REPORT

of the

Session of the Research Group of the Standing Technical Committee

of the

EUROPEAN COMMISSION FOR THE CONTROL OF FOOT-AND-MOUTH DISEASE (EUFMD)

held at

Chania, Crete (Greece)

11 October 2004 (Closed Session)
12-15 October 2004 (Open Session)
TABLE OF CONTENTS

INTRODUCTION

CLOSED SESSION

Item 1 - Adoption of the Agenda

Item 2 – Papers for adoption
2.1 Minimum requirements for FMD serology laboratories
2.2 Diagnostic reagent bank
2.3 Sample transport

Item 3 – Progress Reports of the Working Groups established after the 2003 Gerzensee Session
3.1 Assisted delivery of samples from third countries
3.2 Vaccine selection for the European banks
   3.2.1 Vaccine selection and related issues
   3.2.2 Development of models to improve risk assessment/communication of FMDV circulation
3.3 Comparative evaluation of candidate DIVA tests
3.4 Working Group on post-vaccination surveillance
   3.4.1 Gerzensee issue: Progress on parameter estimations
   3.4.2 Post-vaccination serosurveillance (PVS) for presence of FMD infected animals
3.5 FAO Phase XVIII progress and plan
3.6 Proficiency panel for virus detection; progress report (pilot study)
3.7 Working Group on penside tests
3.8 Laboratory contingency planning
3.9 Working Group on FMD virus inactivation kinetics
3.10 Laboratory sero-diagnostic capacity

Item 4 – Short report of the EUFMD/EC supported studies relating to validation of DIVA tests
4.1 Prevalence in vaccinated herds exposed to infection – report of study undertaken in Israel
4.2 Collection of sera/specimens for validation of DIVA tests for detection of animals received from SAT virus infection

Item 5 – Items arising from the Executive Committee 69th and 70th Sessions
5.1 Performance of the new oil adjuvanted vaccine and conventional vaccines produced by the SAP Institute in 2004
5.2 Guidelines for monitoring performance of FMD vaccines and vaccination in the field
5.3 Terms of Reference / vision for the Research Group of the standing Technical Committee

Item 6 – Items arising from EUFMD implemented actions in FMD control in Transcaucasus under EC support
6.1 Plan for assessment of potency and induction of NSP antibodies by FMD vaccines produced in Armenia and Georgia

Item 7 – Items raised by the Committee members

Item 8 – Upcoming issues and items for consideration in the new workplan

Item 9 – Workplan of the EUFMD Research Group to mid-2005

OPEN SESSION

INTRODUCTION TO THE OPEN SESSION

Item 1 – Recent findings in molecular epidemiology of FMDV

Item 2 – Surveillance: for what purpose and how much is enough?

Item 3 – Transmission and its control

Item 4 – Managing diagnostic demands

Item 5 – Pathobiology and diagnostics

Item 6 – Sero-diagnosis – improvements and standardisation

Item 7 – Optimisation of conventional vaccines

Item 8 – Regulatory issues affecting FMD vaccine selection and use

Item 9 – Novel vaccines

Item 10 – International issues

Item 11 – Persistent and subclinical infections – diagnostic and surveillance issues

Item 12 – Test development and standardisation

Item 13 – Surveillance using DIVA tests

Item 14 – Regulatory compliance

Item 15 – Managing the decision-making process in control of FMD and in the priority setting of research and development
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
</table>
| Appendix 1| Agenda  
**Closed Session**  
**Open Session**                                                                                                                                  | 28   |
| Appendix 2| Minimum standards for bio-security for laboratories undertaking serology with blood samples from areas not considered free from foot-and-mouth disease                                                                 | 34   |
| Appendix 3| Diagnostic reagent banks for FMD - Position paper of the EUFMD Research group  
October 2004                                                                                                                                 | 38   |
| Appendix 4| Summary of Current Regulations for the Safe Transport of Materials Containing infectious FMD Virus by Air                                                                                                    | 41   |
| Appendix 5| Vaccine selection for the European banks  
*D Paton*                                                                                                                                               | 55   |
| Appendix 6| Preliminary Report of a workshop on Comparative evaluation of FMD NSP antibody detection ELISAs  
IZSLER, Brescia                                                                                                                             | 56   |
| Appendix 7| Diagnostic assays used for FMD surveillance, fitness for purpose revisited  
Matthias Greiner                                                                                                                        | 66   |
| Appendix 8| Post-vaccinal serosurveillance for FMD: a European perspective on progress and problems  
*D J Paton, K de Clercq, A Dekker*                                                                                                           | 68   |
| Appendix 9| On the issue of documenting small herds as free from disease  
Matthias Greiner                                                                                                                                 | 72   |
| Appendix 10| FAO Phase XVIII FMD serological standardisation; progress and future prospects  
*D J Paton, R M Armstrong, R Fernandez, P A Hamblin, L Turner, M Corteyn, D Gibson, S Parida, C Wright, J Anderson* | 77   |
| Appendix 11| Proposals for Phase XIX [Abstract]                                                                                                                | 94   |
| Appendix 12| Progress and future prospects for standardisation of FMD tests  
*D J Paton*                                                                                                                                      | 95   |
| Appendix 13| Field evaluation of rapid "penside" tests for FMDV antigen and FMDV-NSP antibody  
FAO-EUFMD pilot study in Erzurum, Turkey; 12-25 September 2004                                                                               | 98   |
| Appendix 14| EUFMD/EC Workshop on Contingency Planning for Foot-And-Mouth Disease Laboratory Diagnostic Activities, Universidad de Córdoba, 28-30 April 2004                                                                 | 103  |
Appendix 15
Virus inactivation kinetics
Soren Alexandersen

Appendix 16
Screening for FMD virus in vaccinated herds affected by field infection
Hagai Yadin, Dalia Chai, Jacob Brener, Zamir Oved, Yuval Hadany, Alexandra Kusak

Appendix 17
Sero logical responses in relation to vaccination and infection in Zimbabwe cattle following outbreaks of FMD
Donal Sammin, David Paton, Geoff Hutchings, Nigel Ferris, Scott Reid, Andrew Shaw, Nick Knowles, Jean-Francois Valarcher, Satya Parida, Catherine Holmes, Debi Gibson, Mandy Corteyn, Rosa Fernandez, Pip Hamblin

Appendix 18
Performance of the new oil adjuvanted vaccine and conventional vaccines produced by the SAP Institute in 2004
Nilay Ünal

Appendix 19
Discussion paper on guidelines for control of Foot-and-Mouth Disease (FMD) vaccine quality and performance in the field
Simon J. Barteling, Hagai Yadin & Paul Sutmoller

Appendix 20
EMEA paper extract - Recommendations for tests for induction of antibodies to NSP antigens by FMD vaccines

Appendix 21
Global Foot-and-Mouth Disease Situation 2003-2004
Jean-François Valarcher, Nick J. Knowles, Rosa Fernandez, Paul R Davies, Rebecca J Midgley, Bob Statham, Geoff Hutchings, Brenda J Newman, Nigel P Ferris and David J Paton

Appendix 22
Molecular epidemiological studies of Foot-and-Mouth disease virus in sub-Saharan Africa indicate the presence of large numbers of topotypes: implications for local and international control
Vosloo, W, Dwarka, R.M, Bastos, A.D.S, Esterhuysen, J.J, Sahle, M, Sangare, O

Appendix 23
Characterisation of a new type O lineage of FMDV from Uganda with atypical clinical manifestations in domestic cattle
Laurids Siig Christensen, Rose Okurut, Kirsten Tjørnehøj, Preben Normann, Karl Johan Soeren sen and Martin Esau

Appendix 24
Identification of a ninth foot-and-mouth disease virus type O topotype and evidence for a recombination event in its evolution
Nick J. Knowles, Paul R. Davies, Rebecca J. Midgley and Jean-Francois Valarcher

Appendix 25
High-resolution molecular analysis of the 1982-3 FMD epidemic in Denmark
Laurids Siig Christensen, Preben Normann, Karin de Stricker and Stig Rosenorn

Appendix 26
Genetic and antigenic analysis of Italian 1993 FMDV isolates
J. I. Núñez, P. Fusi, B. Borrego, E. Brocchi, M.L. Pacciarini and F. Sobrino

Appendix 27
Outstanding but tractable questions regarding the micro-evolution of FMDV [Abstract]
Daniel T Haydon
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Role of European Food Safety Authority (EFSA) and current tasks related to FMD [Abstract]</td>
<td>189</td>
</tr>
<tr>
<td>29</td>
<td>Foot-and-Mouth Disease in small ruminants – an issue of concern</td>
<td>190</td>
</tr>
<tr>
<td>30</td>
<td>FMD in Turkey and Iran - trends and relationships</td>
<td>195</td>
</tr>
<tr>
<td>31</td>
<td>Epidemiological models for global surveillance of foot-and-mouth disease</td>
<td>203</td>
</tr>
<tr>
<td>32</td>
<td>Concepts and considerations for global foot-and-mouth disease surveillance</td>
<td>207</td>
</tr>
<tr>
<td>33</td>
<td>GISVET project in Iran</td>
<td>212</td>
</tr>
<tr>
<td>34</td>
<td>Influence of Exposure Intensity on Efficiency and Speed of FMD Transmission</td>
<td>215</td>
</tr>
<tr>
<td>35</td>
<td>Natural aerosol transmission of foot-and-mouth disease in sheep</td>
<td>222</td>
</tr>
<tr>
<td>36</td>
<td>Moving towards a better understanding of airborne transmission of FMD</td>
<td>227</td>
</tr>
<tr>
<td>37</td>
<td>Quantification of experimental transmission of FMDV O Taiwan in pigs</td>
<td>232</td>
</tr>
<tr>
<td>38</td>
<td>Comparison of transmission of FMDV in groups of vaccinated and non-vaccinated calves</td>
<td>235</td>
</tr>
<tr>
<td>39</td>
<td>Emergency FMD Vaccine: Effect of antigen payload on protection, sub-clinical infection and persistence following direct contact challenge of cattle</td>
<td>238</td>
</tr>
<tr>
<td>40</td>
<td>FMD and camelids: International relevance of current research</td>
<td>246</td>
</tr>
<tr>
<td>41</td>
<td>Laboratory Surge Capacity - Australian approach</td>
<td>260</td>
</tr>
</tbody>
</table>
Appendix 42
Prospects for improved laboratory diagnosis of FMD using real-time RT-PCR
Nigel Ferris, Scott Reid, Donald King, Geoff Hutchings and Andrew Shaw

Appendix 43
Use of automated RT-PCR to detect FMDV in milk
Scott M. Reid, Satya Parida, Donald P. King, Geoffrey H. Hutchings, Andrew E. Shaw,
Nigel P. Ferris, Zhidong Zhang, J. Eric Hillerton and David J. Paton

Appendix 44
Mapping of neutralising sites on FMD virus type Asia 1 and relationships with sites
described in other serotypes
Santina Grazioli, Francesca Fallacara and Emiliana Brocchi

Appendix 45
Validation of a Solid Phase Competitive ELISA (SPBE) based on the use a single
neutralising monoclonal antibody for the measurement of antibodies to FMDV type
Asia 1
Emiliana Brocchi, Santina Grazioli, Hagai Yadin and Franco De Simone

Appendix 46
Potential application of Bayesian probability diagnostic assignment (BPDA) method to
predict FMDV infection from serologic results [Abstract]
Wesley O. Johnson, Mark C. Thurmond and Andrés M. Perez

Appendix 47
Modelling early viral dynamics of FMDV in vivo
M. Quan, S. Alexandersen, L. Matthews, C. Murphy, Z. Zhang, M.E.J. Woolhouse

Appendix 48
The pathogenesis of FMD in young lambs
Eoin Ryan, Stephanie Durand, Joe Brownlie, Soren Alexandersen

Appendix 49
Towards the development of engineered cell lines for FMDV diagnosis
Donald P. King, Andrew E. Shaw, Scott M. Reid, Geoffrey H. Hutchings,
Terry Jackson and Nigel P. Ferris

Appendix 50
Recombinant integrin αvβ6 as a capture reagent in immunoassays for the
diagnosis of FMD
Nigel Ferris, Nicola Abrescia, David Stuart, Terry Jackson, Alison Burman, Donald King
and David Paton

Appendix 51
Development of Secondary Standards for the Foot-and-Mouth Disease Solid Phase
Competition ELISA and Internal Quality Control using Shewhart like Control Charts
Goris, N and De Clercq, K.

Appendix 52
Prediction of protection by FMD vaccines on the basis of LPBE results
Bernd Haas

Appendix 53
Addition of saponin to double oil emulsion FMD vaccines enhances specific antibody
responses in cattle and pigs
Smitsaart E, Espinoza AM, Sanguinetti R, Filippi J, Ham A and Bellinzoni R

Appendix 54
Harmonising regulatory requirements for FMD vaccines within the European Union
DKJ Mackay and K De Clercq
Appendix 68
3 ABC ELISA for the diagnosis of FMD in Egyptian sheep
Laila E. El-Shehawy, Samira El-Kilany & A.M. Doaud

Appendix 69
New strategies for the differentiation of Foot-and-Mouth disease virus-infected from vaccinated animals: Development of a competitive ELISA and a multiplexed Luminex assay
Alfonso Clavijo, Kate Hole, Mingyi Li, Brad Collingnon and Paul Kitching

Appendix 70
In vitro production of Interferon-γ from whole blood of FMD vaccinated and infected cattle after incubation with inactivated FMDV antigen

Appendix 71
Secretory IgA as an indicator of oropharyngeal FMDV replication
Satya Parida, David Paton*, Sarah Cox, Paul Barnett, John Anderson

Appendix 72
Using NSP ELISA (Chekit-FMD-3ABC Bommeli-Intervet) as a Tool for FMDV Serosurveillance in Bulgaria
Georgi Georgiev, Emiliya Veleva, Liliyana Polihronova and Alessandro Rossi

Appendix 73
A serosurvey to measure antibody levels to FMDV and trace antibodies to FMDV NSPs following Spring 2004 FMD vaccination campaign in Turkish Thrace Region [Abstract]
A.N. Bulut, B. Sareyyupoglu, U. Parlak and C. Cokcaliskan

Appendix 74
Results of serosurveillance for FMD and PPR in Evros under an FAO Technical Cooperation project (TCP/RER/2903 Strengthening Active Surveillance for FMD and other Exotic Diseases in Thrace Region)
E. Hondrokouki and E. Reboutsakou

Appendix 75
Diagnostic Tools for Epidemiological Surveillance in South America [Abstract]
Ingrid Bergmann, Viviana Malirat and Erika Neitzert

Appendix 76
Post-vaccinal serosurveillance for FMD: a European perspective on progress and problems
DJ Paton, K de Clercq, A Dekker

Appendix 77
Knowledge Management and Systems Interoperability in Animal Health
Julian Hilton, Apostolos Rantsios, Mark Rweyemamu

Appendix 78
Policy and science of FMD control: the stakeholders’ contribution to decision making – A call for Integrated Animal Disease Management
Mary Marshall and Paul Roger

Appendix 79
Poster Session

Appendix 80
Feedback from group of participants from “European State Veterinary Services”

Appendix 81
Feedback from Middle East and North and East Africa Group

Appendix 82
List of participants
INTRODUCTION

A Session of the Research Group of the Standing Technical Committee of the European Commission for the Control of Foot-and-Mouth Disease (EUFMD) was held in Chania, Crete (Greece), from 11 to 15 October 2004. The Session was composed of two parts, one for Closed business, open only to elected members of the Standing Technical Committee, the Secretariat and seven invited Observers, and an Open part from 12 to 15 October for open discussion of significant technical items with wide participation (over 120 persons) of experts in technical and regulatory affairs relating to FMD control from 48 countries. Observers came from most regions including the Americas (10 persons), Australasia (2), Asia (5), North Africa (4), Near East (7), and Southern and Eastern Africa (4).

The meeting was chaired by Dr Kris De Clercq (Belgium). Members of the Group present were: Drs. Aldo Dekker (Netherlands); Franco De Simone (Italy); Matthias Greiner (Denmark); Bernd Haas (Germany); François Moutou (France); David Paton (UK); José Sanchez-Vizcaíno (Spain); Ms Nilay Ünal (Turkey) and Hagai Yadin (Israel). Apologies were received from Vilmos Pálfi (Hungary) who was unable to attend.

The EUFMD Secretariat was represented by Dr Keith Sumption (Secretary), Dr Dónal Sammin (Associate Professional Officer) and Ms Maria Solari, (secretarial assistance).

Introduction to the Closed Session

The Chairman of the Research Group, Dr Kris De Clercq, welcomed the members of the Group and the observers and passed the floor to Professor Preben Willeberg. The latter expressed his great interest in the work of the Group, and explained that he was present because the Executive had nominated him as the liaison person with the Group, to ensure that there is a two way dialogue between the Group and the Executive. In particular he indicated the importance of passing the concerns of the Executive to the Group to enable the key issues to be addressed and to better identify the type of information that they require. He suggested that his attendance be considered “a pilot project” to identify means of better liaison between the Group and Executive.

Dr De Clercq welcomed the observers present, including Professor Soren Alexandersen, Dr Naci Bulut and Dr Emiliana Brocchi, each of whom had contributed to papers for items to be discussed. Apologies were received from Vilmos Pálfi. Dr Schudel of the OIE and Dr Füssel of DG-SANCO were able to join the follow-up meeting on the 13th.

Note: as several observers could not join the Session on the 11th, a follow-up session was held on Wednesday, 13th. The report below has brought together discussions held on both days.

Introduction to the Open Session

Professor Christos Avgoulas, General Secretary of the Ministry of Rural Development and Food opened the Session and gave a speech of welcome to the participants. The Government of Greece was pleased to host the Session because of the importance of FMD for agriculture in Greece, which continues to the present moment. He emphasized that FMD can have devastating consequences both to stock-breeding and to the economy of the affected countries. The last epidemic of Foot-and-Mouth disease that struck Europe in 2001 reminded Governments in a really dramatic way that we must always be alert to the seriousness of FMD and pointed out the urgency and importance of immediate diagnosis. The work of the research teams is to achieve the targets which will help in the realization of this goal. Although the Foot-and-Mouth disease has been in our agenda for a long period of time, it is evident that constant research is of utmost importance. The level of FMD research in Europe should assist in reaching the rapid lab diagnosis that is required. The importance of the Session can be seen from the number of participants and the breadth of countries represented. He expressed gratitude to FAO for support to FMD control in the region and to Greece, and indicated the strong support of the Greek Ministry for this type of co-operative activity.

In response, on behalf of the Executive Committee of the EUFMD, Professor Preben Willeberg thanked the Government of Greece for the welcome and for arranging the Session in such a beautiful location. He re-iterated his remarks made to the Closed Session that the issues being discussed and the work of the Group, were of vital importance to those charged with decision making in disease control policy. The Executive Committee was therefore concerned to ensure the Group were encouraged in their activities and to focus on the most significant issues for decision makers. He thanked the scientific groups represented for their contributions to the debate and hoped the success of the Session would be noted for years to come.

Dr Sumption, Secretary of the EUFMD Commission, thanked the previous speakers for their encouraging words. A record number of observers had requested to attend the current Session from a
wider range of countries than ever before. The presence of so many persons from FMD endemic countries was welcomed, as this ensured that attention would be given to the problems for laboratories and epidemiologists working in the endemic areas; all should benefit from co-operation to reduce the threat of FMD in these regions. He recalled that type Asia-1 had swept across Iran, Caucasus, Turkey and into Greece as recently as 2000, and therefore the importance of maintaining close working relations between technical staff should assist to reduce the risk of this occurring again. Since the outbreak of SAT 2 in Libya in 2003, it as also clear that Europe, the Near East and North Africa must encourage FMD surveillance in eastern and sub-Saharan Africa as a form of early warning, and therefore he hoped the participants from these regions would be encouraged through contacts with other FMD scientists at the Session.

Representing the FMD Institute of Athens, Dr Helen Hondroouki gave a short presentation on the history of the FMD Institute. In the early years, the threat of exotic FMD infections ensured that Institute had carried out significant research leading to rapid production of vaccines to counter the threats. Recent work had focussed on early detection of FMD and other infections, through surveillance in high risk parts. FAO support had been very significant, especially in the early days.

Mr. Gregorios Archondakis, Vice-Mayor of Chania, welcomed the participants and wished everyone a pleasant stay in the historic region of Chania.

Following the opening speeches, Dr De Clercq, Chairman of the Research Group, reviewed the Agenda items and requested the Secretary to make the proposal for the reporting groups. Each item, as proposed, would have a reporting group, to be comprised of a member of the Research Group, speakers who had presented papers, and a rapporteur. He proposed the names for each reporting group, and these were accepted. In addition, feedback was encouraged from those representing the State veterinary services in Europe, and from those representing non-European countries not free of FMD.
REPORT ON DISCUSSIONS HELD IN THE CLOSED SESSION

11 October 2004

Item 1 - Adoption of the Agenda

The Provisional Agenda (Appendix 1) was adopted, with the exception that the order of discussion was altered to postpone discussion of some items until the 13th.

Item 2 - Papers for adoption

2.1 Minimum requirements for FMD serology laboratories

Dr Haas stated that this paper was initially developed by the biosecurity working Group following the Gerzensee Session, reviewed and revised following consultations with additional laboratory experts at the EUFMD workshop in Cordoba, and was then further revised after receipt of comments upon circulation to additional European experts. The document had been circulated in final draft form (“version 6”) to RG members prior to the Crete Session.

After discussion of a point regarding the location of laboratories in relation to control zones, the paper (Appendix 2) was adopted by RG members without further amendment.

The Chairman congratulated the Group on this important milestone for sero-diagnosis of FMD infection in Europe.

Note – follow up on 13th October

The position reached by the Research Group was summarized for those who were not present on the 11th. Dr Schudel considered that the paper could be used as an input into the deliberations of the Biological standards Commission of the OIE. He informed the Group that an ad hoc Group on laboratory biosecurity will be established by the OIE and in the next two years will develop texts for revision of 2 Chapters. He expressed the wish that the EUFMD Research Group work closely with this ad hoc Group, with possible representation at their meetings.

2.2 Diagnostic reagent bank

Dr Haas gave the background to the paper. It was agreed the paper be revised to change the title to a position paper of the Group, and to place the final sentence as a recommendation, and with these amendments be adopted as the position of the Group on the issue of establishment of a diagnostic reserve. The final version incorporating these changes is given in Appendix 3.

The Chairman described the risk that if national banks are created only in major countries or within the EU block there could become significant gaps in access to diagnostic kits in crisis situations. The suggestion to use the EUFMD/EC Trust Fund to fund the bank in the short term was raised.

Note – follow up, 13th October

The position reached by the Research Group was summarized for those not present on the 11th. In response Dr Füssel thanked the Group for their work and indicated a legal base for financing of the FMD reagent bank by the EC now exists. Decision on the form of funding mechanism had not been finalized and that the position paper would be useful in this respect. He indicated that tenders would take into consideration the technical recommendations of the Session.

Following discussion, the Group agreed that:
- There are benefits to recommending tests on the basis of their performance characteristics rather than by name.
- The Group should come to a recommendation on the minimum performance standards for test kits.
- Decision on test selection for the time being is based on the outputs of the Brescia workshop.
- The updating or replacement of the Brescia workshop data for the selection of tests should be placed on the Agenda for future Group Sessions.
2.3 Sample transport

The Group agreed the title of the paper (Appendix 4) should be revised to read “Summary of the Current Regulations.....” since the aim was to guide laboratory staff to the relevant international regulations, and practices of the WRL, in one document. The Secretary drew attention to the recommendation of the Cordoba workshop that the “summary” be updated yearly or sooner if relevant changes occur.

The Session agreed:
1. To further review the document and provide comments to the Secretariat (Action: Dr Paton).
2. To designate a contact person on the RG for updating the transport regulations (Current designate: Dr Palfi).
3. To discuss the issue of changes in the international regulations concerning shipment of diagnostic specimens with the representative of the OIE.

Note –on follow up on the 13th

The Secretary summarized the work of the Group. Given the primary importance of UN regulations relating to carriage of dangerous goods by air, and the difficulties currently faced by laboratories to transport diagnostic specimens for FMD confirmation, he proposed that Dr Schudel be given the floor to outline the OIE actions being taken with a view to reducing the adverse consequences of current regulations for the work of disease surveillance.

Dr Schudel outlined the position of the OIE taken by the OIE in suppositions to the UN SubCommittee of experts on transport of dangerous goods (UNSCETDG). The elements of the OIE proposal made in July 2004 approved by UNSCETDG, but which required final ratification in December 2004, enabled differentiation between lower risk diagnostic specimens and cultures of infectious agents. The entry into force of these changes is not expected until 1st January 2007, and therefore OIE has approached the International Civil Aviation Organisation (ICAO) for an addendum to the 2005-2006 Technical Instructions to be published, which would if agreed, bring forward the implementation to 2005.

The Session:
1. Supported the OIE position; and
2. Recommended that the national delegates on UNSCETDG and ICAO be requested to support the position.

Item 3 - Progress reports of the Working Groups established after the 2003 Gerzensee Session

3.1 Assisted delivery of samples from third countries

The Secretary gave an update on activities aimed at supporting delivery of virus isolates for characterization from the Horn of Africa/East Africa region, following the agreement made at Gerzensee to focus attention on this region because of potential for introduction to EUFMD member countries, via the Near East and North Africa. He also updated the Group on recently initiated FAO projects in West Africa and Central Asia which should improve delivery of samples from these regions for FMDV characterisation.

Conclusion

1. Despite the relatively slow progress made in establishing agreements, the Group strongly recommended continuation of the efforts.

3.2 Vaccine selection for the European banks

3.2.1 Vaccine selection and related issues

Dr Paton provided a paper on this subject (Appendix 5). In summary, he was pleased to provide reassurance that the characterisation of isolates received in the last year did not indicate the Gerzensee recommendations should be updated (on the antigens in the European vaccine banks).

In discussion, Dr Paton voiced concern that there is an emerging issue relating to strengthening of regional reference labs around the world to the potential detriment of the role of the WRL as a global reference facility. While strengthened regional surveillance was clearly desirable if there were further reduction in timeliness of reporting of virus characterisation results this would negatively affect early identification of trends and events in FMD risk. The EUFMD General Session was suggested as an
occasion to discuss this issue, since it is the appropriate event at which to make decisions upon the level of support for the WRL to be provided from the EUFMD Commission.

Recommendation

1. The global function of the WRL and support given by international bodies should be included in the Agenda of the EUFMD General Session.

3.2.2 Development of models to improve risk assessment/communication of FMDV circulation

The EUFMD Secretariat had agreed to take this item forward. Ideas for developing predictive tools had been discussed with Dr Perez of the University of California Group, whose activities in temporal and spatial mapping of FMD have significantly progressed since Gerzensee, to the point that two papers would be presented at the Open Session. The Secretary considered that prediction of FMD circulation may provide a basis for better risk visualisation, and would assist in identifying areas where the level of risk may be high but surveillance information low, which would help identify targets for improved surveillance. In addition the models may assist in risk analysis calculations if shown to be significantly better than the limited and patchy information from most endemic regions.

It was agreed that:
1. The Group be involved and should consider contributing to design of proposals for international collaborative projects on FMD risk mapping. (Follow-up: Dr P Willeberg, Dr Paton, Dr Sumption).
2. The development of global risk analysis tools should take into consideration requirements for prevention of agro-terrorism.
3. A focal point in the Group for information on agro-terrorism issues should be designated. (Dr Sanchez-Vizcaíno agreed to act as focal point).

Dr Sanchez-Vizcaíno and Dr Sumption agreed to liaise with EC (DG-Research), and to identify the outcomes of NATO Sessions relating to prevention of agro-terrorism.

3.3 Comparative evaluation of candidate DIVA tests

Dr de Simone presented the work of the WG (Appendix 6: report of Brescia WS) which had been entrusted with the task at the Gerzensee meeting; the most significant event to report was the Brescia workshop in May, the organisation of which had required very significant efforts by many parties and could be considered a major success in organisation and output. The WS was supported by EC (through the Improcon project) and through FAO/EUFMD, and the diagnostic companies concerned provided kits at reduced costs. Over three thousand sera were received after heat inactivation, from 9 countries. Eleven people worked in the first 10 days, and very rapidly produced the final preliminary report. Some repeat testing occurred during and following the WS, and final agreement between authors was required before the final report could be produced. One of the key findings is that there were not found to be significant differences in diagnostic specificity (DSp) between vaccinated and non-vaccinated populations. Regarding the results for discrimination of the most critical animal infection status Group, most tests approached 90% (and after re-testing approach 95%) sensitivity. Discrepancy analysis suggested that differences in test result could be exploited, to improve DSn or DSp, for example through parallel testing or re-testing for confirmation of test status. Quality control of kit batches will be essential to maintain confidence in expected test performance.

Principal gaps were in the number of suitable sera available to be tested from sheep and pigs. In the latter there is limited sera available in Europe even if present elsewhere; it is seen as very important that European laboratories can make their own assessment of suitability of diagnostic tests for use in pigs and to have sufficient sera for control purposes available as these would be necessary to support any decision that would result in large scale testing.

The Chairman thanked Dr de Simone and all participants and supporters of this action for the immense effort. He indicated that the final report of the workshop will be agreed between participants and published shortly.

Discussion

The Secretary indicated that in response to the report of the WS, the Secretariat had worked to establish collaboration with Groups working principally on diagnostics for pigs in Asia and as a result
Dr Dyrting from Hong Kong had been partially funded to attend the Crete Session to discuss a programme for collection and supply of suitable sera.

The need to determine suitable test regimens for practical situations, based on an analysis of the workshop data, was mentioned by several members. Dr Willeberg stressed the importance of comprehensive review of test performance in order to develop the guidelines for post-vaccination surveillance (PVS). Dr Bulut indicated that guidelines for interpretation of data could be useful to address the needs of Turkey, using data from problem areas and case-studies. As an example he mentioned that in recent experience, only 11 of 58 positives tested positive on re-bleeding 6 weeks later.

Dr Dekker proposed that further statistical analysis such include maximum likelihood analysis of ELISA results be undertaken, and offered to undertake this.

Regarding performance of alternative tests to the OIE index method, the Chairman considered that results indicate that one or more tests behave sufficiently similarly to the Panaftosa test to enable it to act as equivalent to the OIE index test. Dr Dekker supported this, on the basis that there is no significant difference between most test systems for sensitivity and specificity, thereby providing a measure of confidence that laboratories can select between several of the available tests.

On the issue of recommending test systems, Dr Haas proposed that it was not necessary to make recommendations, rather the publication of diagnostic performance should assist countries to make their own selection of tests.

Dr Willeberg stressed the exceptional importance of the WS was appreciated by the Executive Committee and thanked those responsible for the organization.

Conclusions

1. The Group has identified tests that perform very similarly to the OIE index test, for use in cattle.
2. Provisional figures for test performance have been identified, but which will not be released until final quality checks have been completed, unless required in an emergency situation; the provisional figures can assist the modeling on test use and on impact in surveillance.
3. The Group does not need to recommend a particular test, rather laboratories should be given sufficient information on which to base their own decisions in consultation with their state veterinary services. Guidance on strategies for test application and analysis would be helpful to the latter.

Recommendations

1. The working Group is strongly encouraged to continue to finalise and publish the comparative analysis.
2. The RG should at an early stage identify strategies for test application and analysis to give guidance on the use of single or multiple tests for detection of vaccinated and putatively infected animals.
3. A proposal for activities (to be conducted under Letter of Agreement) should be developed to address the requirements of the European laboratories for sera from pigs for NSP validation purposes. (Action: Dr De Clercq and Donal Sammin to develop, to be funded via the EUFMD/EC Trust Fund).

3.4 Working Group on post-vaccination surveillance

3.4.1 Gerzensee issue: Progress on parameter estimations

Matthias Greiner provided an overview (Appendix 7) of some recent developments relating to parameter estimation on a) performance of diagnostic tests, and b) on design prevalence.

On the first, he illustrated the system intended to provide a transparent and recognized level of test validation ("fit for purpose"), under development by the OIE Biological Standards Commission (OIE-BSC). He suggested that no-gold standard methods be applied to analysis of the data outputs of the Brescia workshop, and to compare these results to other quasi-gold standards such as the current OIE index test for NSP serology.

Regarding the other parameters required in the design of surveillance using NSP tests, he stated that absence of infection/disease is technically impossible to prove, and therefore the target (detection
limits) need to be defined, for example 0.2% between herds and 5% within herds. However defining a scientifically justifiable lower limit for prevalence which requires to be detected is more controversial; here the question is –“at what lower level would there be no virus circulation?”

He recommended that field data should be used to better define the design level prevalence. He indicated that goals need to be defined for test validation; fixed values for required DSe and Dsp are not useful; and that consensus is needed about the levels of “design prevalence”.

Discussion

The use of concept of circulating infection was discussed. A move to the use of “circulation” was seen by some as a simplistic attempt to avoid the problem of carrier animals and detection of low prevalences. However since sustainable, continuous transmission sufficient to maintain an epidemic (“circulation”) is likely to leave far more evidence in the form of recovered, antibody positive animals, the relative ease of testing for circulation has some potential advantages.

There was general agreement that:
1. The disadvantages and advantages of a move from the current surveillance objectives, to adopting the “absence of circulation” objective after emergency vaccination in normally unvaccinated populations, needs to be clearly set out.
2. The issue of low target prevalence is stumbling block to progress on defining acceptable levels of PVS, and therefore the EUFMD Commission should explore alternatives.

3.4.2 Post-vaccination serosurveillance (PVS) for presence of FMD infected animals

Dr Paton outlined the paper prepared with Dr De Clercq and Dr Dekker (Appendix 8), which would be presented in full at the Open Session. The Closed Session was an opportunity to air some of the issues for which the Group would need to propose solutions if doubts about the feasibility of PVS were to be assuaged. Following the Brescia workshop, the DSn and DSp of NSP tests are now far better known and can be applied to model the application to detection of infected farms. The paper raised several significant concerns, and proposed several possible solutions. One issue is that of testing small herds for absence of infection. One solution considered would be to not vaccinate small herds, but this could operationally objectionable to some stakeholders.

Discussion

The effort of the authors to define the problems and possible solutions was widely appreciated. However, some issues raised were not seen as major problems by all members. Dr Haas considered the risk posed by false negative animals in small herds would in principle not be different for such animals between small and large herds. Dr Greiner suggested there would be statistical methods applicable to defining small herds, and grouping of small herds.

Conclusions

1. The small herd problem requires further study to determine if there are guidelines that can be useful to decision makers in the application of vaccination.
2. The problems which require value judgments by policy makers should be clearly set out.
3. The existing Brescia WS data should be sufficient to undertake case studies and scenario modelling to better define the impact and feasibility of surveillance options.
4. The level of complexity in the scenario modeling needs to be defined and may require a new dedicated project to undertake.

Recommendations

1. The Group should identify the problems that may be addressed by technical means, that may be addressed by redefinition of existing standards, and those where higher level policy decisions are needed.
2. A working Group is needed to address the small Group problem (Action: Matthias Greiner, Aldo Dekker, Kris De Clercq and David Paton; Dr Greiner kindly developed a paper relating to this for the Session report – Appendix 9).
3. Attention to the issues for FMD free countries in regaining FMD free status when emergency vaccination is applied must be addressed when changes to the OIE Code and surveillance guidelines are under development or considered for adoption.
4. The OIE Code and surveillance guidelines require re-examination and a WG continues to be required to identify possible Code or guideline changes.
Note on the follow-up discussions with EC and OIE representatives

The issues raised in the Closed Session were reviewed and briefly discussed with the OIE and EC representatives. Dr Schudel indicated that a proposal prepared by the Group should be received by January 2005. This could then be considered by the OIE ad hoc Group, or possibly directly reviewed by the Scientific Commission.

It was agreed it was necessary to:
1. Include and as far as possible, address the issues raised by the Group relating to 3.8.7.
2. Base the proposed revisions on the draft guidelines, as currently exist in the OIE Code.
3. Establish a working Group (David Paton, Matthias Greiner and Keith Sumption) with the aim of producing an agreed text by end of November, for circulation and comment by the Group and EC representative before submission to the OIE.

3.5 FAO Phase XVIII progress and plan

Dr Paton provided a paper (Appendix 10) detailing activities and progress of Phase XVIII. The Committee warmly supported continuation of the Phase and congratulated the WRL team on the progress made. It was agreed that the conclusions and recommendations of the discussion held in Open Session should be considered by a meeting of the subGroup concerned with Phase XVIII and its follow-up, on the 15th November, and their report integrated into the Session report (Appendix 11).

3.6 Proficiency panel for virus detection; progress report (pilot study)

Dr Paton provided a position paper on "Progress and future prospects for standardisation of FMD tests" (Appendix 12). This included the issue of proficiency panels for virus detection tests.

The Chairman thanked Dr Paton for the report which provided a timely reminder and suggestion of the need for further action.

The Committee agreed that:
1. The action needs to be continued, there being currently no system for external evaluation of laboratory competence in virus detection.
2. Additional funding would be required for some elements, for example for cost of transportation of the panels.

The Secretary agreed to consider a request for funding and that an estimate of additional costs should be prepared.

3.7 Working Group on penside tests

The Working Group had made some progress in two areas: 1) a preliminary set of guidelines had been developed at the Cordoba workshop, restricted mainly to general principles applicable to selection and use of portable, rapid tests; and 2) a rapid antigen and antibody detection test (chromatographic strip tests) were utilised in a study in Anatolia, Turkey (Appendix 13), and results compared to conventional laboratory procedures.

Donal Sammin gave the background to the work undertaken in Turkey; the evaluation of tests was undertaken as a secondary objective to the evaluation of FMD outbreak investigation procedures in an endemic region. The potential of rapid tests to provide an immediate result which would support the identification of current or recent infection in a group of animals was attractive. It was assumed before the field study that signs of clinical infection may be transient and not easily found in backwards and forwards tracing, thereby creating a greater need for confirmation of recent infection in animals with recovering lesions.

Regarding performance of chromatographic strip-tests for antigen:
- Dr Bulut stressed that intact vesicles are not commonly found during investigations and therefore to be useful tests should give positive results with the commonly observed stages of the lesions. The antigen test used was found to have a low sensitivity, except with fluid from intact vesicles, whereas with OP fluids from animals with lesions, only 3/38 were positive. Only 16 could be considered conclusive with OP fluids, which may be related to viscosity of samples.
Regarding performance of chromatographic strip-tests for antibody:

- With the NSP strip tests, 6 (strong positive result) to 35% (trace positive) of animals with lesions considered to be between 3 and 10 days old gave a test positive, and when samples 4 to 7 days later, between 11 to 48% (strong to trace, respectively) were positive. When tested by laboratory ELISA methods, 73-100% were positive in 4 Groups and 97-100% when re-tested. The Rapid Test (RT-Ab) may have use in some investigations despite the lower diagnostic sensitivity, as flock or herd test where a positive result is of significance. However, in an endemic area, positives may result from previous waves of infection and thereby complicate detection of recent exposure. In the study, NSP antibodies were detected very early after the lesions were present and this was considered the result of exposure several months earlier, presumably to a different antigenic type.

Dr De Clercq thanked the Working Group for their efforts to evaluate tests in real-time. The experience should be useful in considering how to use existing tests, and the level of sensitivity and specificity required in portable tests.

**Conclusions**

1. The chromatographic tests evaluated have some potential as an adjunct to thorough veterinary clinical examination and epidemiological investigation.
2. The low sensitivity of both the antigen and antibody test strips indicates that negative results must be treated with a great deal of caution; suspicions gained through surveillance investigations will require confirmation through validated laboratory tests.
3. Rapid availability of SP and NSP serology results can be extremely useful in the investigation of FMD in endemic areas where vaccination is practiced.
4. Interpretation of SP and NSP serology results may be difficult in endemic areas, particularly where vaccination is used. Guidance is needed on the interpretation of herd profiles.

**Recommendations**

1. It is strongly recommended to continue with similar, or extended, surveillance studies in endemic areas of eastern Turkey.
2. Greater involvement of the RG in the surveillance activities in countries not free of FMD should be encouraged by the EUFMD Commission, which should provide a high level of mutual benefit.
3. The RG should assist in the analysis and interpretation of herd/village level serology data from eastern Turkey.

**3.8 Laboratory contingency planning**

The EUFMD Cordoba workshop in April 2004, organised by Dr Sanchez-Vizcaíno, Dr De Clercq together with the Secretariat, and with financial support from DG-SANCO, had been very successful and the key points in the report (Appendix 14) were highlighted.

Following discussion, it was agreed that there is a need to consider the revised LCP of the WRL as potential replacement of the model plan developed and discussed at Cordoba. Action: Dr Paton to forward the updated WRL model laboratory contingency plan (LCP) to the Sectrariat for circulation to the working Group.

**3.9 Working Group on FMD Virus inactivation kinetics**

Prof. Alexandersen presented a short proposal (Appendix 15) to establish a working Group, to take forward the recommendations of the Gerzensee Session to develop study plans and carry forward with potential funding sources.

In resolution, there are two items of agreement:
1. A Working Group should develop a study plan, including definition of the level of infectivity in pork products.
2. The Executive Committee should consider if the RG should develop a draft Section for the OIE Code, on treatment of pork from areas not free of FMD, or other sections of the Code relating to conditions for trade in pigs/pig meat from areas not free of FMD.

**3.10 Laboratory sero-diagnostic capacity**

The Secretary drew attention to the discussion and recommendations of the WS in Cordoba. He indicated there remains a need to provide guidelines on what constitutes adequate capacity for sero-
diagnosis to meet post-outbreak requirements. To take this forward the participation of Dr Hammond from the Geelong Laboratory was invited to present the Australian approach to determining laboratory sero-diagnostic requirements post-outbreaks.

**Recommendation**

A paper on “adequate sero-diagnostic capacity” should be developed by the Group, in advance of the EUFMD General Session in 2005.

3.11 Bio-security standards for FMD laboratories

The need to continue the WG on bio-security/bio-containment to revise the EUFMD Minimum Standards for FMD laboratories was discussed. This text has had an importance since the 1980’s and the paper adopted in 1993\(^1\) is a reference text in the EC Directive. The Gerzensee Session agreed that revision of the 1993 paper should be undertaken in late 2004 following first development of the guidelines for serology laboratories. The Group reviewed this requirement and considered that the need to revise the 1993 Standards was not clear as these had worked without recognized problem for at least 10 years, and any change would have financial implications for laboratories which may even lead to closure of facilities.

**Recommendation**

Comments should be solicited, from Group members, on the 1993 Standards, in order to assist the Chairman, and also the OIE, in a decision upon development of new texts on biocontainment for FMD laboratories. *Action: Secretariat to circulate 1993 Standards.*

**Item 4 - Short report of EUFMD/EC supported studies relating to validation of DIVA tests**

4.1 Prevalence in vaccinated herds exposed to infection – report of study undertaken in Israel

The Secretary reported that during the year Dr Yadin made a proposal to use the opportunity of outbreaks occurring in Israel to undertake a study on the spread of infection in vaccinated populations. The EC (DG-SANCO) had agreed to support the action in order to better establish parameters for design of post-vaccinal surveillance.

Dr Yadin reported that the studies were designed to gain information on the level of prevalence in herds where FMD exposure had occurred through contact with infected animals. The study was possible since in Israel such exposed herds are not culled, and highlighted some aspects of the epidemiology of FMDV in vaccinated populations which may be of major significance for control of infection both in vaccinating countries, and in countries considering using emergency vaccination. The experience highlighted that spread in well vaccinated herds may be minimal even where direct or indirect transmission from a clinical case within the herd occurs, and that in well vaccinated groups of animals on same management unit, a few animals may sero-convert without clinical signs being seen, indicating exposure and infection had occurred.

The data provides two estimates of intra-herd prevalence that may be very useful in modeling NSP test use in PVS, and in the absence of other data, used in defining guidelines for PVS.

From the epidemiological investigations, he concluded (Appendix 16) that:
- Sheep are high risk factor as source of infection for cattle herds.
- Feedlot fattening systems, particularly those with vaccination problems, are at high risk of developing clinical FMD.
- Vaccination programmes in feedlot systems need attention to ensure adequate re-vaccination is applied.

**Discussion**

The study was found to be extremely useful and provide very interesting data to support further work on design of surveillance. The figures of within herd prevalence, of 0 to 5% in 6 groups (2/119, 1/58, 1/61, 6/120, 0/49, 6/71), in two vaccinated dairy herds with no clinical signs, on farms where FMD

\(^1\) Appendix 6 (ii), Report of the 30\(^{th}\) Session of the European Commission for the Control of Foot-and-Mouth Disease, Rome, Italy, 27-30\(^{th}\) April, 1993. 

had occurred in associated feedlots, could provide useful indicators of the prevalence to expect in vaccinated herds in Europe exposed to infection but where no clinical signs are observed. However, since only two farms were studied where no FMD signs had been observed, the number of observations were seen as inadequate.

**Recommendation**

Further data on intra-herd prevalence in vaccinated herds exposed to infection is needed, and therefore it was recommended that similar studies should be conducted if further opportunities arise, especially in the context of emergency vaccination.

**4.2 Collection of sera/specimens for validation of DIVA tests for detection of animals received from SAT virus infections**

The context of the study (Reported in Appendix 17) was provided by Donal Sammin; following the Gerzensee (2003) and Çesme (2002) Sessions, to address the lack of suitable sera for validation of NSP tests for detection of antibodies to SAT viruses, the opportunity had arisen to utilize field exposure in Zimbabwe and a contract had been developed with the Zimbabwean authorities. Funding was agreed with the EC (DG-SANCO) through the EUFMD/EC Trust Fund. Together with David Paton, a report was presented on the activities and results, which had been successful in meeting almost all of the objectives; sera had been collected from a high number of animals subsequently shown to be persistently infected with SAT1 or SAT2 virus, and therefore this enabled evaluation of indirect tests including NSP tests, as markers of infection. The results demonstrated that NSP tests have the expected sensitivity for SAT1 and SAT2 and give confidence to the use of NSP tests for these types and therefore do not support inferences from some earlier field studies that NSP tests for SAT infections have a lower sensitivity. In addition, a unique dataset of test results has been obtained on performance of tests which will assist selection of diagnostic tests for detection of carriers.

Dr Paton highlighted the value of the study for collection of samples for validation purposes and cautioned that the herd vaccination/infection status could not be considered similar to vaccination and infection status expected under disease management scenarios in Europe.

**He concluded:**

1. The study provided useful data on the prevalence of SAT 1 and 2 virus carriers in cattle herds 1-5 months after FMDV infection and on their ease of detection by different virological and serological methods.
2. Virological tests on nasopharyngeal brush swabs scored very few cattle as infected compared to the conventional approach of testing samples obtained with a probang sampling cup.
3. Routine RT-PCR was equivalent to, and optimised RT-PCR more sensitive than, virus isolation for the detection of SAT 1 and SAT 2 FMDV in probang cup samples.
4. SPCE and NSPE tests readily detected animals that had been infected with SAT 1 and SAT 2 FMD viruses.
5. Sensitivity estimates of NSPE for detection of FMDV carriers (75-90%) were very similar to those obtained with experimental sera during the NSPE workshop in Brescia in May 2004. By comparison, the VNT could detect all carriers.
6. Since none of the herds from which virological data were available had been optimally vaccinated and since clinical disease was obvious, the study provides limited insight into the prevalence of carriers likely following subclinical infection in well vaccinated herds.

**He recommended that:**

1. Final conclusions should wait until the results of all tests, such as antibody detection tests on saliva samples, use of RT-PCR internal standards and completion of data analysis.
2. It would be useful to conduct similar exercises involving herds with a more certain vaccination status and following use of emergency vaccination in a previously disease-free region, and also in areas where disease has occurred in vaccinated pigs and sheep.

Dr De Clercq congratulated those involved and expressed gratitude on behalf of the RG for the valuable samples collected and the results obtained.

**Recommendations**

1. A further presentation to the group be made after all tests have been completed, which should also provide guidance on use of single or parallel tests for detection of carriers.
2. The distribution of aliquots of the sera should be restricted to RG members participating in the comparative evaluation of DIVA tests, because of the scarcity of sera from animals whose status has been assessed by other tests for evidence of virus infection.

**Item 5 - Items arising from the Executive Committee 69th and 70th Sessions**

**5.1 Performance of the new oil adjuvanted vaccine and conventional vaccines produced by the SAP Institute in 2004**

Dr Ünal presented information (Appendix 18) on vaccine quality assessments conducted in 2004.

Responsibility for vaccine control has still not been transferred to Bornova Institute; FMD Institute continued to control the sterility, safety and potency of the vaccines as usual. BVCRI inspected the safety and potency tests to be conducted in FMD Institute, and FMD Institute sent a dossier for each production batch to BVCRI. She stated that in addition to the regular controls, BVCRI will, at random, inspect control tests being performed.

Conventional, aqueous vaccines (Al-sap) vaccines continue to be the principal type produced and applied in the field. A pilot study in 2002 with trivalent, Montanide ISO 206 (Seppic) oil adjuvanted vaccine (W/O/W) had indicated prolonged and satisfactory levels of antibody. Ninety-four cattle and 90 sheep were tested at 28 dpv and 194 dpv, with protective levels in around 60% cattle at 194 days. A 1 ml sheep dose gave 85% immunity. They had therefore proposed to produce oil adjuvant vaccine for national campaigns in 2004 but could not because of delays in procurement of antigen concentration equipment. However oil vaccine was produced in quantities (5 million doses) that allowed some regional use within Turkey, and also export to Georgia (575,000 bivalent and 500,000 oil adjuvanted trivalent vaccine).

She gave results of 5 serological tests for vaccine potency conducted in 2004 in naive cattle in field locations. For Asia-1, O and A types, the % with protective titres was 93-100%, 90-98% and 87-98% immunity. The regime in the country was been changed in 2004, with move to bivalent vaccine in the autumn campaigns, except in the eastern/south-eastern border area.

**Conclusion**

1. The detailed results of the challenge tests and serological assessments on each batch are of importance to the EUFMD Commission in light of the results obtained of EQA in 2003 and the mission report of 2003.

**Recommendations**

1. The detailed potency test results (laboratory challenge and full results of field serological tests) should be made available to the Commission, until the time that recommendations of the 2003 mission have been seen to be implemented satisfactorily.

2. Further attention should be given to undertaking the recommendations of the 2003 expert mission to the SAP Institute. Expertise in the Group (Aldo Dekker) can assist in technical advice on fulfillment of the recommendations.

**5.2 Guidelines for monitoring performance of FMD vaccines and vaccination in the field**

The Secretary presented the background to this item. In recent years vaccination zones (buffer zones) had been supported in Europe for FMD control, in Thrace region and in the Trans-Caucasus countries. The paper had been commissioned to bring guidance to the Executive on sero-monitoring of these campaigns; in Thrace region the sero-monitoring was based on recommendations of the Research Group, while in the Trans-Caucasus, sero-monitoring in 2003 had been by the FGI-ARRIAH who had applied a lower test cut-offs for assessment of immune status, and thereby obtained results which might be interpreted as overestimation of protection. In addition there is a need to optimise timing of sample collection.

Dr Yadin presented the draft guidelines (Appendix 19) which he had prepared together with Dr Barteling and Dr Sutmoller. The authors emphasized the need to test (or inspect test results) of vaccine prior to and following purchase. They did not recommend a system of only testing after delivery. In Israel, since 1992, vaccine quality has been monitored with a system of testing batches of vaccine before use, and vaccination performance monitored by assessment of herd immunity rates every year. The system currently involves sampling in 4 age groups on 6 farms, located in different
areas. The system had enabled early detection of vaccine performance problems. The paper was presented for discussion.

The Secretary thanked the authors for their efforts. He noted the authors had elected to extend the scope of the paper beyond that requested by the Secretariat, since they considered that post-import testing was inadequate to ensure the quality of purchased vaccines would meet the requirements, and in addition, it is important to win the confidence of stakeholders by full and early publication of information on vaccine quality and potency.

Discussion

Dr Haas supported the use of serological assessment of potency, but considered that it must be on the basis of a well established relationship between titres and protection, obtained with multiple batches. He considered that, depending on the laboratory and the virus strain, the necessary titre to ensure that a vaccine batch will pass a challenge test will often be much higher than the LPBE titre of 1:100, which is frequently cited as a generally applicable cut-off. He therefore warned against the use of test cut-off figures based on invalid assessments, because this could lead to an overestimation of protection.

Paul Sutmoller stressed that field monitoring is not an alternative to quality checks on the purchased vaccine. Both components are required to ensure the eventual herd immunity meets expectation.

The necessity of obtaining panels of reference post-vaccination sera for each strain which is present in the vaccine bank was emphasised in order to ensure that titres recorded for a vaccine batch can be compared to titres of homologous reference batches.

Conclusion

1. Sero-monitoring vaccination in the field provides a useful measure of application of vaccines, but in addition vaccine potency must be monitored by challenge tests or by serological tests where a well established relationship has been described.

Recommendation

1. The RG should finalise, as soon as possible, the sections relating to testing of the vaccine after arrival and in the monitoring of campaigns. The revision of the draft paper should be scrutinised by the Group before a decision to adopt it is made.

5.3 Terms of reference/vision for the Research Group of the Standing Technical Committee

The Secretary presented the Terms of Reference (ToR) for the Standing Technical Committee, which had been agreed at the 70th Executive Committee Session:

1. To provide technical guidance to the Executive Committee of the EUFMD Commission, and thereby to the member states and wider international community.
2. To identify technical gaps relating to FMD control that should be brought to the attention of the Executive Committee, and/or the member states.
3. To assist in the maintenance of expertise on all aspects of FMD control.

He explained that the ToR are not defined in the EUFMD Constitution or Rules of Procedure, and appear to date to the foundation of the Committee in 1957. The ToR did not greatly differ from those of 1957 except in the aspect of maintenance of expertise in Europe, where the present situation is far different from that occurring when FMD was endemic in mainland Europe. Dr Willeberg added that that the Executive were concerned that the Committee maintained sufficient expertise and activities relating to control of the disease to ensure continuation of support to decision makers. The Chairman asked for position of each member on the ToR and the Terms of Reference were unanimously upheld.

Item 6 - Items arising from EUFMD implemented actions in FMD Control in TransCaucasus under EC support

6.1 Plan for assessment of potency, and induction of NSP antibodies by FMD vaccines produced in Armenia and Georgia

The Secretary requested guidance from the RG on the protocol to be recommended to test FMD vaccines for induction of antibodies to NSP tests. This request follows problems suspected to result
from unpurified vaccines in the above countries, but which is also suspected to be a problem in other countries in the region.

**Recommendation**

Testing of FMD vaccines for induction of antibodies to NSP antigens should follow the protocol given in the position paper of the European Medicines Agency (EMEA) of June 2004 on requirements for vaccines against FMD, prepared by the ad hoc Group of the Committee for Veterinary Medical Products (CVMP), at which the Research Group had been represented by the Chairman. The part of the position paper relating to testing for NSP induction, is given in Appendix 20.

**Item 7 - Items raised by the Committee members**

*National responses to new Directive: expert groups/simulation exercises*

The Chairman introduced the subject and that requested the members to outline the activities in their countries on simulation exercises to test contingency plans (CPs), and the role of experts in their national expert Groups. From the response it is clear most countries plan to undertake simulation exercises in the next 1-2 years, and there is a developing body of knowledge and expertise from which to develop "best practice". The subject of laboratory CPs was raised and the issue of use of European expertise in the national expert Groups.

**Recommendation**

It was agreed that it is necessary for the Executive Committee to address the issue of expertise and competence of the national expert Groups, including the use of international experts, and therefore is recommended as an Agenda item for the 2005 General Session.

**Item 8 - Upcoming issues and items for consideration in new workplan**

The discussion on the new workplan (ie October 2005 - onwards) was deferred for discussion at a later time, ahead of the EUFMD General Session.

**Item 9 - Workplan of the EUFMD Research Group to mid-2005**

The Session agreed that the 2004 plan should continue into the second year, as envisaged at Gerzensee, with incorporation of the recommendations of the current Session.

**Item 10 - EUFMD Research Group Sessions in 2005 and 2006**

The locations and provisional dates of the 2005 and 2006 Sessions are:

- **Insel Riems, Germany**
  Dates: 20-23 September 2005 (OIE and David Paton/Coordination Action to approve)

- **Eilat, Israel**
  Dates: 17-20 October 2006 (H Yadin to confirm dates)
REPORT ON DISCUSSIONS HELD IN THE OPEN SESSION

12-15 October 2004

Item 1 – Recent findings in molecular epidemiology of FMDV

Dr Jean-Francois Valarcher provided an overview of the occurrence of FMD worldwide since January 2003 (Appendix 21), highlighting the work of the FAO World Reference Laboratory for FMD, the genetic diversity found within the different serotypes and the available evidence on antigenic matching to vaccine strains. Dr Wilna Vosloo provided a summary (Appendix 22) of genetic and antigenic information on the extremely diverse FMD viruses circulating in sub-Saharan Africa. She discussed the epidemiology and the role of wildlife in the persistence and spread of some serotypes in different regions and outlined some of the difficulties posed for disease control.

Dr Kirsten Tjørnehøj described the antigenic and genetic characterisation of a new lineage of type O from Uganda that has been associated with a syndrome of chronic photophobia in convalescent cattle (Appendix 23). Nick Knowles also described laboratory sequencing studies of FMDV isolates from several East African countries which had identified two previously unrecognised lineages of type O FMDV with differing geographic locations and a possible role for recombination in the generation of new strains (Appendix 24).

Dr Laurids Christensen outlined ambitions for the development of high capacity sequencing at Lindholm and discussed the potential for fine tracing of FMD outbreaks by genetic comparison of isolates from different herds (Appendix 25). He presented sequence data for resolution of the spread of FMDV between herds in the Danish outbreak of 1982-3. Jose Ignacio Nunez analysed sequences from three genomic regions and antigenic profiles with monoclonal antibodies to determine the likely origin and the substitution rate for FMDV type O isolates from the 1993 outbreak in Italy (Appendix 26).

Dr Dan Haydon discussed the prospects for further study of the microevolution of FMDV (Appendix 27), pointing out that there was great potential to use genetic variation to trace outbreaks more accurately, to identify the role of recombination in the emergence of new strains and to predict antigenically significant changes in the amino acid sequences of isolates.

Conclusions

1. FMDV is still active in many parts of the world and there are significant gaps in our knowledge of the global diversity of the virus and of the likelihood for different viruses to spread.
2. Two new type O lineages have been recognised in East Africa, as well as cases of a heat intolerance/photophobia syndrome thought to be a chronic sequel to FMD. The origins and mechanism of emergence of new variants are unresolved, although RNA recombination between FMD viral genomes may play a role and is being increasingly demonstrated.
3. However, recent reports of serotype C in East Africa, Asia and South America are cause for some concern and the origin of these outbreaks is not yet clarified.
4. There is a shortage of standardised antigenic information to aid vaccine selection, but available evidence suggests that current recommendations remain appropriate. The antigenic diversity of SAT strains cause difficulty for vaccine selection and SAT 2 is of the most concern due to its high degree of antigenic diversity, widespread distribution, and frequent historical association with FMD outbreaks in livestock.
5. High resolution analyses of epidemiological dynamics are powerful tools that remain to be fully exploited.

Recommendations

1. A better coordination between reference laboratories will improve the global surveillance of FMD.
2. More research is needed to better define the extent of genetic and antigenic diversity amongst FMD viruses circulating in sub-Saharan Africa.
3. A more comprehensive system of applying vaccine matching is needed as well as the harmonisation of existing techniques and the development and validation of improved methods. More linkages between antigenic and genetic comparisons are needed to improve our ability to predict vaccine coverage.
4. That the laboratory and techniques used for confirmation of an outbreak is recorded in the information system of the OIE (Handistatus II).
5. The presence of serotype C and the occurrence of serotype SAT 3 in some Central, West and East African countries must be confirmed by a reference laboratory and their origin determined.
6. Information on genetic diversity of FMD viruses should be linked to more studies of the epidemiology of the infection in endemic regions to improve predictions on the risk of the spread of FMD viruses.
7. To gain a better understanding of the evolution and spread of FMD more complete genomic sequence data should be generated to identify recombination and mechanisms involved in the emergence of new variants.
8. High volume sequencing capacity should be established in several European laboratories and the latest methods of sequence analysis should be applied to improve our understanding of the evolution of FMD virus and to develop methods for the fine resolution of virus spread.

Item 2 - Surveillance: for what purpose and how much is enough?

Dr Jordi Serratosa described the new European Food Standards Agency (EFSA) and its anticipated role in animal disease risk assessment and its aim to give independent scientific advice on matters related to food and feed safety (Appendix 28). Discussions highlighted the need for this agency to work with existing bodies and that it should not become a competitor for the EUFMD to avoid conflicting advice to stakeholders.

Prof. Prem Kumar Uppal highlighted the potentially underestimated role and importance of small ruminants, particularly in the Middle East and Asia, in FMDV outbreaks and persistence at the population level (Appendix 29). He proposed epidemiological studies to improve our knowledge in this area and the need to include sheep in any surveillance programme.

Dr. Marius Gilbert also highlighted the role of small ruminants and illegal movements across borders in the Middle East region and demonstrated the use of GIS systems for combining spatial data to assess risk factors for outbreaks (Appendix 30).

Dr. Andres Perez continued with the demonstration of the use of spatial data and the development of new Bayesean techniques for mapping the global risk for FMDV (Appendix 31). Issues of data reliability and ground referencing the data were discussed along with the need for collaboration with national veterinary organisations to improve the data quality.

Prof. Mark Thurmond gave an overview of the need and prospect for a global surveillance system and presented the prototype web based portal through which information could be accessed in a real-time global surveillance network (Appendix 32). The need for collaboration was again highlighted.

Dr Hassan Wishte\(^2\) summarized the implementation of a new geo-referenced database in Iran, and reported that it is now operational for 22 of 28 provinces in Iran (Appendix 33). This system records and reports not only disease outbreaks but also other epidemiologically relevant data.

Conclusions

1. Cooperation among national and international bodies on global FMD control and surveillance activities is essential.
2. Methods to validate, summarize, visualize and distribute global FMD surveillance information should be further developed and refined. These approaches, which include modelling and statistical expressions and relations, improve our ability to interpret large amounts of data and to draw clear and reasonably confident conclusions from complex information.
3. The GISVET system facilitates national surveillance of transboundary animal diseases (TADs) in Iran, and should assist understanding of spatial and temporal trends in FMD in this country which may provide insights for wider application.

Recommendations

1. The Executive Committee should consider the proposals from EFSA and the UCDavis-FMD Surveillance and Modeling Laboratory about cooperation or partnership in the proposed joint FMD activities.

\(^2\) Presentation made later in the programme, but because of relevance is summarised in this section.
Governments and international organizations should facilitate and support activities in the following R&D areas:

a. Improved livestock census data for specific regions of importance for FMD risk.
   - In particular sub-national data on livestock density, animal movements, people movements, product movements.

b. Improved understanding of the specific epidemiologies of different serotypes and their interactions with the different host species.
   - Raised awareness and appreciation and design studies to address the role of small ruminants and domestic buffalo and wildlife species in the persistence of FMDV in domestic populations.

c. Raised awareness of geospatial data and ways of combining data from different sources to provide summary statistics, analysis and predictions.
   - Quantitative and analytic methods and approaches should be strongly encouraged in presenting scientific data in order to succinctly and clearly interpret data and results in ways that offer confidence assessments and that are compatible with decision and policy making.

d. The processes for sharing information, data and reagents that will maximise the utility of the available information while minimising delays related to legal requirements and competition.

Training in spatial epidemiology should enable the wider application and significance of the GISVET surveillance system to be realised in Iran. Adequacy of information at regional level should be strengthened by the transfer of rapid, validated diagnostic test methods to regional laboratories.

**Item 3 - Transmission and its control**

All presentations in this Session aimed at the quantification of transmission of FMDV. Prof. Soren Alexandersen showed that the number of infectious animals could influence the speed and intensity of the infection in contact pigs and sheep (Appendix 34). Dr Isabel Esteves described that an estimated dose of 300 TCID<sub>50</sub> was sufficient to infect contact sheep by the airborne route (Appendix 35). John Gloster showed with ample data that current airborne spread models, although very well validated for spread over long distances, are far less accurate in predicting airborne spread over short distances (Appendix 36). These airborne spread models should be used with caution during an outbreak. Both Dr Phaedra Eblé (Appendix 37) and Dr Karin Orsel (Appendix 38) showed estimates of the reproduction ratio in pigs and cows respectively. They both showed that vaccination 7-14 days before infection reduced the reproduction ratio significantly below 1. Dr Phaedra Eblé also showed that additional data from the experiments can be used to estimate other transmission parameters. Dr Sarah Cox showed that increasing the antigen payload in the vaccine might reduce the local replication and therefore the development of carrier animals (Appendix 39). Prof Ulrich Wernery showed results that camelids (Tylopoda) are less susceptible to FMDV than ruminants and swine (Appendix 40). He suggested that this difference should be further studied and reflected in the OIE code.

**Conclusions**

1. The number of pigs and sheep kept together in direct contact influence incubation period and the efficiency of spread.
2. Even at low concentration, airborne transmission occurred after longer term exposure of sheep to an FMDV containing aerosol. Surprisingly levels of airborne virus excreted by lambs were as high as levels excreted by adult sheep.
3. FMD airborne prediction models can currently provide useful advice. Further research on the models and their input parameters is still necessary.
4. Several vaccination strategies before infection significantly reduced transmission of foot-and-mouth disease virus in co-mingled calves and pigs; R<sub>v</sub> < 1 and/or R<sub>v</sub> < R<sub>c</sub>.
5. Estimates (transmission rate β, infectious period T and reproduction ratio R) from transmission experiments can be of importance to model FMDV transmission in order to optimise control strategies during future outbreaks.
6. High potency emergency vaccines are capable of reducing local virus replication in the all important early post exposure period following severe direct contact challenge.
7. Increasing antigen payload results in an improved immune response which has an effect on local virus replication and persistence.
8. Camelids possess a low susceptibility to FMD, and do not appear to be long-term carriers of the FMDV.
**Recommendations**

1. More studies should be done using varying conditions (housing, species etc.) and different strains of virus to provide a better understanding of the epidemiology of FMD. Such studies should also provide the necessary data for modelling disease and airborne spread and calculations of R.
2. Meteorologists should include local flows in their transport and dispersion models at the earliest time possible.
3. Results of airborne spread models should be evaluated in a multidisciplinary manner. Assessment of emergency vaccines and antigen payload should also address subclinical infection.
4. More studies are needed in camelids to quantify their susceptibility.
5. More attention is needed to identify factors that accurately predict between herd transmission.

**Item 4 - Managing diagnostic demands**

Dr Jef Hammond gave an overview on the steps being taken to increase Australia’s preparedness for an outbreak of FMD (Appendix 41). As a result of FMD simulation exercises a number of changes have been made to the way in which Australia will deal with an outbreak. AAHL has undergone major changes and improvements in its platform capabilities to support FMD diagnosis and surveillance. These include the establishment of an emergency response plan, the introduction of a Laboratory Information Management System (LIMS) and robotic sample handling along with a variety of testing options including high-throughput PCR screening.

Dr Nigel Ferris outlined the prospects for improved laboratory diagnosis of FMD using real-time RT-PCR (Appendix 42). The real-time PCR was of superior sensitivity compared to virus isolation. However, modified probes were necessary to detect a group of isolates from Wales.

Scott Reid described the use of automated real-time RT-PCR to detect FMDV in milk. Again RT-PCR matched closely the results of virus isolation but also detected FMDV after mild (72°C) heat-treatment (Appendix 43). However, no positive results could be obtained by PCR or VI in milk before the onset of clinical signs.

Dr Emiliana Brocchi presented a paper on the mapping of neutralizing sites on FMDV type Asia 1 and relationships with sites in other serotypes (Appendix 44). She produced 24 new Mabs of which 10 were neutralizing and described a new independent site on the C-terminus of VP3. In a second presentation (Appendix 45) she described the validation of a new solid phase competition ELISA (SPCE) based on the use of a single neutralizing monoclonal antibody for the measurement of antibodies to FMDV type Asia 1, which appears to reduce the variability of the SPCE and which can be more easily mass-produced.

Dr Wesley O. Johnson gave a talk on the application of the Bayesian probability diagnostic assignment method to predict FMDV infection from serological results (Appendix 46). He suggested development of improved analytical, quantitative and statistical methods to evaluate distribution of laboratory readings from various groups of animals as an alternative to the determination of optimal cut off values for tests. The objective would be to estimate the probability of infection in individual animals and at the herd level.

**Conclusions**

1. The real time RT-PCR currently in use at the FAO World Reference Laboratory for FMD provides an extremely sensitive and rapid additional procedure for improved diagnosis.
2. The Mab-based SPCE has a very high specificity and sensitivity and has some advantages over polyclonal-based SPCEs.
3. Current analytical methods provide valuable tools for assessing diagnostic protocols.

**Recommendations**

1. Lab Contingency plans should be constantly reviewed, tested and updated.
2. Molecular diagnostic development should be closely linked to molecular epidemiology.
3. The feasibility of PCR-testing of milk to detect FMD infection should be further investigated.
4. The development and funding of a mAb-bank should be investigated.
5. The development of SPCE using Mabs for all serotypes and the conversion of in-house SPCEs to complete kits is encouraged.
6. The standardization of terminology for neutralizing sites of FMDV should be considered.
7. Analytical methods for evaluating and determining protocols to quantify the presence or absence of FMD in animals/herds/regions/countries should be explored.

8. NCPs should include guidance to the lab on the capacity to be established for the situation in post-outbreak surveillance.

**Item 5 - Pathobiology & Diagnostics**

Dr Melvyn Quan started this session by describing a model of FMDV dynamics in pigs infected by FMDV, which related virus concentrations in the circulation, interstitial space and cells of the epithelium (Appendix 47). Dr Eoin Ryan then described the early pathogenesis of FMD in contact infected lambs (Appendix 48).

FMDV infection of the host cell is assumed to follow attachment to a surface integrin, and both Dr Don King and Dr Nigel Ferris described experiments using the integrin αvβ6. Dr King had transfected an MDBK cell line with αvβ6 in an attempt to increase its susceptibility to FMDV (Appendix 49), and Dr Ferris used αvβ6 to trap FMDV in an antigen ELISA (Appendix 50), generating type-specific reactions with monoclonal antibody detectors in contrast to high levels of heterotypic reactivity with polyclonal detectors.

Questions from the audience resulted in discussion of the use of integrins for other diagnostic tests (Dr Sammin) and the advantage of *in situ* hybridisation for studying the pathogenesis of FMDV (Dr Goris).

**Conclusions**

1. A linear model of the early FMDV dynamics *in vivo* did not adequately describe experimental data but this discrepancy could be explained by a limited infection rate of epithelial cells at low FMDV concentrations, and the model adapted to better fit the observed data.
2. FMDV in lambs is initially dermotropic but thereafter infected lambs either clear the virus or sustain high-level viraemia with consequent myocardial involvement and death.
3. Neither the expression of integrin β6 on the cell surface nor the expression of SV5-v increased the sensitivity of transfected MDBK cell-lines to field isolates of FMDV.
4. Recombinant αvβ6 protein binds FMDV and this property has potential to be exploited in diagnostic assays such as FMDV antigen detection.

**Recommendations**

1. Further studies on mathematical models of early FMDV infection, comparing the outputs of the model with the outcome of infecting epithelial cells, are required to demonstrate the validity of the model.
2. The pathogenesis of FMD in lambs should be further investigated using *in situ* methods to identify patterns of infection and to correlate this with the progression of disease.
3. Efforts to develop alternative cell-lines, sensitive to field isolates of FMDV, should continue; additional bovine/porcine cell lines should be transfected with β6 and/or other integrin subunits.
4. Diagnostic applications of the selective binding of FMDV by integrins should be further explored, in particular the potential use of this format in rapid "penside" tests for virus should be considered.

**Item 6 – Sero-diagnosis – improvements and standardisation**

Dr David Paton presented the aims and preliminary results for the FAO Phase XVIII serological standardisation exercise which incorporated the distribution to 22 participating laboratories of reference sera, reagents for solid phase competition ELISA and a proficiency panel of unknown sera (Appendix 10). A preliminary analysis was summarised for the inter-laboratory comparative testing conducted in 2004. Recommendations were made concerning future direction of serological standardisation exercises.

Dr Nesya Goris described the preparation of secondary reference sera for day-to-day control of assay performance and presented data on the use of different software for the visualisation of trend analysis (Appendix 51).
Conclusions

1. The Phase XVIII comparative testing exercise revealed an overall, high level of consistency in results between laboratories for both reference sera and proficiency panel using both NSP and SP tests.
2. Antigenic variability of type A strains can affect sensitivity of "structural protein" tests that use "heterologous" virus/antigens.
3. SPCE specificity data for serotypes A, Asia 1 and O appeared to be similar.
4. Control charts are an essential part of internal quality control and for maintenance of quality accreditation and the mutual recognition of results.

Recommendations

1. An annual round of inter-laboratory proficiency testing is essential for quality accreditation. This should be the core activity of future Phase exercises. An improved proficiency panel is needed for NSPE.
2. The issue of establishing reference sera should be separated from that of proficiency testing and further steps are urgently needed to realise the objective of their production.
3. The purpose and use of reference sera in FMD serodiagnosis needs to be clarified and the development and distribution of reference sera could be simplified by distribution of strong positive and negative sera only. Different dilutions could be specified for the local generation of weak positive standards applicable for different tests and test purposes.
4. National laboratories wishing to obtain strong positive sera for the generation of secondary standards are encouraged to make arrangements to obtain such sera from laboratories undertaking animal experiments.
5. More work needs to be done on the development and validation of tests for the detection of antibodies to SAT serotypes.
6. Different cut-offs need to be identified for the SPCE tests taking account of the purpose of testing as well as the specificity and the sensitivity of the tests.
7. The OIE should consider recommending the use of BEI inactivation or gamma irradiation to render sera for inter-laboratory transfer free of infectious FMD virus.
8. Future inter-laboratory comparative trials should give priority to the establishment of best practices in quality control issues, such as trend analysis.
9. A working group should be convened to establish the plan for future activities on inter-laboratory standardisation exercises.

Item 7 – Optimisation of conventional vaccines

Three papers were presented in this session, one dealt with improvement of vaccine and two with monitoring of vaccine quality for field application.

Dr. Bernd Haas presented a paper (Appendix 52) on the prediction of vaccine potency (PD50 values according to the European Pharmacopoeia) of FMDV type A and Asia, vaccines on the basis of liquid-phase-blocking ELISA (LPBE) results. The correlation between group mean LPBE titers and PD50 values was in the range 0.8 to 0.9. However, correlation may be strain dependant.

A discussion paper on guidelines for control of Foot-and-Mouth Disease (FMD) vaccine quality and performance in the field was presented by Dr. Simon Barteling (Appendix 19). The elements needed for the implementation of FMD control by vaccination were evaluated. Emphasis was put on quality control of the vaccine and monitoring of performance in the field.

Dr. Eliana Smitsaart reported results of experiments for enhancing specific antibody response by the addition of saponin to double or single oil emulsion vaccines (Appendix 53).

Conclusions

1. Serology could be one of the methods used in batch release testing, as given in the "Position Paper on Requirements for Vaccines against Foot-and-Mouth Disease" issued by EMEA. However, tests have to be calibrated to make data from different laboratories comparable and it has to be checked whether data on additional strains within a serotype fit into an established correlation.
2. The added saponin to double oil emulsion vaccine based on Montanide ISA 206 enhanced significantly the immune response in pigs and cattle. Saponin in single oil emulsion vaccine
induced higher immune response in pigs than saponin- DOE vaccine. No adverse side effects were associated with the addition of saponin to vaccine oil formulations.

**Recommendations**

1. Laboratories and producers are encouraged to make their data and sera available to groups working on correlations between serology and protection.
2. Buyers should check quality of vaccines by audit or testing.
3. Vaccine performance should be monitored by serological screening of different age groups on selected farms at different locations in the country on an annual basis.
4. Laboratories using serology for evaluation of herd protection should validate the test in their own laboratory. 80% of the animals should reach titres considered indicative of protection.
5. Evaluation and reporting of results should be carried out annually as well in order to inform and involve stakeholders.
6. Further studies are encouraged to investigate the protective capacity of the addition of saponin to the vaccine formulation and to characterize the specific immune response associated to the adjuvant effect of saponin.

**Item 8 – Regulatory issues affecting FMD vaccine selection and use**

Dr David Mackay summarised the current regulatory requirements for FMD vaccines within the EU (Appendix 54). The Committee for Veterinary Medicinal Products has recently adopted a Position Paper on Requirements for Vaccine against FMD (EMEA/CVMP/775/02). This paper proposes practical means whereby manufacturers can overcome the regulatory ‘hurdles’ that currently act as deterrents to authorisation in the EU. Following the recent review of EU pharmaceutical legislation, there is currently an opportunity to amend the annexes to directive 2001/82/EC to make specific provision for the unique requirements of FMD vaccines. The Commission was encouraged to make use of this opportunity to promote the authorisation of FMD vaccines in the interests of animal health and consumer protection.

Dr Tim Doel reviewed how virus strains are selected for use in FMD vaccines (Appendix 55). Well established vaccine strains are suitable in the great majority of cases. New vaccine strains are required when outbreaks occur due to field strains against which existing vaccine strains do not provide adequate protection. Existing vaccine strains of serotypes O, C and Asia 1 generally provide a sufficient spectrum of antigenic coverage that the possible development of new vaccine strains is rarely necessary, although some strains may be developed as a result of a specific customer request. In contrast, new variants of type A repeatedly emerge requiring constant surveillance and the possible development of appropriate, new vaccine strains. The wide genetic and antigenic diversity of the SAT serotypes makes vaccine strain selection more difficult and further work to characterise the antigenic coverage of existing, and newly developed, SAT vaccine strains was encouraged.

In the discussion that followed an aspiration was expressed that a system of surveillance, and selection and distribution of vaccine strains, would be set up for FMD that would operate in a similar way to the network of WHO human influenza reference laboratories.

**Conclusions**

1. That authorisation of FMD vaccines is strongly desirable in the interests of animal health and consumer protection.
2. That sufficient general guidance on the requirements for authorisation already exists in the European Pharmacopoeia, the OIE Manual and in EU legislation and guidelines.
3. That the recently adopted Position Paper EMEA/CVMP/775/02 on ‘Requirements for Vaccines against Foot-and-Mouth Disease’ provides additional, specific guidance on the requirements for authorisation of FMD vaccines within the EU.
4. That the position paper may serve as a useful model for regulatory agencies in other regions.
5. That surveillance and the development of new vaccine strains continues to be essential, particularly for serotypes A and the SAT serotypes.
6. That submission of samples from countries worldwide is essential for this surveillance to be worthwhile.
**Recommendations**

1. Member Countries of the EU FMD Commission should use vaccines for which marketing authorization has been gained, wherever possible.
2. Manufacturers should obtain appropriate licences for their FMD vaccines in any country or region where they might be used.
3. The European Commission should amend the annexes to Directive 2001/82, as amended, and Commission Regulation 1084/2003 to make specific provision for the exceptional requirements of FMD vaccines.
4. Active surveillance by national, regional and the FAO World Reference Laboratories should remain a priority to detect new antigenic variants and supply potential new vaccine strains to manufacturers for adaptation.
5. Submission of samples to national reference laboratories, and interchange of samples between reference laboratories, is strongly encouraged, and the EUFMD Commission should facilitate this process where required for risk assessment purposes for Europe.

**Item 9 – Novel vaccines**

The first presentation by Dr Artur Summerfield presented novel immunological approaches for emergency Foot-and-Mouth disease (FMD) targeting the innate immune defence (Appendix 56). In addition, the immunological basis for breaking the barrier between the non-mucosal and mucosal immunological compartments was presented. The knowledge is being used towards improving adjuvants to induct mucosal immunity.

The second presentation by Dr Zhidong Zhang presented a study (Appendix 57) on cytokine and Toll-like receptor mRNAs in the nasal-associated lymphoid tissues (NALT) in cattle during FMD virus (FMDV) infection in order to explore host factors which are involved in controlling FMDV infectivity at the mucosal surface (pharyngeal regions). The level of cytokine IL-1alpha, TNF-alpha, IFN-alpha, beta and gamma and Toll-like receptor 3 and 4 mRNA was investigated by real-time RT-PCR. Data showed that IFN-α mRNA was significantly up-regulated during the acute stage of disease and TNF-α mRNA was significantly up-regulated during persistence.

The third presentation given by Dr Shugene Lynn showed full protection against FMDV challenge following single dose synthetic emergency vaccine (Appendix 58). The UBITH-VP1 O synthetic peptide vaccine for swine was evaluated in a 1-shot emergency vaccine protocol, and full protection was observed at 28 dpv. Numerous earlier studies proved the peptide vaccine to be safe and effective in challenge and in field trials when used as a 2-shot schedule. Swine at 28dpv lacked neutralizing antibodies. Neutralizing antibodies were induced by a boost at 28dpv. INF-gamma is a possible correlate of immunity that may account for the protection at 28dpv. Correlates of immunity need further investigation. The peptide vaccine is a chemically defined vaccine for easy quality control and for use as a marker vaccine.

The fourth presentation by Dr Luis Rodriguez presented early development of adenovirus-vectored FMD vaccine and antiviral pINF-alpha (Appendix 59). A novel approach combining vaccination with adenovirus-vectored FMD empty capsid (VLP) and adenovirus-vectored porcine interferon was evaluated for rapidly controlling and minimizing the impact of FMD outbreaks.

Dr Paul Barnett presented a strategy for DNA vaccination involving a protein antigen boost (Appendix 60). Advantages and limitations of a DNA vaccine were followed by an overview of the plasmid construction and previous experimental results. A pig experiment aimed at further optimising this was detailed involving single, double and triple DNA injection and a final protein boost. Specific and neutralizing antibody response following protein boost was significantly enhanced compared to conventional vaccinates. Results from a DTH test suggested that multiple DNA plasmid administration can desensitise against the antigen in this system.

The final presentation by Dr Belén Borrego presented a study on immunogenicity and protection conferred by DNA vaccines based on FMDV minigenes in a mouse model (Appendix 61). Different DNA constructs based on the FMDV antigens called “BTT”, fused to different cell – targeting signals, have been tested in a mouse model in order to analyse their immunogenicity and protection capacity. The plasmid coding for BTT fused to a signal peptide was able to induce neutralizing protective antibodies. However, the best construction seemed to be the one expressing the BTT epitope alone.
Conclusion

1. Targeting the innate immune defences, particularly, induction of interferon-α production by natural interferon producing cells (NIPC), has the potential to induce protection against FMD.
2. Mucosal cellular immune response may have a highly significant role in controlling FMDV, and improving current adjuvants for conventional FMD vaccine to induce mucosal immunity may reduce or prevent infection and the development of carrier animals.
3. A synthetic peptide vaccine for FMDV O in swine was reported to be safe and efficient in 2-shot protocol, and as a 1-shot emergency protocol.
4. Use of the peptide vaccine is fully compatible with requirements for sero-surveillance with NSP antibody tests.
5. Human adenovirus 5-vectorised FMD vaccines seem as effective as current commercial vaccines in inducing early protection against FMD.
6. Human adenovirus 5-vectorised pINF-alpha conferred an antiviral state and complete protection against FMD challenge in swine as early as 1 dpv and for up to 3dpv.
7. The immediate and long-term protection resulting from use of a combination of Ad5-A24 vaccine and Ad5-pIFN-alpha inoculations may provide an important tool to control FMD for emergency situations.
8. FMDV DNA (P1) vaccination in swine followed by an inactivated FMDV antigen and protein 3D boost resulted in higher antibody responses, and may be a more efficient vaccination strategy than single shots of DNA vaccine or conventional vaccines.
9. Specific immune responses to FMDV were significantly enhanced in pigs receiving two P1 DNA vaccinations and a protein antigen boost than a single DNA vaccination followed by a protein antigen boost.
10. A DNA vaccine based on FMDV minigenes can protect against a viral challenge in the mouse model. Protection can occur in the absence of neutralizing antibodies.

Recommendations

1. Research be continued to improve adjuvants for FMD vaccines through novel immunological understanding of effector mechanisms active in control of FMD.
2. Further studies to fully investigate local (mucosal) interaction between virus and host during infection to define the associations of FMDV-induced changes with viral persistence/clearance. Improving our understanding of this will provide fundamental knowledge to help develop improved strategies for FMD control as well as improved vaccines which are able to prevent the development of carriers.
3. The work on Ad5-FMD vaccine and vectored delivery of antivirals is encouraged to progress to a stage where it can be evaluated in the control of FMD outbreaks in the field.
4. Further work is encouraged on use of DNA vaccination strategies and regimes that incorporate primer/boost regimes. Further work must be done to elucidate the mechanisms involved in the protection observed in pig and mouse systems.
5. OIE guidelines should be developed or revised relating to importation of fresh meat products from vaccinated pigs, from countries that are FMD-free with vaccination.
6. The relevant texts for European countries relating to marketing authorisation of FMD vaccines should be reconsidered to allow authorisation of peptide-based vaccines.
7. An assessment of advantages, disadvantages, and regulatory steps and timetable required in the realisation of the various novel vaccine technologies as emergency tools should be made to guide further investment.

Item 10 - International Issues

Dr Keith Sumption informed the meeting of a paper that was adopted by the EUFMD Research Group setting the ‘minimum requirements for FMD serology laboratories’ (Appendix 2). The Research Group also produced a position paper on the establishment of a ‘diagnostic reagent bank’ (Appendix 3) and a paper summarizing the information on the regulations concerning sample transport (Appendix 4).

During the Session on International Issues a presentation from the World Organization for Animal Health was made by Dr Alejandro Schudel, informing on the latest standards and guidelines related to FMD (Appendix 62). The new criteria for OIE listed diseases and notification, the procedures for validation and certification of diagnostic assays, the changes in Chapter 2.2.10 on FMD introducing the concept of virus circulation, the standards for diagnostics and vaccines and the advances made in the validation process for the NSP test for bovines were described as well as the actions implemented by the OIE on the United Nations Sub-Committee of Experts on the Transport of Diagnosis Goods (UNSCETDG). OIE has proposed to amend the model regulations on the transport of dangerous goods with regard to diagnostic materials from animal origin to be included in Category B and for the
consideration of "substances from animals for which there is a low probability that infectious substances are present, or where the concentration is at the level naturally encountered, not to be subject to these Regulations (2.6.3.2.3.2)" since these samples do not represent a risk to transport workers or to the environment.

Conclusion

1. The meeting endorsed and supported the actions taken by EUFMD /FAO and OIE on these subjects.

Recommendations

1. The actions taken by OIE to guarantee a realistic possibility for transport of samples should be supported.
2. Laboratories should improve their collaboration and information exchange, which will support global FMD control.
3. Close collaboration between the EUFMD Research Group and the OIE experts is essential for a coordinated improvement of the international standards.

Item 11 - Persistent and subclinical infections – Diagnostic and surveillance issues

Drs. Paul Sutmoller and John Bashiruddin discussed vaccinated carriers and recovered carriers, respectively. An account of the actual risks compared to the perceived risks of FMD carriage by vaccinated carriers was discussed by Dr Sutmoller and co-authors, who considered that based on historical data, the risk of transmission of FMDV from carriers after emergency vaccination is smaller than the risk of introduction of FMDV by illegally imported meat (Appendix 63). Further it was suggested that the risk of transmission of FMDV from carriers might be of the same magnitude as the risk of import of meat from animal populations in countries using vaccination against FMD. Dr Bashiruddin from experimental evidence concluded that there were differences in the rate of carriage and clinical presentation dependent on the age of the cattle at the time of infection (Appendix 64).

Drs. Franco De Simone and Kris De Clercq reported on the results of the validation exercise, undertaken as part of the EU ImproCon project, for various NSP-ELISA kit tests on sera from naïve, FMDV vaccinated, infected and vaccinated plus infected populations of cattle, sheep and swine (Appendix 6). Extensive analyses were shown and the workshop results were considered to have produced sufficient information to enable test comparison. However, they considered further analysis is needed before publication of the final report. Dr. Kitman Dyrting reported on the NSP-ELISA evaluation that is part of the Coordination Action of the IAEA/FAO, on pig sera from Hong Kong (Appendix 65). The sensitivity of NSP ELISA systems applied to the detection of exposed animals after outbreaks in pigs was reported to decrease with time subsequent to outbreaks.

Dr. Nesya Goris considered the validation and batch-to-batch consistency of commercial diagnostic kits and their testing to ensure consistency of test results (Appendix 66).

Conclusions

1. Experimental infection with the FMDV type O virus responsible for the outbreak in 2001 in the UK resulted in more carrier cattle in older than in younger cattle.
2. High specificities (CI lowest test, highest test system-prelim) with the current NSP ELISA systems were obtained in both unvaccinated and vaccinated, non-infected cattle.
3. The finding that samples from naive animals that scored false positive in one NSP tests often scored correctly in the other NSP tests may provide a basis for use of confirmatory tests to increase specificity.
4. Where there is no relevant national system, batch-to-batch testing is necessary when using diagnostic kits to ensure consistency of test results; this could be organised internationally.

Recommendations

1. Science-based risk assessments should be made to compare the risk associated with persistent infections, and risks associated with different eradication methods of FMD and trade in animals and animal products.
2. The ability and likelihood of FMD carrier bulls to transmit disease by the sexual route should be investigated.
3. Efforts should be made to corroborate the finding of higher susceptibility to virus carriage in older animals, and to investigate the basis for the observation.
4. Extensive collaborations to evaluate and validate diagnostic tests are very valuable and should be encouraged for all types of diagnostic tests.
5. Control of vaccines, and monitoring of vaccination programmes and more epidemiological research is necessary in regions where FMD is endemic in pig populations.
6. NRL should use International Standard Sera to control diagnostic tests including those commercially produced. Batch testing should always be included as part of the IQC.
7. More samples from vaccinated and infected pigs from different time points after infection should be obtained for the validation of NSP diagnostics in pig sera.

Item 12 – Test development and standardisation

Dr Liesbeth Jacobs described the use of the CEDI test for detecting cattle that became carriers of FMD virus following challenge in a vaccine potency test over a two year period (Appendix 67). The use of the Chekit 3ABC ELISA in experimentally infected sheep was reported by Dr Laila El-Shehawy to be valuable in differentiating between infected and vaccinated sheep (Appendix 68).

A competition 3ABC ELISA using biotinilated 3ABC antigen was shown by Dr Kitching to be a potentially useful screening test for evidence of FMD virus infection in different species (Appendix 69). Positive samples could be confirmed using a multiplex luminex-based assay, which was very specific and measured antibodies to 3A, 3B, 3ABC and 3D proteins. Further work is required to define the characteristics of these two tests.

A correlation between the production of interferon – gamma and virological protection in vaccinated and challenged cattle was reported by Dr Satya Parida (Appendix 70). This could also potentially be used to confirm infection in vaccinated cattle.

Dr Paton described the measurement of secretory IgA in saliva by a capture ELISA (Appendix 71). This assay may be an indicator of oropharyngeal replication of FMD virus and was promising for detection of persistently infected cattle in vaccinated groups.

Conclusion

1. Additional assays to differentiate infection from vaccination such as a multiplex luminex-based assay, IgA and gamma interferon assays are being developed, which have potential for use as confirmatory tests.

Recommendations

1. Fitness for purpose should be considered when selecting a test for NSP antibody detection.
2. There is a need of confirmatory tests, with equal or better sensitivity and specificity as screening tests. The development of novel technology and the detection of alternative infection indicators is encouraged.
3. Panels of sera should be evaluated to validate new NSP tests, and provision should be made by FAO or other international organizations to support laboratories preparing these panels.

Item 13 - Surveillance using DIVA tests

Six papers were presented in which the field application of NSP antibody tests was described.

Drs Donal Sammin and David Paton reported on the rationale and laboratory test results of a field study in Zimbabwe that evaluated the performance of diagnostic methods for detecting SAT-type FMDV infection in cattle (Appendix 17). Dr Hagai Yadin reported on the FMD outbreaks in Israel in January 2004 and described the findings of post-outbreak serosurveillance with DIVA tests (Appendix 16). Dr Georgi Georgiev reported on the use and interpretation of NSP serosurveillance in Bulgaria in the years 2002 and 2003, which was mainly targeted at sentinel herds located at the Bulgarian-Turkish border (Appendix 72). Dr Naci Bulut presented the results of the serosurveillance conducted in the Thrace region of Turkey after the Spring 2004 FMD vaccination campaign which included the evaluation of both post vaccinal immunity and of tests for subclinical infection (Appendix 73). Follow-up investigations of NSP seropositive results have provided confidence that at the time of the surveillance there was no evidence of virus circulation in the Thrace region.
Dr Helen Hondrokouki presented preliminary results of serosurveillance conducted in the Evros prefecture of North-West Greece for both FMD and Peste des petits ruminants (PPR) (Appendix 74). Dr Ingrid Bergmann gave an overview of the occurrence of FMD in South America, presented data on the genetic and antigenic characterisation of recent isolates including a type C virus from Brazil and discussed the approach of the PANAFTOSA laboratory to diagnosis and serosurveillance (Appendix 75).

**Conclusions**

1. The ability of NSP tests to detect FMDV infection in vaccinated cattle under field conditions allows prevalence rates in vaccinated populations to be estimated.
2. NSP tests can be used in the serodiagnosis of SAT 1 and SAT 2-type FMD infections, such that they can be considered as serotype-independent serodiagnostic tests; SPCE tests also readily detected antibodies to these viruses.
3. The sensitivity of NSP tests for detection of SAT serotype FMDV carriers (75-90%) was very similar to estimates obtained with experimental sera during the NSP workshop in Brescia in May 2004.
4. Optimised RT-PCR was found to be more sensitive than virus isolation for detecting virus in probang samples; virus was detected rarely in nasopharyngeal swabs.
5. Serotype O and A FMD viruses isolated in South America between 2000 and 2004 represent strains that are indigenous to the region. Strains circulating in the Andean region are clearly separate from those that have occurred in the Southern Cone region.

**Recommendations**

1. Age stratification should be used as part of the assessment of potential virus circulation in a population following FMD outbreaks or in the determination of the absence of virus circulation.
2. To further evaluate the use of NSP tests for DIVA purposes they should be applied in different epidemiological situations and in different susceptible species.
3. Follow-up epidemiological investigations and additional laboratory tests are indicated where NSP seropositive animals are identified.
4. Sampling strategies which require the use of appropriate validated tests, should be developed that would assist countries in regaining the disease free status after an FMD outbreak and where vaccination has been used.
5. NSP serosurveillance (and follow-up investigation) should be conducted at least on an annual basis, and more frequently where risk indicates, in the Thrace region of Turkey and in neighbouring regions of Greece and Bulgaria.
6. Careful consideration should be given to the statistical validity of the sampling regime for the surveillance purpose intended and to subsequent interpretation of the data.
7. The work presented should be continued, with further analysis and sequencing of strains from epidemiologically important regions of S. America.

**Item 14 - Regulatory compliance**

Dr David Paton reviewed progress on the development of serosurveillance strategies that could be used by European countries adopting a vaccinate-to-live policy for controlling future FMD outbreaks (Appendix 76). Information is now available on the sensitivity and specificity of diagnostic tests for use in cattle. However, uncertainty remains over: (i) the level of certainty with which freedom from infection must be demonstrated; (ii) how to interpret results from herd-based tests when herds comprise small numbers of animals and (iii) details of how to resolve test specificity problems by retesting and resampling.

**Conclusions**

1. Many of the problems associated with false positive results may be overcome by retesting and resampling/retesting.
2. It is impossible to prove complete absence of infection.
3. The issues of confidence in the status of a group of animals is is greatest in small herds.

**Recommendations**

1. Further work is needed to define sensitivity and specificity parameters for use of DIVA tests with susceptible species other than cattle.
2. LCPS should include decision trees to indicate the follow-up tests to be conducted.
3. Laboratories should make quantitative estimates of follow-up testing and resampling to confirm the seropositive test results obtained with NSP screening tests.
4. A consensus needs to be developed on the appropriate threshold level for detection of carriers in vaccinated animals following the adoption of a vaccinate-to-live outbreak-control option in EU Member States. Once this has been achieved, it should be possible to refine guidelines for post-outbreak serosurveillance.
5. It is recommended that the EUFMD provide further input to the development of the OIE Guidelines on FMD serosurveillance.

**Item 15 - Managing the decision making process in control of FMD and in the priority setting of research and development**

Professor Julian Hilton gave a paper on the importance of communications systems that enable cross-talking between the emergency services (*interoperability*) (Appendix 77). He illustrated how interoperability may be applied to planning for emergency response to FMD and other epizootic diseases, at national and European level. He indicated that communications systems are rapidly developing which have applicability for the needs he observed in the decision makers for disease control. With moderate investment this could greatly reduce problems within and between veterinary services and avoid some of the communications problems observed in 2001.

Mary Marshall made a case for engagement with stakeholders in decision making on investment in research, development and implementation of research findings relating to prevention and control of FMD (Appendix 78). She considered that stakeholders can be supportive to decision making process in various ways, as well as acting to keep the issues to the front of the agenda for funding agencies. She suggested that the process of two way communication between stakeholders and the scientific community could have advantages for each party, and outlined how this could be organised. She emphasised the importance of the competence of members of expert groups in the range of disciplines required for integrated control of FMD, and suggested European expertise could be effectively used to balance of panels where expertise is restricted.

**Conclusions**

1. Recent developments in information systems are relevant to the decision making in risk management process, and to communication of risk management and scientific opinions.
2. Emergency management requires an effective suite of communications tools that will enable laboratory and epidemiology experts to focus on essential tasks while maintaining or enhancing the public understanding of risk and risk management decisions.
3. Stakeholders could provide a positive contribution to the priority setting process of researchable questions on FMD prevention, surveillance and control.
4. The mechanisms for collection and review of stakeholder opinion require careful development to ensure technical questions can be presented in a format that enables an effective and rapid response by bodies that fund research or are required to provide a response.

**Recommendations**

1. That the EUFMD Commission develops a working group to identify user requirements for information management.
2. That this working group prepare a paper outlining options for information management and communication relevant to the needs of end-users in decision making at central or field level.
3. That this group address the options for improving knowledge transfer and training of national experts on FMD control, to meet current and future anticipated demand for FMD expertise.
4. That member countries of the EUFMD Commission ensure that national experts on FMD control are familiar with the published positions of the EUFMD Standing Technical Committee, and of the contact points for request for additional expertise provided by the STC.
5. Stakeholder groups are encouraged to develop a mechanism for presenting of priorities for research or opinion on FMD to those responsible for co-ordination of research on FMD.
6. Two way communication between stakeholders and policy makers should be improved.
7. Stakeholders in the livestock sector should be encouraged to make their own contribution to disease control, particularly through application of biosecurity measures at all relevant points of animal management and marketing.
8. The role of the EUFMD Research Group be further considered and developed to help meet the needs of the European member states for a range of competences in their national FMD expert groups.