WRLFMD Quarterly Report July to September 2016

Reference Laboratory Contract Report

Foot-and-Mouth Disease

BBSRC bioscience for the future

THE Pirbright INSTITUTE

Department for Environment Food & Rural Affairs

eufmd

CONTENTS

1. Summary of samples tested and reported FMD outbreaks

1.1. ASIA

Afghanistan

27 samples were received to WRLFMD on 13/09/2016. Typing and sequencing results are awaited.

Hong Kong SAR

Six FMD type O viruses were isolated from samples collected from pigs in August 2016. All belonged to the CATHAY topotype.

Iran

Sixteen FMD type O, 7 type A and 1 type Asia 1 viruses were isolated mainly from cattle and sheep between January and April 2016. All 10 samples collected from sheep were from the hearts of cases of acute fatal myocarditis and were identified as O/ME-SA/PanAsia-2^{QOM-15}. Unusually, a heart sample from a puppy dog (which also died) was also submitted. This was also identified as O/ME-SA/PanAsia-2^{QOM-15}. Virus was identified in the heart tissue and was also isolated in cell cultures. Epithelium samples collected from cattle were identified as O/ME-SA/PanAsia-2^{QOM-15} (n=3), A/ASIA/G-VII (n=6), A/ASIA/Iran-05^{SIS-10} (n=1) or Asia 1/ASIA/Sindh-08 (n=1). Complete genome sequencing of the dog heart and a sheep heart has been undertaken.

Malaysia

Twelve FMD type O viruses and 1 type A virus were isolated from samples collected from cattle between July 2014 and September 2016. These were identified as O/SEA/Mya-98 and A/ASIA/Sea-97, respectively.

Mongolia

An outbreak due to FMD type A was reported in cattle on 16/07/2016 at Muu Khoot, 6 Bag, Sumber soum, Govi-Sumber. No samples have been received by the WRLFMD and no sequence analysis has been reported.

Myanmar

Two FMDV type O VP1 sequences were received from the OIE and Regional Reference Laboratory in Pakchong, Thailand. They were from two viruses collected in Rakhine State in 2016 and belonged to the O/ME-SA/Ind-2001d lineage. **This is the first report of this lineage in Myanmar, and these cases appear to represent a new introduction of the O/ME-SA/Ind-2001d lineage into Southeast Asia from the Indian Sub-continent (independent to cases in Laos and Vietnam)**.

Nepal

Fifteen FMD type O viruses were isolated from cattle (and one pig) collected between May 2014 and December 2015. These were all identified as O/ME-SA/Ind-2001d.

1.2. AFRICA

Botswana

Four FMD type SAT1 viruses and one SAT 2 virus were isolated from cattle samples collected between March and August 2015. The samples (provided by the Botswana Vaccine Institute; BVI) were collected in two distinct geographical locations: Maun, North-west district (SAT 1 and SAT 2) and Kasane, Chobe district (SAT 1). Although all SAT 1 viruses belonged to topotype III, they fell into two distinct lineages which corresponded with their geographical origin. The SAT 2 virus belonged to topotype III.

Egypt

From a batch of 32 samples received, 18 were typed as FMD type O, two as FMD type A and one as FMD type SAT 2. The other samples were FMDV-GD (n=1) or NVD (n=10). All the type O viruses were of the EA-3 topotype, the A's were AFRICA/G-IV and the SAT 2 was VII/Alx-12. Three historical samples were also received for confirmatory identification.

Malawi

FMDV genome was detected in a single sample of bovine epithelium collected in September 2015 (Mthumba Dip Tank, T/A Katunga, Chikwawa, Shire Valley), however, no virus could be isolated in cell cultures and therefore has remained untyped. The BVI, who supplied the sample, were able to type and sequence FMDV SAT 1 (topotype I). They also typed as SAT 1 a sample collected from a later outbreak in cattle at Bangula Dip Tank, Bangula, Nsanje in January 2016. The two sequences shared 98.9% identical nucleotides in VP1.

Mauritius

FMD was reported for the first time on 7th July 2016 on the island of Rodrigues (>158 outbreaks). It subsequently spread to the main island of Mauritius on 1st August where five outbreaks were reported up to 5th September. The virus was identified as FMD type O and VP1 sequenced by ANSES (labelled MAUR in the tree below) and the BVI (labelled MUS in the tree below). The outbreaks were caused by O/ME-SA/Ind-2001d. Samples were received to WRLFMD from ANSES and were typed and sequenced (VP1); complete genome sequencing and vaccine matching is underway.

Mozambique

Two samples were submitted by the BVI that were collected from cattle in Mapulanguene, Magude, Maputo in June 2015. One was identified as FMD type SAT 2 (topotype I) and the other was NVD.

Namibia

Four samples were submitted by the BVI which had been collected from cattle in May and August 2015. Only one grew in cell cultures and was identified as FMD SAT 2 (topotype III). Two were FMDV-GD and one was NVD.

Zambia

Three samples were submitted by the BVI which had been collected from cattle in three different locations. One was identified as FMD type A (AFRICA/G-I), one as SAT 2 (topotype IV) and the other as SAT 3 (topotype II). Complete genome sequencing has also been performed.

Zimbabwe

Between 20th June and 5th September 2016, 20 outbreaks of FMD type SAT 2 were reported in cattle. These occurred in two areas, Matabeleland South/Masvingo and Matabeleland North/Midlands. Four samples (which were collected from cattle in April and August 2015) were submitted by the BVI. Two of these were identified as FMD SAT 2 (topotype II), while the other two were FMDV-GD and NVD.

1.3. SOUTH AMERICA

No new outbreaks of FMD were reported in the region.

STOP PRESS - RUSSIA:

On 20th October, an FMD outbreak has been reported to the OIE from the Russian Federation. Ninety FMD cases have been detected in cattle in Vyshmanovo, Sobinsky, VLADIMIRSKAYA OBLAST.

The serotype has been reported as Asia-1.

1.4. Uncharacterised FMD viruses

A number of outbreaks have occurred where samples have not been sent to the WRLFMD. It is probable that the countries involved have performed their own genetic characterisation; however, through the OIE/FAO laboratory network we would also like to encourage the submission of samples (or complete VP1 sequences) to the WRLFMD.

An up-to-date list and reports of FMD viruses characterised by sequencing can be found at the following website: http://www.wrlfmd.org/fmd_genotyping/2016.htm.

Results from samples received at WRLFMD (status of samples being tested) are shown in Table 1 and a complete list of clinical sample diagnostics made by the WRLFMD between July and September 2016 is shown in Annex 1 (Summary of Submissions). A record of all samples received by WRLFMD (July to September 2016) is shown in Annex 1 (Clinical Samples).

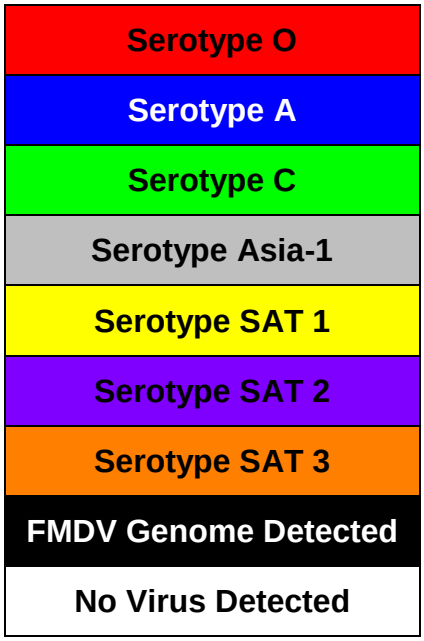
Table 1: Status of sequencing of samples received by the WRLFMD from July to September 2016 (* indicates samples carried over from the last quarter)

WRLFMD Batch No.	Date received	Country	Serotype	No. of samples	No. of sequences	Sequencing status
WRLFMD/2016/00017	14/06/2016	Egypt	O	1	1	Completed*
WRLFMD/2016/00017	14/06/2016	Egypt	SAT 2	1	1	Completed*
WRLFMD/2016/00018	15/06/2016	Iran	O	16	16	Completed*
WRLFMD/2016/00018	15/06/2016	Iran	A	7	7	Completed*
WRLFMD/2016/00018	15/06/2016	Iran	Asia 1	1	1	Completed*
WRLFMD/2016/00019	10/06/2016	Botswana	SAT 1	4	4	Completed*
WRLFMD/2016/00019	10/06/2016	Botswana	SAT 2	1	1	Completed*
WRLFMD/2016/00021	10/06/2016	Mozambique	SAT 2	1	1	Completed*
WRLFMD/2016/00022	10/06/2016	Zambia	A	1	1	Completed*
WRLFMD/2016/00022	10/06/2016	Zambia	SAT 2	1	1	Completed*
WRLFMD/2016/00022	10/06/2016	Zambia	SAT 3	1	1	Completed*
WRLFMD/2016/00023	10/06/2016	Zimbabwe	SAT 2	2	2	Completed*
WRLFMD/2016/00024	14/06/2016	Egypt	O	18	18	Completed*
WRLFMD/2016/00024	14/06/2016	Egypt	A	2	2	Completed*
WRLFMD/2016/00024	14/06/2016	Egypt	SAT 2	1	1	Completed*
WRLFMD/2016/00025	07/07/2016	Nepal	O	15	15	Completed
WRLFMD/2016/00026	10/06/2016	Namibia	SAT 2	1	1	Completed*
WRLFMD/2016/00027	24/08/2016	Hong Kong SAR of PRC	O	6	6	Completed
WRLFMD/2016/00028	07/09/2016	Malaysia	O	12	12	Completed
WRLFMD/2016/00028	07/09/2016	Malaysia	A	1	1	Completed
WRLFMD/2016/00029	13/09/2016	Afghanistan	Pending	(27†)		Pending
WRLFMD/2016/00030	20/09/2016	Mauritius	O	23	23	Completed
			Total	**116**	**116**	

*, received during the 2nd quarter of 2016
†, not included in totals

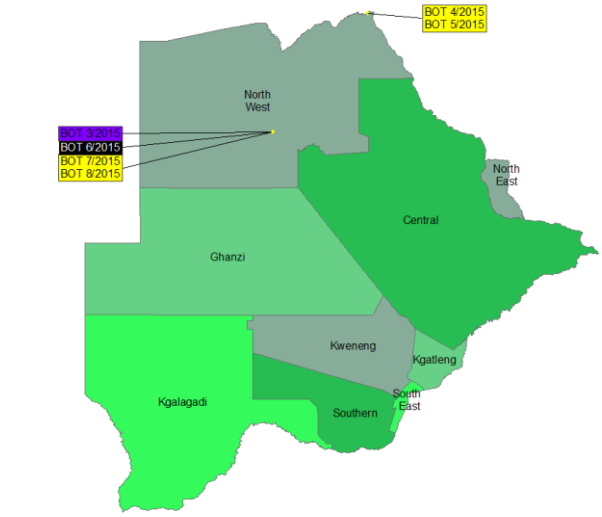
2. Detailed Analysis

Key for maps and trees:

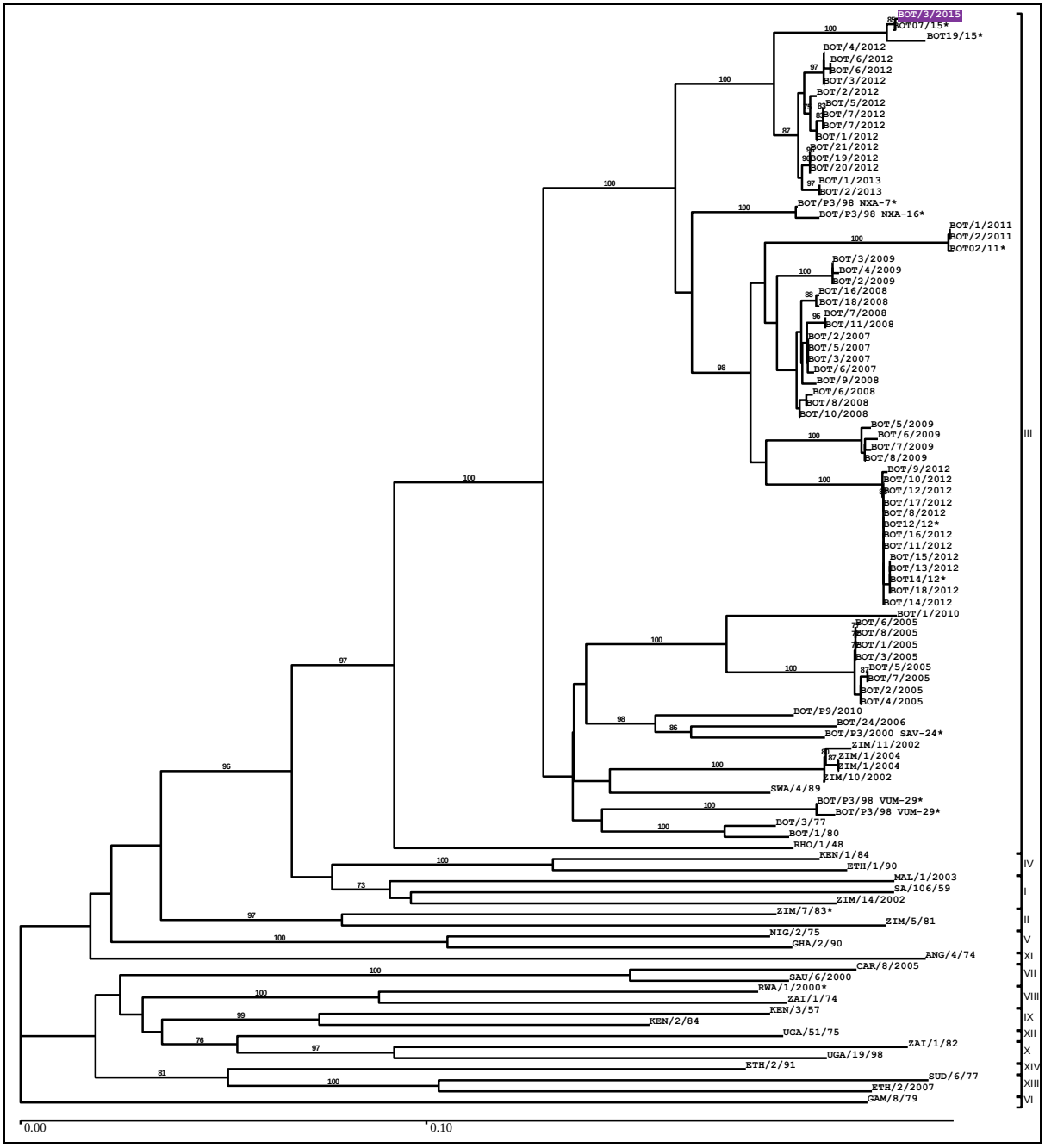


2.1. Africa

Botswana
WRLFMD/2016/00019
Date received: 10/06/2016
No. of samples: 6
SAT1 (III): 4
SAT2 (III): 1
FMDV-GD: 1

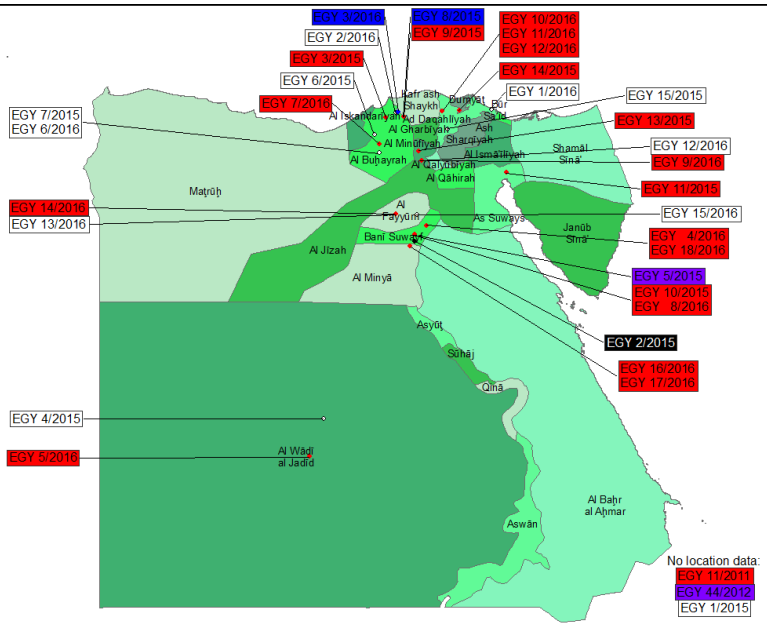


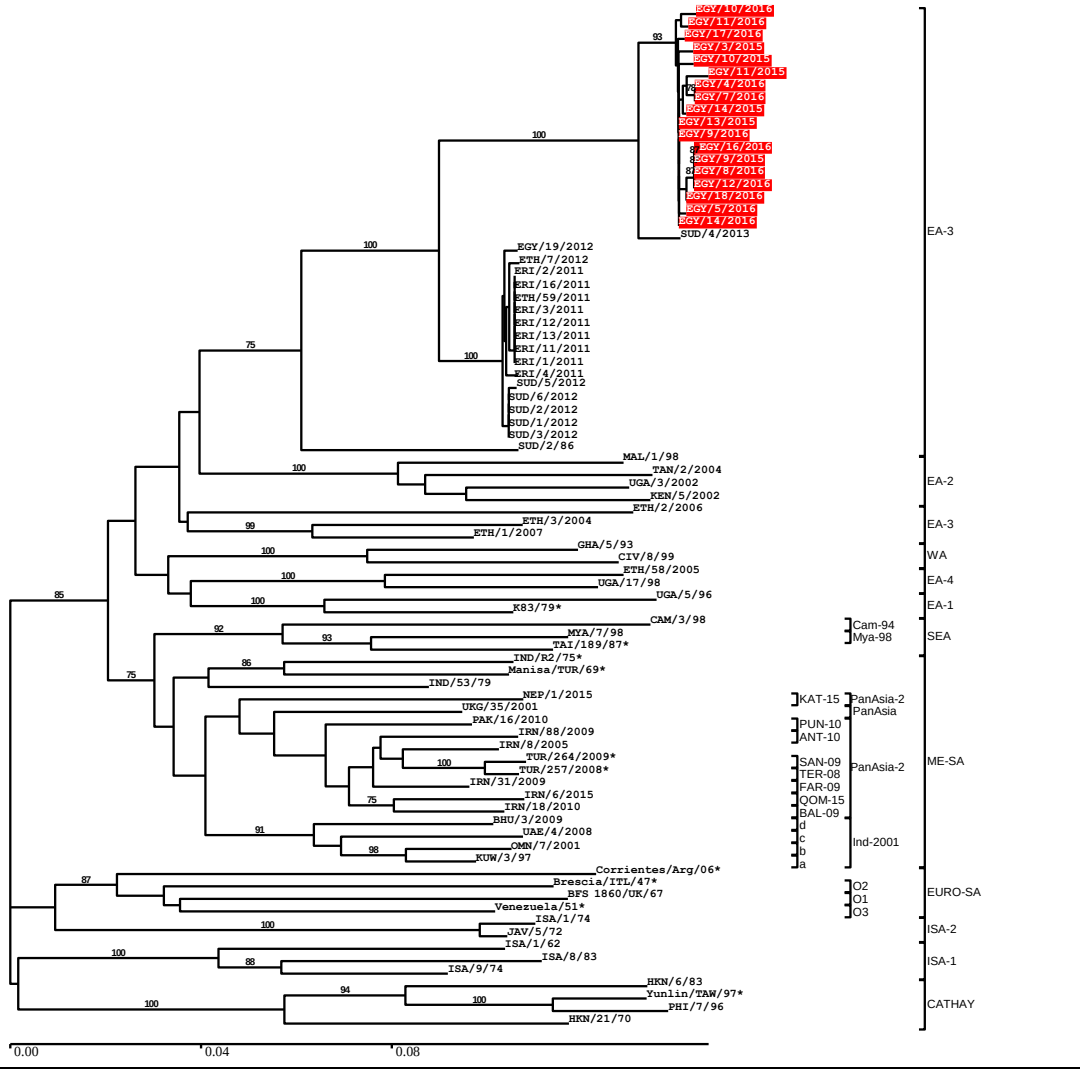
(Botswana Continued)



Egypt

WRLFMD/2016/00017
Date received: 14/06/2016
No. of samples: 3
O (ME-SA): 1
SAT2 (VII/Ghb-12): 1
NVD: 1
&
WRLFMD/2016/00024
Date received: 14/06/2016
No. of samples: 32
O (EA-3): 18
A (AFRICA/G-IV): 2
SAT2 (VII/Alx-12): 1
FMDV-GD: 1
NVD: 10





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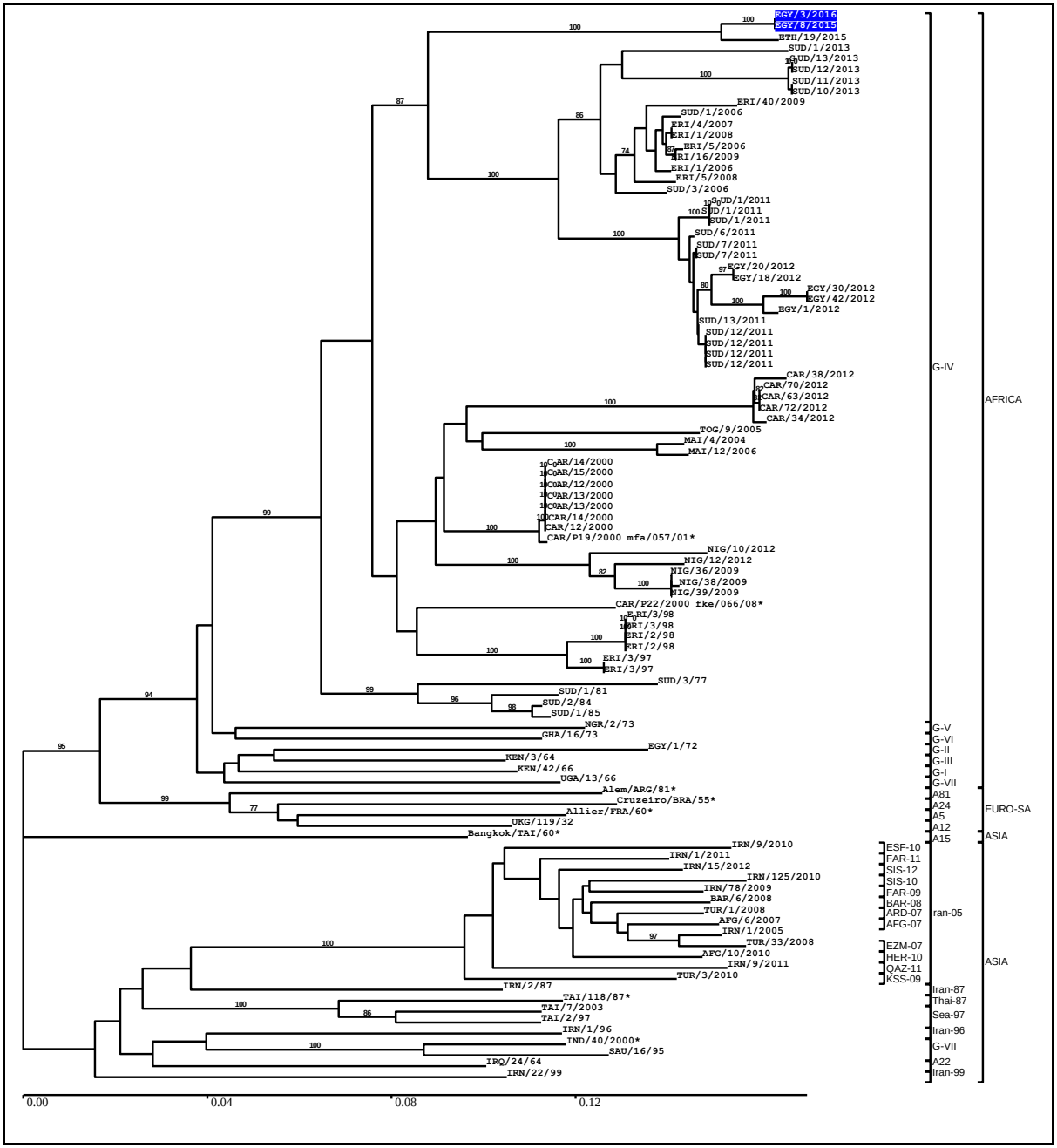
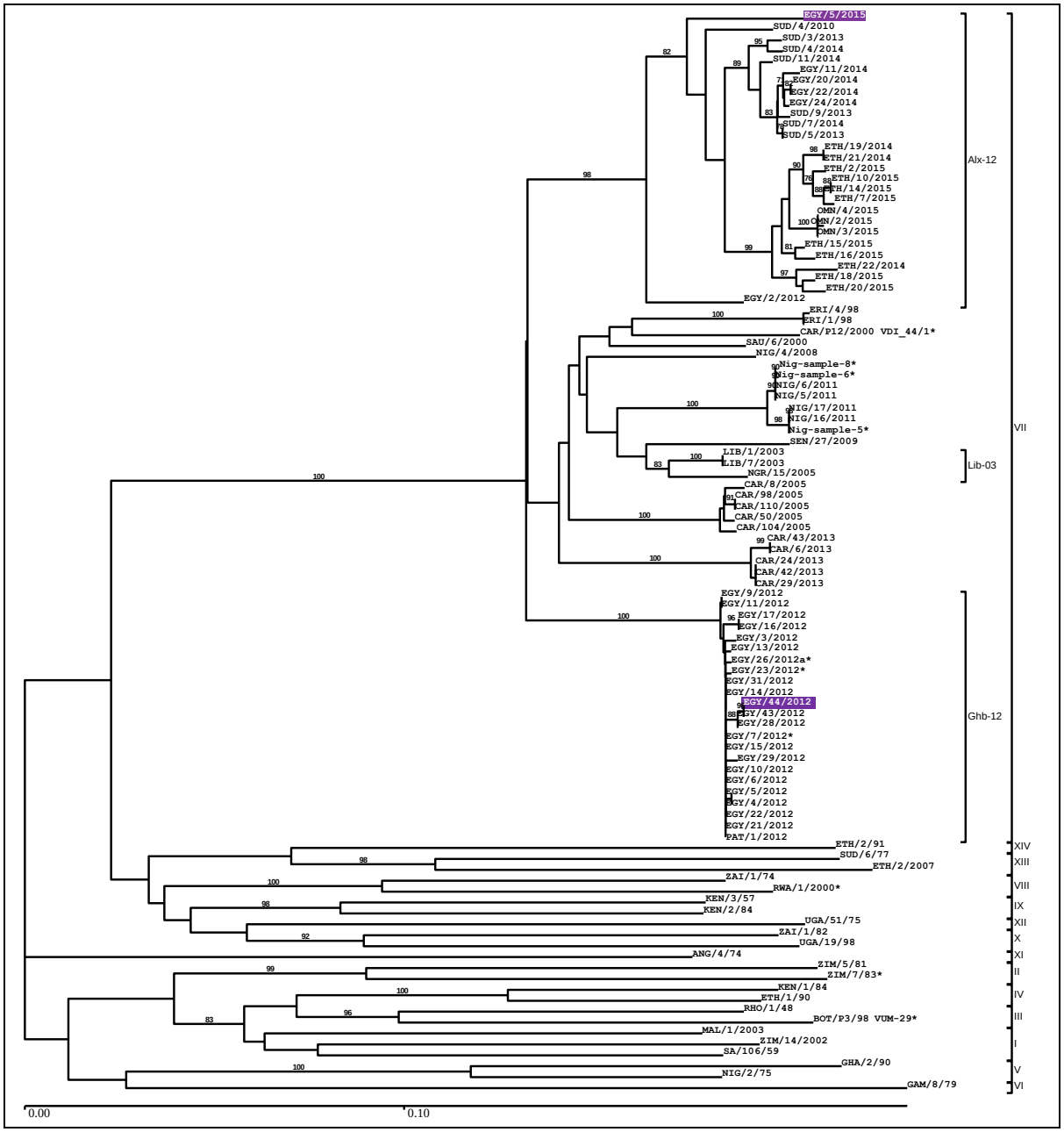
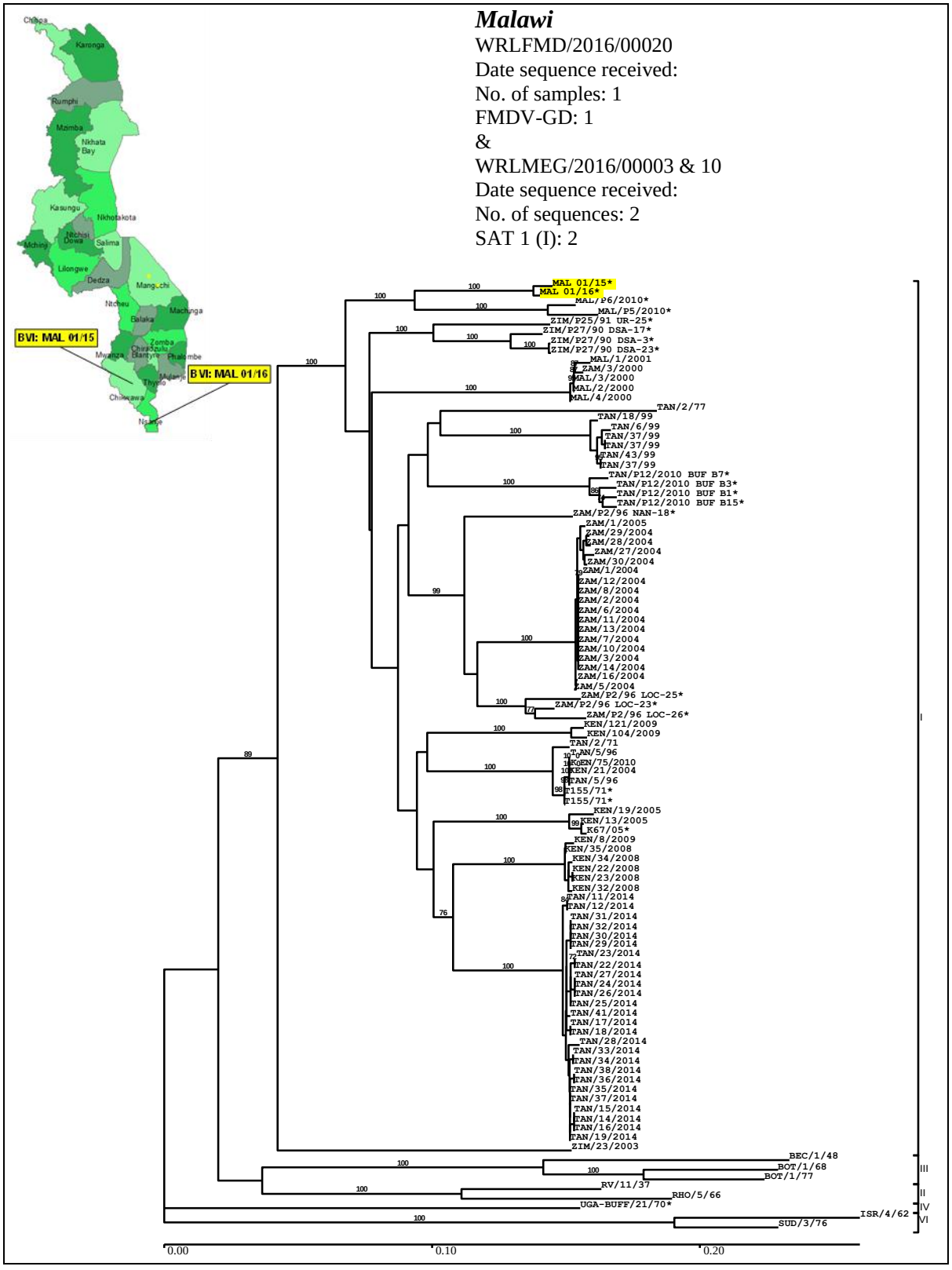


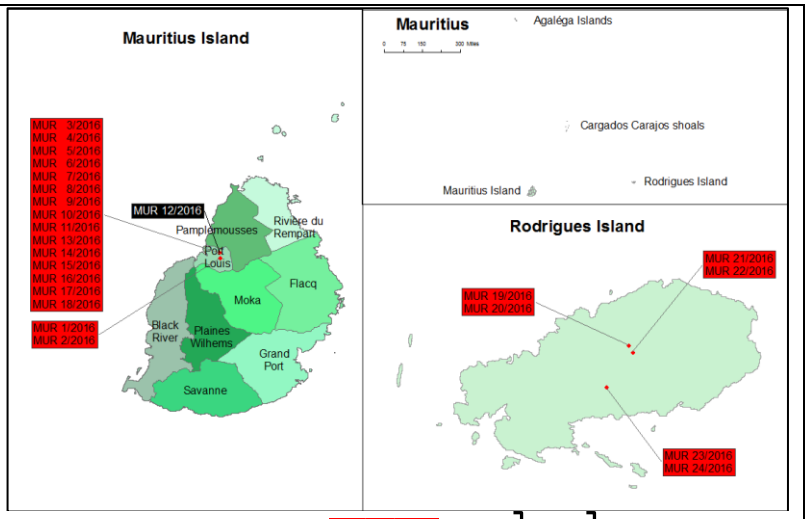
(Egypt continued)

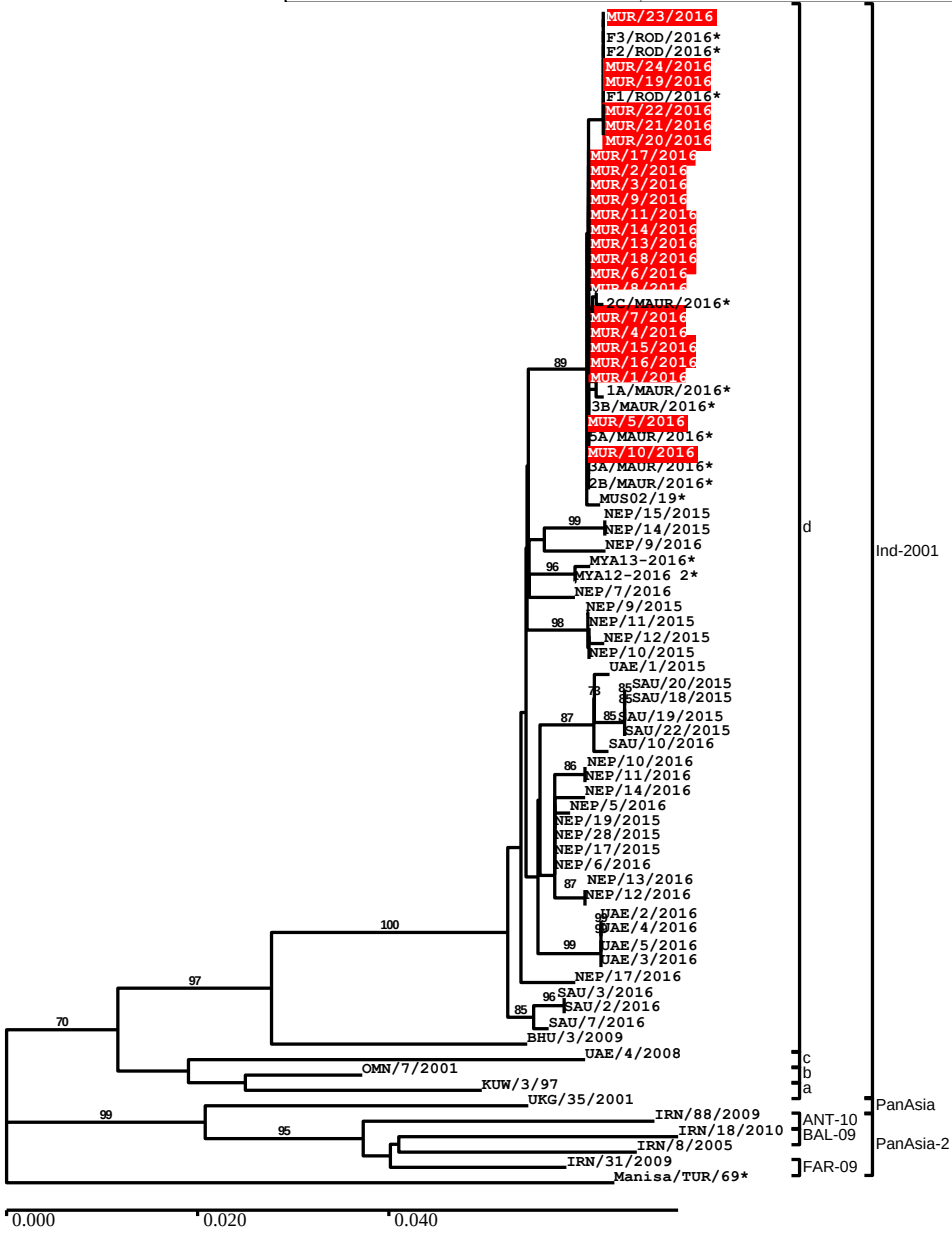




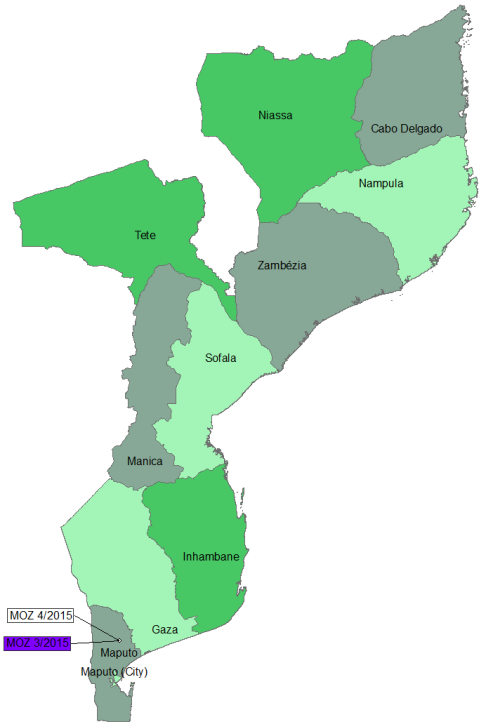
Malawi
WRLFMD/2016/00020
Date sequence received:
No. of samples: 1
FMDV-GD: 1
&
WRLMEG/2016/00003 & 10
Date sequence received:
No. of sequences: 2
SAT 1 (I): 2

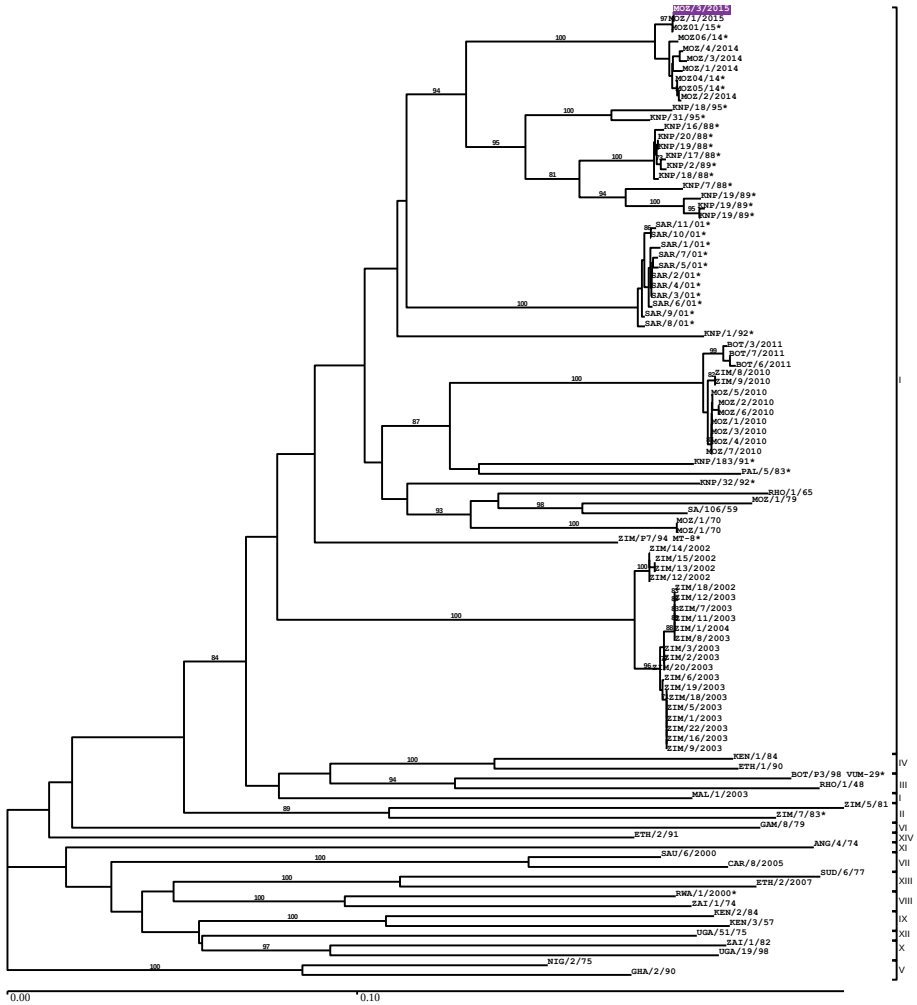
Mauritius
WRLFMD/2016/00030
Date received: 20/09/2016
No. of samples: 24
O (ME-SA/Ind-2001d): 23
FMDV-GD: 1



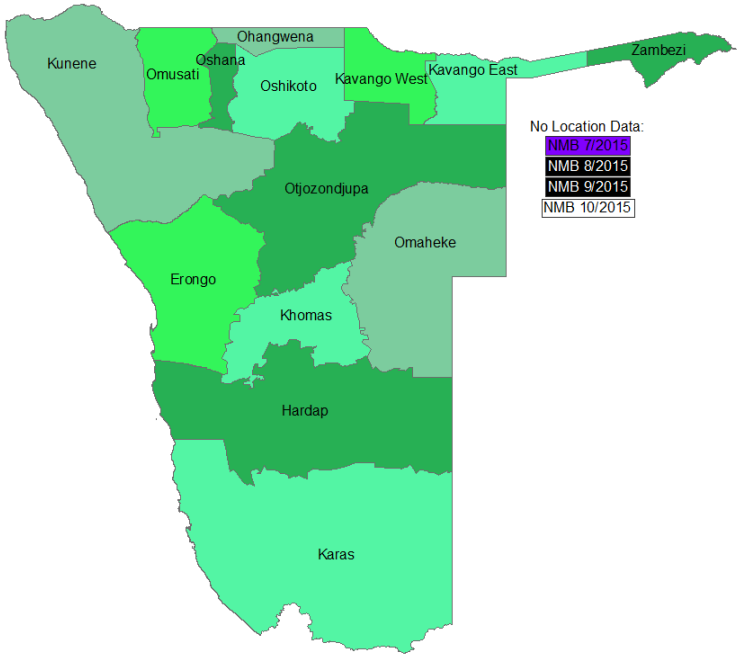


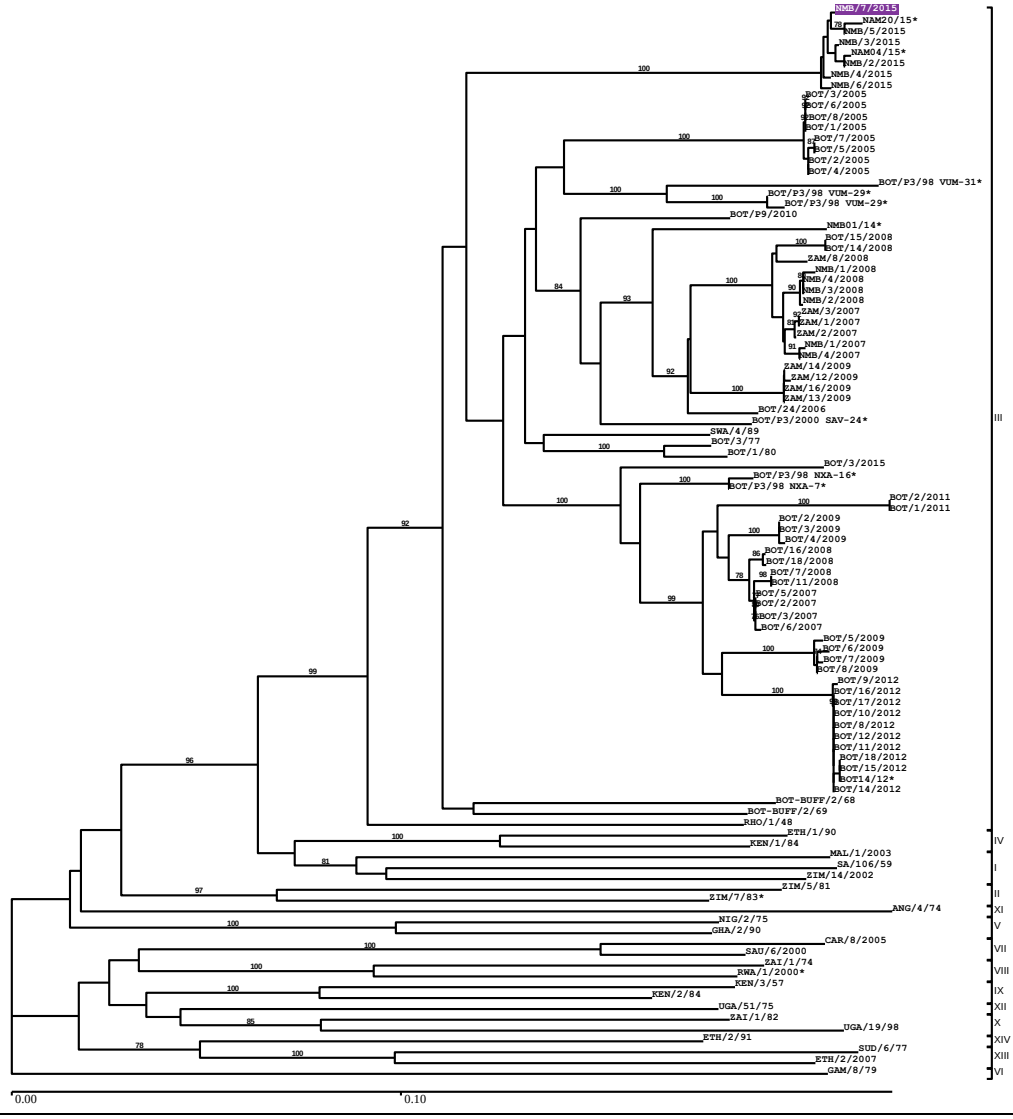
Mozambqique
WRLFMD/2016/00021
Date received: 10/06/2016
No. of samples: 2
SAT2 (I): 1
NVD: 1



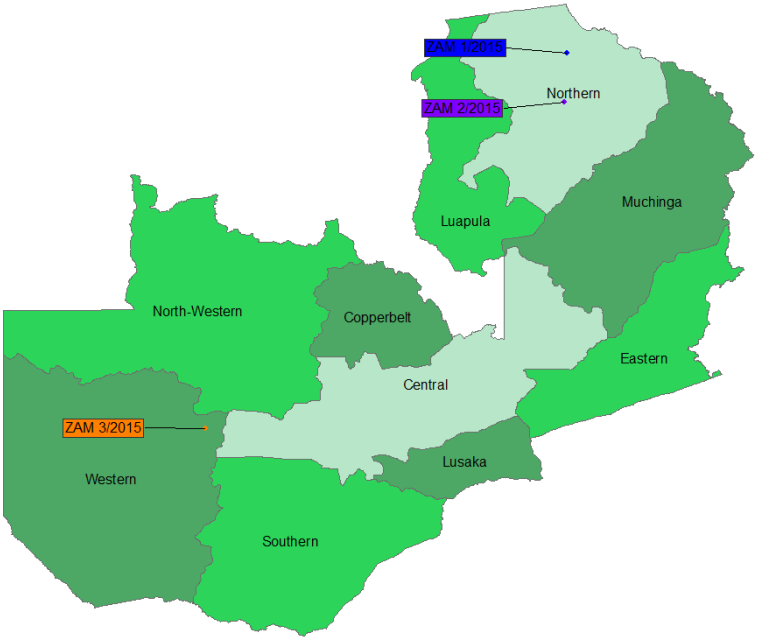


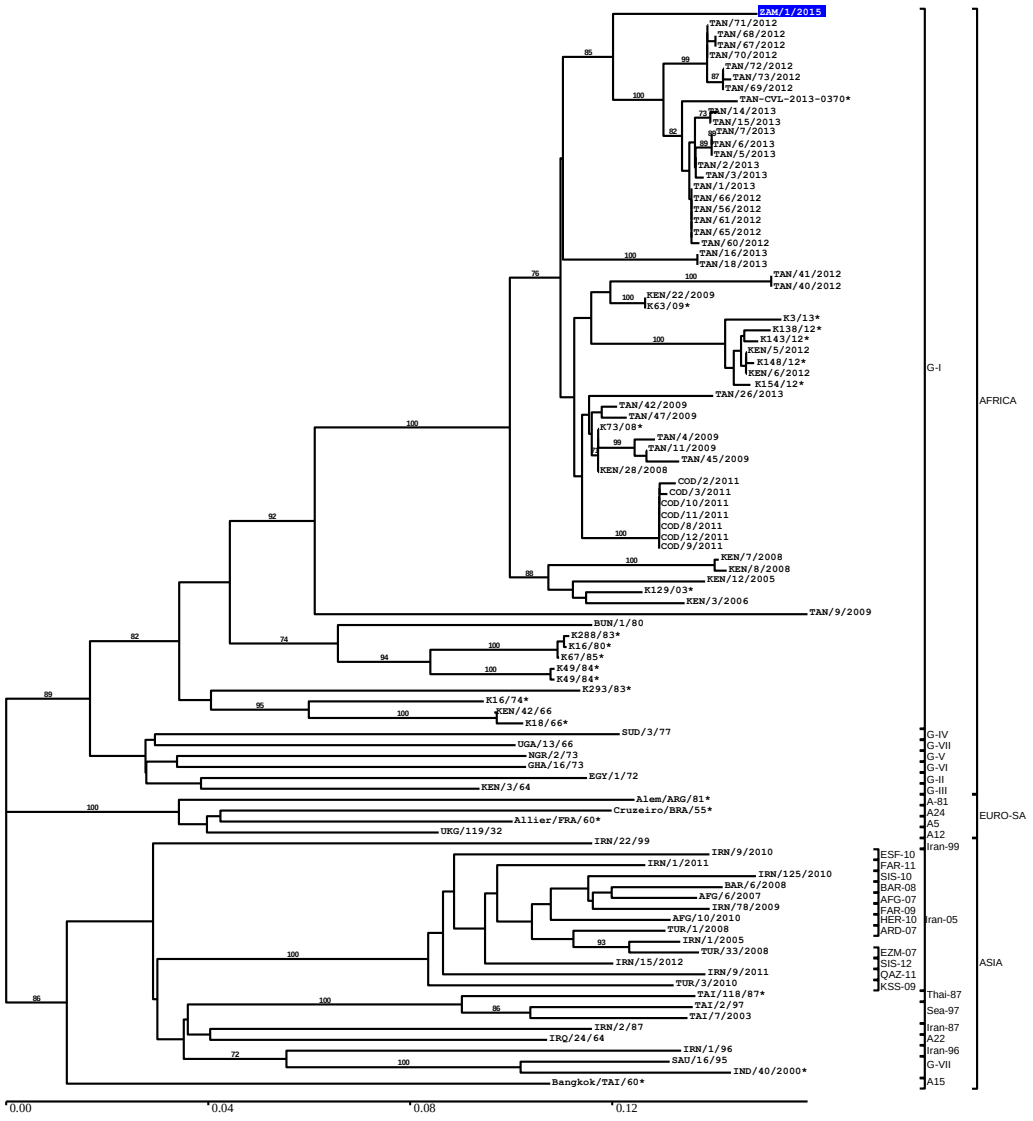
Namibia
WRLFMD/2016/00026
Date received: 10/06/2016
No. of samples: 4
SAT2 (III): 1
FMDV-GD: 2
NVD: 1





Zambia
WRLFMD/2016/00022
Date received: 10/06/2016
No. of samples: 3
A (AFRICA/G-I): 1
SAT2 (IV): 1
SAT3 (II): 1





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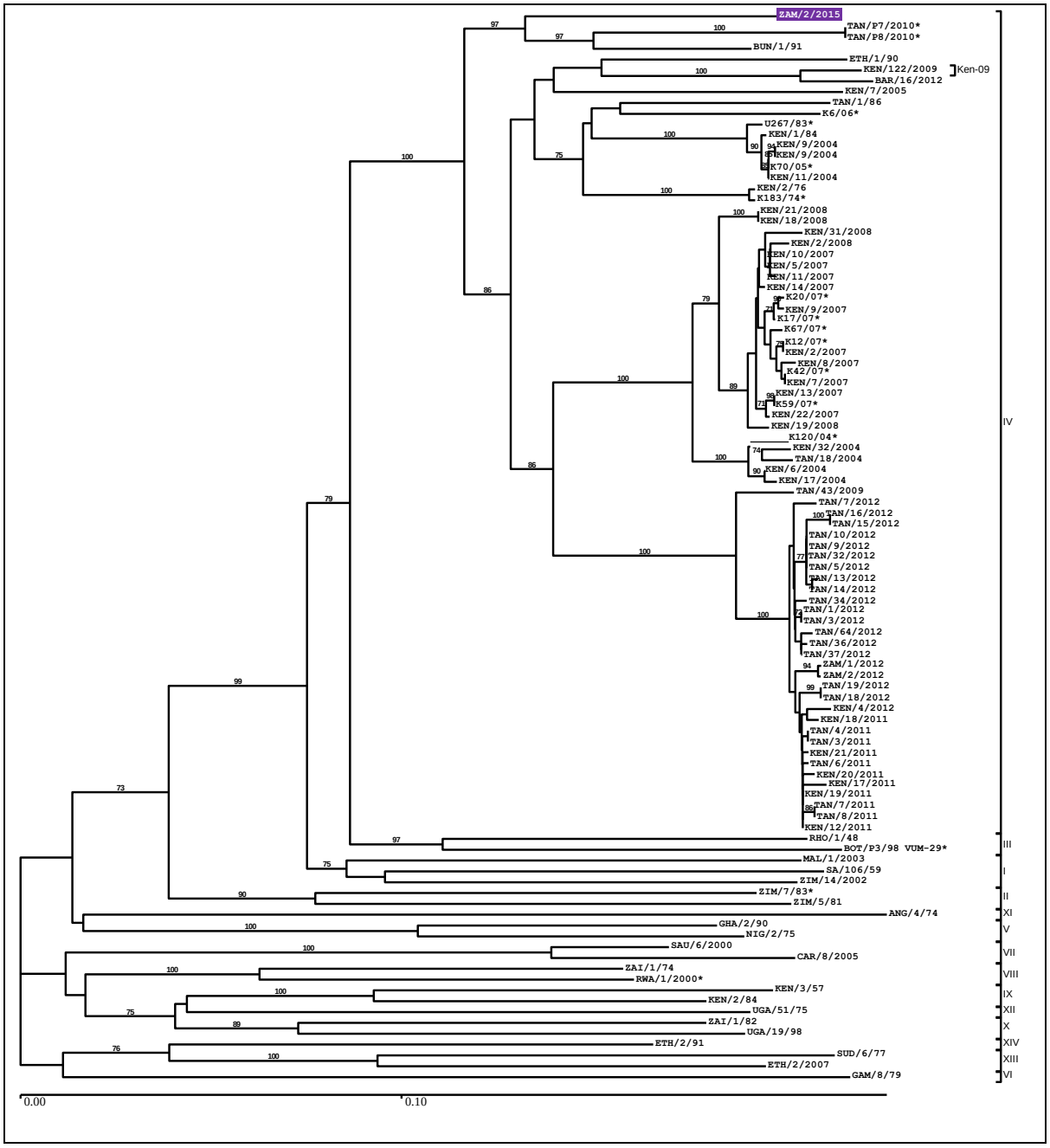
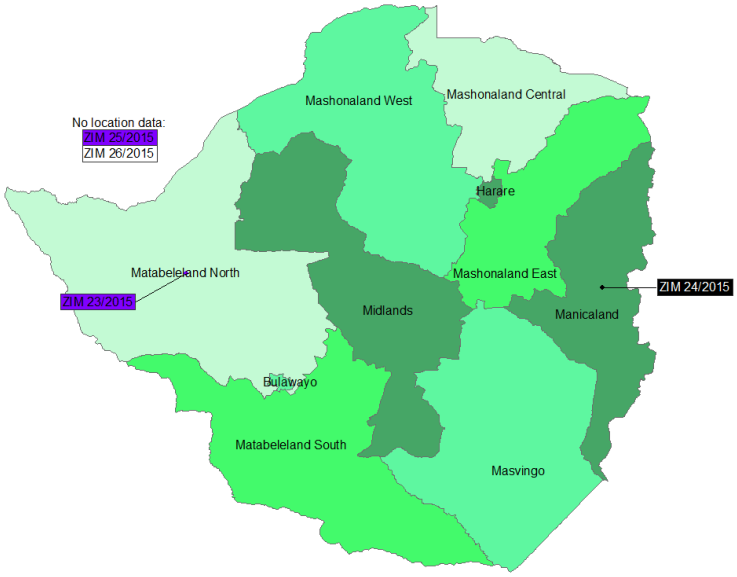
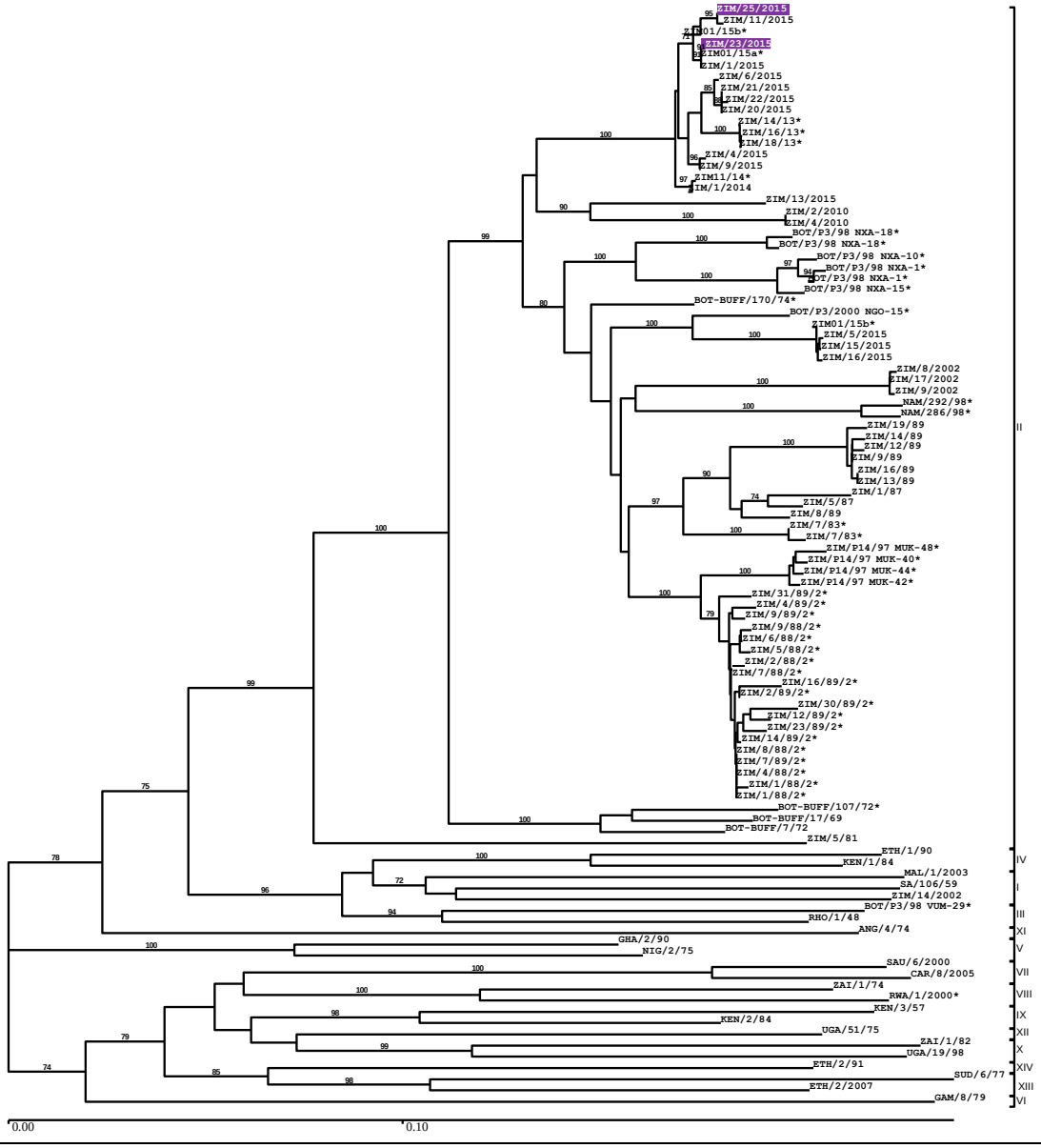


(Zambia continued)

Zimbabwe

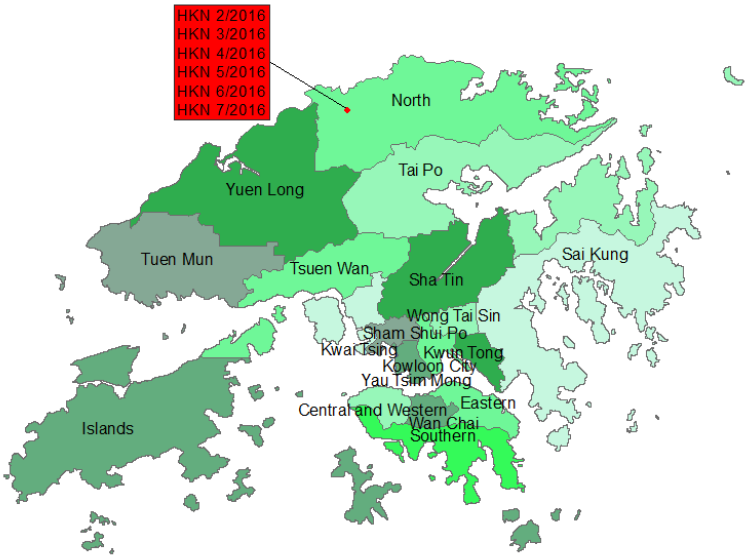
WRLFMD/2016/00023
Date received: 10/06/2016
No. of samples: 4
SAT2 (II): 2
FMDV-GD: 1
NVD: 1

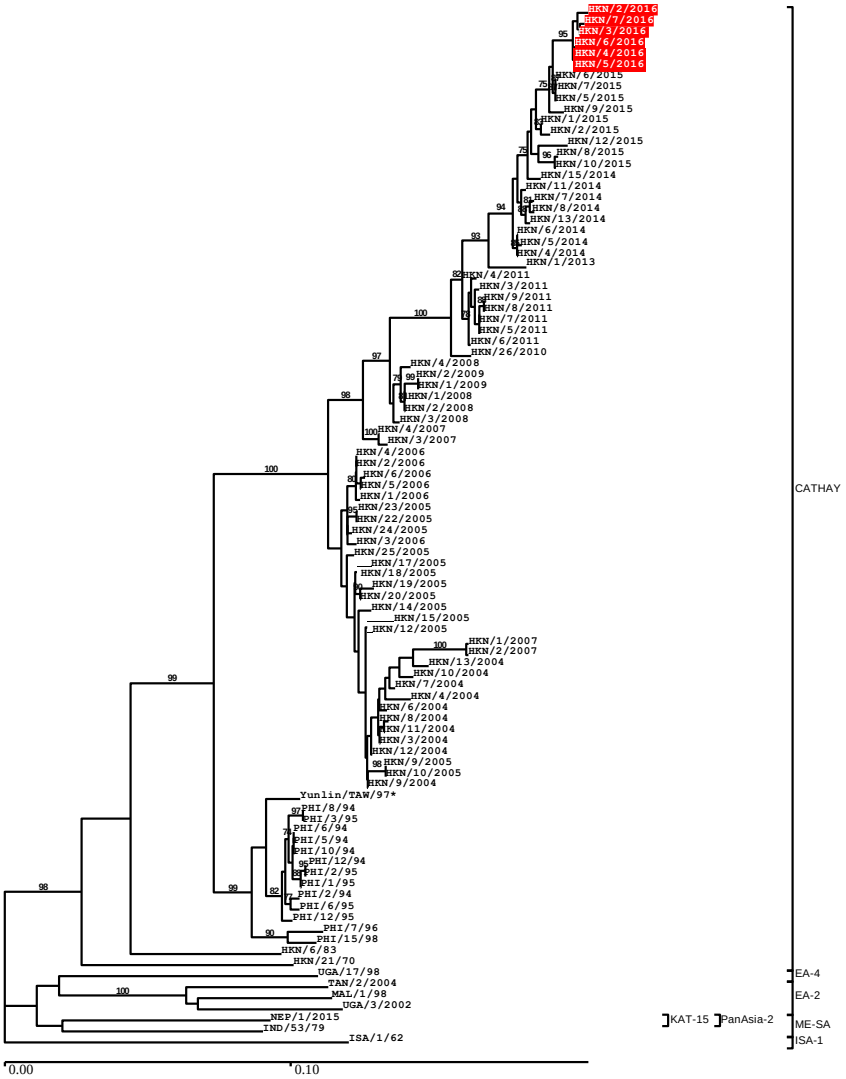




2.2. Asia

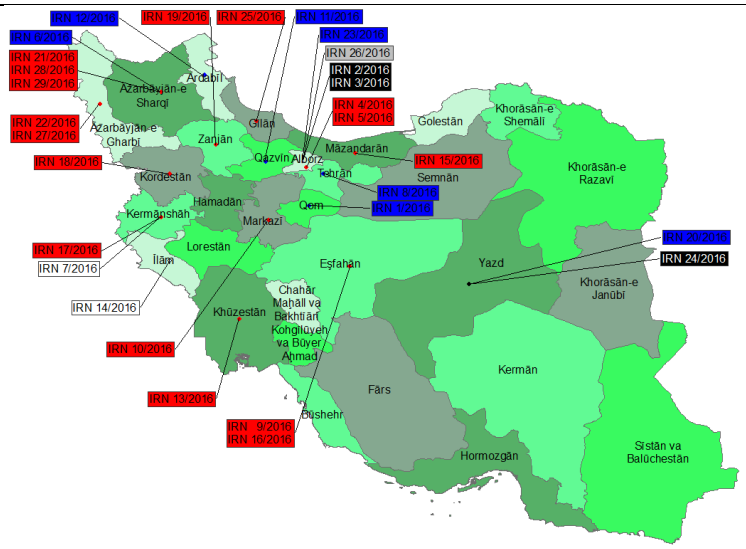
Hong Kong SAR
WRLFMD/2016/00027
Date received: 24/08/2016
No. of samples: 6
O (CATHAY): 6

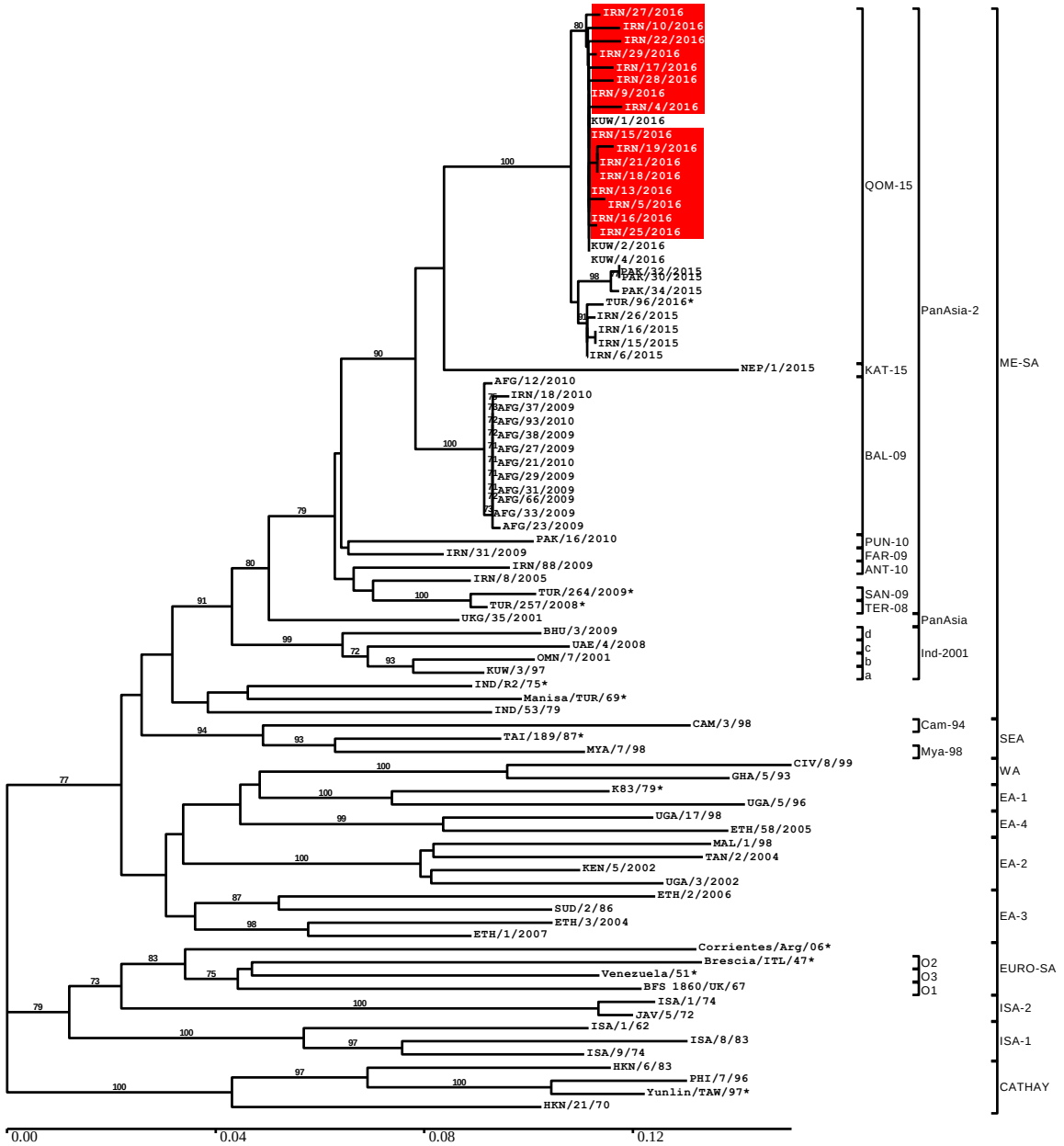




Iran

WRLFMD/2016/00018
Date received: 15/06/2016
No. of samples: 29
O (ME-SA/PanAsia-2^{QOM-15}): 16
A (ASIA/G-VII): 6
A (ASIA/Iran-05^{SIS-10}): 1
Asia1 (ASIA/Sindh-08): 1
FMDV-GD: 3
NVD: 2





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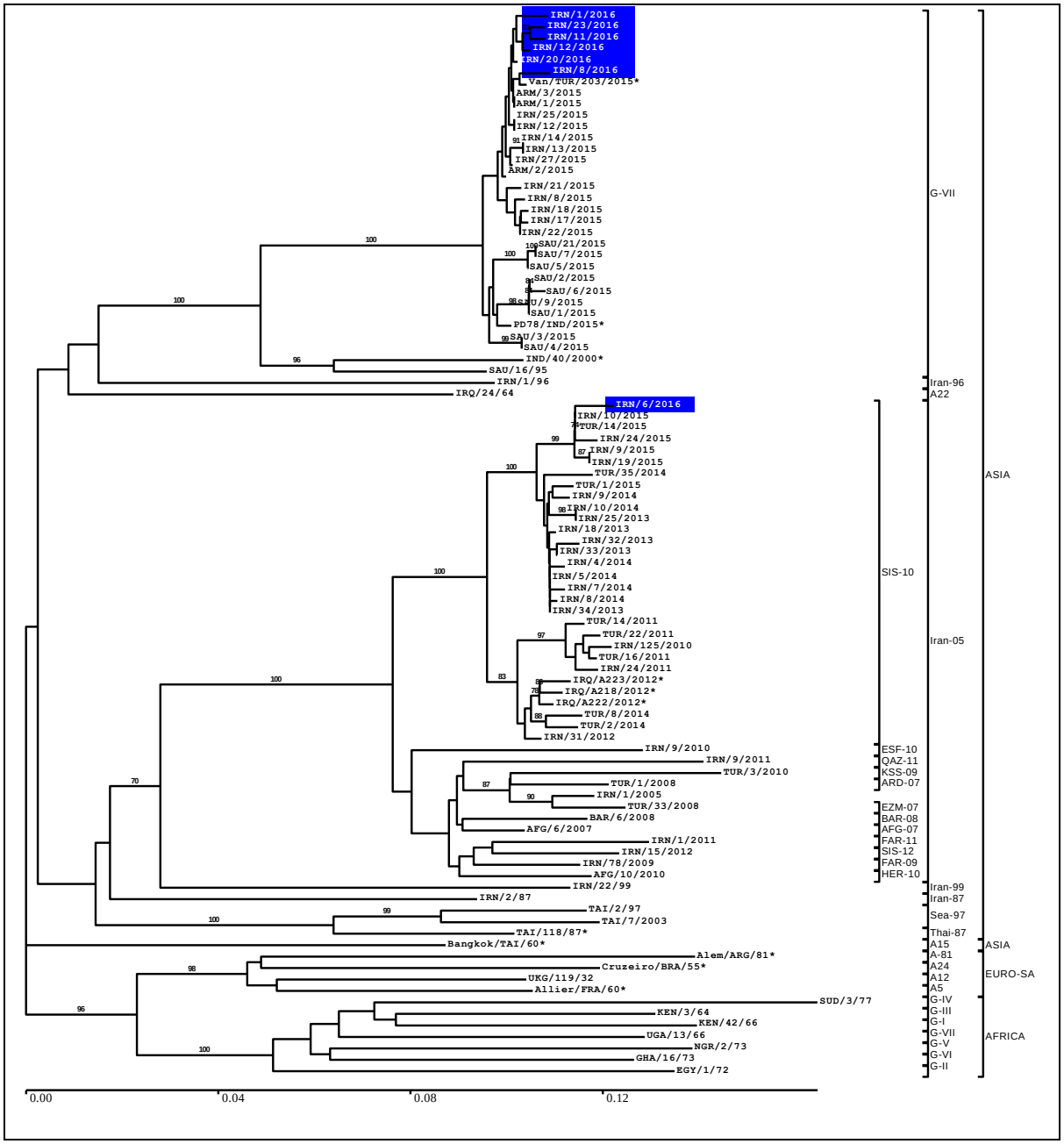

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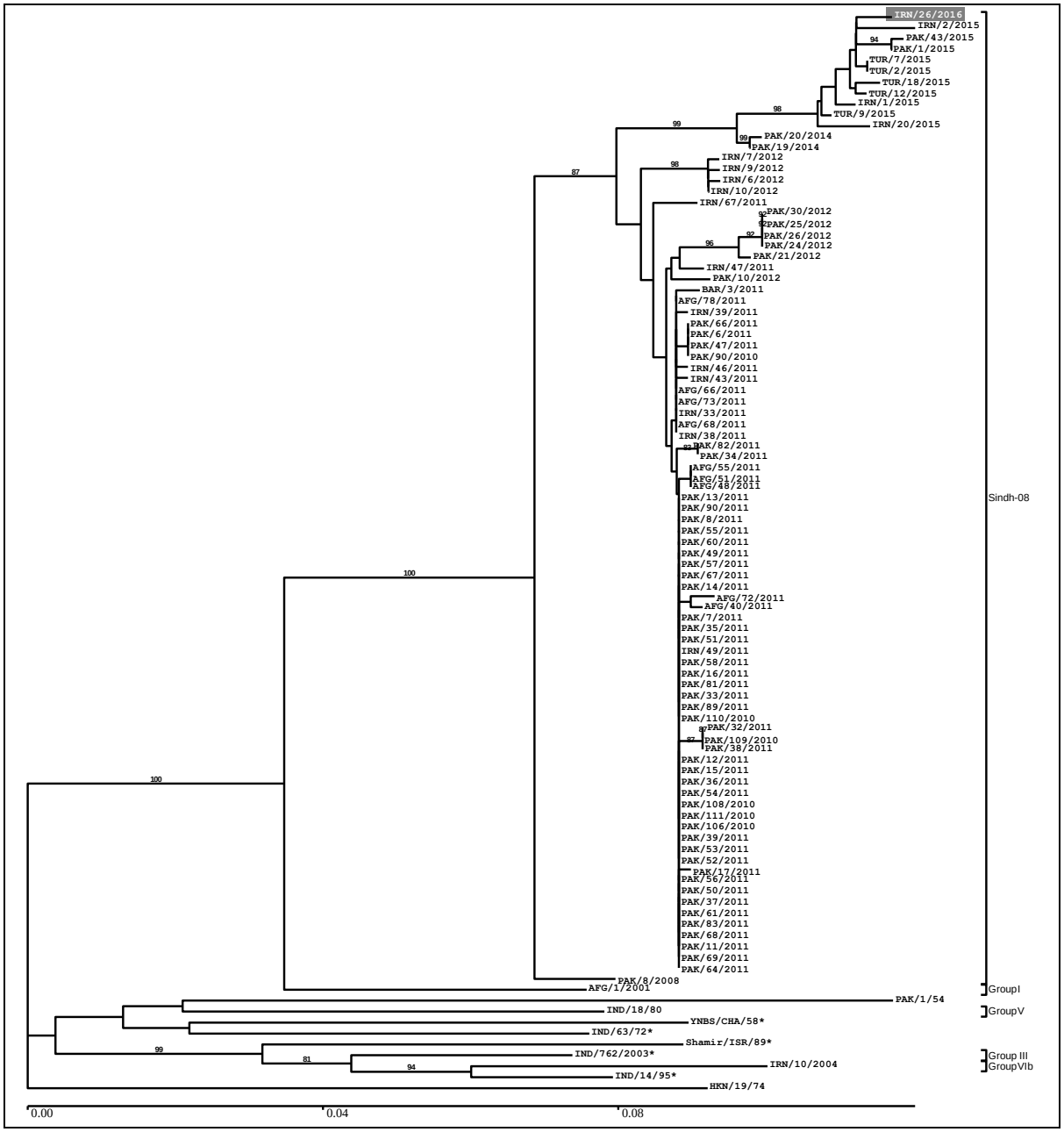
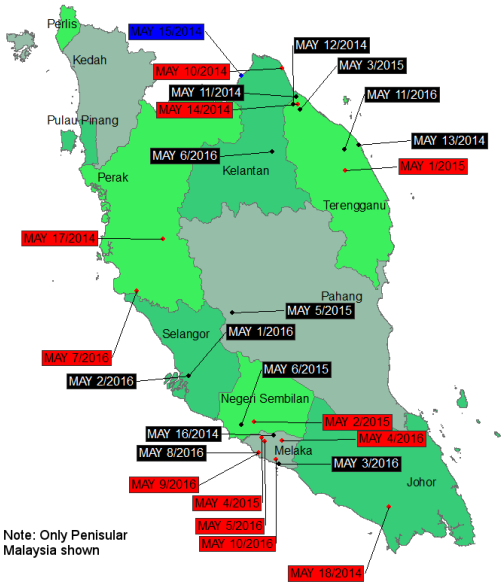
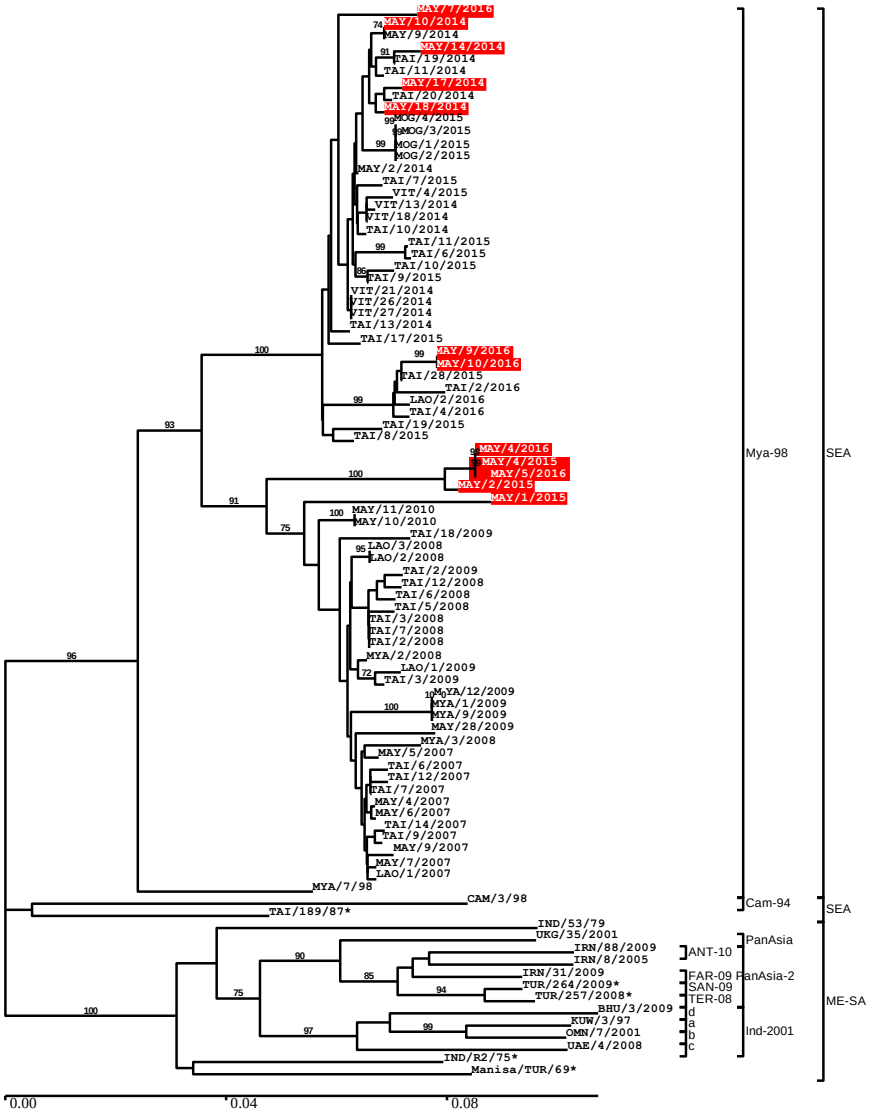
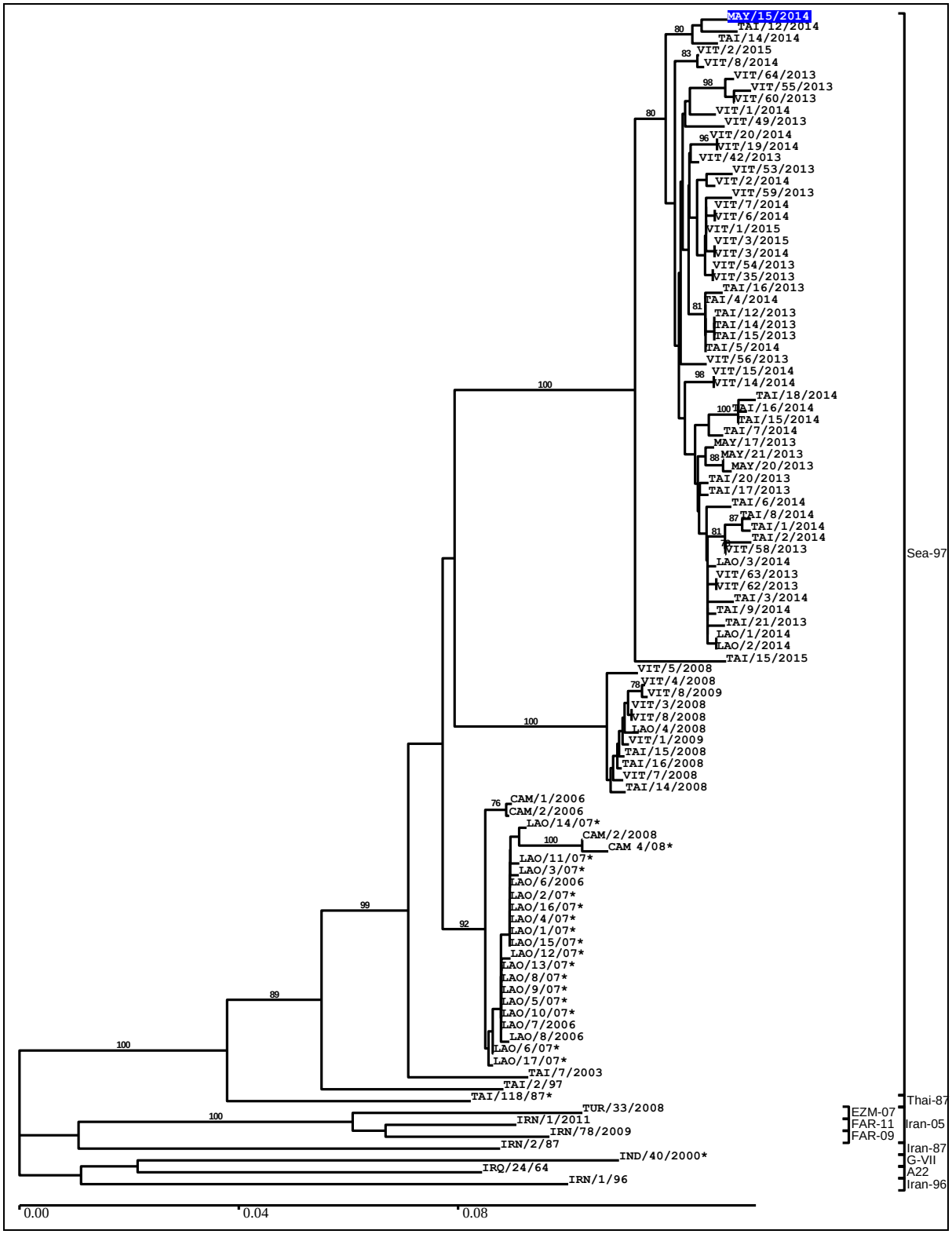


Malaysia
WRLFMD/2016/00028
Date received: 07/09/2016
No. of samples: 26
O (SEA/Mya-98): 12
A (ASIA/Sea-97): 1
FMDV-GD: 13

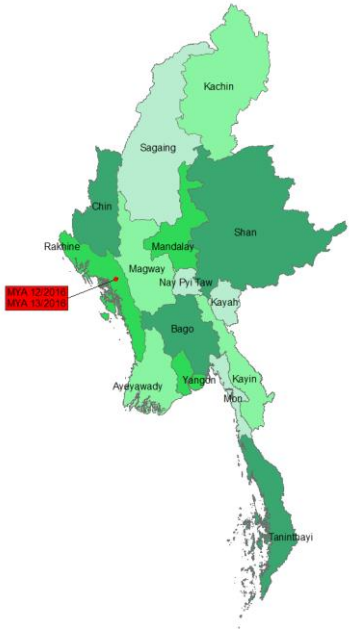


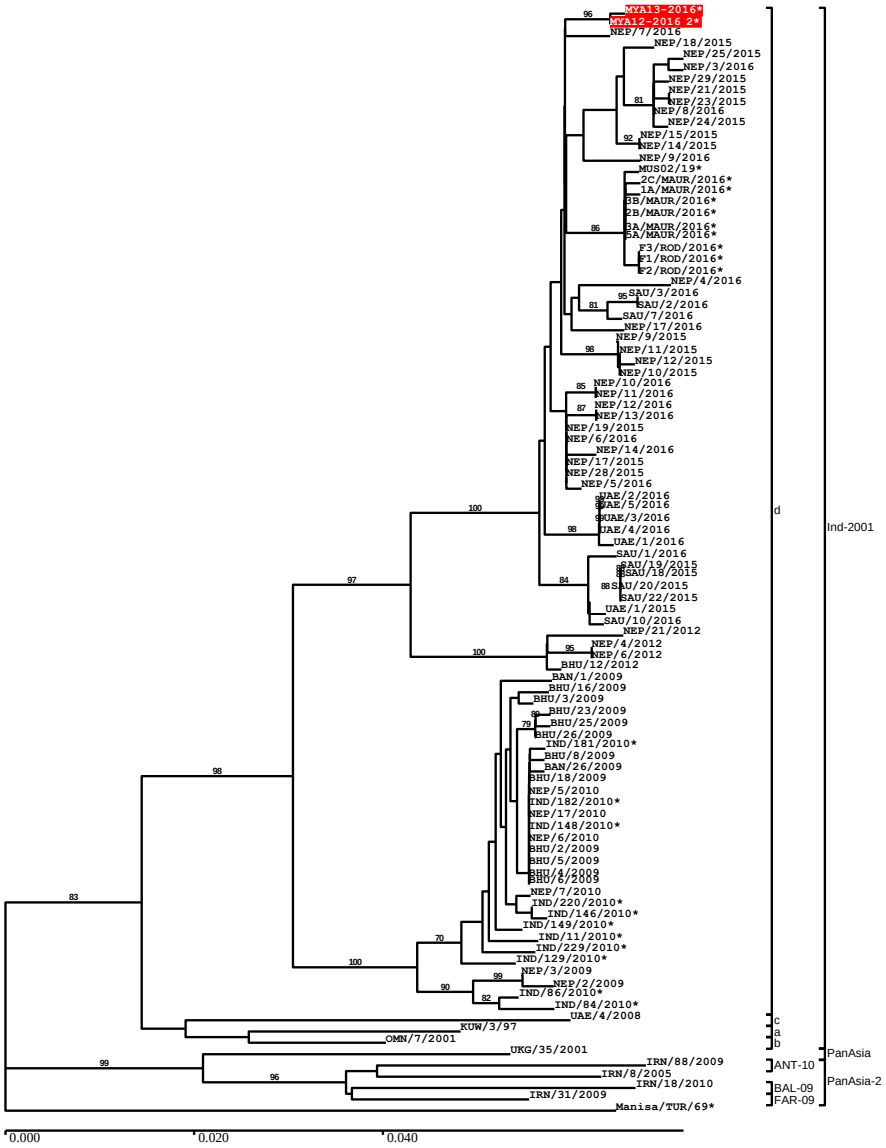


(Malaysia Continued)

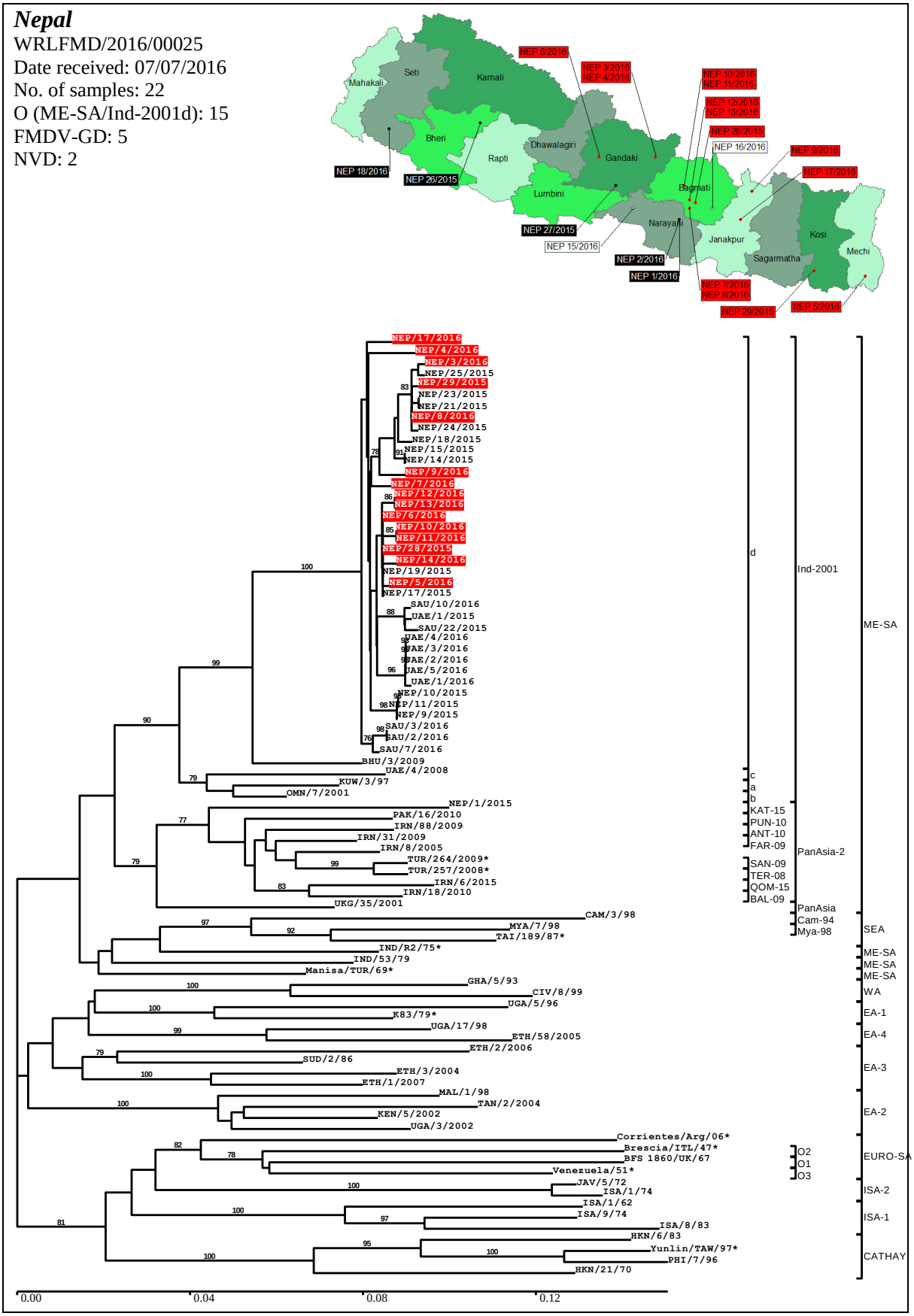


Myanmar
WRLMEG/2016/00015
Date sequences received: 24/08/2016
No. of sequences: 2
O (ME-SA/Ind-2001d): 15
(Note: these are TRRL Ref. nos.)





Nepal
WRLFMD/2016/00025
Date received: 07/07/2016
No. of samples: 22
O (ME-SA/Ind-2001d): 15
FMDV-GD: 5
NVD: 2



3. Vaccine matching

For individual data see Annex 1, section 4.3 (Antigenic Characterisation).

3.1. Serotype Asia 1

One virus from Iran was tested against Asia 1 Shamir and the result was negative. This result is consistent with previous results for Asia 1 strains within the Sindh-08 lineage.

3.2. Serotype A

One sample from Egypt, two samples from Iran and one sample from Zambia were tested against a panel of serotype A vaccines.

3.3. Serotype O

Two Egypt viruses and one Iranian virus were tested against a panel of serotype O vaccines.

3.4. Serotype SAT 1, SAT 2 and SAT 3

One SAT 1 virus from Botswana was tested and found to be antigenically matched against SAT 1/RHO/12/78. Six SAT 2 viruses from Botswana, Egypt, Mozambique and Sudan were also tested.

4. Annex 1

4.1. Summary of Submissions

Table 2: Summary of samples collected and received to WRLFMD (July to September 2016)

Country	№ of samples	Virus isolation in cell culture/ELISA								RT-PCR for FMD (or SVD) virus (where appropriate)	
		FMD virus serotypes							No Virus Detected		
		O	A	C	SAT 1	SAT 2	SAT 3	ASIA-1		Positive	Negative
BOTSWANA *	6	-	-	-	4	1	-	-	1	6	-
EGYPT *	32	18	2	-	-	1	-	-	11	7	25
MALAWI *	1	-	-	-	-	-	-	-	1	1	-
MOZAMBIQUE *	2	-	-	-	-	1	-	-	1	1	1
NAMIBIA *	4	-	-	-	-	1	-	-	3	3	1
ZIMBABWE *	4	-	-	-	-	2	-	-	2	3	1
AFGHANISTAN	27	10	1	-	-	-	-	3	13	22	5
HONG KONG, SAR OF PRC	6	6	-	-	-	-	-	-	-	6	-
MALAYSIA	26	12	1	-	-	-	-	-	13	26	-
MAURITIUS	24	23	-	-	-	-	-	-	1	24	-
NEPAL	22	15	-	-	-	-	-	-	7	19	3
TOTAL	**154**	**84**	**4**	**-**	**4**	**6**	**-**	**3**	**53**	**118**	**36**

* Samples received before, but untested, July 2016

Abbreviations used in table

VI / ELISA	FMD (or SVD) virus serotype identified following virus isolation in cell culture and antigen detection ELISA
FMD	Foot-and-mouth disease
SVD	Swine vesicular disease
NVD	No FMD, SVD or vesicular stomatitis virus detected
NT	Not tested
rRT-PCR	Real-time reverse transcription polymerase chain reaction for FMD (or SVD) viral genome

4.2. Clinical Samples

Table 3: Clinical sample diagnostics made by the WRLFMD® July to September 2016

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
Botswana	BOT 3/2015	Bovine	08-Mar-15	SAT 2	POS	SAT 2
	BOT 4/2015	Bovine	27-Jun-15	SAT 1	POS	SAT 1
	BOT 5/2015	Bovine	27-Jun-15	SAT 1	POS	SAT 1
	BOT 6/2015	Bovine	28-Jul-15	NEG	POS	FMDV GD
	BOT 7/2016	Bovine	28-Jul-15	SAT 1	POS	SAT 1
	BOT 8/2015	Bovine	02-Aug-15	SAT 1	POS	SAT 1
Egypt	EGY 2/2015	Cattle	05-May-15	NEG	POS	FMDV GD
	EGY 3/2015	Cattle	27-May-15	O	POS	O
	EGY 4/2015	Cattle	17-Jun-15	NEG	NEG	NVD
	EGY 5/2015	Cattle	26-Jul-15	SAT 2	POS	SAT 2
	EGY 6/2015	Cattle	16-Aug-15	NEG	NEG	NVD
	EGY 7/2015	Cattle	31-Aug-15	NEG	NEG	NVD
	EGY 8/2015	Cattle	21-Sep-15	A	NEG	A
	EGY 9/2015	Cattle	21-Sep-15	O	NEG	O
	EGY 10/2015	Cattle	07-Oct-15	O	NEG	O
	EGY 11/2015	Buffalo	05-Nov-15	O	NEG	O
	EGY 12/2015	Buffalo	18-Nov-15	NEG	NEG	NVD
	EGY 13/2015	Cattle	03-Dec-15	O	POS	O
	EGY 14/2015	Cattle	29-Dec-15	O	POS	O
	EGY 15/2015	Cattle	30-Dec-15	NEG	NEG	NVD
	EGY 1/2016	Cattle	04-Jan-16	NEG	NEG	NVD

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	EGY 2/2016	Cattle	06-Jan-16	NEG	NEG	NVD
	EGY 3/2016	Cattle	11-Jan-16	A	NEG	A
	EGY 4/2016	Cattle	19-Jan-16	O	NEG	O
	EGY 5/2016	Cattle	19-Jan-16	O	NEG	O
	EGY 6/2016	Cattle	06-Feb-16	NEG	NEG	NVD
	EGY 7/2016	Buffalo	20-Feb-16	O	NEG	O
	EGY 8/2016	Cattle	22-Feb-16	O	NEG	O
	EGY 9/2016	Cattle	24-Feb-16	O	NEG	O
	EGY 10/2016	Cattle	07-Mar-16	O	POS	O
	EGY 11/2016	Cattle	07-Mar-16	O	NEG	O
	EGY 12/2016	Cattle	07-Mar-16	O	POS	O
	EGY 13/2016	Cattle	10-Mar-16	NEG	NEG	NVD
	EGY 14/2016	Cattle	10-Mar-16	O	NEG	O
	EGY 15/2016	Cattle	14-Mar-16	NEG	NEG	NVD
	EGY 16/2016	Cattle	24-Mar-16	O	NEG	O
	EGY 17/2016	Cattle	24-Mar-16	O	NEG	O
	EGY 18/2016	Cattle	27-Mar-16	O	NEG	O
Malawi	MAL 1/2015	Bovine	10-Sep-15	NEG	POS	FMDV GD
Mozambique	MOZ 3/2015	Bovine	11-Jun-15	SAT 2	POS	SAT 2
	MOZ 4/2015	Bovine	11-Jun-15	NEG	NEG	NVD
Namibia	NMB 7/2015	BOVINE	13-May-15	SAT 2	POS	SAT 2
	NMB 8/2015	BOVINE	23-May-15	NEG	POS	FMDV GD

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	NMB 9/2015	BOVINE	23-May-15	NEG	POS	FMDV GD
	NMB 10/2015	BOVINE	22-Aug-15	NEG	NEG	NVD
Zimbabwe	ZIM 23/2015	Bovine	15-Apr-15	SAT 2	POS	SAT 2
	ZIM 24/2015	Bovine	15-Apr-15	NEG	POS	FMDV GD
	ZIM 25/2015	Bovine	15-Apr-15	SAT 2	POS	SAT 2
	ZIM 26/2015	Bovine	17-Aug-15	NEG	NEG	NVD
Afghanistan	AFG 1/2016	BOVINE	18-Apr-16	NEG	POS	FMDV GD
	AFG 2/2016	BOVINE	20-Apr-16	NEG	NEG	NVD
	AFG 3/2016	BOVINE	28-Apr-16	NEG	POS	FMDV GD
	AFG 4/2016	BOVINE	01-May-16	O	POS	O
	AFG 5/2016	BOVINE	04-May-16	A	NEG	A
	AFG 6/2016	BOVINE	08-May-16	ASIA-1	POS	ASIA-1
	AFG 7/2016	BOVINE	08-May-16	NEG	POS	FMDV GD
	AFG 8/2016	OVINE	12-May-16	NEG	POS	FMDV GD
	AFG 9/2016	BOVINE	12-May-16	NEG	POS	FMDV GD
	AFG 10/2016	BOVINE	17-May-16	ASIA-1	POS	ASIA-1
	AFG 11/2016	BOVINE	23-May-16	O	POS	O
	AFG 12/2016	BOVINE	24-May-16	O	POS	O
	AFG 13/2016	BOVINE	26-May-16	NEG	POS	FMDV GD
	AFG 14/2016	OVINE	29-May-16	NEG	NEG	NVD

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	AFG 15/2016	BOVINE	29-May-16	O	POS	O
	AFG 16/2016	BOVINE	01-Jun-16	O	NEG	O
	AFG 17/2016	BOVINE	08-Jun-16	O	POS	O
	AFG 18/2016	BOVINE	08-Jun-16	O	POS	O
	AFG 19/2016	BOVINE	08-Jun-16	O	POS	O
	AFG 20/2016	BOVINE	11-Jun-16	O	POS	O
	AFG 21/2016	BOVINE	19-Jun-16	ASIA-1	POS	ASIA-1
	AFG 22/2016	BOVINE	19-Jun-16	NEG	POS	FMDV GD
	AFG 23/2016	BOVINE	19-Jun-16	NEG	NEG	NVD
	AFG 24/2016	BOVINE	17-Jul-16	NEG	POS	FMDV GD
	AFG 25/2016	BOVINE	20-Jul-16	O	POS	O
	AFG 26/2016	BOVINE	20-Jul-16	NEG	POS	FMDV GD
	AFG 27/2016	BOVINE	29-Jul-16	NEG	POS	FMDV GD
Hong Kong, SAR of PRC	HKN 2/2016	PORCINE	06-Aug-16	O	POS	O
	HKN 3/2016	PORCINE	06-Aug-16	O	POS	O
	HKN 4/2016	PORCINE	06-Aug-16	O	POS	O
	HKN 5/2016	PORCINE	06-Aug-16	O	POS	O
	HKN 6/2016	PORCINE	06-Aug-16	O	POS	O
	HKN 7/2016	PORCINE	06-Aug-16	O	POS	O
Malaysia	MAY 10/2014	CATTLE	01-Jul-14	O	POS	O
	MAY 11/2014	CATTLE	05-Aug-14	NEG	POS	FMDV GD

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	MAY 12/2014	CATTLE	13-Aug-14	NEG	POS	FMDV GD
	MAY 13/2014	CATTLE	20-Aug-14	NEG	POS	FMDV GD
	MAY 14/2014	CATTLE	25-Aug-14	O	POS	O
	MAY 15/2014	CATTLE	27-Aug-14	A	POS	A
	MAY 16/2014	CATTLE	28-Aug-14	NEG	POS	FMDV GD
	MAY 17/2014	CATTLE	22-Sep-14	O	POS	O
	MAY 18/2014	CATTLE	12-Nov-14	O	POS	O
	MAY 1/2015	CATTLE	26-Mar-15	O	POS	O
	MAY 2/2015	CATTLE	16-Apr-15	O	POS	O
	MAY 3/2015	CATTLE	25-May-15	NEG	POS	FMDV GD
	MAY 4/2015	CATTLE	22-Jul-15	O	POS	O
	MAY 5/2015	CATTLE	21-Sep-15	NEG	POS	FMDV GD
	MAY 6/2015	CATTLE	29-Oct-15	NEG	POS	FMDV GD
	MAY 1/2016	CATTLE	11-Jan-16	NEG	POS	FMDV GD
	MAY 2/2016	CATTLE	11-Jan-16	NEG	POS	FMDV GD
	MAY 3/2016	CATTLE	05-Feb-16	NEG	POS	FMDV GD
	MAY 4/2016	CATTLE	14-Mar-16	O	POS	O
	MAY 5/2016	CATTLE	14-Mar-16	O	POS	O
	MAY 6/2016	CATTLE	10-May-16	NEG	POS	FMDV GD

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	MAY 7/2016	CATTLE	02-Jun-16	O	POS	O
	MAY 8/2016	PIG	23-Jun-16	NEG	POS	FMDV GD
	MAY 9/2016	CATTLE	27-Jun-16	O	POS	O
	MAY 10/2016	CATTLE	08-Aug-16	O	POS	O
	MAY 11/2016	CATTLE	11-Aug-16	NEG	POS	FMDV GD
Mauritius	MUR 1/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 2/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 3/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 4/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 5/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 6/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 7/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 8/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 9/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 10/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 11/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 12/2016	BOVINE	09-Aug-16	NEG	POS	FMDV GD
	MUR 13/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 14/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 15/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 16/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 17/2016	BOVINE	09-Aug-16	O	POS	O

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	MUR 18/2016	BOVINE	09-Aug-16	O	POS	O
	MUR 19/2016	BOVINE	15-Aug-16	O	POS	O
	MUR 20/2016	BOVINE	15-Aug-16	O	POS	O
	MUR 21/2016	BOVINE	15-Aug-16	O	POS	O
	MUR 22/2016	BOVINE	15-Aug-16	O	POS	O
	MUR 23/2016	BOVINE	15-Aug-16	O	POS	O
	MUR 24/2016	BOVINE	15-Aug-16	O	POS	O
Nepal	NEP 26/2015	CATTLE	27-Sep-15	NEG	POS	FMDV GD
	NEP 27/2015	BUFFALO	05-Oct-15	NEG	POS	FMDV GD
	NEP 28/2015	CATTLE	01-Dec-15	O	POS	O
	NEP 29/2015	CATTLE	29-Dec-15	O	POS	O
	NEP 1/2016	BUFFALO	02-Jan-16	NEG	POS	FMDV GD
	NEP 2/2016	BUFFALO	02-Jan-16	NEG	POS	FMDV GD
	NEP 3/2016	BUFFALO	10-Jan-16	O	POS	O
	NEP 4/2016	BUFFALO	10-Jan-16	O	POS	O
	NEP 5/2016	CATTLE	30-Jan-16	O	POS	O
	NEP 6/2016	CATTLE	01-Feb-16	O	POS	O
	NEP 7/2016	GOAT	12-Feb-16	O	POS	O
	NEP 8/2016	CATTLE	12-Feb-16	O	POS	O
	NEP 9/2016	PIG	12-Feb-16	O	POS	O
	NEP 10/2016	GOAT	10-Mar-16	O	POS	O

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
	NEP 11/2016	GOAT	10-Mar-16	O	POS	O
	NEP 12/2016	CATTLE	15-Mar-16	O	POS	O
	NEP 13/2016	CATTLE	15-Mar-16	O	POS	O
	NEP 14/2016	BUFFALO	29-Mar-16	O	NEG	O
	NEP 15/2016	CATTLE	29-Mar-16	NEG	NEG	NVD
	NEP 16/2016	CATTLE	29-May-16	NEG	NEG	NVD
	NEP 17/2016	CATTLE	09-Jun-16	O	POS	O
	NEP 18/2016	CATTLE	15-Jun-16	NEG	POS	FMDV GD
	TOTAL :	**154**				

Abbreviations used in table

FMD(V)	Foot-and-mouth disease (virus)
FMDV GD	Genome detected
FMDV NGD	Genome not detected (samples submitted in Trizol, only rRT-PCR carried out)
VI/ELISA	FMDV serotype identified following virus isolation in cell culture and antigen ELISA
rRT-PCR	Real-time reverse transcription polymerase chain reaction on epithelial suspension for FMD (or SVD) viral genome
NVD	No foot-and-mouth disease, swine vesicular disease or vesicular stomatitis virus detected
NT	Not tested

4.3. Antigenic Characterisation

Antigenic characterisation of FMD field isolates by matching with vaccine strains by 2dmVNT from July to September 2016.

Table 4: Vaccine matching studies for Asia 1 FMDV by VNT

Strain	Serotype	Topotype	Strain	Asia 1 Shamir
IRN/26/2016	Asia 1	ASIA	Sindh-08	N

Table 5: Vaccine matching studies for A FMDV by VNT

Strain	Serotype	Topotype	Strain	A22 IRQ	A IRN 05	A/TUR/20/2006	A/Eritrea
EGY/3/2016	A	AFRICA	G-IV	N	N	N	Y
IRN/6/2016	A	ASIA	SIS-10	Y	Y	N	n/a
IRN/8/2016	A	ASIA	G-VII	N	N	N	n/a
ZAM/1/2016	A	AFRICA	G-I	N	N	N	N

Table 6: Vaccine matching studies for O FMDV by VNT

Strain	Serotype	Topotype	Strain	O 3039	O Manisa	O/TUR/5/2009
EGY/7/2016	O	EA-3		N	Y	N
EGY/18/2016	O	EA-3		N	N	N
IRN/25/2016	O	ME-SA	PanAsia-2	Y	N	Y

Table 7: Vaccine matching studies for SAT 1 FMDV by VNT

Strain	Serotype	Topotype	Strain	SAT1/Rho
BOT/5/2015	SAT 1	III		Y

Table 8: Vaccine matching studies for SAT 2 FMDV by VNT

Strain	Serotype	Topotype	Strain	SAT 2 Eritrea	SAT 2 ZIM/7/83
BOT/3/2015	SAT 2	III		Y	Y
EGY/5/2015	SAT 2	VII	Alx-12	Y	Y
EGY/44/2012	SAT 2	VII	Ghb-12	Y	B
MOZ/3/2015	SAT 2	I		Y	Y
SUD/9/2013	SAT 2	VII	Ghb-12	Y	Y
ZIM/25/2015	SAT 2	II		Y	Y

Table 9: Vaccine matching studies for SAT 3 FMDV by VNT

Strain	Serotype	Topotype	Strain	SAT3 Zim
ZAM/3/2015	SAT 3	II		N

Abbreviations used in tables

M	Vaccine Match *r_1 = ≥ 0.3. Suggests that there is a close 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. Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect*
B	Borderline *Any r_1 values between 0.28 to 0.32*
NT	Not tested against this vaccine

5. Annex 2

Recent FMD Publications (April-June 2016) cited by Web of Science (Pirbright Institute papers and authors are highlighted in **BOLD AND GREY**)

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6. Annex 3

RECOMMENDATIONS FROM WRLFMD® ON FMD VIRUS STRAINS TO BE INCLUDED IN FMDV ANTIGEN BANKS (FOR FMD-FREE COUNTRIES) September 2016

Note: Virus strains are NOT listed in order of importance

High Priority	**A/ASIA/G-VII(G-18)*** O Manisa O PanAsia-2 *(or equivalent)* O BFS or Campos A24 Cruzeiro Asia 1 Shamir A Iran-05 *(or A TUR 06)* A22 Iraq SAT 2 Saudi Arabia *(or equivalent i.e. SAT 2 Eritrea)*
Medium Priority	A Eritrea SAT 2 Zimbabwe SAT 1 South Africa A Malaysia 97 (or Thai equivalent such as A/Sakolnakorn/97) A Argentina 2001 O Taiwan 97 *(pig-adapted strain or Philippine equivalent)*
Low Priority	A Iran '96 A Iran '99 A Iran 87 or A Saudi Arabia 23/86 *(or equivalent)* A15 Bangkok related strain A87 Argentina related strain C Noville SAT 2 Kenya SAT 1 Kenya SAT 3 Zimbabwe

Note: Discussions are currently underway to adopt a risk-based approach for different FMD viral lineages to identify priority vaccines for use in Europe and other FMD-free settings.

*Recent *in vitro* data from WRLFMD for serotype A viruses from Saudi Arabia and Iran highlights an apparent gap in vaccine coverage. An *in vivo* PPG study undertaken during 2016 at Pirbright demonstrated that a polyvalent vaccine containing A22 Iraq and A-Sau-95 antigens only protected 56% of vaccinated cattle. Work is urgently required to evaluate whether *in vivo* protection may be provided by any other high potency international vaccines.