Food and Agriculture Organization of the United Nations

eufmd
european commission for the control of foot-and-mouth disease

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

Foot-and-Mouth Disease

2022

Quarterly report

January-March

Funded by the European Union

EuFMD's programme, tools and initiatives

FAST
Foot-and-mputh And Similar Transboudary animal diseases

Dt
eufmd digital transformation

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vlearning
eufmd virtual learning centre

microLearning
eufmd virtual learning

vlc EA
virtual learning centre for East Africa

Tom
eufmd training management system

SimExOn
simulation exercises online

KnowBank
eufmd knowledge bank

GetPrepared
emergency preparedness toolbox

RiskComms
risk communications

SQRA
a method for spatial qualitative risk analysis applied to fmd.

Pragmatist
prioritization of antigen management with international surveillance tool

EuFMDiS
european foot-and-mouth disease spread model

Vademos
fmd vaccine demand estimation model

GVS
global vaccine security

PQv
vaccine prequalification

PCP
progressive control pathway

PSO
pcp practicioner officers

VPP
veterinary paraprofessionals

PPP
public private partnership

Sustainable development goals, UN-SDGs. EuFMD's programme has a focus on

Together against wasting resources, think twice before printing.

Foot-and-Mouth Disease

Quarterly Report

January-March 2022

Food and Agriculture Organization of the United Nations

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This report is version 1

Editorial corrections and updates for previous reports:

- **2020 Q1 (Jan-Mar)**
  - SRL 1/2019 (Sri Lanka) has been corrected from O/ME-SA/Ind-2001d to O/ME-SA/SA-2018 in sections 3.3 and 4.2.
  - SRL 14/2019 (Sri Lanka) has been updated from O/ME-SA/ to O/ME-SA/Ind-2001d in sections 3.3 and 4.2.
- **2020 Q4 (Oct-Dec)**
  - The results of O_1 Campos and O PanAsia-2 vaccine matching testing in table 5 of this report were incorrectly all reported as O_1 Campos. The results have been now appropriately split between the two vaccine strains.
  - SRL 1/2019 has been corrected from O/ME-SA/Ind-2001d to O/SA-2018 in the Vaccine Matching table (section 4.5, table 5).
  - SRL 14/2019 (Sri Lanka) has been updated from O/ME-SA to O/ME-SA/Ind-2001d in the Vaccine Matching table (section 4.5, table 5).
- **2021 Q2 (Apr-Jun)**
  - ISR 1/2021 and ISR 5/2021 were incorrectly reported as O/ME-SA/Ind-2001 in the Vaccine Matching table (section 4.2, table 5). These isolates have been corrected to O/ME-SA/PanAsia2^{QOM-15}.

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Jammu and Kashmir: *Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.*

Sudan and South Sudan: *Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.*

Abyei: *Final status of the Abyei area is not yet determined.*

Falkland Islands (Malvinas): *A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).*

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Abbreviations and acronyms

BVI	Botswana Vaccine Institute
EIDRA	Emerging Infectious Disease Research Association
EuFMD	European Commission for the Control of Foot-and-Mouth Disease
FAST reports	Foot-and-mouth and similar transboundary animal diseases reports
FGBI "ARRIAH"	Federal Governmental Budgetary Institution "Federal Centre for Animal Health"
FMD	Foot-and-mouth disease
FMDV	Foot-and-mouth disease Virus
FMDV GD	Foot-and-mouth disease Virus Genome detected
FMDV NGD	Foot-and-mouth disease Virus Genome not detected
GF-TAD	Global Framework for the Progressive Control of Transboundary Animal Diseases
LVRI	The National Reference Laboratory for FMD, The Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences
MEVAC	International Facility for Veterinary Vaccines Production (Egypt)
NT	Not tested
NVD	No virus detected
OIE	World Organisation for Animal Health
PIADC	Plum Island Animal Disease Center
rRT-PCR	Real-time reverse transcription polymerase chain reaction
SAARC	South Asian Association for Regional Cooperation
SADC	Southern Africa in collaboration with the Southern African Development Community
SAT	Southern African Territories
SEACFMD	South-East Asia and China FMD campaign
SSARRL	Sub-Saharan Africa Regional Reference Laboratory
SVD	Swine vesicular disease
VETBIS	Veterinary Information System of Turkey
VI	Virus Isolation
WAHIS	World Animal Health Information System (of the OIE)
WRLFMD	World Reference Laboratory for Foot-and-Mouth Disease

1. Highlights and headlines

Welcome to the first quarterly report for 2022 covering foot-and-mouth activities for January-March. During this period, the WRLFMD has reported test results for samples received from DR Congo, Jordan, Nepal, Nigeria, Pakistan and Uganda. New data has also been analysed for sequence submissions from Israel (KVI), Namibia (BVI), Kazakhstan & Russia (ARRIAH) and Tunisia (IRVT and ANSES). Sequences for the FMD viruses causing Russian and Kazakh outbreaks represent further spread of the O/ME-SA/Ind-2001e lineage, where their close relationship to Mongolian sequences highlights the new threats posed by pathway from East to Central Asia (previously last exploited by serotype A viruses in 2013). New cases of FMD in Israel have been caused by viruses from the O/ME-SA/PanAsia-2^{ANT-10} sub-lineage most closely related to viruses previous collected in Jordan and Palestine. These viruses also share a common genetic history with FMDVs collected recently from Pakistan (see this report). Elsewhere, sequence data for FMDV-positive samples collected recently from Tunisia shared close relationship to O/EA-3 FMD viruses collected in Nigeria (in 2021), supporting the idea that these cases represent a new introduction of FMDV into North Africa, presumably following a similar trans-Saharan pathway as occurred previously for O/EA-3 (in 2018) and A/AFRICA/G-IV (in 2017). Regional road map meetings provide a great opportunity to exchange the latest FMD information and I was pleased to join two recent meetings in virtual format for East Africa https://rr-africa.oie.int/en/news/4th-gf-tads-eastern-africa-roadmap-meeting-for-foot-and-mouth-disease/ and Southeast Asia (https://rr-asia.oie.int/en/events/26th-meeting-of-the-oie-sub-commission-for-foot-and-mouth-disease-in-south-east-asia-china-and-mongolia/)

STOP PRESS: A new FMDV VP1 sequence has been shared by BVI, Botswana for a sample collected in the Central Region of Malawi during Feb 2022. This sequence shares closest genetic relationship (>99.5% nt identity) to an FMDV isolate collected in Zambia (in 2018) and demonstrates that the O/EA-2 topotype is now present in Malawi (further details will be presented in the next report). A recent joint paper describes the detection of this topotype for the first time in Namibia (see: https://onlinelibrary.wiley.com/doi/10.1111/tbed.14561).

Don King, Pirbright, April 2022

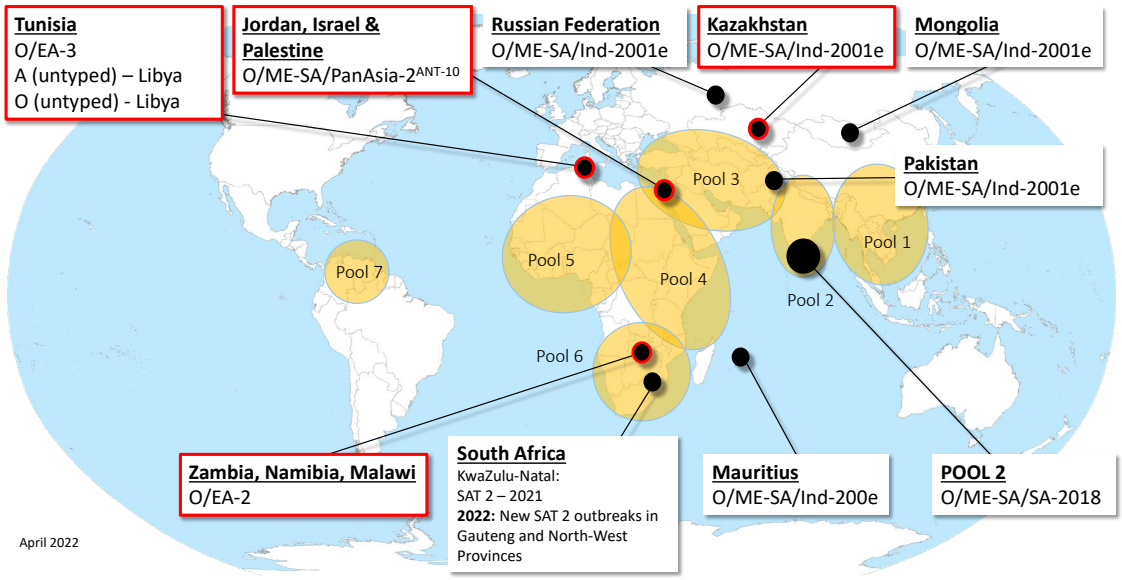


Figure 1: Recent FMD global outbreaks (new headline events reported January to March 2022 are highlighted) with endemic pools highlighted in orange. Source: WRLFMD. Map conforms to the United Nations World Map, June 2020.

2. General overview

Endemic Pools represent independently circulating and evolving foot-and-mouth disease virus (FMDV) genotypes; within the pools, cycles of emergence and spread occur that usually affect multiple countries in the region. In the absence of specific reports, it should be assumed that the serotypes indicated below are continuously circulating in parts of the pool area and would be detected if sufficient surveillance was in place.

POOL	REGION/COUNTRIES	SEROTYPES PRESENT
1	**SOUTHEAST ASIA/CENTRAL ASIA/EAST ASIA** Cambodia, China, China (Hong Kong SAR), Taiwan Province of China, Democratic People's Republic of Korea, Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, Russian Federation, Thailand, Viet Nam	A, Asia 1 and O
2	**SOUTH ASIA** Bangladesh, Bhutan, India, Mauritius[1], Nepal, Sri Lanka	A, Asia 1 and O
3	**WEST EURASIA & MIDDLE EAST** Afghanistan, Armenia, Azerbaijan, Bahrain, Georgia, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Syrian Arab Republic, Tajikistan, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan	A, Asia 1 and O (SAT 2)
4	**EASTERN AFRICA** Burundi, Comoros, Djibouti, Egypt[3], Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Uganda, United Republic of Tanzania, Yemen	O, A, SAT 1, SAT 2 and SAT 3
	NORTH AFRICA[2] Algeria, Libya, Morocco, Tunisia	A, O and SAT 2
5	**WEST/CENTRAL AFRICA** Benin, Burkina Faso, Cabo Verde, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, Togo	O, A, SAT 1 and SAT 2
6	**SOUTHERN AFRICA** Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe	SAT 1, SAT 2 and SAT 3 (O, A)[4]
7	**SOUTH AMERICA** Venezuela (Bolivarian Republic of)	O and A

[1]FMD outbreaks in 2016/21 due to O/ME-SA/Ind-2001 demonstrate close epidemiological links between Pool 2 and Mauritius

[2]Long-term maintenance of FMDV lineages has not been documented in North Africa and therefore this region does not constitute an Endemic Pool, but data is segregated here since FMD circulation in this region poses a specific risk to FMD-free countries in Southern Europe

[3]Egypt represents a crossroads between East African Pool 4 and the Middle East (Pool 3). NB: Serotypes SAT 1 and SAT 3 have not been detected in this country

[4]Detection of O/EA-2 in southern/western Zambia (2018-2021), Namibia (2021) and Malawi (2022) represent a new incursion into Pool 6

3. Summary of FMD outbreaks and intelligence

3.1. Global overview of samples received and tested

The location of all samples detailed in this report can be seen on the map below. More detailed maps and sample data, on a country by country basis, can be found in the following sections of this report.

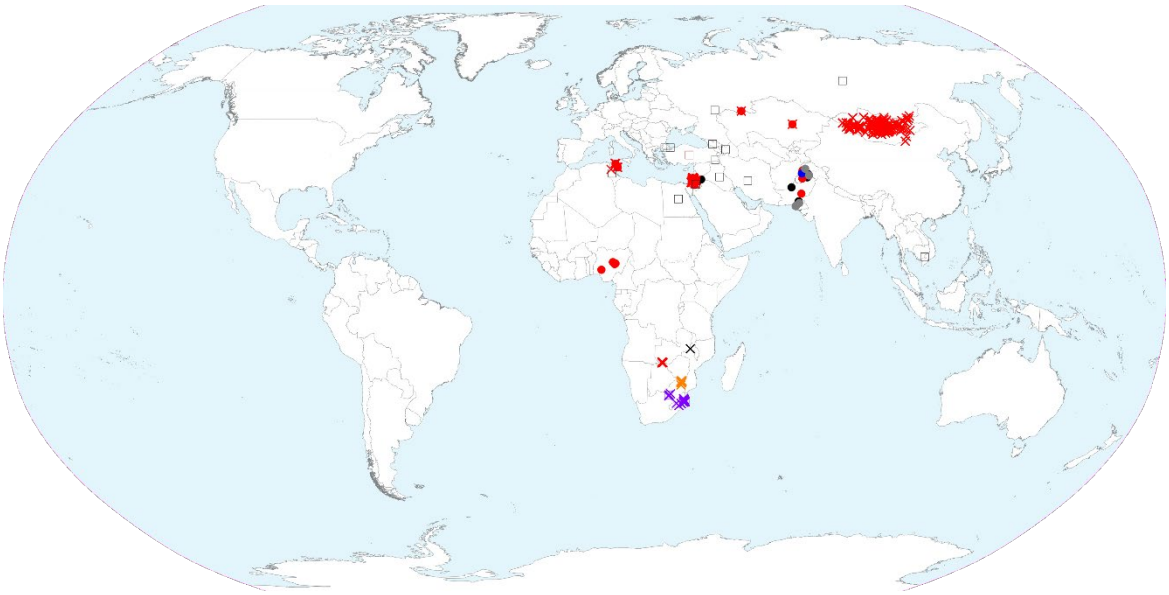
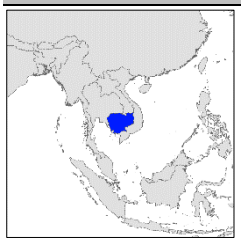


Figure 2: Samples tested by WRLFMD or reported in this quarter. ● indicates samples analysed; × indicates new outbreaks reported to the OIE, but where results to define the genotype have not been reported; □ indicates reports of FMD from other sources. Shape colours define the serotype detected ●O; ●A; ●C; ●Asia1, ●SAT1, ●SAT2, ●SAT3, ○ FMD not detected, ● serotype undetermined/not given in the report.

Source: WRLFMD. Map conforms to the United Nations World map, June 2020.

3.2. Pool 1 (Southeast Asia/Central Asia/East Asia)

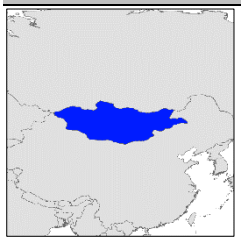
The Kingdom of Cambodia



FMD has been detected in the districts of vay Chrum, Romeas Hek, Romduol, Chantrea, and Kampong Ro of Svay Rieng Province. Vaccination of cattle in three communes were planned to begin from 10 February.

ProMED post: 20220217.8701492

Mongolia



During 2021, 99 outbreaks of **FMD type O** were reported to have occurred throughout the country. Recent FMD outbreaks in the country are summarised at:

https://rr-asia.oie.int/wp-content/uploads/2022/03/05_mongolia.pdf

3.3. Pool 2 (South Asia)

No new outbreaks of FMD were reported in South Asia.

3.4. Pool 3 (West Eurasia and Middle East)

The Republic of Azerbaijan

Passive and active surveillence is active in Armenia and almost 1.5 million cattle and small ruminants were vaccinated in this quarter.

FAO Eu-FMD FAST report Jan-Mar 2022

Georgia

The spring prophylatic vaccination campaign has commenced and the sero-surveillence data for 2021 has been anaylsed where NSP sero-prevalence was 5 percent.

FAO Eu-FMD FAST report Jan-Mar 2022

The Islamic Republic of Iran

Passive and risk-based surveillence is active in Iran. Over 36 million large and small ruminants have been vaccinated with trivalent (O, A and Asia-1) vaccines.

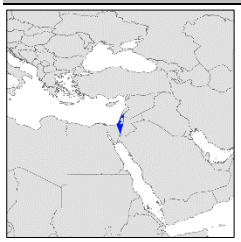
FAO Eu-FMD FAST report Jan-Mar 2022

The Republic of Iraq

There have been 681 cases of FMD (serotypes O and A) reported this quarter. Vaccination has not been conducted in the last six months.

FAO Eu-FMD FAST report Jan-Mar 2022

The State of Israel



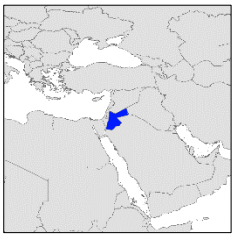
Twenty-seven outbreaks due to **FMD type O** were reported in February and March 2022. Seven **FMD type O** VP1 sequences were submitted to WRLFMD on 17 March 2022 by the Kimron Veterinary Institute. Genotyping revealed that they all belonged to the ME-SA/ PanAsia-2^{ANT-10} sublineage.

Outbreaks of FMD serotype O (of the same topotype and genotype as the currently active outbreaks in Jordan and Palestine) were reported to the OIE (OIE event ID: evt_4305). Most of the clinically affected animals have been young animals or those not vaccinated in the past 12 months.

OIE World Animal Health Information System

ProMED posts: 20220209.8701353, 20220304.8701784 and 20220321.8702125

The Hashemite Kingdom of Jordan



A batch of 13 samples was received at WRLFMD on 20 December 2021. Seven **FMD type O** viruses were identified while four samples contained FMDV genome (FMDV-GD) and two were NVD. Genotyping revealed that four of the type O viruses belonged to the O/ME-SA/PanAsia-2^{ANT-10} sublineage while three collected in 2017 were chracterised as belonging to the O/ME-SA/Ind-2001e sublineage.

The on-going spread of FMD in the Jordan Valley continues to put pressure on cattle breeders with lower prices for dairy products and increased veterinary costs.

ProMED post: 20220213.8701433

FAO Eu-FMD FAST report Jan-Mar 2022

The Republic of Kazakhstan

An outbreak of **FMD type O** in cattle was reported to have occurred on 3 January 2022 at Kiikty village, Shetskiy, Qaraghandy. A VP1 sequence was provided by the FGBI ARRIAH showed that the virus belonged to the O/ME-SA/Ind-2001e sublineage and to be most closely related to a FMD virus from Mongolia in 2021, and ultimately to viruses from Southeast Asia. (OIE event ID: evt_4244).

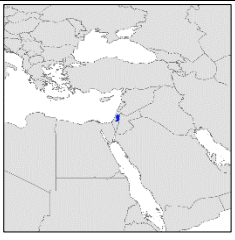
OIE World Animal Health Information System

The Islamic Republic of Pakistan

A batch of seven samples was received on 21 December 2021. Virus isolation and typing revealed that five contained **FMD type O** virus and two **FMD Asia 1** virus. Genotyping showed that the type O viruses belonged to the O/ME-SA/PanAsia-2/ANT-10 sublineage, while the Asia 1's belonged to the ASIA/Sindh-08 lineage.

A second batch of 50 samples was received on the 4 February 2022. Typing results were as follows: **FMD type O**: 19; **FMD type A**: 4; **FMD type Asia 1**: 12; FMDV-GD: 13; and NVD: 2. Genotyping showed that the type O viruses belonged to the O/ME-SA/PanAsia-2^{ANT-10} sublineage; the type A viruses belonged to the A/ASIA/Iran-05^{FAR-11} sublineage; and the Asia 1 viruses belonged to the ASIA/Sindh-08 lineage.

The State of Palestine



A further outbreak of **FMD type O** was reported on 3 January 2022 in cattle in Jericho governorate (Marj Na'je).

More than 200 000 sheep and cows have been vaccinated in the West Bank and in mid-March it was announced that livestock markets would close for a month in an effort to control and contain the spread of an outbreak of FMD that started in December 2021.

ProMED post: 20220123.8701032 and 20220312.8701947

FAO Eu-FMD FAST report Jan-Mar 2022

The Russian Federation

On 20 December 2021, an outbreak of **FMD type O** was reported in cattle close to the border with Kazakhstan in Karagach, Belyaevskiy raion, Orenburg oblast. A VP1 sequence was provided by the FGBI ARRIAH and genotyping showed that the virus belonged to the O/ME-SA/Ind-2001e sublineage, most closely related to the FMD virus sequence from Kazakhstan described above.

The government of the Saratov Region has allocated 10 Million Rubles from its reserve fund for the emergency vaccination of animals connected with the recent outbreak of FMD in the Orenburg region and Kazakhstan.

ProMED post: 20220113.8700835

Temporary restrictions on the import of goods from Jordan, The State of Palestine and Kazakhstan due to recent FMD outbreaks have been imposed. Russia has also announced a ban on the transit of live animals susceptible to Foot-and-Mouth Disease.

ProMED post: 20220123.8701032

The Republic of Turkey

During this quarter there were 15 outbreaks of FMD in the Anatolia region. These were typed as O/ME-SA/PanAsia-2^{QOM-15}.

Across Turkey more than 130,000 animals were clinically examined for signs of FMD and over 1000 serum samples collected as part of the Thrace RBSP. The spring preventative-vaccination campaign commenced in February and achieved > 95 percent coverage in large ruminants in eastern and southeastern Turkey. In other areas of the country it is expected to be completed by mid-April.

FAO Eu-FMD FAST report Jan-Mar 2022

3.5. Pool 4 (North and Eastern Africa)

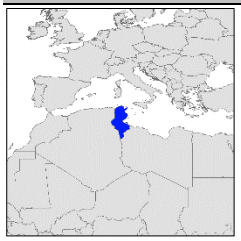
The Arab Republic of Egypt

There were 4 confirmed cases of FMD in Egypt this quarter.

Samples were also collected for post-vaccination monitoring across five Governates (results are pending) and a new vaccination campaign started in mid-March

FAO Eu-FMD FAST report Jan-Mar 2022

The Republic of Tunisia



Three **FMD type O** virus isolates were received from ANSES on 16 March 2022. Genotyping revealed they belonged to the O/EA-3 topotype. Two batches of **FMD type O** VP1 sequences were submitted by ANSES on 14 January 2022 (n=2) and 3 February 2022 (n=13). All belonged to the O/EA-3 topotype.

An outbreak of FMD serotype O (topotype EA-3) starting on 4 January from the governorate of Ben Arous and later Monastir, Kassérine and Tunis was reported to the OIE (OIE event ID: evt_4232).

By the end of March perifocal vaccination in response to the outbreaks and the start of the annual mass vaccination campaign has achieved 27 percent coverage in cattle and 23.8 percent in small ruminants.

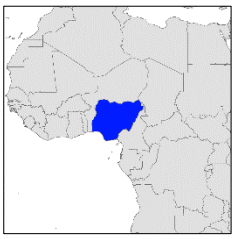
OIE World Animal Health Information System

ProMED post: 20220125.8701061

FAO Eu-FMD FAST report Jan-Mar 2022

3.6. Pool 5 (West/Central Africa)

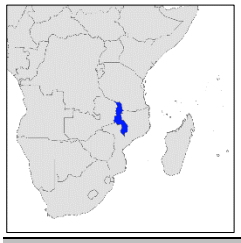
The Federal Republic of Nigeria



A batch of 13 samples was received on 21 December 2021. **FMD type O** was identified in 10 samples, while two were FMDV-GD and one was NVD. Genotyping reveals that all of the isolates belonged to the O/EA-3 topotype.

3.7. Pool 6 (Southern Africa)

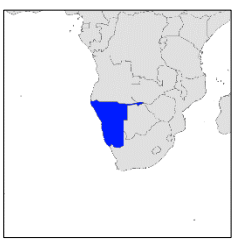
The Republic of Malawi



An outbreak of FMD was reported on 4 February 2022 in cattle at Lifiledi village (Central region), close to the border with Zambia. (OIE event ID: evt_4325).

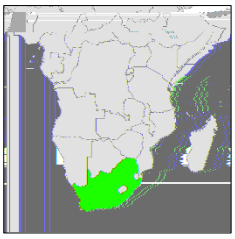
OIE World Animal Health Information System

The Republic of Namibia



Four FMD type O VP1 sequences were submitted by the BVI on 8 March 2022. All belonged to the O/EA-2 topotype and were identical to the previous sequence submitted (data not shown. WRLMEG/2022/00009 in Table 3 below).

The Republic of South Africa



A further 10 outbreaks of FMD type SAT 2 were reported in cattle in KwaZulu-Natal.

Following an outbreak of FMD in KwaZulu-Natal in May 2021 (OIE event ID: evt_3738) a Disease Management Area (DMA) was put in place on 30 June 2021. It was reduced in size in September 2021. After 6 months of monitoring with no active spread, two of the originally affected locations were removed from the list of affected locations. However, following the detection of FMD in the reduced size DMA, a new location was added. This new outbreak then spread through the northern part of KwaZulu-Natal during March.

OIE World Animal Health Information System

ProMED post: 20220208.8701324 and 20220320.8702090

In mid-March cases of FMD were reported in a farm from the area between Potchefstroom and Ventersdorp, North-West Province (OIE event ID: evt_4368). The farm (and other linked farms) were immediately placed under quarantine and surveillance in the area was begun.

OIE World Animal Health Information System

ProMED post: 20220320.8702090 and 20220323.8702168

3.8. Pool 7 (South America)

No new outbreaks of FMD were reported in South America.

3.9. Extent of global surveillance

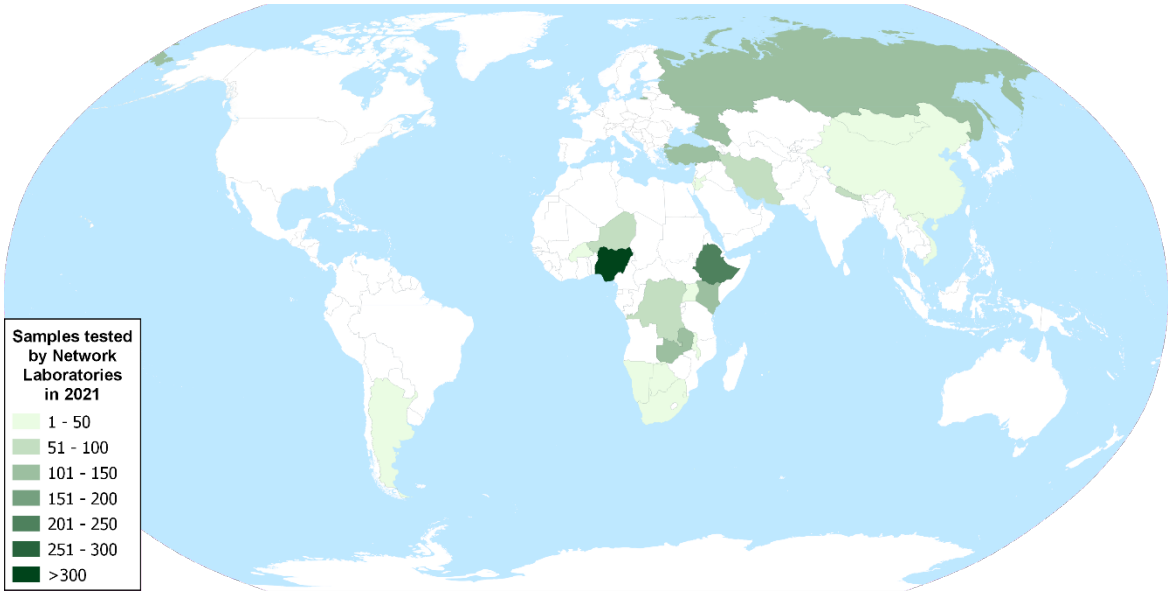


Figure 3: Samples received during 2021 from FMD outbreaks (routine surveillance that is undertaken in countries that are FMD-free without vaccination is not shown). Data from presentations given at the OIE/FAO Reference laboratory Network annual meeting (https://www.foot-and-mouth.org/Ref-Lab-Network/Network-Annual-Meeting). Source: WRLFMD. Map conforms to the United Nations World map, June 2020.

In regions where FMD is endemic, continuous evolution of the virus generates geographically discrete lineages that are genetically distinct from FMD viruses found elsewhere. This report displays how different FMD lineages circulate in different regions; these analyses accommodate the latest epidemiological intelligence to assess the relative importance of the viral strains circulating within each region (see Table 1, below).

Table 1: Conjectured relative prevalence of circulating FMD viral lineages in each Pool. For each of the regions, data represent the relative importance of each viral lineage [prevalence score estimated as a percentage (%) of total FMD cases that occur in domesticated hosts]. These scores (reviewed at the OIE/FAO FMD Laboratory Network meeting in December 2021) can be used to inform the PRAGMATIST tool (see Annex 3). Recent changes to increase risks are shown in **red**, while a reduction in risk is shown in **green**.

Lineage	Southeast / Central / East Asia [Pool 1]	South Asia [Pool 2]	West Eurasia & Middle 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			35					
O ME-SA PanAsia	10							
O SEA Mya-98	**21.5**							
O ME-SA Ind2001	**40**	**86**[1]	7	**2**				
O EA or O WA			3	55	**55.5**	**65**	16	
O EURO-SA								**90**
O CATHAY	10.5							
A ASIA Sea-97	**18**							
A ASIA Iran-05	0		**32**					
A ASIA G-VII		**10**	**10**					
A AFRICA				**33**	22	**17**		
A EURO-SA								**10**
Asia-1	**0**	4	12.5					
SAT 1				0	8	3	**16**	
SAT 2			0.5	10	14	**15**	**52**	
SAT 3					**0.5**		16	
C								

[1] includes cases due to the emerging O/ME-SA/SA-18 lineage that has been recently detected in Pool 2

A number of outbreaks have occurred where samples have not been sent to the WRLFMD or other laboratories in the OIE/FAO FMD Laboratory Network. An up-to-date list and reports of FMD viruses characterised by sequencing can be found at the following website: http://www.wrlfmd.org/country-reports/country-reports-2021.

Results from samples or sequences received at WRLFMD (status of samples being tested) are shown in Table 2 and a complete list of clinical sample diagnostics made by the WRLFMD from January to March 2022 is shown in Annex 1: (Summary of submissions). A record of all samples received by WRLFMD is shown in Annex 1: (Clinical samples).

Table 2: Status of sequencing of samples or sequences received by the WRLFMD from January to March 2022 (* indicates a batch carried over from the previous quarter).

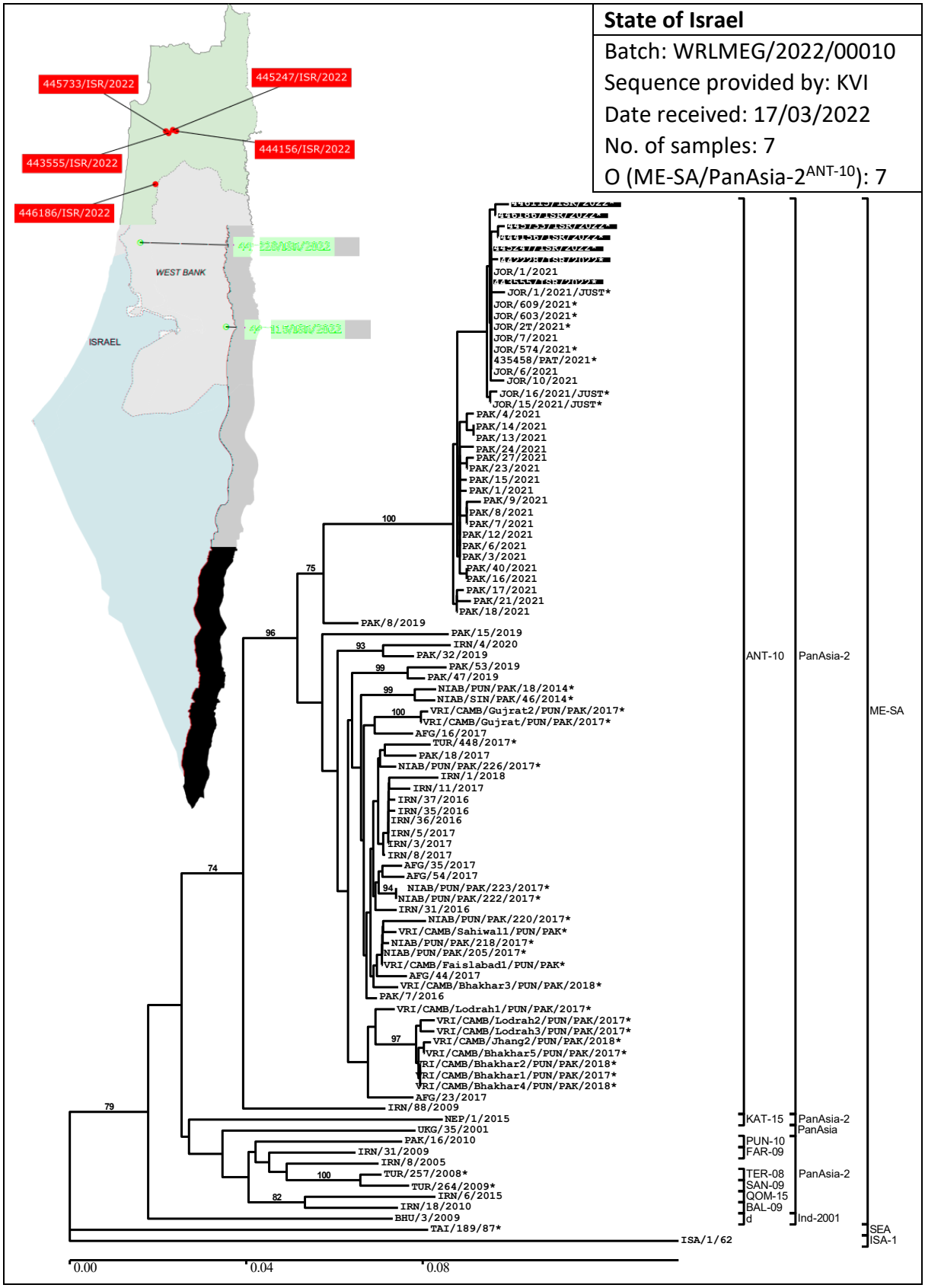
WRLFMD Batch No.	Date received	Country	Total No. samples	Serotype	No. of samples	No. of sequences	Sequencing status
WRLFMD/2021/00017	20/12/2021	Jordan	13	O	7	7	Finished
				FMDV-GD	4	-	
				NVD	2	-	
WRLFMD/2021/00018	21/12/2021	Nigeria	13	O	10	10	Finished
				FMDV-GD	2	-	
				NVD	1	-	
WRLFMD/2021/00019	21/12/2021	Pakistan	7	O	5	5	Finished
				Asia 1	2	2	Finished
WRLFMD/2022/00001	04/02/2022	Pakistan	50	O	19	19	Finished
				A	4	4	Finished
				Asia 1	12	12	Finished
				FMDV-GD	13	-	
				NVD	2	-	
WRLFMD/2022/00004	16/03/2022	Tunisia	3	O	3	3	Finished
Totals			**86**		**86**	**62**	

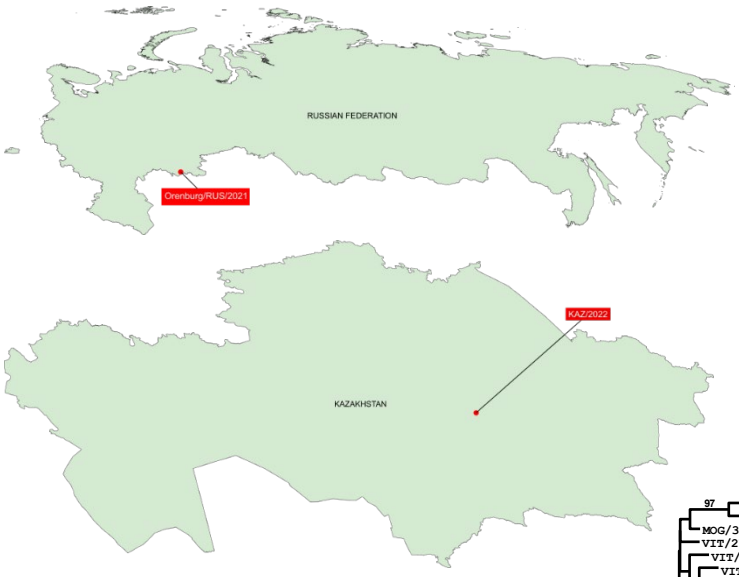
Table 3: VP1 sequences submitted by other FMD Network laboratories to the WRLFMD from January to March 2022.

WRLFMD Batch No.	Date received	Country	Serotype	Date Collected	No. of sequences	Submitting laboratory
WRLMEG/2022/00004	14/01/2022	Tunisia	O	04/01/2022	2	ANSES
WRLMEG/2022/00005	18/01/2022	Russia	O	18/01/2022	1	ARRIAH
WRLMEG/2022/00006	03/02/2022	Tunisia	O	03/02/2022	13	ANSES
WRLMEG/2022/00007	14/02/2022	Kazakhstan	O	14/02/2022	1	ARRIAH
WRLMEG/2022/00009	08/03/2022	Namibia	O	08/03/2022	4	BVI
WRLMEG/2022/00010	17/03/2022	Israel	O	17/03/2022	7	KVI
				Total	**28**	

4. Detailed analysis

4.1. Pool 3 (West Eurasia and Middle East)



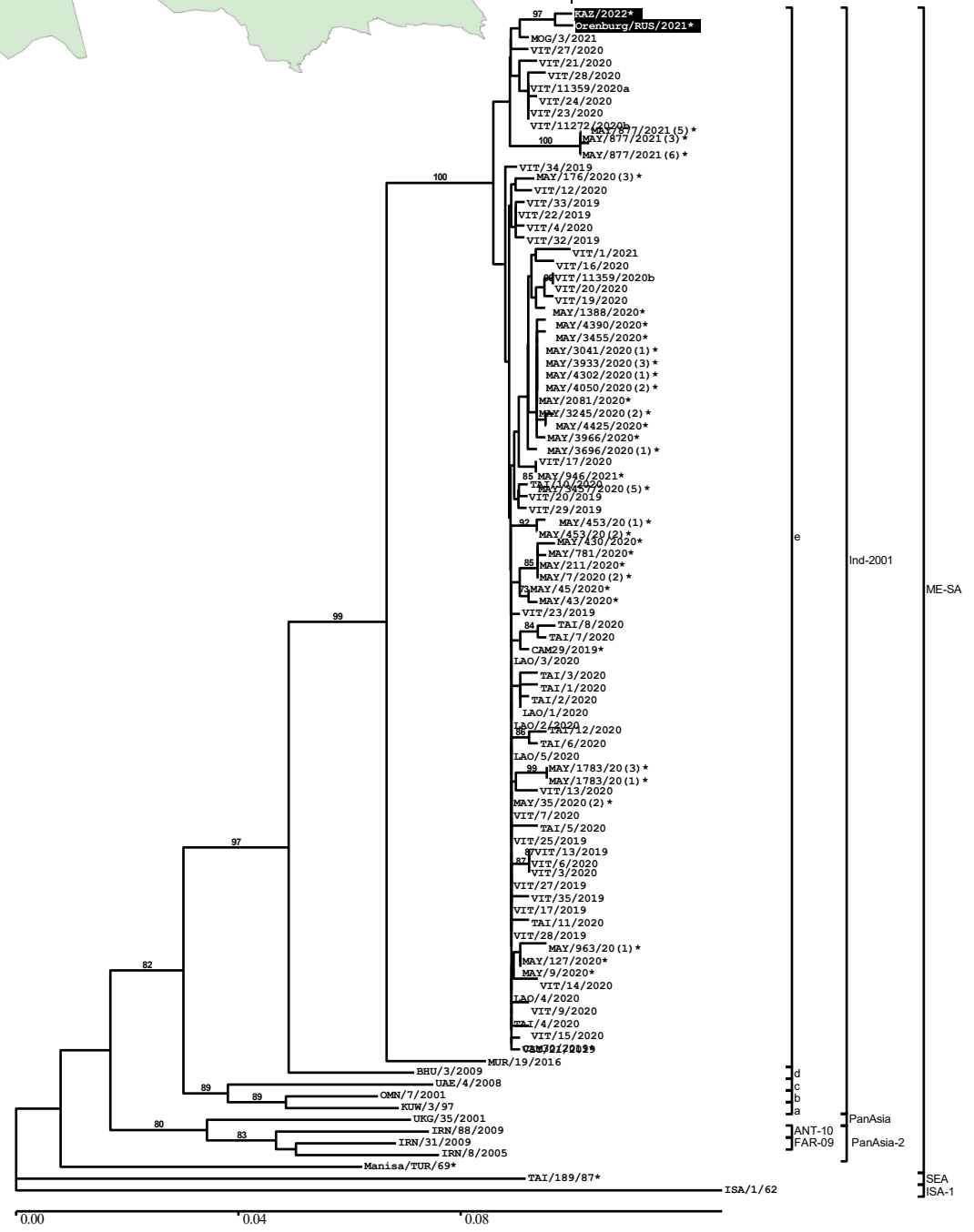


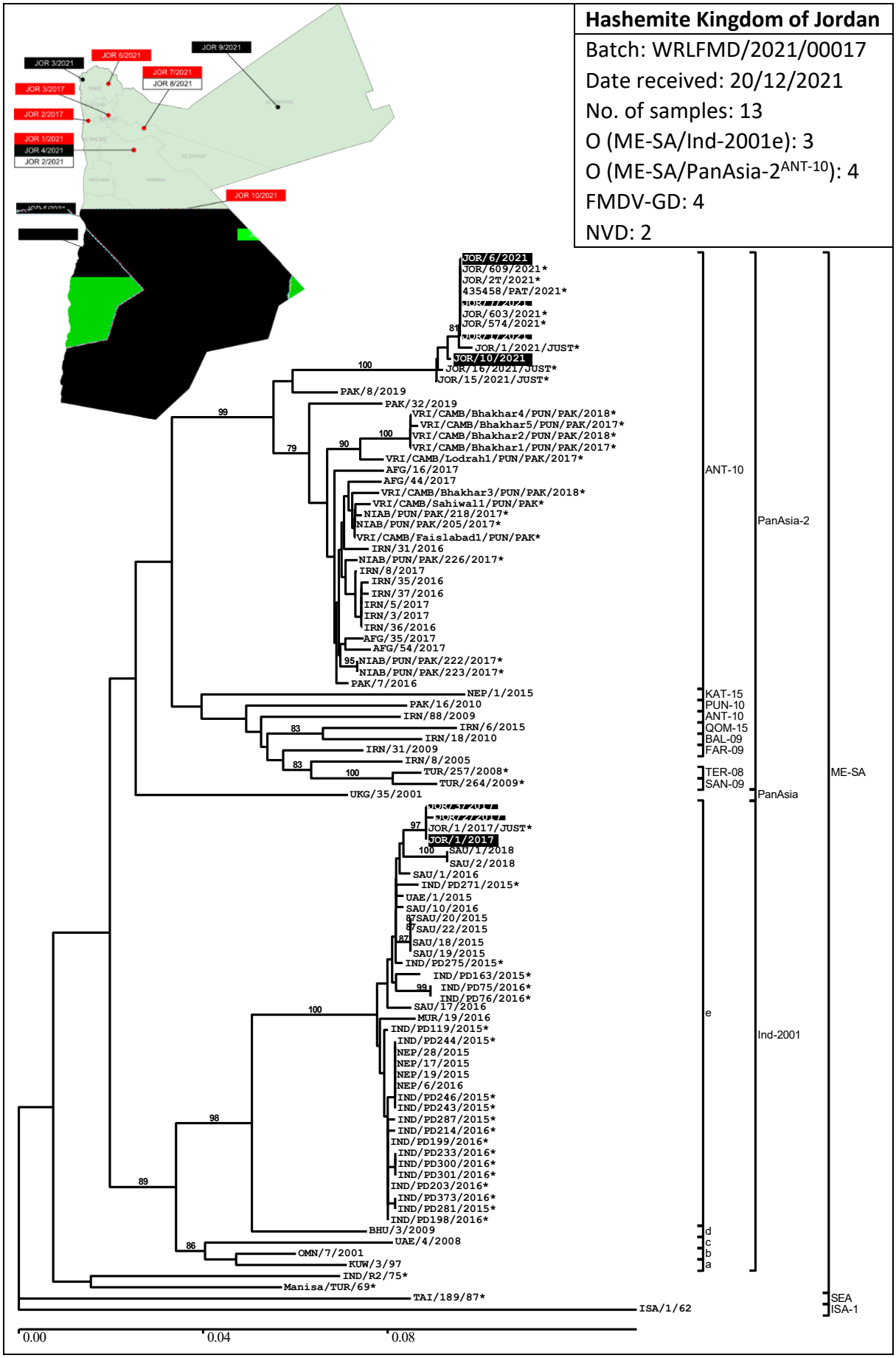
Russian Federation

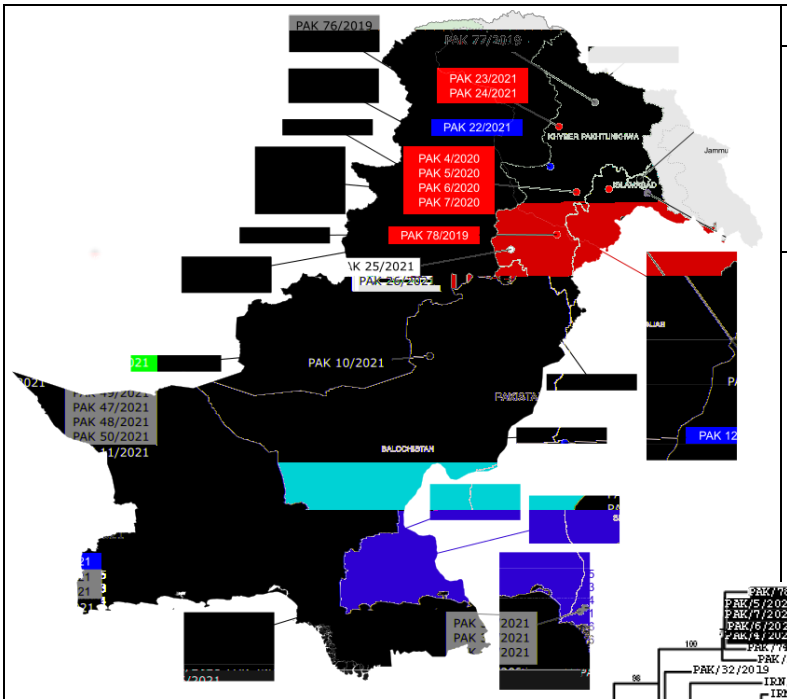
Batch: WRLMEG/2022/00005
Sequence provided by: ARRIAH
Date received: 18/01/2022
No. of samples: 1
O (ME-SA/Ind-2001e): 1

Republic of Kazakhstan

Batch: WRLMEG/2022/00007
Sequence provided by: ARRIAH
Date received: 14/02/2022
No. of samples: 1
O (ME-SA/Ind-2001e): 1



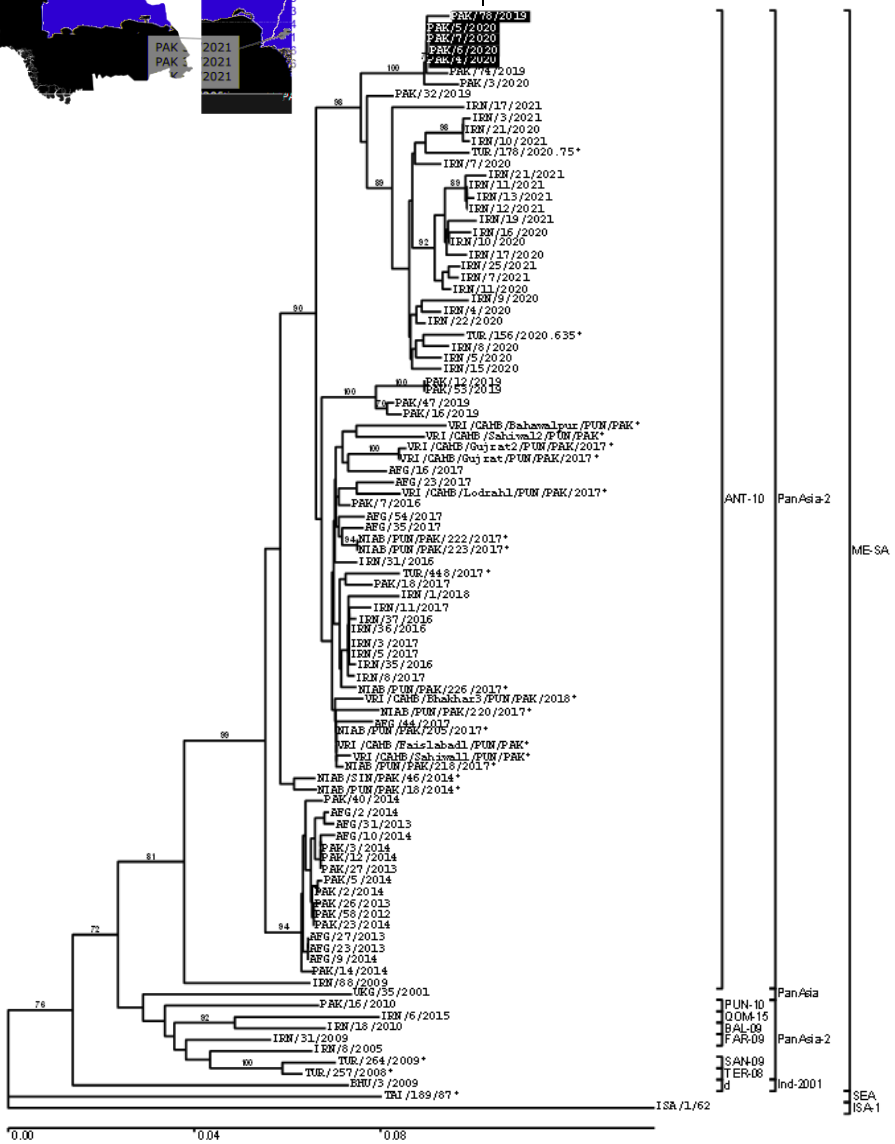

Hashemite Kingdom of Jordan
Batch: WRLFMD/2021/00017
Date received: 20/12/2021
No. of samples: 13
O (ME-SA/Ind-2001e): 3
O (ME-SA/PanAsia-2ANT-10): 4
FMDV-GD: 4
NVD: 2
JOR 3/2021
JOR 6/2021
JOR 9/2021
JOR 7/2021
JOR 8/2021
JOR 3/2017
JOR 2/2017
JOR 1/2021
JOR 4/2021
JOR 2/2021
JOR 10/2021
JOR/6/2021
JOR/609/2021*
JOR/2T/2021*
435458/PAT/2021*
JOR/603/2021*
JOR/574/2021*
JOR/1/2021/JUST*
JOR/10/2021
JOR/16/2021/JUST*
JOR/15/2021/JUST*
PAK/8/2019
PAK/32/2019
VRI/CAMB/Bhakhar4/PUN/PAK/2018*
VRI/CAMB/Bhakhar5/PUN/PAK/2017*
VRI/CAMB/Bhakhar2/PUN/PAK/2018*
VRI/CAMB/Bhakhar1/PUN/PAK/2017*
VRI/CAMB/Lodrah1/PUN/PAK/2017*
AFG/16/2017
AFG/44/2017
VRI/CAMB/Bhakhar3/PUN/PAK/2018*
VRI/CAMB/Sahiwal1/PUN/PAK*
NIAB/PUN/PAK/218/2017*
NIAB/PUN/PAK/205/2017*
VRI/CAMB/Faislabad1/PUN/PAK*
IRN/31/2016
NIAB/PUN/PAK/226/2017*
IRN/8/2017
IRN/35/2016
IRN/37/2016
IRN/5/2017
IRN/3/2017
IRN/36/2016
AFG/35/2017
AFG/54/2017
NIAB/PUN/PAK/222/2017*
NIAB/PUN/PAK/223/2017*
PAK/7/2016
NEP/1/2015
PAK/16/2010
IRN/88/2009
IRN/6/2015
IRN/18/2010
IRN/31/2009
IRN/8/2005
TUR/257/2008*
TUR/264/2009*
UKG/35/2001
JOR/1/2017
JOR/1/2017/JUST*
SAU/1/2018
SAU/2/2018
SAU/1/2016
IND/PD271/2015*
UAE/1/2015
SAU/10/2016
SAU/20/2015
SAU/22/2015
SAU/18/2015
SAU/19/2015
IND/PD275/2015*
IND/PD163/2015*
IND/PD75/2016*
IND/PD76/2016*
SAU/17/2016
MUR/19/2016
IND/PD119/2015*
IND/PD244/2015*
NEP/28/2015
NEP/17/2015
NEP/19/2015
NEP/6/2016
IND/PD246/2015*
IND/PD243/2015*
IND/PD287/2015*
IND/PD214/2016*
IND/PD199/2016*
IND/PD233/2016*
IND/PD300/2016*
IND/PD301/2016*
IND/PD203/2016*
IND/PD373/2016*
IND/PD281/2015*
IND/PD198/2016*
BHU/3/2009
UAE/4/2008
OMN/7/2001
KUW/3/97
IND/R2/75*
Manisa/TUR/69*
TAI/189/87*
ISA/1/62
0.00
0.04
0.08
ANT-10
KAT-15
PUN-10
ANT-10
QOM-15
BAL-09
FAR-09
TER-08
SAN-09
e
d
c
b
a
PanAsia-2
PanAsia
Ind-2001
ME-SA
SEA
ISA-1



Islamic Republic of Pakistan

Batch: WRLFMD/2021/00019
Date received: 21/12/2021
No. of samples: 7
O (ME-SA/PanAsia-2^{ANT-10}): 5
Asia1 (ASIA/Sindh-08): 2

Batch: WRLFMD/2022/00001
Date received: 04/02/2022
No. of samples: 50
O (ME-SA/PanAsia-2^{ANT-10}): 19
A (ASIA/Iran-05^{FAR-11}): 4
Asia1 (ASIA/Sindh-08): 12
FMDV-GD: 13
NVD: 2



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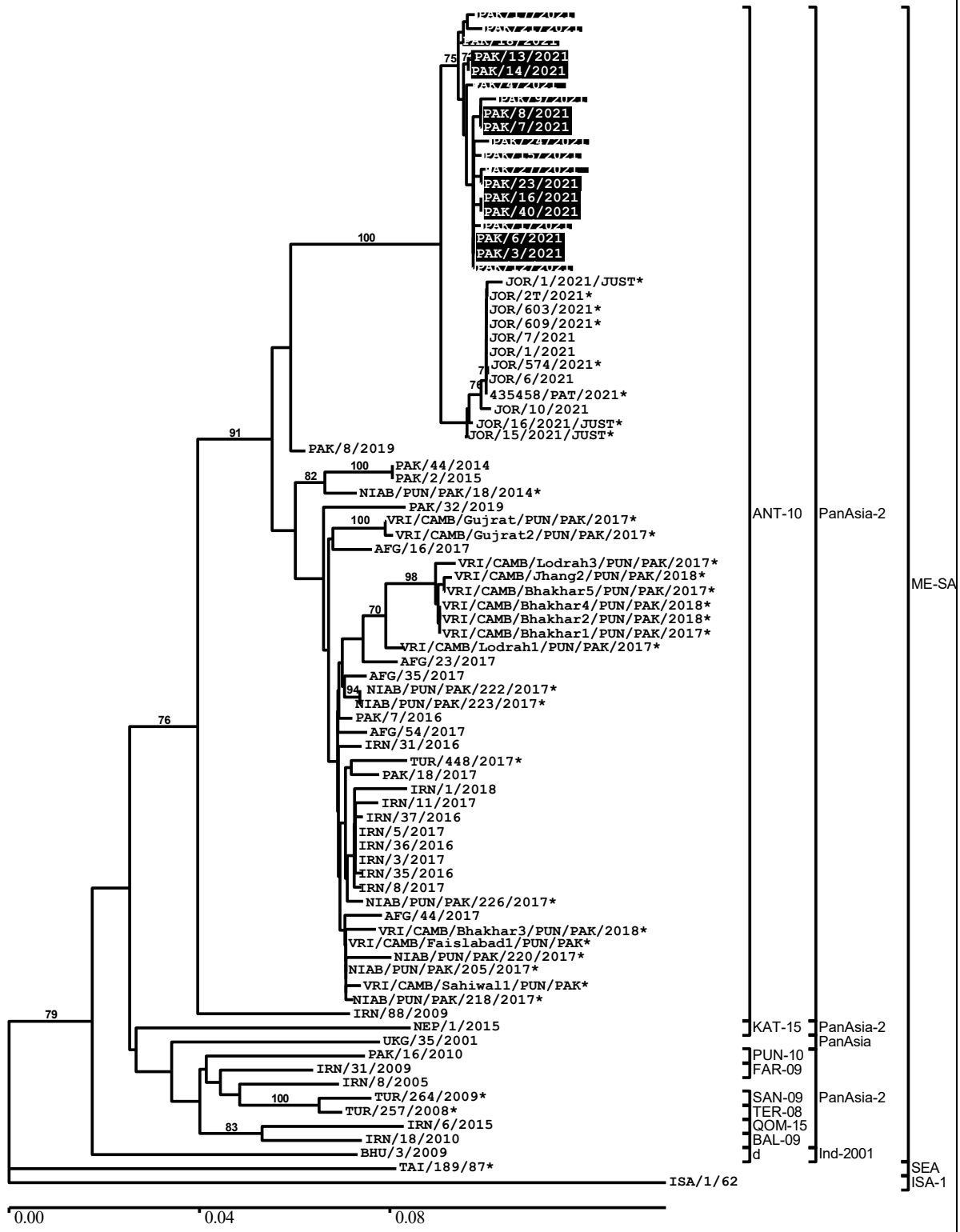
Pakistan continued



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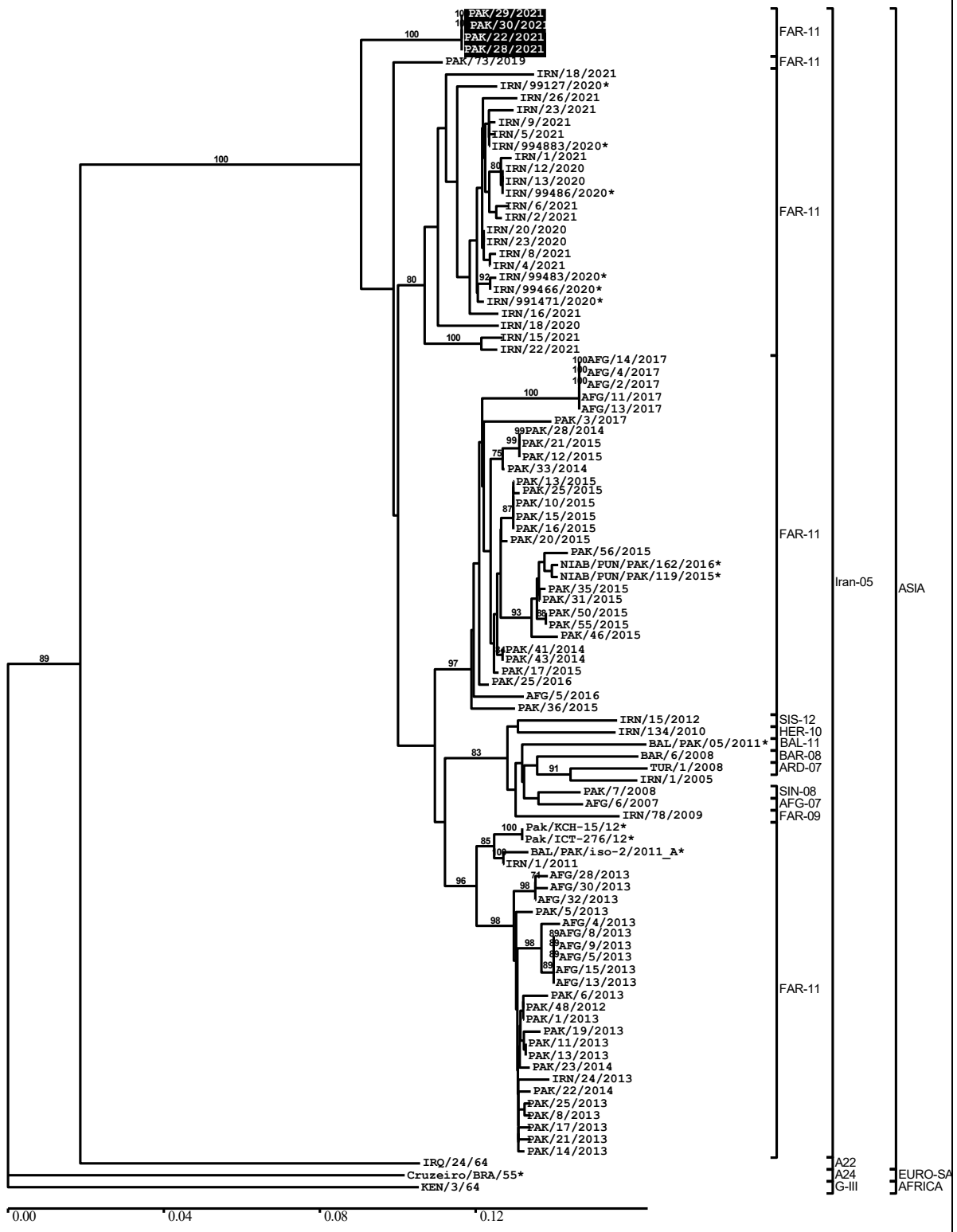

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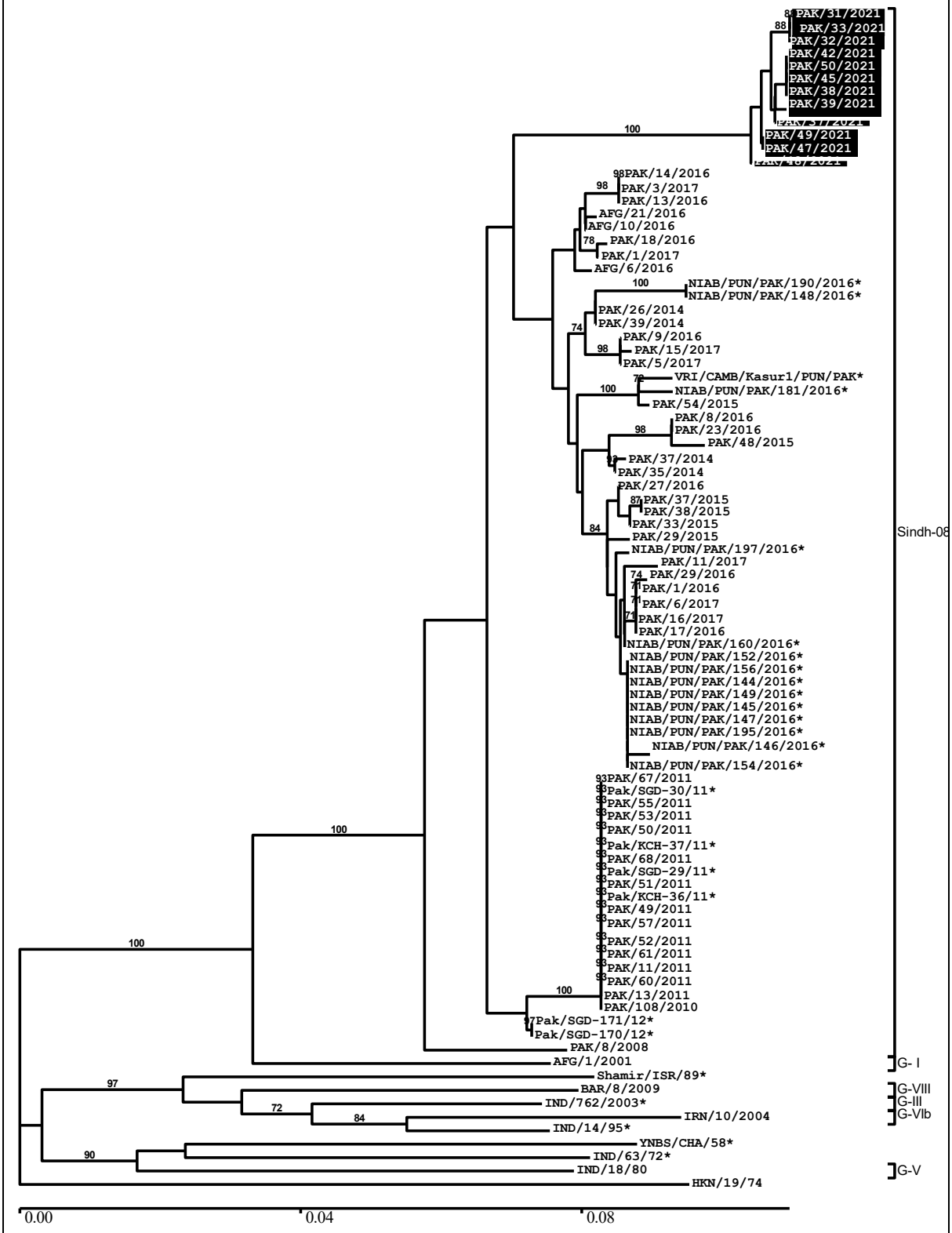
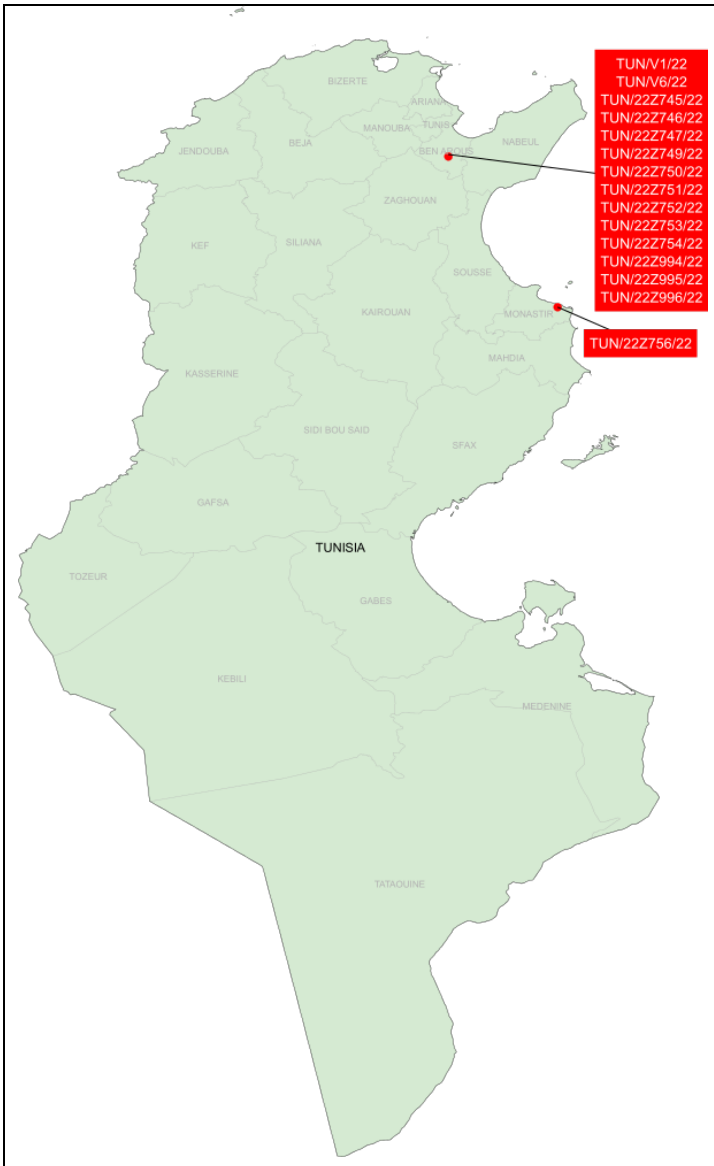
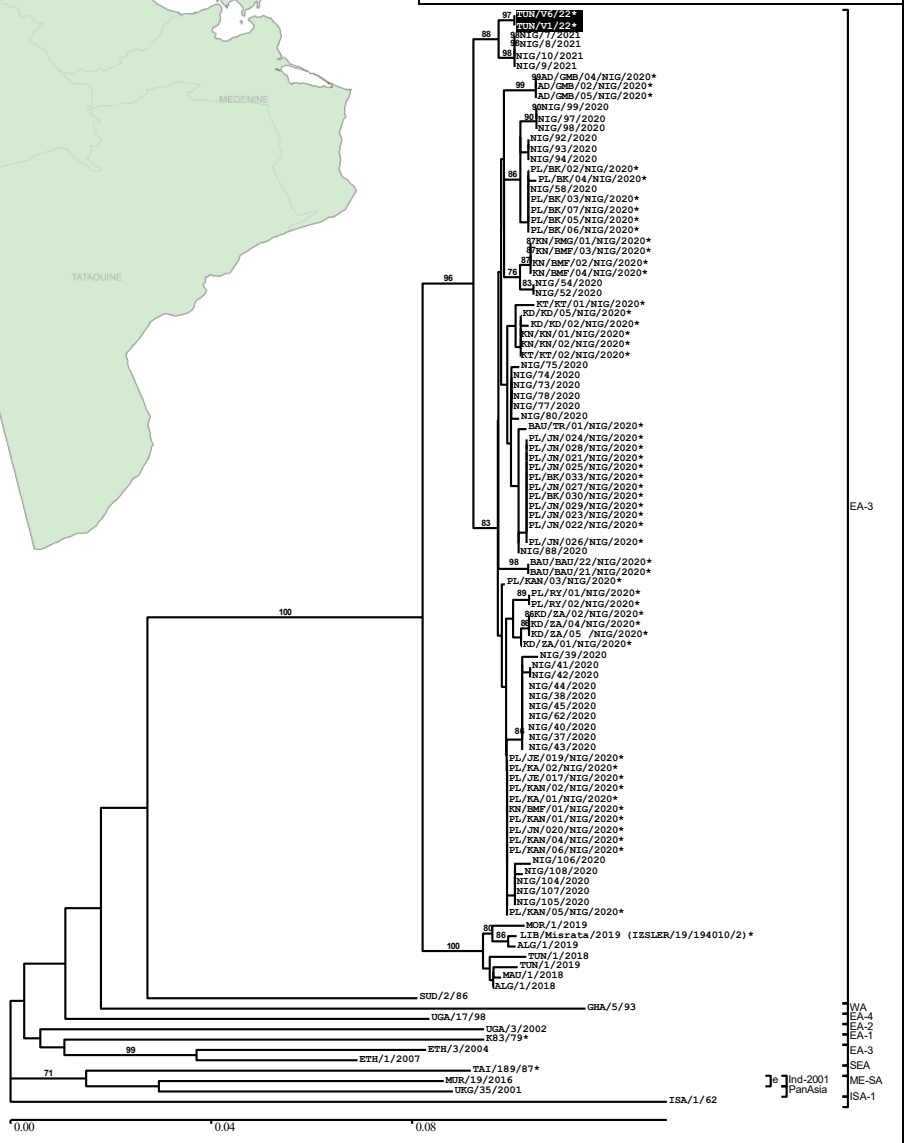


4.2. Pool 4 (North and East Africa)

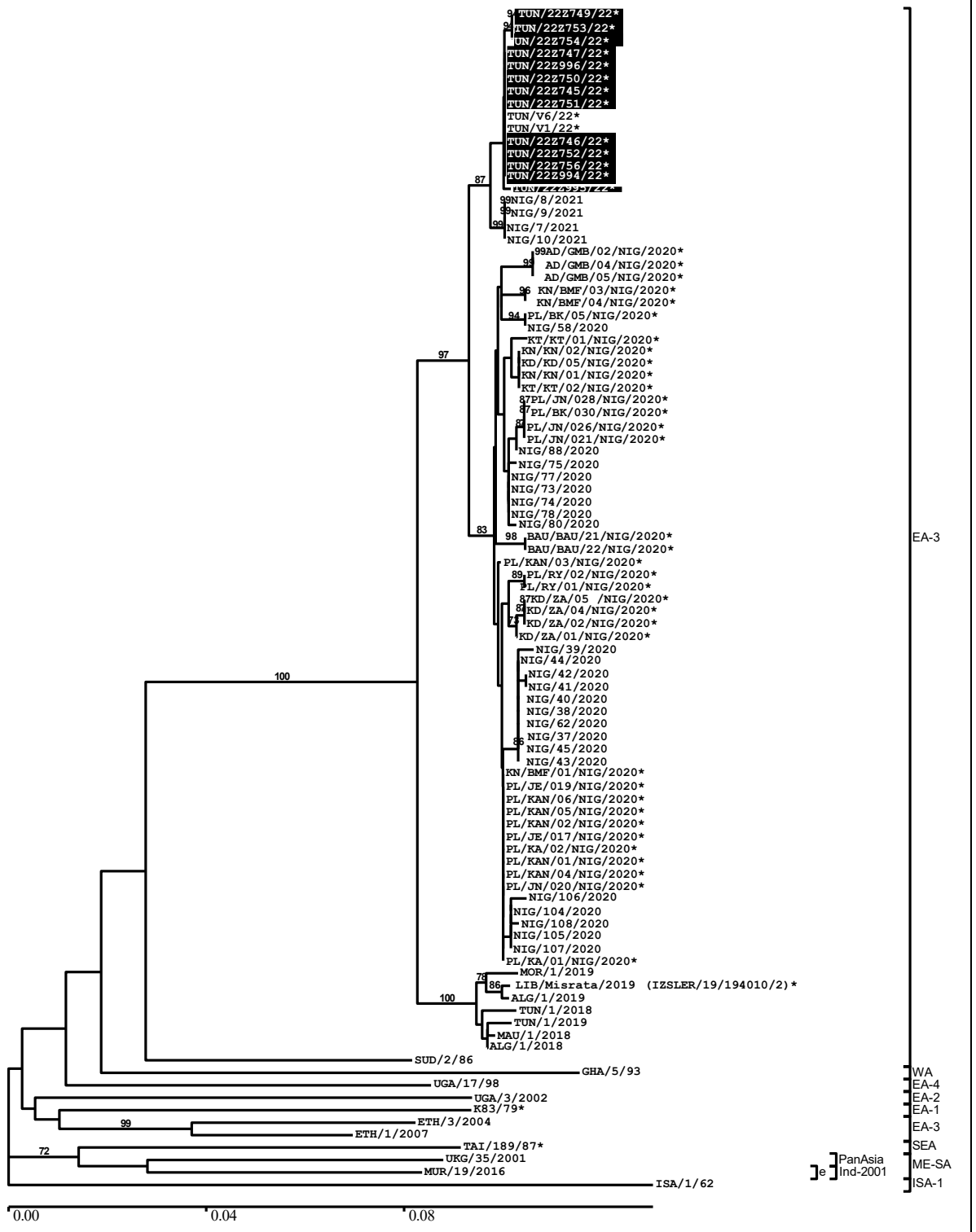


Republic of Tunisia
Batch: WRLFMD/2022/00004 Date received: 16/03/2022 No. of samples: 3 O (EA-3): 3
Batch: WRLMEG/2022/00004 Sequence provided by: ANSES Date received: 14/01/2022 No. of samples: 2 O (EA-3): 2
Batch: WRLMEG/2022/00006 Sequence provided by: ANSES Date received: 03/02/2022 No. of samples: 13 O (EA-3): 13

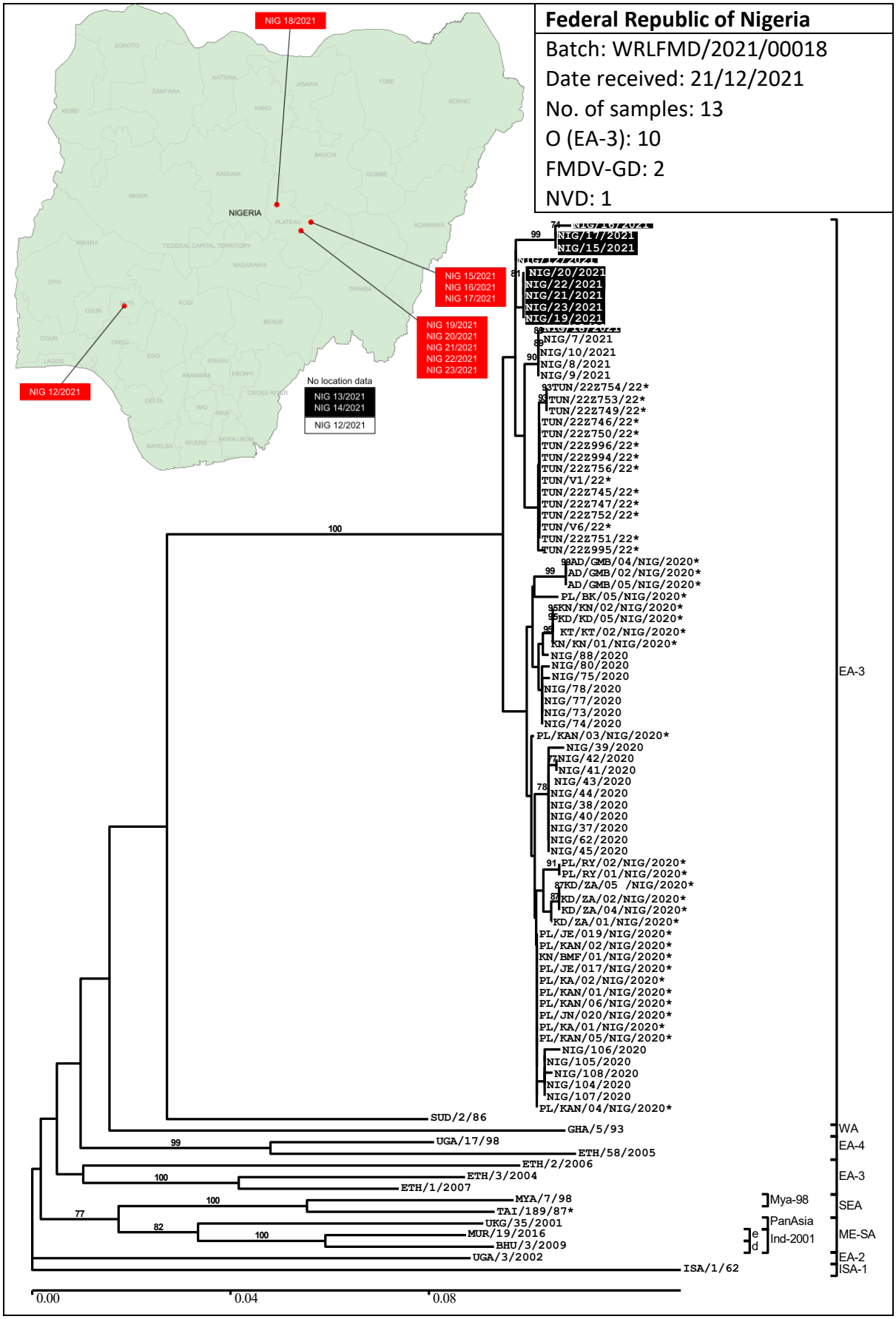


Tunisia continued on next page

Tunisia continued



4.3. Pool 5 (West Africa)



4.4. Vaccine matching

Antigenic characterisation of FMD field isolates by matching with vaccine strains by 2dmVNT from January to March 2022.

NOTES:

1. Vaccine efficacy is influenced by vaccine potency, antigenic match and vaccination regime. Therefore, it is possible that a less than perfect antigenic match of a particular antigen may be compensated by using a high potency vaccine and by administering more than one vaccine dose at suitable intervals. Thus, a vaccine with a weak antigenic match to a field isolate, as determined by serology, may nevertheless afford some protection if it is of sufficiently high potency and is administered under a regime to maximise host antibody responses (Brehm, 2008).
2. Vaccine matching data generated in this report only considers antibody responses in cattle after a single vaccination (typically 21 days after vaccination). The long-term performance of FMD vaccines after a second or multiple doses of vaccine should be monitored using post-vaccination serological testing.

Table 4: Summary of samples tested by vaccine matching

Serotype	O	A	C	Asia-1	SAT 1	SAT 2	SAT 3
Congo, Democratic Republic of	2	-	-	-	-	-	-
Jordan	4	-	-	-	-	-	-
Nepal	2	1	-	-	-	-	-
Nigeria	6	3	-	-	-	3	-
Pakistan	2	-	-	2	-	-	-
Uganda	2	-	-	-	-	-	-
Total	**18**	**4**	**0**	**2**	**0**	**3**	**0**

Abbreviations used in tables

For each field isolate the r_1 value is shown followed by the heterologous neutralisation titre (r_1-value / titre). The r_1 values shown below, represent the one-way serological match between vaccine strain and field isolate, calculated from the comparative reactivity of antisera raised against the vaccine in question. Heterologous neutralisation titres for vaccine sera with the field isolates are included as an indicator of cross-protection.

M	**Vaccine Match** *r_1 = ≥ 0.3 - suggests that there is a close antigenic relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.*
N	**No Vaccine Match** *r_1 = < 0.3* - suggest that the field isolate is antigenically different to the vaccine strain. Where there is no alternative, the use of this vaccine should carefully consider vaccine potency, the possibility to use additional booster doses and monitoring of vaccinated animals for heterologous responses.
NT	**Not tested against this vaccine**

NOTE: A "0" in the neutralisation columns indicates that for that particular field virus no neutralisation was observed at a virus dose of a 100 $TCID_{50}$.

NOTE: This report includes the source of the vaccine virus and bovine vaccinal serum. Vaccines from different manufactures may perform differently and caution should be taken when comparing the data.

Table 5: Vaccine matching studies for O FMDV

Isolate	Serotype O		O 3039 *Boehringer Ingelheim*		O Campos *Boehringer Ingelheim*		O_1 Campos *Biogénesis Bagó*		O Manisa *Boehringer Ingelheim*		PanAsia 2 *Boehringer Ingelheim*		O/TUR/5/09 *MSD*	
	Topotype	Lineage	r_1	*titre*	r_1	*titre*	r_1	*titre*	r_1	*titre*	r_1	*titre*	r_1	*titre*
COD 40/2021	EA-2	-	0.47	*1.71*	NT	-	0.68	*2.62*	0.18	*1.88*	0.30	*1.95*	0.63	*2.08*
COD 76/2021	EA-2	-	1.00	*2.14*	NT	-	0.76	*2.67*	0.46	*2.28*	1.00	*2.47*	0.91	*2.24*
UGA 20/2020	EA-2	-	0.83	*2.10*	NT	-	0.76	*2.55*	0.45	*2.22*	0.59	*2.29*	0.79	*2.21*
UGA 25/2020	EA-2	-	0.68	*2.01*	NT	-	0.65	*2.48*	0.39	*2.16*	0.60	*2.30*	0.48	*1.99*
NIG 38/2020	EA-3	-	0.37	*1.68*	NT	-	0.63	*2.65*	0.45	*2.20*	0.44	*2.17*	0.54	*0.21*
NIG 46/2020	EA-3	-	0.35	*1.65*	NT	-	0.56	*2.60*	0.17	*1.78*	0.30	*2.00*	0.62	*2.16*
NIG 8/2021	EA-3	-	0.51	*1.82*	NT	-	1.00	*2.88*	0.55	*2.29*	0.48	*2.21*	0.85	*2.30*
NIG 12/2021	EA-3	-	0.69	*2.07*	NT	-	0.72	*2.72*	0.41	*2.22*	0.33	*2.19*	0.60	*2.37*
NIG 16/2021	EA-3	-	0.49	*1.92*	NT	-	0.66	*2.68*	0.38	*2.19*	0.40	*2.27*	0.48	*2.27*
NIG 18/2021	EA-3	-	0.59	*2.00*	NT	-	0.81	*2.77*	0.81	*2.52*	0.35	*2.21*	0.51	*2.30*
JOR 1/2017	ME-SA	Ind-2001	0.87	*1.95*	0.42	*2.06*	0.54	*2.62*	0.72	*2.42*	0.68	*2.29*	0.72	*2.34*
JOR 3/2017	ME-SA	Ind-2001	0.72	*1.88*	0.34	*1.97*	0.46	*2.55*	0.48	*2.24*	0.48	*2.14*	0.50	*2.18*
NEP 25/2021	ME-SA	Ind-2001	0.59	*1.88*	0.21	*1.98*	0.58	*2.58*	0.46	*2.14*	NT	-	1.00	*2.39*
NEP 55/2021	ME-SA	Ind-2001	0.54	*1.84*	0.15	*1.82*	0.43	*2.45*	0.45	*2.13*	NT	-	0.60	*2.12*
JOR 6/2021	ME-SA	PanAsia-2	0.38	*1.54*	0.17	*1.73*	0.25	*2.24*	0.19	*1.82*	0.30	*1.95*	0.56	*2.12*
JOR 10/2021	ME-SA	PanAsia-2	0.37	*1.53*	0.22	*1.85*	0.18	*2.09*	0.11	*1.61*	0.23	*1.84*	0.35	*1.92*
PAK 78/2019	ME-SA	PanAsia-2	0.33	*1.56*	0.36	*1.97*	0.40	*2.24*	0.32	*2.03*	0.41	*2.14*	0.49	*1.99*
PAK 4/2020	ME-SA	PanAsia-2	0.11	*1.10*	0.26	*1.83*	0.39	*2.41*	0.07	*1.41*	0.34	*2.06*	0.59	*2.07*

Table 6: Vaccine matching studies for A FMDV

Isolate	Serotype A		A22 Iraq *Boehringer Ingelheim*		A Eritrea 98 *Boehringer Ingelheim*		A GVII 2015 *Boehringer Ingelheim*		A Malaysia 97 *Boehringer Ingelheim*		A Saudi 95 *Boehringer Ingelheim*		A/TUR/20/06 *MSD*	
	Topotype	Lineage	r_1	*titre*	r_1	*titre*	r_1	*titre*	r_1	*titre*	r_1	*titre*	r_1	*titre*
NIG 16/2020	AFRICA	G-IV	0.55	*2.34*	0.43	*2.42*	0.19	*1.35*	NT	-	0.51	*2.19*	0.09	*1.04*
NIG 86/2020	AFRICA	G-IV	0.13	*1.72*	0.22	*2.13*	0	*0*	NT	-	0.37	*2.05*	0.08	*0.97*
NIG 100/2020	AFRICA	G-IV	0.35	*2.14*	0.56	*2.54*	0	*0*	NT	-	0.47	*2.15*	0.13	*1.19*
NEP 5/2021	ASIA	G-VII	0.38	*2.28*	NT	-	0.2	*1.47*	0.15	*1.77*	NT	-	0.41	*1.72*

Table 7: Vaccine matching studies for Asia-1 FMDV

Isolate	Serotype Asia-1		Asia 1 Shamir *Boehringer Ingelheim*	
	Topotype	Lineage	r_1	*titre*
PAK 76/2019	ASIA	Sindh-08	0.45	*2.26*
PAK 77/2019	ASIA	Sindh-08	0.48	*2.29*

Table 8: Vaccine matching studies for SAT 2 FMDV

Isolate	Serotype SAT 2		SAT2 Zim 83 *Boehringer Ingelheim*		SAT2 Eritrea 98 *Boehringer Ingelheim*	
	Topotype	Lineage	r_1	*titre*	r_1	*titre*
NIG 14/2020	VII	-	0.32	*2.03*	0.60	*1.80*
NIG 51/2020	VII	-	0.35	*2.08*	1.00	*2.09*
NIG 1/2021	VII	Lib-12	0.35	*2.03*	0.71	*1.87*

Annex 1: Sample data

Summary of submissions

Table 9: Summary of samples collected and received to WRLFMD (January to March 2022)

Country	Nº of samples	Virus isolation in cell culture/ELISA								RT-PCR for FMD	
		FMD virus serotypes							No Virus Detected		
		O	*A*	*C*	*SAT 1*	*SAT 2*	*SAT 3*	*ASIA-1*		*Positive*	*Negative*
Jordan	13	7	0	0	0	0	0	0	6	11	2
Nigeria	13	10	0	0	0	0	0	0	3	12	1
Pakistan	57	24	4	0	0	0	0	14	15	55	2
TOTAL	83	41	4	0	0	0	0	14	24	78	5

Clinical samples

Table 10: Clinical sample diagnostics made by the WRLFMD January to March 2022

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
Jordan	20/12/2021	24/01/2022	JOR 1/2017	CATTLE	15-Feb-17	O	POS	O
			JOR 2/2017	SHEEP	28-Feb-17	O	POS	O
			JOR 3/2017	SHEEP	05-Mar-17	O	POS	O
			JOR 1/2021	CATTLE	03-Nov-21	O	POS	O
			JOR 2/2021	CATTLE	08-Nov-21	NEG	NEG	NVD
			JOR 3/2021	CATTLE	21-Nov-21	NEG	POS	FMDV GD
			JOR 4/2021	CATTLE	02-Dec-21	NEG	POS	FMDV GD
			JOR 5/2021	SHEEP	06-Dec-21	NEG	POS	FMDV GD
			JOR 6/2021	CATTLE	07-Dec-21	O	POS	O
			JOR 7/2021	CATTLE	08-Dec-21	O	POS	O
			JOR 8/2021	CATTLE	08-Dec-21	NEG	NEG	NVD
			JOR 9/2021	SHEEP	11-Dec-21	NEG	POS	FMDV GD
			JOR 10/2021	SHEEP	13-Dec-21	O	POS	O
Nigeria	21/12/2021	09/02/2022	NIG 11/2021	CATTLE	08-Oct-21	NEG	NEG	NVD
			NIG 12/2021	CATTLE	08-Oct-21	O	POS	O
			NIG 13/2021	CATTLE	08-Oct-21	NEG	POS	FMDV GD
			NIG 14/2021	CATTLE	12-Sep-21	NEG	POS	FMDV GD
			NIG 15/2021	CATTLE	12-Sep-21	O	POS	O
			NIG 16/2021	CATTLE	12-Sep-21	O	POS	O
			NIG 17/2021	CATTLE	12-Sep-21	O	POS	O
			NIG 18/2021	CATTLE	21-Oct-21	O	POS	O

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
			NIG 19/2021	CATTLE	12-Nov-21	O	POS	O
			NIG 20/2021	CATTLE	12-Nov-21	O	POS	O
			NIG 21/2021	CATTLE	12-Nov-21	O	POS	O
			NIG 22/2021	CATTLE	12-Nov-21	O	POS	O
			NIG 23/2021	CATTLE	12-Nov-21	O	POS	O
Pakistan	21/12/2021	04/02/2022	PAK 76/2019	CATTLE	23-May-19	ASIA-1	POS	ASIA-1
			PAK 77/2019	CATTLE	23-May-19	ASIA-1	POS	ASIA-1
			PAK 78/2019	CATTLE	24-Dec-19	O	POS	O
			PAK 4/2020	CATTLE	19-Jan-20	O	POS	O
			PAK 5/2020	CATTLE	20-Jan-20	O	POS	O
			PAK 6/2020	CATTLE	27-Jan-20	O	POS	O
			PAK 7/2020	CATTLE	27-Jan-20	O	POS	O
Pakistan	04/02/2022	03/03/2022	PAK 1/2021	CATTLE	23-Feb-21	O	POS	O
			PAK 2/2021	CATTLE	24-Feb-21	NEG	POS	FMDV GD
			PAK 3/2021	CATTLE	11-Mar-21	O	POS	O
			PAK 4/2021	BUFFALO	11-Mar-21	O	POS	O
			PAK 5/2021	CATTLE	16-Mar-21	NEG	POS	FMDV GD
			PAK 6/2021	CATTLE	30-Mar-21	O	POS	O
			PAK 7/2021	CATTLE	07-Apr-21	O	POS	O
			PAK 8/2021	CATTLE	07-Apr-21	O	POS	O
			PAK 9/2021	CATTLE	08-Apr-21	O	POS	O
			PAK 10/2021	CATTLE	16-Apr-21	NEG	POS	FMDV GD
			PAK 11/2021	CATTLE	23-Apr-21	NEG	POS	FMDV GD
			PAK 12/2021	BUFFALO	23-Apr-21	O	POS	O
			PAK 13/2021	CATTLE	19-May-21	O	POS	O
			PAK 14/2021	CATTLE	20-May-21	O	POS	O
			PAK 15/2021	CATTLE	20-May-21	O	POS	O
			PAK 16/2021	CATTLE	20-May-21	O	POS	O
			PAK 17/2021	CATTLE	29-May-21	O	POS	O
			PAK 18/2021	CATTLE	29-May-21	O	POS	O
			PAK 19/2021	CATTLE	02-Jun-21	NEG	POS	FMDV GD
			PAK 20/2021	CATTLE	02-Jun-21	NEG	POS	FMDV GD
			PAK 21/2021	CATTLE	03-Jun-21	O	POS	O
			PAK 22/2021	CATTLE	15-Jul-21	A	POS	A
			PAK 23/2021	CATTLE	15-Jul-21	O	POS	O
			PAK 24/2021	CATTLE	09-Sep-21	O	POS	O
			PAK 25/2021	CATTLE	09-Sep-21	NEG	NEG	NVD
			PAK 26/2021	BUFFALO	15-Sep-21	NEG	NEG	NVD
			PAK 27/2021	CATTLE	30-Sep-21	O	POS	O
			PAK 28/2021	CATTLE	30-Sep-21	A	POS	A
			PAK 29/2021	CATTLE	30-Sep-21	A	POS	A

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
			PAK 30/2021	CATTLE	30-Sep-21	A	POS	A
			PAK 31/2021	CATTLE	13-Nov-21	ASIA-1	POS	ASIA-1
			PAK 32/2021	CATTLE	13-Nov-21	ASIA-1	POS	ASIA-1
			PAK 33/2021	CATTLE	15-Nov-21	ASIA-1	POS	ASIA-1
			PAK 34/2021	CATTLE	16-Nov-21	NEG	POS	FMDV GD
			PAK 35/2021	CATTLE	16-Nov-21	NEG	POS	FMDV GD
			PAK 36/2021	CATTLE	16-Nov-21	NEG	POS	FMDV GD
			PAK 37/2021	CATTLE	17-Nov-21	ASIA-1	POS	ASIA-1
			PAK 38/2021	CATTLE	18-Nov-21	ASIA-1	POS	ASIA-1
			PAK 39/2021	CATTLE	19-Nov-21	ASIA-1	POS	ASIA-1
			PAK 40/2021	CATTLE	19-Nov-21	O	POS	O
			PAK 41/2021	CATTLE	19-Nov-21	NEG	POS	FMDV GD
			PAK 42/2021	CATTLE	19-Nov-21	ASIA-1	POS	ASIA-1
			PAK 43/2021	CATTLE	19-Nov-21	NEG	POS	FMDV GD
			PAK 44/2021	CATTLE	20-Nov-21	NEG	POS	FMDV GD
			PAK 45/2021	CATTLE	24-Nov-21	ASIA-1	POS	ASIA-1
			PAK 46/2021	CATTLE	24-Nov-21	NEG	POS	FMDV GD
			PAK 47/2021	CATTLE	20-Dec-21	ASIA-1	POS	ASIA-1
			PAK 48/2021	CATTLE	20-Dec-21	ASIA-1	POS	ASIA-1
			PAK 49/2021	CATTLE	20-Dec-21	ASIA-1	POS	ASIA-1
			PAK 50/2021	CATTLE	21-Dec-21	ASIA-1	POS	ASIA-1
TOTAL					**83**			

Annex 2: FMD publications

Recent FMD Publications (January to March 2022) cited by Web of Science.

1. **[Anonymous]** (2022). Foot-and-mouth disease. Is foot-and-mouth disease transmissible to humans through meat consumption? *Actualites Pharmaceutiques*, **61**(613): 12-12.
2. **Abegaz, S.B.** (2022). Milk production status and associated factors among indigenous dairy cows in Raya Kobo district, north eastern Ethiopia. *Veterinary Medicine and Science*: 12. DOI: 10.1002/vms3.740.
3. **Adamchick, J., Rich, K.M., and Perez, A.M.** (2021). Assessment of the risk of foot-and-mouth disease among beef cattle at slaughter from East African production systems. *Viruses-Basel*, **13**(12): 24. DOI: 10.3390/v13122407.
4. **Adibnia, S., Zarei, A., Sadeghi, A.A., and Chamani, M.** (2022). Effect of palmitic, linoleic and alpha-linolenic acids on blood cells count and interleukin-4, 8 genes expression in lambs experimentally infected with *Foot-and-mouth disease virus*. *Animal Biotechnology*: 8. DOI: 10.1080/10495398.2021.2013855.
5. **Arzt, J., Fish, I.H., Bertram, M.R., Smoliga, G.R., Hartwig, E.J., Pauszek, S.J., Holinka-Patterson, L., Diaz-San Segundo, F.C., Sitt, T., Rieder, E., and Stenfeldt, C.** (2021). Simultaneous and staggered *Foot-and-mouth disease virus* coinfection of cattle. *Journal of Virology*, **95**(24): 18. DOI: 10.1128/jvi.01650-21.
6. **Biswal, J.K., Jena, B.R., Ali, S.Z., Ranjan, R., Mohapatra, J.K., and Singh, R.P.** (2022). One-step SYBR green-based real-time RT-PCR assay for detection of *Foot-and-mouth disease virus* circulating in India. *Virus Genes*: 9. DOI: 10.1007/s11262-021-01884-3.
7. **Cavalera, S., Russo, A., Foglia, E.A., Grazioli, S., Colitti, B., Rosati, S., Nogarol, C., Di Nardo, F., Serra, T., Chiarello, M., Baggiani, C., Pezzoni, G., Brocchi, E., and Anfossi, L.** (2022). Design of multiplexing lateral flow immunoassay for detection and typing of *Foot-and-mouth disease virus* using pan-reactive and serotype-specific monoclonal antibodies: Evidence of a new hook effect. *Talanta*, **240**: 11. DOI: 10.1016/j.talanta.2021.123155.
8. **Childs, K., Juleff, N., Moffat, K., and Seago, J.** (2021). Demonstration of co-infection and trans-encapsidation of viral RNA *in vitro* using epitope-tagged foot-and-mouth disease viruses. *Viruses-Basel*, **13**(12): 11. DOI: 10.3390/v13122433.
9. **Choudhury, S.M., Ma, X.S., Li, Y.Y., Nian, X.F., Luo, Z.K., Ma, Y.H., Zhu, Z.X., Yang, F., Cao, W.J., and Zheng H.X.** (2022). FMDV leader protein interacts with the NACHT and LRR domains of NLRP3 to promote IL-1 β production. *Viruses-Basel*, **14**(1): 24. DOI: 10.3390/v14010022.
10. **Cokcaliskan, C., Tuncer-Goktuna, P., Sareyyupoglu, B., Turkoglu, T., Yildiz, M., Deveci, M.N.F., Aras-Uzun, E., Arslan, A, Kurkcu, A., Uzunlu, E., and Asar, E.** Booster administration can make a difference in the antibody response to intradermal foot-and-mouth disease vaccination in cattle. *Archives of Virology*: 9. DOI: 10.1007/s00705-021-05273-x.
11. **Das, L., Sarmah, K., Borah, P., Barman, N.N., Kalita, D.J., Hussain, I., and Devi, B.** (2022). Detection of *Foot-and-mouth disease virus* type O in recovered as well as healthy cattle to study carrier status in Assam. *Indian Journal of Experimental Biology*, **60**(3): 200-206.
12. **Fana, E.M., Mpoloka, S.W., Leteane, M., Seoke L., Masoba, K., Mokopasetso, M., Rapharing, A., Kabelo, T., Made, P., and Hyera, J.** (2021). A five-year retrospective study of foot-and-mouth disease outbreaks in southern Africa, 2014 to 2018. *Veterinary Medicine International*, **2021**: 11. DOI: 10.1155/2021/7438809.
13. **Garay, E., Fontana, D., Leschiutta, L., Kratje, R., and Prieto, C.** Rational design of novel fusion rabies glycoproteins displaying a major antigenic site of *Foot-and-mouth disease virus* for vaccine applications. *Applied Microbiology and Biotechnology*: 14. DOI: 10.1007/s00253-021-11747-4.

14. **Gowda, K.H., Swmay, M.N., Nagaraja, C.S., Ganesh, K., and Kumar, G.S.N.** (2022). Association between MHC gene and immune response to FMD vaccine in Malnad Gidda cattle. *Indian Journal of Animal Sciences*, **92**(1): 12-16.
15. **Gunasekera, U., Biswal, J.K., Machado, G., Ranjan, R., Subramaniam, S., Rout, M., Mohapatra, J.K., Pattnaik, B., Singh, R.P., Arzt, J., Perez, A., and VanderWaal, K.** Impact of mass vaccination on the spatiotemporal dynamics of FMD outbreaks in India, 2008-2016. *Transboundary and Emerging Diseases*: 15. DOI: 10.1111/tbed.14528.
16. **Guo, Z.J., Zhao, Y., Zhang, Z.D., and Li, Y.M.** (2021). Interleukin-10-mediated lymphopenia caused by acute infection with *Foot-and-mouth disease virus* in mice. *Viruses-Basel*, **13**(12): 19. DOI: 10.3390/v13122358.
17. **Guyver-Fletcher, G., Gorsich, E.E., and Tildesley, M.J. .** A model exploration of carrier and movement transmission as potential explanatory causes for the persistence of foot-and-mouth disease in endemic regions. *Transboundary and Emerging Diseases*: 15. DOI: 10.1111/tbed.14423.
18. **Harvey, Y., Jackson, B., Carr, B.V., Childs, K., Moffat, K., Freimanis, G., Tennakoon, C., Juleff, N., and Seago, J.** (2022). An improved α v β6-receptor-expressing suspension cell line for foot-and-mouth disease vaccine production. *Viruses-Basel*, **14**(3): 14. DOI: 10.3390/v14030621.
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20. **He, Y., Li, K., Wang, L., Sun, Z.X., Cao, Y.M., Li, P.H., Sun, P., Bao, H.F., Zhou, S.S., Wang, S., Bai, X.W., Liu, X.R., Zhao, L.X., Fan, X.L., Liu, Z.X., Lu, Z.J., Yang, C., and Lou, Z.Y.** (2021). Structures of *Foot-and-mouth disease virus* with bovine neutralizing antibodies reveal the determinant of intraserotype cross-neutralization. *Journal of Virology*, **95**(24): 13. DOI: 10.1128/jvi.01308-21.
21. **Hopker, A., Pandey, N., Bartholomew, R., Blanton, A., Hopker, S., Dhamorikar, A., Goswami, J., Marsland, R., Metha, P., and Sargison, N.** (2021). Livestock vaccination programme participation among smallholder farmers on the outskirts of National Parks and Tiger Reserves in the Indian states of Madhya Pradesh and Assam. *PloS One*, **16**(8): 27. DOI: 10.1371/journal.pone.0256684.
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of differentially expressed circular RNAs identified in *Foot-and-mouth disease virus* infected PK-15 cells. *Veterinary Research*, **53**(1): 13. DOI: 10.1186/s13567-022-01037-w.

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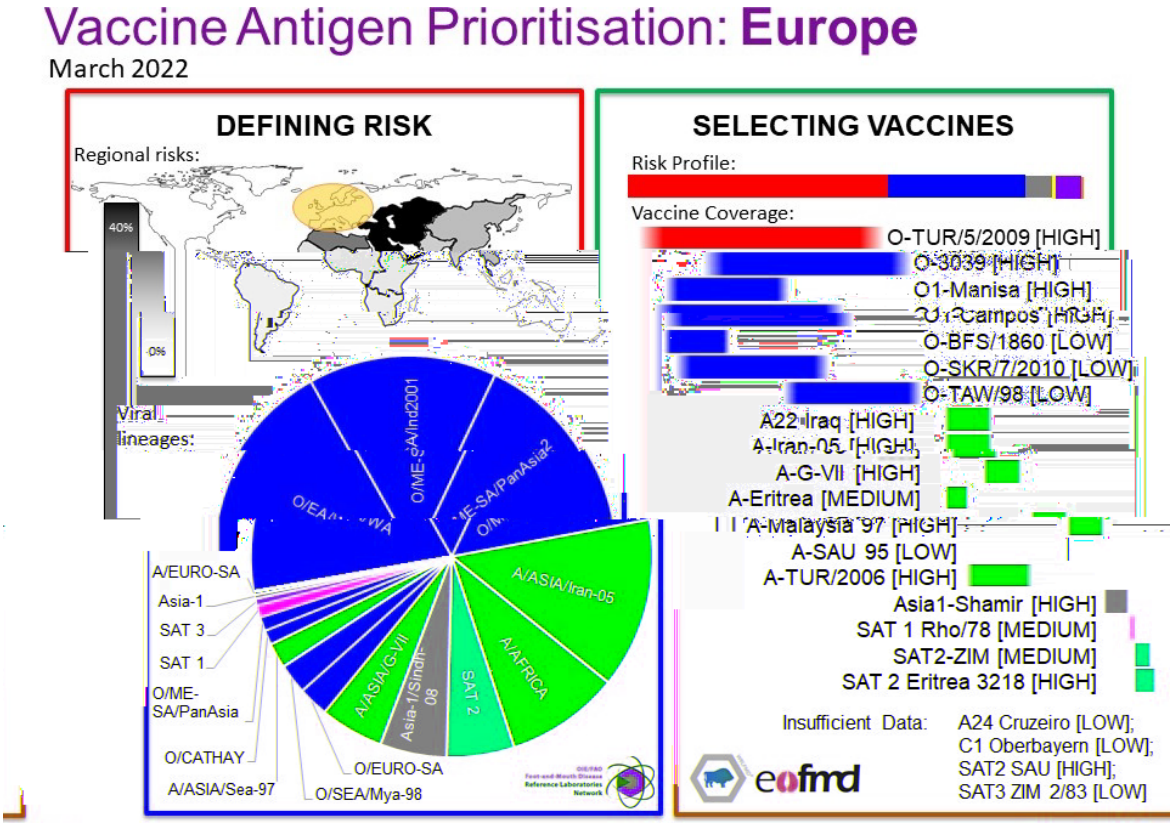
Annex 3: Vaccine recommendations

This report provides recommendations of FMDV vaccines to be included in antigen banks. These outputs are generated with a new tool (called PRAGMATIST) that has been developed in partnership between WRLFMD and EuFMD (http://www.fao.org/3/cb1799en/cb1799en.pdf). These analyses accommodate the latest epidemiological data collected by the OIE FAO FMD Laboratory Network regarding FMDV lineages that are present in different *source regions* (see Table 1 in Section 3.9, above), as well as available *in vitro, in vivo* and field data to score the ability of vaccines to protect against these FMDV lineages.

Vaccine prioritisation (for Europe): March 2022:



Please contact WRLFMD or EuFMD for assistance to tailor these outputs to other geographical regions.
NB: Vaccine-coverage data presented is based on available data and may under-represent the true performance of individual vaccines.

Annex 4: Brief round-up of EuFMD and WRLFMD activities

Courses

- The EuFMD Virtual Learning platform provides convenient self-paced training which you may study anytime, anywhere, free of charge. Open access courses currently offered are:
  - **Introduction to FMD course** (available in English and French), introducing foot-and-mouth disease (FMD), its importance, diagnosis, outbreak investigation and the control measure that might apply in a previously free country experiencing an outbreak.
  - **Introduction to Lumpy Skin Disease**, a short open-access module made available to support countries in Asia and the Pacific face this rapidly emerging threat.
  - **Introduction to Rift Valley Fever** aims to build your understanding of Rift Valley fever diagnosis, surveillance, prevention and control.
  - **What is the Progressive Control Pathway** (available in English and, for anyone who is new to the PCP-FMD, a short e-learning module is also available in Arabic) providing an overview of the Progressive Control Pathway for Foot-and-Mouth Disease (PCP-FMD), the tool used to FMD control under the GF-TADs Global Strategy.
  - **Simulation Exercises for Animal Disease Emergencies** aiming at building your understanding of simulation exercises and their value as part of the emergency preparedness cycle.
  - **Introduction to the Risk-Based Strategic Plan** introducing the Risk-Based Strategic Plan (RBSP).
- **Public Private Partnerships in the Veterinary Domain** course, developed in partnership with the World Organisation for Animal Health OIE, applying public-private partnerships to the control of FMD and similar transboundary animal diseases.
- The next **WRLFMD residential training course on FMD diagnostic methods** is scheduled for May 2022.

Other resources

Podcasts (http://www.fao.org/eufmd/resources/podcasts/en/)

- We have a constantly updated series of short podcasts relating to the FAST world
- The EuFMD has opened an FMD Emergency Toolbox (EN, FR).
- A series of videos on foot-and-mouth disease in English, Bulgarian, Greek and Turkish (https://www.fao.org/eufmd/who-we-are/fr/)
- Leaflets on FMD in English, Turkish, Bulgarian and Greek, for the Thrace region (https://www.fao.org/publications/card/en/c/CB4903EN)
- Join our Telegram channel to receive EuFMD updates (https://t.me/eufmd)
- Find out who TOM is and why you need him (https://www.eufmd.info/tom-training)

Emergency Preparedness Network (http://www.fao.org/eufmd/network/en/)

The Emergency Preparedness Network is a forum for emergency preparedness experts to share information and experience. You will regularly receive the latest information on topics related to prevention and control of foot-and-mouth and other similar transboundary animal diseases ("FAST" diseases).

Meetings

- Open Session 2022 - Digitalization and innovation applied to the prevention and control of foot-and-mouth and similar transboundary animal diseases (FAST) – it will be held on 26, 27, 28 October 2022. https://www.eufmd.info/os22

Proficiency test scheme organised by WRLFMD

Phase XXXIII of the WRLFMD proficiency testing scheme (PTS) is underway and we anticipate that a final report will be produced during the next reporting period. Plans for a further exercise (Phase XXXIV) in 2022 are underway and updates on the progress of this PTS will be described in future quarterly reports.

EuFMD Committees

Executive Committee, Standing Technical Committee (STC), Special Committee for Surveillance and Applied Research (SCSAR), Special Committee on Biorisk Management (SCBRM), Tripartite Groups.

Hold-FAST tools

AESOP. Assured emergency supply options; **EuFMDiS**, FMD spread model; **GET PREPARED** toolbox. Emergency preparedness; **GVS**. Global Vaccine Security; **Online Simulation Exercises**; **Outbreak Investigation application**; **Pragmatist**. Prioritization of antigen management with international surveillance management tool; **PCP-FMD**. Progressive Control Pathway for foot-and-mouth disease; **PCP-Support Officers**; **SAT**. PCP Self-Assessment Tool; **RTT**. Real Time Training; **SMS Disease reporting**; **SQRA toolkit**. A method for spatial qualitative risk analysis applied to FMD; **Telegram**; **TOM**. EuFMD training management system; **Global Monthly reports**; **VADEMOS**. Vaccine Demand Estimation Model; **VLC**. Virtual Learning Center. **Microlearning**.

United Nations Sustainable Development Goals (UN-SDGs)

EuFMD's programme has a main focus on

Thinking of the environmental footprint

Together against wasting resources, think twice before printing.

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