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Report

OPEN SESSION OF THE STANDING TECHNICAL COMMITTEE OF THE EUFMD

2016

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
European Commission for the control of Foot-and-Mouth disease (EuFMD)
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Day 1 – Plenary

1.1 Opening: Global Situation (Frenkel lecture)

Issues for the online conference to discuss / Points or/and questions for discussion

- Importance of vaccine quality
- Variability of potency tests
- Threat posed by newly emerging lineages such as A/G-VII, for which there is evidence of poor commercial vaccine protection

Conclusions and recommendations:

- The session noted the tremendous contribution of the late Bernd Haas;
- The importance of evaluating vaccine quality continues to be an important theme in FMD control;
- Global coordination under the OIE/FAO FMD strategy is essential to detect and evaluate new virus emergence.

1.3 Higher health compartments: The way ahead?

In the presentations, different options to update/ fine tune/ implement the FMD control and eradication approaches were given.

- G. Thomson described an approach based on HACCP to differentiate within a country based on district features of the contact structure or the characteristics of the type of virus circulating in different parts of the country to ensure a safe product, whilst seeking to preserve the wildlife to the greatest extent possible.

- E. Parker presented reflections on progress on the concepts of compartmentalisation and regionalisation, the added value of testing and training with the different stakeholders involved during simulation exercises. Both to see where plans need to be updated and to raise awareness and commitment of stakeholders and create a shared vision on the approach.

- The approach presented by M. Marsot gives a tool to get insight in the needs and availability of resources needed during an outbreak. It is a vital part of the preparedness plan.

- C. Bartels gives an approach for data collection during an outbreak to enable epidemiological analysis during and after an outbreak, to evaluate the underlying assumptions in the contingency plan. Based on the results it can be decided to update this plan.

- In the presentation of J. Gonzales a decision tree analysis was presented to prioritizes areas based on the risk of introduction and/or spread in case countries want to select areas that can be proposed to be free without vaccination.

The presentations give a nice overview of aspects to be considered and tools that can be usedb when updating contingency plans.
EU FMD could consider **to collect** these tools and one way or another **make them available** for countries that want to update their approach to remain free fight an outbreak or move forward on the CPP pathway.
EU FMD could create a **toolbox** with the available tools categorized and briefly described.

1.4 Vaccination as an option: What challenges remain?

Vaccination is likely to reduce the FMD epidemic size and suppress the probability of a run-away epidemic. But uncertainties about the logistics of vaccination campaigns in previously-FMD-free countries and the post-vaccination consequences hamper the decision to start a vaccination campaign. Therefore it is highly recommended:

- to determine early decision indicators;
- to determine the vaccination capacity, optimal vaccination radius and time to start vaccination;
- to investigate the logistics and contingency planning required to execute a vaccination campaign effectively;
- to define trigger points for outsourcing laboratory testing during and after the outbreak period;
- to implement the semi-quantitative decision tool for vaccine strain prioritisation;
- to improve access to emergency FMD vaccines through vaccine bank sharing agreements worldwide;
- to make vaccination-to-live more acceptable by including quality criteria for evaluating the vaccination strategy applied and the post-vaccination surveillances;
- to start an international campaign making it clear that the refusal to sell meat from vaccinated animals on the local market is as unethical as the killing of thousands of animals.

Day 1 – Parallel

2.P1 Global Progress against FMD: Session organised by the FMD working group of FAO and OIE

Issues for the online conference to discuss / Points or/and questions for discussion

The global FMD control strategy rolled in 57 countries in FMD virus pools 2-5. The majority of these countries are in progressive control pathway (PCP) stages 1 and 2. Afghanistan (PCP stage 1), Turkey (PCP stage 2 with a free zone recognised by the OIE) and Thailand (PCP stage 3 with an official control programme endorsed by the OIE) shared their experience in FMD control and expressed different as well as common hurdles to advance and sustain their exerted effort since embarked on FMD control program. These hurdles include but not limited to cross border animal movement, vaccine effectiveness, diagnostic capability and more importantly increasing the political commitment.

Conclusions and recommendations

Countries suggested that the objectives of FMD control be defined in order to motivate the stakeholders and government officials and that legislation framework be established.

2.P2 Vaccine Efficacy (GFRA)

The session provided very interesting information on antigenic matching which is important for vaccine strain selection. Models that predict antigenic matching from sequence data have been developed and are performing very well. Recent cross-protection studies show that good quality vaccines can have at least 3 PD_{50}/dose against heterologous challenge even when r-values are low and genetic difference is huge.
An interesting observation from studies in Africa shows that many animals no clinical signs were observed in animals that become infected. In one of the presentations a new adjuvant was presented based on direct binding to the virus capsid via a genetically introduced HIS-tag. Another presentation the possibility of removing epitopes that hamper the immunogenicity of SAT strains was presented.

Conclusions and recommendations

The recent cross-protection studies that have been presented should be analysed further, including r-values, homologous potency based on serology, genetic differences to optimise the understanding successful protection by vaccination

2.P3 FMD Endemicity (GFRA))

Report not available.

Day 2 – Plenary

3.1 Global and regional FMD surveillance

- The A/ASIA/G-VII lineage has apparently spread from the Indian sub-continent, where it is normally endemic, to the Middle East. This stresses the importance of close and careful surveillance and development of tailored diagnostic methods as well as highlights the complexity of the application of robust FMDV control measures.
- WGS provides high-resolution tool to investigate the origin of outbreaks FMDV outbreaks but virus genome recombination events can significantly impact analyses and lead to false interpretations.
- Genome sequence data exchange is required for better understanding of FMDV evolutionary events.
- Genetic analysis shows that viruses belonging to the A-Iran05 lineage are continuously evolving in the region.
- Detection of two different serotypes of FMDV or/and two different strains of the same serotype in one animal/sample shows complexity in epidemiology of FMD.
- Constant surveillance and looking of previous molecular epidemiology is the key to control FMD in endemic settings of Pakistan. This study adds to the knowledge-base of FMD epidemiology in Pakistan.
- The outbreak of FMD O serotype in Korea in 2016 is considered to have originated from previously isolated viruses 2014 and 2015. These findings raise concerns regarding the recurrence of FMD, suggesting that the control efforts should focus primarily on reducing FMDV circulation around the outbreak area.
- The information from the phylogenetic analysis of the P1 sequences for the viruses isolated in relation to geographical distribution of FDMV serotypes isolated during 2014-2015 in Uganda could be useful for the improvement of disease control strategies and for vaccine strain selection for Uganda in the future.
- The epidemic in Iran caused by O/ME-SA/PanAsia 2 was characterized by two facts: First, in spite of all control and preventive measures all farms affected by FMD due to virulence of new FDMV serotype. Second, High prevalence of myocarditis showed good tropism of new FMDV serotype to myocardium. High morbidity and mortality in 4-12 months calves showed high sensitivity of this age group due to myocarditis.
- Phylogenetic analysis carried out using the capsid nucleotide sequence indicated three different topotypes (ME-SA, SEA and Cathay) of FMD serotype O viruses circulating in SEA. Preliminary vaccine matching results indicate PanAsai-2 vaccine strains to be broadly protective with all the three topotypes SEA serotype O FMD viruses.

- A study provides evidence of co-occurrence of FMDV serotypes and topotypes in West, Central, East and North Africa and this has implication for its control. The findings may help fill the knowledge gap of FMDV dynamics in Nigeria and West Africa sub-region to support local and regional control plans.

Recommendations:

- Regional rather than local surveillance programs are preferred.
- Centralized coordination for regional surveillance programs is needed.
- It is recommended to be aware of new emerging viruses causing similar clinical symptoms of FMD (like Seneca Valley Virus) and have a rapid and accurate differential laboratory diagnostic.
- It is recommended to search the origin of SVV (rodents?) and conduct more studies concerning epidemiology of other vesicular diseases such as SVV.
- Molecular epidemiological studies are valuable but should be supplemented by vaccine matching studies contributing to effective vaccination programs.

3.2 New insights from epidemiology studies

Points/questions for discussion:

- Obtaining whole genome sequence data from viruses circulating in Southern Africa can complement epidemiological investigations, but gaps still remain in the availability of representative sequences from field cases of FMD in Africa. This problem is particularly evident for SAT serotype viruses (where sequence diversity is high).
- Studies from Nigeria reported the first detection of serotype SAT 1 since the 1980s in the region. This important information motivates further studies to understand the circulation of this serotype in West Africa. It was suggested that this virus represents a new topotype – is this true?, or do we need to have a better understanding of the relationship of this new virus with historical viruses from the region?
- Phylogenetic analysis of whole genome sequence of O/ME-SA/Ind-2001 from outbreaks in North Africa reconstruct the movement of FMD viruses across the region. Do the long branches in the TCS and phylogenetic trees provide evidence for the extent of unsampled infection in the different countries? Are additional samples available to fill in some of these gaps?
- It was discussed that FMDV spreads rapidly in countries with large populations of small ruminants. How might we better estimate the contribution of FMDV infection in small ruminants as a factor in the persistence of the virus in countries with large populations of small ruminants?
- Seasonal movement of animals plays important role in circulation of FMD. All seasonal migrating herds should be clinically checked prior and during the migration. Checkpoints, vaccination of animals (at least 3

weeks before the start of migration) in villages, located close to migration routes is crucial. Serosurveys at the pastures is necessary.

Recommendations:

Regional and local epidemiological networks are encouraged to further data sharing, close collaboration on common goals, exchange of know-how and knowledge.

Submission of more suspect samples from more regions should be encouraged as characterization of circulating viruses is essential for a comprehensive and likely epidemiological picture.

Issues:

The studies presented highlighted the need for structured epidemiological studies on FMD in areas of unknown or uncertain disease status.

3.3 Risk based approaches: What have we learnt?

In this session, we got some very nice examples of understanding risks of FMD virus transmission by bringing together field observations and value-chain analysis with results from laboratory analysis.

In the presentation of Angus Cameron, key points were:

- There is few guidelines on how to conduct early detection and much to invest
- Quality standards for early detection relate to detection sensitivity (what proportion of disease incursions do we want to detect) and detection delay (how quickly do we want to detect)
- Farmer reporting seems the obvious choice because it allows to have 100% of population under surveillance, all the time.
- Risk-based surveillance may be used to improve or supplement existing farmers reporting. It should be used to
  - Invest in areas where farmer reporting is weak
  - Trying to achieve uniformly high sensitivity
- To assess the best use of investment, it asks for combining the risk of introduction with risk of failure to detect with the consequence of introduction ($$). Asking the question: With the available budget, where is it best invested?

In the presentation of N Nelson, the question asked was “If detection during the incubation period will stop transmission. And the objective of the study was to evaluate the potential of preclinical detection during reactive surveillance to reduce risk of between-farm transmission. For this, it was needed to estimate the sensitivity of sampling methods used for preclinical detection and to estimate of any of these methods

were likely to result in more effective control compared with clinical surveillance. The hypothesis was tested using a pair-transmission model. Sensitivity values of different sampling methods were used in mathematical models to evaluate impact of preclinical surveillance on controlling between-herds transmission. It was concluded that simple and fast methods of sampling and diagnosis can be used such as oral (saliva) swabs and air sampling.

In the discussion, it was asked how to operationalize such techniques: instruction to farmers, collection of samples and application in what zone (protection, surveillance) at what costs.

In the presentation of Antonello di Nardo, it was discussed how a retrospective investigation was to answer

- How FMD virus lineages were generated and moved across the Middle East region for last 10 years
- What evolutionary pressure FMD virus exhibits at geographical level
- Which evolutionary competition acts at serotype level

It was shown that there is a westerly direction by which FMD virus spreads. The evolutionary pressure is an accrual of genetic diversity at local level and that there is a constant emergence and dying out of FMD virus lineages. These lineages move with livestock and might be affected by pre-existing immunity.

The latter point was not further discussed as that would have made for a nice discussion between laboratory analysis and understanding of livestock production systems in the Middle-East and West Eurasian countries.

The presentation of Yu Qiu was exactly that, the combination of livestock movement analysis with results of phylogenetic across South-East Asia. Such analysis helped to understand the spread of FMD virus in the region and assisted in the investigation of incursions of exotic FMD virus strain O/ME-SA/Ind-2001d in 2015.

Extensive studies into the cattle price differentials in the region were conducted previously. Main cattle routes go from West (India – Bangladesh - Myanmar – Thailand – Laos or Cambodia into Vietnam and China. With the cattle movements move FMD virus with examples for serotype A/SEA-97 and O/MYA-98. In 2015, serotype O/ME-SA/Ind-2001d emerged and could be followed along these cattle movement routes.

It was concluded that strong official control on cross-border animal movements and strategies for promoting safer cross-border animal trade are highly desirable to mitigate FMD spread.

Dr Eyal Klement discussed a study to elucidate the endemicity of FMD in Israel and to hypothesize the routes of FMD virus transmission between domestic and sylvatic populations. It was concluded that wild boars and deers were potential introducers of FMD virus into Israel, infecting grazing beef herds. Infection may be further spread to feedlots through calves and subsequently nearby dairy herds may be infected. Although small ruminant herds across Israel demonstrated FMD infection, it was contested that small ruminants were responsible for outbreaks in cattle.

Tsvatko Alexandrov presented the epidemio-surveillance programme in Bulgaria, Greece and Turkey. It is an example of high-efficient and well co-ordinated surveillance network in maintaining confidence of FMD freedom in Thrace region. It aggregates the information of multiple surveillance systems and uses online software for combining databases and mapping features.

Dr Nick Lyons presented work from Iran on the detection of FMD virus in puppies died of myocarditis after being fed lambs that had died of FMD infection. This detection was seen in two different provinces following a reported FMD outbreak.

COMMENTS FROM THE RAPPORTEURS:

Two main concepts have been highlighted in the session: (i) a risk-based approach for early detection will attempt to allocate resources towards populations/areas where the risk of introduction has been quantified as being higher. In this regard the presentation from A. Cameron addresses the methodological approach on how to prioritize areas/compartments to make best use of available resources. The poster short-presentation from Tsvatko showed a practical example of an area where surveillance is supposed to early detect potential incursions of FMDV; (ii) a risk-based approach in endemic settings and to move along the PCP-FMD has the purpose to prioritize and address identified risks with appropriate control and preventive measures. Risks can be better characterized through combining animal movement with phylogenetic analysis (Yu Qiu presentation) or through sero-prevalence studies (presentation from E. Klement).

3.4 Measuring impact of vaccination and other preventive measures

The first two presentations by G. Ferrari and M. Afzal clearly indicated that use of good quality vaccine and use of appropriate tools to monitor the implementation of the vaccination campaign can be very effective in achieving an important objective in endemic settings: protection from clinical disease. The use of simple tools as presented by G. Ferrari can greatly enhance the capacity to build appropriate indicators to monitor and evaluate the conduction and outcomes of a vaccination campaign. Moreover the presentation from M. Afzal showed that use of high quality vaccines has contributed to enhance farmers confidence that clinical FMD can actually be prevented even in very challenging dairy production systems.

The presentation from N. Lyons confirmed that only partial protection is conferred (at field level) by the A Saudi-95 strain against the A/Asia/G-VII. This is based on findings in a large scale dairy farm in Saudi Arabia where evidence of clinical disease was found in a specific area despite the satisfactory heterologous serological titers obtained and the intense vaccination schedule adopted in the farm.

The presentation from E. Klement have highlighted an important aspect in relation to the age at which animals receive their first injection. In herds where vaccination is routinely carried out the vaccination of

calves lower than three months of age (in the presence of maternally derived antibodies) will elicit a very weak immune response resulting in a prolonged period of protective coverage.

W.T. Jemberu has highlighted in his presentation the perception that farmers have in Ethiopia about FMD. This is an important point that leads to assess the willingness of the farmers to be engaged into preventive activities that can range from vaccination to movement control. The study clearly show that there is a need to get more engagement of farmers when designing control measures as they are the once that can primarily benefit from those but at the same time bear the negative consequences of the restriction measures that could possibly be applied.

The current epidemiological in China was presented by Y. Li that has led to formulate a 5-year plan and to progressively reach freedom. It was interesting to note that the plan foresees the achievement of serotype specific freedom over time and not necessarily simultaneous.

POSTER: the short presentation made by K. Vanderwaal showed the value of modeling in both endemic and non-endemic (free) settings. Of interest that in free settings an expansion of 50% of the control zones can reduce the size and duration of an outbreak.

COMMENTS FROM THE RAPPORTEUR: there three important aspects which have been addressed across the presentations and are further summarized: (i) use of simple tools can greatly enhance the ability to monitor and evaluate the performance of a vaccination campaign not only in terms of immune response but also in terms of monitoring the efficiency of the distribution and the delivery system of the vaccine from central level to the animals to be injected: (ii) correct schedule of a vaccination campaign is critical to minimize the risk period during which calves have lost maternal immunity and they become susceptible. Vaccinating too early (less than 3 months) can have negative consequence and prolong the risk period; (iii) the perception of the farmer is an important aspect to be considered when implementing control and preventive measures (study in Ethiopia). Such perception can be improved if farmers are clearly showed the benefits of doing things properly (experience from Pakistan proposing good quality vaccine).

Day 2 – Parallel

4.P1 New Vaccines

General recommendations from the session:

- Research on recombinant FMD vaccines should be continued and expanded as the preliminary results are more than promising.
- Precise criteria and parameters required for recombinant vaccines to be compliant with the EU regulations should be determined.

4.P1.a *G. Belsham, A prime-boost vaccination strategy in cattle to prevent serotype O FMDV infection using a "single-cycle" alphavirus vector and empty capsid particles*

Conclusion

Complete protection of cattle against homologous FMDV challenge is possible using recombinant vaccines and empty capsids that can be produced outside of high containment. A booster vaccination is necessary to achieve protection.

List of issues/questions

The application of the recombinant virus induces anti-vector immunity; repeated application of the recombinant virus is not possible. How can the induction of anti-vector immunity be avoided?
The presented study used purified empty capsids for the booster; are there other combinations that should be explored?

Recommended follow-up action

The potency and the duration of immunity for the vaccine need to be determined. The authors of the study should communicate the results of these additional experiments once they are available.

4.P1.b *E. van den Born, Vaccine efficacy of FMD virus-like particles produced by the baculovirus expression system*

Conclusion

Using information about the quaternary structure of the FMDV capsid, VLPs can be stabilized by the targeted introduction of amino acid changes. Since VLPs can be produced with high yield outside of containment, production costs are lower than for conventional killed vaccines.

List of issues/questions

In this study, residue 93 of VP2 was modified to increase capsid stability. What other residues are known to influence capsid stability?

For some strains/serotypes, increasing the stability proved harder than for others. What are possible reasons for this, and how can it be mitigated?

Recommended follow-up action

So far, only the immunogenicity of the VLPs in guinea pigs has been studied; challenge studies should be carried out to assess the protective efficacy. The authors of the study should communicate the results of these challenge experiments once they are available.

4.P1.c *S. Parida, Enhanced potency and immunogenicity for cattle vaccinated with FMD A serotype vaccine adjuvanted with poly (I:C)*

Conclusion

The potency of an existing fully formulated vaccine with ISA 206 adjuvant can be improved by blending with poly (I:C).

List of issues/questions

Does the aftermarket addition of adjuvant influence the stability of the product?

Recommended follow-up action

A large duration of immunity study is already being planned. The authors should communicate the results of this experiment once it is concluded.

4.P1.d *M. Perez-Filgueira, Effect of the antigen payload, polyvalency and revaccination in the protection conferred by FMD vaccines against heterologous challenge in cattle*

Conclusion

For animals that had been vaccinated with A_{24}, protection against challenge with A/Arg/2001 was not correlated with antibody titers determined by VNT or LPBE, but animals that were not protected had antibodies with lower avidity.

List of issues/questions

How comparable are 146S particle quantification methods between different laboratories? (see also Doel and Mowat 1985, J Biol Stand 13(4):335-44, PMID: 2997228)

Do other groups have experience with avidity testing for anti-FMDV antibodies induced by vaccination and/or infection?

Recommended follow-up action

EuFMD should determine if there is a need for a new ring trial like the one done by Doel and Mowat.

4.P1.e *S. Lacour, Immune responses to foot-and-mouth disease virus in guinea pigs after vaccination with canine adenovirus vector*

Conclusion

Two doses of a canine adenovirus vector expressing the P1 precursor and the 3C protease of FMDV protected guinea pigs against homologous challenge.

List of issues/questions

Does canine adenovirus have the same problems with anti-vector immunity as Semliki Forest virus? If there is a difference, how can that be explained?
Good results have been previously reported for recombinant vaccines based on human adenovirus Ad5. What are the differences and commonalities between the two systems?

Recommended follow-up action

A vaccination and challenge study should be done in cattle, to assess the efficacy of the vaccine in a target species.

4.P1.f *M. Ilott, EU authorization of novel vaccines*

List of issues/questions

The critical issue for the dossier is the ability to back up the label claims with high-quality data.

Conclusion

Many replication-competent recombinant vaccines have already received marketing authorization in the EU, and the regulatory climate is favorable if relevant guidelines and requirements are being followed.

Recommended follow-up action

Prospective applicants are strongly encouraged to reach out to the European Medicines Agency's Innovation Task Force for advice on the authorization process as early as possible.

4.P2 Improving current vaccines

4.P2.a *A. Capozzo, Application of indirect and avidity ELISA tests to assess anti-FMDV antibodies induced by vaccination in buffalo and swine serum samples*

Conclusion

For buffalo sera, a combination of single-dilution indirect ELISAs with and without urea (avidity ELISA) can achieve high concordance with VNT results.

List of issues/questions

Is the combined test a useful alternative to the VNT? Is it being used in other laboratories, and are any data available on inter-laboratory differences?

Recommended follow-up action

The protocol for the single-dilution indirect ELISAs is available; all partners are encouraged to use these protocols and communicate their experiences.

4.P2.b *M. Curet, Demonstration of early protection against foot-and-mouth disease virus seven days post-vaccination*

Conclusion

A 2-ml dose of ≥6 PD_{50} Aftovaxpur DOE protected cattle against viremia and generalization after intranasal challenge at 7 days post vaccination and reduced virus shedding.

List of issues/questions

Is the intranasal challenge route preferable over an intradermolingual challenge? What are its advantages and disadvantages?

Are efficacy data collected by intranasal challenge acceptable from a regulatory standpoint?

Recommended follow-up action

The nature of the protective immune response needs to be examined in more detail. How do different aspects of the innate and adaptive response (interferons, antibody isotypes) contribute to the observed outcome?

4.P2.c *C. Hamers, Efficacy of an FMD inactivated vaccine (Aftovaxpur DOE) administered at a 1-ml dose to sheep*

Conclusion

Compared to sheep vaccinated with 2 ml, sheep vaccinated with 1 ml of trivalent (A_{22}, SAT2, O_1) vaccine develop virtually identical serology against A_{22} and SAT2. The half-dose protected sheep against O_1 challenge.

List of issues/questions

A member of the audience mentioned the 30-year experience of Israel with 1-ml doses for sheep. Are there any other examples of this dosage being used in vaccination campaigns in sheep, and what outcomes were observed?

Recommended follow-up action

It should be determined and communicated whether the similar serological reaction seen for A_{22} and SAT2 is associated with a similar protection against challenge.

4.P2.d *A. Dekker, No heterologous protection with FMD SAT2/SAU vaccine against SAT2/BOT challenge*

Conclusion

The potency of the final formulation of the SAT2 SAU vaccine against homologous challenge of cattle was 94 PD_{50} per dose, but only 0.8 PD50 per dose when challenged with SAT2 BOT.

List of issues/questions

In one PD_{50} experiment in the study, more animals were protected in a 1/4-dose group than in the 1/1-dose group. This kind of biological variation is not uncommon. How can the design of challenge studies be improved to avoid spurious results based on biological variation?

Challenge studies often focus on strains with a high perceived relevance for Europe and its neighboring areas. How can this bias be mitigated?

Recommended follow-up action

For the SAT2 serotype heterologous protection is much lower than for serotype A und O, and the inclusion of more than one SAT2 strain in vaccine banks is necessary. Suitable strains should be identified by the WRL and other stakeholders.

4.P2.e *B. Sanz-Bernardo, Selection of an adjuvant to raise polyclonal antibodies to foot-and-mouth disease virus in rabbits and guinea pigs*

Conclusion

The tested alternative adjuvants were effective in stimulating an antibody response, but still had severe adverse effects.

List of issues/questions

Apart from the candidate preparations used in this study, what other adjuvants are available? What data are available on their safety and efficacy in rabbits and guinea pigs?

Recommended follow-up action

Further studies are necessary to find an alternative to Freund's adjuvant that is both ethical and effective. This should be a high priority for all laboratories that produce polyclonal sera for research and diagnostic applications.

4.P2.f *J.H. Park, Application of mouse model for effective evaluation of FMD vaccine*

Conclusions

Mouse-adapted challenge strains can be used for the swift and simple evaluation of FMD vaccines in adult C57BL6 mice.

List of issues/questions

There were comments from the audience recalling the routine use of mice for FMDV protection studies in the past. How widespread are mouse models in FMDV research nowadays? What are the experiences and opinions of the community on their use?

Recommended follow-up action

Further studies are necessary to build confidence that results obtained in the mouse model can be translated to ungulates.

4.P2.g *C. Hamers, Development of a virulent FMD challenge model in sheep*

Conclusion

The intradermolingual application of A_{22} Iraq, O_1 Manisa and SAT2 SAU caused clinical disease and viremia in sheep. IDL application was found to be a credible alternative to coronary band injection.

List of issues/questions

How does IDL application in sheep compare to intra-nasopharyngeal instillation? What the advantages and disadvantages of each method?

Are vaccine efficacy data collected by intra-nasopharyngeal challenge acceptable from a regulatory standpoint?

Recommended follow-up action

More strains should be tested in larger groups of sheep to further validate and compare both challenge models, IDL application and intra-nasopharyngeal instillation.

4.P3 Preventing FMD: tools to assist decision making

Within this session different models on FMDV transmission were presented. The first model evaluated outbreaks in Turkey, based on transport data and estimates of transmission parameters. The model shows that movement control on local and district level do reduce transmission of FMDV significantly. Further work is necessary on e.g. reactive vaccination in case of an outbreak.

A network model for transport of animals in the USA was generated which can be the basis of disease spread models. A simple model was improved by including attraction, covariates and supercontact nodes. Combining different models improve the overall estimates on size and duration of outbreaks, but the uncertainty increases, which has to be communicated. Still it is not clear whether the risk of transmission due to pre-emptive culling is implemented in the models.

Nowcasting is used to inform decision makers on the most likely current status, and providing the estimates of the parameters in the model together with their confidence interval real-time during an outbreak. The model was developed using the 2010 Japan FMD outbreak. Using the nowcasting system the possible control measures can be ranked in time. Evaluation on both the UK 2001 and Japan 2010 outbreaks show a high prevalence for emergency vaccination in a ring around infected farms.

Farmer compliance was modelled and non-compliance had a huge influence on duration and size of the outbreak. The current model does not include the effect of vaccination yet, and the effect of local spread is most likely overestimated, so more input and validation is necessary.

- Is it possible with all models developed so far to provide a rule of thumb that can be used in most outbreaks (e.g. vaccination is always a wise strategy).
- Does output of models during an outbreak influence decision making and if not, should it be used in decision models.
- The clarity of models is becoming less and less with the increasing complexity of the models. How can decision makers decide which model has the best prediction.

- Are models that fit the last outbreak best, more likely to predict the future outbreak.

4.P4 Innovation in diagnosis

- Zhidong Zhang presented a very nice presentation on the use of rRT-PCR as the endpoint measurement for VNT assays. This method could reduce the assay time from 3 days to a number of hours (20 hours). Important questions which were raised were: 1**. How does combining molecular and serological reagents affect the cost of the test? 2. Will cross contamination be a problem? E.g. in this method a lot of virus is being produced before the rRT-PCR therefore there is potential for easy contamination. 3. Why is the % reduction in copy number never exceed 60%?**
- Charles Nfon presented a new immunoassay for the detection of FMD and VSNJ antibodies. **The audience was keen to learn how long the coated beads are stable for and how the test will work in a multiplex format.**
- David Lefebvre presented a wonderful talk on how we could improve our rRT-PCR assays by using FLAP (AT rich) sequences at the 5' end of the primers. Frank demonstrated that not only was the amplification earlier, but the fluorescence signal was higher. The mechanism behind the benefit is that FLAPs are believed to prevent artefacts such as the formation of dimers. When FLAPS were added to the 5'UTR primers they improved the test especially for the SAT strains. Why is this? When FLAPs were added to the 3D primers not much change was noted, other than for 5 strains which detection was improved by the modifications by allowing the forward primers to bind to hairpin loops. These modified primers are no in routine use within CODA-CERVA. **Should other reference laboratories consider also using FLAP primers? Should a standardisation (inter/intra laboratory) assessment be carried out?**
- Amir Shehata presented a new conventional RT-PCR for detection of Egyptian strains (presented by Kees). This assay appears robust and better performing than the antigen ELISA. However, the limit of detection is 10^3**. In this context, could some samples be missed?**
- Emma Howson presented a great talk highlighting the assumptions that we all make when we use accredited rRT-PCR tests. We assume that because they are accredited that they are fit for purpose, however some of the tests we use were validated a number of years ago. Emma presented a talk showing how primer -template mismatches can affect the performance of our rRT-PCR assays. Surprisingly only 2 mismatches can be tolerated at the 3'end and a 82% match is required across the whole primer or the test fails. Emma has designed a new tool to enable researchers to rapidly assess their assays in silico, which should hopefully encourage researchers to regularly assess existing assays, or with the design of new assays. **When this program goes online would anyone be willing to use it?**

  Overall conclusion/recommendation:

  The main emphasis of this session was tools we could use to improve our diagnostics. It is clear that a large

emphasis is placed on molecular diagnostics (rRT-PCR) and two simple new ways of improving our existing diagnostic rRT-PCR assays were presented in this session. The use of FLAPs and the new bioinformatics program have the potential to hugely improve the performance (and understanding of loss of performance) of our current pan-specific rRT-PCRs. A strong recommendation would be to consider a inter/intra laboratory evaluation of both of these new solutions.

Day 3 – Plenary

5.1 Innovations in Training and Knowledge Exchange

Innovation in Education and Knowledge Exchange: Launching the Progressive Control Practitioners' Network (Jenny Maud and Chris Bartels)

Aim of the session was to discuss EuFMD's approach to training and training development with an introduction on post-graduate training as currently developed by RVC and with a launching of the PCP-Practitioner Network.

Innovation in post-graduate training for vets

Key elements were:

- Modern technology allows access to learning when learners and instructor are separated by distance and/or time
- Using a "Stepping Stones Model" anyone can create his/her own course that suits his/her own ambitions or needs
- To make it work, there is a collaboration with variety of partners in delivering different types of training
- EuFMD training is an example of such partner where capacity building and development of global networks for practitioners is materialized

5.1.a *The Who, What and Where of Building Capacity for FMD Control in The Information Age J. Maud*

Key elements were:

- For EuFMD to support capacity building, there is a challenge to make best use of limited resources
- Need assessments have indicated and have helped to prioritize what capacity building is requested for EuFMD Member States and countries in the European neighborhoods
- EuFMD is working on further establishing its web-based training and knowledge environment to support capacity building for anyone interested in FMD control. This allows for a large number of people being trained, online discussions and networking and adoption to different languages
- New releases are the EuFMD Knowledge Bank and the PCP-FMD e-Learning course

The PCP-Practitioner Network

- The PCP practitioner is any person (private or public sector) that is making active use of the PCP approach
- The PCP-Practitioner Network is to support and promote the global use of PCP-FMD
- A Practitioner Network will support practitioners directly through webinars, discussion forums, job-aids as well as promote peer-to-peer training with the aim to establish a self-sustained network

Participants were from various backgrounds: central veterinary services, world organizations and educational institutes.

Feedback to the questions:

1) **Defining our audiences and encouraging peer to peer training**

We would like you to discuss further on who our potential audiences might be, and particularly on how we can encourage these audiences to join the network, take ownership of the network, and share knowledge and training amongst eachother.

Discussion focussed on:

- Participation to the network could be encouraged in two ways- “top down” commitment, where decision makers/CVOs are invited to participate on a country level and instruct their staff to participate, and relying on the individual participants/champions in each country who are self-motivated to participate. Perhaps initially the latter, but as the network grows it may be more appropriate to seek decision maker support to allocate their staff time to participate and motivate them to do so.
- Content needs to be dynamic and useful- the quality of content will draw in the participants
- Suggestion to advertise the network at face to face events (roadmaps, training courses, etc)- networks work better together if participants meet face to face initially.

2) **Identifying collaborators**

Who can help us in establishing the network? Please give us ideas as to:

- People, institutions or organisations who may assist as expert trainers or facilitators
- People, institutions or organisations who can contribute resources (existing training resources, funding etc)

Discussion focussed on:

- Academic institutions are the obvious collaborators. Feeding in of network participation to formal qualifications (MSc etc) would be very attractive to motivate participation
- Use of local academic institutions for translation and local applicability of content: role for OIE vet school twinning in this

- Linking with OIE PVS gap analysis and how the practitioner's network address key PVS gaps may be useful, particularly when advocating for funding.
- High level guidance (GF-TADs) partnership would be important to motivate participation
- Private sector involvement could also be key although private sector not well organized in many target countries

3) **Tools for cascade training**

Our network is unlikely to reach as far as livestock owners, community animal health workers or field veterinarians. How can we encourage the PC Practitioners to pass on our training to these groups? What tools can we add to our knowledge bank to assist?

- Often, training for livestock owners and community animal health workers is 'event-driven'. Meaning to say that interest for training is related to a new outbreak of clinical disease. While it seems equally important to train in 'peace time' on issues of preventive control and improving animal health (as opposed to treatment of diseased livestock)
- Important to cascade training is the identification of socalled 'champions' and 'opinion leaders' in a community or group. Through these, further cascade training into a community is best secured.
- This may involve support to local associations such as milk-corporations, breeding associations or any other grouping of livestock owners
- When going down further to the field level, one has to consider specific situations and local norms and values more and more.

Discussion focused on:

- Field level/private sector actors are most motivated to engage in FMD topics when an event has occurred, rather than in peacetime
- The need for involving key opinion leaders
- Field level/private sector unlikely to focus on only one disease- principles covered by network may apply to other disease
- Training will need to be adapted to the local situation so it is suitable for the end audience- aim of network is to inspire people to provide this local training and adapt materials provided.

4) **Topics covered by the Progressive Control Practitioners Network**

Below is a current rough outline of the planned topics for the Progressive Control Practioners' Network in its first year. Please comment on our ideas- are there other topics we should cover? Should we leave some out? Which are the most important?

- Cascade training
- Risk-based control

- Stakeholder consultation
- FMD control at the basis (field level)
- Vaccine effectiveness
- Monitoring and evaluation
- Strengthening veterinary services
- Policies for Practice
- FMD control through addressing other livestock infections

Discussion focused on:

- In addition to the above, important issue is to train on
  - Assessing the impact of disease on livestock and livelihoods (economic losses due to disease and costs to prevention and treatment)
  - Wider impact of disease on livelihoods
  - Possibility of providing cases studies to demonstrate
  - May need to define content according to communities of practice.

5.1.b *Training for Change or Changing the Training C. Bartels*

How can we change FMD management mindset?

Aim of the session was to discuss the need for change management in particular in relation to building sufficient epidemiologic competence for FMD control. We shared experience and discussed how changes to the organizational mind set to incorporate a risk-oriented approach for developing FMD control may be introduced.

Participants were from various backgrounds: central veterinary services, industry (vaccine production), world organizations and educational institutes.

The programme covered short introductions followed by discussion. Of the three questions in the programme, most time was spent on questions 2 and 3.

Key elements for inducing and supporting change to the veterinary services are with:

- Motivation
- Commitment
- Culture

Motivation

There is a need for a combined and concurrent interest from private and public stakeholders to increase animal production and health. These interests often have an economic drive as to create export

opportunities for animals and animal products. Examples are with Kazachstan, Botswana, Zimbabwe, Thailand (see presentation of Dr Prapas Pinyocheep). It does require that the private sector is organized to have a particular sector (beef, dairy, wool) be represented in discussions with government when setting out long-term vision and strategies.

This may mean that within a country there may be parallel sector-dependent developments ongoing. For example, beef-fattening and dairy production may request public sector to create the enabling environment to have access to quality vaccines, health certification and identification whereas no such needs are expressed by small-holdings or subsistence animal production sectors.

Commitment

There is a need for government commitment to pursue long-term vision and strategies. These may go beyond export (as to increase GDP) and also relate to food security and food safety. Commitment refers to allocation of budgets as well as supporting the enabling environment with regard to adopting laws and regulations, promotion of private-public partnerships, creating opportunities for continued professional development and post-graduate training, and setting in motion organizational change within veterinary services to establish integrated disease control approaches (see also next paragraph).

This then raises the question what tangible commitment is needed for EuFMD to work with a country's veterinary services (question was not further elaborated).

Culture of veterinary services

Changes within the veterinary services very much refer to changes in mindset and culture. Adopting a risk-based approach means that one has to think about disease control in terms of probabilities rather than *statuses of present versus absent. It also requires one to think of what is feasible and acceptable given the ever-limited availability of resources (time, money, people). Thus, the attitude is to be critical and go one step further to include monitoring and evaluation of proposed actions in order to understand what works and what doesn't.

Next and at an organizational level, it needs an integrated approach in which staff from different department within the VS work together in a Task Force or team. This will require a horizontal or matrix structure of the organization in which task forces or teams are given a clear set of responsibilities and targets.

Support

The participants were then asked what they could contribute to making changes happen:

- OIE
    - The OIE-PVS tool indicates where and what changes are needed for a veterinary services to become a veterinary authority. The PVS tool in itself is not the driving force for countries to start changing the

VS organization. However, the PVS tool provides an overview of changes needed and a prioritization of how best to make changes happen.

  - Provision/aggregating stories of countries that made a successful transition into a veterinary authority

- SEACFMD-OIE
  - When training on FMD control, to put more emphasis on the risk-based approach for different livestock sectors in different countries
- DLD-Thailand
  - To support harmonization of techniques and approaches to risk-based control in countries in South-East Asia
- Merial
  - As service providers and experts, to actively promote messages on the need for risk-based control of FMD with emphasis on monitoring and evaluation
  - Supporting staff of veterinary services to attend EuFMD training or conferences
- AHAP-England
  - Training on influential skills
- Nottingham university-England
  - Training on soft skills – communication, team work

Conclusion:

There is a role for EuFMD to indicate to VS that organizational change is needed when adopting a risk-based approach to disease control

The elements of this role have not been discussed in full detail but some suggestions were given:

- Provide case studies of country situations where change management has been successfully applied with emphasis on elements that are motivational for decision and policy makers such as socio-economic impact, trade incentives, support to food security and safety.
- Clearly illustrate cost-effectiveness to risk-based control of animal diseases. For this, simulation models that combine epidemiologic and economic parameters will be useful to have informed-based decisions made. The current EuFMD Impact calculator may be extended to include an FMD-endemic scenario.
- Illustrate that the necessary changes to organization of VS goes beyond FMD control but will have a positive impact on its overall functioning benefitting animal health and production in general
- Consider that within each countries there is diversity because of stronger and weaker livestock production sectors. This meaning that within each country, EuFMD has to identify for which sectors organizational change of VS may be most relevant and to incorporate these sectors when discussing the progressive control of FMD.

5.2 Globalising Access to Knowledge and Innovation

Participants discussed the challenges faced when implementing the national FMD control program and the support that could be provided by the scientific community to reach the objectives set forward by the countries.

Achieving a better understanding on the role of small ruminants in the epidemiology of FMD, especially in North Africa or the Middle East, could help in a better allocation of resources (particularly, in terms of vaccination programme).

For countries lacking resources, success stories were considered as a good incentive and advocacy tool. Conducting pilot projects involving appropriate vaccination standards in defined areas/region was a topic discussed as a way to show the benefit of FMD vaccination to the stakeholders.

Recommendations:

- Explore possible ways to contribute to a better understanding of the role of small ruminants in the epidemiology of FMD in North Africa and the Middle East
- Establish pilot programs to show the positive impact of FMD control measures (e.g. vaccination). The quantification of the benefits will demonstrate the benefits to stakeholders.
- Initiate or strengthen regional cooperation as the most important strategy for a long-term FMD control, and a marketing tool for efficient and effective vaccine supply and delivery (better matching, better quality, reduced price).

Day 3 – Parallel – Innovative surveillance and diagnostics

6.G4 Innovative Surveillance Options for Field Use

Background

Rapid, robust, accurate confirmation and typing of FMDV is a vital part of decision making in FMD emergencies in free countries. In endemic countries, there are also many potential uses, with typing of the virus in the field important to determine the serotype to be included in vaccination, and also for detection of antibody (e.g. for post-vaccination response). As many laboratories do not process many samples, and may not be equipped for live virus manipulations, tests conducted in the field or in field laboratories may potentially assist decisions that are required to be made at field level. Robust tests may also have a role in reducing operator error associated with complex lab based biological assays.

In addition, new work indicates that some penside tests media can be used to transport FMDV RNA in a safe form that could reduce risks and costs of transport to labs. Potentially lateral flow devices (LFD) and other such media may act as a first screening in the field, and if adequate virus for a positive result, these could be sent for more advanced typing tests (including sequencing, even transfection to recover live virus) , a potential revolution in submission of samples to reference centres.

Four presentations were given in this session:

1) “Evaluation of Oral Swabs for FMDV Surveillance” given by Dr P. Kirkland
2) “Use of Lateral Flow Device For Safe and Low Cost Shipment of FMDV Suspected Samples” given by Dr S. Blaise-Boisseau
3) “Progress to Develop Practical Field-Based Tools for Detection of FMD Virus” given by Dr V. Fowler
4) “Development of a Successful Surveillance Model for FMD in Pakistan” given by Dr M. Hussain

Main questions and discussion:

The main questions and discussion were on the use of the LFD for shipment of FMDV suspected samples. Two main issues were discussed. The first issue was related to rescue of live virus from non-inactivated LFD. The results presented indicated that live FMDV can be eluted from LFD if it is not inactivated. This finding is different from the one previously published. The second issue was related to shipment of the inactivated LFD. Since FMDV RNA is still present on the inactivated LFD it was discussed how the LFD should be shipped (regular mail or under UN3373).

Conclusion and recommendations:

1. The use of pooled swabs for detection of FMDV by rtRT-PCR should improve surveillance in small ruminants. Development of such high through-put qRT-PCR to detect FMDV in oral fluid and the possibility of pooling samples should be continued. Validation on filed samples is recommended.
2. Use of LFD for shipment of FMDV suspected samples could be a shipper and safe alternative shipment method. Evaluation and validation on filed samples and optimization of RNA transfection to rescue live virus are needed. The safety of inactivated LFD and modality of shipment need to be discussed and established by the biosafety group.
3. The portable rtRT-PCR and RT-LAMP are useful tools for FMDV detection in the field. It is recommended to continue validation and implementation of these methods in the field including typing methods.
4. The surveillance model significantly improved FMD outbreak reporting in Pakistan. A Risk-based Control Strategy was implemented. Similar surveillance model could be implemented in other endemic countries.

6.G5 Diagnostics: Harmonisation of Laboratory Tests, and Tools to Share Sequence

Points/questions/recommendations for discussion:

- An increasing number of labs are participating in the annual PT for FMD diagnostic tests organized by the WRL/EURL; this can be an indication of the increasing diagnostic capacity, facilitated by availability of more and simpler tools. However, for serological tests, fitness for purposes of the different assays needs better insight – and future PT sample panels will address specific outbreak scenarios to better focus test section and interpretation in the participating laboratories.
- Some failures of the polyclonal Antigen ELISA for the detection of some FMD viruses has been recently observed, even if belonging to the same genomic lineage (ex isolates of type O Cathay lineage), indicating poor relationships between genomic and antigenic features. The monoclonal antibody-based ELISA kit seems surprisingly less affected, thanks to the wide intra-type reactivity of the MAbs selected and to the presence of a “pan-FMDV” Mab. Therefore, its routine use should be encouraged, also to maintain knowledge on its diagnostic performance (necessary for endemic countries) and alert in case of virus evolution that couldaffect its diagnostic capability.
- A presentation from the WRL provided evidence that three commercially available lysis buffers used for molecular testing inactivated “live” FMD viruses. These data appear to contrast with results presented at the previous EuFMD meeting (in Cavtat) that raised concerns about the effectiveness of these procedures. It is recommended that the two lab involved in these studies share data to attempt to understand the

factors that underlie these discrepant results (such as selection of specific lysis buffers used in these studies or differences in the experimental protocols).

- This session discussed approaches that could be employed to improve the exchange of FMD virus sequence data among the FMD community. On behalf of the OIE/FAO FMD Laboratory Network, the WRLFMD will host a new web-based tool that can be used for simple annotation and phylogenetic tree reconstruction. It is anticipated that this website would be made available shortly (by mid-November) and feedback from users is welcomed
- Initiatives within the OIE/FAO FMD Laboratory Network to harmonise and define virus nomenclature were also presented. A new working group has been established to provide expertise on the rational naming of virus lineages (see: http://www.foot-and-mouth.org/foot-and-mouth-disease-virus-nomenclature-working-group-0) for further information).

Addition Recommendation:

Development of guidelines for selection of serological assays to be used among the variety of serological assays/kits available that provide answers to the different epidemiological situations (ex. in countries free without vaccination if samples are submitted for antibody detection, rather than in endemic settings to estimate virus circulation, or for post-vaccination monitoring, etc…).

6.G6 Biocontainment of FMDV: Challenges and Solutions for Laboratory Biorisk Management

Points/questions/recommendations for discussion:

- The EuFMD biorisk management network was launched at the OS; what should its priorities be?
  Based on the data presented by C. Colenutt and E. Brown, should we shorten the time period before re-stocking is allowed on infected farms post-cleaning and disinfection?
- What can we learn from the human health sphere about control of environmental contamination?
- Labs should interact with contingency planners and modellers to estimate the expected numbers and types of samples they might receive for testing during an outbreak, and use this to determine whether they have sufficient capacity, as illustrated by R. Spence.
- What are the relationships between our knowledge of on-farm and in-lab biosecurity? For example, could disinfectants be overused on farms? Or are they underused?

Conclusions and recommendations:

1. The EuFMD biorisk management network was launched at the OS, chaired by Kathin Summermatter of the EuFMD biorisk management group. It will provide support, training and advice to those involved in biorisk management issues related to FMD, and will focus on issues raised by the members.

2. Environmental transmission of FMD is an efficient way of spreading the virus; research presented at the OS suggests the environmental survival times may be less than estimated in previous literature.
3. Those involved in the design of FMD labs should interact closely with contingency planners and modellers to estimate likely demand for sample test capacity in the face of an outbreak and during post-outbreak surveillance.

6.G10 New Developments in Wildlife (FMDV in African Buffalo)

The talks were focused on FMD studies in African buffalo in Kruger national park and wild boar and deer in Europe.

African buffalo:

Four presentations were given describing the outputs from a large multifaceted research project in the Kruger Park, South Africa to understand FMDV transmission in a population of wild buffalo kept in isolation and a series of challenge experiments in captured wild buffalo. Sixteen individual African buffalo were experimentally challenged with three different SAT viruses at the same time by tongue inoculation. The duration and magnitude of viraemia was similar for each of the three viruses in all of the buffalo challenged and persistent infection with all three viruses was established. However, over a period of 400 days it was clear that one virus dominated (SAT-1) in all the buffalo and the other two viruses could not be detected. The viruses were analysed in vitro and the same virus dominated in mixed cell cultures. The one-step growth curves for the viruses were similar too, but the dominant virus killed cells more quickly.

These same viruses were used to infect individual buffalo housed separately, which resulted in persistent infections. The persistently infected buffalo were then mixed together with additional naïve buffalo and the animals were sampled on a regular basis. The SAT-1 virus that dominated in individual animals also infected the naïve animals. The plan is to repeat this observation with the same viruses and then show whether a similar correlation between killing capacity, persistence and transmission from persistently infected animals can be demonstrated.

If these observations can be repeated they will change the way we think about transmission from persistently infected animals. Virus specific factors may play a key role in determining whether transmission from persistently infected animals occurs, rather than environmental triggers or co-infections.

It cannot be concluded that all SAT-1 viruses will preferentially persist and transmit, but in the analysis of the isolated wild buffalo herd, SAT-1 viruses were the most prevalent.

European wild ungulates:

Presentations were given on studies and practical issues as regards the FMD surveillance in wildlife in Europe.

Yanko Ivanov presented the specificity of FMD surveillance in wild ungulates. The presentation gave very detailed information about specificity of the surveillance mainly in wild boar but also touching such activities in wild ruminants. Construction of sampling frame and selection of sampling units in wildlife surveillance, sampling methods, trapping as a tool of wildlife surveillance, non-invasive sampling as a tool of wildlife surveillance and different sampling designs were described.

Dr Tsviatko Alexandrov informed about practical training for wildlife surveillance and control of FMD that was carried out in Bulgaria, in February 2016 for experts on contingency planning/wildlife from the Balkan countries aiming to improve the FMD preparedness for wildlife management, disease surveillance and control and to promote alternative diagnostic method - non-invasive sampling.

The discussions were focused that wildlife management and surveillance should be incorporated as part of the Contingency plans and that non-invasive sampling should be considered as first indicator method for the early detection of FMD introduction in wild boar in Europe.

6.G11 Pathology and Pathological Basis of Persistence

6.G11.a *M. Yamada, Pathological change of the development of the vesicular lesion in pigs experimentally infected with FMDV O/JPN/2010*

Conclusion

There were striking differences in the development of vesicular lesions in the coronary band and the tongue epithelium of pigs.

List of issues/questions

-

Recommended follow-up action

Similar studies could be conducted with other species to highlight differences in pathogenesis that can ultimately guide a better understanding of the pathological mechanisms of acute FMD.

6.G11.b *S. Blaise-Boisseau, FMDV host interactions in a model of persistently infected bovine cells*

Conclusion

In-vitro models of persistent FMDV infection have been developed that recapitulate the tropism of persistence in vivo (soft palate vs. lung).

List of issues/questions

Ultimately, a better understanding of persistent infection might allow its prevention or at least its reliable detection on an individual animal level. Will this reduce the amount of surveillance required as part of current vaccinate-to-live policies?

Recommended follow-up action

The epidemiological impact of persistent infection in cattle and buffalo is very different. Could a similar model be established for buffalo?

6.G11.c *R. Ranjan, Localization of FMDV RNA and antigen in different tissues from cattle and buffalo under natural conditions in India*

Conclusion

FMDV RNA was detected in cattle and buffalo, but immunofluorescence staining only found persistent viral antigen in tissues from buffalo. Detection was predominantly in subepithelial layers of the soft palate and nasopharynx.

List of issues/questions

It is not known when the animals in the study had been exposed to FMDV because the samples were collected at slaughterhouses. Would earlier sampling increase the detection of persistent infection in cattle?

Recommended follow-up action

Co-staining with immune and other host cell markers would give very important information about the host cells and mechanisms associated with persistent FMDV infection in Indian buffalo.

www.fao.org/eufmd.html