

AVTRW

## Model debate at the AVTRW congress

**Field epidemiology versus theoretical epidemiology . . . Measurement versus prediction . . . The veterinary profession versus mathematical modellers . . . A culture clash or a communication problem?**

**The opening debate of this year's AVTRW conference, held in Scarborough in the week before Easter, highlighted some of the contentious issues that have arisen around the use of mathematical modelling for the purposes of disease control, particularly since the foot-and-mouth disease epidemic in 2001. However, the value of modelling to veterinary science was also emphasised, and the profession warned not to dismiss models out of hand.**

WHY do people with quantitative training – say in mathematics or physics – have a role in veterinary epidemiology? This was the question addressed by Dr Rowland Kao, from the University of Oxford, who pointed out that it was generally agreed that, to control disease, a situation had to be understood at the population level.

Mathematical concepts could be used to express the complex dynamics of a population, but these then needed to be translated into ideas that were familiar to veterinarians. 'How do you translate mathematical principles into something that is useful to people practising veterinary epidemiology in the field? Do you know the language? You need people with mathematical training to translate mathematical concepts into something that veterinarians are familiar with,' he said.

Surely, he argued, it was better to have someone with mathematical training doing the translation, as they would be aware of the assumptions that lay behind a concept, rather than someone who had no such training, who was simply trying to produce something that was 'veterinary epidemiology friendly'.

'Complex dynamics can be expressed as simple ideas, but there are always assumptions that you have to be aware of,' he said. 'It's not about supremacy, it's about people getting the best out of what each discipline has to offer.'

### So what's the difference?

What is field epidemiology and how does it differ from theoretical modelling? Well, said Mr Alasdair Cook from the Veterinary Laboratories Agency (VLA), put simply, it's epidemiology in a field! It's surveillance, targeted surveys measuring what is known, and scanning, for example, of clinical submissions to the VLA's regional laboratories, to detect the unknown.

Field epidemiology tried to answer questions – the where, the what, the when, the why and the how. An easy



**Professor Alun Williams, the AVTRW president, introduces the modelling debate that helped get congress off to a lively start**

distinction to make between field epidemiology and theoretical modelling was to view epidemiologists as peo-

ple who measured what was going on within a system, while modellers tried to predict what might happen within the system if something was changed.

Nonetheless, theoretical modelling offered advantages to field epidemiology, he said. It provided the opportunity to enhance the value of the hard work put in in the field. Adding a modelling component to a field survey added value, he suggested, and allowed some 'What if?' questions to be considered, such as: 'What if we did manage to reduce the prevalence of infection on farms – would it really bring any benefits in its wake or not, and what might it cost?' Modelling and field epidemiology should, he said, be considered as complementary to one another, not in conflict.

### Why do conflicts arise?

'If there is a conflict – and I'm not sure to what extent there is a real conflict – then it often comes from miscommunication and different cultures. The people doing the modelling are very different from the people who are either using the modelling or interpreting it. And that difference begins in training.'

So said Professor Graham Medley of the University of Warwick, who suggested that theoretical modellers were interested in patterns and generalities and laws – they were trained to look for patterns at a population level. Clinicians, on the other hand, were interested in individual outcomes – they were trained in the diagnosis of individuals rather than control at the population level. A conflict inherent



**Speakers in the modelling debate: (from left) Mr Alasdair Cook and Dr James Wood, who discussed the value of field epidemiology, and Professor Graham Medley and Dr Rowland Kao, who made the case for theoretical epidemiological techniques. Despite this being a potentially contentious issue, there was in reality a great deal of agreement between all four speakers**

in infectious disease control was that between what was best for the individual and what was best for the population as a whole. Infectious disease control necessarily had to have a population perspective; the health status of

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an individual was dependent on the health status of the population – and at a population level, animals were economic entities not individuals.

The use of models in determining policies for controlling foot-and-mouth disease (FMD) in 2001 had generated a great deal of controversy. Professor Medley suggested that some of the complications were due to the fact that, from a modelling perspective, the constraints were very unclear. 'What was the aim of the eradication programme?' he asked, adding, 'It was to eradicate, but what? Within the shortest possible time frame? At the least cost, or by killing the least number of animals, or clearing the least number of farms? It was never clear what the aims of the control programme were.'

'We all have mental constructs of the way the world works – and those are models,' he said. 'We walk around with models in our heads all the time. You cannot claim that modelling is not a valuable thing to do, because we all do it. What we don't all do is quantitative modelling, where we put the numbers in.' Models were essential means to understanding data, but were tools to be used in conjunction with other techniques. 'Any conflicts that there are are generated largely by the training and the language . . . and the fact that infectious diseases have within them an inherent conflict of individual versus population. Anytime where disagreements arise, it usually means that the two protagonists – or at least one group – feel that there is a misbalance of power, or distrust, that has developed somewhere. I think this is where the conflicts come, rather than the scientific aspect. The interdisciplinary use of models is actually beneficial to understanding the subject.'

#### **Barriers to progress?**

'Obviously, the roots of why we're having this discussion lie in 2001,' said

Dr James Wood of the Cambridge Infectious Diseases Consortium.

The suggestion during the FMD epidemic that the results of models could directly inform disease control policies had resulted in the feeling among many in the profession – particularly those involved in the practical aspects of disease control – that 'all models are wrong, and probably dangerous'. However, modelling was an important part of veterinary epidemiology and disease control, and the attitude of the veterinary profession to mathematical modelling had perhaps given an impression to the wider scientific community that 'the veterinary profession is backward and not interested in or engaged in science and is generally a barrier to progress . . . and I think that does us great harm,' he said.

Despite this perception, there was actually consensus among those working in veterinary epidemiology that a dialogue was needed between modellers and the profession, so that the useful aspects of modelling could be incorporated into veterinary science.

'Modelling must never, and can never, replace empirical research, but it can be a valuable adjunct to empirical research programmes,' he said. 'I think that where there have been problems in the past within veterinary disease control, these come from when you separate the modelling from other research activities. This is just another scientific discipline that we use to better understand the control and prevention of infectious disease problems, and I think that it is important that we recognise that and just get on with it, and exploit the benefits of it.'

#### **Importance of validation**

The debate was opened to the floor, and the first point to be made, by Dr Alex Donaldson, was that it was essential to validate models before they were used. This was what had been missing in 2001, he said. The initial models had been based on data from the 1967 FMD epidemic, which had been driven by cattle and airborne transmission, and an epidemic in Taiwan, which had been pig driven. The 2001 epidemic had been driven by sheep and by poor biosecurity. Every epidemic would be different, and it would be impossible to develop a single mathematical model for a disease such as FMD. He suggested that, instead, a series of models of components of an outbreak of FMD – such as the manner of its transmission – could be constructed.

Professor Medley commented that the question of validation still held true regardless of whether a single model or a series of models was developed. The challenge was how to validate

an approach when an epidemic was already underway. Dr Wood pointed out that, while there were many tried and tested empirical disease control methods, a number of such methods, particularly for diseases that were

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exotic to the UK and those that had not been seen in the country before, were similarly unvalidated, and there was a need to be cautious about them.

Dr Kao reiterated the importance of integrating modelling into other disciplines. If modelling had been integrated already in 2001, he suggested, many of the problems that had arisen would have been much less prevalent. However, he disagreed that modelling components was the best solution. Modelling components was an extension of existing field and experimental work, but the type of modelling he was involved in was very much about integration and asking what might happen when different components interacted.

Professor Joe Brownlie, from the Royal Veterinary College, suggested that a further problem in 2001 had been the access that the mathematical modellers had had to those making disease control policy. Models, he said, were 'fantastically useful' to analyse existing data, to see if parts of the jig-



**Every other year, the AVTRW awards its Selborne Medal for Veterinary Research. This year, Professor Joe Brownlie of the Royal Veterinary College received the medal, in recognition of his work on bovine viral diarrhoea virus**

saw were missing, but to use them prospectively in situations that were new and of national importance was very dangerous. 'I think it was a pity that the veterinary leaders and scientists did not have more authority, because they had the greatest knowledge at that time,' he said. 'The modellers did not have knowledge of the disease, they had knowledge of what you do with complex situations, but it shouldn't be taken that they had the answers to where the foot-and-mouth outbreak was going.'

'Prediction is always dangerous – especially about the future!' remarked Professor Medley. Modelling could, however, be useful in prediction, but had to be viewed in the context in which it was done. It was, for example, a legal requirement that someone constructing a bridge or a building did the appropriate calculations, based on mathematical models, to ensure that the construction was going to be safe. 'I would like to get to the situation where you can't introduce a national level control programme against an infectious disease until someone somewhere has done the appropriate modelling calculations as part of the evidence that this is going to work or be cost effective.'



**The plenary lecture at this year's conference was given by Professor Robin Franklin of the University of Cambridge. Entitled 'Repairing the brain – from molecules to medicine', the lecture gave an insight into the work that Professor Franklin and his colleagues were conducting to investigate damage to the nervous system resulting from either trauma or the demyelination of neurons. Naturally occurring diseases in animals such as dogs could, he suggested, help to fill the 'translational gap' between animals and humans**

## Teaching ethics and welfare

**THE AVTRW congress programme is traditionally characterised by short presentations of about 15 minutes, including time for questions. It is an opportunity for young researchers to present their work and for more established scientists and teachers to update their peers on the latest thinking in research and education. As part of this year's stream of education lectures, the three BVA Animal Welfare Foundation (AWF) lecturers discussed the teaching of welfare and ethics within their veterinary schools and the work that they were undertaking to enhance it.**

IS THERE a need for ethics teaching in the veterinary schools? What should be taught and how should it be taught? These questions were raised by Dr Dorothy McKeegan, the BVA AWF lecturer at Glasgow at the start of her presentation. The veterinary profession, she said, was acknowledged as ethically challenging, with vets having a range moral obligations to the animals and clients that they dealt with, to society at large, and to themselves. These obligations often conflicted, she commented, and could be a source of stress to the veterinary surgeon involved.

So what situations were felt to be particularly stressful? Fourth-year veterinary students at Glasgow had undertaken a questionnaire study of a small sample of veterinary surgeons, asking them about the ethical dilemmas they faced in practice and how often they arose.

The responses to the questionnaire had indicated that, on average, the vets were facing between one and five ethical dilemmas each week, and that female vets scored more highly on the stress ratings. The stress ratings did not decrease with increasing time in practice. Seventy-one per cent of the respondents said that they had not had adequate training in this area at university. This, Dr McKeegan said, indicated the need for training in ethics during the undergraduate course.

In terms of what should be taught, an aim was to foster reflective thinking about ethical issues throughout the whole course. There needed to be training in ethical decision-making, recognising moral conflicts, using an ethical framework to make a decision, and developing the skills to act appropriately. Perhaps it would be appropriate for there to be an RCVS 'day 1 competency' in ethics, she suggested.

Teaching ethics needed a framework. Ethics could be taught through lectures, through small group teaching and tutorials and through case-based scenarios. Students seemed to enjoy learning and thinking about ethics, although some found it hard because there was no 'right' answer. However, there seemed to be a genuine desire for



**Dr Dorothy McKeegan: students seem to enjoy learning and thinking about ethical issues**

more ethics teaching to be included in the undergraduate course.

Discussing the teaching of animal welfare in veterinary schools, the second BVA AWF lecturer, Dr Jennifer Duncan



**Dr Jennifer Duncan: welfare teaching must reflect the broad role vets have in animal welfare**



**Dr David Main – advocated considering positive welfare when evaluating quality of life in animals**

from Liverpool university, pointed to the broad role vets had in animal welfare. Teaching had to reflect this, she said, and a number of approaches were being used at Liverpool. Teaching was broken down into three components – welfare science, welfare ethics and welfare law. The core principles of welfare were taught during the preclinical course, and then revisited during the clinical years to give a practical side to the theory.

One of the most important parts of the teaching was exposure to real-life scenarios. During ‘welfare investi-

gation week’ at Liverpool, students in their clinical years investigated a health or welfare problem in a farmed species. Areas that had been covered included mastitis, nutrition and lameness in cattle, sheep and goats. Most of the farms that had been involved had been referred to the university by external veterinary practices. ‘One of the most important parts of ethical teaching seems to be keeping it relevant by constant reference to case examples,’ she said.

#### **Value of positive welfare**

Should animals do what they like and get what they want, asked Dr David Main, the BVA AWF lecturer at Bristol university. Would this necessarily improve their welfare? Traditionally, improving animal welfare had focused on limiting negative aspects relating to their keeping. Indeed, four of the Five Freedoms related to freedom from something negative. However, should not consideration be given to positive welfare? Quality of life was essentially a balance between the positive and negative. ‘Quality of life surely has to include positive experiences as well as the negative experiences,’ he said. A positive experience might be one mechanism to help an animal cope with suffering, much as occurred in humans.

Rewarding good outcomes could also be a strong motivation for those



**The annual general meeting of the AVTRW took place on April 3. Professor David Taylor (left) of Glasgow university was elected as president of the association for 2007/08; Professor Alun Williams of the Royal Veterinary College was elected as senior vice-president and Professor Malcolm Bennett of Liverpool university as junior vice-president. Professor Donald Kelly and Dr Zerai Woldehiwet continue in their respective roles as honorary secretary and honorary treasurer**

who cared for animals. Farm assurance schemes tended to concentrate on penalising negative welfare and telling people what they must do. ‘Surely we can reward them for the good stuff,’ he said. He also noted that people derived pleasure from watching an animal enjoying itself, whether it was a dog playing, or a lamb gambolling. Positive welfare was about putting back a common sense approach to the human-animal interaction.

There was a balance to be struck between what an animal wanted and what it should be allowed. It was important to ask what an animal would want or choose and then to ask whether this could be provided without harming the animal or others around it.