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GFRA NEWSLETTER

Fighting Foot-and-Mouth Disease together

Global Foot-and-Mouth Disease Research Alliance

GFRA Scientific Meeting

Seoul, South Korea
25–27 October 2017

Cover photo courtesy of David Paton

Dedication

Ngo Thanh Long

6 November 1960 – 14 June 2017

In dedication to Long Ngo, president of the GFRA 2014–2015, in remembrance of his contribution to the GFRA and FMD control in Vietnam.

Capacity development programs by the Transboundary Animal Disease Mitigation team in South East Asia

Nagendrakumar Singanallur, Jacquelyn Horsington, Wilna Vosloo

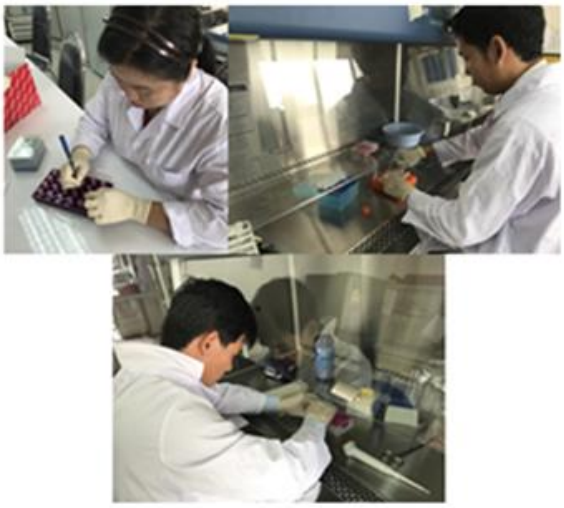
Transboundary Animal Disease Mitigation, Australian Animal Health Laboratory, CSIRO-Health & Biosecurity, Geelong, Australia

Foot-and-mouth disease (FMD) is a major disease of livestock impacting the livelihoods of people in South East Asia (SEA). The social impacts of the disease are also significant. Scientists from the CSIRO's Australian Animal Health Laboratory (AAHL) are helping several countries in the region to improve their diagnostic capabilities and research into FMD, which in turn helps us better understand the FMD virus strains circulating in the region. In collaboration with several national laboratories and the World Organisation for Animal Health Regional Reference Laboratory (OIE-RRL) for FMD in South East Asia, Pakchong, Thailand, the project serves to improve preparedness in the event of an outbreak, through processing infected samples and performing molecular, cell culture and serological assays to detect and characterise FMD viruses. Since 2011, extensive work has been carried out in countries including Vietnam, Lao PDR, Myanmar and Thailand to improve their existing diagnostic methods, virus characterisation and analysis of FMDV sequences.

The project has invested heavily in antigen matching studies with the vaccine strains available in the Australian Vaccine Bank, thereby generating valuable data on the antigenic variation of circulating viruses in SEA. The project works in close collaboration with the OIE-RRL in Pakchong in generating data on 'r1' values and also assisting in analysis of sequences.

In addition, we are working in collaboration with the FMD control program initiatives by the Ministry of Primary Industries and Massey University, New Zealand, in Lao PDR and Myanmar. CSIRO scientists, with co-operation from the OIE-SEACFMD campaign, have made several missions to the national laboratories of these countries and assisted in capacity building in the areas of serology (NSP ELISA and post-vaccine monitoring by liquid-phase blocking (LP-ELISA)) and virus detection methods (virus isolation and real-time PCR).

The National Animal Health Laboratory in Vientiane (NAHL), Lao PDR, is the national laboratory for FMD diagnosis and confirmation. The laboratory has a strong team of laboratory staff that perform antigen ELISAs for serotyping of FMD, and serological testing based on the LP-ELISA. However, the laboratory lacked the ability to perform FMD virus genome detection using molecular methods. To address this need in capability, a training program on FMD genome detection using real-time reverse transcription PCR (qRT-PCR) was organised 1–8 March, 2017. We are grateful to the OIE-SEACFMD campaign who supplied the reagents for this training.



NIAH, Vientiane

Two workshops were conducted at the new BSL2 FMD diagnostic laboratory facility in Nay Pyi Taw, Myanmar, with OIE-SEACFMD assistance, to train newly recruited young scientists in the use of the FMD antigen ELISA (20 Feb–3 Mar, 2017) and post-vaccine monitoring through LP-ELISA (13–23

Aug, 2017). Assistance has been provided in the form of standard operating procedures and standard testing protocols, reagents, and continued technical support to attain self-sufficiency in laboratory methods. We also suggested a plan of development for both the laboratory staff and functioning of the laboratory for the next 1–2 years. In addition, we identified prospective staff for further training in FMD diagnostics and serology. NSP ELISA and LP-ELISA have now become routine tests in these laboratories. The AAHL team will continue in its commitment towards reducing the burden of FMD in SEA.

**This project is supported by Meat & Livestock Australia (MLA), through funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit programme, and by Cattle Council of Australia, Australian Dairy Farmers, Australian Lot Feeders' Association, Sheepmeat Council of Australia, Wool Producers Australia, Australian Pork Limited, Goat Industry Council of Australia and Charles Sturt University, leveraging significant in-kind support from the research partners.*

LBVD National Lab, Nay Pyi Taw

Determinants of FMDV lethality in a mouse model

Marco Cacciabue[a], María Soledad García Núñez[a], Fernando Delgado[b], Anabella Currá[a], Rubén Marrero[a], Paula Molinari[a], Elizabeth Rieder[c], Elisa Carrillo[d] and María Inés Gismondi[a]

[a] *Instituto de Biotecnología, Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina*
[b] *Instituto de Patobiología, INTA, Argentina*
[c] *Foreign Animal Disease Research Unit, United States Department of Agriculture, Agricultural Research Service, Plum Island Animal Disease Center, USA*
[d] *Centro de Investigación en Ciencias Veterinarias y Agronómicas (CICVyA), INTA, Argentina*

As part of a collaborative project funded by the National Agency for Scientific and Technological Promotion and by the National Institute of Agriculture (INTA) in Argentina, researchers from INTA and from Plum Island Animal Disease Center (USA) used the adult C57BL/6 mouse model to study two related FMDV A/Arg/01 variants displaying different pathogenicity: virus A01L caused death of all inoculated animals independently of the dose used (10^3–10^6 pfu/mouse), whereas virus A01NL was attenuated and only caused mild signs of disease in inoculated mice (Figure 1a) [1].

Histopathological examination of tissues of inoculated animals at 22 hpi revealed the development of acute pancreatitis affecting the exocrine pancreas in both groups, although to a greater extent in A01L infected mice. The lethal variant reached higher levels of viral load both in plasma and in pancreas (Figure 1b); only this variant reached the central nervous system in inoculated mice.

We compared the whole-genome consensus sequences of both variants in order to investigate viral determinants of pathogenesis. Six non-synonymous mutations were found along with 23 synonymous changes and 2 substitutions located in the IRES element. The 6 amino acid changes occurred within VP2, VP1 and 2C proteins (Figure 2). Predictions by *in silico* modeling of both viral

capsids showed that changes in VP1 and VP2 proteins would lead to modification of the electrostatic charge on virus particles, thus potentially rendering the lethal virus more sensitive to pH changes. Amino acid substitutions present in the A01NL 2C protein were either infrequent within serotype A FMDVs or had been related to a less virulent phenotype in cultured cells.

Recently, an A01NL-derived infectious clone comprising the 6 amino acid changes of A01L has been constructed. Surprisingly, this virus is capable of mirroring the lethal phenotype. Additionally, we have made use of next-generation sequencing methods to reconstruct the viral quasispecies present in fourth cell passages of A01L and A01NL prior to mice infection. The lethal virus turned out to be more complex with 10 coexisting genomes, whereas A01NL virus displayed only 3 genomic variants.

Currently, we are performing additional experiments with mutant infectious clones in order to establish whether replication (and lethality) are determined by a particular amino acid or by a combination of all substitutions.

Collaborations with other research groups in the field of FMDV biology are welcome!

References

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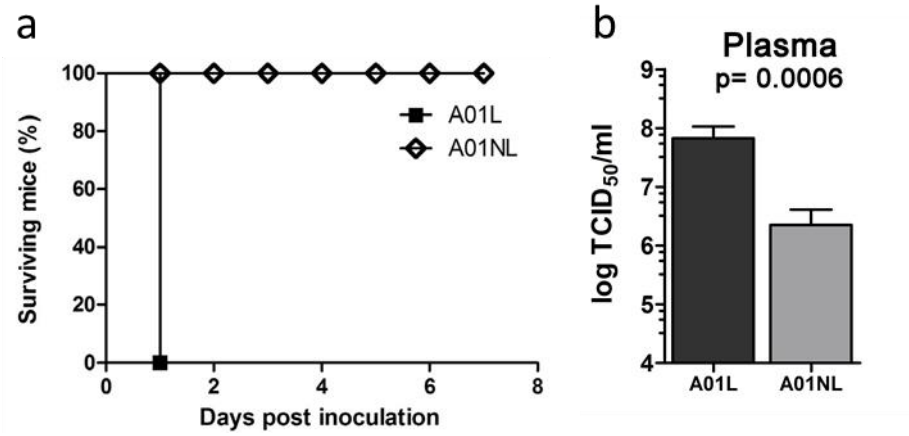

Figure 1: (a) Lethality of A01L and A01NL viruses in adult C57BL/6 mice. (b) Quantification of viremia in inoculated animals at 22 hpi.

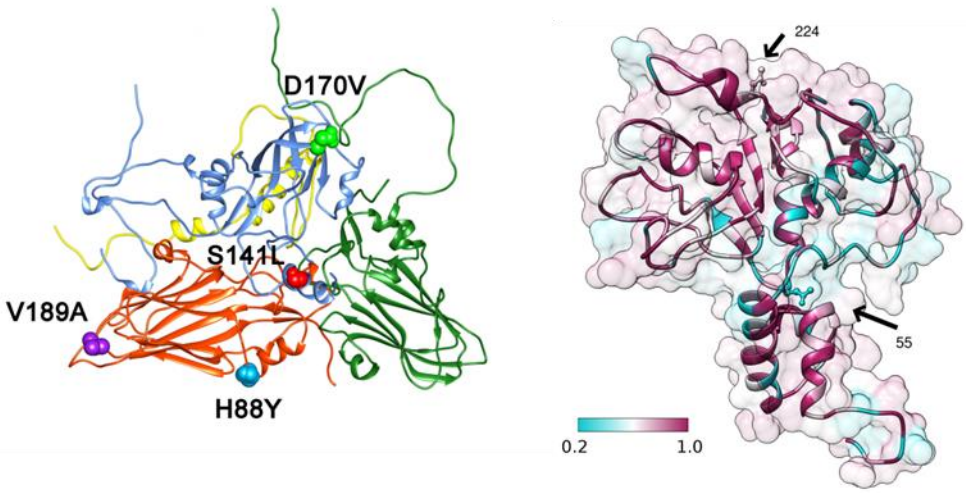

Figure 2: *In silico* models showing the localisation of amino acid changes present in A01NL within a single protomer (*left*) or 2C protein (*right*).

CEBRA Project 1604D: Incorporating real-time economic components in Australia's FMD modelling capability and evaluating post-outbreak management to support return to trade

Graeme Garner[1], Richard Bradhurst[2], Clare Death[1], Aaron Dodd[2], Iain East[1] and Tom Kompas[2]

[1]*Animal Health Policy Branch, Department of Agriculture and Water Recourses, Canberra, ACT, Australia*
[2]*Centre of Excellence for Biosecurity Risk Analysis, University of Melbourne, Parkville, VIC, Australia*

Foot-and-mouth disease has been identified as the single greatest disease threat to Australia's livestock industries. Vaccination is increasingly being recognised as an important tool to assist in containing and eradicating FMD outbreaks. The options for dealing with vaccinated animals at the end of an outbreak are to remove them from the population in order to expedite regaining FMD-free status ('vaccinate-and-remove'), or to keep the animals in the population and allow them to live out their normal commercial lives ('vaccinate-and-retain'). More than 90% of the economic costs of an FMD outbreak in Australia would arise from revenue losses caused by immediate and prolonged export bans by Australia's FMD sensitive markets. Following an outbreak of FMD, surveillance will be required to demonstrate that infection has been eradicated from the population in order to meet international requirements to regain FMD-free status and to satisfy trading partners so as to regain access to international markets. Although there is growing interest in vaccinate-and-retain policy for the control of FMD to avoid the need for large scale culling of at-risk animals, keeping vaccinated animals in the population will make achieving recognition of free status more difficult under current international rules.

From a policy perspective it would be very useful if disease managers had access to decision support tools that could be used to evaluate policies and approaches to regain FMD-free status and facilitate early return to trade. This project expanded the functionality of the Australian Animal Disease model (AADIS), currently being

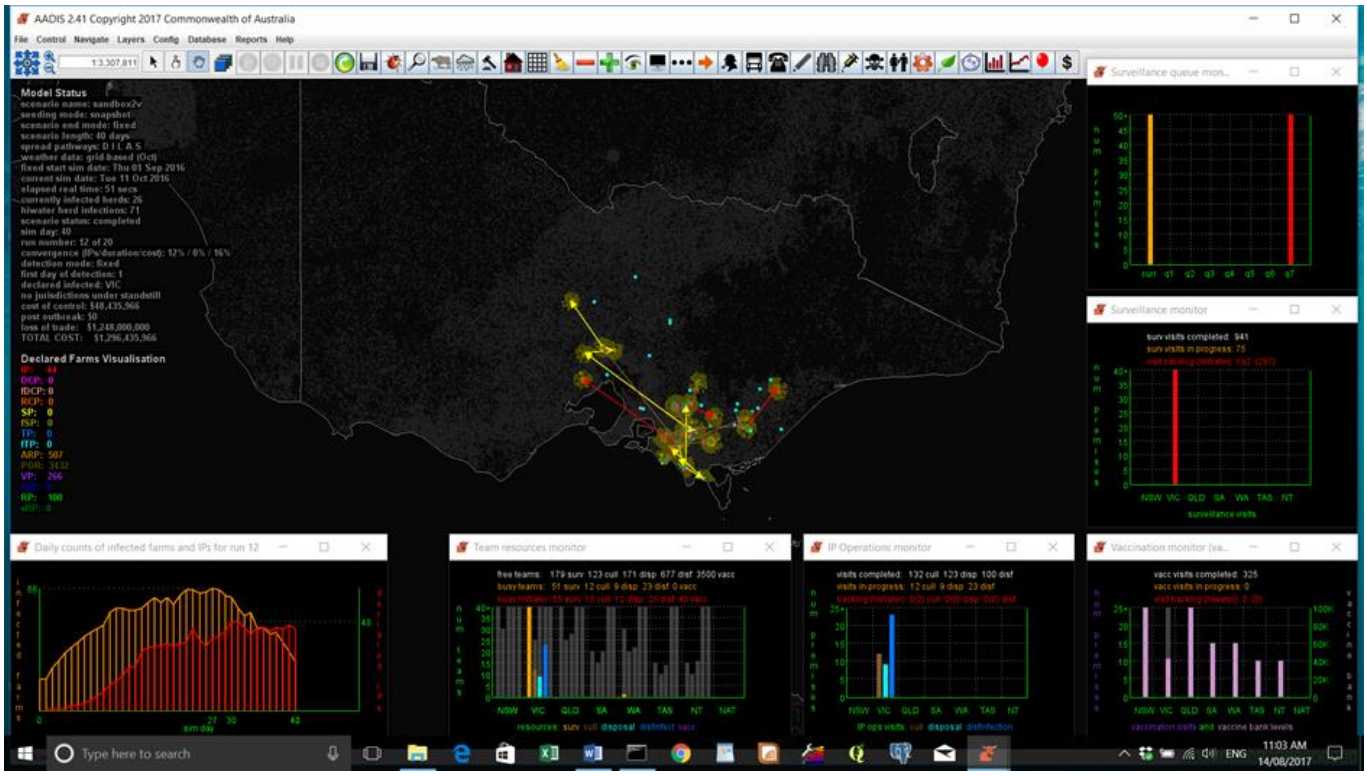

Figure 1: FMD outbreak in Victoria simulated with the AADIS model

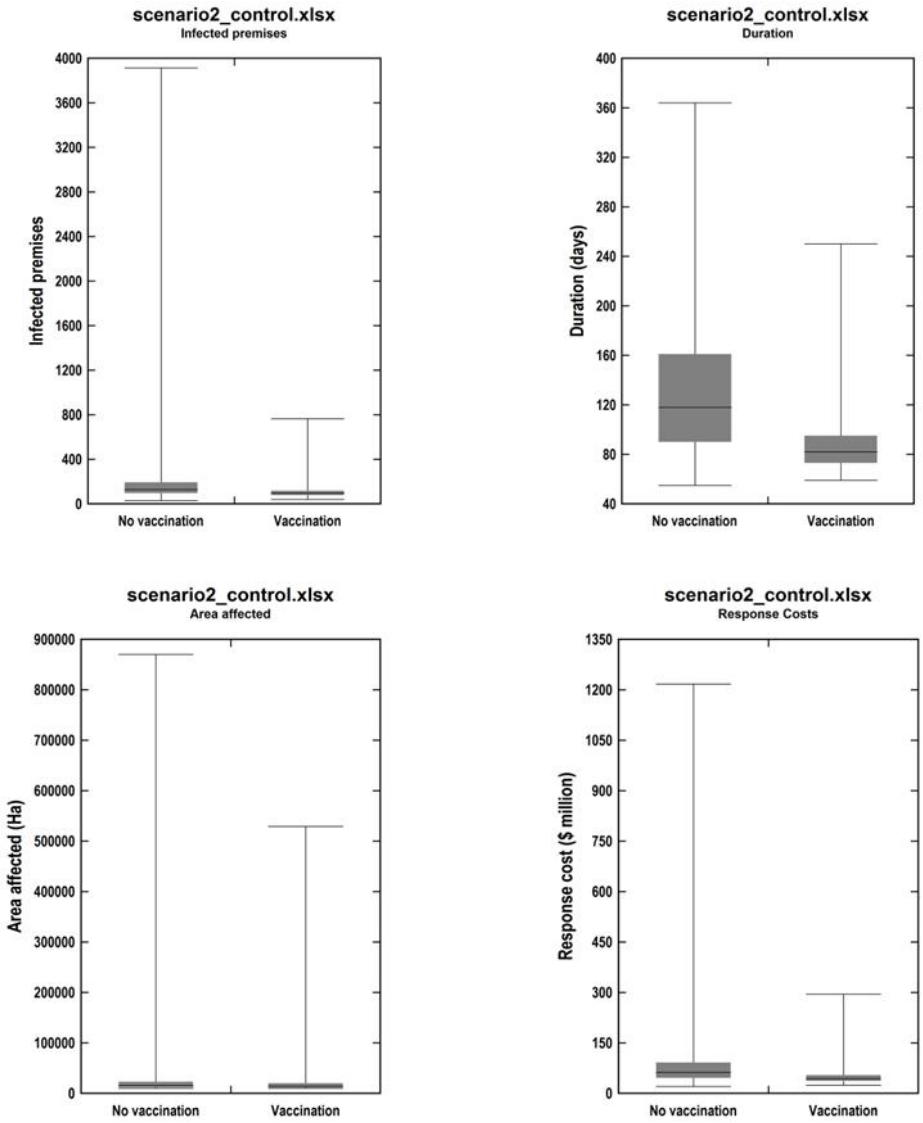

Figure 2: Simulated FMD outbreak in Victoria. Comparison of control programs with and without emergency vaccination

used by animal health authorities in Australia to support FMD planning and preparedness, to include capacity to evaluate different approaches to post-outbreak surveillance in previously infected areas, and a module for post-outbreak management of vaccinated animals.

To demonstrate how the improved functionality can be used, case studies of hypothetical outbreaks in Queensland, Western Australia and Victoria are reported. These studies involved comparing different approaches to disease control and post-outbreak management. In the first study, vaccination used with stamping out provided no improvement over stamping out on its own in the Queensland case study scenario, provided a small but significant improvement in the Western Australia case study and was highly effective in reducing the size and duration of the outbreak in the Victoria case study. This finding highlights that when it comes to considering the use of vaccination, a 'one size fits all' approach is not appropriate.

In the second demonstration study we showed how a reduced sampling intensity surveillance approach used with a control program not involving vaccination, could significantly reduce the number of samples collected and the cost of the post-outbreak surveillance program without increasing the risk of missing residual infected herds when compared to a baseline surveillance based on the European Union FMD Directive. However when emergency vaccination is used, there was a high likelihood that some vaccinated herds will be exposed to infection and under a

vaccinate-and-retain policy, post-outbreak surveillance programs, even when census sampling is used, cannot be guaranteed to find all of these herds.

The third demonstration study compared (a) vaccinate-and-retain; (b) vaccinate-and-remove (slaughter to waste) and (c) vaccinate-and-remove (slaughter and salvage) policies for managing vaccinated animals. The vaccinate-and-remove strategies were associated with higher post-outbreak management costs but lower loss of trade costs. In terms of overall cost, there would be significant savings compared to the vaccinate-and-retain policy. From a cost point of view there was no advantage of removal with salvage compared to removal to waste under the study assumptions. Any savings made through salvage are offset by trade losses associated with longer time required to remove all vaccinated animals, and regain markets.

This project has developed and demonstrated modelling functionality to support policy development around important issues to facilitate regaining FMD free status and regaining market access after an FMD outbreak. However, the limited nature of the studies and uncertainty around some parameters means that more work is required before it is possible to provide clear advice and guidelines to disease managers. The work done in this project will continue under a MLA-CSIRO FMD project funded under the Rural R&D for Profit Program (see page 10).

The Quads Epiteam: report on research and current activities

Charlotte Cook

Biomathematics & Risk Research Unit, Animal and Plant Health Agency (APHA), UK

In 2005, the Quadrilateral Animal Health Emergency Management Group (AHEMG) held a workshop on modelling to support decision making in a disease emergency with a focus on the experience of modelling the 2001 FMD outbreak in the UK. One of the outcomes of the workshop was agreement from the governments of New Zealand, Australia, United States of America, Canada and UK to support the formation of the Animal Health Quadrilateral (Quads) Epiteam. The Epiteam aims to foster collaboration on the development and use of animal disease epidemiological models to aid government officials and policymakers in animal disease outbreak preparedness and management.

The Epiteam has undertaken a number of studies using epidemiological models to evaluate FMD outbreak management policies in countries that are disease free without vaccination. These studies encourage cooperation and knowledge sharing between the countries involved.

One of the first projects undertaken by the group was a formal multi-model evaluation study [1]. Initially, a conceptual comparison was made among the countries' independently developed, complex models for FMD outbreak simulation. The models included were AusSpread from Australia, InterSpread Plus from New Zealand and NAADSM from North America. Subsequently each of the models was used to simulate a number of increasingly complex FMD outbreaks and the results compared. A hypothetical dataset was used to make the results comparable across all the models. Metrics used to compare the scenarios were the number of infected premises (IPs), temporal and spatial spread. Despite being independently developed models, the results from all three were broadly in line with each other, and where there were significant differences they could be attributed to variations between the models in how transmission is handled.

Following the initial study, the group completed a second study to extend the application of comparative model validation [2]. A dataset of

holdings, markets and animal movement patterns in the Republic of Ireland was used to model a range of FMD outbreaks that all involved a market in the early phase of infection spread. Control policies implemented within the models included stamping out of IPs, and the study also investigated the use of vaccination. When comparing the model outputs there were some differences between each model, however between-scenario comparisons were similar. This work indicated that the early use of vaccination was a promising method of control for FMD outbreaks in this particular scenario.

In 2010, the UK model Exodis-FMD and the Netherlands FMD model joined the team for the next phase of work looking at vaccination as a control option for a large outbreak of FMD [3]. Using a scenario similar to the UK outbreak, Exercise Silver Birch, all the models used an identical dataset and simulated forward until disease was eradicated. Variations in vaccination deployment were included, such as timing, zone size and order of priority for vaccination application. Performance of the different scenarios was compared between the models using outcomes such as length of outbreak, number of IPs and numbers of animals vaccinated. All the models agreed that vaccination with stamping-out of IPs led to a significant reduction in predicted outbreak size and duration, compared to using a stamping-out policy alone.

Subsequently each of the countries involved have taken the results from the 2010 study of the most effective vaccination strategies and performed further modelling studies using population data, control policies and resources from their home country. Making comparisons between the countries is a challenge due to the differences in susceptible species density, management practices and response plans. However, within each country insights into effective vaccination strategies were obtained, thus improving contingency plans.
Currently the team is focused on a study looking for factors in the early days of an outbreak that indicate how severe the outbreak may be in the long-term. Sweden has also joined the team for this study, using the DADS-DTU model. These early decision indicators may help to provide evidence of the types of outbreak where vaccination is likely to be of benefit for outbreak management. This would assist disease managers in these countries in determining if and when vaccination is likely to be beneficial in FMD control and contribute to improved decision-making during an outbreak. All of the completed studies are, or will be, published as peer reviewed articles that are freely available for download.

Acknowledgements: We thank the supporting governments and all the people involved in the Quads Epiteam: C. Birch, T. Boyer, C. Cook, B. Corso, C. Dubé, F.D. Dorea, I. East, K. Forde Folle, N. Harvey, M.G. Garner, J. Griffin, F. Gauntlett, K. Ståhl, M. Mclawes, R. Moir, J. O'Connor, K.A. Patyk, T. Rawdon, SE. Roche, R.Sanson, T. Smylie, M.A. Stevenson, M. Van Andel, Z. Yu

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3. *Roche, S.E., et al., Evaluating vaccination strategies to control foot-and-mouth disease: a model comparison study. Epidemiol Infect, 2015.* ***143****(6): p. 1256-75.*

Examining cattle with FMD during Real Time Training in Kenya (EuFMD)

Improved Surveillance, Preparedness and Return to Trade for Emergency Animal Disease Incursions Using Foot and Mouth Disease (FMD) as a Model

Wilna Vosloo[1], Yiheyis Maru[2], Marta Hernandez-Jover[3], Tim Capon[2], Peter Durr[1], Francette Geraghty-Dusan[4]

[1]*Australian Animal Health Laboratory, CSIRO-Health & Biosecurity, Australia*
[2]*CSIRO-Land and Water, Australia*
[3]*Charles Sturt University, Australia*
[4]*Animal Health Australia*

Australia's biosecurity system helps protect our livestock industries from many disease threats. However, there is a need to strengthen preparedness and response to facilitate an early return to trade for Australia should there be an emergency animal disease incursion.

FMD is currently regarded as one of the most economically and socially devastating livestock disease threats to Australia which could cost this country up to $50 billion over 10 years, should a multi-state outbreak occur. Because of the impact of this disease, FMD is being used as a model to help Australia improve surveillance, preparedness and return to trade for this and other emergency animal diseases.

The project - 'Improved Surveillance, Preparedness and Return to Trade for Emergency Animal Disease Incursions Using Foot and Mouth Disease as a Model' (the Project) commenced in July 2016. It combines the expertise of research partners from several disciplines, working closely with livestock industries and governments to enhance emergency animal disease surveillance, preparedness and response in Australia. In addition, the Project will contribute to improving the way Australia manages endemic diseases through strengthening disease recognition and management.

This project is supported by Meat and Livestock Australia, through funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit programme, and by producer levies from Australian FMD-susceptible livestock (cattle, sheep, goats and pigs) industries and Charles Sturt University, leveraging significant in-kind support from the research partners. The research partners for this project are the Commonwealth Science and Industrial Research Organisation (CSIRO), Charles Sturt University, the Bureau of Meteorology and the Australian Department of Agriculture and Water Resources, supported by Animal Health Australia (AHA).

Consisting of four integrated sub-projects, the Project looks at improving on-farm livestock surveillance, investigating response strategies, managing vaccines and determining how disease is spread.

The sub-projects are:

- Rapid Diagnostics and Vaccination Strategy Preparedness
- Farmer-led Partnerships for Surveillance
- Outbreak Decision Support Tools
- Analytical Tools to Determine the Path of Farm-to-Farm Disease Transmission

What do The Project's sub-projects do?

The **'Rapid Diagnostics and Vaccination Strategy Preparedness'** project aims to deliver improved diagnostic capabilities (better tests and staff skilled in conducting these tests) and identify vaccines that have been shown to be effective against FMD.

The **'Farmer-led Partnerships for Surveillance'** project will seek the participation of Australian producers in a pilot program demonstrating the value of farmer-led partnerships for improving livestock surveillance at the farm level, for endemic and emergency animal diseases.

The **'Outbreak Decision Support Tools'** project builds on an existing computer simulation model (Australian Animal Disease Spread - AADIS). This project will enhance and use the AADIS model to better inform strategic decision-making around managing a FMD outbreak. Researchers will work with government and industry stakeholders to design and test response strategies for FMD through simulations and interactive workshops. The project aims to provide robust guidelines for responding to an FMD outbreak, including approaches to post-outbreak surveillance and management options for vaccinated animals, to support proof-of-freedom and a faster return to trade.

The **'Analytical Tools to Determine the Path of Farm-to-Farm Disease Transmission'** project is an important initiative to help us better understand how the FMD virus might spread via natural pathways, for example wind, between properties in the event of an outbreak. Next generation sequencing data management will be an important aspect of this project.

Where can I find out more?
For more information go to https://research.csiro.au/fmd

If you have any specific questions about the project, email the project lead - Wilna Vosloo, at Wilna.Vosloo@csiro.au.

Participants at a stakeholders meeting held 20 June 2017 in Canberra, Australia, to engage the departments of veterinary services

CODA-CERVA, Belgium

David Lefebvre

Project proposal

CODA-CERVA has taken the initiative to bring together 16 different research partners in the European Union (EU) Framework Program for Research and Innovation "Horizon 2020": twelve partners from the EU, two from Asia, one from Africa and one from South-America. Eight of them are GFRA partners. The submitted project proposal was entitled "**Research to develop improved approaches to prevent and respond to emerging strains of highly virulent foot-and-mouth disease virus in livestock in the European neighborhood**".

The FMDV strains O/ME-SA/Ind-2001d and A/ASIA/G-VII recently emerged from the Indian subcontinent to cause widespread outbreaks in North Africa, Turkey and the Middle East and in countries in South East and East Asia that have strong trade links to the EU. The long-distance spread of these FMDV strains poses a particularly

increased threat for onward spread to the EU. Therefore our research consortium developed a research and innovation project, addressing molecular epidemiology and risk management, diagnostics, means of prevention and disease control, the study of host-pathogen interactions and translating results from the laboratory into the field. The purpose is to enhance the capacity within Europe to monitor risks and respond to a future incursion of FMDV.

Due to the current unfavorable situation of African swine fever, lumpy skin disease and bluetongue in Eastern and Southern Europe, the European Commission unfortunately decided not to fund our FMD project proposal. However, our project proposal is a strong signal to the European Commission that FMD is still one of the most important livestock diseases at a global scale, that FMD still poses a significant threat to agriculture in FMD-free countries, and that there is a very strong and united scientific community that keeps on taking up the glove to stop this disease.

Results from international collaborations

The CODA-CERVA, an OIE Collaborating Center and an FAO Reference Centre, has a bilateral collaboration with the Botswana Vaccine Institute (BVI), an OIE Reference Center, with particular emphasis on hands-on training of BVI staff on genome sequencing and analysis at CODA-CERVA. In 2016, CODA-CERVA participated in an Inter Laboratory Comparison diagnostic trial organised by BVI. Twenty field samples (SAT serotypes) from Botswana, Malawi, Mozambique, Zambia and Zimbabwe were successfully characterised by means of viral isolation, antigen ELISA and RT-qPCR.

The CODA-CERVA is involved as a parent collaborating centre in an OIE Laboratory Twinning Program for capacity building via a technical and scientific collaboration with the National Veterinary Research Institute (NVRI) from Vom, Plateau State, Nigeria. The CODA-CERVA provides laboratory training to scientists and technicians from the NVRI. From a scientific perspective, particular attention is given to extensive molecular characterisation of Nigerian FMDV isolates, and includes sequencing, sequence analysis and phylogeny. FMD virus of serotype SAT1 was isolated, identified and characterised at CODA-CERVA, during a joint effort of NVRI and CODA-CERVA staff, 35 years after the last report of FMDV SAT1 in West Africa. Based on phylogenetic analysis, both Nigerian SAT1 isolates from 2015 branched out as a separate, new topotype X, with a nucleotide divergence of ≥29% between these 2 isolates and isolates from other topotypes. Nigerian isolates of 1975–1976 and 1979–1981 were mapped to topotype V and topotype VI, respectively (Ehizibolo et al., 2017a).

In epithelial samples collected during outbreaks in the period 2013–2015, three other serotypes were isolated and characterised: O, A and SAT2. Phylogenetic analysis showed that two topotypes of FMDV serotype O were circulating in Nigeria, East Africa-3 (EA-3) and West Africa (WA), respectively, as well as FMDV strains belonging to lineage G-IV of the African topotype of serotype A and FMDV SAT2 topotype VII strains (Ehizibolo et al., 2017b). Blood samples collected during these outbreaks showed 80% NSP positive samples and antibodies were detected against FMDV serotypes O, A, SAT1, SAT2 and SAT3, the latter probably due to cross-reactivity. We did not find evidence for circulation of FMDV SAT3 strains (Ehizibolo et al., 2017b). Nigeria's complex FMD situation is linked to its status as the largest importer of livestock in Africa, with over 1.4 million animals imported annually; including 1 million live cattle, sheep and goats from Niger. This figure does not include the illegal trade in live animals.

Vaccination of susceptible livestock against FMD is not practiced in Nigeria due to the prohibitive cost of foreign vaccines and the absence of locally produced FMD vaccines (Ehizibolo et al., 2017b). Since March 2017 a new FMDV strain is circulating in Algeria and Tunisia. The laboratories of ISZLER (Brescia, Italy) and the WRL (Pirbright, UK) serotyped this new strain as FMDV-A and genotyped it as topotype Africa, lineage G-IV, closely related to the Nigerian strains that were collected in 2013 and 2015 (ProMed-20170411) and that were characterised during the OIE Laboratory Twinning Program (Ehizibolo et al., 2017b). The Nigerian FMDV-A, G-IV strains are closely related to a strain collected in Cameroon

in 2000.

The results of the OIE Laboratory Twinning Program between CODA-CERVA and NVRI help to fill the knowledge gap of FMDV dynamics in the West African region to support local and regional development of vaccination-based control plans and international risk assessment. The current spread of a West African FMDV strain into the Maghreb, threatening Europe, underlines the importance of the Nigerian project.

The CODA-CERVA has a bilateral collaboration with the National Veterinary Laboratory (LNV) from Bujumbura, Burundi, with particular emphasis on full serologic, antigenic and genomic characterisation of FMDV samples from the field. One-hundred ninety-five tissue samples and 195 serum samples taken from clinical cases suspected of FMD in 6 different provinces of Burundi were submitted to CODA-CERVA. The analysis is currently ongoing and the publication of the results is scheduled for 2018.

Science reports

Scientific publications on FMD involving CODA-CERVA in 2017 (so far)

De Vleeschauwer AR, Lefebvre DJ, De Clercq K, 2017. Antiviral Therapies for Foot-and-mouth Disease (Ch. 15). In: Sobrino F and Domingo E (Eds.), Foot-and-Mouth Disease Virus: Current Research and Emerging Trends. Caister Academic Press, pp. 357-384. DOI: https://doi.org/10.21775/9781910190517.15

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Ehizibolo DO, Haegeman A, De Vleeschauwer AR, Umoh JU, Kazeem HM, Okolocha EC, Van Borm S, De Clercq K, 2017a. Foot-and-mouth disease virus serotype SAT1 in cattle, Nigeria. Transbound Emerg Dis, 64(3):683-690. doi: 10.1111/tbed.12629.

Ehizibolo DO, Haegeman A, De Vleeschauwer AR, Umoh JU, Kazeem HM, Okolocha EC, Van Borm S, De Clercq K, 2017b. Detection and Molecular Characterization of Foot and Mouth Disease Viruses from Outbreaks in Some States of Northern Nigeria 2013-2015. Transbound Emerg Dis, doi: 10.1111/tbed.126

INTA Visit

Guido König

Instituto de Biotecnología, INTA, Argentina

Thanks to the ARTURO FALASCHI ICGEB (International Centre for Genetic Engineering and Biotechnology) SMART FELLOWSHIP PROGRAMME, the veterinarian David Ehizibolo, from the National Institute of Veterinary Research (Vom, Nigeria), has completed three months laboratory training at INTA (Instituto Nacional de Tecnología Agropecuaria), Argentina.

The research activities were carried out mainly at the IB (Instituto de Biotecnología) from December 2016 to February 2017 and were based on FMDV diagnosis and molecular characterisation techniques, and analysis of the results using specific software. These activities were performed under the direction of Guido König with the collaboration of Andrea Peralta and Sebastián Di Giacomo.

Two full working days were also organised by Sabrina Galdo Novo at the Animal Laboratory of SENASA (Servicio Nacional de Sanidad y Calidad Agroalimentaria).

The main goal of the training was to upgrade the diagnostic and research capability at the National Institute of Veterinary Research through technology transfer.

Collaboration projects between the two groups are expected to be designed in the near future.

An update on EuFMD's training programme: breadth and depth, live and online!

Jenny Maud, Keith Sumption, Nadia Rumich, Mark Hovari and the EuFMD Training Team

European Commission for the Control of Foot-and-Mouth Disease, Food and Agriculture Organization of the United Nations, Rome, Italy.

The European Commission for the Control of Foot-and-Mouth Disease (EuFMD) works to improve preparedness for FMD incursion in its 38 Member States, to promote control of FMD in European neighbourhood countries, and to support the GF-TADs Global Strategy for FMD Control. Central to the success of any emergency response or programme of progressive control are veterinarians and wider stakeholders who have the knowledge and skills needed to play their part effectively. Recognising this, EuFMD's capacity building activities have increasingly focussed on training. The challenge of a wide range of countries in need of training, all with differing needs, combined with broad potential audiences, including farmers, field veterinarians and those in central government, means that we have had to be strategic and innovative. A training needs assessment process has allowed EuFMD to identify the most important gaps in capacity, and the appropriate methodologies to address them. The use of e-learning tools, often combined with face to face training, means that we are able to reach broader audiences in a cost-effective

manner. The EuFMD has now trained over 3000 veterinarians from over 50 countries through tutored online courses.

Promoting emergency preparedness in FMD-free countries

The training for EuFMD Member States is organized through a "training credits" system. Each country may choose from a menu of training options in order to build a programme tailored to their particular needs. Tools are provided to allow each country's "training focal point" to assess their current capacity gaps and select appropriate training to address these gaps. We recognise the need for breadth and depth. Those in central veterinary services need in-depth training to build specialist capacities in FMD contingency planning. A large number of field veterinarians, both private and public, along with livestock owners, need less intensive training on recognition and diagnosis of FMD and their role in an outbreak response.

Epidemiological interview during Real Time Training in Kenya

To build such "depth" in contingency planning capacity we have organized a number of workshops, including on surveillance and diagnosis of FMD in wildlife, crisis management and communication, simulation exercises, disease spread modelling applied to decision making, and the practical aspects of emergency vaccination. We have now held over 60 "Real Time Training" courses in Turkey, Kenya and Nepal. These courses allow veterinarians to learn about FMD diagnosis, outbreak investigation and biosecurity in real, field situations. Alongside EuFMD Member States, veterinarians and wider stakeholders from Australia and New Zealand take part in Real Time Training courses, which have been organised under a project in Nepal since 2013.

EuFMD's e-learning courses attempt to address training "breadth". The FMD Emergency Preparation course involves approximately 120 veterinarians in a four week tutored online course which covers FMD diagnosis, epidemiological investigation, aspects of emergency control and biosecurity. The course involves live webinars, interactive course modules, videos and quizzes. The highlight is an online discussion forum, in which expert tutors and participants interact in often lively discussions. The course is offered in English for a combination of different Member States. Additionally, one country may take up the course, adapt it to its particular situation and run it for a large cohort of both public and private veterinarians. National courses have been organised for the UK, France, Spain, Estonia, Turkey, Algeria, Croatia and Australia and have been particularly interactive.

We recognise that raising awareness amongst livestock owners and field veterinarians is key to early recognition of a disease incursion. We equally recognise that EuFMD cannot itself provide training to such audiences. In order to assist countries to conduct their own national level training we are building a range of tools to assist "cascade training" and making them available through our online FMD Knowledge Bank. All those joining our Real Time training

FMD crisis management communication workshop

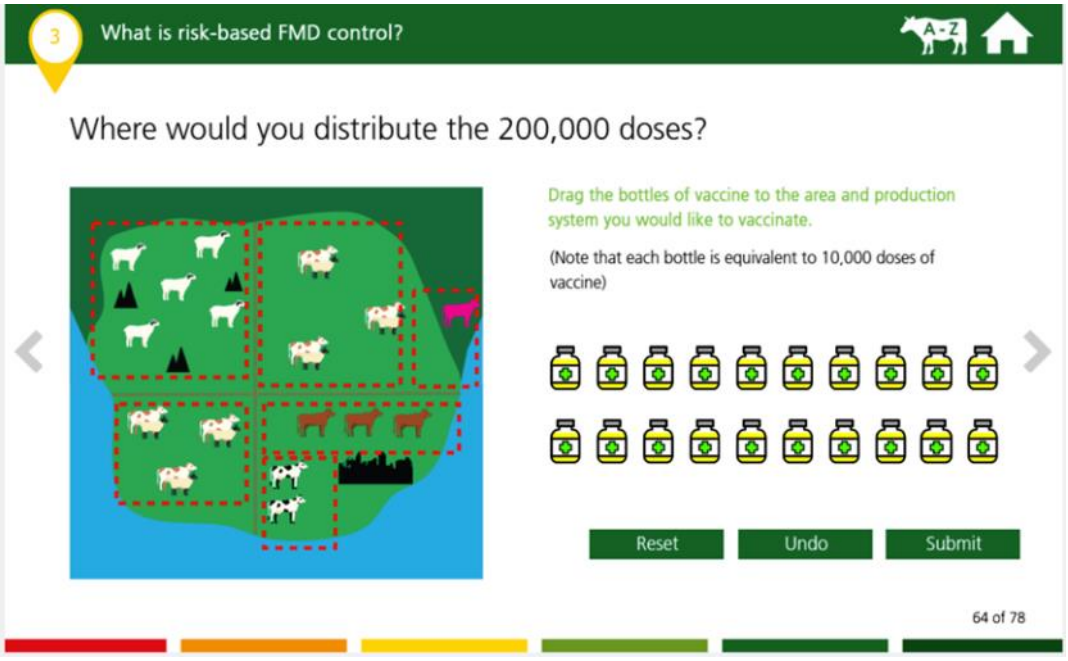
courses are assisted to carry out their own cascade training when they return home. Promoting such national training on FMD is still a work in progress, and we would welcome colleague's experiences and ideas in how to assist further in this area.

Building capacity for the progressive control of FMD

Assisting non-free countries to develop and implement national strategies for risk-based control of FMD requires building a broad range of knowledge and skills. EuFMD has worked with a number of countries in the European neighbourhood to conduct a series of national workshops to develop, implement and evaluate such control strategies. A training needs assessment conducted in 2016 identified a number of common capacity gaps across all countries in this region, and as a result three new "in-depth" e-learning courses have been developed; FMD Socio-economic Impact Assessment, FMD Risk Analysis Along the Value Chain and FMD Post Vaccination Monitoring. These in-depth courses are aimed at those working in central veterinary services and are intensively tutored, requiring a commitment of four hours study per week for a six-week period. Through a collaboration with The Pirbright Institute we will soon pilot an online course aimed at national FMD laboratories, in which training modules developed by Pirbright will be hosted in a tutored online course on the EuFMD e-Learning platform.

Workshop on the development of a Risk-based Strategic Plan for FMD control in Mauritania

Again, we also seek to provide a breadth of training in non-free countries. A six hour open-access online course "Introduction to the Progressive Control Pathway (PCP)" is available to anyone who would like to be introduced to the concepts and processes of the PCP and can be used as an induction course for workshops, in-depth e-learning, or prior to regional roadmap



Open access online training course "Introduction to the Progressive Control Pathway"

meetings. We have also worked with regional FAO offices to pilot the use of our e-learning course outside the European neighbourhood region. Our online FMD Investigation Training course has been organised as a pilot of e-learning in both Southern Africa and South Asia, and both of these courses showed the potential of online tools for training of veterinarians in these countries, along with lively online discussions promoting international collaboration and networking between colleagues working on similar issues in neighbouring countries.

We speak your language!

We recognise that everyone prefers to learn and discuss in a language that they are comfortable using. A benefit of e-learning is the relative ease with which training materials can be produced in multiple languages. To date, EuFMD e-learning courses have been organised in English, French, Spanish, Russian, Turkish, Estonian, Croatian, Serbian, Bulgarian and Greek. The latest language added to our repertoire is Arabic, with an online FMD Investigation Training Course organised for 180 veterinarians in North Africa and the Middle East, working in partnership with the Jordan Institute of Science and Technology. The discussion forum in this course was especially lively, with a wide range of discussions including the challenges of FMD control in nomadic farming systems, biosecurity at live animal markets, reports of ongoing FMD outbreaks, optimising vaccination strategies and field diagnostics. Our programme for the next two years includes further translation of our courses aimed at improving FMD control in non-free countries.

The online FMD Emergency Preparation Course in Spanish

Useful resources for GFRA members

We have a number of online resources of interest to GFRA members, all of which can be accessed from our e-learning website https://eufmdlearning.works:

Networks
EuFMD's informal networks organise regular webinars and aim to link global colleagues working on similar issues. For FMD-free countries, we organise the FMD contingency planning, modelling, biorisk management and vaccination networks. For non-free countries, our Progressive Control Practitioners' Network and Francophone FMD Network offer regular webinars and informal training for all those working to control FMD in endemic settings. Visit our networks page to find out more.

Knowledge Bank
EuFMD's online Knowledge Bank is a searchable database of FMD resources. The database includes access to over 40 recordings of webinars recently conducted under our networks. It also includes "training tools" such as factsheets, powerpoints, games and videos that you can use to conduct your own FMD training.

Open Session Online
Video recordings of all of the presentations given at the 2014 and 2016 EuFMD Open Sessions are available, each presentation is 5-15 minutes in length, perfect for a short break with a cup of tea!

How can GFRA members be involved?

We would be pleased to hear from colleagues who would like to be involved in our training activities. Could you:

- Contribute a resource to build our Knowledge Bank?
- Present a webinar?
- Provide us with experience, comments or suggestions to help us improve our training in future?
- Join a course as a participant or an expert trainer?

If so, please contact us on **eufmd@fao.org.**

GFRA Scientific Meeting
Seoul, South Korea
25-27 October 2017

- FMD In Swine: Pathogenesis and Immunology
- FMD Vaccines in the 21st Century
- Vaccine Delivery Routes and Adjuvants
- Persistent FMD: New Knowledge, Old Problem
- FMD Ecology and Epidemiology: Differences in Africa and Asia
- Socio Economics of FMD: Endemic and Non-endemic Settings
- FMD Modeling: More Data Better Models?
- Research on Diagnostics, including sample collection and management
- Intervention strategies, including disinfection, control methods, and success stories

Global Foot-and-Mouth Disease Research Alliance

Want to know more?

The Global Foot-and-Mouth Disease Research Alliance (GFRA)

A worldwide association of animal health research organisations to assist the global control and eventual eradication of foot-and-mouth disease.

www.ars.usda.gov/gfra

CSIRO
Australian Animal Health Laboratory

GFRA
Global Foot-and-Mouth Disease Research Alliance

The GFRA Executive Committee

Wilna Vosloo	Chief Executive Officer (Australian Animal Health Laboratory, Australia – wilna.vosloo@csiro.au)
Do Huu Dung	President (Department of Agriculture, Hanoi, Vietnam – dung.dah@gmail.com)
Cyril Gay	Executive Secretary (Agricultural Research Service, USA – cyril.gay@ARS.USDA.GOV)
Luis Rodriguez	Science Director (Plum Island Animal Diseases Centre, USA – luis.rodriguez@ars.usda.gov)
Bryan Charleston Toby Tuthill	Finance Directors (Pirbright Institute, UK – bryan.charleston@pirbright.ac.uk; toby.tuthill@pirbright.ac.uk)

Secretarial Assistance: Dylan Helgeson, CRDF Global

Newsletter compiled by Jacquelyn Horsington, Transboundary Animal Disease Mitigation, Australian Animal Health Laboratory, CSIRO-Health & Biosecurity

**Please note the contents of this newsletter are not peer reviewed.*