



Foot-and-Mouth Disease

2023

Quarterly
report

October –
December

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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	Lanzhou Veterinary Research Institute
MEVAC	International Facility for Veterinary Vaccines Production (Egypt)
MNFMDL	Malaysian National Foot-and-Mouth Disease Laboratory
NT	not tested
NVD	no virus detected
PIADC	Plum Island Animal Disease Center
Pusvetma	Pusat Veteriner Farma (Indonesia)
rRT-PCR	real-time reverse transcription polymerase chain reaction
SAARC	South Asian Association for Regional Cooperation
SADC	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 Türkiye
VI	virus isolation
WAHIS	World Animal Health Information System (of the WOA)
WOAH	World Organisation for Animal Health
WRLFMD	World Reference Laboratory for Foot-and-Mouth Disease

1. Highlights and headlines

Thanks for reading this last Quarterly report for 2023 which concludes a busy twelve months for the WRLFMD and our partner laboratories in the WOA/FAO FMD Laboratory Network (www.foot-and-mouth.org). The epidemiology of FMD continues to be very dynamic and during the year there has been particular attention on new FMD events in the Middle East (SAT2/XIV), East Asia (O/ME-SA/Ind-2001e) and North Africa (O/EA-3).

During the last three months, the WRLFMD has reported test results for samples received from Israel, Pakistan, Palestine, Thailand and Türkiye. There have also been new sequence submissions from Algeria (ANSES, France), Botswana (BVI, Botswana), Ethiopia (BVI, Botswana) and India. Data for samples from Türkiye shows how the SAT2/XIV topotype has recently spread within Anatolia, where 30 further outbreaks due to this lineage have been detected in the country during this quarter. Elsewhere in the Middle East, recent samples show that the O/ME-SA/PanAsia-2^{ANT-10} sub-lineage is still circulating in Israel and Palestine. In Egypt, data presented at the GFRA meeting in November indicate that viruses from the A/EURO-SA lineage continue to be detected; vaccine matching is now underway using a selection of historical viruses from South America (Argentina, Bolivia, Brazil, Ecuador, Paraguay, Uruguay, and Venezuela; provided by PANAFTOSA, Brazil) to help understand whether FMD vaccines will provide protection against this exotic lineage (as well as O/EURO-SA that was also detected in Egypt during 2022). This report also presents analyses of older sequences for diverse serotype Asia 1 viruses circulating in India, representing different two named genotypes including the first detection of genotype IX in the country.

STOP PRESS (data from January 2024):

Sequence data recently shared by ANSES (France) demonstrates that FMD cases detected in Algeria during December 2023, were due to an unusual SAT2 topotype (SAT2/V). These unexpected cases represent the first time that serotype SAT 2 has been detected in any of the Maghreb countries (Tunisia, Algeria and Morocco). Viruses from this lineage were last found in Ghana (1991), Togo (1990) and Ivory Coast (1990) and further work is now urgently needed to understand the source of this virus (presumably from Central/West Africa), and the risk pathways by which SAT2/V has been introduced into North Africa; where previous and other on-going outbreaks have involved the O/EA-3 and A/AFRICA/G-IV lineages which originate from West Africa.

I take this opportunity to pass on my best wishes to you, your colleagues, and families for the New Year.

Don King, Pirbright, January 2024

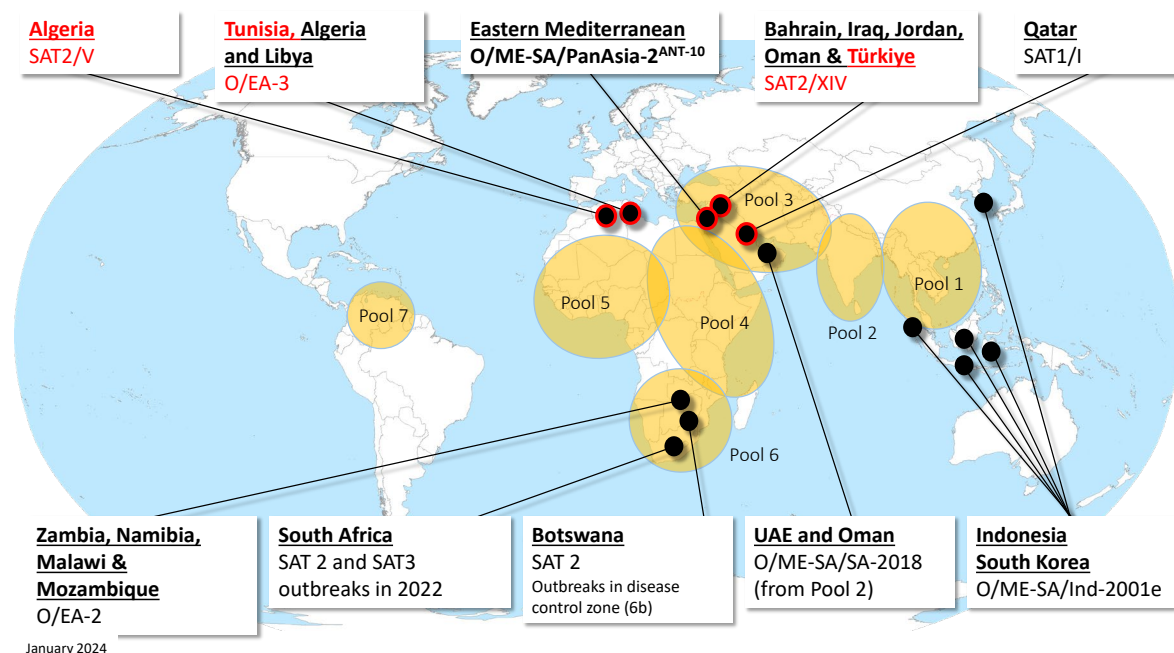


Figure 1: Recent FMD global outbreaks

Note: New headline events reported October to December 2023 are highlighted in red with FMD endemic pools highlighted in orange.
Source: WRLFMD. Map conforms to the United Nations World Map, June 2020.

2. General overview

Endemic Pools comprise separate ecosystems that maintain independently circulating and evolving foot-and-mouth disease virus (FMDV) genotypes. In the absence of specific reports, it should be assumed that the serotypes indicated below are continuously circulating in parts of these pools and would be detected if sufficient surveillance was in place.

POOL	REGION/COUNTRIES	SEROTYPES PRESENT
<u>SOUTHEAST ASIA/CENTRAL ASIA/EAST ASIA</u>		
1	Cambodia, China, China (Hong Kong SAR), Taiwan Province of China, Indonesia, Democratic People's Republic of Korea, Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, Russian Federation, Thailand, Viet Nam	A, Asia1 and O
<u>SOUTH ASIA</u>		
2	Bangladesh, Bhutan, India, Mauritius ¹ , Nepal, Sri Lanka	A, Asia1 and O
<u>WEST EURASIA & NEAR EAST</u>		
3	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, Türkiye, Turkmenistan, United Arab Emirates, Uzbekistan	A, Asia1 and O (SAT2)
<u>EASTERN AFRICA</u>		
4	Burundi, Comoros, Djibouti, Egypt ³ , Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Uganda, United Republic of Tanzania, Yemen	O, A, SAT1, SAT2 and SAT3
<u>NORTH AFRICA</u>²		
	Algeria, Libya, Morocco, Tunisia	A and O
<u>WEST/CENTRAL AFRICA</u>		
5	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, SAT1 and SAT2
<u>SOUTHERN AFRICA</u>		
6	Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe	SAT1, SAT2 and SAT3 (O ⁴ , A)
<u>SOUTH AMERICA</u>		
7	Venezuela (Bolivarian Republic of)	O and A

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

²Long-term maintenance of FMDV lineages has not been documented in the Maghreb countries of 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.

³Egypt represents a crossroads between East African Pool 4 and the Near East (Pool 3). NB: Serotypes SAT1 and SAT3 have not been detected in this country.

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

3. Summary of FMD outbreaks and intelligence

3.1. Overview of reports

The location of information provided 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.

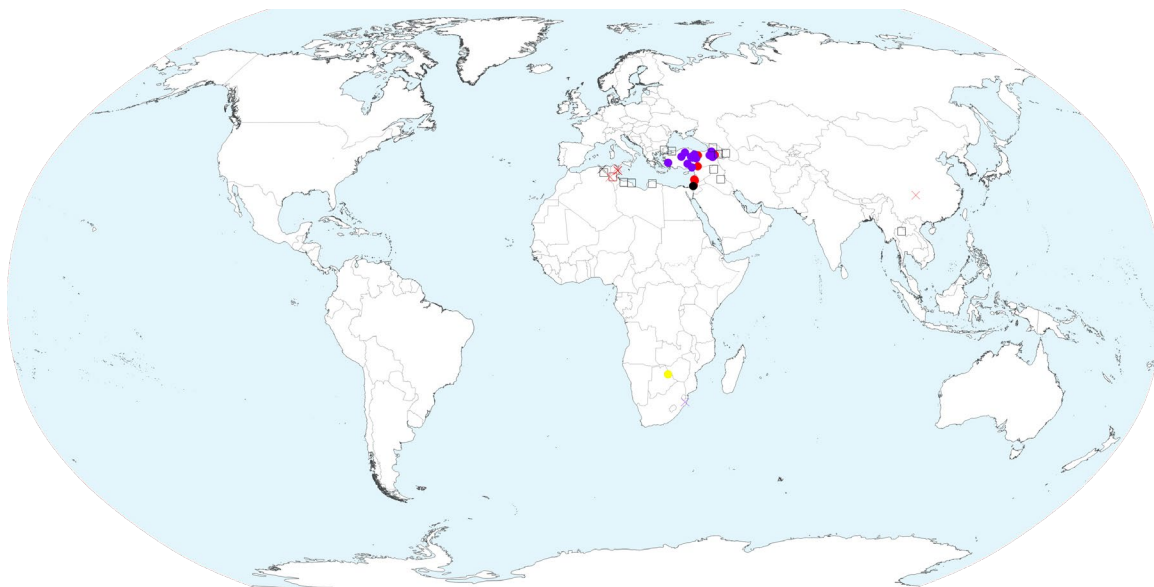
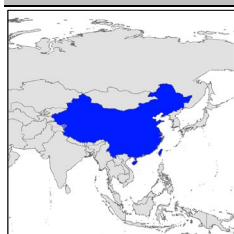


Figure 1: Samples tested by WRLFMD or reported in this quarter. ● indicates samples analysed; × indicates outbreaks reported/updated to the WOAHA this quarter; □ indicates reports of FMD from other sources. Shape colours define the serotype detected ● O; ● A; ● C; ● Asia1, ● SAT1, ● SAT2, ● SAT3, ○ FMD 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 People's Republic of China



Seven cases of **FMD type O** in swine from a slaughterhouse in Qijiang District, Chongqing, Chongqing Municipality were reported on 13 December 2023.

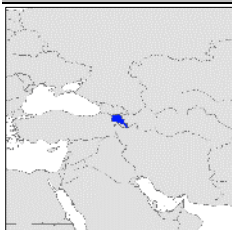
[WOAH World Animal Health Information System \(event ID: 5393\)](#)

3.3. Pool 2 (South Asia)

No new outbreaks of FMD were reported in South Asia.

3.4. Pool 3 (West Eurasia and Near East)

Armenia



Data shared by the country indicates that 316,390 large ruminants and 367,263 small ruminants have been vaccinated using a quadrivalent vaccine (A/Iran05, A/G-VII, O/PanAsia2, Asia-1/Sindh 08) and 96,151 calves were vaccinated by SAT 2 monovalent vaccine. Passive and active surveillance continues: NSP sero-surveillance has been conducted where 4,400 samples have been collected (2,383 large ruminants samples and 1,951 small ruminants samples). In addition, 991 samples (675 large and 316 small ruminants) have been tested for SP. Results are pending.

[EuFMD FAST Report](#)

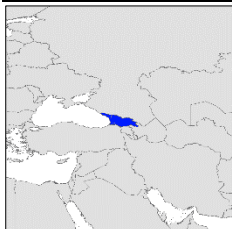
The Republic of Azerbaijan



2,381,580 cattle and 4,382,229 small ruminants were vaccinated during the period October- December 2023. The calculated vaccination coverage is 97.8% for large and 101.1% for small ruminants. For surveillance purposes, 2,140 serum samples from large ruminants and 3,050 serum samples from small ruminants were collected after autumn vaccination campaign.

[EuFMD FAST Report](#)

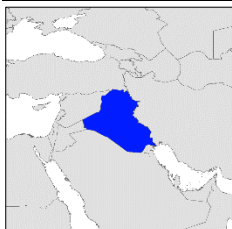
Georgia



SP and NSP surveillance has been conducted, where 500 samples for SP and 4,000 NSP samples have been submitted to the Laboratory for testing. Analysis of data is ongoing. In the reporting period, 540,914 animals (250,252 large and 290,662 small ruminants) have been vaccinated against FMD using tetravalent vaccines (A, O, Asia-1, SAT 2).

[EuFMD FAST Report](#)

Iraq



26 FMD outbreaks have been reported in Ninawa and Baghdad Governorates. There have also been unofficial reports of FMD outbreaks in other locations in the country.

[EuFMD FAST Report](#)

Israel



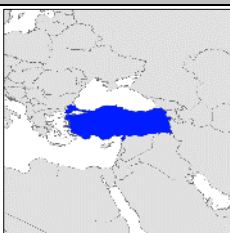
On 05 October 2023, six samples were received. They had been collected from cattle during July 2022 from Northern District and January 2023 from the Golan Heights. They were all identified as **FMD type O** and genotyped as ME-SA/PanAsia-2^{ANT-10} (see below).

Palestine



On 05 October 2023, six samples were received. They were collected from sheep and goats in various provinces between December 2022 and August 2023. Four were identified as **FMD type O** and in two FMDV genome was detected (FMDV-GD). Genotyping revealed all the type O viruses to belong to the ME-SA/PanAsia-2^{ANT-10} sublineage (see below).

Türkiye



On 24 August 2023, a batch of 21 samples was received. They were collected from cattle (and one sheep) in various provinces between January and June 2023. Three were identified as **FMD type O** and 17 as **FMD type SAT 2**. Genotyping revealed two of the type O viruses belong to the ME-SA/PanAsia-2^{QOM-15} sublineage, while the third type O virus belonged to the ME-SA/PanAsia-2^{ANT-10} sublineage; the type SAT 2 viruses all belonged to the XIV topology (see below).

In this quarter, 30 outbreaks were detected, all due to serotype SAT 2, although cases due to SAT 2 appear to be decreasing since October. Serotype O has not been detected clinically since May 2023. In this quarter: 18,000 large ruminants and 7,154 small ruminants were clinically examined for FMD in the Thrace region under the Thrace RBSP. 1,199 sera were collected from the European side of Istanbul and tested by NSP ELISA. Clinical surveillance was achieved in 368 epi-units out of 394 in the buffer zone area. A total of 28,321 animals were examined for FMD surveillance.

[EuFMD FAST Report](#)

3.5. Pool 4 (North and Eastern Africa)

The People's Democratic Republic of Algeria



Outbreaks of **FMD** were reported in cattle on 10 December 2023 in Mezcloug and Guelta Zerka, Sétif province. Genotyping is pending for samples collected from cases (**see STOP PRESS in section 1**).

[WOAH World Animal Health Information System \(event ID: 5391\)](#)

ProMED post: [20231207.8713554](#)

In mid-December the governors of M'Sila and Tebessa provinces temporarily closed livestock markets and other livestock gathering across the provinces to prevent the gathering of animals to reduce the spread of FMD.

ProMED post: [20231220.8713816](#)

The State of Libya



In December 2023, four outbreaks occurred in the Jabal al Akhdar district. Two other FMD outbreaks were reported in the Western region of the country in January 2024 (one outbreak occurred in the Misrata district and one in the Zawiya district).

[EuFMD Fast report](#)

The Republic of Tunisia



Thirteen cases of **FMD type O** in cattle were reported on 04 December 2023 from Ouerdanine Nord, Ouerdanine District, Monastir Govenorate and Bir Chalouf, Nabeul District, Nabeul Govenorate and a further on six cases on 14 December 2023 from Jammel, Jammel District, Monastir Govenorate and Elhadhar, Tozeur District, Tozeur Govenorate

[WOAH World Animal Health Information System \(event ID: 5379\)](#)

ProMED post: [20231212.8713667](#)

The president of the Tunisian Veterinary Statutory Body declared on 20th December to the radio that there are FMDV outbreaks in several wilayas such as (Nabeul, Monastir, Kasserine, Tozeur).

ProMED post: [20231222.8713852](#)



Twelve outbreaks have been reported (in governorates of Monastir, Tozeur, Nabeul, Kassérine, Le Kef and Sidi Bouzid). In total, 168 infected animals were detected, and 13 died. Some outbreaks have been reported in unvaccinated animals belonging to traders. The circulating strain was confirmed as the topotype O/EA-3 by the FMD reference laboratory. This is the second FMD event reported this year (the other one was reported between May and June, with 6 outbreaks), and some governorates were already affected during this previous event (Monastir). The spread of the virus is thought to be due to the introduction of infected animals or to visits to the animal markets.

[EUFMD Fast report](#)

3.6. Pool 5 (West/Central Africa)

No new outbreaks of FMD were reported in West or Central Africa.

3.7. Pool 6 (Southern Africa)

The Republic of Botswana	
	On the 13 October 2023, one FMD type SAT 1 VP1 sequence was received from the Botswana Vaccine Institute (BVI). It was obtained from a sample collected on the 19 September 2023 from a buffalo at Nata, Central District. Genotyping showed it to belong to the SAT1/III topotype (see below).
The Republic of South Africa	
	One new case of FMD type SAT 2 in wild African buffalo (Cape buffalo) were reported on 14 December 2023 from Big Five Hlabisa, Umkhanyakude, KwaZulu-Natal Province. No new cases have been reported from the on-going FMD type SAT 3 event this quarter. <u>WOAH World Animal Health Information System (event IDs: 3738 & 4368)</u>

3.8. Pool 7 (South America)

No new outbreaks of FMD were reported in South America.

3.9. Extent of global surveillance

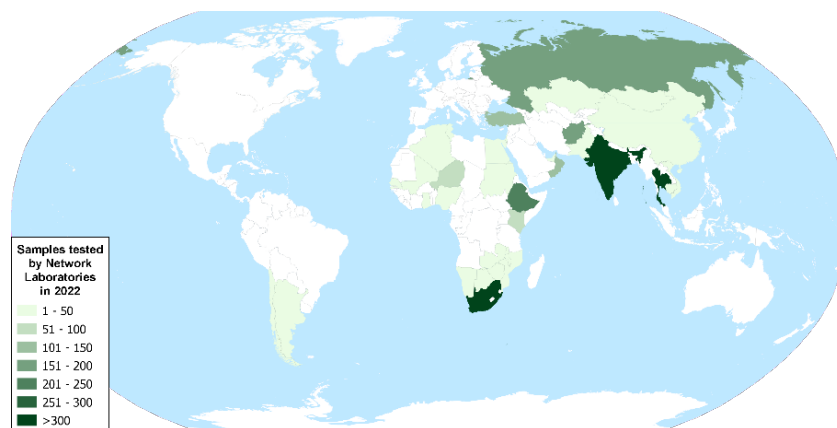


Figure 2: Samples received during 2022 from FMD outbreaks (routine surveillance that is undertaken in countries that are FMD-free without vaccination is not shown). Data from presentations given at the WOA/FAO FMD reference laboratory network annual meeting (<https://www.foot-and-mouth.org/Ref-Lab-Network/Network-Annual-Meeting>).

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: 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 ¹	5.5 ¹	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								

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

Note: For each of the regions, data represent the relative importance of each viral lineage (prevalence score estimated as a percentage [percent] of total FMD cases that occur in domesticated hosts). These scores (reviewed at the WOA/FAO FMD reference laboratory network meeting in October 2023) 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**. NB: In response to the FMD cases due to SAT2/XIV, risks in Pool 3 were reviewed and revised in April 2023.

A number of outbreaks have occurred where samples have not been sent to the WRLFMD or other laboratories in the WOA/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-2023>.

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 October to December 2023 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 October to December 2023.

WRLFMD Batch No.	Date received	Country	Total No. samples	Serotype	No. of samples	No. of sequences	Sequencing status
WRLFMD/2023/000074	24/08/2023	Republic of Türkiye	20	O	2	2	Finished
				O	1	1	
				SAT2	17	18*	
WRLFMD/2023/000075	05/10/2023	State of Israel	6	O	6	6	Finished
WRLFMD/2023/000076	05/10/2023	Palestine	6	O	4	4	Finished
				FMDV-GD	2	0	
WRLFMD/2023/000077	27/10/2023	Argentine Republic	4	O	1	1	Finished
				A	3	3	
WRLFMD/2023/000078	27/10/2023	Plurinational State of Bolivia	1	O	1	1	Finished
			1	A	1	1	
WRLFMD/2023/000079	27/10/2023	Federative Republic of Brazil	1	A	1	1	Finished
WRLFMD/2023/000080	27/10/2023	Republic of Colombia	4	O	4	4	Finished
			1	A	1	1	
WRLFMD/2023/000081	27/10/2023	Republic of Ecuador	1	O	1	1	Finished
WRLFMD/2023/000082	27/10/2023	Republic of Paraguay	2	O	2	2	Finished
WRLFMD/2023/000083	27/10/2023	Oriental Republic of Uruguay	1	O	1	1	Finished
			2	A	2	2	
WRLFMD/2023/000084	27/10/2023	Bolivarian Republic of Venezuela	2	A	2	2	Finished
Totals			52		52	51	

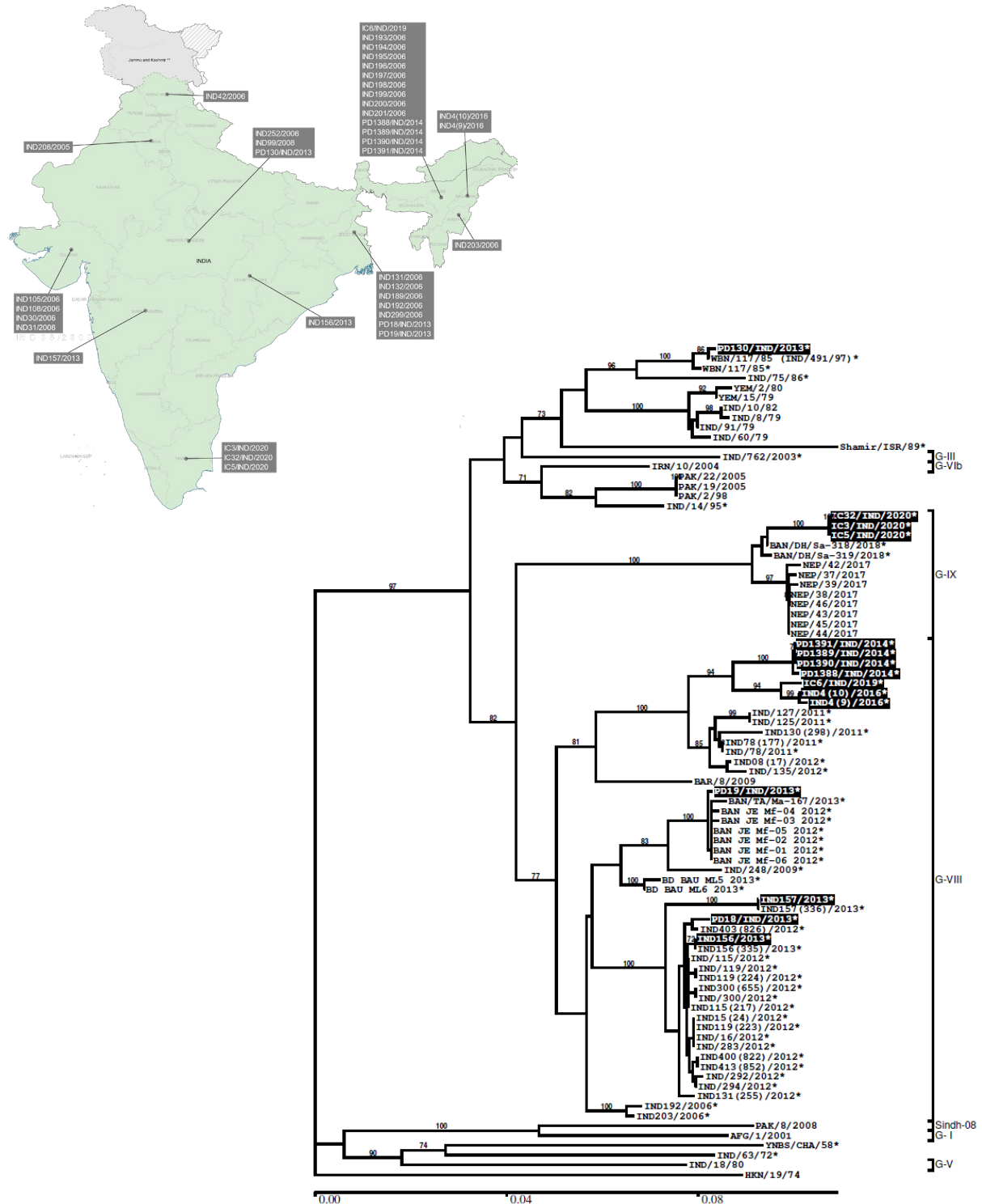
* sample TUR/20/2023 had two closely related sequences.

Table 3: VP1 sequences submitted by other FMD laboratories to the WRLFMD from October to December 2023.

WRLFMD Batch No.	Date received	Country	Serotype	Date Collected	No. of sequences	Submitting laboratory
WRLMEG/2023/000032	13/10/2023	Republic of Botswana	SAT 1	2023	1	BVI
WRLMEG/2023/000033	17/10/2023	Republic of India	Asia 1	205-2019	36	ICAR-DFMD
			Asia 1	2020	3	
Total					40	

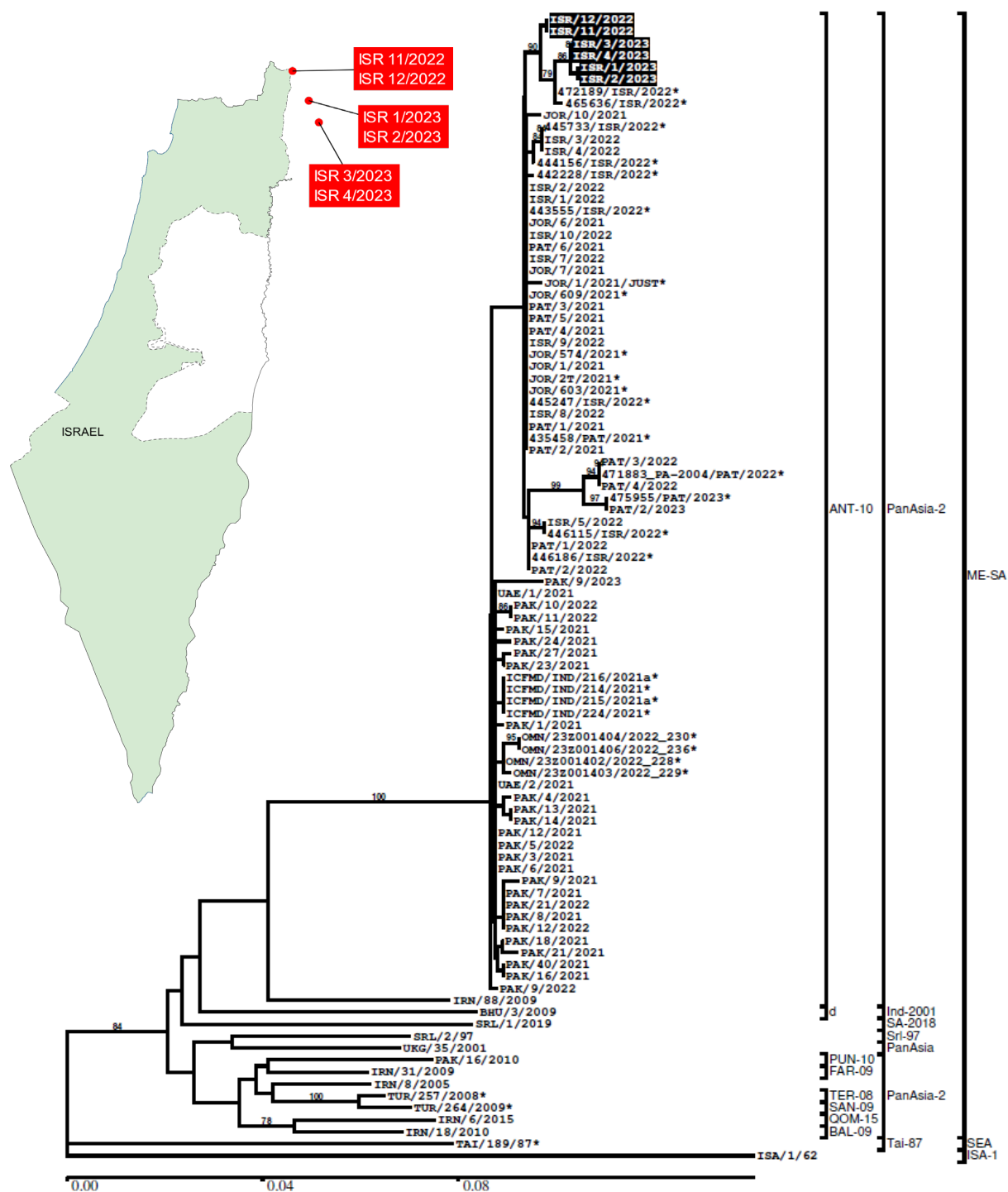
The Republic of India

Batch:	WRLMEG/2023/00033B
Sequences provided by:	retrieved from GenBank
Date Received:	19 October 2023
Number of Sequences	15
Asia 1 (ASIA/G-VIII):	11
Asia 1 (ASIA/G-XI):	3
Asia 1 (ASIA):	1



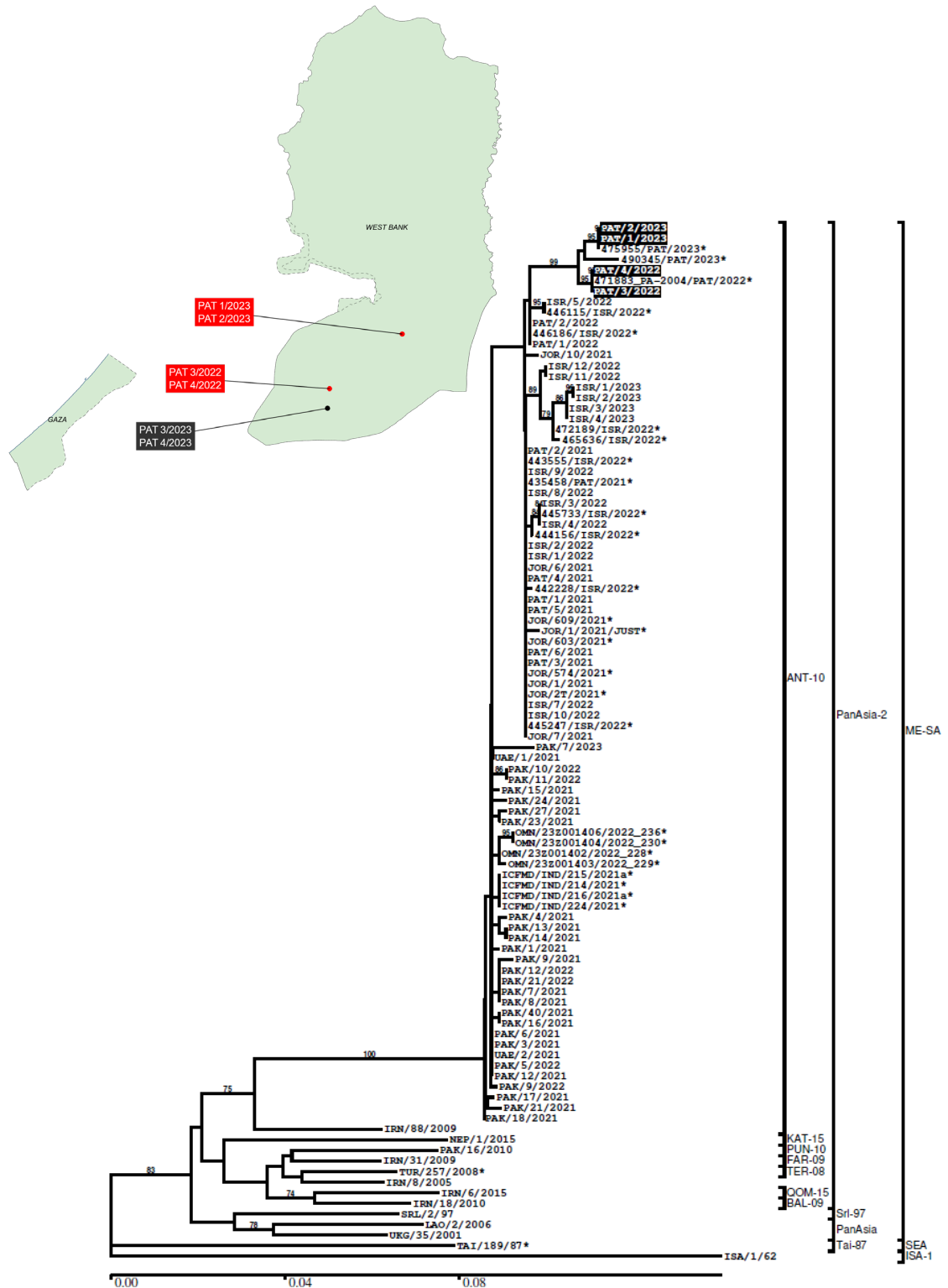
4.3. Pool 3 (West Eurasia and Near East)

The State of Israel	
Batch:	WRLFMD/2023/000075
Samples provided by:	KVI, Israel
Date Received:	16 October 2023
Number of Sequences	6
O (Me-SA/PanAsia-2 ^{ANT-10}):	6



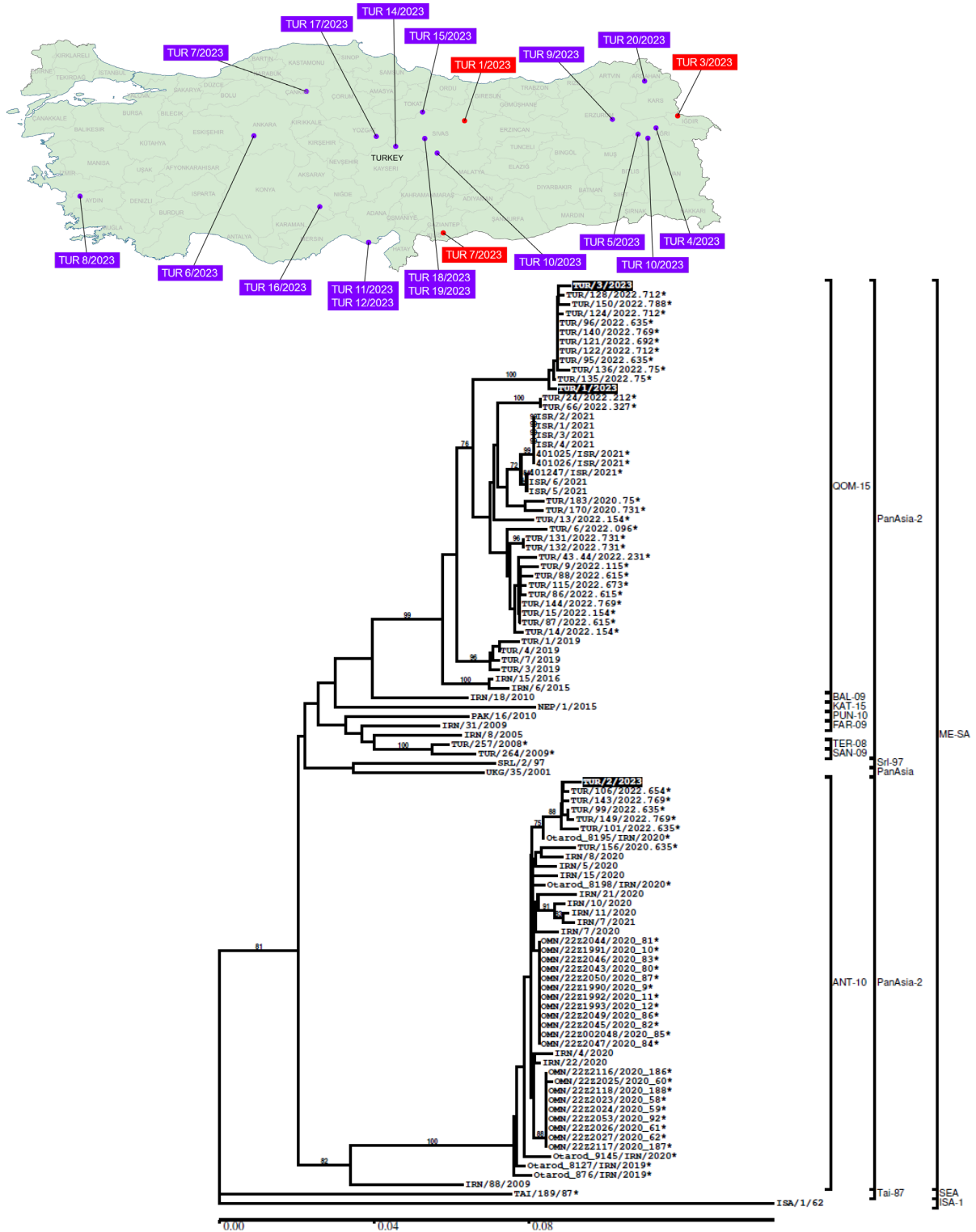
Palestine

Batch:	WRLMEG/2023/000076
Samples provided by:	KVI, Israel
Date Received:	16 October 2023
Number of Sequences	4
O (Me-SA/PanAsia-2 ^{ANT-10}):	4



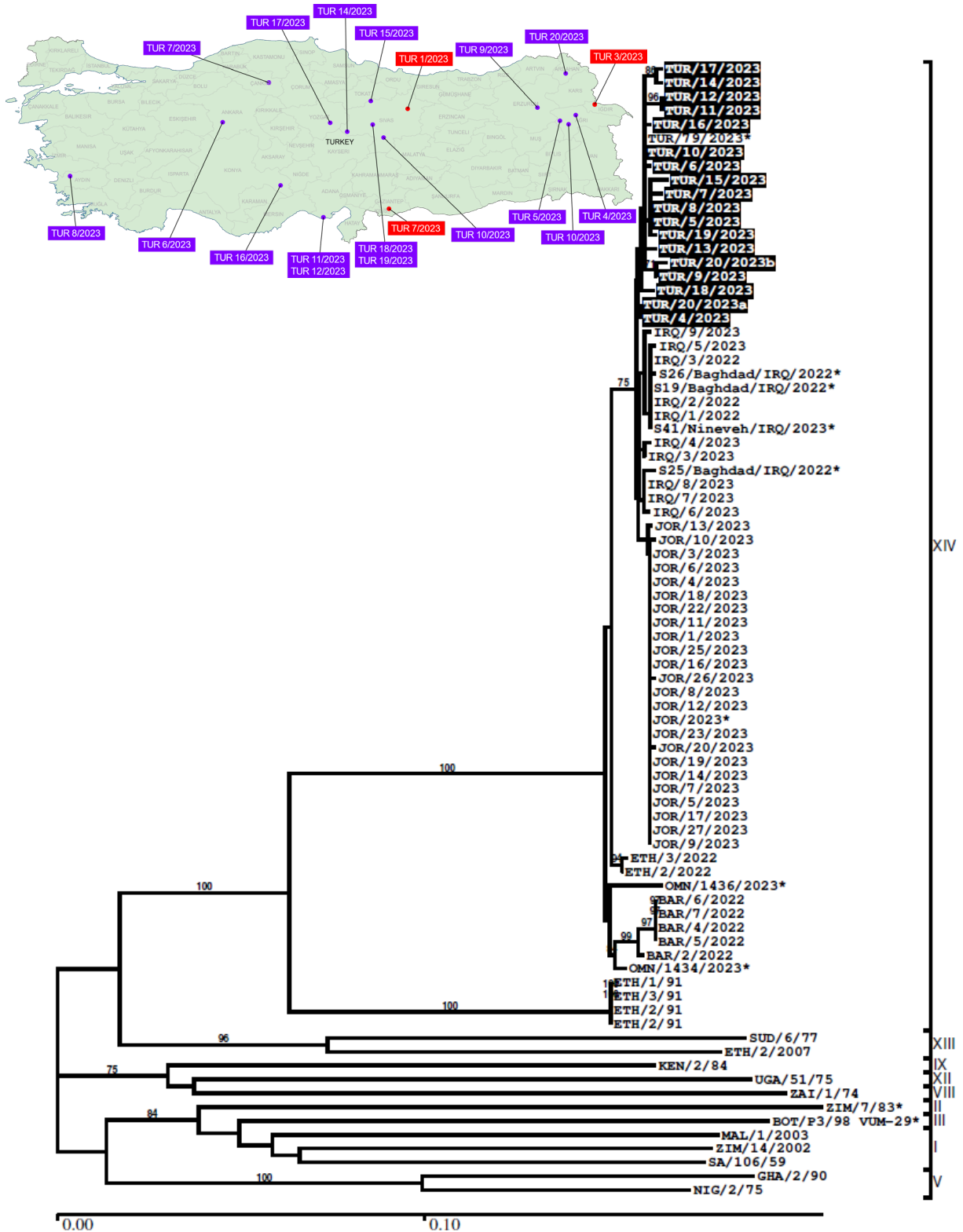
The Republic of Türkiye

Batch:	WRLFMD/2023/000074
Samples provided by:	Şap Institute, Türkiye
Date Received:	05 October 2023
Number of Sequences	3
O (ME-SA/PanAsia-2 ^{QOM-15}):	2
O (ME-SA/PanAsia-2 ^{ANT-10}):	1



The Republic of Türkiye

Batch:	WRLFMD/2023/000074
Samples provided by:	Şap Institute, Türkiye
Date Received:	05 October 2023
Number of Sequences	18
SAT 2 (XIV):	18



4.4. Pool 4 (North and East Africa)

No samples/sequences received.

4.5. Pool 5 (West/Central Africa)

No samples/sequences received.

4.6. Pool 6 (Southern Africa)

The Republic of Botswana	
Batch:	WRLMEG/2023/000032
Samples provided by:	BVI, Botswana
Date Received:	16 October 2023
Number of Sequences	1
SAT 1 (III):	1

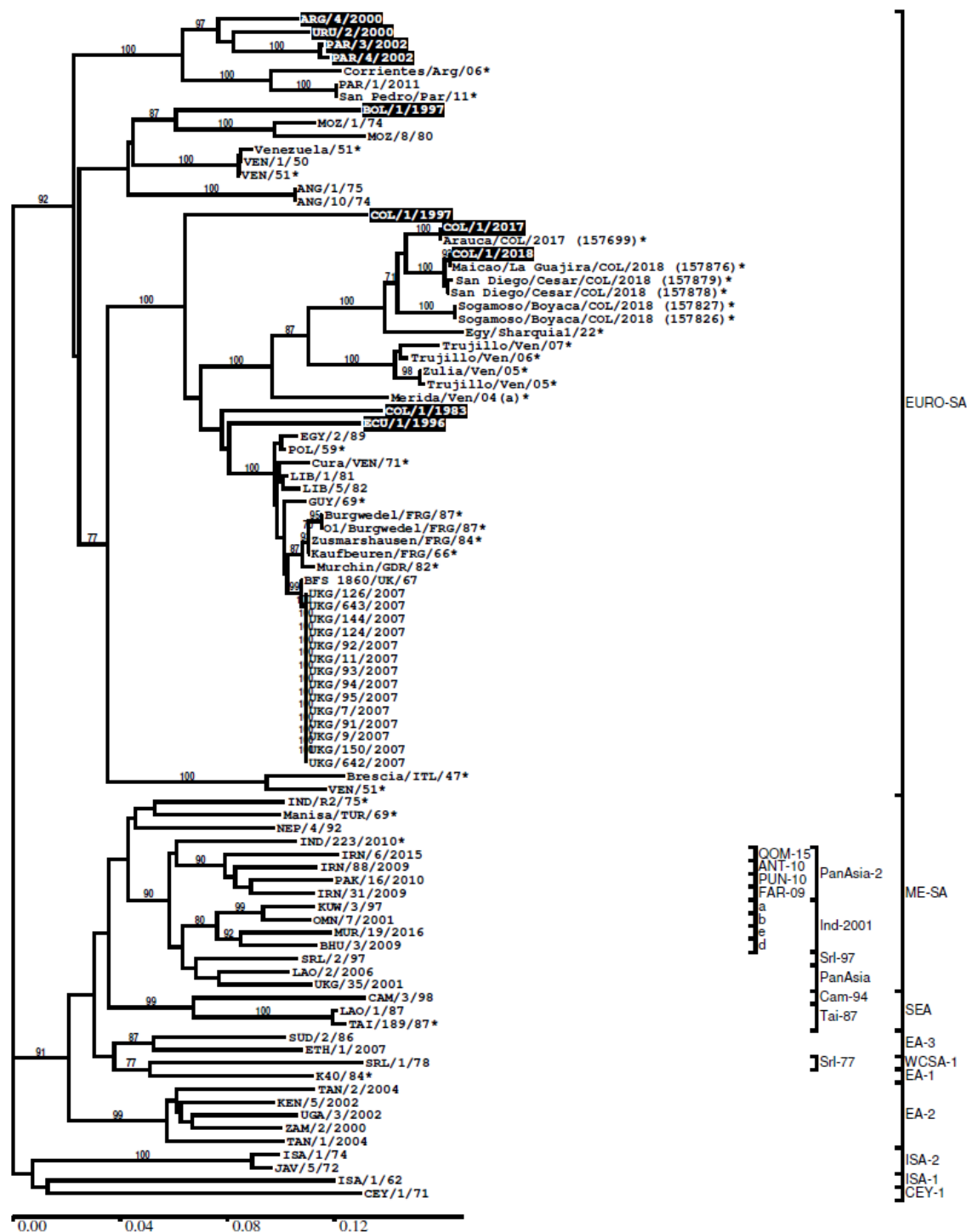


4.7. Pool 7 (South America)

South America

(historical reference virus samples, NOT from current outbreaks)

Batch:	WRLMEG/2023/000077-84
Samples provided by:	
Date Received:	15 November 2023
Number of Sequences	10
O (EURO-SA):	10



South America

(historical reference virus samples, NOT from current outbreaks)

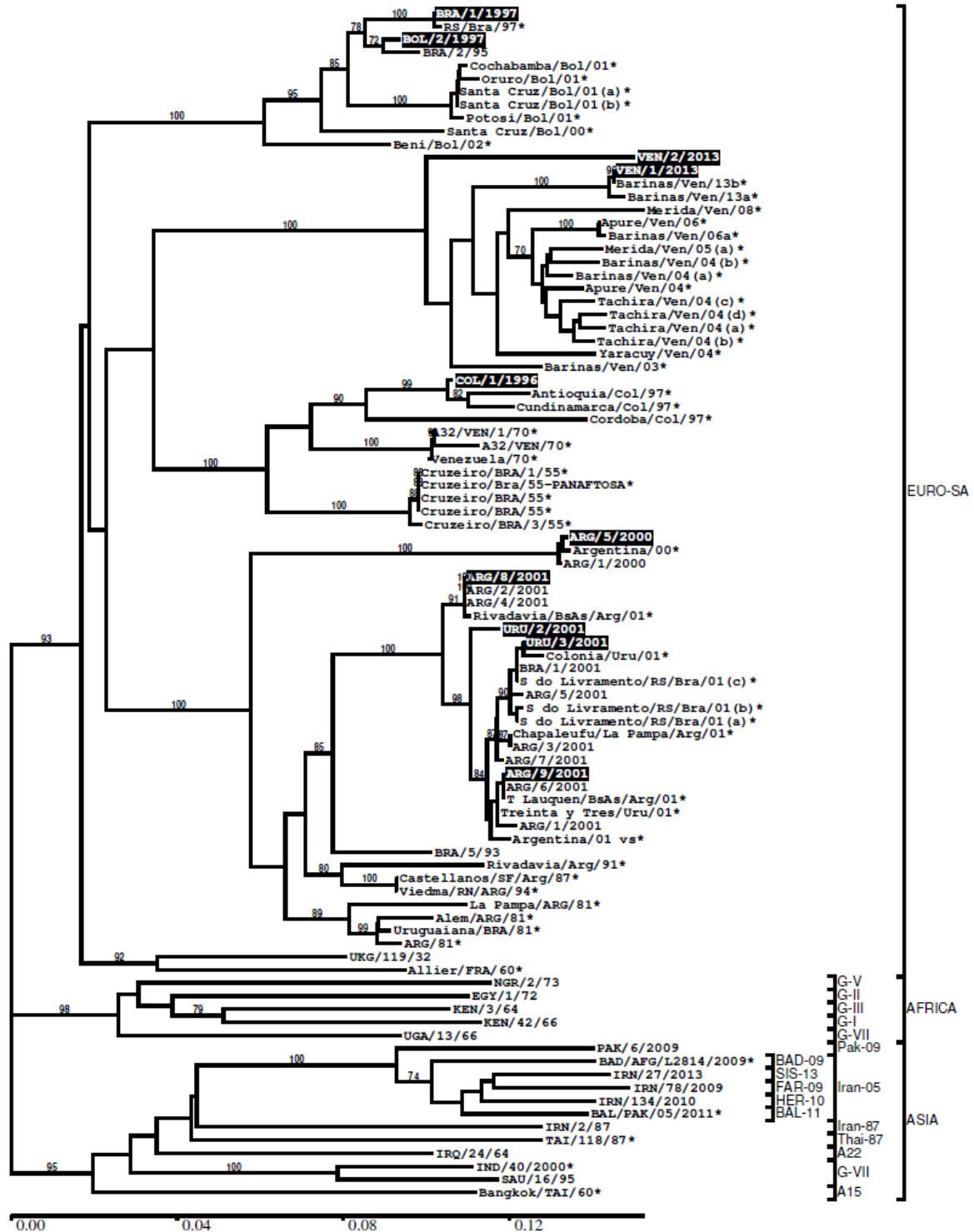
Batch: WRLMEG/2023/000077-84

Samples provided by:

Date Received: 15 November 2023

Number of Sequences 10

A (EURO-SA): 10



4.8. Vaccine matching

Antigenic characterisation of FMD field isolates by matching with vaccine strains by 2dmVNT from October to December 2023.

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
Israel	2	-	-	-	-	-	-
Palestine	2	-	-	-	-	-	-
Pakistan	2	2	-	2	-	-	-
Thailand	3	3	-	-	-	-	-
Türkiye	3	-	-	-	-	2	-
Total	12	5	0	2	0	2	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 $r_1 = \geq 0.3$ - 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 TCID₅₀.

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 <i>Boehringer Ingelheim</i>		O Campos <i>Boehringer Ingelheim</i>		O ₁ Campos <i>Biogénesis Bagó</i>		O Manisa <i>Boehringer Ingelheim</i>		PanAsia 2 <i>Boehringer Ingelheim</i>		O/TUR/5/09 <i>MSD</i>	
	Topotype	Lineage	r ₁	titre	r ₁	titre	r ₁	titre	r ₁	titre	r ₁	titre	r ₁	titre
O/ISR 12/2022	ME-SA	PanAsia-2	0.32	1.66	0.24	1.72	0.59	2.52	0.38	1.89	0.34	1.90	0.43	1.81
O/ISR 2/2023	ME-SA	PanAsia-2	0.38	1.74	0.26	1.75	0.45	2.40	0.32	1.85	0.28	1.80	0.47	1.84
O/PAK 9/2022	ME-SA	PanAsia-2	0.41	1.79	0.16	1.66	0.13	2.04	0.28	1.91	0.27	1.88	0.26	1.88
O/PAK 2/2023	ME-SA	PanAsia-2	0.41	1.80	0.36	2.00	0.35	2.48	0.35	1.98	0.36	2.01	0.90	2.22
O/TAI 5/2022	ME-SA	Ind-2001	0.91	2.00	0.32	2.22	0.85	2.83	0.55	2.27	0.60	2.31	1.00	2.39
O/TAI 1/2023	ME-SA	Ind-2001	0.44	1.69	0.15	1.90	0.35	2.44	0.40	2.14	0.33	2.06	0.63	2.16
O/TUR 1/2023	ME-SA	PanAsia-2	0.37	1.65	0.28	1.93	0.63	2.61	0.51	2.04	0.37	2.14	0.56	1.97
O/TUR 2/2023	ME-SA	PanAsia-2	0.33	1.60	0.25	1.88	0.56	2.56	0.34	1.86	0.34	2.06	0.67	2.05
O/TUR 3/2023	ME-SA	PanAsia-2	0.45	1.73	0.32	1.99	0.62	2.60	0.48	2.01	0.31	2.02	0.55	1.96
O/PAT 3/2022	ME-SA	PanAsia-2	0.65	1.82	0.29	1.79	0.51	2.43	0.52	1.90	0.27	1.93	0.59	2.02
O/PAT 2/2023	ME-SA	PanAsia-2	0.52	1.62	0.30	1.76	0.34	2.26	0.37	1.76	0.15	1.68	0.58	2.01
O/TAI 16/2022	SEA	Tai-87	0.18	1.29	0.00	0.00	0.08	1.78	0.06	1.30	0.11	1.57	0.18	1.61

Table 6: Vaccine matching studies for A FMDV

Isolate	Serotype SAT 2		A GVII 2015 <i>Boehringer Ingelheim</i>		A Iran 2005 <i>Boehringer Ingelheim</i>		A Malaysia 97 <i>Boehringer Ingelheim</i>		A/TUR/20/06 <i>MSD Animal Health</i>		A22 Iraq <i>Boehringer Ingelheim</i>	
	Topotype	Lineage	r ₁	titre	r ₁	titre	r ₁	titre	r ₁	titre	r ₁	titre
A/PAK 4/2023	ASIA	Iran-05	0.20	1.24	0.16	1.77	0.15	1.72	0.26	1.85	0.25	2.05
A/PAK 5/2023	ASIA	Iran-05	0.14	1.08	0.23	1.91	0.11	1.59	0.25	1.83	0.20	1.96
A/TAI 8/2021	ASIA	Sea-97	0.54	1.75	0.14	1.67	0.45	2.06	0.17	1.64	0.25	1.95
A/TAI 1/2022	ASIA	Sea-97	0.38	1.60	0.08	1.46	0.32	1.92	0.19	1.70	0.18	1.80
A/TAI 14/2022	ASIA	Sea-97	0.71	1.87	0.17	1.76	0.66	2.23	0.29	1.89	0.28	2.00

Table 7: Vaccine matching studies for Asia-1 FMDV

Isolate	Serotype Asia-1		Asia 1 Shamir <i>Boehringer Ingelheim</i>	
	Topotype	Lineage	r ₁	titre
ASIA1/PAK 26/2022	Asia	Sindh-08	0.40	2.14
ASIA1/PAK 39/2022	Asia	Sindh-08	0.33	2.06

Table 8: Vaccine matching studies for SAT 2 FMDV

Isolate	Serotype SAT 2		Eritrea 98 <i>Boehringer Ingelheim</i>		SAT2 Zim 83 <i>Boehringer Ingelheim</i>	
	Topotype	Lineage	r ₁	titre	r ₁	titre
SAT2/TUR 4/2023	XIV	-	1.00	1.68	0.31	1.95
SAT2/TUR 17/2023	XIV	-	0.72	1.52	0.25	1.86

Annex 1: Sample data

Summary of submissions

Table 9: Summary of samples collected and received to WRLFMD October to December 2023

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	ASIA1		Positive	Negative
Israel	6	6	-	-	-	-	-	-	-	6	-
Palestine	6	4	-	-	-	-	-	-	2	6	-
Türkiye	20	3	-	-	-	17	-	-	-	20	-
TOTAL	32	13	0	0	0	17	0	0	2	32	0

Clinical samples

Table 10: Clinical sample diagnostics made by the WRLFMD October to December 2023

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	VI/ELISA	Results	
	Received	Reported					RT-PCR	Final report
Türkiye	24 Aug 2023	06 Oct 2023	TUR 1/2023	CATTLE	02 Jan 2023	O	FMDV GD	O
			TUR 2/2023	SHEEP	17 Jan 2023	O	FMDV GD	O
			TUR 3/2023	CATTLE	03 Mar 2023	O	FMDV GD	O
			TUR 4/2023	CATTLE	11 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 5/2023	CATTLE	11 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 6/2023	CATTLE	17 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 7/2023	CATTLE	17 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 8/2023	CATTLE	21 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 9/2023	CATTLE	24 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 10/2023	CATTLE	24 Mar 2023	SAT2	FMDV GD	SAT2
			TUR 11/2023	CATTLE	17 Apr 2023	SAT2	FMDV GD	SAT2
			TUR 12/2023	CATTLE	17 Apr 2023	SAT2	FMDV GD	SAT2
			TUR 13/2023	CATTLE	04 May 2023	SAT2	FMDV GD	SAT2
			TUR 14/2023	CATTLE	18 May 2023	SAT2	FMDV GD	SAT2
			TUR 15/2023	CATTLE	26 May 2023	SAT2	FMDV GD	SAT2
			TUR 16/2023	CATTLE	30 May 2023	SAT2	FMDV GD	SAT2
			TUR 17/2023	CATTLE	08 Jun 2023	SAT2	FMDV GD	SAT2
			TUR 18/2023	CATTLE	14 Jun 2023	SAT2	FMDV GD	SAT2
			TUR 19/2023	CATTLE	14 Jun 2023	SAT2	FMDV GD	SAT2
			TUR 20/2023	CATTLE	26 Jun 2023	SAT2	FMDV GD	SAT2

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
Israel	05 Oct 2023	17 Oct 2023	ISR 11/2022	CATTLE	14 Jul 2022	O	FMDV GD	O
			ISR 12/2022	CATTLE	14 Jul 2022	O	FMDV GD	O
			ISR 1/2023	CATTLE	03 Jan 2023	O	FMDV GD	O
			ISR 2/2023	CATTLE	03 Jan 2023	O	FMDV GD	O
			ISR 3/2023	CATTLE	12 Jan 2023	O	FMDV GD	O
			ISR 4/2023	CATTLE	12 Jan 2023	O	FMDV GD	O
Palestine	05 Oct 2023	17 Oct 2023	PAT 3/2022	SHEEP	13 Dec 2022	O	FMDV GD	O
			PAT 4/2022	SHEEP	12 Dec 2022	O	FMDV GD	O
			PAT 1/2023	GOAT	15 Feb 2023	O	FMDV GD	O
			PAT 2/2023	GOAT	15 Feb 2023	O	FMDV GD	O
			PAT 3/2023	SHEEP	09 Aug 2023	NVD	FMDV GD	FMDV GD
			PAT 4/2023	SHEEP	09 Aug 2023	NVD	FMDV GD	FMDV GD
TOTAL					95			

Annex 2: FMD publications

Recent FMD Publications October to December 2023 cited by Web of Science.

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8. Chanchaidechachai, T., H.W. Saatkamp, H. Hogeveen, M.C.M. de Jong, and E.A.J. Fischer (2023). Evaluation of foot and mouth disease control measures: Simulating two endemic areas of Thailand. *Preventive Veterinary Medicine*, **220**: 10. DOI: [10.1016/j.prevetmed.2023.106045](https://doi.org/10.1016/j.prevetmed.2023.106045).
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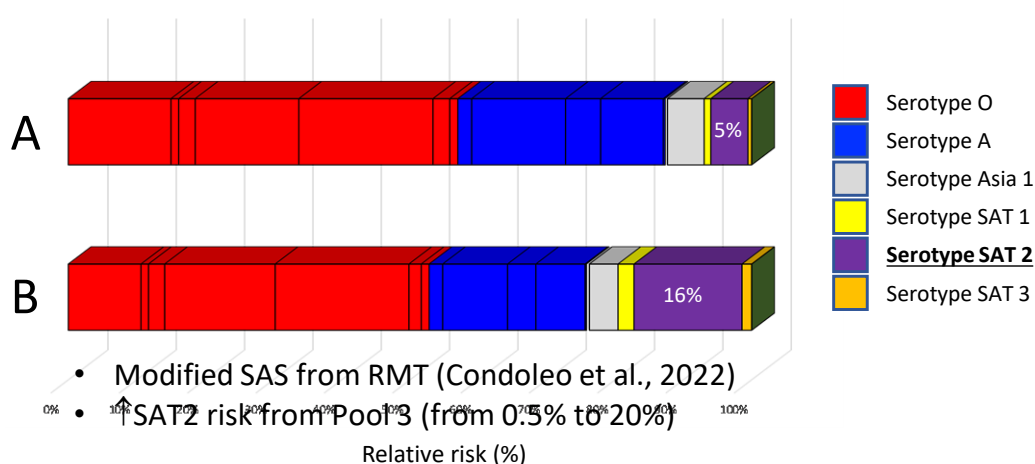
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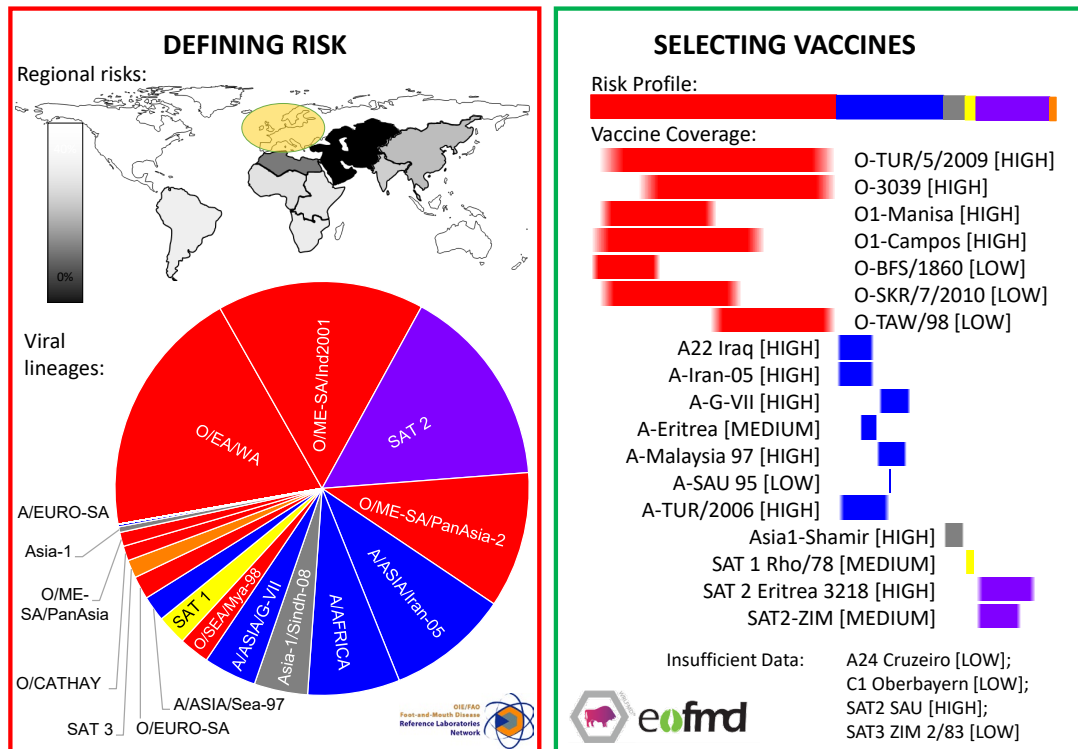
Annex 3: Vaccine recommendations

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 WOAHA/FAO FMD reference 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. NB: The outputs below consider the viral lineage score for October 2023 and will be updated for the next report to accommodate the proposed changes highlighted in Table 1 (Section 3.9).

FMD risk profiles for Europe: October 2023:

NB: The two outputs below define FMD risks for Europe which reflect the on-going situation in Pool 3 where FMD cases due to SAT2/XIV have been reported in three countries (Iraq, Jordan and Türkiye). These outputs use Score Area Scores from PRAGMATIST that have been parameterised with data from the FMD EURL meeting in 2017 (A) or the approach describe by Condoleo *et al.*, 2022). The PRAGMATIST figure (below) uses the worst case SAT2 scenario.





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

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.

Further information about the PRAGMATIST system has been published in *Frontiers in Veterinary Science* - see: <https://doi.org/10.3389/fvets.2022.1029075>.

Condoleo *et al.*, 2022: Risk monitoring tool for FAST diseases (RMT-FAST): a semi-quantitative framework to estimate the risk of disease introduction. EuFMS Open Session, Marseille. (<https://www.eufmd.info/os22>)

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

Courses

- The WRLFMD will host a two-week practical training course in FMD Diagnostic methods (<https://www.pirbright.ac.uk/instructor-led-training/diagnosis-foot-and-mouth-disease>) during May 2024.
- A second practical course will be offered at Pirbright during May 2024 to cover FMD post-vaccination monitoring through VNT and ELISA (<https://www.pirbright.ac.uk/instructor-led-training/fmd-post-vaccination-monitoring-through-vnt-and-elisa>).
- The [EuFMD's open-access Courses](#) provide convenient self-paced training which you may study anytime, anywhere, free of charge. There are currently 8 courses in English and 1 in Arabic:
 - **Introduction to Foot-and-Mouth Disease** (available in [English](#) and [French](#)), introducing foot-and-mouth disease (FMD), its importance, diagnosis, outbreak investigation and the control measures 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 facing 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.
 - **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 (WOAH), applying public-private partnerships to the control of FMD and similar transboundary animal diseases.
- **Simulation Exercises for Animal Disease Emergencies** (available through FAO eLearning academy) aiming at building your understanding of simulation exercises and their value as part of the emergency preparedness cycle.
- A course on **Introduction to the FMD Minimum Biorisk Management Standards** is currently in development. The virtual course will be open access, will target National Competent Authorities, Institute directors for FMD facilities, biorisk managers and laboratory personnel in laboratories handling infectious FMD. The learning objectives will include introduce the importance, implications and responsibilities of implementing the FMD Minimum Biorisk Management Standards.
- **Real Time Training in Kenya Induction Course (NTC 34)** from 20 to 23 February 2024 in Nakuru, Kenya.
- **Real Time Training in Kenya Induction Course (RTC 3)** from 25 to 28 February 2024 in Nakuru, Kenya.

Podcasts

We have a constantly updated series of short podcasts relating to the FAST world (<http://www.fao.org/eufmd/resources/podcasts/en/>).

- A series of videos on foot-and-mouth disease in English, Bulgarian, Greek and Turkish (<https://www.fao.org/eufmd/en/>).
- 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

- [EuFMD Special Committee on Biorisk Management](#) - 7 February 2024
- [EuFMD Standing Technical Committee](#) - 12 February 2024
- [Quadripartite meeting between Iraq, Jordan, Lebanon, the Syrian Arab Republic - EuFMD/FAO](#) - 13 February 2024
- [103rd Executive Committee of the EuFMD](#) - 12 March 2024
- [104th Executive Committee of the EuFMD](#) - 26 September 2024
- [Open Session of the Standing Technical Committee of the EuFMD - OS24 in Madrid, Spain](#) - 29 to 31 October 2024
- [105th Executive Committee of the EuFMD](#) - 12 March 2025
- [46th General Session of the EuFMD](#) - 6 to 7 May 2025

Proficiency test scheme organised by WRLFMD

Sample panels have been dispatched for the FMD PTS (Phase XXXV, supported with funding from EuFMD and UK Defra). Any laboratories interested in participating in future exercises should contract the WRLFMD for further information. 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; **Impact Risk Calculator**; **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.

Natural Resources and Sustainable Production Stream

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Together against wasting resources,
think twice before printing.

United Nations Sustainable Development Goals (UN-SDGs)

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