we compare performance on same scenario if they were not suited/developed for them. MS: On large farms, the disease may not leave the farm. GG: Models are likely to work better for the country in which they were developed.

*Robert Sanson:* Consider what is making up the heterogeneity – and if you have accommodated that in your parameterisation then maybe one set of parameters is OK and don't need sub-models.

Eg. If the production systems are different in different areas but you have coded for them, OK; but if one production system differs within itself markedly over the region and this is not accommodated, then would need sub-model/regional model. Is the heterogeneity due to different production types or different behaviours of farmers within the one production type?

*Peter Black:* Go back to when you were first comfortable making a prediction! We note that was 45 days – compare with likely situation here when politicians may want predictions after the first 2 or 3 days!! Draw attention of policy people to that! *JW:* The size and duration of the outbreak was predictable from March 12. *MS:* If you know the date of infection of the initial property and if the epidemiology data is good, the model should be able to work from that point.

Dr Caroline Dube then presented a talk on validation of the North American model. Discussion points raised were:

*Dorothy Geale:* Interested in the supercomputer/desktop differences – what sort of differences are you finding and what are the implications for desktop models? *Barbara Corso:* the models were set up differently and coded in different languages; it wasn't a difference between the computers per se. The supercomputer can handle bigger datasets and the PC version has a better interface. The new model will have the super-computer code behind the PC interface – speed is then the only difference.

*Mark Teachman:* I am not hearing that the appropriate professionals have been involved in model development for NZ (and Australian models?) ie computer programming experts to assist in development and verification. Be careful with this, for building credibility. Is the Uruguayan data proving useful? *Barbara Corso:* The studies have started and the data is good but so far not much progress has been made.

*Michel Jean:* Note that small differences in things like random number generators will cause differences in results and need to be understood, noted and explained to maintain credibility.

*John Wilesmith:* Quality assurance and quality control is well understood in other fields and should be developed and integrated into modeling.

*Caroline Inch:* Is there any assurance that people can't change the code? *Barbara Corso:* the executable program is distributed, not the code – so they can't change the code; but you could put anything in the model and make it say anything.

*Caroline Inch:* Think ahead to the issue of misuse of models.

*Caroline Dube:* Who are the users of the model – this should come out of this workshop?

*Dorothy Geale:* Can see the situation occurring where industry pays a consultant to input different assumptions and come up with the answers. *GG:* You can get whatever answer you want out of a model.

*Colin Holden:* we need to work in partnership with industry to avoid multiple users of the model producing different results.

*Sam Beckett:* Note that models are changing all the time. Their outputs are going to differ. Hard to make comparisons in a shifting field. *John Wilesmith:* Well, things are going to have to stop at certain points. That is, if are contracted to produce a model for policy decisions, should produce that, then stop. *Matthew Stone:* Are we talking about changes to the model or to the base data? *SB:* Very much the model. We need to have milestones with identifiable versions of the models eg Interspread and Interspread Plus

*Caroline Inch:* This group is solidifying what is needed for confidence building ... need to identify the operators.

Participants broke up into four groups to address the issue of **Generating joint confidence in models: presenting limitations and strengths of models to decision makers**. The four groups were modellers/technical (two groups) , policy group, and an interface group (bridging the two). The groups were asked to identify action plans. The findings of the four groups are summarised below:

Technical group 1:

Identification of the limits and strengths of models

- Role of internal peer review
- Quality control issues
- Publishing of results of models – important for credibility but issues of intellectual property

What do policy makers want?

- Requirements seem to change!
- Key requirements:
  - How long will epidemic last (present options)
  - What resources necessary
  - What cost (role of economic models)
  - Political fallout/other important implications
  - Trust in advisor/robust process/sure of consultation
- Also for continual review of biosecurity/contingency plans

Presenting limits and strengths to decision makers:

- Outputs need to be contextualised, interpreted and analysed
- Need to be filtered to ensure correct emphasis placed on outputs
- If put in broad terms much more likely that recommendations (advice) taken up
- Analyst role also important in preparedness plans

<b>What</b>	<b>By Whom</b>	<b>When</b>
Publish journal	Model makers	As appropriate
Validate models on common datasets	“	“
Independent review of software	Independent experts	“
Ask policy people what they want	Model makers	NZ – next week (Operation Taurus)
Formulate models for their needs		
Include them in training	Departments	
Role of interface analysts Involved in practical exercises Contextualising	Interface Analyst	
Careful use of language	Interface analyst	Communicative outputs
Summarise uncertainty		
Illustrate worst case scenario		

Technical group 2:

How to communicate the objectives/scope of models to policy/decision makers:

<b>What</b>	<b>By Whom</b>	<b>When</b>
Workshop for policy makers (wargames)	Technical	Peace time
Be clear with objectives of modeling	Technical/policy	Peace time
Be clear on benchmarks (by what criteria are relative worth of intervention strategies being judged) –how best to compare scenarios	Technical/policy	Peace time
Increase number of people familiar with the operation of the models	Technical/policy	Peace time
Increase access to models by policy makers		
Better understand policy makers needs		
Report of this workshop		

In summary – local strategies, maybe not one size fits all for the QUADS

Interface group

<b>What</b>	<b>By Whom</b>	<b>When</b>
DESIGN DOCUMENT Documents purpose of the model, includes quality control as well	Technical team lead Country specific	6 months 01/09/05
Guideline doc for how model is used - must produce options	Collaboration Policy interface people lead this with technical input	01/03/06
Market survey ○ Public perception ○ Risk communication (to get a better picture for the spin doctors of misconceptions arising from use of language)	Contractors in each country	
Lexicon Technical – policy + common language (market survey)	Coordinate P Technical lead	01/03/06
Business plan (forces you to justify investment in model) Resources/skill set	Country specific	01/09/05
Steering committee formation	This group	Now

## Policy Group

What	By Whom	When
Clear information on what policy-makers need <ul style="list-style-type: none"> <li>○ Multidisciplinary</li> <li>○ Multiple information streams</li> </ul> Forum	Policy	Before models are built (ideal) then ongoing
Quality control on our sources of advice	Policy-direct Modellers – determine codes, peer review	Ongoing
Technical people need a broad understanding of policy process and where science advice input sits	Policy science advisors	Early!
“STEEP” (science, technical, economic, environmental, policy) How we integrate streams of advice	Collective discussion multidiscipline led by	Early
Concept of ‘centres’ <ul style="list-style-type: none"> <li>○ Virtual/physical – to be seen to bring in outside advice (part of quality assurance)</li> <li>○ Models are tools; knowledge base of the groups is important to giving good advice, whether they model or not.</li> <li>○ Multidisciplinary <ul style="list-style-type: none"> <li>○ Mathematical</li> <li>○ Ecologist</li> <li>○ Sociologists</li> <li>○ Epidemiologists</li> </ul> </li> </ul> Consult outside advice to show effective engagement	Government (collectively or individually) Integrating mechanism	2-5 years  soon
Understanding of ‘completeness’ When cost exceeds benefit Ongoing refinement	Mutual informing community	0-2 years
Need to prioritise order of questions to ask “streams of advice” experts Model is a form of advice		

## Day 2, afternoon session

The afternoon session contained a number of presentations about FMD policy development and its drivers in the QUADS countries. The session began with Dr Chris Bunn presenting Australian strategy in policy development. A point of clarification was raised:

*Matthew Stone:* On federal/state issue, aren't state CVOs part of CCEAD, so isn't it a matter of establishing combined accountability?

CB: Yes, but it's an advisory body. Occasionally one CVO will deviate from agreed plan or not agree. The States/Territories implement the decisions on the ground so they have the power in reality.

Dr Dorothy Geale then presented the New Zealand strategy in policy development. Points raised in discussion included:

*Caroline Inch:* you want 4 things done in advance so that things can go ahead immediately in an outbreak situation? DG/MS: it's not that no questions will be asked, it is just to speed up the making of some of these important decisions by getting some preparation done in advance. For example, having cabinet papers pre-prepared. It's a process of creating prior awareness and preparations to pre-empt the decision making process. CH: Implementation requires money so preparedness will speed the decision and the allocation of money.

*Chris Bunn:* Is a standstill affected by animal welfare considerations? CB: In a standstill, everything is prohibited unless it is permitted. Eg at distant locations, movement to slaughter is OK. CI: will the decision to vaccinate be made ahead of time? DG: the decision criteria will be in place ahead of time. Comments made on national standstill issue: not that this means that everything is prohibited unless it is specifically permitted. GG: made point that movement standstill in Australia involves thousands of animals in transit on trucks – need policy developed for them. CI: In the AI incident, general permits allowed some movements. CB: note too that people could waste lots of time away from the epicentre writing permits far away without adding value to anything and simply tying up personnel.

*Susan Keenan:* Movement controls impose blanket restrictions but specific actions are on a premise by premise basis.

*Rob Brennan:* Clarification on prepared cabinet decisions: does this not also impose the requirement to refresh and re-engage them so that it is retained in corporate memory. Notes that things change.

*Colin Holden:* Policy requirements also change and now there is a need to incorporate environmental, social and cultural implications.

Drs Giles Dulac (Canada) and Larry Granger (USA) jointly presented the North American strategy in policy development. The following issues were raised in discussion:

*Michel Jean:* Serological testing – are there agreed standards? LG: not for the non-structural protein tests yet at this stage. JW: 3 tests (all commercial tests) have been validated to some extent by Pirbright; dossiers have gone up to the OIE and probably won't be long before at least one validated. Laurie Gleeson: One of them has been validated and is up for acceptance this May. The dossier has been approved.

*Rob Keogh:* The expectation of there being a 'correct decision' is a problem. Peter Black: discussed this morning. RK: To do nothing is also a decision.

*Dorothy Geale:* Re- Vaccine Banks: Does NA recognize the VMD as does NZ? JW: Using the vaccines effectively off-label may have influence on international trade. If not licensed in traditional way, there might be some fallout e.g. using a non-registered product may limit markets. GD: this must be considered by Canada.

*Laurie Gleeson:* Explained UK situation a little further. JW: Noted that there had been no preparation about what would happen to the products. Lots of reaction from farmer's unions.

*Rob Keogh:* Australia's situation – has there been a policy decision about the importation and use of the vaccine we own? Rules about its use and which State would get the vaccine are undecided. Could we get them through customs safely? GG: At least we have NRA approval.

*Matthew Stone:* What's the status of the North American vaccine bank with respect to non-structural proteins? GD: this has been considered – the post-1999 vaccine is much better, much

less NSP as contaminant and things to continue to improve so will have less chance of producing antibodies to NSPs. The post-2005 vaccine will be a further improvement with even less NSPs.

*Matthew Stone:* Is it part of the strategy for the NAVB to source a supply of test kits or is that separate from the vaccine bank? GD: Right now it is separate. Mark Teachman: supply of test kits has to be built in to future planning

*Rob Floyd:* Has there been consideration of need for a better vaccine? MT: yes research going on. (Not sure of status of projects going on.) GD: Not going to be anything new available in the next 5 years. MT: one possibility is using off-the-shelf vaccine to augment an immune response – database being built and thoughts of approvals. RT: Issues such as a better vaccine and combination with anti-viral drugs are under consideration for the next five year contract.

*Graeme Garner:* What is capacity and how would it be allocated across border? GD/MT: there is a protocol in place, supposedly risk-based, in reality maybe country-based and negotiable.

*Dorothy Geale:* Comment on division of vaccine bank. Protocol rewritten after tri-partite and revised last year. Although there is a protocol, the CVOs don't necessarily follow it in the exercises. The delivery system maybe JW will tell more tomorrow about UKs experience. Maybe we should be looking at each other rather than outside off-the-shelf supply of vaccines

Dr Michel Jean (Canada) then made a presentation on Environmental applications of meteorology: from atmospheric tracers to FMD. Discussion issues are summarised below.

*Graeme Garner:* Comment; general agreement – one of the biggest problems is the weakness of the underlying data – based on few studies with very few animals. The biggest problem is the exposure risk data with the data on the impact of animals being exposed to certain concentrations of virus being based on very few animals and calves rather than cattle. MJ: Noted also that much of the relative humidity data has been questioned. But suggests go with worst case scenario. GG: that's not always helpful when a country has limited resources.

*Robert Sanson:* How far back do records go... MJ: long way

*Andre van Halderen:* Mentioned that wind still days mess up the meteorological models; what is the impact of that when get windy days afterwards i.e. build-up of particles?? MJ: Actually seldom happens, but does sometimes particularly with averaging. Now strategy is to build up particles then transport them when wind starts up again. Lots of research going on. What happens with the virus that is produced in wind still days – does it settle and so not available for dispersion. MJ: On microenvironment – wind is NEVER still, so not as simple as particles dropping to the ground. The Danish model sets wind to 0.5 km/h if the wind is actually still.

*Graeme Garner:* Do models take into account local topography? MJ: Yes; 1km especially in Canada.

*Dorothy Geale:* Queried the comment GG had made with respect to risk/exposure data and viral production etc – JH: There are only 2 keynote papers and the data is questionable. It was designed to determine the minimum infectious dose and provides little information to base sophisticated modeling on. JW: John Gloucester at Pirbright is revisiting this data. It looks as though there was wind-based spread in the UK in 2001. GG: Use of this published data involves heroic assumptions.

*Rob Brennan:* What would happen if you all did not do what you do i.e. no modeling. MN: Life would go on. Decisions still have to be made. We would get the necessary information from different sources.

*Rob Brennan:* General comment: Why are we doing modelling?

*Comments from participants:* For efficiency; to aggregate information in a useful way; to advance the methods of epidemiology and knowledge; to manage disease; to protect the economy/avoid trade barriers; to feed the planet; to maintain our lifestyle/human health; to maintain disease status; to advance our future; it's a research tool to advance knowledge and come up with better ways to address a problem. From the Homeland Security viewpoint, modeling can be adapted to other problems such as the protection of critical infrastructure.

The final session of the day looked at **Key drivers for choosing a control strategy**. The following drivers were identified:

1. Public perception
2. Economics
3. Stakeholders expectations/interests/acceptability to
4. Social values - disruption, heritage
5. Resource limitations/uses/management/requirements/capacity
6. Technological options/tools/availability/knowledge
7. Disease outbreak/world situation
8. Destruction methods
9. Disease type/biology/strain
10. Animal welfare
11. Disposal limitations/efficiency of method to destroy agent/legalities
12. Efficacy - will it work
13. Length of outbreak – possible/predicted length, existing length since started, the foreign trade
14. Geographical area – size/extent and location; possible/actual
15. Trade restrictions – local and international
16. Demography population at risk, density, farm types, wildlife
17. Politics
18. Environmental impacts
19. History/tradition
20. Cause/source
21. Capacity/resources

A 'brainstorming' approach was used to group or lump issues together. Some common themes were identified for discussion the next day.

### **Day 3, Morning session**

Day 3 began with a review of the previous day's findings by Rob Brennan. He identified that there appear to be two major themes emerging – validating models and growing joint confidence. The results from the brainstorming the key drivers for controlling strategies could be grouped into the following "lumps" using the 'STEEP' analysis style. We have added an 'A' for issues specific to the agent.

- Social
- Technical
- Environmental
- Economic
- Political
- Agent

A vote was taken on which issues people believed were important with each participant being allowed to rank each issue with a score of 0, 1 or 2.

Agent	23
Social	28
Political	19
Technical	27
Economic	33
Environmental	18

Several questions were posed:

**What can we do in our disciplines to contribute to the most important drivers?  
Review of objectives and progress – what have we not addressed?**

There was group discussion of these issues with the following comments made:

We still need to link the model outputs to the economic cost of control options. There is also a need to link to social models.

*Caroline Inch:* When should we start to use the models and stop trying to improve them?

*Larry Granger:* Model is a part of the decision support system not all of it – we need to better understand the role of the model – I need to know what are my options and when do the available options change.

*Chris Bunn:* We need to include some social input into the model.

*Tom McGinn:* We are talking about trigger points, how do we set them up and how will it benefit global control of FMD? In emergencies, most people are waiting for the emergency to pass and then clean up. This doesn't work with contagious disease, we need to educate people on how to make those decisions.

*Rob Floyd:* Modellers believe that their models will be used by policy makers because the models are good and therefore continually improve them. Perhaps we can better ensure adoption of models by improving the relationship with policy makers.

*Rob Keogh:* Decision makers are always making decisions – the normal state is disease freedom. If models are for use in emergencies only, decision makers will be unfamiliar and will be less likely to use them. Can we make models relevant in peace time – prioritise biosecurity issues etc?

*Dorothy Geale:* Gaming is a special form of simulation – decision makers have little time and patience – we need to use models more holistically

*Mark Teachman:* Models are still developmental, but we need to look at models and tease out what is important and what is not – simplify the model.

*Graeme Garner:* Models are not the product. It is the outputs of modeling. We should be influencing decisions. We need to start using them not just developing them.

*Caroline Inch:* Yes, but we also need a different set of skills, training for the interface group and closer relationship to the policy people

*Susan Keenan:* We also need to engage all stakeholders including industry

Rob Brennan summarised the emerging values as he saw them:

- Collaboration
- Stakeholder engagement
- Multidisciplinary
- Proactivity using the calms between the storms
- Cohesion – develop common message

The morning session proper then began with a presentation from New Zealand on uncertainty in decision-making in the early stages of an epidemic. Issues that were raised in subsequent discussion included:

*Nick Taylor:* Comment: The notion that can't really have idea of what's going on until at least week 3 is an extremely important message. There can't be really solid decision support until data has started rolling in. Awareness of the timeline important. We need to damp down the expectations until the data is available and this is best done in advance of the epidemic.

*Caroline Inch:* Sees in previous NZ presentations an effort to predict a number of farms and where in the modeling presented early – but that's not what is seen in this presentation. MS: This presentation was less about what would do with model outputs and more about organizing the process for data collection to inform the model.

*Michel Jean:* Clarify statement on slide 26 – 'know capacity in non-political terms' MS: maybe specific to NZ context – standing capacity delivered in outsourced forms – contracts with outsourced agencies. Some capacity within MAF, but the rest is within a contracting model. Poses some limitations. MJ: must be some way to overcome all that and fix the problem later MS: overcome all what? MJ: the contracting business.

*Dorothy Geale:* Have contracted with supplier to have enough resources to supply an outbreak of 25 properties the first week /10 next week /10 week after – but have to consider what to do if need more

*Mike Nunn:* A very powerful paper – very important message to modelers and decision-makers that it will take time to get sufficient data to feed the models. In the interim during those first five weeks, we need a library of scenarios to help guide decisions.

*Rob Brennan:* Very important to guide the decision makers with tools other than modeling in those early weeks.

*Dorothy Geale:* Surveillance effectiveness measure p. 19: how realistic is this prediction that official surveillance will find 85% of cases before public reporting, if you have a good communications program – the reporting by animal owners might be expected to be the major source. MS: Might be a high target, but if the incubation period is 5 – 7 days, that gives us the opportunity to find these places and bring them into the system before producing virus – during the incubation period. Clearly competition between effectiveness of public awareness strategies and the surveillance processes. DG: you are putting high amount of resources into the surveillance instead of focusing on public which is not resource intensive.

*Chris Bunn:* What of the less-than-ideal outbreak? As a manager you'll be looking for where the outlying factors are and how they are getting away from you. Managers want to know what the limiting factors in the response are. Anything that helps identify this is good – this timeline helps that process.

*Andre van Halderen:* What is your payoff, what is the bottom line? MS: The bottom line is economic – the time to regaining disease freedom status. Cost of the response is only a tiny cost of the outbreak!

*Rob Keogh:* Struggled to understand how you could measure efficiency before you measure effectiveness? Terminology perhaps? Is efficiency here the implementation of control actions and effectiveness perhaps how well they work? MS: Yes. We might not have the terminology right for our stakeholders.

*Susan Keenan:* NZ has such a small group – looks at multiple disciplines, multiple issues. When looking at a process, one quickly looks at how that affects other policies and activities.

*Larry Granger:* Can we send people to the farm to detect illness earlier than the farmer could, seeing them all day long? If this is visual detection? On the other hand, if these people have tools to detect disease pre-clinical, then could see the utility. Otherwise, how could they be better at detecting disease? RS: Comment on that, it is not a competition thing. Issue is – is the farm under movement control. Is it in the system, do we know about it. The issue is not who does the diagnosis. Is the system on top of things?

*Barbara Corso:* Do we know enough epidemiologically about the situation to be able to say who should be looked at? JW: one of the key issues was the need for a cow-side PCR test. One gets worried about teams turning up, saying that animals are negative – what does that do to farmer awareness once cows declared OK, when perhaps they are incubating?

*Tom McGinn:* What movement control mechanisms are there? How do you communicate with the farmers in the area? MS: have agreement with the police to use national media services. Also direct approach – stakeholder networks to disseminate information. MS: national farms database supports that approach as well.

*Tom McGinn:* How do you communicate with farms in the area? MS: Police, media services, radio, TV, stakeholder networks. TM: We have all the FAX, phone and Email contact details for farmers in a particular area recorded so that we can contact them rapidly.

Peter Black (Australia) then gave a presentation on other epidemiological tools that can be used to assist decision-making, particularly in the early stages. Issues raised in subsequent discussions included:

*John Wilesmith:* The DCP/IP ratio should improve as the epidemic progresses but you might find it rises at the end due to resource availability as the number of IPs goes down

*Iain East:* Measure of EDR – need the first couple of points – so CAN'T use it in the first couple of days – 4 to 5 weeks.

*John Wilesmith:* Mathematicians do not like EDR – they like  $R_0$ . PB: it's easy to measure and understand...GG: Note that EDR is very dependant on efficacy of diagnosis and reporting system.

John Wilesmith (UK) gave a presentation on Current and future role or uses of models in the UK. A copy of the presentation is attached. Issues raised in discussions included:

*Dorothy Geale:* Does this imply that the Science Advisory Council does not speak directly to the Minister/s? JW: Not really – more bits to the diagram that is shown

*Matthew Stone:* The national FMD experts group – the makeup of that group – an EU requirement – but DEFRA people/body? JW: It's not an EU body. At the moment we've said that we won't have people from other member states sitting in there, although we will draw on them. So at the moment, formal group makeup is DEFRA and agencies plus those outside modelers.

*Paul Holden:* It's a very technical looking group. Where do the more social type things fit in, and economics. *JW:* Economics slot in various places including Animal Disease Policy Group that also includes a lawyer.

*Graeme Garner:* Is EXODIS a spatial simulation model? *JW:* yes it is. *GG:* Duplication of InterSpread? *JW:* Indeed, but it has a resource allocation module

*Dorothy Geale:* A question about vaccination teams. *JW:* AI people, an offshoot of the old milk marketing board has the contract for vaccination (makes sense as most of their staff will be laid off in wartime). Teams of 3, 50 to be on hand at outbreak of war. 1 vet, 2 vaccinators; trained. So it's an external contract. *DG:* how about movement tracking etc *JW:* team responsible for clinical examination, vaccination, tracking, data entry – onto a separate database.

*Matthew Stone:* Interested that the team would be from people who would be otherwise inactive during wartime. In NZ, the artificial insemination would be prioritized to be allowed to proceed as much as possible. *JW:* Well, the AI guys would be 'active' on a risk assessment basis.

*Larry Granger:* Query re- animal movement and licensing system. Isn't there a law in Britain that all animal movement needs to be under government control but this is waived under peace-time conditions? *JW:* DEFRA is responsible for local enactment of law and local bodies responsible for enforcing it e.g. the 6 day standstill. If an incursion of FMD, there is legislation to put immediate movement ban on, enforced by local authorities. NB in England and Wales if you buy an animal, have to wait the 6 days before can buy another. *LG:* How can this be enforced, as this would be a nightmare for the US. How? *JW:* Well that's the local guys' problems! Lots of publicity, so everyone knows. The local mayor is deputized to sign permits. The DEFRA people are not the enforcers. The police will stop all animal traffic.

*Chris Bunn:* With the Hendra incident, we had a national standstill for horses. People will comply if there is a sound reason. Enforcement is a small matter.

*Rob Brennan:* What happens to animals in saleyards or on trucks? *JW:* can't quite remember – maybe sent home or slaughtered. *PB:* in Australia, the details of what happens with standstills are being worked on. *CB:* estimates that 80-90% people ready to cooperate if they can see it is done for a sound reason.

*Rob Keogh:* the intention in Australia is that if the animal is in transit but hasn't arrived, it could be returned. If it's mixed with other animals, it wouldn't go back home; but would go to slaughter. (*GG:* maybe not thought through enough).

### Third day, afternoon session

After lunch participants broke up into groups to consider **who, when and how to use simulation models, how results should be communicated, and the interaction between modellers, decision-makers and policy people** was discussed. The results from the discussion groups are summarised below.

What	By whom	When
<b>Group A</b>		
<b>1. During Peacetime - Epidemiologists can:</b>		
Provision of data to inform trigger points	Recognised Center or network; some approaches will be country-specific	On-going
Risk profiling		
Evaluate different control options under different conditions		
Contribute to formalisation of links/lines of communication		

Provide input to resource allocation decisions	Within countries	On-going
Identify and prioritise key information to be tracked and measures of efficiencies and effectiveness	Review NZ performance indicators – all countries Identify suite of performance measures for each country to select	By end of year
Build up job cards to allocate work load to non-epi people Handbook or Guidelines Put weighting into building up relationships EXERCISE! Put program in front of QUADS	Country specific  QUADS umbrella network Singly/together/video conferencing	Revision – NZ, Australia Starts now On-going
<b>2. During storm, epidemiologists can:</b> Provide analysis of field information and condense to - What are today’s limiting factors - What can we do to address them  “standard sitrep” to meet end-users needs	Field – EPIs - policy	Input into reporting frameworks During calm Daily during outbreak
<b>3. What we need:</b> To build credibility of models Wider application Increased communication (threats, consequences, understanding) Building information bases – richness, accuracy, precision		
<b>Group B</b> Within country: Identify people involved in policy-making and decision making and engage them with communication at all levels.  Run a series of exercises to illustrate capabilities (range of exercises from desk top to large scale simulation). Communication with stakeholders will be facilitated by exercise Invite other countries to share experience  Horizon scanning – to provide information to policymakers and decision makers in response to outbreaks in other countries (extra work of no value??) Early warning system to stimulate sharpening of defenses plus allocation of resources Series of scenario runs - banks; insights gained from these rather than the outputs that informs. Helps get feedback from policymakers as to what is needed. Need to share information within scenario banks between QUADS countries. People who design exercises should share their experiences about what works and what doesn’t. Simulation exercises don’t have to be huge. Spontaneity! <i>Brief CVOs; Agenda item for OIE meeting</i> <i>Endorse recommendations from this meeting</i> <i>(wiiift???)</i>	QUADS Emergency Group informs CVOs who ensure that approach permeates through all levels        Epidemiologists	Ongoing        Australia has a program of exercises with a large exercise scheduled biannually On-going
<b>Group D ( How to collaborate in the future)</b>		

Improve relevance, credibility and acceptance of modeling and its outputs with policymakers		
Apply modeling to: Biosecurity planning Resource deployment	Policy and technical (technical lead)	On-going
Disease response preparedness Emergency respons Cost and cost/benefits	Modelling sub-group of QERWG	October 05
Need to standardize: Dat sets Data file format Scenarios	Modelling sub-group of QERWG	Work program by June 06
Need to establish a collection of epidemics (data from?) for FMD, AI and other diseases	Sub-group and beyond QUADS	Work program start in June 06
Work as QUADS to leverage status of modeling within OIE to gain international acceptance similar to that gained by surveillance and risk assessment in recent years.	Sub-group to CVOs	Next OIE meeting
Need to share methodologies and data sources for background risk studies. We need to recognize the limits on quality and sensitivity of the data	Subgroup	
We need to engage with other established networks e.g. Meteorological, human medicine and economists. (Engage economists at ISVEE 2006)	All Michel Jean	On-going
Develop linkages between Ag/Vet interests and homeland security interests. Consider Ag as part of critical infrastructure.	All Rob Floyd Tom McGinn	On-going 12 Months
<b>Group C</b>		
Develop a formal link with the UK	John Wilesmith CVOs	
Develop links with other modelers (within each country there will be issues of how to identify these, how they are managed during an outbreak etc)		
We need to develop collaborations between the modelers at this meeting	Caroline, Graeme	
- need to develop a scenario bank ideally with the four countries working similarly to set up a similar core.		
We need to compare the performance of the three models (this needs to be organized and QUADS support sought)		
We need to establish standards for data collection and parameters so there is consistency between the three modeling systems.		
We need to determine what sort of output is presented to decision makers		
We need to build links with economists		
We need to collaborate on work with AI and other diseases to avoid duplication (FAO/WHO/OIE)		

## 5. **Summary of the outcomes**

The workshop was rated highly successful by all participants. Early in the meeting it became clear that different skill-sets are required to incorporate modelling into disease policy. These are technical, policy and an interface group linking the two. There was enhanced understanding of the respective roles of the three different groups involved in policy development for animal health emergency management.

The participants were presented with a description of the current situation in each of the QUADS' countries with regards to modelling for animal health emergency management and policy. The participants then explored lessons learned from the UK and devised strategies for the practical use of modelling and other analytical tools used by epidemiologists to advise policy makers. Key outcomes were identified and an action plan to address these outcomes was developed. These will be presented to the QUADS CVOs for acceptance and approval for endorsement at a mini-Quads meeting in Paris in May 2005.

### Summary of discussions

The objectives that the group worked to during the workshop are shown in Appendix 1. These objectives were slightly modified from the original objectives given out prior to the workshop, to better reflect activities once all participants had the opportunity to comment on them.

A range of presentations were made covering:

- the individual models being developed by member countries
- experience and lessons learned in the UK
- validation and verification of models
- uncertainty in decision-making
- the use of other epidemiological tools during outbreaks.

The workshop also included a number of discussion sessions targeting:

- key policy questions
- lessons learned from the UK including communication issues
- generating confidence in models
- identifying key drivers for FMD policy development
- future collaboration on developing and using epidemiological tools and models

### Key outcomes

The participants of the QUADS modelling workshop acknowledged the importance of:

1. building trust by proactively engaging with all stakeholders and organisations that will use or make use of disease simulation and economic impact models
2. using a range of epidemiological tools (including models) to provide decision-makers with useful insights
  - a. in planning and preparing for exotic disease events
  - b. in managing and debriefing exotic disease incidents
3. collaborating to share information, approaches and undertake joint validation studies.
4. using economic analysis in decision-making. Outputs from epidemiological models can be inputs to these economic analyses.

To meet these key outcomes, an action plan was developed, to be implemented over the next few years, involving both the Quadrilateral Emergency Management Working Group (QEMWG -- Table 1) and a proposed new subgroup (the EpiTeam). Essential to achieving these outcomes is the formation of the EpiTeam as a subgroup of QEMWG, with membership expanded to include Ireland and the United Kingdom, who are signatories to the International Animal Health Emergency Reserve (IAHER).

The action plan is given below. Key items that would be undertaken by the EpiTeam subgroup are also listed in Appendix 2. However, a comprehensive draft work programme is a deliverable under item 4 of the proposed action plan, to be delivered by November 2005 at the mini-Quad meeting held in conjunction with USAHA in the US.

### Action Plan

<b>Item</b>	<b>What</b>	<b>By when</b>
<b>Steering Group (Completion of 2004-05 work program)</b>		
1.	Draft executive summary of workshop	May 2005
2.	Present the executive summary of workshop to the CVOs at the mini-QUADS at OIE with proposal to form subgroup QEMWG (EpiTeam) with recommended inclusion of UK and Ireland (IAHER)	May 2005
3.	Draft report of Workshop	July 2005
4.	Prepare: <ul style="list-style-type: none"> <li>• EpiTeam subgroup's Terms of Reference (ToR) <ul style="list-style-type: none"> <li>• Purpose</li> <li>• Members</li> <li>• Areas of activity</li> <li>• <i>Modus operandi</i></li> </ul> </li> <li>• EpiTeam draft workplan (identified tasks are attached in Appendix 2)</li> </ul> First draft of ToR and workplan by USAHA 2005	Within 30 days of approval by CVOs  Nov 2005
<b>SG/EpiTeam Subgroup</b>		
5.	Collaborate on validation of epidemiological models: <ul style="list-style-type: none"> <li>• Share common datasets and approaches</li> <li>• Present results at QUADS 2006</li> </ul>	March 2006
<b>QEMWG (as part of 2005-06 work program)</b>		
6.	QEMWG work program activities identified: <ol style="list-style-type: none"> <li>1. Develop disease management exercises program <ul style="list-style-type: none"> <li>• Designers share insights and methods used in developing exercises</li> <li>• Investigate ways to exercise models or the use of models through such techniques as "gaming" (this is a technique used by some exercise developers and is very prevalent in the military) or other methods.</li> </ul> </li> <li>2. Building relations with policy people</li> <li>3. Raise awareness <ul style="list-style-type: none"> <li>• share ideas and approaches</li> <li>• identify stakeholders</li> </ul> </li> <li>4. Develop/promote "interface skills"</li> <li>5. Succession planning for modelling skills <ul style="list-style-type: none"> <li>• Build in-country capacity</li> </ul> </li> <li>6. Building relations with other disciplines involved in modelling to</li> </ol>	05-07

Item	What	By when
	promote a multidisciplinary approach e.g.: <ul style="list-style-type: none"> <li>• meteorology</li> <li>• economics</li> <li>• public health</li> <li>• defence</li> <li>• specific agricultural industries</li> </ul> 7. Marketing analysis associated with public acceptance of modelling	
7.	Strengthen international modelling capacity through training courses provided by OIE Collaborating Centre on Animal Disease Surveillance and Risk Analysis (CEAH) Draft curriculum, to be discussed at QUADS training workshop (March 2006)	30 days after approval by CVOs
<b>QUAD CVOs</b>		
8.	Recommend to OIE <ul style="list-style-type: none"> <li>• the establishment of a virtual OIE Collaborating Centre on epidemiological modelling</li> <li>• Special edition of OIE Scientific and Technical Review on application of modelling to support animal health emergency disease management</li> <li>• Code chapter on guidelines for the use of disease models in animal health emergency disease management</li> </ul>	06-07

Workshop Objectives (as modified during the workshop)

1. To understand the purpose and scope of models being developed by the QUADS countries.
2. To determine the current status of FMD policy in the QUADS countries and the UK.
3. To determine how, when, where and why disease models should be used.
4. To identify how the QUADS models can support policy development in:
  - Making decisions about disease management
  - Understanding trigger points where options for control will change
5. To develop an action plan to progress implementation of modelling in policy development.
6. To establish a process for:
  - Updating QUADS member countries
  - Identifying opportunities for information exchange and future collaboration
  - Exchanging expertise during an outbreak