

Science Advisory Council Epidemic Diseases sub-group

Review of the Foot and Mouth Disease contingency plan, including Exercise Hornbeam: recommendations of the Science Advisory Council

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Confidentiality status: For information- may be shown freely or discussed with anyone.

Sign-off: This report has been signed off by the Chair of the Science Advisory Council (Professor Roy Anderson) and the Chair of the SAC Epidemic Diseases sub-group (Professor Jeffrey Waage).

Date: 2 September 2004

BACKGROUND

The government has undertaken a successful review of its Foot and Mouth Disease (FMD) contingency plan, including Exercise Hornbeam. The Science Advisory Council established its Epidemic Diseases sub-group to review the science underpinning the plan that was set before Ministers in April 2004. The sub-group focused on the scientific aspects underpinning the FMD contingency plan, although it was also necessary to consider some operational and policy matters where they were of relevance. This review was carried out in consultation with senior Defra experts. The Chair of the Science Advisory Council was invited to actively participate in Exercise Hornbeam during the real-time invocation of Defra's response at days 7 and 8.

The following are the major science issues identified, from the exercise in its entirety, that require attention in the shorter term.

VOTE OF THANKS

We would like to formally thank Defra officials and co-opted sub-group members for their valuable input and, in particular, for their willingness to be open and frank during discussions.

The exercise was extremely valuable and useful, it was well conceived, conducted and serviced, showing the professionalism of the Civil Service at its best. In general the tactics used during the exercise were excellent.

MEMBERS OF THE SUB-GROUP

SAC members

Prof. Jeffrey Waage	Dept. Agricultural Sciences, Imperial College
Prof. Roy Anderson	Dept. Infectious Disease Epidemiology, Imperial College
Prof. Philip Lowe	Centre for Rural Economy, University of Newcastle
Prof. Mark Woolhouse	Centre for Infectious Diseases, Royal School of Veterinary Studies, University of Edinburgh

Co-opted members for the FMD contingency plan work

Mr David Black	Practising veterinarian, Paragon Veterinary Grp., Cumbria
Mr Roger Eddy	Ex-President, Royal College of Veterinary Surgeon
Dr Matt Keeling	Dept. Biological Sciences and Maths Institute, University of Warwick
Dr Laura Green	Ecology and Epidemiology Group, Dept. Biological Sciences, University of Warwick
Mr Jeremy Worth	Countryside Agency

Secretariat

Dr Tim Bradshaw	SAC Secretary
Dr Joanne Wallace	Science Directorate, Defra

SUMMARY OF RECOMMENDATIONS

Recommendation 1: It would be useful if the key changes (relative to the Foot and Mouth Disease contingency plan that was in place before 2001) were stated, including information on new research instigated and how social science lessons have been analysed and incorporated into the revised plan.

Recommendation 2: The government should clearly state its policy priorities in terms of control during an outbreak. Priorities in the event of different outbreak scenarios should be considered.

Recommendation 3: A strategy document should be produced to set out a framework for decision-making based on the different scenarios and policy priorities.

Recommendation 4: Defra should build UK epidemiological modelling expertise into further refinement of its contingency plan. A range of different outbreak scenarios should be modelled and the best approach available for each should be established.

Recommendation 5: Constraints on electronic data capture, transmission and access that could limit use of real time information for prediction during an outbreak should be addressed.

Recommendation 6: Independent experts should be involved in the development of data capture systems.

Recommendation 7: In peace time, mechanisms that provide the proposed independent modelling consortium with easy access to the modelling data collected at the centre must be agreed and tested.

Recommendation 8: A review of the experimental and epidemiological data on the efficacy of vaccines should be undertaken as a high priority.

Recommendation 9: Modelling, including systematic sensitivity analysis, should be done to determine how vaccine efficacy, availability, deployment, post-vaccination monitoring and other factors will influence the success of a given vaccination strategy in different outbreak scenarios.

Recommendation 10: Discussions to better define a Dangerous Contact (DC) should continue.

Recommendation 11: The non-outbreak standstill time of cattle and sheep should be reviewed. If there are overriding factors favouring 6 days then these must be clearly stated.

Recommendation 12: Defra should explore innovative ways to work with farmers to encourage adoption of good biosecurity at national, regional and local level. Options might involve new selective incentives, e.g. a scaling of the levy burden on farmers according to the level of biosecurity adopted.

Recommendation 13: Accurate pen-side tests should be developed for the diagnosis of FMD in cattle and pigs. The Department should develop the capability to identify further research needs, including a review of current technology and the identification of novel future technologies.

Recommendation 14: During any future outbreak, the Science Directorate should ensure the production of a daily e-mail of scientific briefing, outlining the science underpinning the various policy options.

Recommendation 15: It is important that the plan be presented in an accessible format to all, including clear explanations of objectives and strategy and risk.

Recommendation 16: Defra should take proactive steps to ensure the engagement of farmers, vets and the public with the plan. Uncertainties influencing the plan should be identified and made public.

Recommendation 17: Defra should produce clear explanatory notes for the public on what the policy would be in the event of another outbreak and what it would mean for them in terms of access to rural areas.

Recommendation 18: The sub-group should meet again to consider what scenarios should be modelled and how best to take this work forwards.

Recommendation 19: Members of the sub-group should visit the Institute of Animal Health (Pirbright) to follow up on some of the issues raised.

Recommendation 20: The operations of the SAC during an outbreak, including their interaction with policy colleagues and the modelling consortium require formalising.

INTRODUCTION

The Defra Foot and Mouth Disease (FMD) Contingency Plan represents the Department's 'Gold Standard' for contingency plans and will be used as the basis for the development of other epidemic disease contingency plans. As such, many of the following generic comments and recommendations will be relevant to the future development of these plans.

LAYOUT OF THIS REPORT

The report is divided into a number of sections that reflect the balance of issues raised during our review of the FMD contingency plan and Exercise Hornbeam:

- GENERAL COMMENTS ON THE PLAN
- STRATEGY AND DECISION-MAKING
- MODELLING
- DATA CAPTURE
- VACCINATION
- DEFINITION OF DANGEROUS CONTACTS (DCs)
- STANDSTILL POLICIES
- BIOSECURITY
- PEN-SIDE TESTING
- COMMUNICATION AND STAKEHOLDER ENGAGEMENT
- FUTURE ROLE OF THE SCIENCE ADVISORY COUNCIL

GENERAL COMMENTS ON THE PLAN

The contingency plan has been a major piece of work involving extensive consultation with stakeholders.

Many lessons have been learnt as a result of the 2001 FMD outbreak and it is clear that many have been incorporated into the plan. The welcome emphasis on speed and organisation of response obviously builds on that experience.

Recommendation 1: It would be useful if the key changes (relative to the Foot and Mouth Disease contingency plan that was in place before 2001) were stated, including information on new research instigated and how social science lessons have been analysed and incorporated into the revised plan.

STRATEGY AND DECISION-MAKING

The contingency plan is strong on the operational aspects of delivery and how decisions will be implemented efficiently. This focus needs to be balanced by more consideration of strategy, indicating the basis on which decisions would be made and how this would address specific objectives. Two aspects need particular attention as they will determine the best approach that can be taken in the event of a future outbreak:

- setting out the government's policy priorities clearly, and
- considering different outbreak scenarios.

Defra's first priority with respect to FMD is prevention, followed by early detection. In event of an outbreak the Defra policy is to stop virus production and to prevent its spread. This is appropriate, although the best way of achieving this will be determined by the nature of the outbreak and on the chosen policy priority.

Objectives of a contingency plan could be to (1) minimise loss of animals, (2) minimise duration of epidemic, (3) minimise cost to the nation (or other costs), or (4) provide the shortest duration to an exit point which allows international trading to commence. These are not all compatible: a strategy which minimises culling of animals may increase the duration and cost of an outbreak; shortening the duration of an epidemic may necessitate the culling of more animals; vaccination used to shorten the duration of an epidemic may lengthen the duration to a final 'exit point'.

There may also be points in an outbreak where objectives may need to change and achieving this may require different tactics to be used. It is important to establish now what the policy priorities are/will be when faced with different scenarios so that strategy, based on good science, can be developed in advance and can then be delivered effectively as required.

Government should set out its policy priorities with reference to at least three different outbreak scenarios:

- (1) quick detection, limited spread;
- (2) moderate time to detection and moderate spread (i.e. a scenario between (1) and (3); and
- (3) late detection, extensive spread.

There is no evidence to indicate that the 2001 outbreak constitutes the 'worst case' scenario. The possibility of a significantly worse epidemic must therefore be considered in scenarios for the contingency plan.

Recommendation 2: The government should clearly state its policy priorities in terms of control during an outbreak. Priorities in the event of different outbreak scenarios should be considered.

Recommendation 3: A strategy document should be produced to set out a framework for decision-making based on the different scenarios and policy priorities.

MODELLING

Advising policy makers will require real time mathematical modelling capability to explore scenarios, predicting the outcomes of particular strategies and conveying accurately the likelihood of success.

Modelling can help to predict how much resource (e.g. vaccine) at what level of effectiveness would be needed to contain an outbreak of a particular size. Whilst specific predictions may be impossible, the conduct of systematic sensitivity analysis may help decision-makers to understand the conditions under which a particular strategy is likely to be feasible, risky or impossible.

There is a need to establish a consortium of independent experts working in 'peace time' to conduct rigorous simulations of the potential impact of different policy options, implemented in different regions, at different times post-'day Zero' of an outbreak. A diversity of expert perspectives in modelling serves the crucial function of addressing uncertainties concerning the structure and style of individual modelling approaches. This consortium should operate alongside, and in addition to, the 'Interspread' model. In order properly to inform decision making, it is desirable that a number of reasonable policy alternatives be explored equally rigorously in modelling and be published in full to ensure consensus regarding validity.

The predictive model(s) used must provide real time, day-by-day output of both predicted case numbers (Infected Premises) and logistical information (number to be killed, vaccinated, etc) and the case reproductive number 'R' (the average number of secondary cases generated by one primary case) to assess whether the epidemic is 'under control' in a rigorous scientific sense as opposed to a policy sense.

A detailed retrospective analysis of the 2001 epidemic should be undertaken to identify the characteristics, if any, of a farm that predispose it to infection.

Recommendation 4: Defra should build UK epidemiological modelling expertise into further refinement of its contingency plan. A range of different outbreak scenarios should be modelled and the best approach available for each should be established.

DATA CAPTURE

In peacetime it will be important to optimise systems to capture data, including transmission from the field and access by modelling groups. Data capture should be continuous (i.e. "real time", or as close to real time as is possible), so that rapid changes can be analysed and used to advise on action. We welcome Defra's plans to provide a centralised source of data during any future outbreak and that this will be shared by both the veterinary and scientific groups advising Defra.

The data required during an outbreak should be agreed with the modelling, veterinary and epidemiological communities in advance and should be reviewed regularly.

In the event of an outbreak there is a clear need to optimise the type of data collected in the field, the mode and speed of transfer to the centre and the ability of independent experts to access the data in 'real-time'. The outputs of these simulations should be able to be displayed in graphical form to ease communication to a diverse audience.

Independent experts need to be involved in data capture (web based entry, secure site). Analyses required include:

- the distribution of times to Infected Premises (IP) and Dangerous Contact (DC) removal, and for delivery of vaccine to a vaccine targeted herd;
- a Bayesian risk analysis of the factors that predispose a farm to infection and lead to an improved DC definition;
- the estimation of 'R' by spatial location, time, species etc.

The structure of the veterinary telephone report (FM1) and epidemiological assessment (FM21) forms should be as simple and precise as possible. Field based digital entry systems should be developed to speed data transfer to the centre.

Recommendation 5: Constraints on electronic data capture, transmission and access that could limit use of real time information for prediction during an outbreak should be addressed.

Recommendation 6: Independent experts should be involved in the development of data capture systems.

Recommendation 7: In peace time, mechanisms that provide the proposed independent modelling consortium with easy access to the modelling data collected at the centre must be agreed and tested.

VACCINATION

The plan adds vaccination as a major disease control option. This raises scientific and logistical concerns about whether, and under what circumstances, a vaccination-based campaign (or a vaccination campaign in tandem with culling) is feasible.

Whilst vaccination to live and vaccination to kill are suggested as strategies there was concern that much of the apparent attraction of vaccination was to reduce the killing of animals, and for this same reason vaccination to kill is not likely to be an acceptable strategy to either the public or the veterinary community.

In the event that vaccination were used as a key part of the control strategy, the number of animals that would need to be culled would remain significant, in part as a consequence of requirements under EU guidelines on FMD control. Where vaccination is not likely to be effective, culling becomes critical and it will be important to strike swiftly and hard to prevent extensive spread. Strategically more emphasis needs to be given to the use of pre-emptive culling, and ensuring the rapidity of the decision making process.

The review highlighted several scientific uncertainties related to the possible use of vaccination as part of the control strategy.

Vaccination is a high-risk approach, due to outstanding questions about the parameters and effectiveness of vaccination and the resources needed. Currently there is insufficient scientific evidence to be confident that vaccination will be an effective tool in controlling an outbreak. Much research and modelling is still required before vaccination can be used

with confidence. A limited vaccination programme is unlikely to be effective, and may be counter-productive— absorbing resources that might be better utilised elsewhere.

There is an urgent requirement for a quantitative scientific review of the properties, including efficacy, of vaccines from experimental and epidemiological studies. The logistics of vaccine supply, manufacture and delivery need to be more precisely defined. Before a decision to vaccinate is taken strategists must know how long it will take a company to scale up manufacture and replenish used stocks and how many doses can be delivered per day given widely separated spatial hot spots.

Before emergency vaccination could be used, clear guidance would be required on different strategies to be used for different disease scenarios involving different animals and stock intensities and for special cases such as rare breeds and zoo animals.

Key questions include:

- Will there be adequately matching vaccine in stock in sufficient quantity or which can be bulked up sufficiently quickly from a seed stock?
- Will vaccines be sufficiently effective in preventing infection and carriage of disease by a sufficient proportion of treated animals? And with what time lag after vaccination?
- Can available vaccines be deployed and animals treated quickly enough to accommodate reasonable outbreak scenarios with existing resources?
- Are methods to distinguish vaccinated from infected individuals sufficiently accurate to allow monitoring of spread and a clear exit strategy?
- In the event that the epidemic was self-sustaining in sheep, even if vaccinations were very successful in cattle, how would disease in sheep be controlled?

Recommendation 8: A review of the experimental and epidemiological data on the efficacy of vaccines should be undertaken as a high priority.

Recommendation 9: Modelling, including systematic sensitivity analysis, should be done to determine how vaccine efficacy, availability, deployment, post-vaccination monitoring and other factors will influence the success of a given vaccination strategy in different outbreak scenarios.

DEFINITION OF DANGEROUS CONTACTS (DCs)

The definition of a DC is critically important in deciding the most appropriate control strategy. For scientific purposes a very precise definition that is applied consistently is highly desirable. The definition may require revision during an epidemic depending on strain type, the origin host species involved, climate, location, etc.

Recommendation 10: Discussions to better define a Dangerous Contact (DC) should continue.

STANDSTILL POLICIES

The Royal Society report on FMD indicates that a standstill ban of at least 13 days is optimum during non-outbreak times to help prevent the unseen spread of disease. The duration of movement restrictions for sheep and cattle (6 days in England and Wales and 13 days in Scotland) should be reviewed, based on model simulations. Would a 13 day movement restriction have shortened the last epidemic and reduced its severity? (Note that during an outbreak different movement controls would operate: initially a complete standstill and after that all movements would be controlled by licence.)

Recommendation 11: The non-outbreak standstill time of cattle and sheep should be reviewed. If there are overriding factors favouring 6 days then these must be clearly stated.

BIOSECURITY

It will be important to integrate farmers into a national policy aimed at the best possible biosecurity measures at all times (not just during a disease outbreak). Better biosecurity is typically achieved by farmers for livestock like poultry and pigs, in contrast to cattle and sheep due to the different ways these are farmed and the industry is structured.

Recommendation 12: Defra should explore innovative ways to work with farmers to encourage adoption of good biosecurity at national, regional and local level. Options might involve new selective incentives, e.g. a scaling of the levy burden on farmers according to the level of biosecurity adopted.

PEN-SIDE TESTING

Time to detection of the first case is critical in determining how easily/quickly an outbreak can be contained. Rapid detection and confirmation of clinical diagnosis using reliable tests is of paramount importance. The UK capacity for laboratory testing is now in an excellent state following significant improvement and investment since 2001. There are still opportunities to develop reliable and effective pen side tests to aid field diagnosis.

Recommendation 13: Accurate pen-side tests should be developed for the diagnosis of FMD in cattle and pigs. The Department should develop the capability to identify further research needs, including a review of current technology and the identification of novel future technologies.

COMMUNICATION AND STAKEHOLDER ENGAGEMENT

In the event of an outbreak it is essential that Defra communicates widely, informatively and accurately, being specific about terms such as 'under control'.

Media presentations should not exclude the use of terminology such as 'R' estimates that are commonly understood by the science community and science journalists. Similarly, it

will be important to ensure that national experts outside of Defra are appropriately briefed on the science underpinning Defra's policy options.

The contingency plan clearly identifies those involved in outbreak suppression, including their responsibilities. Farmers and veterinarians are not explicitly included in this process, although their representative organisations are. It is likely that the roles they will have to play in an outbreak will be substantial. Positive engagement of farmers and vets in this plan will help to build ownership and a collective approach to this problem. It is essential to build this prior engagement and understanding of stakeholders if the response to an outbreak is to be as rapid as possible.

There will be a number of uncertainties and unknowns that will affect the plan and how it can be implemented. A list of these uncertainties and unknowns should be compiled and published on the Defra web site for external feedback.

A cost-benefit analysis of outbreak scenarios, and a programme to improve farm hygiene, are being funded by Defra. This information should be made available on completion.

Recommendation 14: During any future outbreak, the Science Directorate should ensure the production of a daily e-mail of scientific briefing, outlining the science underpinning the various policy options.

Recommendation 15: It is important that the plan be presented in an accessible format to all, including clear explanations of objectives and strategy and risk.

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Recommendation 17: Defra should produce clear explanatory notes for the public on what the policy would be in the event of another outbreak and what it would mean for them in terms of access to rural areas.

FUTURE ROLE OF THE SCIENCE ADVISORY COUNCIL

It will be important for the SAC to receive feedback on the actions taken from this report.

Recommendation 18: The sub-group should meet again to consider what scenarios should be modelled and how best to take this work forwards.

Recommendation 19: Members of the sub-group should visit the Institute of Animal Health (Pirbright) to follow up on some of the issues raised.

Recommendation 20: The operations of the SAC during an outbreak, including their interaction with policy colleagues and the modelling consortium require formalising.