



WRLFMD

(some recent) history and vision for the future

Donald King



Then....



World Foot-and-Mouth Disease Reference Laboratory

In connection with the action taken by FAO in appointing the Research Institute, Pirbright, United Kingdom as a World Foot-and-Mouth Disease Reference Laboratory, it was decided that the interests of the Commission should be included. Following negotiations, the Government of the United Kingdom accepted a contribution of £250 per annum for the next two years, beginning 1958 from the Commission in recognition of the Commission's interest in the work.



Ferris and Donaldson (1992) The World Reference Laboratory for Foot and Mouth Disease: a review of thirty-three years of activity (1958-1991) *Rev Sci Tech*

EUFMD (1954) WRLFMD (1958)*

Established at a time when:

- Regular FMD epidemics in Europe (serotypes O, A, C were ubiquitous)
- Recent FMD outbreaks in Canada (A) and Mexico (O)
- Lab diagnostics were based on CFT, mice inoculation and tongue cultures

*designated as Reference Lab by OIE in 1960

- 1993: FMD-free (without vaccination) policy adopted in Europe
- 2007: RT-PCR diagnostics and full genome sequencing used to support FMD control in the UK
- 2011: last reported FMD cases in Europe (Bulgaria – O)
- 2013: Next-generation sequencing located at Pirbright
- 2015: Occupied new high containment “Plowright” laboratory
- Houses all our work with “live” FMD and International Reference Laboratories for FMD, BT, PPR, ASF, AHS, capripox

.... and now





OIE Reference Laboratory World Reference Laboratory

OIE Twinning Project
NAHDIC, Ethiopia

Diagnostics Training Course
Pirbright



Diagnostics Training
via e-learning



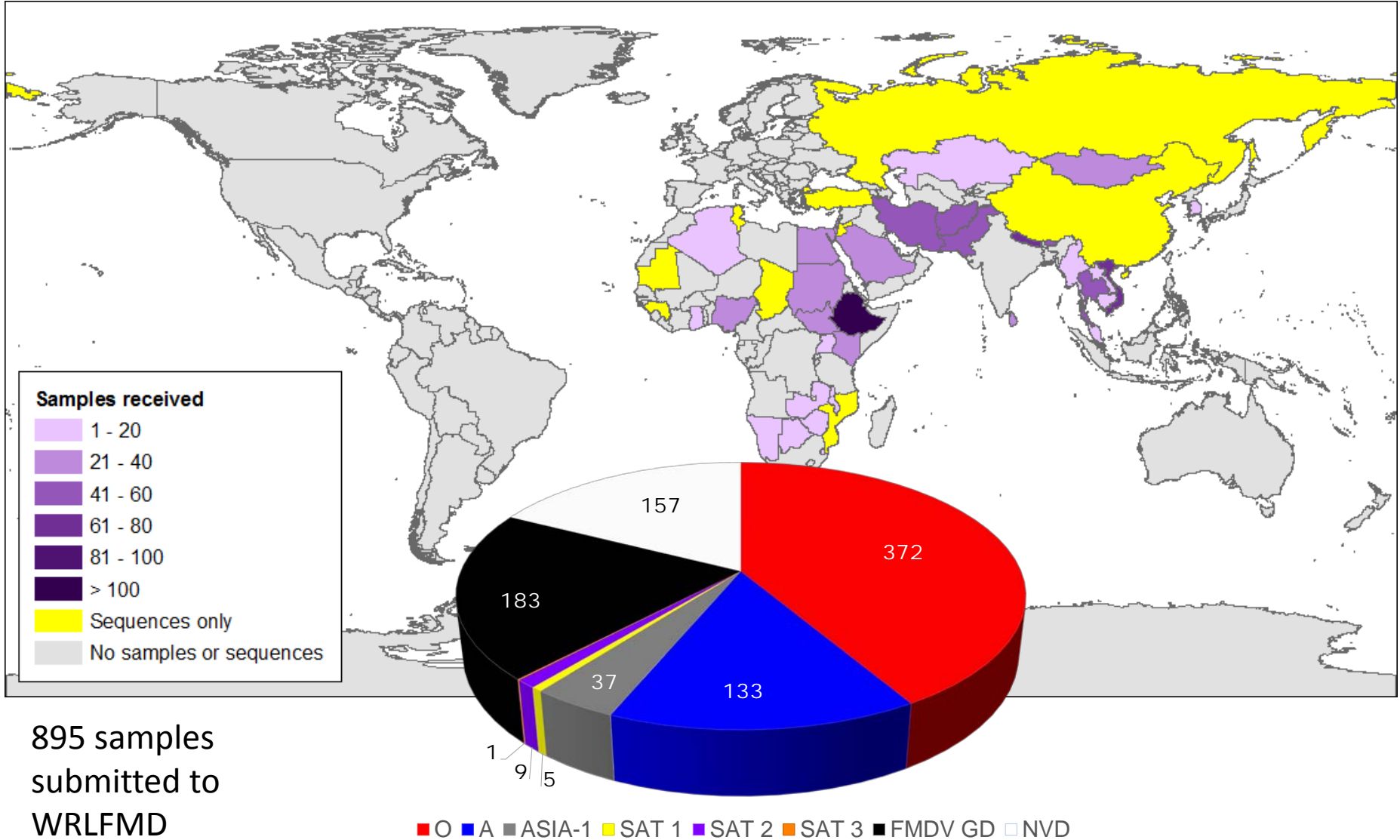
This course is aimed at those working in national or regional foot-and-mouth disease laboratories and involved in carrying out or managing laboratory testing activities.



- Referral diagnostic service to test samples from overseas outbreaks
- Development of new diagnostic tests and supply of reagents
- Monitor the performance of FMDV vaccines
- Provide training and capacity building
- Coordination of the OIE/FAO FMD Laboratory Network
- **Monitoring global circulation of virus lineages**
- **Highlighting risks of disease introduction**

Samples and sequences received at WRLFMD

October 2016 – September 2018



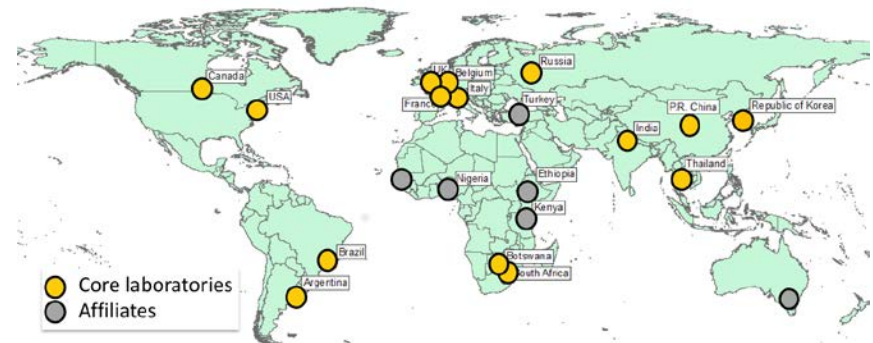
895 samples submitted to WRLFMD

Enhanced surveillance via the OIE/FAO FMD Laboratory Network



- **Global surveillance and changing patterns in risk**
- **Harmonised and improved lab capacity**

Core Network Members and affiliates:



- Established in 2004
- MoU now signed by all “core members”
- Meeting and annual reports available:

<http://www.foot-and-mouth.org/>

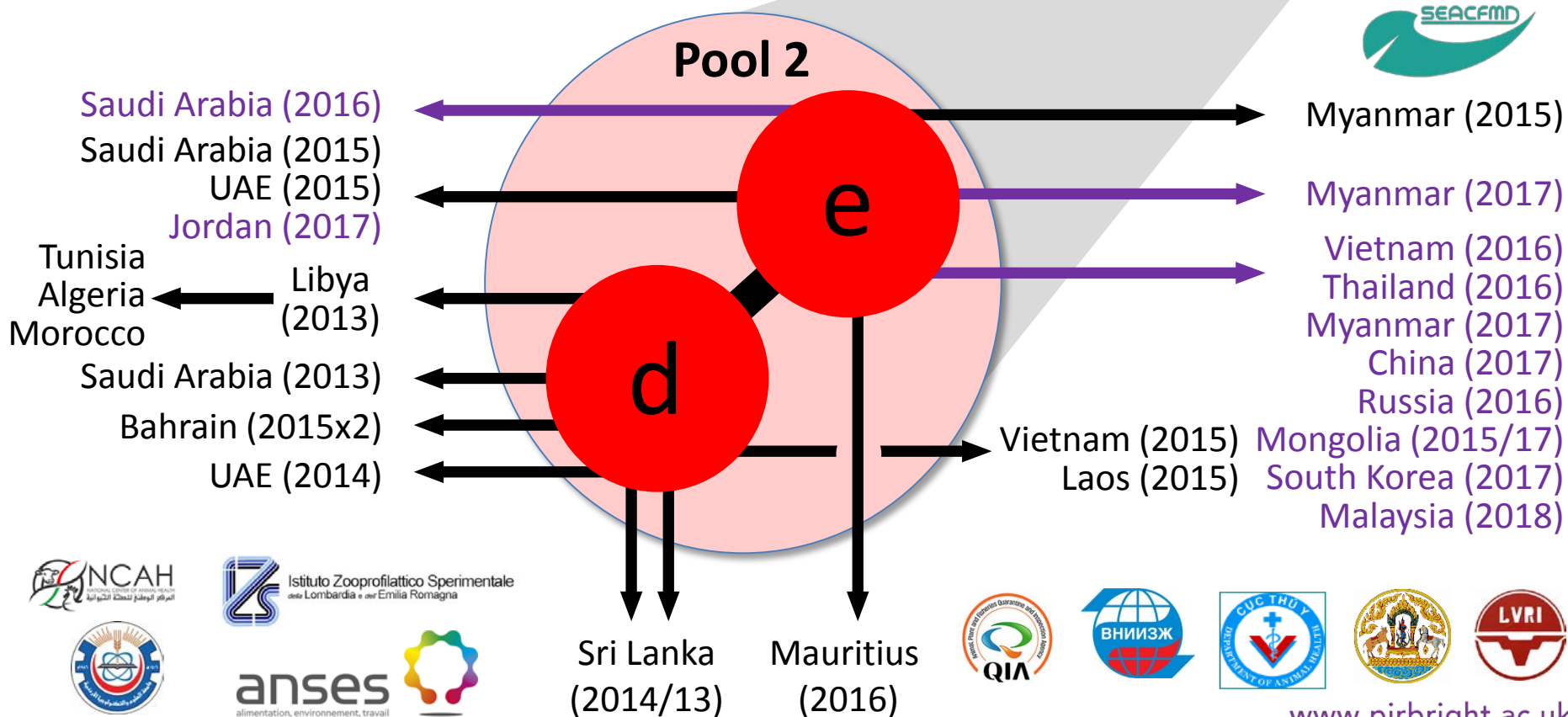
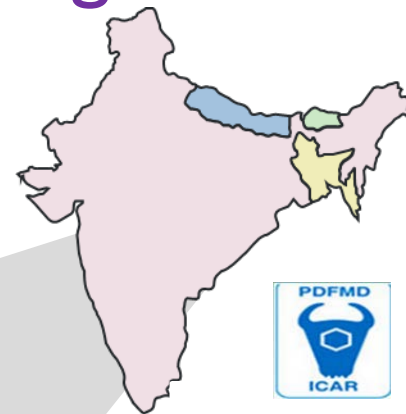


Pretoria– November 2017

O/ME-SA/Ind-2001: a new pandemic lineage?

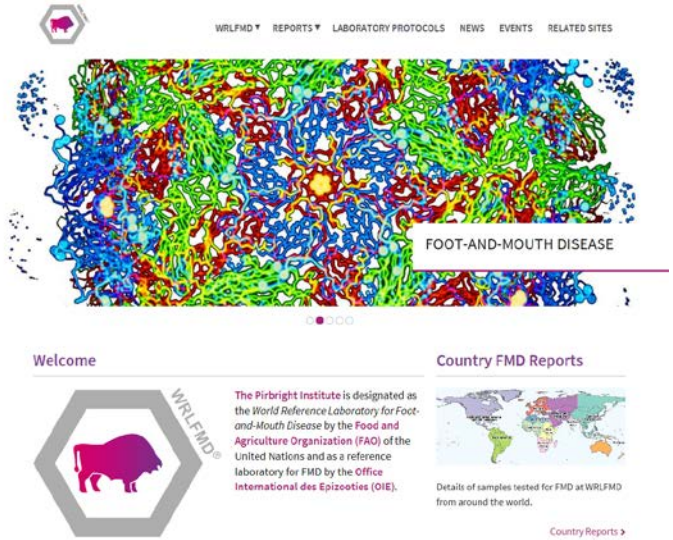
- Two sub-lineages (d and e)
- Since 2013, full genomic sequence data indicates that there have been multiple “escapes” from Pool 2

(Bachanek-Bankowska et al., 2018)



Reports and information

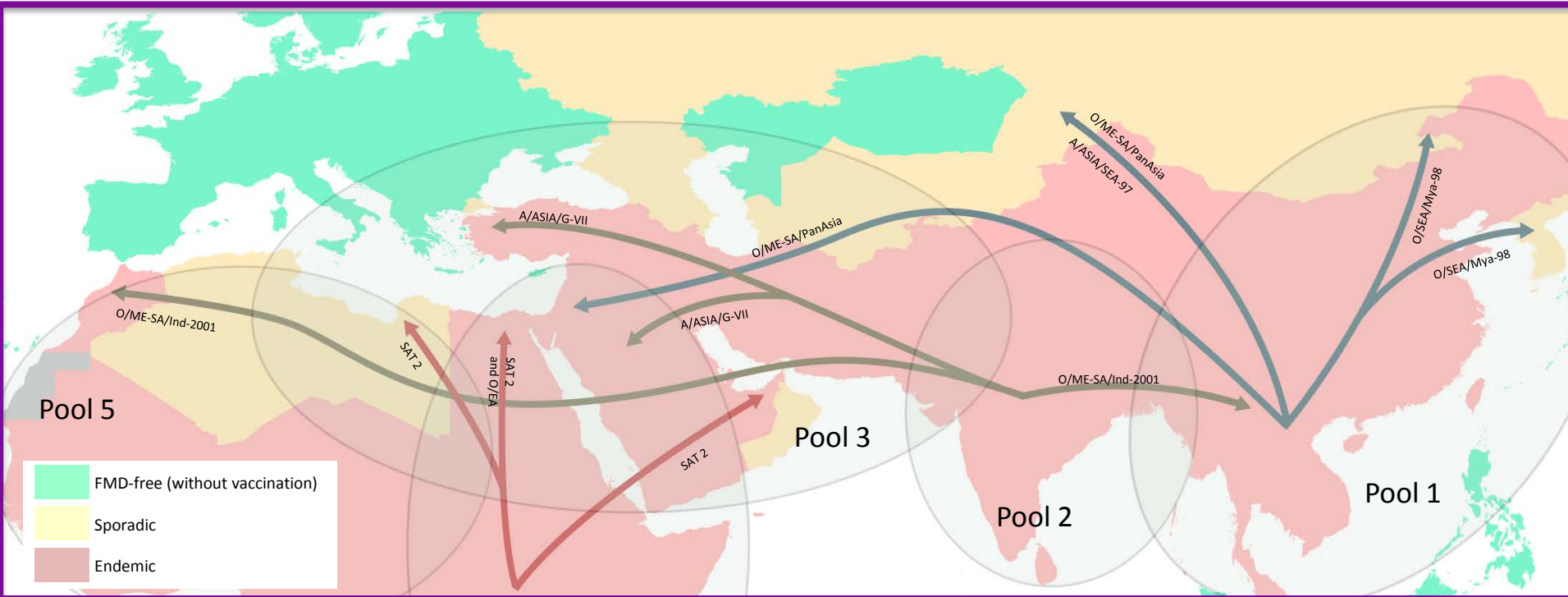
- New website (wrlfmd.org) launched last week
- In addition to *Genotyping reports*, now contains *Vaccine matching* and *Serotyping reports*
- Other data sources:
 - EuFMD Monthly report
 - Quarterly WRLFMD report
 - Annual report for Network
 - OIE-WAHIS & FAO-EMPRES-i
- Tools for FMDV sequences
 - Priority for the FMD community
 - FMDVTools:
<https://mallorn.pirbright.ac.uk>



The screenshot shows the WRLFMD website interface. At the top, there is a navigation menu with links for WRLFMD, REPORTS, LABORATORY PROTOCOLS, NEWS, EVENTS, and RELATED SITES. Below the menu is a large, colorful world map with a legend for FOOT-AND-MOUTH DISEASE. The map shows various colored regions representing different FMD reports. Below the map, there is a 'Welcome' section with the WRLFMD logo (a purple bull in a hexagon) and a text box stating: 'The Pirbright Institute is designated as the World Reference Laboratory for Foot-and-Mouth Disease by the Food and Agriculture Organization (FAO) of the United Nations and as a reference laboratory for FMD by the Office International des Epizooties (OIE)'. To the right of the welcome message is a 'Country FMD Reports' section with a world map and a link to 'Country Reports >'. Below the screenshot are two overlapping report covers. The left cover is the 'WRLFMD Quarterly Report April to June 2018', featuring the WRLFMD logo and the text 'Foot-and-Mouth Disease'. The right cover is the 'OIE/FAO Foot-and-Mouth Disease Reference Laboratory Network Annual Report 2017', featuring the OIE/FAO logo and the text 'Editors: Dr Donald King, Dr Antonello Di Nardo and Dr Mark Henstock, The Pirbright Institute, UK'. At the bottom of the slide, there are logos for BBSRC, the Department for Environment, Food & Rural Affairs, and eofmd.

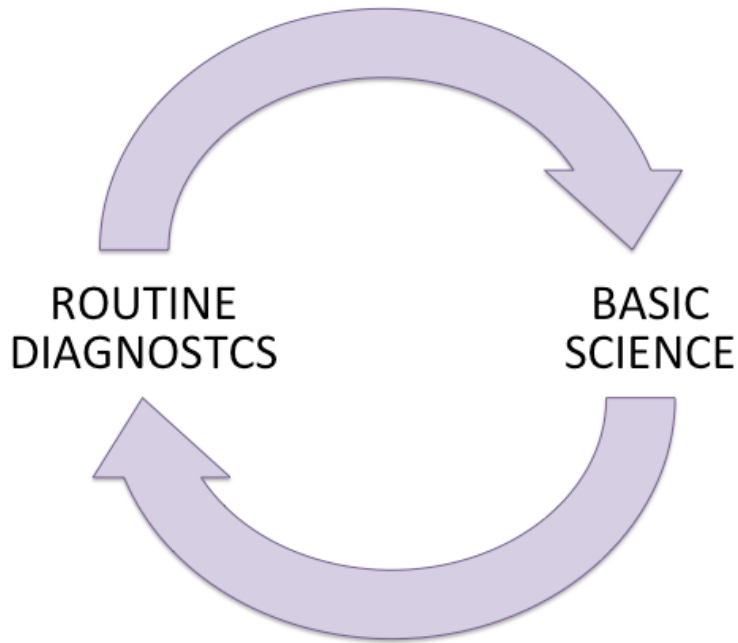
FMD: Global perspective

- The epidemiology of FMD in endemic regions is very dynamic



- These recent long-distance movements may reflect:
 - Increasing market for meat and animal products in East Asia
 - Movement of South Asian workers into the Gulf states
 - Migration of people from sub-Saharan Africa

Reference Laboratories and basic science



Reference Laboratory

- Routine testing
- Molecular epidemiology
- Emergence of new strains

Applied Research

- Assay development and validation
- New assay formats

Fundamental science

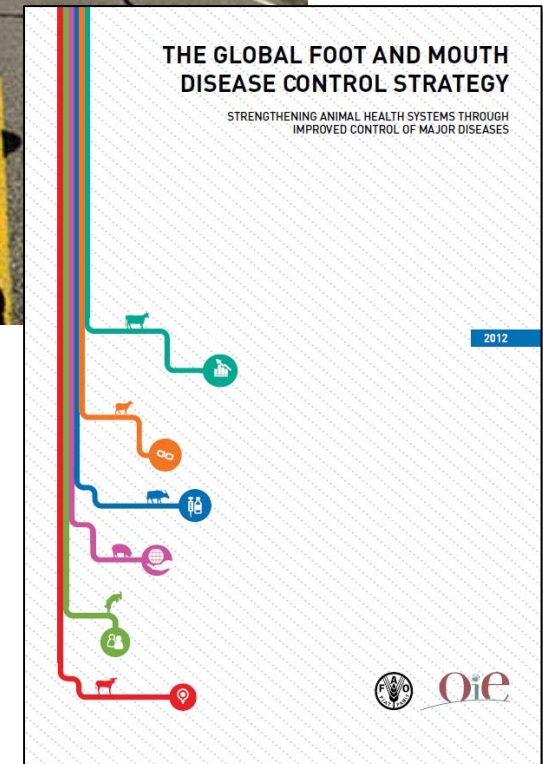
- Epidemiological modelling
- Mechanics of viral evolution
- Viral replication
- Host and vaccine immunology
- Drivers of antigenic change

Future priorities

- Worldwide, an estimated 700 million poor people rely on livestock for their livelihood
- Annual Impact* of FMD
 - Production losses and vaccination: (\$ 6.5-21 billion)
 - Incursions into FMD-free countries (>\$1.5 billion)
- FMD circulation and maintenance in endemic regions remains poorly understood
- Pose risks to FMD-free (without vaccination) countries



THE GLOBAL FOOT AND MOUTH DISEASE CONTROL STRATEGY



*estimated by Knight-Jones and Rushton 2013

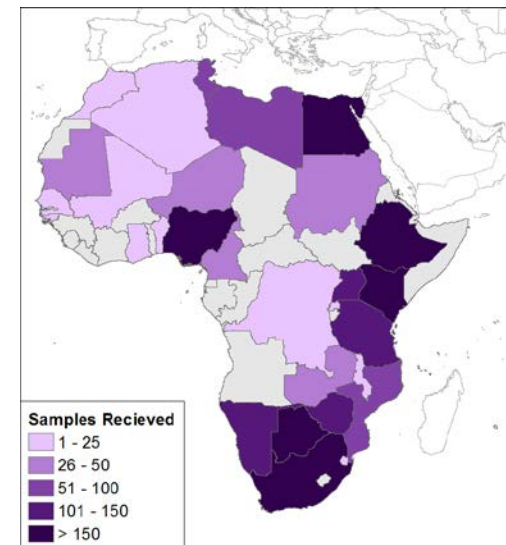
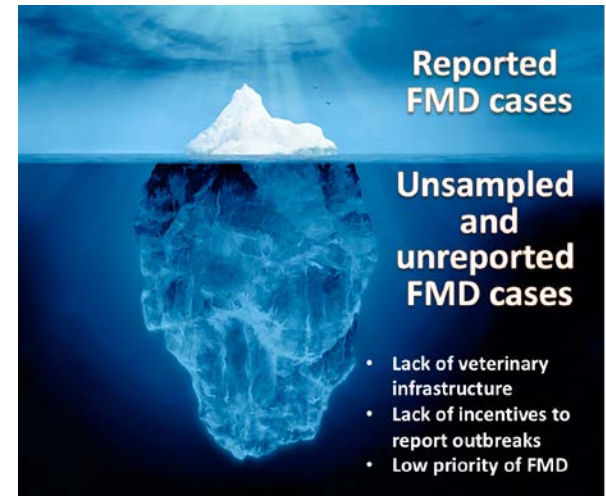
Challenge 1: How can we improve disease surveillance in countries where vet/lab resources are limited?

- Collecting and shipping samples to labs is often reliant on a cold-chain (£/\$/€)
- Recent research partnerships have pioneered the development of rapid, simple-to-use pen-side test kits (LFDs, PCR, LAMP, RPA)
- Pilot studies with collaborators in West and East Africa show that RNA can be recovered from LFDs
- New pipelines to provide local confirmation of disease, triage of materials and stabilization of viruses (for shipping)?

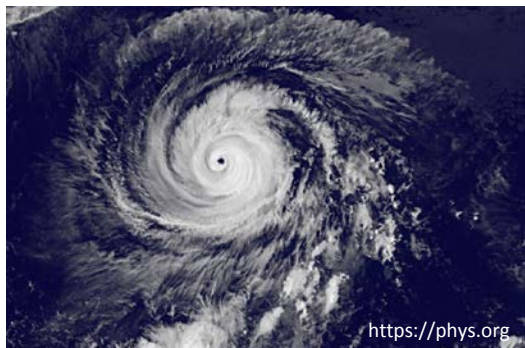


Challenge 2: Can we develop new tools to quantify missing events and more accurately estimate disease burden in endemic countries?

- Sampling for livestock diseases is ad-hoc and biased
- Evolutionary rates for viruses are *clock-like* and can be estimated
- Can we use sequence differences to model the extent of un-sampled sequences (“dark matter”) between samples received for analysis?
- Empirical data can be collected to parameterise these models
- At the regional scale – can this be used as a proxy for disease prevalence?



Challenge 3: Can we predict future threats?



Observing and collecting



Data and models



Predicting (and controlling)

- Spread of FMD is governed by factors such as:
 - Trade (market prices)
 - Pre-existing herd-level immunity
 - Viral fitness in the different hosts
 - Presence of contemporary viral lineages
- Opportunities to combine data from these different sources to develop *predictive* models of disease spread
- Model frameworks for livestock diseases could have applications for human diseases

Thanks to:

Valerie Mioulet, Nick Knowles, Anna Ludi, Ginette Wilsden, Mehreen Azhar, Hannah Baker, Kasia Bachanek-Bankowska, Antonello Di Nardo, Bob Statham, Lissie Henry, Jemma Wadsworth, Clare Browning, Britta Wood, Alison Morris, David Paton, Abid Bin-Tarif, Ashley Gray, Beth Johns, Mark Henstock, Andrew Shaw, David King, Bryony Armson, Nick Lyons, Jamaliah binti Senawi, Dexter Wiseman, Julie Maryan, Sarah Belgrave





Many thanks to our meeting sponsors:



The terms under which the WRL was to operate were:

- a)* to perform tests for the presence of FMD virus on specimens sent by member governments of the FAO and the European Commission for the Control of FMD;
- b)* to identify the virus, if present, and/or the strain and antigenic properties of the isolated virus(es) if deemed necessary;
- c)* to send all relevant information regarding the results of such tests to the government(s) requesting the test(s), with duplicate copies to the Animal Production Division of the FAO in Rome.

Summary

- Epidemiology of FMD is very dynamic
 - New unpredictable patterns in Asia (East and West) and North Africa
- **Sampling of field outbreaks is critical**
- Importance of an active FMD Reference Laboratory Network to facilitate sample collection from FMD outbreaks in the field– to feed real-time lab data back to FMD control programmes

2017/18 FMD situation – “headlines”

