

# Global situation of FMD

*David Paton, on behalf of WRLFMD*

**Acknowledgements:** Don King, Valerie Mioulet, Nick Knowles, Anna Ludi, Britta Wood, Ginette Wilsden, Krupali Parekh, Andrew Shaw, Antonello Di Nardo, Jemma Wadsworth, Clare Browning, Mark Henstock, Hayley Hicks, Dexter Wiseman, Jozhel Baguisi, Harry Bull, Amy McCarron, Bryony Armson, Sarah Belgrave, Sarah Belton

**INTERNATIONAL SEMINAR – PRE-COSALFA 50**

**Getting Close to Regional Eradication: Half a Century of Progress**

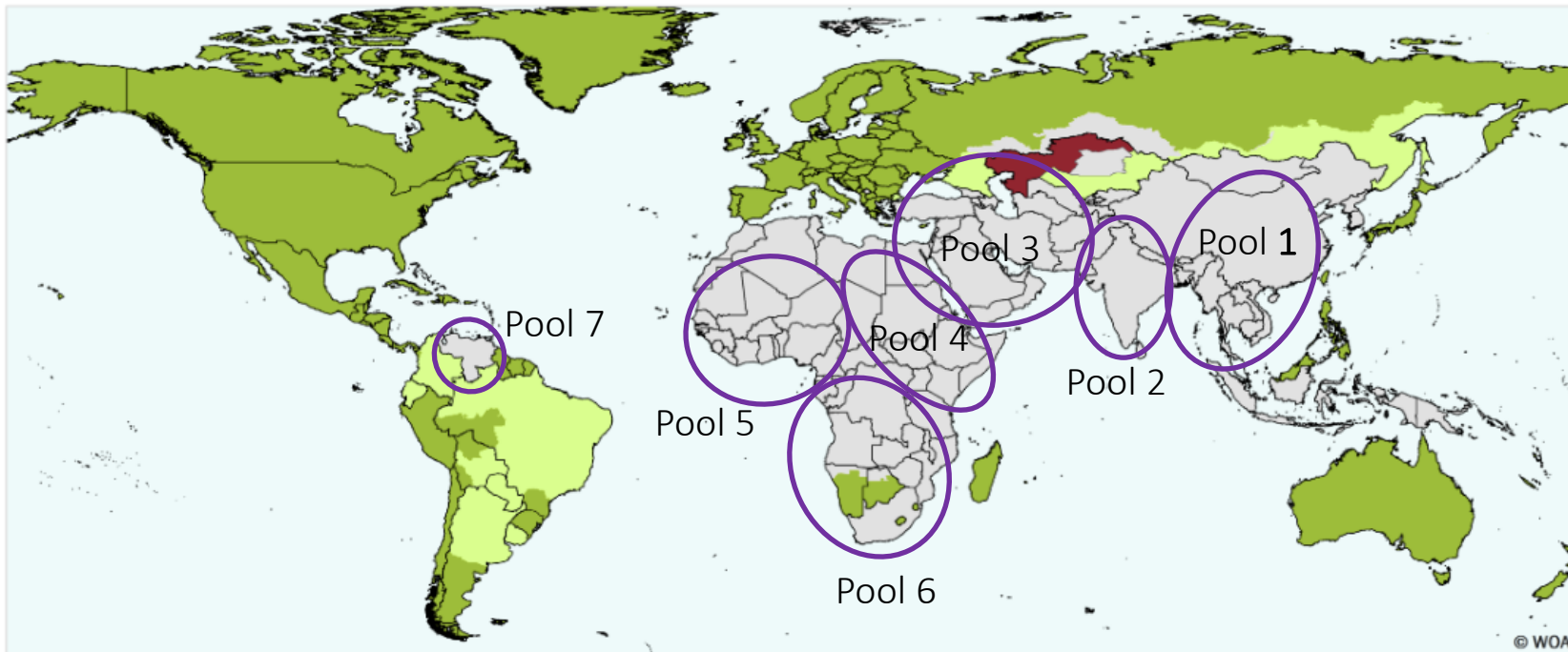
*22- 23 April 2024*

# Global Overview

FMD is Endemic in Asia and Africa (and parts of South America)

WOAH Members' official FMD status map

Last update April 2024



Countries with endorsed official control programmes for FMD:  
Botswana, India, Kyrgyzstan, Morocco, Namibia, Thailand

7 endemic pools of specific viral lineages

6 circulating serotypes with unequal / dynamic distributions

Serotypes O and then A most prevalent; in Africa, SAT 1 & 2 more common than SAT 3

Serotype C undetected since 2004

- Members and zones recognised as free from FMD without vaccination
- Members and zones recognised as free from FMD with vaccination
- Suspension of FMD free status
- Countries and zones without an official status for FMD

<https://www.woah.org/en/disease/foot-and-mouth-disease/#ui-id-2>

# Suspensions of Official Disease Status

General Information

Official Disease Status

Resources

## Suspension of an “FMD-free country where vaccination is not practised” status

### Guyana

Following the failure to submit the annual reconfirmation and the adequate documentary evidence by the end of January 2024, according to Articles 1.6.2. and 8.8.2. of the *Terrestrial Animal Health Code*, the “FMD-free country where vaccination is not practised” status of Guyana as recognised by the WOAHP World Assembly of Delegates in terms of Resolution No. 11 in May 2023 is suspended with effect from 20 February 2024.

Reinstated

## Withdrawal of WOAHP endorsement of ‘official control programme for FMD’

### China (People’s Rep. of)

Following the assessment of China’s annual reconfirmation for its official control programme for FMD endorsed by WOAHP, the Scientific Commission for Animal Diseases concluded that China no longer fulfils the requirements in Articles 1.6.2. and 8.8.39. of the *Terrestrial Animal Health Code* for a country having an endorsed official control programme for FMD. As a result, the endorsement of the “official control programme for FMD” for China, as recognised by the World Assembly of Delegates in terms of Resolution No. 12 in May 2023, was withdrawn with effect from 20 February 2024.

# Suspensions of Official Disease Status

**China (People's Rep. of):** The Commission acknowledged the information submitted by China regarding the progress made in implementing its official FMD control programme. The Commission noted that, as per recommendations by the

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Report of the Meeting of the WOAHA Scientific Commission for Animal Diseases / February 2024

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Commission, China had followed up on FMD outbreaks by investigating the vaccination status and the herd immunity level of the farms where clinically positive animals had been detected and performed PVM data analysis stratified by age. However, the Commission noted that FMDV-positive animals detected through pathogenic surveillance were not classified as FMD cases or outbreaks. The Commission considered that this is a critical component of an endorsed programme, and whilst noting that some of the recommendations had been addressed, this remained pending. In addition, the Commission noted that the revision of the prevention and control targets and performance indicators of the FMD official control plan initiated three years ago had not been finalised. Therefore, the Commission concluded that China no longer fulfils the requirements in Articles 1.6.2. and 8.8.39. of the *Terrestrial Code* for a country having an endorsed official control programme for FMD and recommended the withdrawal of the endorsement. The Commission stressed that should China wish to apply for the endorsement of an FMD official control programme, an updated plan must be submitted including a revised case definition aligned with Article 8.8.8.



## FMD Regions: Regional FMD Roadmap approaches aligned to FMD virus pools

POOL	SEROTYPES PRESENT
1	O, A, Asia-1
2	O, A, Asia-1
3	O, A, Asia-1
4	O, A, SAT 1, SAT 2, SAT 3
5	O, A, SAT 1, SAT 2
6	SAT 1, SAT 2, SAT 3
7	O, A

FMD Pool	
	Pool 1: East Asia
	Pool 2: South Asia
	Pool 3: West Eurasia
	Pool 4: East Africa
	Pool 5: West Africa
	Pool 6: Southern Africa
	Pool 7: South America



Source:  OIE/FAO Reference Laboratory  
Network for Foot-and-Mouth Disease

# PCP-FMD Status

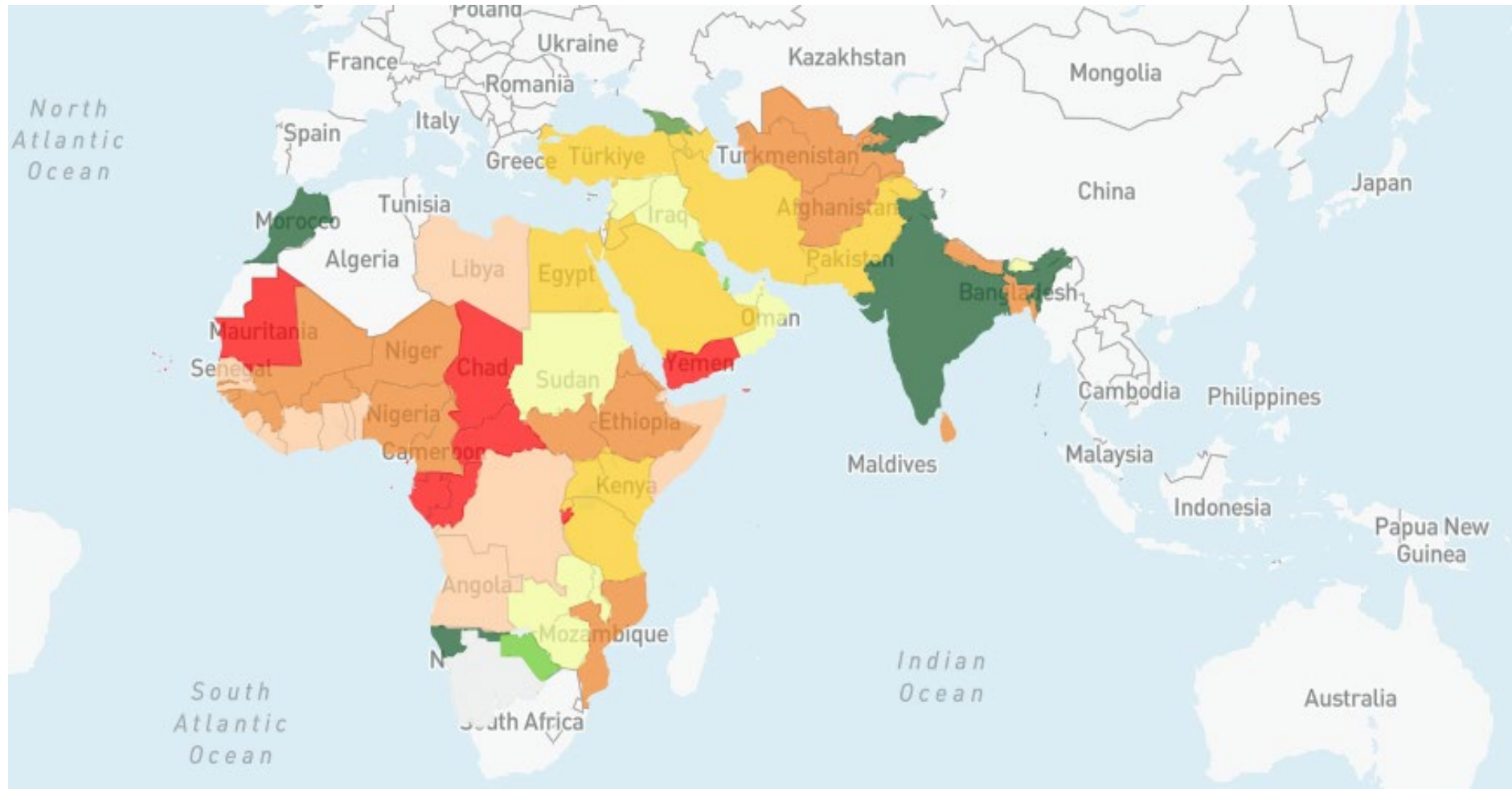
<https://www.gf-tads.org/fmd/progression-fmd-control-strategy/en/>



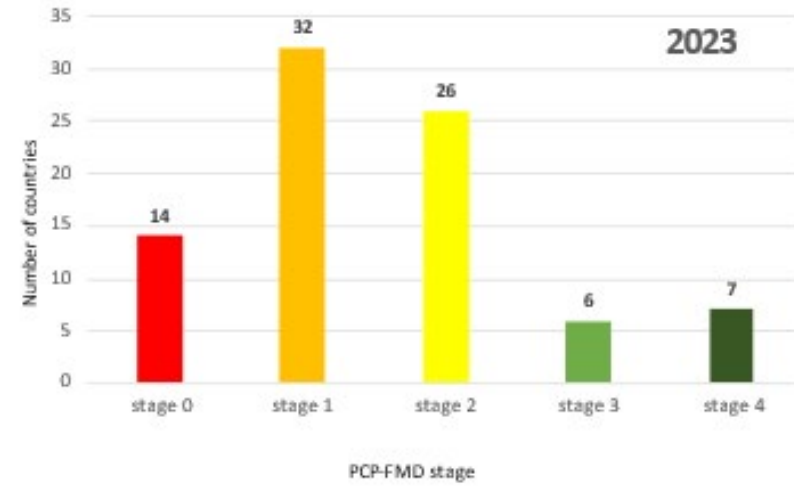
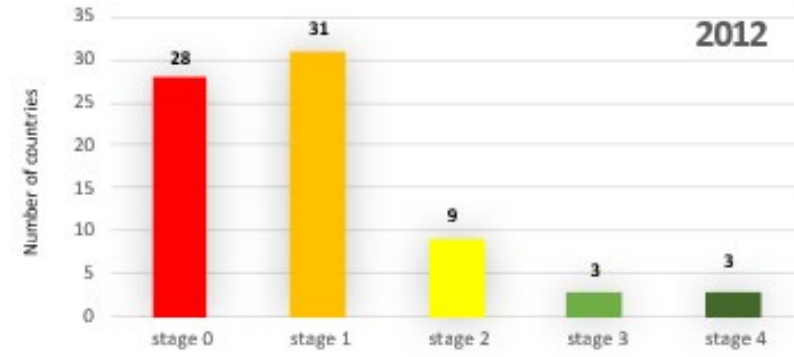
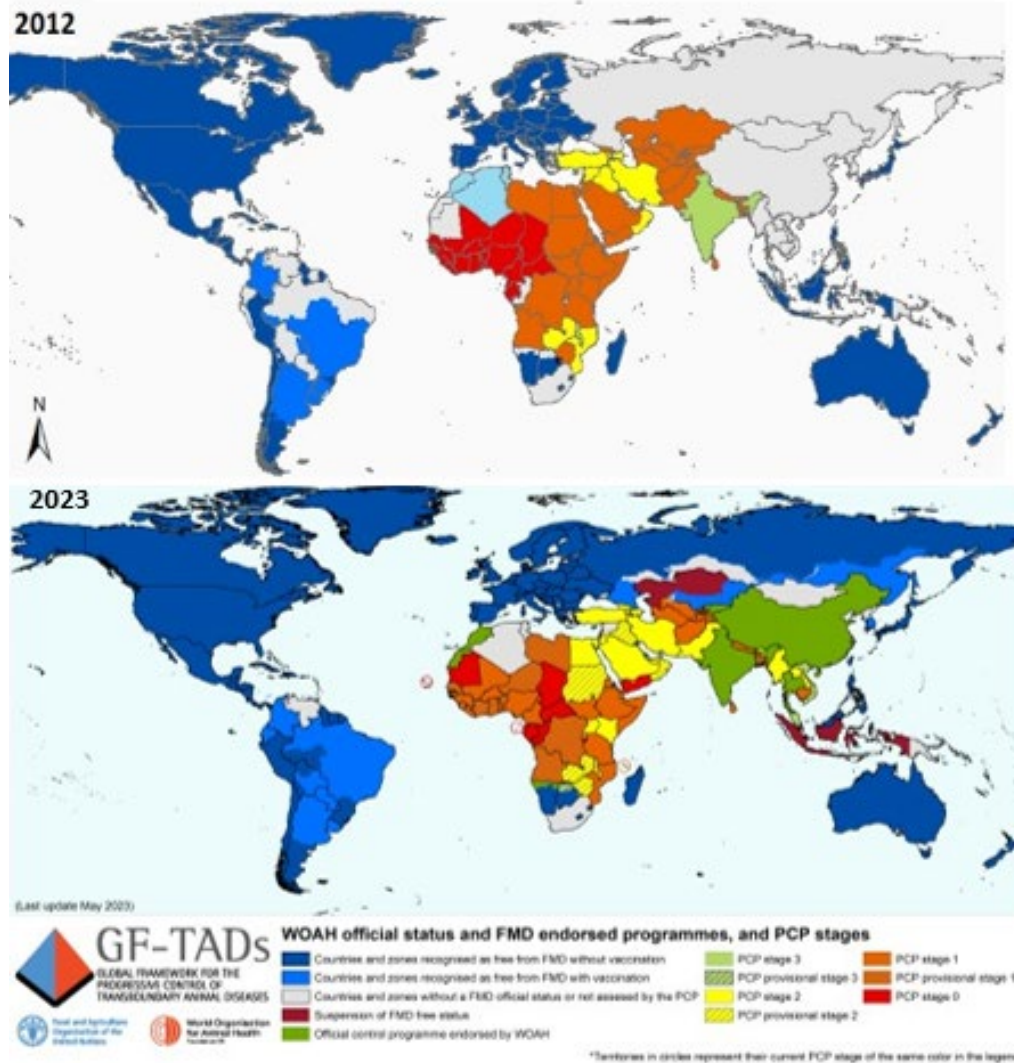
The Progressive Control Pathway for Foot and Mouth Disease control (PCP-FMD)  
Principles, Stage Descriptions and Standards



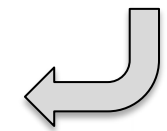
- PCP-0
- PCP-1-Provisi...
- PCP-1
- PCP-2-Provisi...
- PCP-2
- PCP-3-Provisi...
- PCP-3
- PCP-4 or above



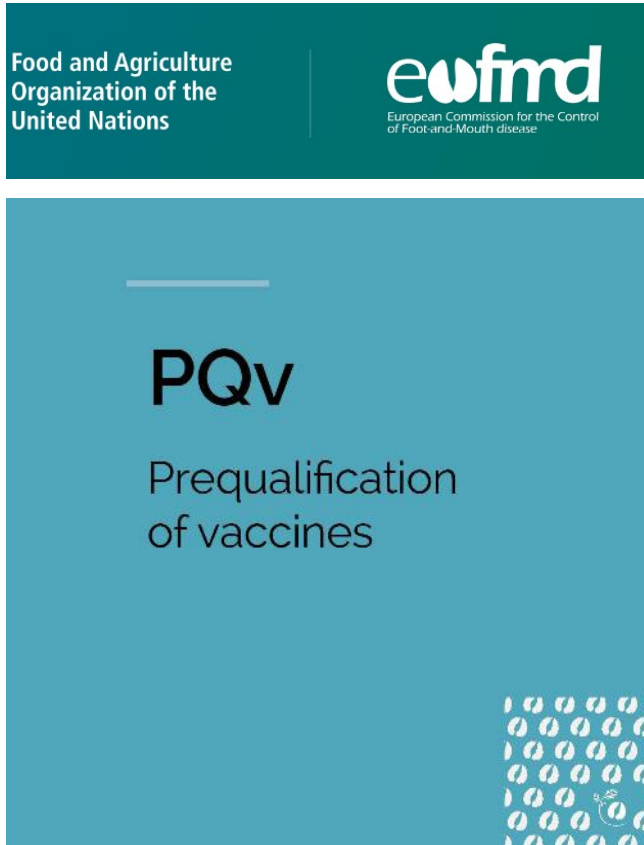
# Evolution of progress along the PCP-FMD and WOAAH official FMD status between 2012 and 2023.



Challenges of moving from Stage 2 to Stage 3



# EuFMD initiative on vaccine prequalification



Aims to help users select appropriate vaccines – initially FMD

Vaccines must already have a marketing authorisation (i.e. licensed/registered by at least one national competent authority)

A risk-based evaluation of evidence provided by the applicant in the prequalification evidence file (PEF) to demonstrate that the vaccine meets at least the minimum standards in the WOAHP Terrestrial Manual with respect to the key properties of the vaccine that are essential for its safe and effective use.

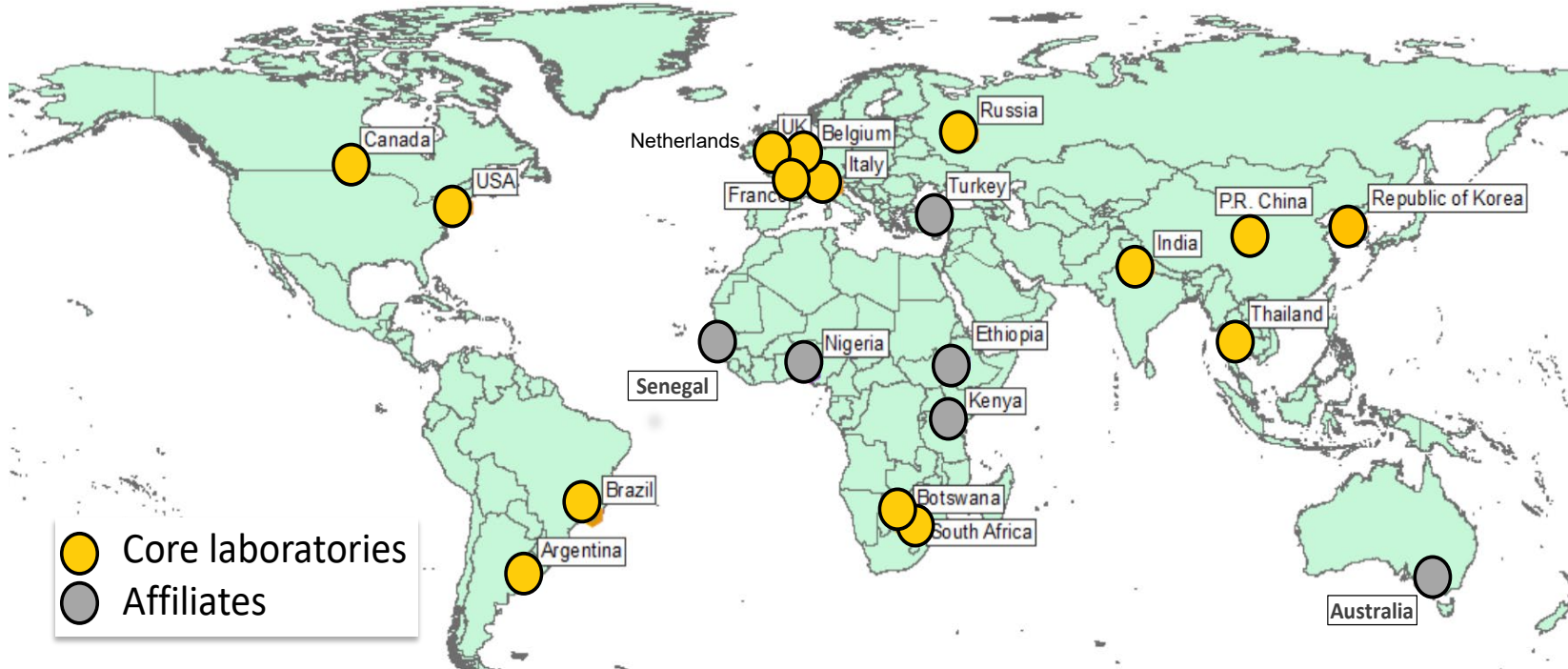
The level of assurance is rated from 'Full', through 'Partial' to 'Incomplete' to recognize that the level of assurance depends on the amount and quality of data provided.

In the case of vaccines rated 'Partial' or 'Incomplete', the outcome of PQv does not call into question the evaluation performed by a national competent authority in qualifying the vaccine but only reflects that data has not been provided to EuFMD to demonstrate compliance with the minimum standards of the WOAHP Manual.



# WOAH/FAO FMD Laboratory Network

<https://www.foot-and-mouth.org/Ref-Lab-Network>

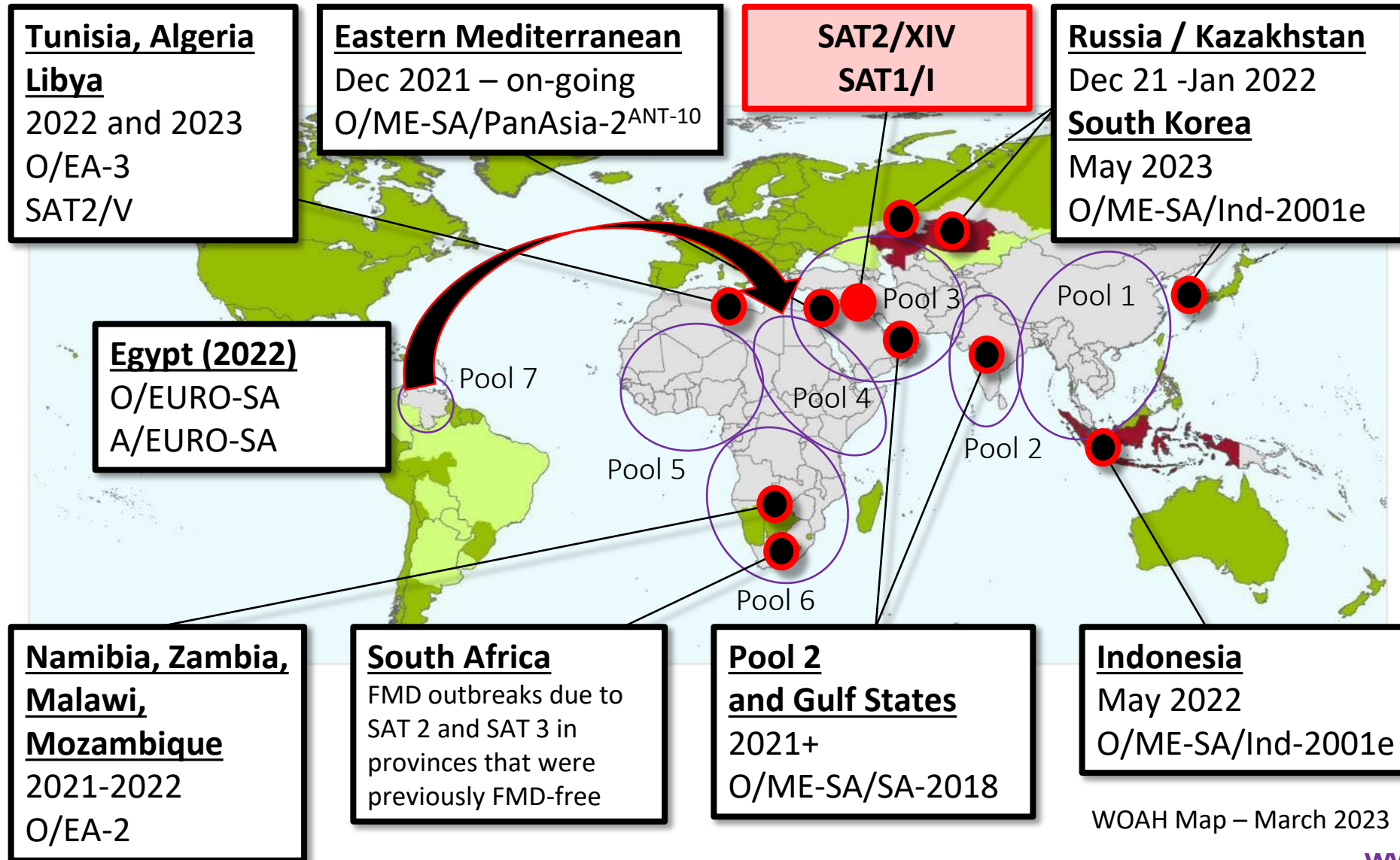


2023 Network Meeting, Winnipeg, Canada

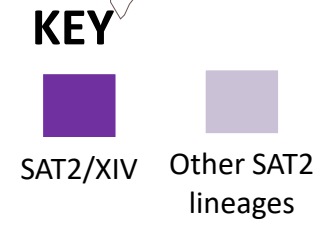
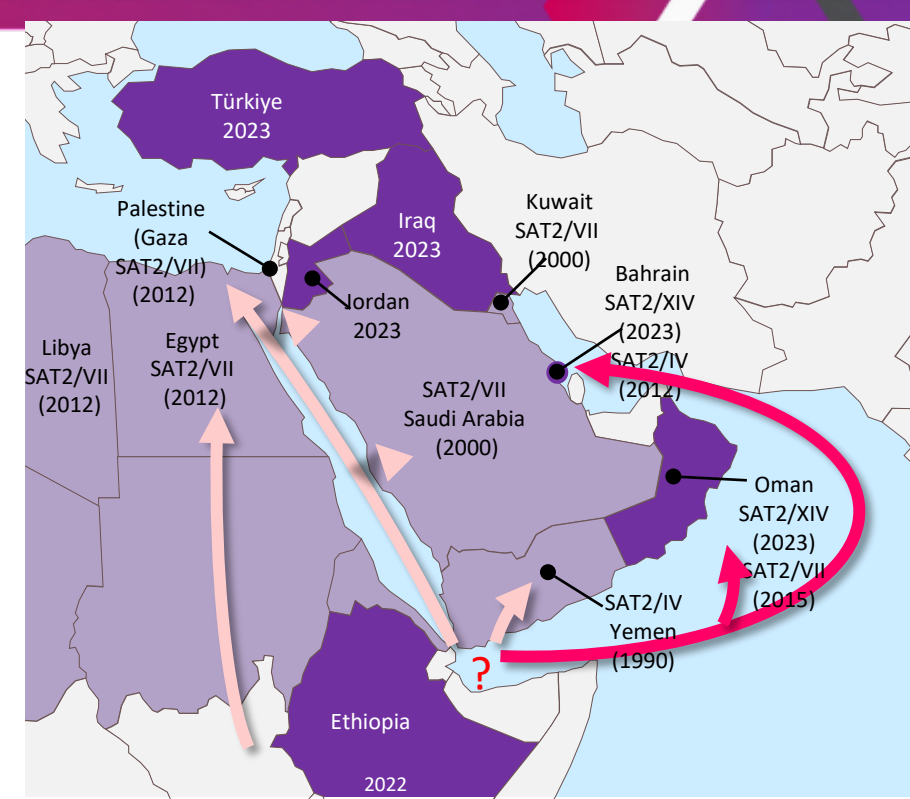
## Core activities:

- FMDV detection and characterisation
- Collation, exchange and release of data
- Test improvement and harmonization
- Evaluating vaccine performance
- Review of FMD risks
- Support to GF-TADs regional RoadMaps

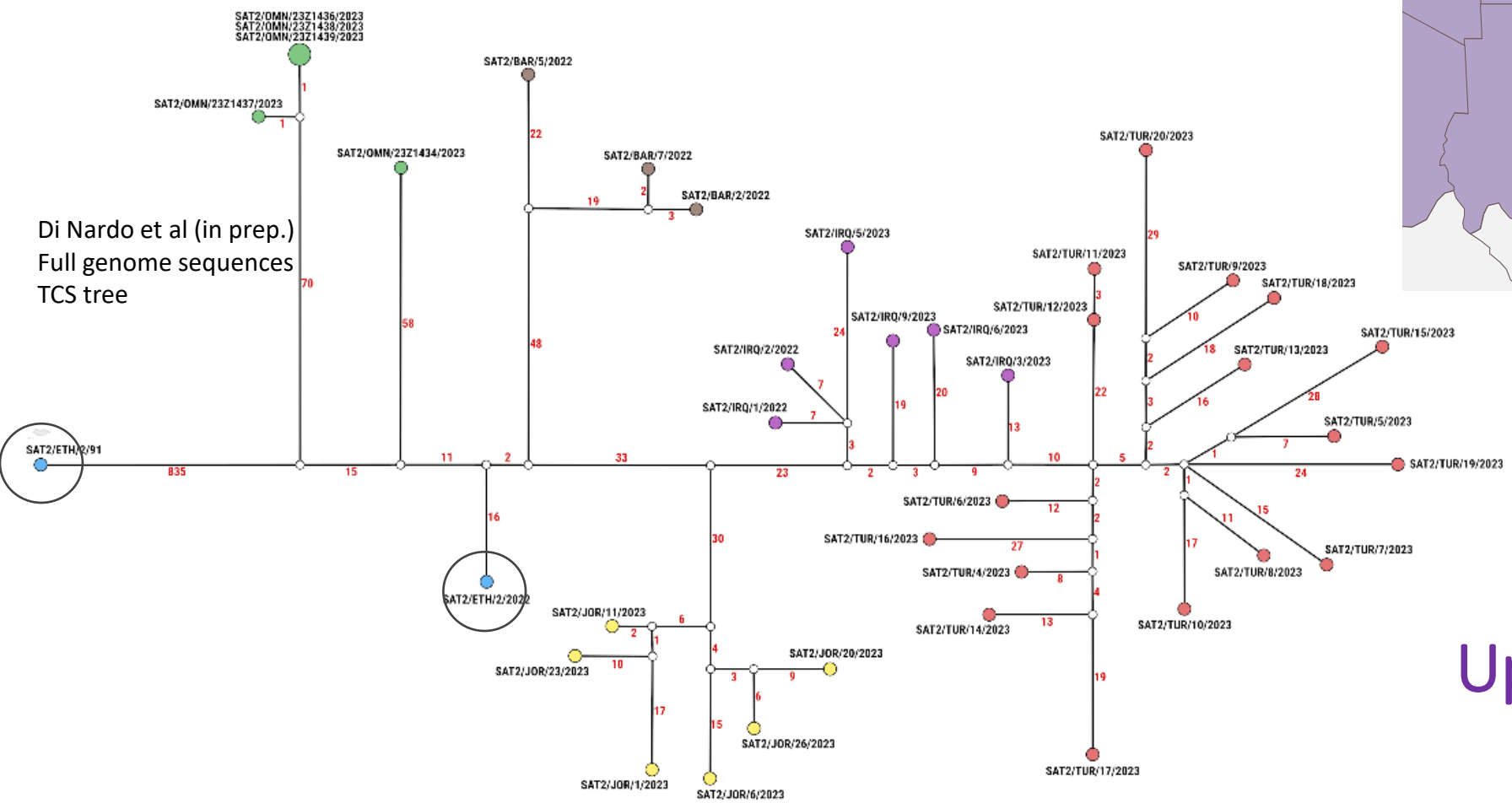
# Headline global events (2021/23)



- Full genome data supports at least two independent introductions of SAT2/XIV into the Middle East from East Africa
- New samples tested from Türkiye linked to cases in Iraq
- Vaccine trial (SAT2-Eri-98 and SAT2-Zim-83) in cattle conducted recently at Pirbright (funded by UK Defra and BI)



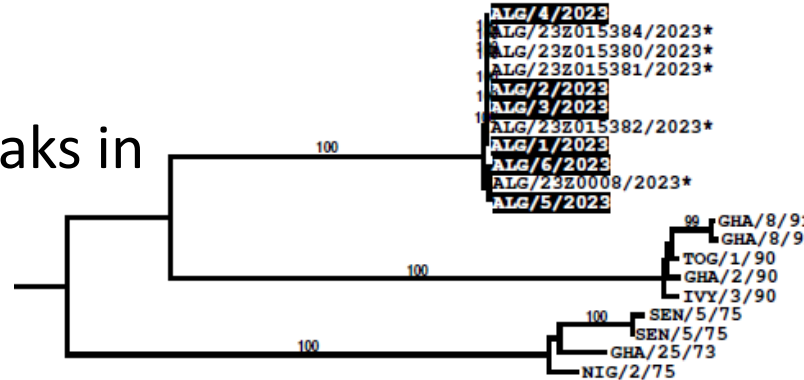
## Update on SAT2/XIV



# North Africa: Unexpected emergence of SAT2/V in Algeria

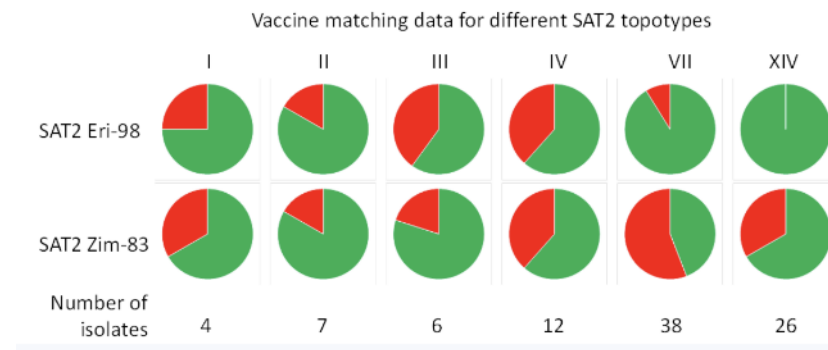


- Sequences/samples shared by ANSES
- Associated with FMD outbreaks in cattle (December 2023)
- Characterised as SAT2/V
- Last detected in West Africa in 1991



WRLFMD SAT2 vaccine matching data

Field virus	SAT 2 Eri-98 (BI)		SAT2 ZIM-83 (BI)		SAT2 Oman 2015 (BB)	
	Heterologous titre (log <sub>10</sub> )	r <sub>1</sub>	Heterologous titre (log <sub>10</sub> )	r <sub>1</sub>	Heterologous titre (log <sub>10</sub> )	r <sub>1</sub>
ALG/4/2023	1.58	0.70	2.07	0.40	2.52	0.42
ALG/6/2023	1.59	0.72	2.07	0.40	2.67	0.59



- SAT2/V real-time RT-PCR is under development

# Emergence of foot and mouth disease virus, serotype O, Europe–South America topotype in Egypt, 2022

Mohamed A. Soltan ✉, Mohamed M. Mahmoud, Yamen Hegazy, Mohamed M. Abd-Eldiam

First published: 09 June 2022 | <https://doi.org/10.1111/tbed.14612> | Citations: 1

From where and how introduced?

Will they persist and cause problems?

Vaccines used in Europe and Asia not often tested for efficacy against S American field viruses. Thanks to PANAFTOSA for sending viruses to WRLFMD for matching tests.

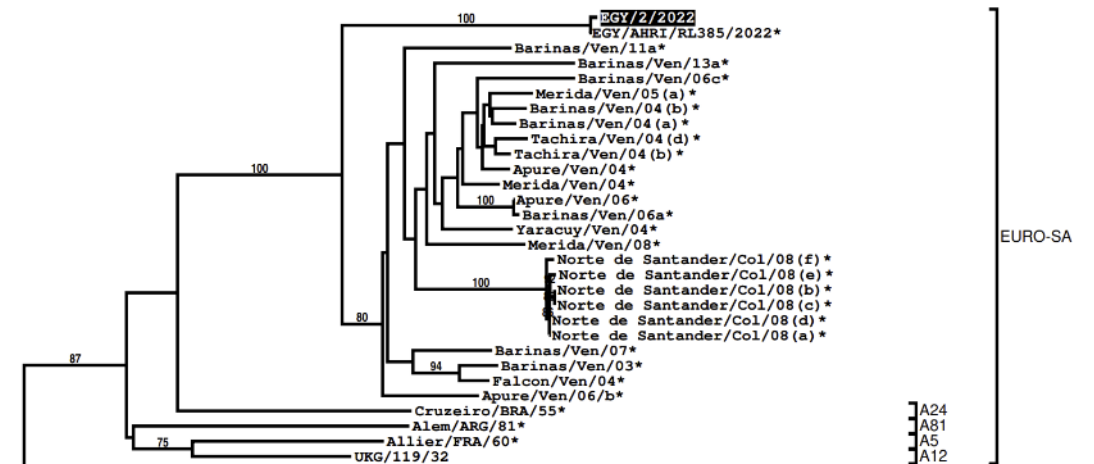


# Molecular detection and phylogenetic analysis of newly emerging foot-and-mouth disease virus type A, Lineage EURO-SA in Egypt in 2022

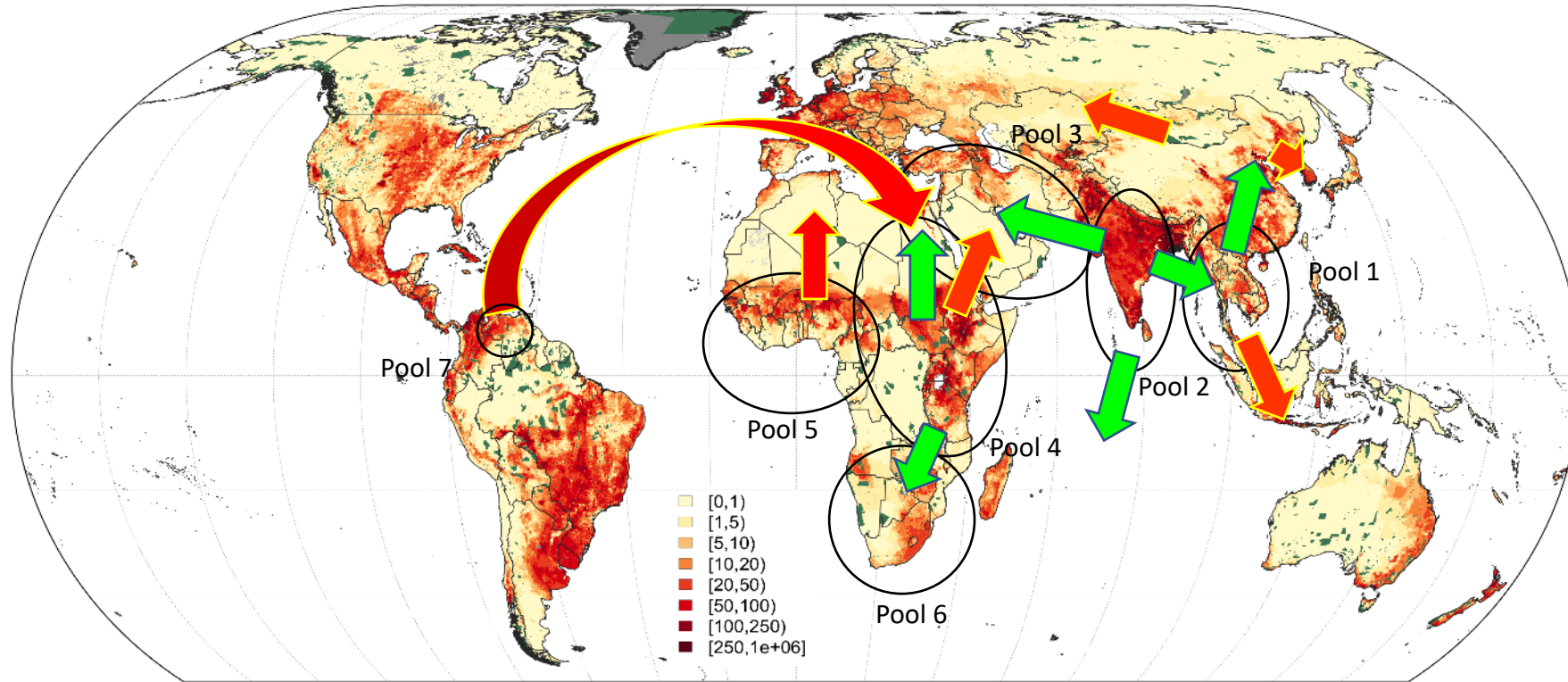
Naglaa M. Hagag<sup>a</sup> ✉, Ayah M. Hassan<sup>a</sup>, Mostafa R. Zaher<sup>a</sup>, Sara M. Elnomrosy<sup>a</sup>, Omayma A. Shemies<sup>b</sup>, Heba A. Hussein<sup>b</sup>, Eman S. Ahmed<sup>b</sup>, Mohamed H. Ali<sup>b</sup>, Mohamed Ateay<sup>c</sup>, Mahmoud A. Abdel-Hakim<sup>c</sup>, Ahmed R. Habashi<sup>d</sup>, Samah Eid<sup>e</sup>, Mohamed E. El Zowalaty<sup>f</sup> ✉, Momtaz A. Shahein<sup>b</sup>

Report on FMDV A in Egypt in 2020, 2021, 2022

Batch: WRLFMD/2022/00090



# Long distance spread of FMD



Cattle density map, Robinson et al., 2007

➡ New events 2021-24

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

- Related to strain prevalence/emergence at source and transmission opportunities, new and old
- Impact/change regional FMD risks for FMD free and endemic countries and vaccine selection

# Risks for Transboundary Spread

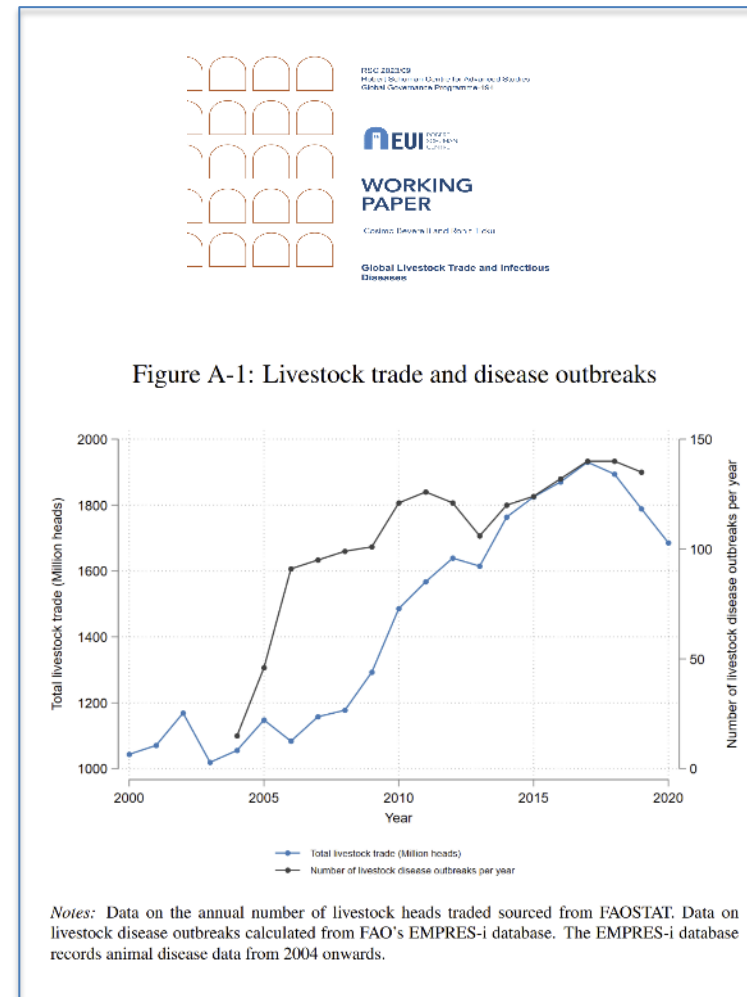
Readiness for an exotic incursion?

- Vaccine supply (banks)
- Decision to vaccinate
- Diagnostic coverage

**Animal products:** especially illegal movements



**Probability = risk x frequency**  
**Millions of passengers travel between FMD-endemic and free countries every year**



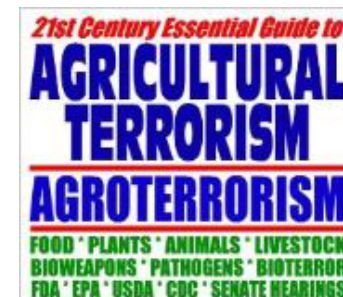
**People:** farm workers, tourists, military



**Wild animals:** wild pigs and deer



**Bioterrorism:**



## Current and future trade in livestock products

D. Enahoro <sup>(1)\*</sup>, S. Bahta <sup>(2)</sup>, C. Mensah <sup>(1)</sup>, S. Oloo <sup>(2)</sup> & K.M. Rich <sup>(3)</sup>

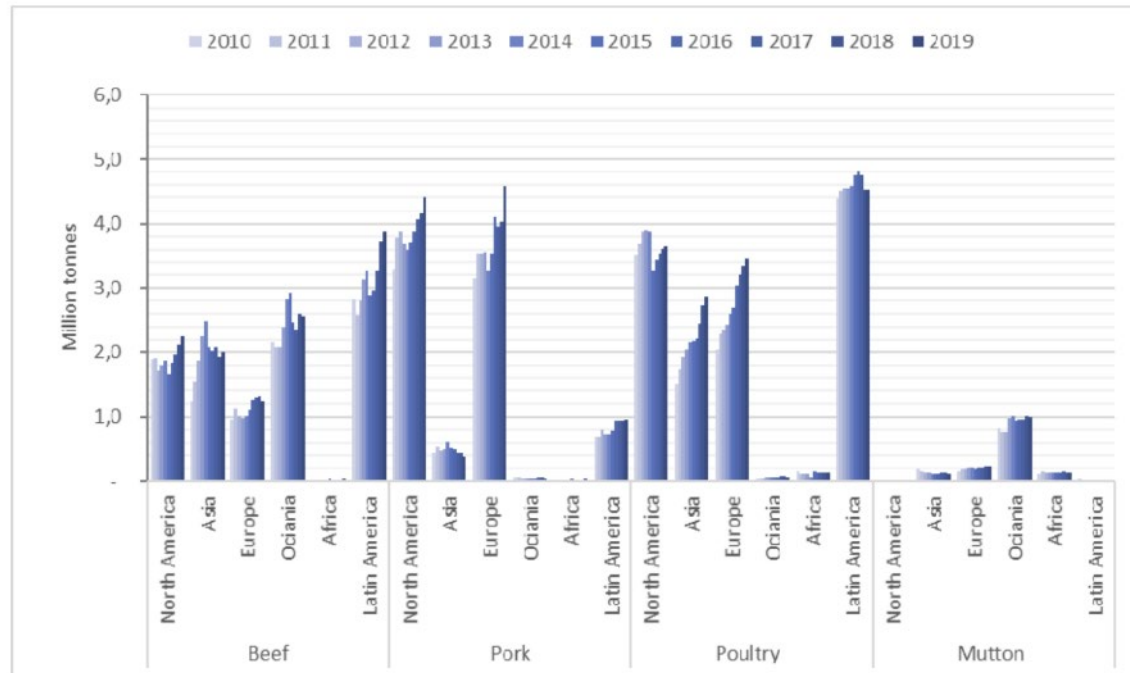
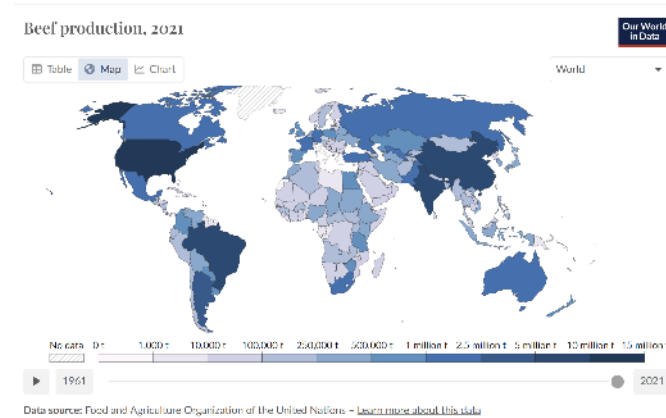


Fig. 3

Exports of major livestock products by region (2009–2019), million tonnes. Data source: (16)

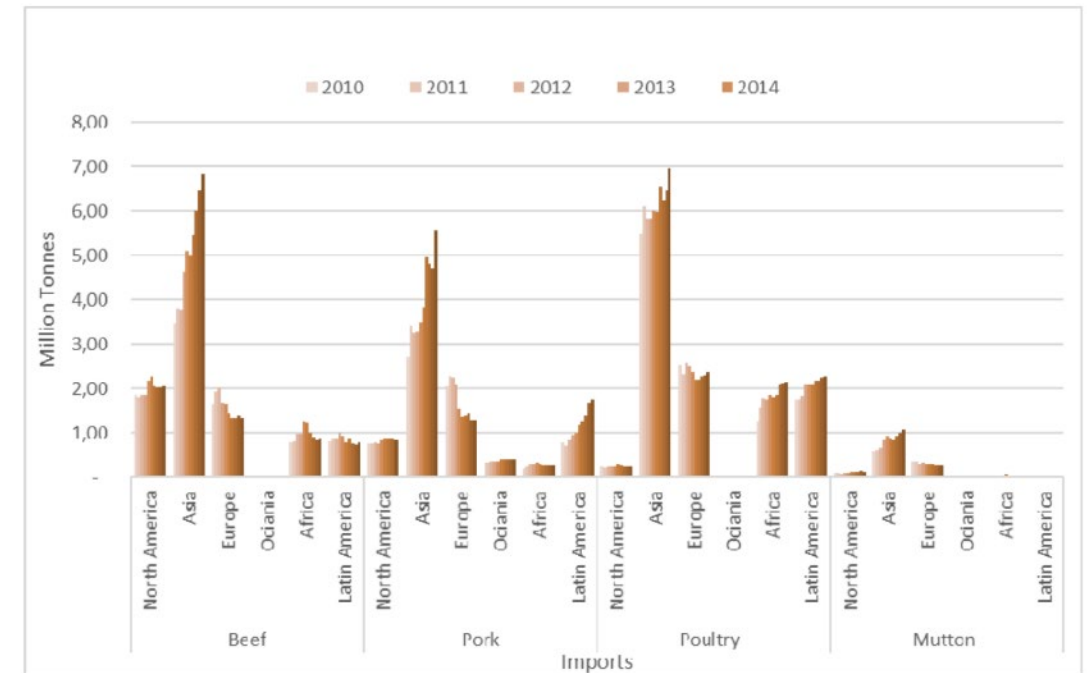


Fig. 5

Imports of major livestock products by region (2009–2019). Data source: (16)



# The PRAGMATIST tool for regional/national vaccine prioritisation and vaccine bank managers

## Vaccine Antigen Prioritisation: Europe

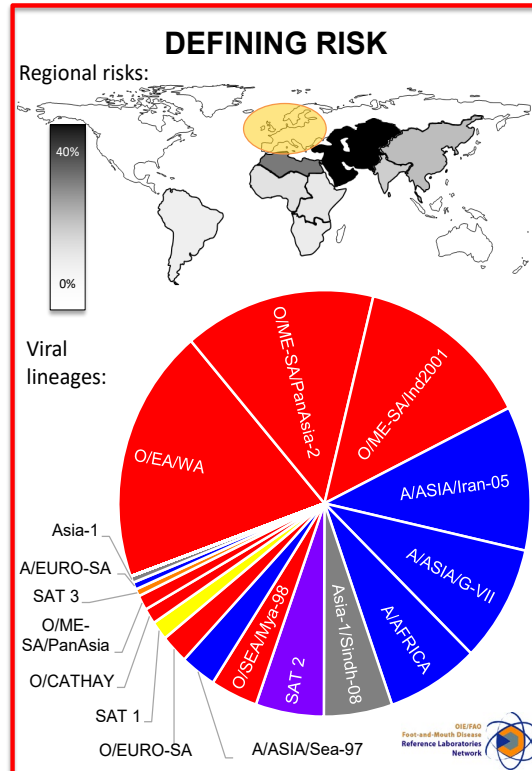
July 2021

1. Define source risks

Trade and risk experts

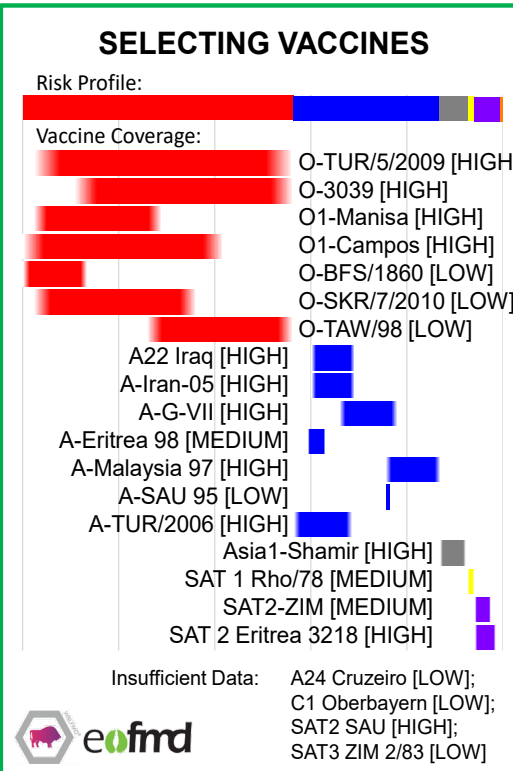
2. Review source viruses

Annual Lab Network Task



NB: Analyses uses best available data, however there are gaps in surveillance and vaccine coverage data

PRAGMATIST: A tool to prioritize foot-and-mouth disease virus antigens held in vaccine banks

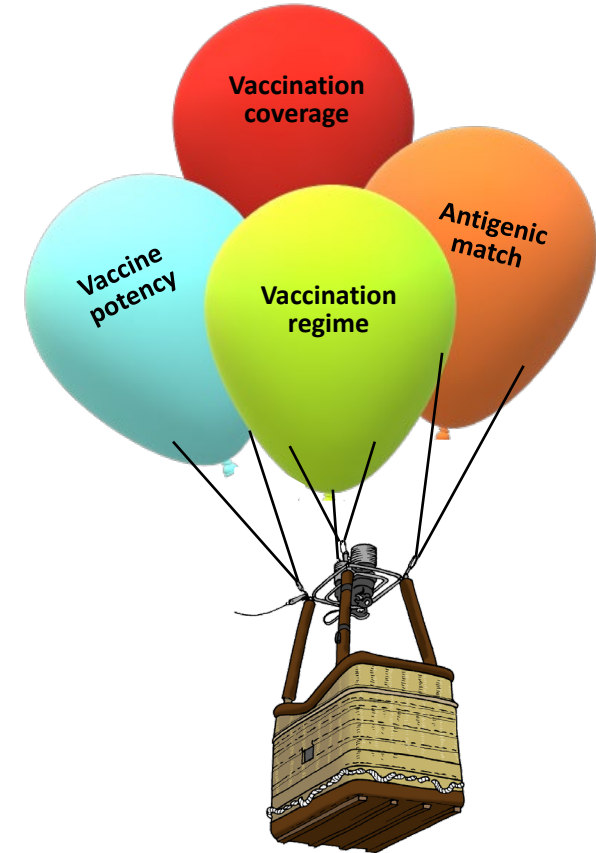


3. Review vaccine matching

WRLFMD

4. Select vaccines

Bank Managers



Vaccine failure



www.pirbright.ac.uk



# Foot-and-Mouth Disease

2023

Quarterly report

October – December

**Table 1:** Proposed changes to the conjectured relative prevalence of circulating FMD viral lineages in each Pool.

Lineage	Southeast/ Central / East Asia [Pool 1]	South Asia [Pool 2]	West Eurasia & Near East [Pool 3]	North Africa	Eastern Africa [Pool 4]	West / Central Africa [Pool 5]	Southern Africa [Pool 6]	South America [Pool 7]
O ME-SA PanAsia-2			30					
O ME-SA PanAsia	10							
O SEA Mya-98	21.5							
O ME-SA Ind2001	40	76 <sup>1</sup>	5.5 <sup>1</sup>	0				
O EA or O WA			1.5	60	53.5	69	16	
O EURO-SA								90
O CATHAY	10.5							
A ASIA Sea-97	18							
A ASIA Iran-05	0		28					
A ASIA G-VII		20	5					
A AFRICA				30	17	15		
A EURO-SA								10
Asia1	0	4	10					
SAT 1			1	0	15	1	16	
SAT 2			19	10	14	15	52	
SAT 3					0.5		16	
C								

<sup>1</sup> Includes cases due to the emerging O/ME-SA/SA-18 lineage that has been recently detected in Pools 2 and 3.

# Estimating cross-protection



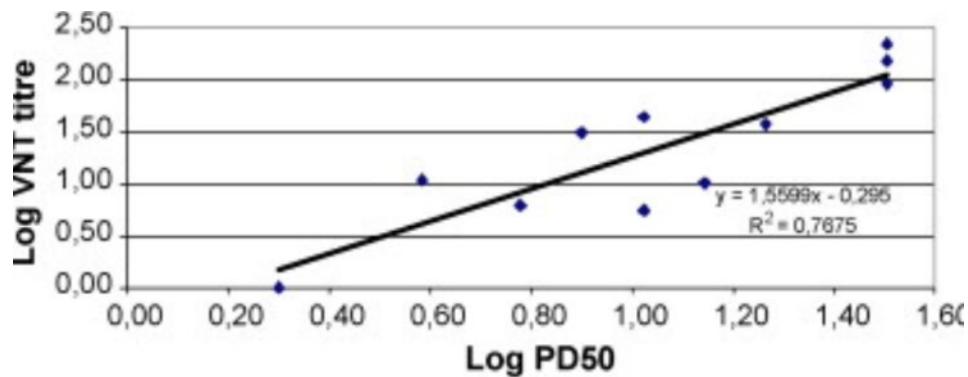
Vaccine

Volume 26, Issue 13, 20 March 2008, Pages 1681-1687



## High potency vaccines induce protection against heterologous challenge with foot-and-mouth disease virus

K.E. Brehm<sup>a</sup>, N. Kumar<sup>a</sup>, H.-H. Thulke<sup>b</sup>, B. Haas<sup>a</sup>



Heterologous VNT can predict protection in a potency test

But multiple variables can affect this association

Check for updates

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<sup>‡</sup>Retired

## Predicting cross-protection against foot-and-mouth disease virus strains by serology after vaccination

Simon Gubbins<sup>1†</sup>, David J. Paton<sup>1\*†</sup>, Aldo Dekker<sup>2</sup>,  
Anna B. Ludi<sup>1</sup>, Ginette Wilsden<sup>1</sup>, Clare F. J. Browning<sup>1</sup>,  
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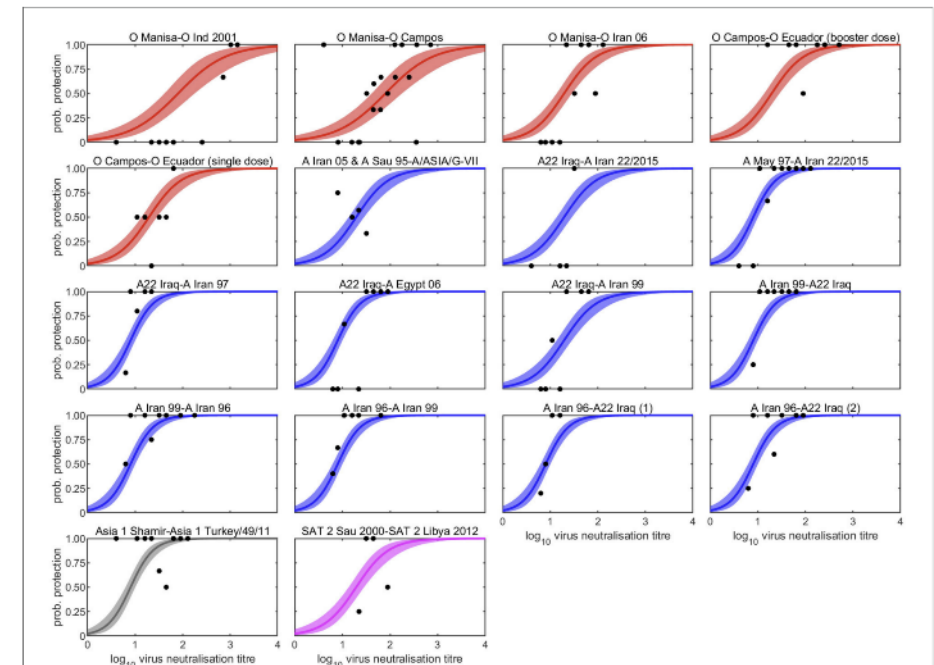
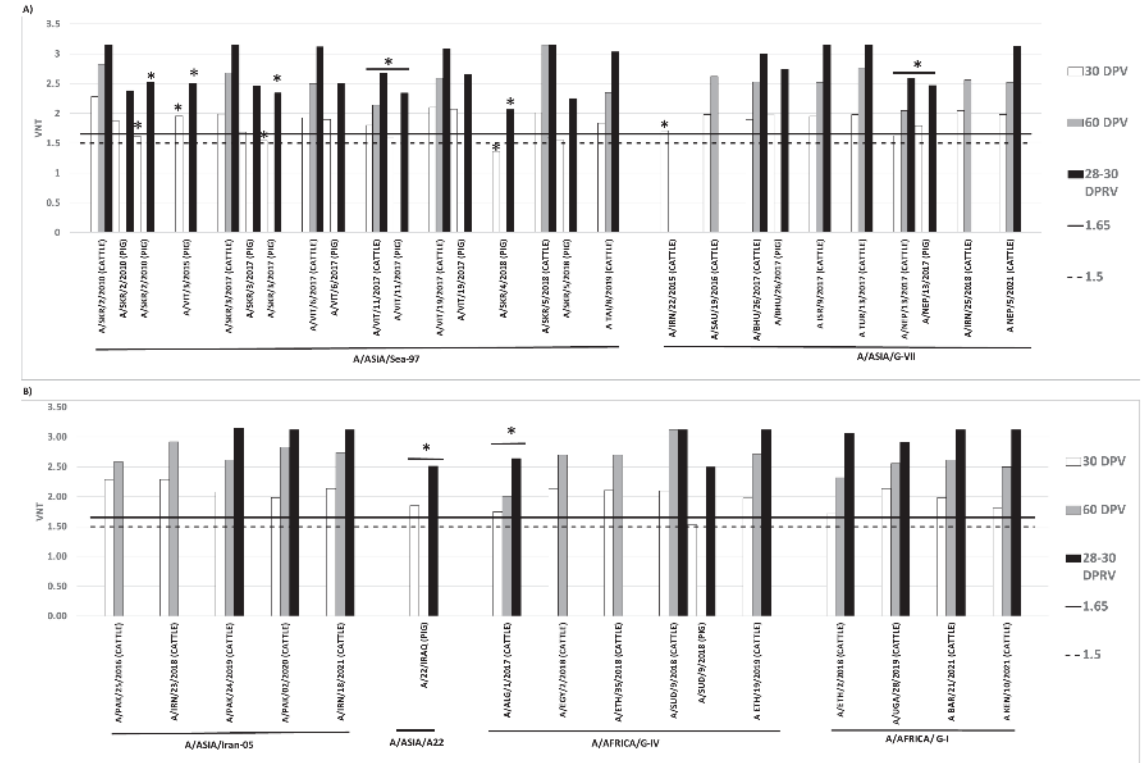
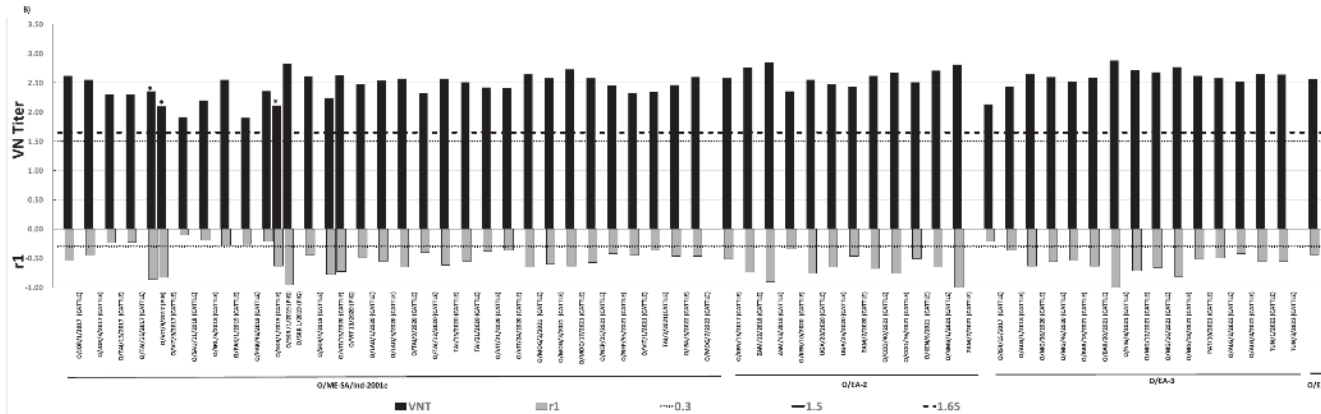
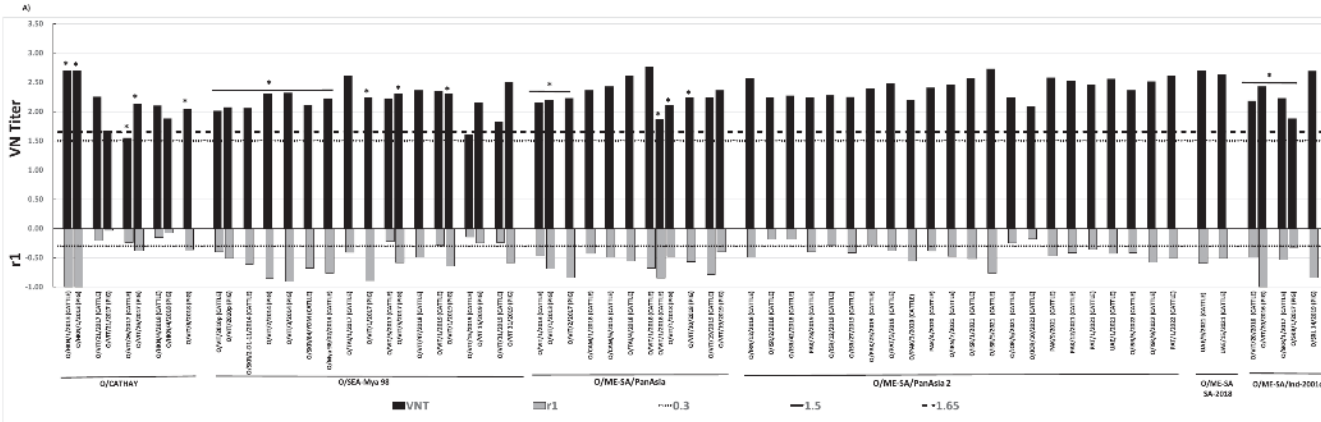


FIGURE 1  
Observed and estimated probability that a vaccinated bovine animal is protected following heterologous challenge and its dependence on log<sub>10</sub> virus neutralisation titre for eighteen vaccine-challenge studies. The vaccine and challenge strains are identified before and after the hyphen, respectively. Each plot shows the observed proportion of cattle protected at each titre in the study (circles) and the posterior median (line) and 95% credible interval (shading) for the probability of protection. Colour indicates serotype: O (red), A (blue), Asia 1 (grey), and SAT 2 (magenta).



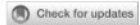
# Broad immunogenic spectrum of monovalent and trivalent foot-and-mouth disease virus vaccines containing O<sub>1</sub> campos, A24 cruzeiro and A Argentina 2001 strains against circulating viral lineages in cattle and pigs

Viviana Malirat<sup>a</sup>, Cecilia Caldevilla<sup>b</sup>, Sabrina Cardillo<sup>b</sup>, Ana María Espinoza<sup>b</sup>,  
Sabrina Galdo Novo<sup>c</sup>, Ana Taffarel<sup>c</sup>, Melanie Barrios Benito<sup>c</sup>, Ingrid E. Bergmann<sup>a,\*</sup>



Serotype A ↗

↖ Serotype O



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## Application of the Nagoya Protocol to veterinary pathogens: concerns for the control of foot-and-mouth disease

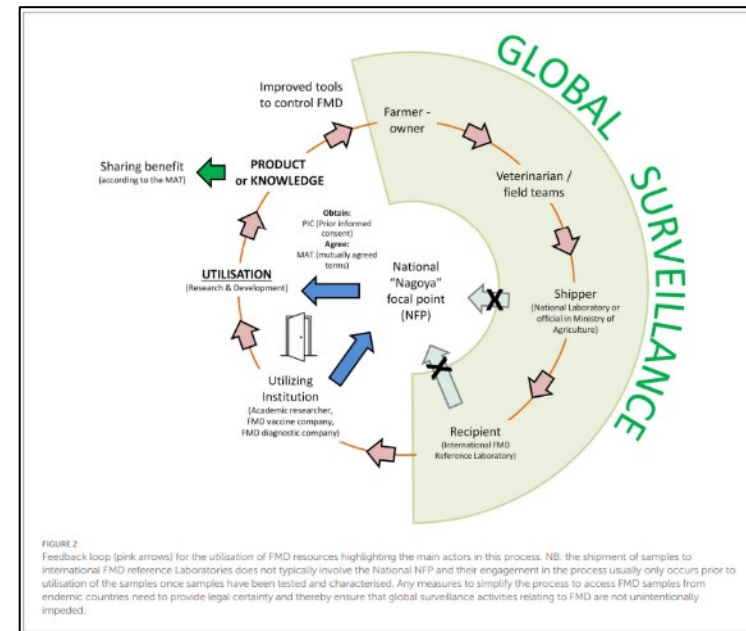
Jacquelyn Horsington<sup>1</sup>, Elke Abbeloos<sup>2</sup>, Labib Bakkali Kassimi<sup>3,4</sup>, Kingkarn Boonsuya Seeyo<sup>3,5</sup>, Alejandra V. Capozzo<sup>6</sup>, Eunice Chepkwony<sup>7</sup>, Phaedra Eblé<sup>3,8</sup>, Sabrina Galdo-Novo<sup>3,9</sup>, Daniel Gizaw<sup>10</sup>, Lizelle Gouverneur<sup>11</sup>, Santina Grazioli<sup>3,12</sup>, Livio Heath<sup>3,13</sup>, Pascal Hudelet<sup>2</sup>, Joseph M. K. Hyera<sup>3,14</sup>, Martin Illott<sup>1</sup>, Alasdair King<sup>15</sup>, David J. Lefebvre<sup>3,16</sup>, David Mackay<sup>1</sup>, Samia Metwally<sup>17</sup>, Frank N. Mwiine<sup>6,18</sup>, Charles K. Nfon<sup>3,19</sup>, Min-Kyung Park<sup>20</sup>, Edviges Maristela Pituco<sup>21</sup>, Fabrizio Rosso<sup>1</sup>, Francisco Simon<sup>22</sup>, Hussaini G. Ularamu<sup>23</sup>, Paul Vermeij<sup>15</sup>, Wilna Vosloo<sup>6,24</sup> and Donald P. King<sup>3,11\*</sup>

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The Nagoya Protocol is an international agreement adopted in 2010 (and entered into force in 2014) which governs access to genetic resources and the fair and equitable sharing of benefits from their utilisation. The agreement aims to prevent misappropriation of genetic resources and, through benefit sharing, create incentives for the conservation and sustainable use of biological diversity. While the equitable sharing of the benefits arising from the utilisation of genetic resources is a widely accepted concept, the way in which the provisions of the Nagoya Protocol are currently being implemented through national access and benefit-sharing legislation places significant logistical challenges on the control of transboundary livestock diseases such as foot-and-mouth disease (FMD). Delays to access FMD virus isolates from the field disrupt the production of new FMD vaccines and other tailored tools for research, surveillance and outbreak control. These concerns were raised within the FMD Reference Laboratory

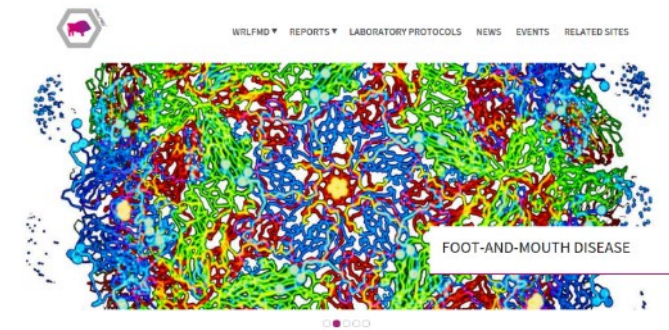
## Opinion piece co-authored by:

- FAO
- EuFMD
- WOAH
- Network Laboratories (free and endemic)
- Vaccine companies



# Further 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 WOA/FAO FMD Laboratory Network (<http://foot-and-mouth.org/>)



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.

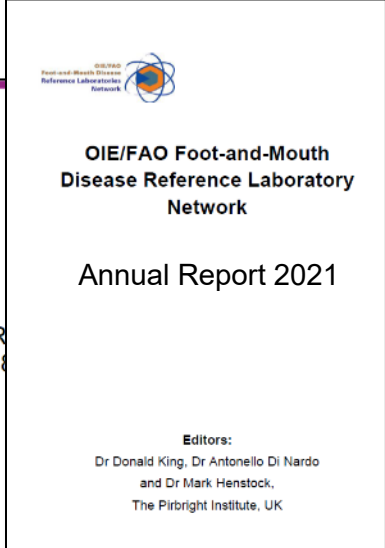
Country Reports >



WRLFMD Quarterly Report  
April to June 2018

Foot-and-Mouth Disease

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

Annual Report 2021

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for Environment  
Food & Rural Affairs

