



OIE/FAO  
Foot-and-Mouth Disease  
Reference Laboratories  
Network



# Global foot-and-mouth disease situation: risks and new developments

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FMD Reference Laboratory



# OIE/FAO FMD Laboratory Network

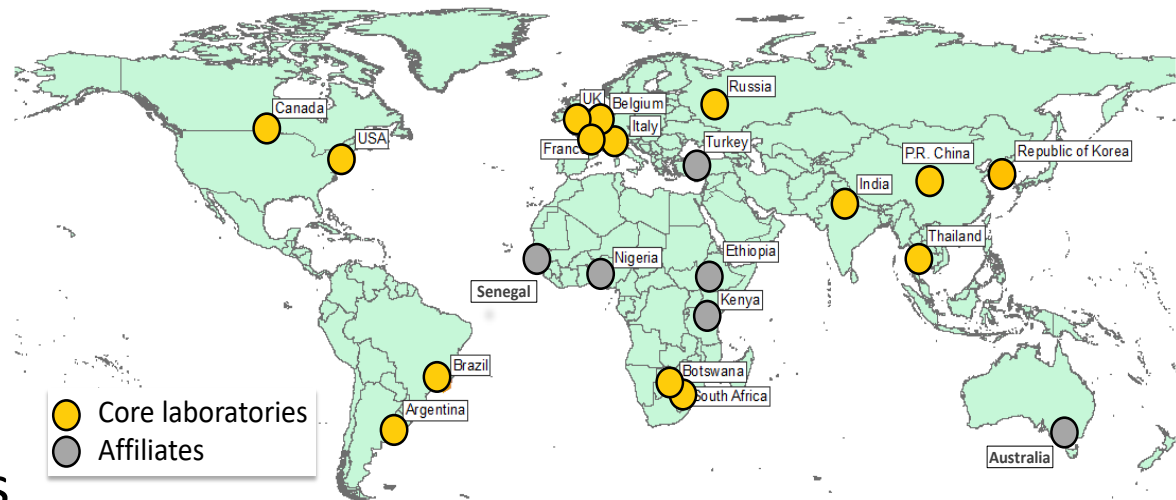
[www.foot-and-mouth.org](http://www.foot-and-mouth.org)



Network Members and affiliates:

## Core activities:

- Collation and exchange of data
- Review of FMD risks
- Test improvement and harmonization
- Support to GF-TADs regional RoadMaps
- *A big “thanks” to members of the Network for exchanging data included in this presentation*

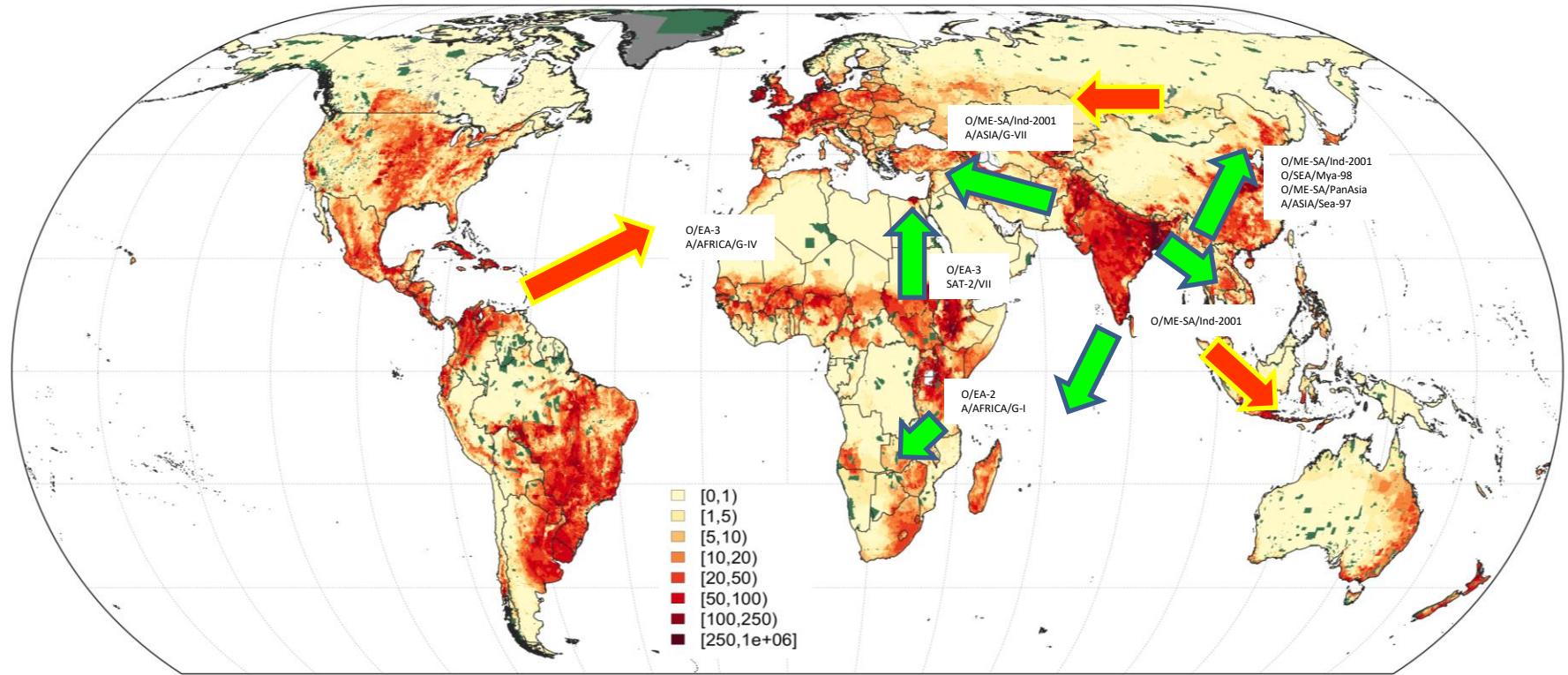


Network “virtual format” with >70 participants – December 2021  
Next meeting 29<sup>th</sup> Nov – 1<sup>st</sup> Dec 2022 - Lelystad

# Long-distance (trans-pool) movements of FMDV since 2015

Why do trans-pool movements matter?

- Impact/change regional FMD risks including FMD free countries
- Selection of vaccines to control outbreaks



Cattle density map

Robinson et al., 2007

 New events 2021/22

# Pool 1: Status in 2021

## Characterisation of different FMD virus lineages



Based on data from WRLFMD, RRLSEA, the OIE/FAO Lab Network and reported @SEACFMD

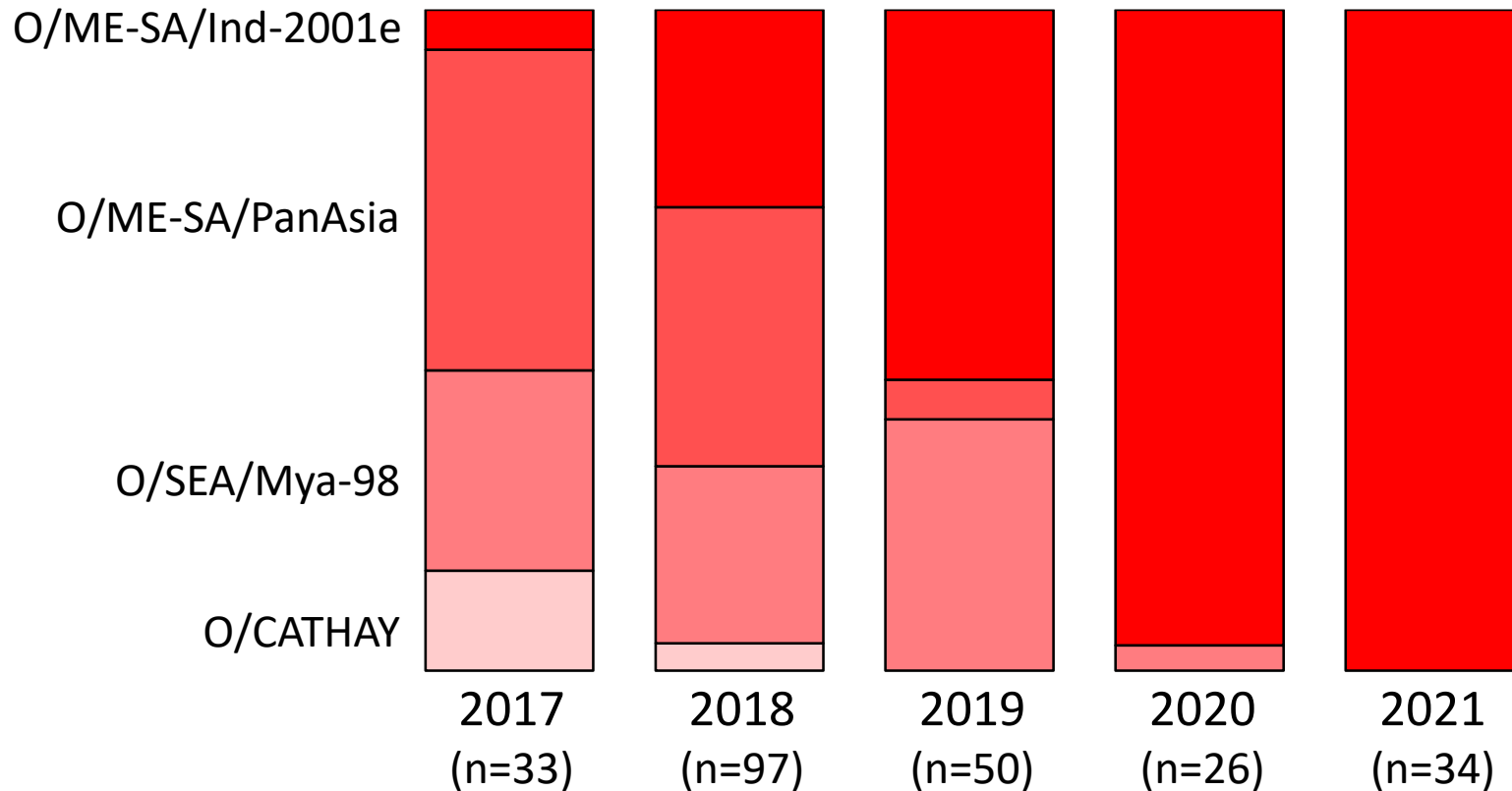
Country	O					A		Asia-1
	ME-SA/Ind-2001e	SEA / Mya-98	CATHAY	ME-SA / PanAsia	ME-SA/ PanAsia-2	ASIA / Sea-97	ASIA/Ind	
Cambodia	2019	2016		2018		2016		
Laos	2020	2017		2018		2018		
Malaysia	2022	2016	2005	2020	2009	2014		
Myanmar	2021	2021				2021	2010	2017
Thailand	2021	2018	2012	2019		2021		
Vietnam	2021	2019	2018	2018		2017		2006
PR China	2021	2020	2021	2019		2019		2009
Indonesia	2022							
Mongolia	2022	2018		2017		2015		

Is this the true picture of FMD in SEACFMD countries?

..... or does under-sampling bias our understanding of the epidemiology?

# Increasing dominance of O/ME-SA/Ind-2001e

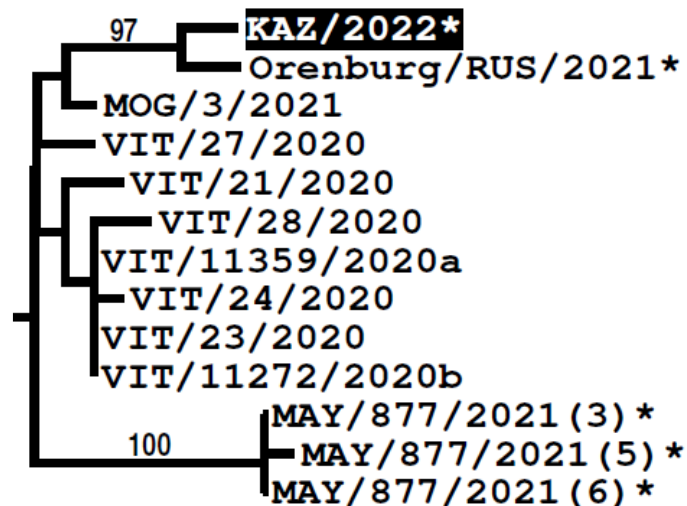
- Origins in SEA reviewed in Bachenek-Bankowska et al., 2018
- Multiple introductions from Pool 2 – events started in 2015-17
- Serotype O data for SEACFMD countries (WRLFMD data):



Data for 2022: this was the only FMDV lineage detected in samples submitted from Mongolia (2022) and Thailand (2022) – as well as sequences from Malaysia (2022)

# O/ME-SA/Ind-2001e in Russia and Kazakhstan

- New FMD outbreaks in cattle, Orenburg, Russia (Dec 2021)
- Located in southern FMD vaccination buffer zone close to the border with Kazakhstan
- Caused by O/ME-SA/Ind-2001e lineage
- Sequence\* demonstrates 98.9% nt identity to virus from Mongolia (2021)
- FMD outbreaks due to O/ME-SA/Ind-2001e also reported in an FMD-free without vaccination) zone in Kazakhstan (Jan 2022)



\* Thanks to Dr Alexei Scherbakov, ARRIAH, Russia

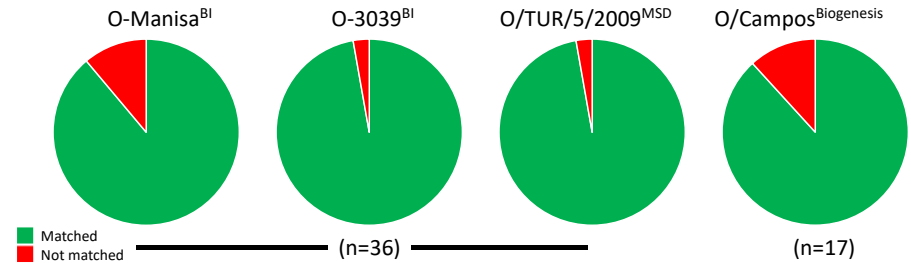


# O/ME-SA/Ind-2001e: vaccine matching (2017-2022)

- Vaccine matching data for field isolates from regions where this lineage is present
- Recent vaccine matching data from WRLFMD for an Indonesian field isolate supports the selection of these vaccines
- Data supported by *in vivo* studies with O-3039, O-Manisa and combination (Boehringer-Ingelheim)

Fishbourne et al., (2017) Vaccine 35: 2761-2765

Singanallur et al., (2021) Vaccines 9: 1110



	O
	ISA/3/22
	r-value titre
O1 Campos, Biogénesis Bagó	0.47, 2.46
O-3039, Boehringer Ingelheim	0.69, 1.76
O Campos, Boehringer Ingelheim	0.20, 1.92
O Manisa, Boehringer Ingelheim	0.54, 2.14
O Panasia 2, Boehringer Ingelheim	0.40, 2.12
O/TUR/5/09, MSD Animal Health	0.50, 2.09

Samples from Pusvetma, Indonesia

# Vaccine selection - for Southeast Asia?



AU-PANVAC  
Pan African Veterinary Vaccine Centre of Africa Union



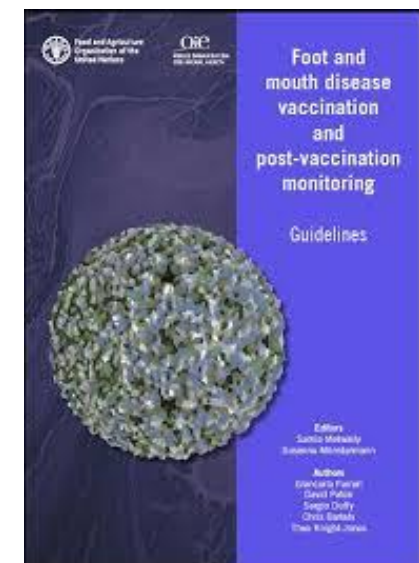
Twining project 2019-2022

## Obvious gaps and challenges:

1. Homologous/monovalent QA/QC (OIE Manual) vs heterologous vaccine performance **in the field** with multivalent products
2. Vaccine-matching considers strain suitability but NOT the quantity/quality/combinations of antigens in a final product (and is **limited** due to access to vaccine strains and BVS)

## Proposed testing:

- Increased focus on measurement of **heterologous responses**
- Using **final formulated product supplied to customers**
- Use common/standardized FMDV viruses (**Antigen Panels**) representative of the antigenic threats in a region – proposal for reference antigens for East Africa (<https://www.wrlfmd.org/node/2096/>)





# Advantages of “heterologous” testing pipeline

1. Access to vaccine strains from the companies is not required
  2. Serological performance is assessed using the formulated vaccine which may contain multiple FMD vaccine antigens
  3. Data can be used to compare responses for different vaccines
    - But need to adopt standardized protocols for sera (numbers of animals and sampling time points [including booster doses])
- Testing can be tailored to product-level or batch-level testing
    - Reference sera for specific vaccines is also useful for these purposes (and to test against other antigens)
  - Testing can be designed to assess animal-to-animal variability of responses in target host populations (incl. different species)

# Global headlines: 2021/22

## Tunisia/Algeria

Jan 2022  
O/EA-3

## Eastern Mediterranean

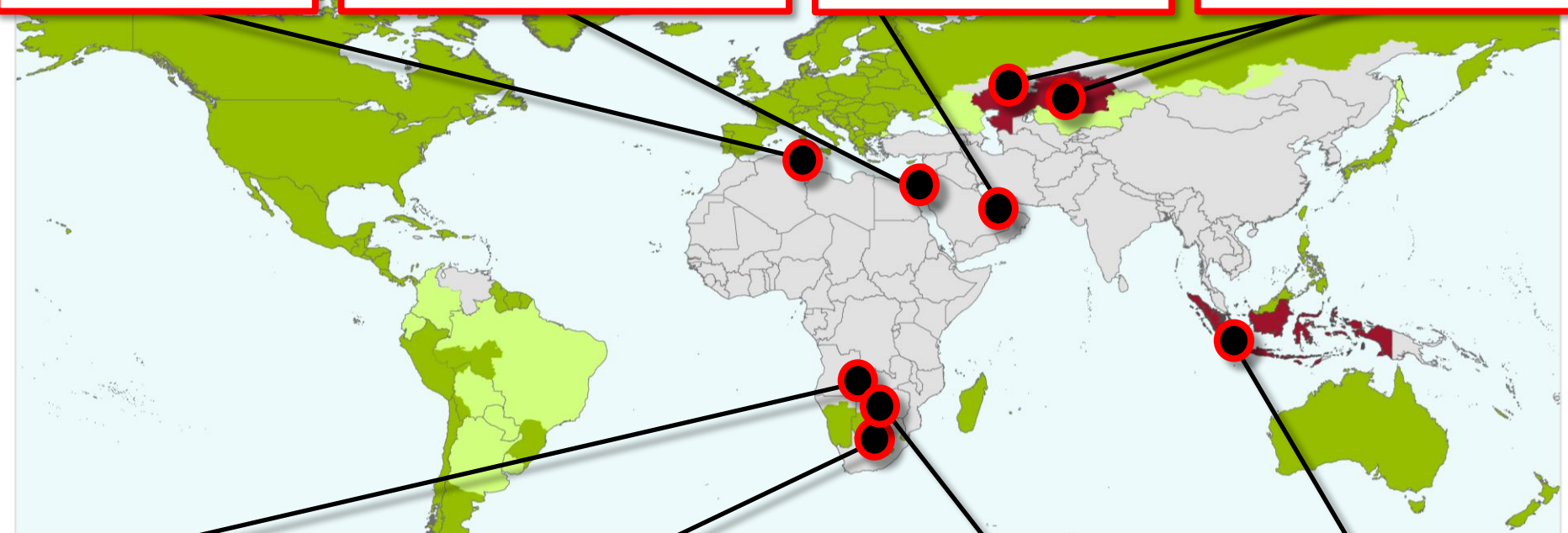
Dec 2021 – on-going  
O/ME-SA/PanAsia-2<sup>ANT-10</sup>

## UAE

Samples from 2021  
O/ME-SA/SA-2018

## Russia / Kazakhstan

Dec 21 -Jan 2022  
O/ME-SA/Ind-2001e



## Namibia/Zambia

/Malawi  
Mozambique  
2021-2022  
O/EA-2

## South Africa

KwaZulu-Natal:  
SAT 2 – 2021  
**2022:** New outbreaks  
due to SAT3 in the  
provinces of Goteng and  
North East

## Botswana

August 2022  
SAT 2  
In FMD-free zone

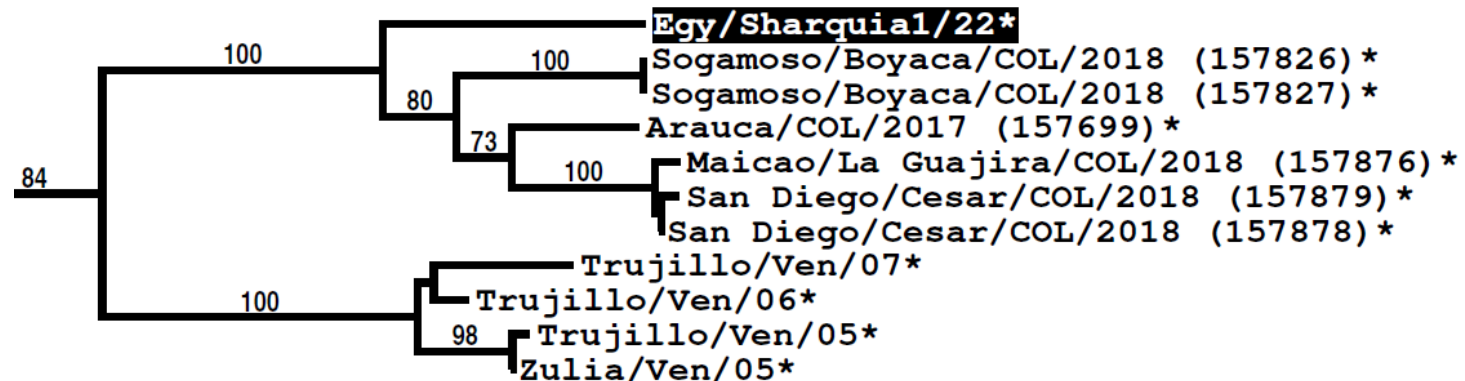
## Indonesia

May 2022  
O/ME-SA/Ind-200e

WOAH Map – Sept 2022

# New risks posed by FMD viruses from South America?

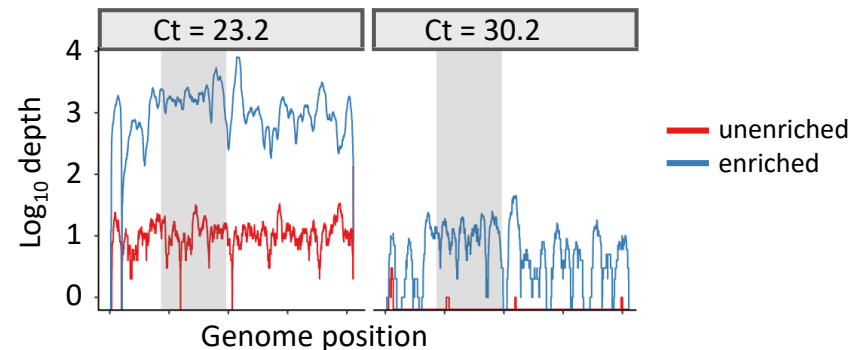
- Unofficial reports of FMD cases in Egypt (during 2022)
- Sequence is authentic and characterised within the O/EURO-SA topotype
- >95% nt identity to FMDV sequences from South America (sequences shared with PANAFTOSA, Brazil)
- If this virus circulates it will pose a new exotic threat to other countries in the region



# Improved sequencing methods

Characterisation of environmental samples collected from Cameroon

- New **probe enrichment** method developed to increase chances to sequence poor quality samples
- 26,275 probes; >100-fold increase in sensitivity
- Validated using heated and diluted FMDV template
- Evaluated using environment sample collected from Cameroon
  - Project awarded to the Emerging Infectious Disease Research Association (EIDRA) with University of Buea, Cameroon
- Sequence reported to WOA/FAO/EuFMD



Shaw et al. In Prep.

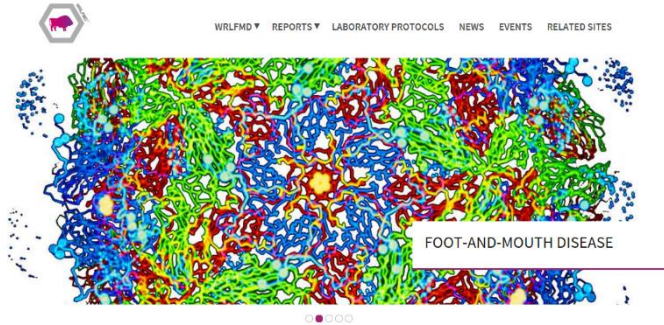
# Remote capacity: MinION sequencing

- Rapid and portable sequencing method for full genome sequencing
- Sample-to-sequence <24 hrs
- Equipment requirements: PCR machine, Qubit, MinION,
- pan-FMDV pools of primers have been designed to amplify 20 overlapping amplicons
- Preliminary data indicates that the protocols can be applied for the O/ME-SA/Ind-2001e lineage
- WRLFMD can provide assistance to set up these methods and analyse data



# Additional information


- FMD reports and lab testing (<https://www.wrlfmd.org/ref-lab-reports>)
  - *Genotyping reports, Vaccine matching and Serotyping reports*
- Other data sources:
  - Quarterly WRLFMD/EuFMD report (<https://www.wrlfmd.org/ref-lab-reports>)
  - Annual report of the OIE/FAO FMD Laboratory Network (<http://foot-and-mouth.org/>)



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FOOT-AND-MOUTH DISEASE

Welcome



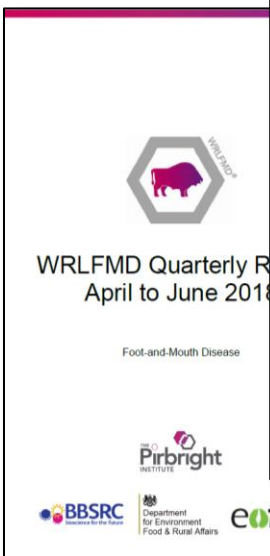
The Pirbright Institute is designated as the World Reference Laboratory for Foot-and-Mouth Disease by the Food and Agriculture Organization (FAO) of the United Nations and as a reference laboratory for FMD by the Office International des Epizooties (OIE).

Country FMD Reports



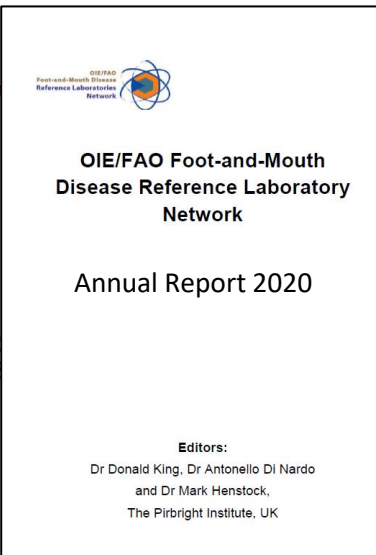

Details of samples tested for FMD at WRLFMD from around the world.

Country Reports >



WRLFMD Quarterly Report  
April to June 2018

Foot-and-Mouth Disease



OIE/FAO Foot-and-Mouth Disease Reference Laboratory Network

Annual Report 2020

Editors:  
Dr Donald King, Dr Antonello Di Nardo  
and Dr Mark Henstock,  
The Pirbright Institute, UK

# Training

- eLearning training course covering FMD diagnostics
  - Selecting appropriate diagnostic tests and interpretation of results
  - characterization of FMD viruses including genomic sequencing and vaccine matching tests
  - Quality assurance and biosafety
- Content provided in English and French
- 14 hours of learning content over 4 weeks
- Certificate provided on successful course completion
- To register:

[https://docs.google.com/forms/d/e/1FAIpQLSc2p2YEXx\\_20Ry3qVK6kgLKHI0MMzD1BdezpMERi4m4iSjR\\_g/viewform](https://docs.google.com/forms/d/e/1FAIpQLSc2p2YEXx_20Ry3qVK6kgLKHI0MMzD1BdezpMERi4m4iSjR_g/viewform)

## Foot-and-mouth disease laboratory investigation training course



Food and Agriculture  
Organization of the  
United Nations



**SPirE**

Sharing Pirbright's Expertise



# Acknowledgements

- Support for the WRLFMD and research projects
- Collaborating FMD Reference Laboratories in Europe
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