

Science Advisory Council

SAC Epidemic Diseases sub-group

Review of Foot and Mouth Disease Contingency Plan

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This is the final version of the report of the SAC Epidemic Diseases sub-group set up to undertake a review of the scientific aspects underpinning Defra's Foot and Mouth Disease contingency plan.

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

Issues arising from this report and the work undertaken by the sub-group will be discussed at the SAC meeting on 19th July 2004.

VOTE OF THANKS

In the course of our work the sub-group has been able to discuss issues with a number of senior Defra experts. We would like to formally thank them for their valuable input and, in particular, for their willingness to be open and frank in the discussions.

SUMMARY OF KEY POINTS

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

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

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.

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

Vaccination is a high risk approach, due to outstanding questions about the parameters and effectiveness of vaccination and the resources needed. Currently there is not sufficient scientific evidence to be confident that vaccination will be an effective tool in controlling an outbreak alongside culling.

Modelling, including systematic sensitivity analysis, should be done to determine how vaccine effectiveness, availability, deployment, post vaccination monitoring and other factors will influence the success of a given vaccination strategy in different outbreak scenarios. A review should be conducted of the experimental and epidemiological data on the efficacy of vaccines as a high priority.

Defra should explore imaginative ways to work with farmers, providing selective incentives to encourage adoption of good biosecurity at national, regional and local level.

Defra should include farmers and vets more directly in the plan and take pro-active steps to build prior 'buy-in'. Defra should also take into consideration the need to engage and inform the public in promoting the plan more widely. Uncertainties affecting the plan should be identified and made public.

Clear explanatory notes for the public should be produced 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.

The sub-group will meet again to consider feedback on this report and the live test of the plan and will discuss its work at the July 2004 meeting of the SAC. We will give consideration to what scenarios should be modelled and how best to take this work forwards.

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

INTRODUCTION

Background

1. At the first meeting of the Science Advisory Council (30th April 2004) it was agreed that a sub-group would be established to carry out a rolling review of Defra's emergency contingency plans where science was an important aspect. The sub-group would focus initially on epidemic diseases and its first piece of work would be to review the Foot and Mouth Disease (FMD) contingency plan. It was agreed that the sub-group should report back in time to be able to offer advice to Defra's Chief Scientific Adviser ahead of a 'live' test of the FMD contingency plan on 29th June 2004. This is our summary report of that work.
2. Professor Jeffrey Waage, Head of the Department of Agricultural Sciences at Imperial College chaired the sub-group for the FMD work. The sub-group met in private twice (26th May and 8th June 2004) and also exchanged comments via e-mail and telephone. 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.

Terms of reference

3. The following terms of reference were agreed:
 - To review the scientific, including veterinary and social science, aspects of Defra's Foot and Mouth Disease contingency plan and to report back to the Science Advisory Council.
4. We recognise that our comments are unlikely to allow any modification to the up-coming trial and how it will be run, but they may be useful in its interpretation, in the future refinement of the plan and in new trials. We understand that the plan may also be used as the basis for the development of other epidemic disease contingency plans and many of our generic comments will be relevant to that work too.

Lay-out of this report

5. The report is divided into a number of sections which reflect the balance of issues raised during our review of the FMD contingency plan:
 - General comments on the plan
 - Strategy and decision-making—including Defra's policy priorities
 - Modelling and data
 - Vaccination
 - Other factors—including biosecurity, standstill policies and testing
 - Communication and stakeholder engagement
 - The role of the SAC in advising Defra on an FMD outbreak.

GENERAL COMMENTS ON THE PLAN

6. We recognise that producing the contingency plan has been a major piece of work and that a significant number of stakeholders have been considered in its preparation.
7. 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. However, it would be useful if some of the other key changes (relative to the plan that was in place before 2001) were stated and if new research started as a result of the 2001 outbreak could be identified; including how social science lessons have been analysed and incorporated. This would help to ensure the widest possible confidence in the plan by demonstrating that problems encountered in 2001 and concerns raised since have now been addressed.
8. The plan adds vaccination as a major new element in addition to culling. This raises a number of both scientific and logistical concerns about whether, and under what circumstances, a vaccination-based campaign (or a vaccination campaign in tandem with culling) is feasible. These concerns are set out in detail below.
9. It should be noted (and the public made aware of the fact) that even if vaccination is used as a key part of the control strategy in any future FMD outbreak, the number of animals that would need to be culled would still be 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 may be better to over-react early on in order to prevent extensive spread. More emphasis needs to be given to pre-emptive culling and its use, including a procedure that would allow a decision to cull pre-emptively to be reached very quickly.

STRATEGY AND DECISION-MAKING

10. The contingency plan is strong on the practical details of delivery and how decisions will be implemented efficiently. However, this focus on the operational aspects of FMD control 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.
11. We recognise that Defra's first priority with respect to FMD is prevention, followed by early detection. These points are discussed in a later section. 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 depend on the nature of the outbreak and on the chosen policy priority. Neither of these points are considered in the plan at the moment.

12. For instance, different 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 again. 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 more animal deaths; vaccination used to shorten the duration of an epidemic may lengthen the duration to a final 'exit point'.
13. 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.
14. To do this the government must set out its policy priorities and we recommend that this be done 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.
15. It should also be noted that there is no evidence to show that the 2001 outbreak can be considered as the 'worst case' scenario. The possibility of a significantly worse epidemic must therefore be considered in scenarios for the contingency plan.
- 16. We recommend that the government should clearly state its policy priorities in terms of control during an outbreak. Priorities in the event of different outbreak scenarios must be considered.**
- 17. A strategy document should be produced to set out a framework for decision making based on the different scenarios and policy priorities.**

MODELLING AND DATA

18. Advising policy makers will require matching actions to particular objectives and conveying accurately the likelihood of success (e.g. of a campaign employing a vaccine with limited efficacy).
19. Mathematical modelling has considerable potential to improve a contingency plan by exploring scenarios. For instance, a model 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. In this regard, though specific predictions may be impossible, the conduct of systematic sensitivity analysis may nonetheless help decision-makers understand the conditions under which a particular strategy is likely to be feasible, risky or impossible. The structuring and bounding of such sensitivity analysis is an integral part of the dialogue with policy makers and the representation of results.

20. Once again definite policy priorities need to be known to enable models to predict the optimal form of control and explore key sensitivities. Without these the number of combinations that can be considered is prohibitive. However, modelling should not be restricted simply to the optimisation of a single policy response in any given scenario. 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.
21. Modelling will also be an important tool in decision making during an outbreak. To do this, however, there needs to be more attention paid to data capture, transmission and access. This can and 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.
22. Many more elements could be included "real-time" given the data, for example recent animal movements could be used to improve our estimations of the likelihood of long-range future spread etc. Information such as this needs to be made available centrally. 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.
23. Access to good data is vital if models are to be correctly parameterised and scientific advice is to be accurate. It is always better to have too much data than not enough and we anticipate that it will be possible to incorporate much more data in models in 5 or 10 years time as computational power and modelling complexity increases. The data that is required to be collected and made available during an outbreak should be agreed with the modelling community in advance and should be reviewed regularly.
24. Consideration must also be given to securing access to sufficient modelling expertise prior to the emergence of an outbreak and we understand that Defra is already working on this. A diversity of expert perspectives in modelling serves the crucial function of addressing uncertainties concerning the structure and style of individual modelling approaches. For this reason, it is desirable that the preparation of important policy responses be based not simply on a single model operated by a particular team, but is informed by a suite of models, encompassing a variety of approaches.
25. Modelling of vaccination scenarios is considered specifically below.
- 26. We recommend that 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.

27. Constraints on electronic data capture, transmission and access that could limit use of real time information for prediction during an outbreak must also be addressed.

VACCINATION

28. Vaccination is a major element of the plan. While both vaccination to live and vaccination to kill are suggested as strategies, the Committee felt 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.

29. We believe that vaccination is a high risk approach, due to outstanding questions about the parameters and effectiveness of vaccination and the resources needed. Currently there is not sufficient scientific evidence to be confident that vaccination will be an effective tool in controlling an outbreak alongside culling.

30. Much research and modelling is still required before vaccination can be used with confidence. In particular, there is an urgent requirement for a quantitative scientific review of the properties of vaccines from experimental and epidemiological studies.

31. Key questions include:

- For a particular new strain of disease, 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 of a sufficient proportion of treated animals? And with what time lag after vaccination?
- What is the probability of a vaccinated animal carrying and transmitting the disease, under different conditions of exposure prior to and immediately post immunisation?
- 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, restoring freedom to trade internationally?

32. A limited vaccination programme is unlikely to be effective, and may even be counter-productive: it will absorb resources which might be better used elsewhere, and it will create confusion in the minds of stakeholders. If vaccination is to be used then experience and initial simulations produced for

the sub-group suggest that it must be used on a large scale and be implemented as quickly as possible. Counter-intuitively, this could ultimately mean that fewer animals are vaccinated in total and that the outbreak is over more quickly, simply because the disease is better controlled.

33. Before emergency vaccination could be used, clear guidance would also 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.
34. Vaccination policy should be based on a series of detailed calculations using the best available technology. **We recommend that modelling, including systematic sensitivity analysis, should be done to determine how vaccine effectiveness, availability, deployment, post vaccination monitoring and other factors will influence the success of a given vaccination strategy in different outbreak scenarios. We also recommend that a review be done of the experimental and epidemiological data on the efficacy of vaccines as a high priority.**
35. Representatives of the sub-group intend to visit IAH-Pirbright in the near future to discuss vaccine efficacy and vaccine purchasing priorities, operational support provided to Defra (e.g. surveillance and diagnosis) and research related to FMD epidemiology and transmission.

OTHER FACTORS

36. While the sub-group's brief was the Contingency Plan, both Defra staff and sub-group members agreed that the plan had to be viewed in the context of other issues. Three key issues were considered:
 - The need for active prevention through good biosecurity and testing in non-outbreak times;
 - Standstill policies to control stock movement; and
 - Pen side testing.

Biosecurity

37. An issue that needs to be addressed is how to integrate farmers into a national policy aimed at the best possible biosecurity measures at all times (not just during a disease outbreak). We note that better biosecurity is typically achieved by farmers for livestock like poultry and pigs, in contrast to cattle and sheep largely because of the different ways these are farmed, but partly because of the industry structuring. While there is a good deal of information on how specific biosecurity measures affect the FMD pathogen, the effectiveness of measures when implemented on farm is still poorly known, which does not help the development of good biosecurity.

38. **We recommend that Defra should explore imaginative ways to work with farmers to encourage adoption of good biosecurity at national, regional and local level.** Some of these might involve new selective incentives, e.g. a scaling of the levy burden on farmers according to the level of biosecurity adopted on their farms.

Standstill policies

39. Members noted that risk models indicated a standstill ban of at least 13 days was the optimum (as recommended in the Royal Society report on FMD). However, current policy for pigs was 20 days and for cattle and sheep was only 6 days. Other countries used different protocols. We could not see a good scientific basis for the decision to limit standstill to 6 days for cattle and sheep and we feel that this will leave Defra open to scientific challenge. If there are other overriding factors favouring 6 days then these must be clearly stated.

Pen-side testing

40. We understand that time to detection of the first case is a critical factor in determining how easily/quickly an outbreak can be contained. Rapid detection and confirmation of clinical diagnosis using reliable tests is of paramount importance during an outbreak. It is clear that UK capacity for laboratory testing is now in an excellent state following significant improvement and investment since 2001. However there are still opportunities to develop reliable and effective pen side tests that will aid the diagnosis by vets in the field.
41. The priority should be for the development of pen side tests for the diagnosis of FMD in cattle and pigs as we recognise that there are considerably more difficulties in validating pen side tests for sheep.

COMMUNICATION AND STAKEHOLDER ENGAGEMENT

42. The Contingency plan identifies clearly the people to be involved in outbreak suppression and their responsibilities and line management. Farmers and veterinarians are not explicitly included in this process, although their representative organisations are “stakeholder groups”. It is likely that the roles they will have to play in an outbreak are substantial. This is particularly true if local vets will be required for vaccination in the event of a large outbreak. 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 ‘buy-in’ of stakeholders if the response to an outbreak is to be as rapid as possible.
43. The sub-group noted that the effective closure of the countryside in the last epidemic was largely an action of good will to farmers on behalf of the public. Public involvement and concern about a future outbreak is therefore very relevant to the success of the plan, and the plan may need to be presented in

a way which is accessible to the public, including a clear explanation of objectives and strategy and risk.

44. It is also important to recognise that, even when based on the best available science, there will still be a number of uncertainties and unknowns which will affect the plan and how it can be implemented. This report has highlighted some of these, but it is likely that the experts who drafted the plan are aware of other factors too. A list of these uncertainties and unknowns should be brought together and published on the Defra web site for external feedback.
45. The sub-group was informed of other Defra activities on FMD including a cost benefit analysis of outbreak scenarios, and a programme to improve farm hygiene, both of which are welcome. The sub-group should have access to the outcome of the cost-benefit scenario work when it becomes available.
- 46. We recommend that Defra seek to include farmers and vets more directly in the plan and take proactive steps to build prior 'buy-in'. Defra should also take into consideration the need to engage and inform the public in promoting the plan more widely. Uncertainties affecting the plan should be identified and made public.**
- 47. We recommend that Defra 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.**

ROLE OF THE SAC

48. Beyond this sub-group report, it is not completely clear how the SAC will contribute to the improvement or implementation of the contingency plan.
49. It will be important for the SAC to receive feedback on the actions taken from this report, and feedback on the FMD exercise being held at the end of June. **We recommend that the sub-group meet again to consider both issues (feedback on this report and the live test of the plan) later in the year and that the sub-group should discuss its work at the July 2004 meeting of the SAC. We will give consideration to what scenarios should be modelled and how best to take this work forwards.**
50. The identification of further research needs, including review of current technology and the identification of novel future technologies, could be an activity for the SAC. **We invite Defra's views on this.**
51. During an outbreak, SAC members may be consulted for advice. It is appropriate to formalise this contingency by constituting our sub-group as an FMD advisory unit. However, recommendations above indicating a likely need for real time data capture and modelling would be beyond the activities of a sub-group of the SAC, and need more consideration.

SAC SECRETARY