WRLFMD Quarterly Report April to June 2018

Foot-and-Mouth Disease

THE Pirbright INSTITUTE

BBSRC bioscience for the future

Department for Environment Food & Rural Affairs

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CONTENTS

1. Summary of samples tested and reported FMD outbreaks

1.1. Asia

Afghanistan

On 03/04/2018, a batch of 22 samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/ME-SA/PanAsia-2^{ANT-10}** (n=3), **A/ASIA/Iran-05^{SIS-13}** (n=4), **Asia1/ASIA/Sindh-08** (n=1), FMDV-GD (n=10), NVD (n=4).

Bhutan

On 08/05/2018, a batch of 11 samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/ME-SA/Ind-2001e** (n=4), **A/ASIA/G-VII** (n=3), FMDV-GD (n=2), NVD (n=2).

China, People's Republic of

Between 22/03/2018 and 05/06/2018, various outbreaks of **FMD type O** were reported in the provinces of Gansu (cattle), Xinjiang (cattle), Guangxi (pigs), Hubei (cattle), Shanxi (cattle), Anhui (cattle) and Guizhou (cattle). No genotyping results are currently available. Two sequences submitted to GenBank by the LVRI were from samples collected in Guizhou province on 08/01/2018. **O/CATHAY/GZSD/CHA/2018** (MG840803) was isolated from pigs and **A/ASIA/Sea-97/GZCS/CHA/2018** (MG840802) was isolated from cattle (see trees below).

Hong Kong Special Administrative Region

On 18/04/2018, a batch of nine samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/CATHAY** (n=3), FMDV-GD (n=3), NVD (n=3).

Iran

On 12/03/2018, a batch of 26 samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/ME-SA/PanAsia-2^{ANT-10}** (n=1), **O/ME-SA/PanAsia-2^{QOM-15}** (n=10), **A/ASIA/Iran-05^{SIS-13}** (n=8), **A/ASIA/G-VII** (n=2), Asia1/ASIA/Sindh-08 (n=4), NVD (n=1).

Israel

During April 2018, five outbreaks of **FMD type O** were reported in Hazafon. Four were from cattle and one from Mountain gazelles (Gazella gazella). On 24/04/2018, a batch of four samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/ME-SA/PanAsia-2^{QOM-15}** (n=4).

Myanmar

Outbreaks of **FMD O** were reported to the OIE on 17/05/2018, but no details were provided.

Palestinian Autonomous Territories

During June 2018, four outbreaks of **FMD** were reported in cattle, sheep and goats at Jenin, West Bank. No typing results are currently available.

Republic of Korea (South Korea)

An outbreak due to **FMD type A** was reported on 01/04/2018 in pigs in Gyeonggi-Do. On 03/04/2018, a batch of four samples was received by the WRLFMD and a second batch of one on the 08/05/2018. Virus serotyping and genotyping results were as follows: **A/ASIA/Sea-97** (n=2), FMDV-GD (n=3).

Sri Lanka

On 17/05/2018, a batch of 16 samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/ME-SA/Ind-2001d** (n=7), **O/ME-SA/Ind-2001e** (n=2), FMDV-GD (n=2), NVD (n=5).

Vietnam

On 27/02/2018, a batch of 40 samples was received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/CATHAY** (n=6), **O/SEA/Mya-98** (n=5),

O/ME-SA/PanAsia (n=8), **O/ME-SA/Ind-2001e** (n=1), **A/ASIA/Sea-97** (n=13), FMDV-GD (n=6), NVD (n=1).

1.2. Africa

Algeria

An outbreak of **FMD type O** was reported in cattle at Mekla, Tizi Ouzou on 20/06/2018.

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Samples received by the WRLFMD in early July 2018 have been genotyped as O/EA-3.

In contrast to previous serotype O cases in North Africa which were due to the O/ME-SA/Ind-2001 lineage originating from South Asia, phylogenetic analyses place West Africa as the source of this virus (closest viral sequences are from Nigeria); however, without obvious direct epidemiological connections, we should be cautious in attributing specific sources since there are many countries in West and Central Africa that do not submit samples for analyses. Vaccine matching results are pending (expected July 2018).

Botswana

On 09/06/2018, an outbreak of **FMD type SAT 2** was reported in cattle at Naune Crush, Maun, Ngamiland. On the 25/06/2018 a VP1 sequence was submitted to the WRLFMD from the SSARRL (BVI). Genotyping revealed the virus to belong to **topotype III** being most closely related to sequences from previous outbreak viruses in 2017 and 2015.

Democratic Republic of the Congo

During May and June 2018, five outbreaks of **FMD** were reported in cattle at Uvira, Sud-Kivu (close to the border with Burundi). These were said to be a continuation of outbreaks which were reported in May 2017. No typing results are currently available.

Ethiopia

On 14/03/2018, a batch of 28 samples were received by the WRLFMD. Virus serotyping and genotyping results were as follows: **O/EA-3** (n=11), **A/AFRICA/G-I** (n=4), **A/AFRICA/G-IV** (n=3), **SAT2/VII/Ghb-12** (n=1), FMDV-GD (n=6), NVD (n=2). A/AFRICA/G-I is normally found in countries to the south of Ethiopia (e.g. Kenya and Tanzania).

Malawi

During May and June 2018, three outbreaks of **FMD type SAT 2** were reported in cattle at three locations (Neno, Southern region; Ntcheu, Central region; and Dedza, Central region). No genotyping results are currently available.

Mozambique

Om 17/05/2018 and outbreak of **FMD** was reported in cattle at Namachepa, Mogovolas, Nampula in the north-east of the country. No typing results are currently available.

South Africa

On 17/05/2018, an outbreak of **FMD type SAT 2** was reported in cattle at Thulamela, Limpopo. No genotyping results are currently available.

Zambia

Two outbreak of **FMD type O** occurred on the 23/03/2018 (Chisamba Camp, Chisamba, Central province) and 03/04/2018 (Chibombo, Chibombo, Central province) in cattle. On 17/04/2018, a batch of three samples (from Chismba) was received by the WRLFMD. Virus serotyping and genotyping results were as follows: O/EA-2 (n=3). The finding of type O in the centre of the country is worrying. Outbreaks occasionally occur in the north of Zambia adjacent to Tanzania where it is thought type O viruses originate.

Zimbabwe

It was reported that between 29/11/2017 and 03/04/2018, 62 outbreaks of **FMD type SAT 1** occurred in the Midlands and Masvingo provinces. No genotyping results are currently available. On 28/06/2018, an untyped outbreak of FMD was reported in cattle at Bopoma, Mary Mount, Rushinga, Mashonaland Central (in the north-east close to the border with Mozambique). Outbreaks of FMD in this area are rare.

1.3. South America

No new reports of FMD during this period.

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/2018.htm.

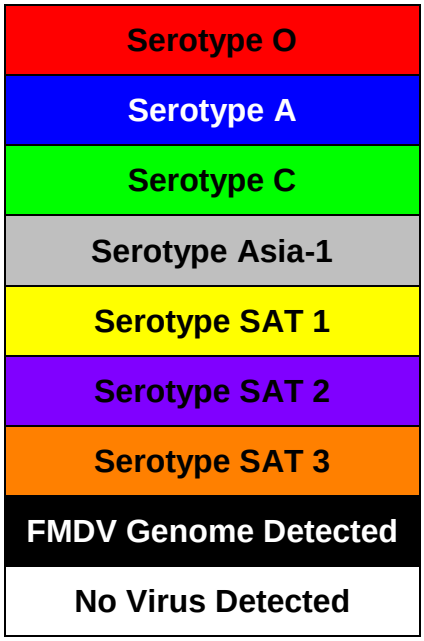
Results from samples or sequences received at WRLFMD (status of samples being tested) are shown in Table 1 and a complete list of clinical sample diagnostics made by the WRLFMD from April to June 2018 is shown in Annex 1 (Summary of Submissions). A record of all samples received by WRLFMD is shown in Annex 1 (Clinical Samples).

Table 1: Status of sequencing of samples or sequences received by the WRLFMD from April to June 2018 (* indicates a batch carried over from the previous quarter).

WRLFMD Batch No.	Date received	Country	Serotype	No. of samples	No. of sequences	Sequencing status
WRLFMD/2018/00007*	12/03/2018	Iran	O	11	11	completed
WRLFMD/2018/00007*	12/03/2018	Iran	A	10	10	completed
WRLFMD/2018/00007*	12/03/2018	Iran	Asia 1	4	4	completed
WRLFMD/2018/00009*	14/03/2018	Ethiopia	O	11	11	completed
WRLFMD/2018/00009*	14/03/2018	Ethiopia	A	7	7	completed
WRLFMD/2018/00009*	14/03/2018	Ethiopia	SAT 2	1	1	completed
WRLFMD/2018/00010	03/04/2018	South Korea	A	1	1	completed
WRLFMD/2018/00011	27/02/2018	Vietnam	O	20	20	completed
WRLFMD/2018/00011	27/02/2018	Vietnam	A	13	13	completed
WRLFMD/2018/00012	03/04/2018	Afghanistan	O	3	3	completed
WRLFMD/2018/00012	03/04/2018	Afghanistan	A	4	4	completed
WRLFMD/2018/00012	03/04/2018	Afghanistan	Asia 1	1	1	completed
WRLFMD/2018/00013	17/04/2018	Zambia	O	3	3	completed
WRLFMD/2018/00014	18/04/2018	Hong Kong	O	3	3	completed
WRLFMD/2018/00015	24/04/2018	Israel	O	4	4	completed
WRLFMD/2018/00016	08/05/2018	South Korea	A	1	1	completed
WRLFMD/2018/00017	08/05/2018	Bhutan	O	4	4	completed
WRLFMD/2018/00017	08/05/2018	Bhutan	A	3	3	completed
WRLFMD/2018/00018	17/05/2018	Sri Lanka	O	9	9	completed
			Total	**113**	**113**	

2. Detailed Analysis

Key for maps and trees:



2.1. ASIA

Afghanistan

Batch: WRLFMD/2018/00012

Date received: 03/04/2018

No. of samples: 22

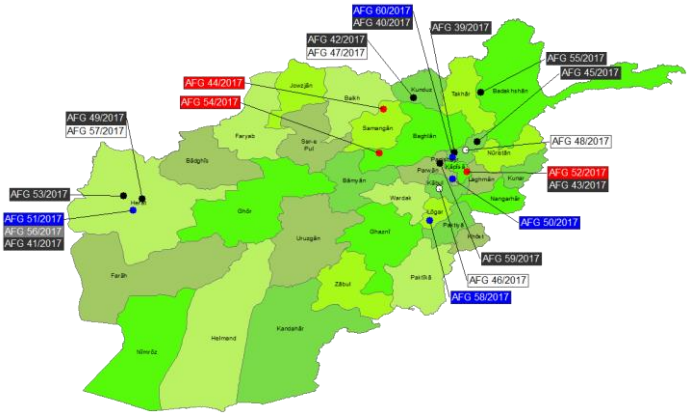
O/ME-SA/PanAsia-2/ANT-10: 3

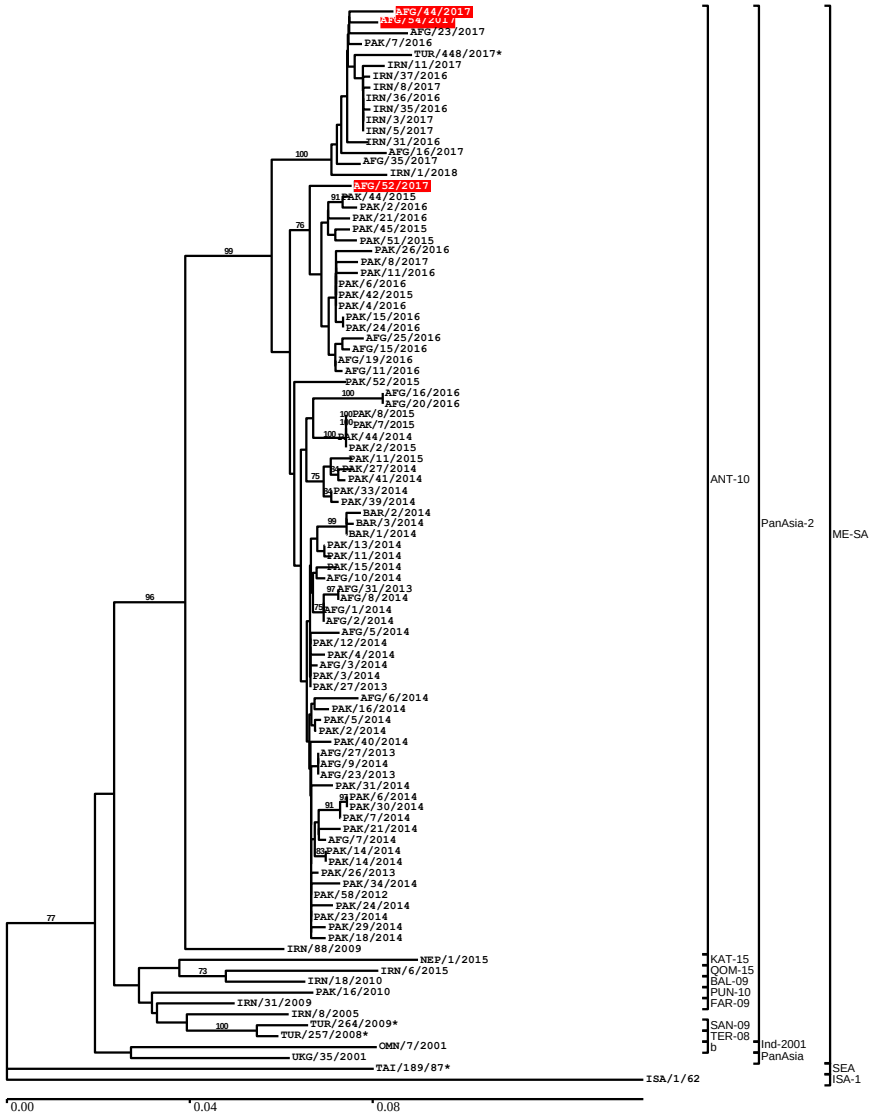
A/ASIA/Iran-05/SIS-13: 4

Asia1/ASIA/Sindh-08 : 1

FMDV-GD: 10

NVD: 4





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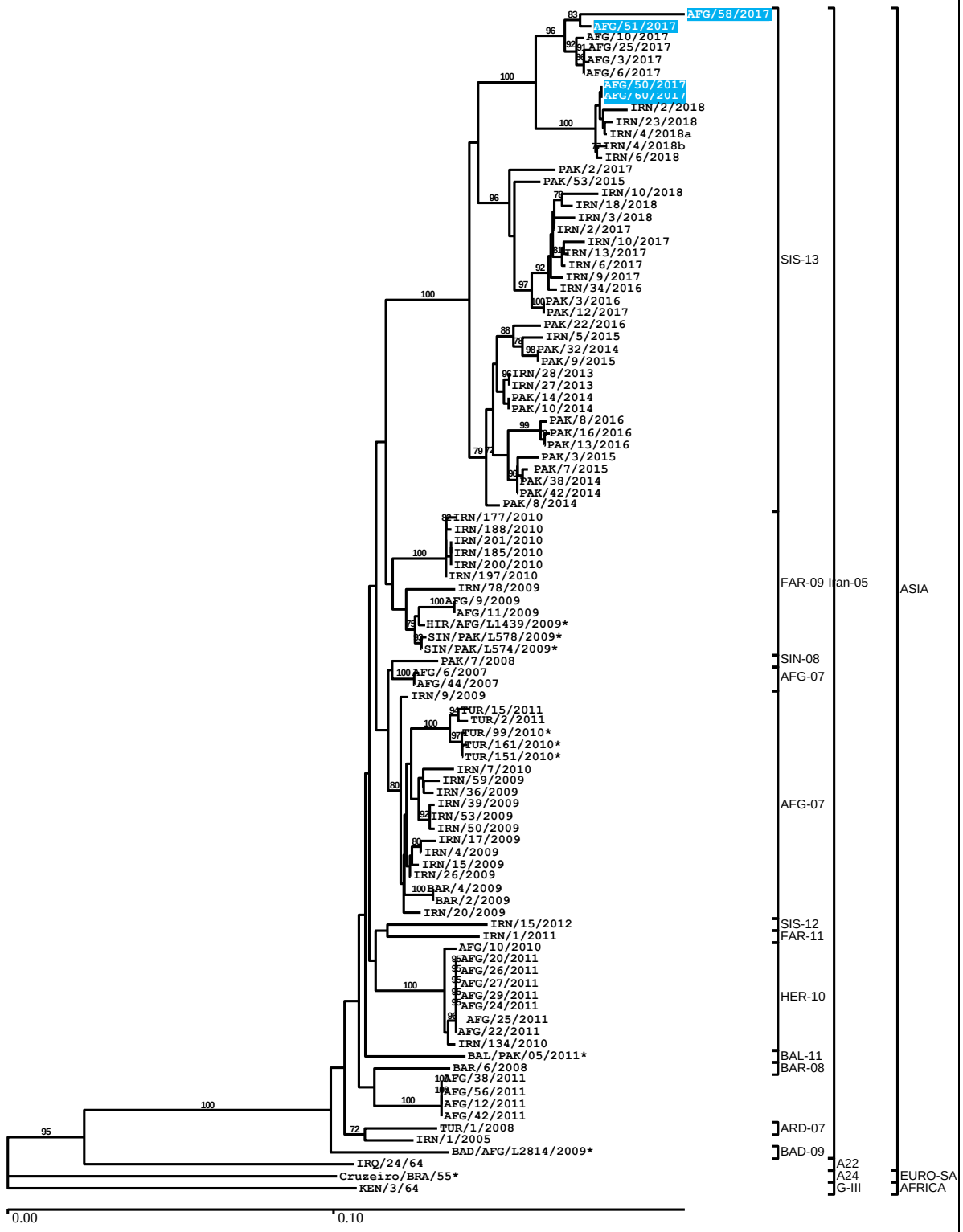
Afghanistan continued



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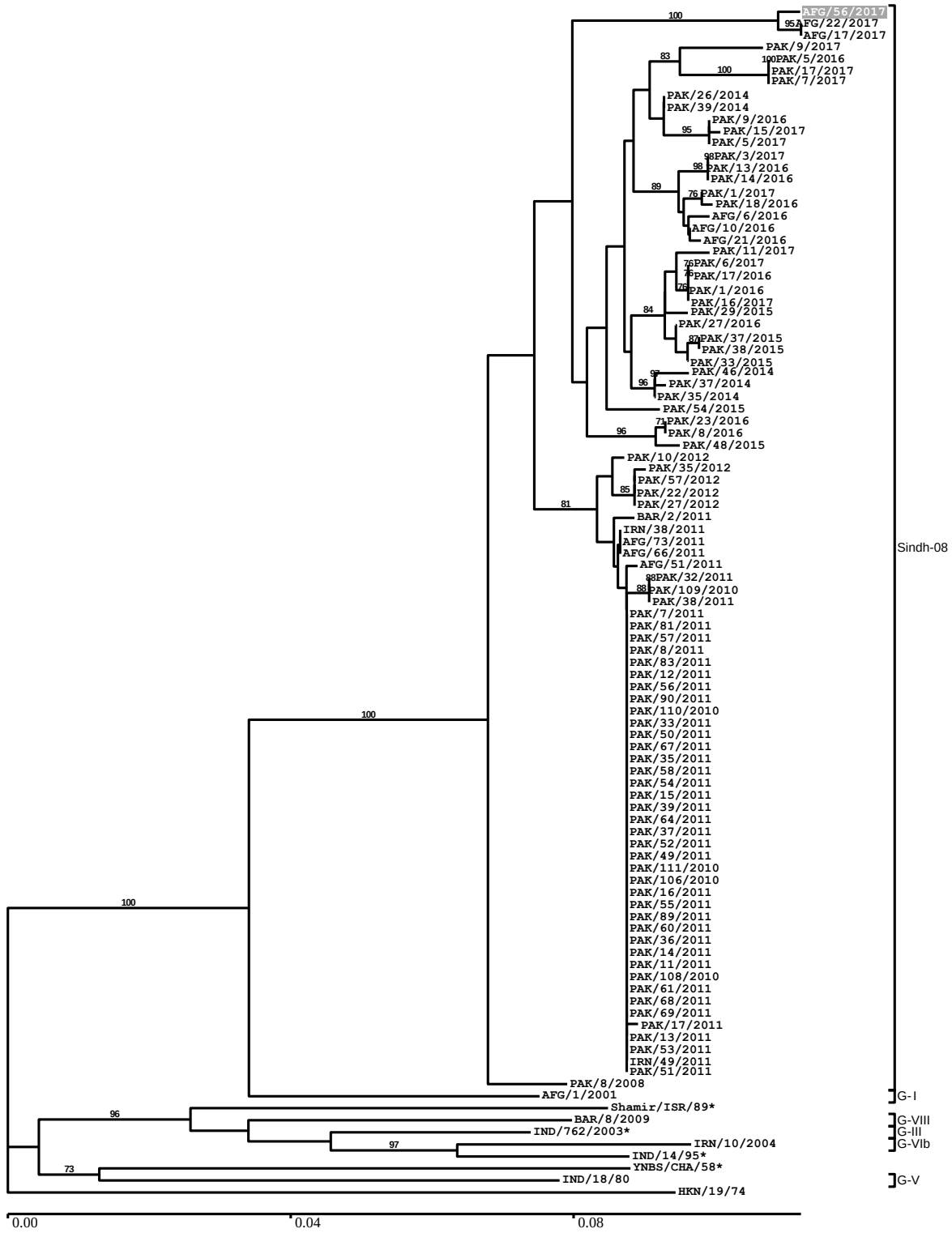
Afghanistan continued



Bhutan

Batch: WRLFMD/2018/00017

Date received: 08/05/2018

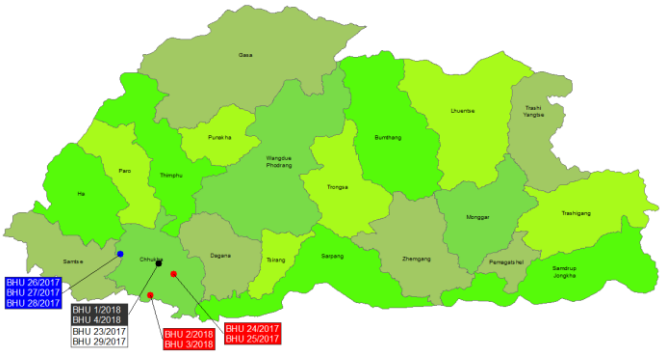
No. of samples: 11

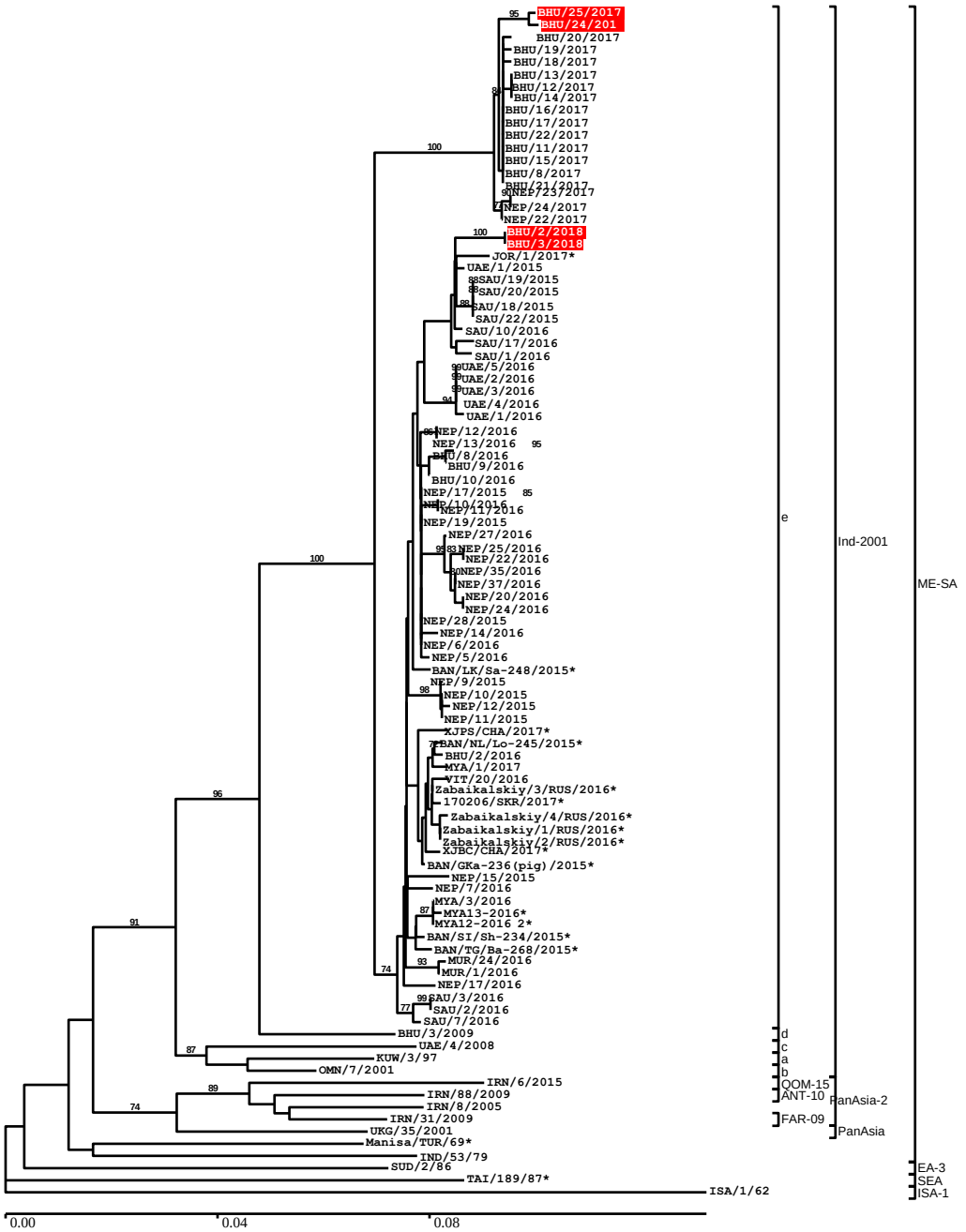
O/ME-SA/Ind-2001e: 4

A/ASIA/G-VII: 3

FMDV-GD: 2

NVD: 2





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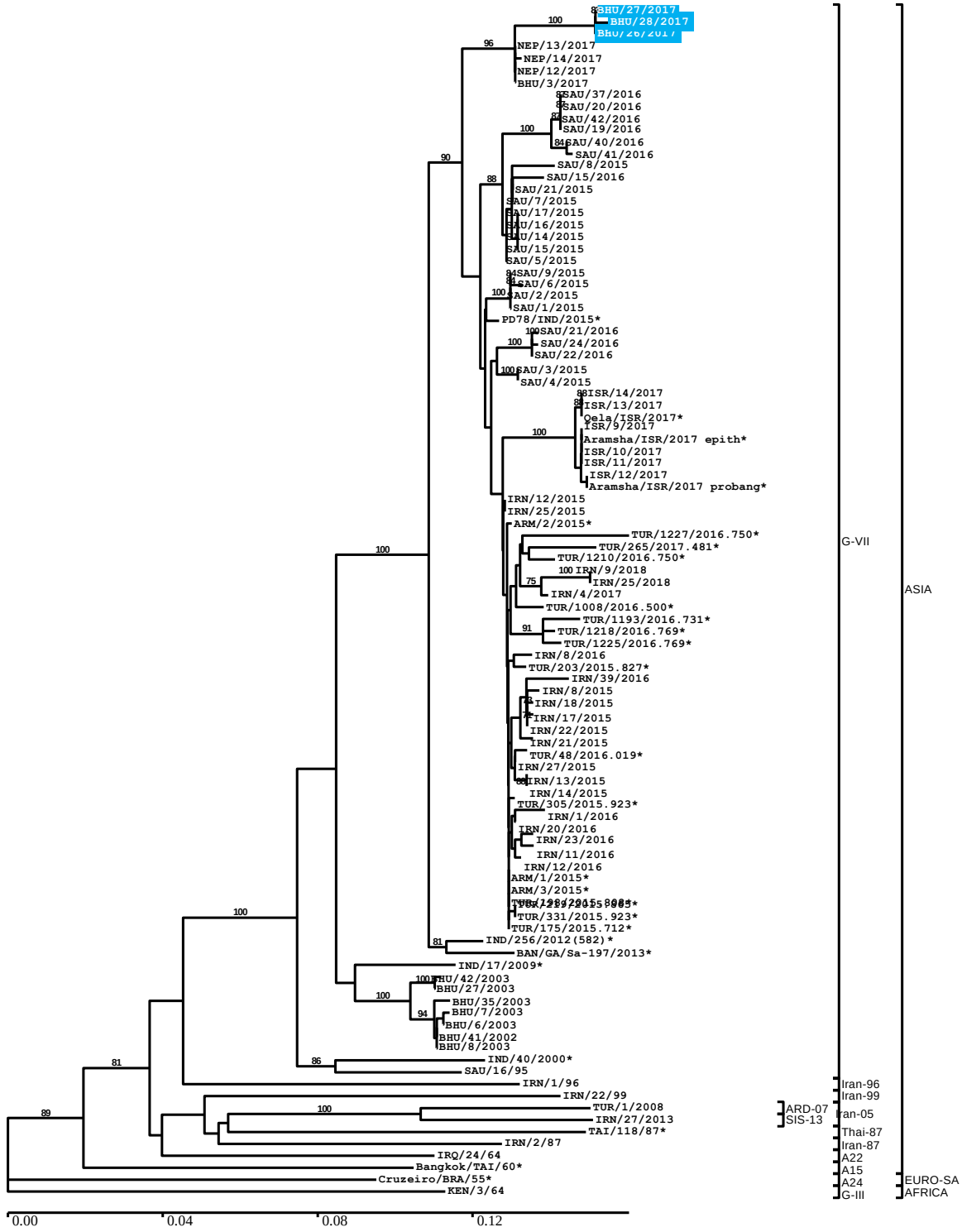
Bhutan continued



China, People's Republic of

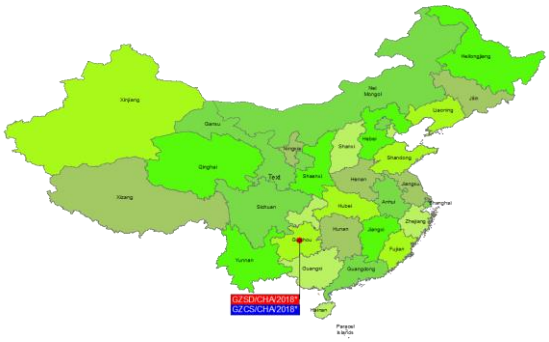
Batch: WRLMEG/2018/00022

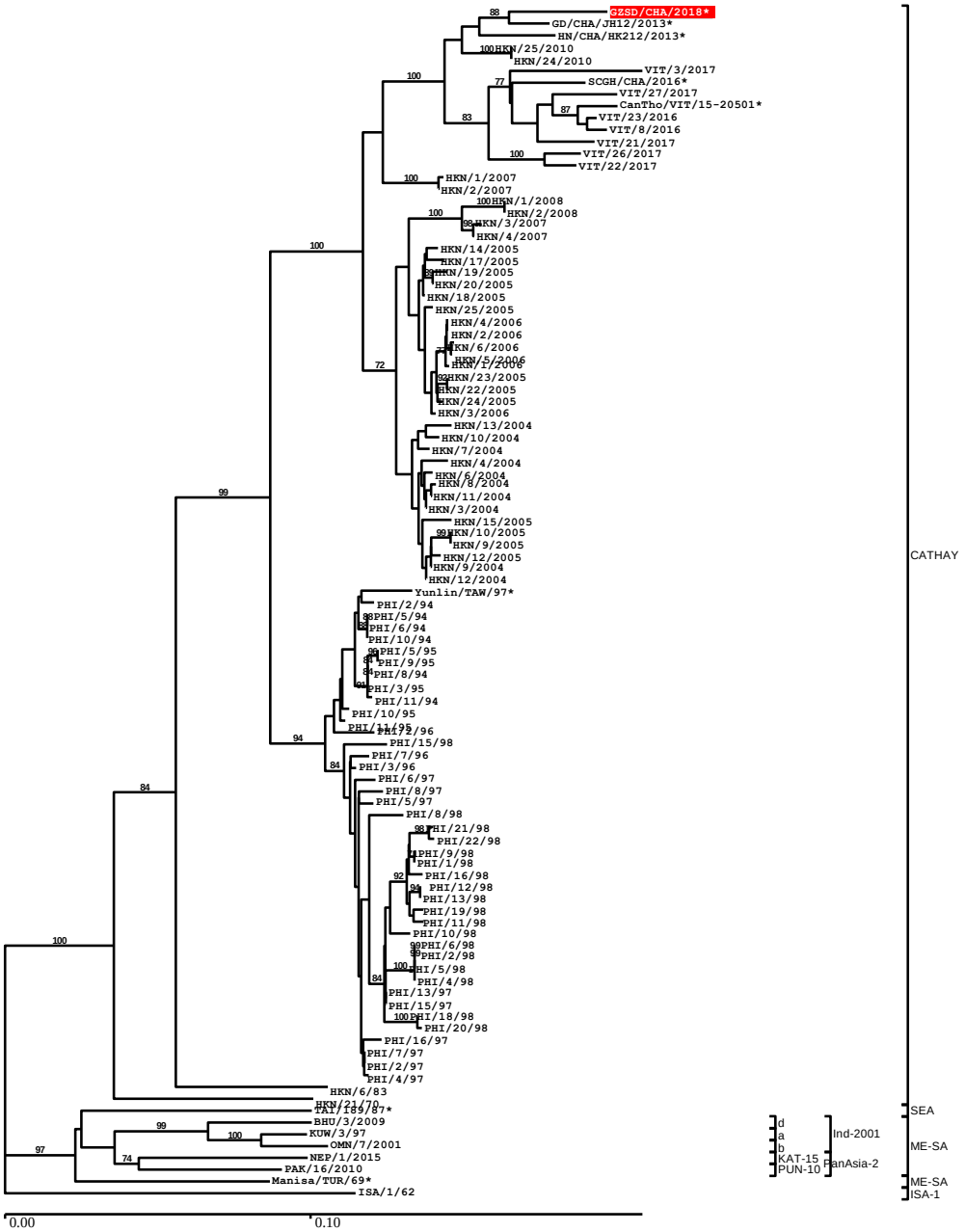
Date received: 12/05/2018

No. of sequences: 2

O/CATHAY: 1

A/ASIA/Sea-97: 1





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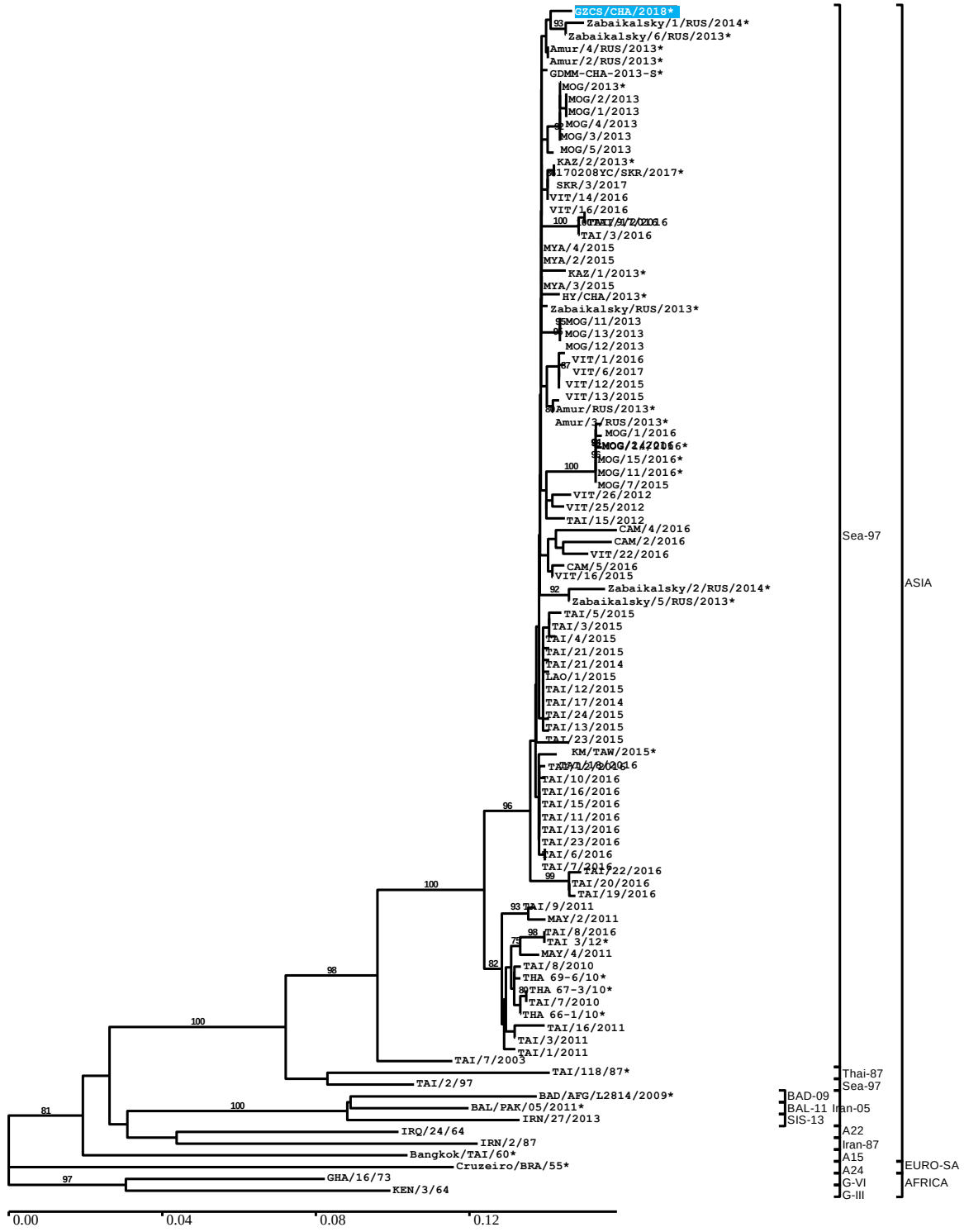
China continued



Hong Kong SAR

Batch: WRLFMD/2018/00014

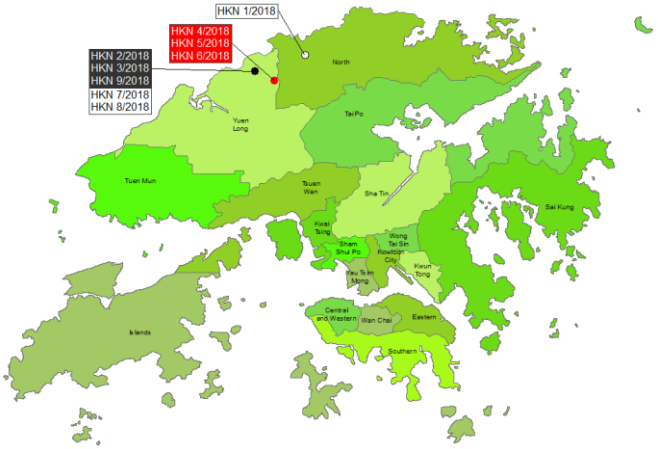
Date received: 18/04/2018

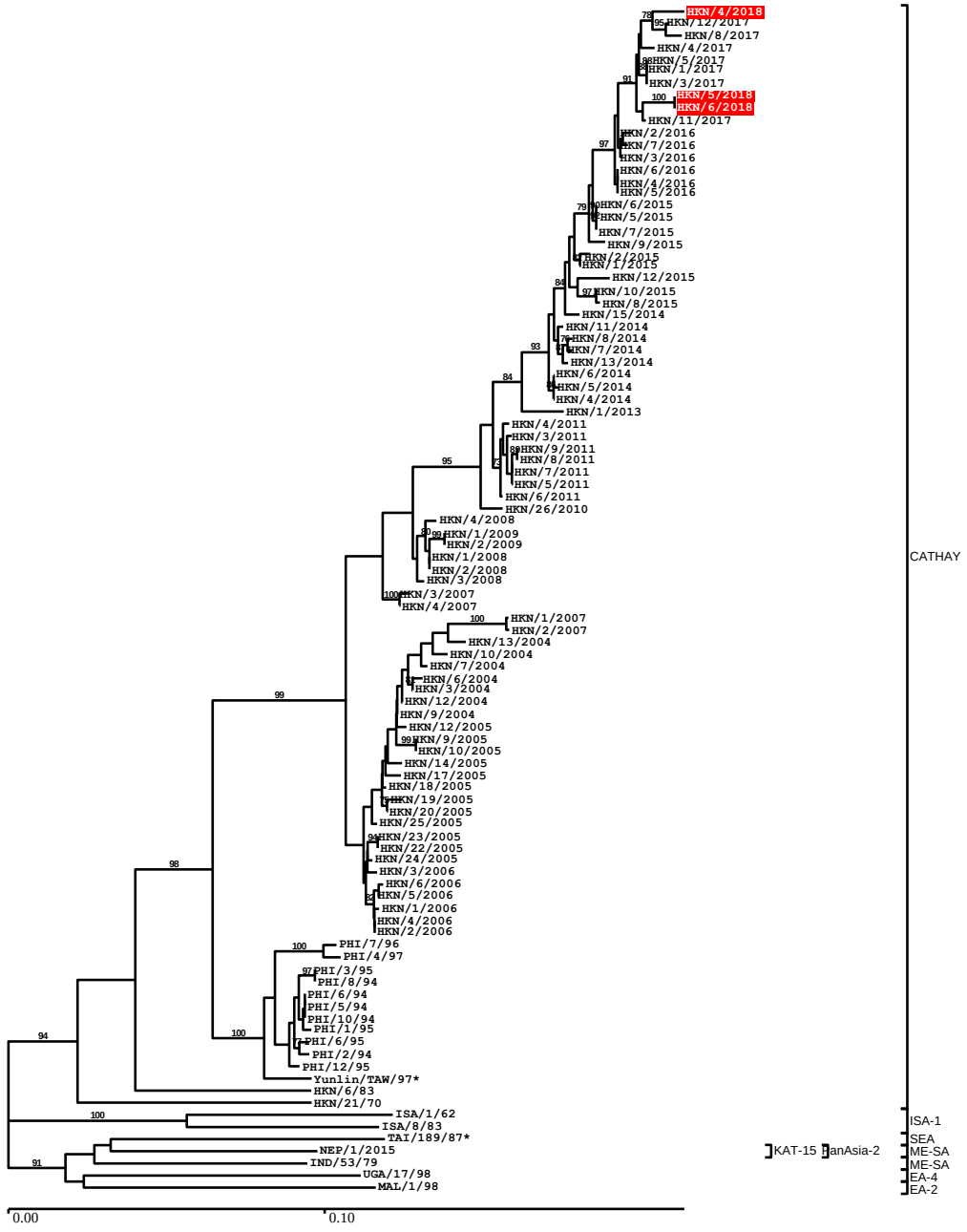
No. of samples: 9

O/CATHAY: 3

FMDV-GD: 3

NVD: 3





Iran

Batch: WRLFMD/2018/00007

Date received: 12/03/2018

No. of samples: 26

O/ME-SA/PanAsia-2/ANT-10: 1

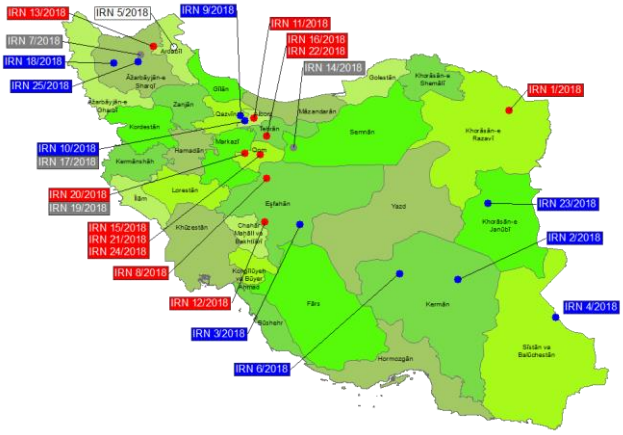
O/ME-SA/PanAsia-2/QOM-15: 10

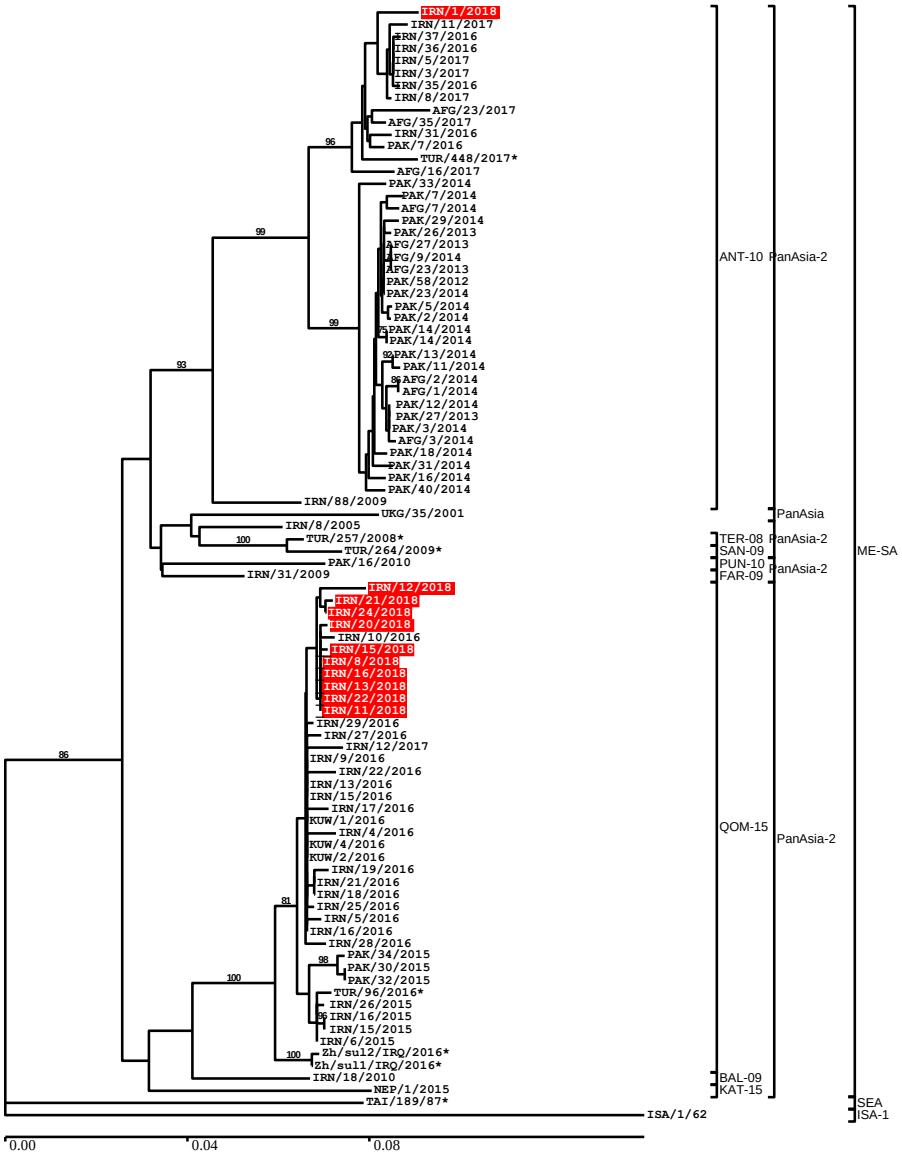
A/ASIA/Iran-05/SIS-13: 8

A/ASIA/G-VII: 2

Asia 1: 4

NVD: 1





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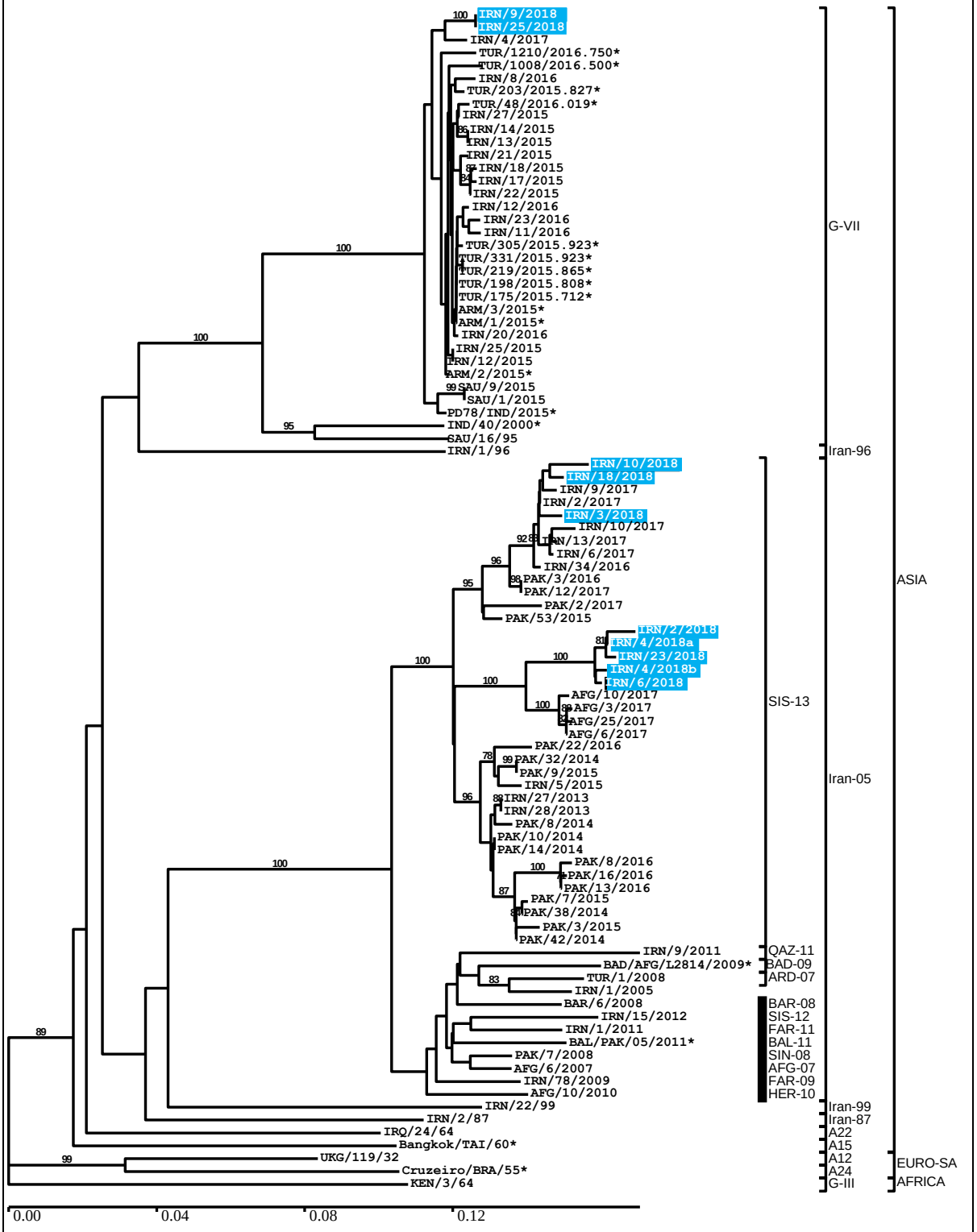

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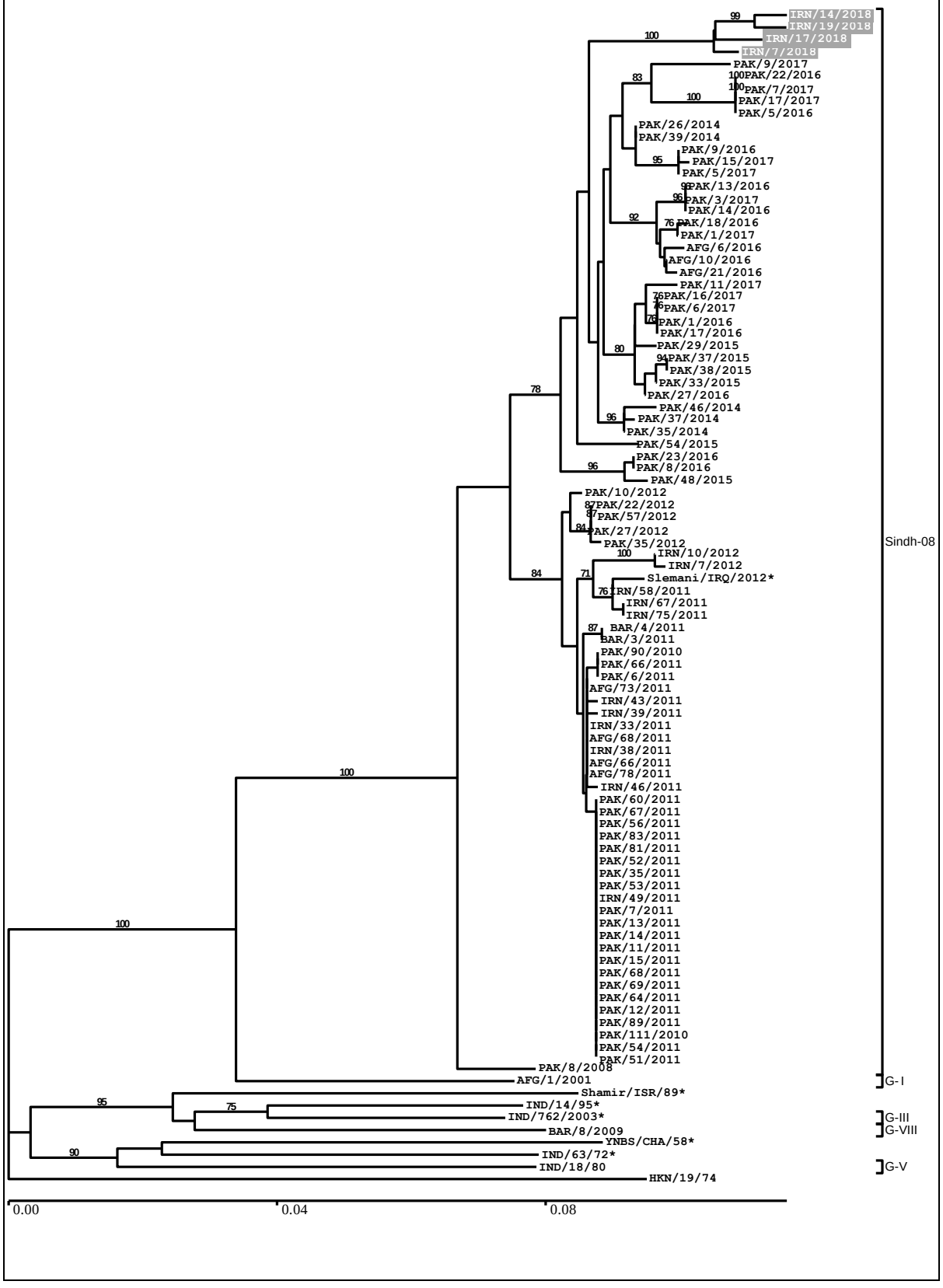
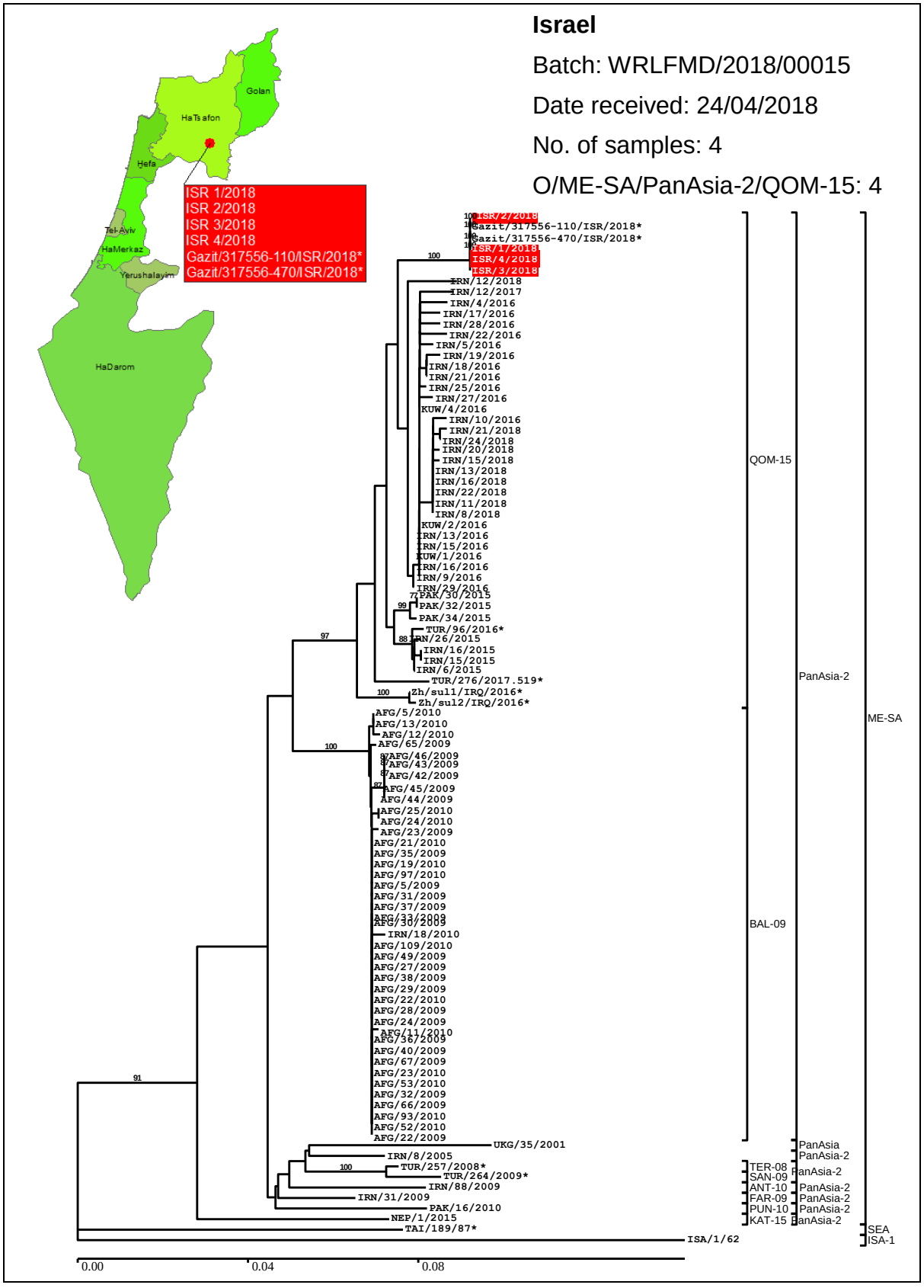
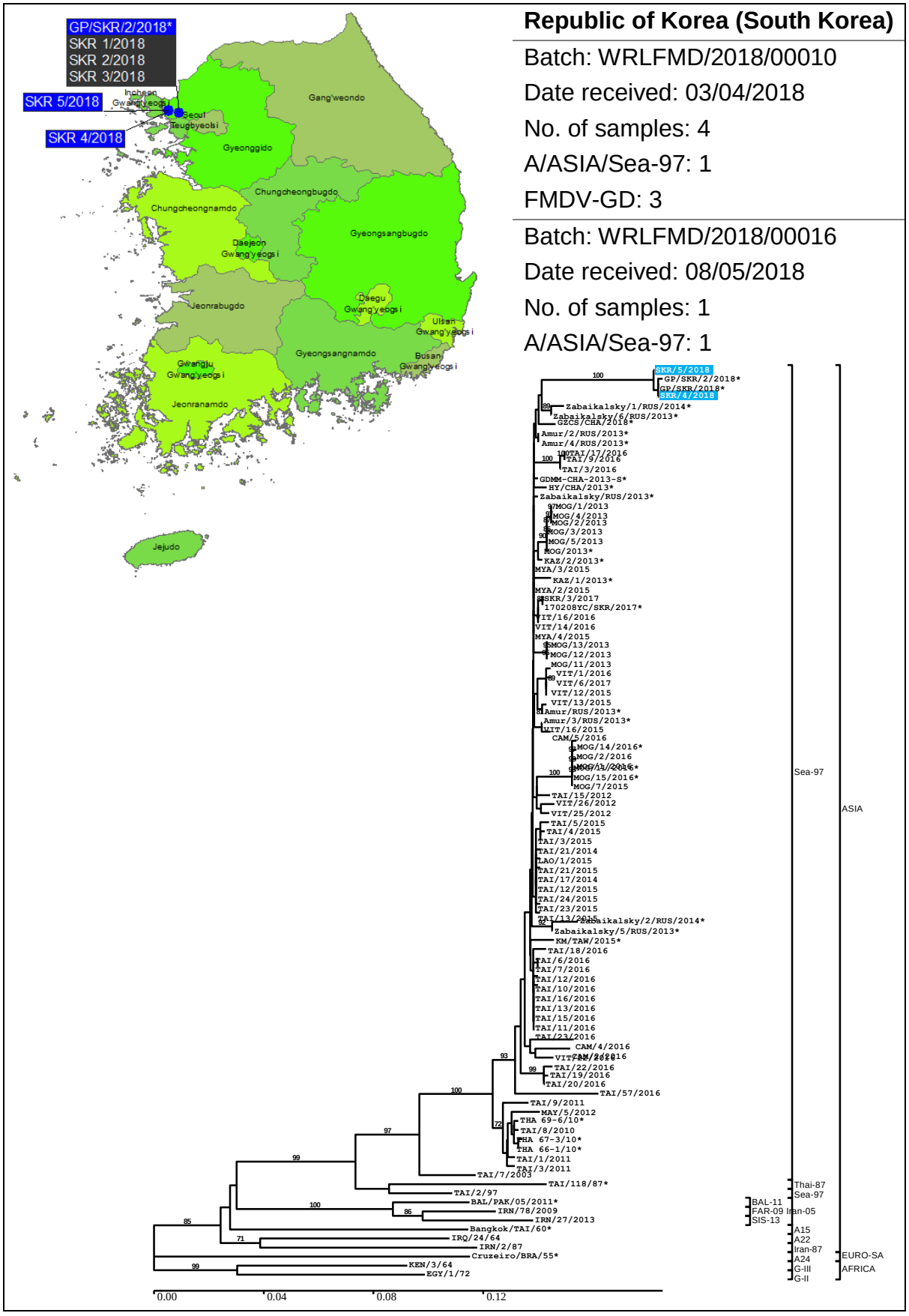
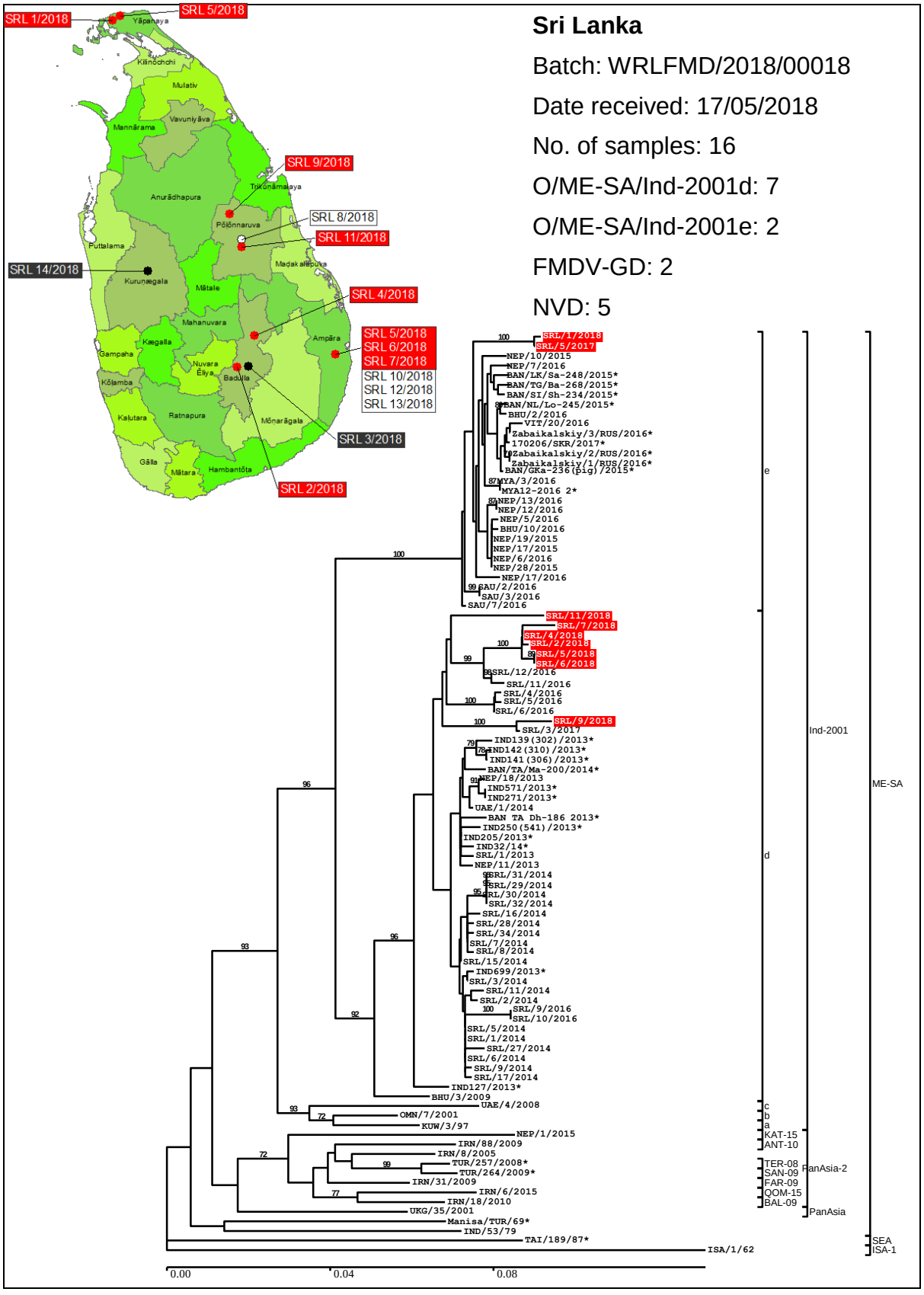
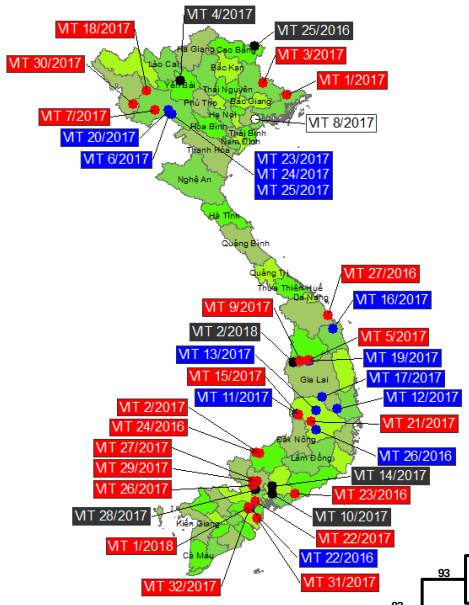


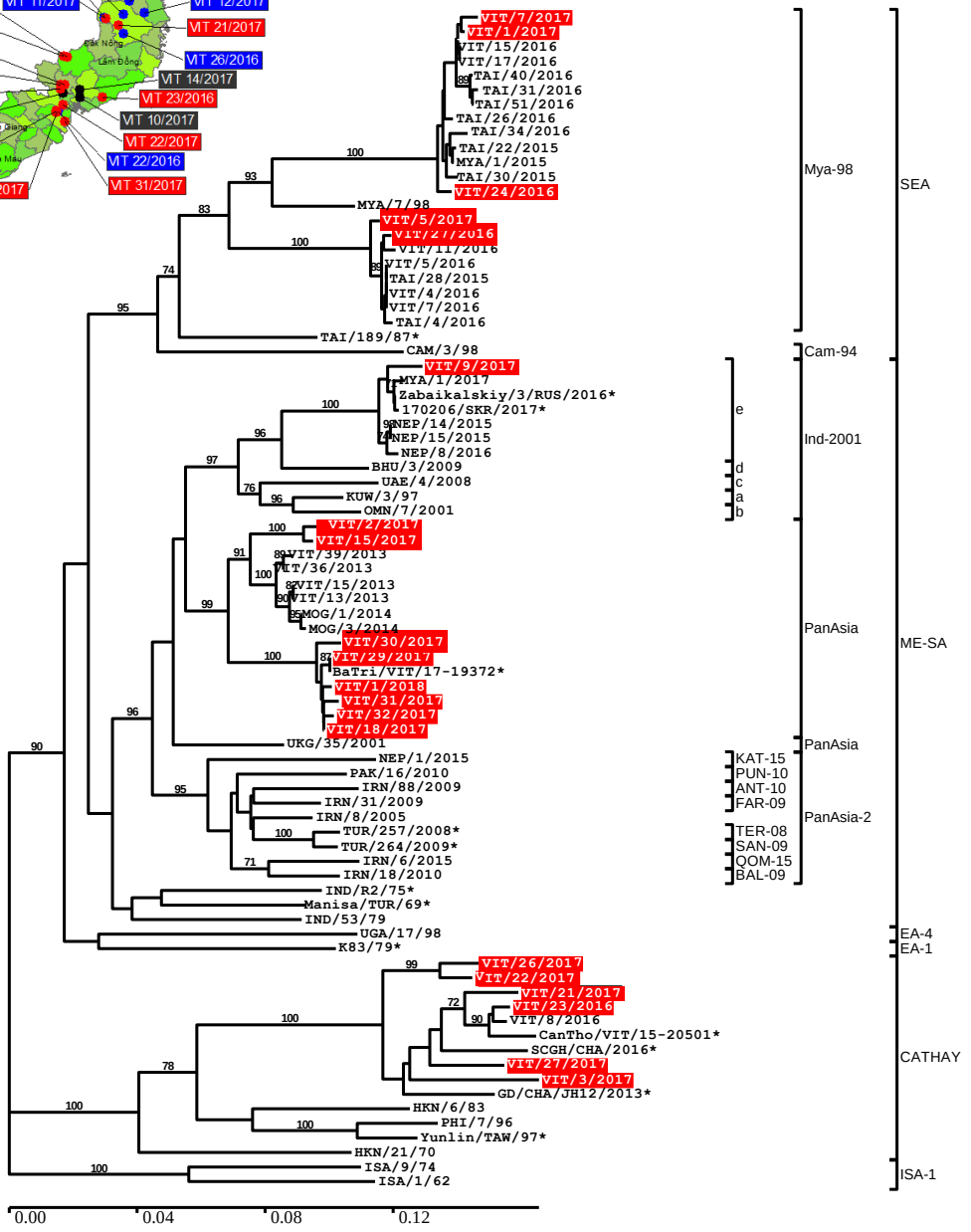








Vietnam
Batch: WRLFMD/2018/00011
Date received: 27/02/2018
No. of samples: 40
O/CATHAY: 6
O/SEA/Mya-98: 5
O/ME-SA/PanAsia: 8
O/ME-SA/Ind-2001e: 1
A/ASIA/Sea-97: 13
FMDV-GD: 6
NVD: 1



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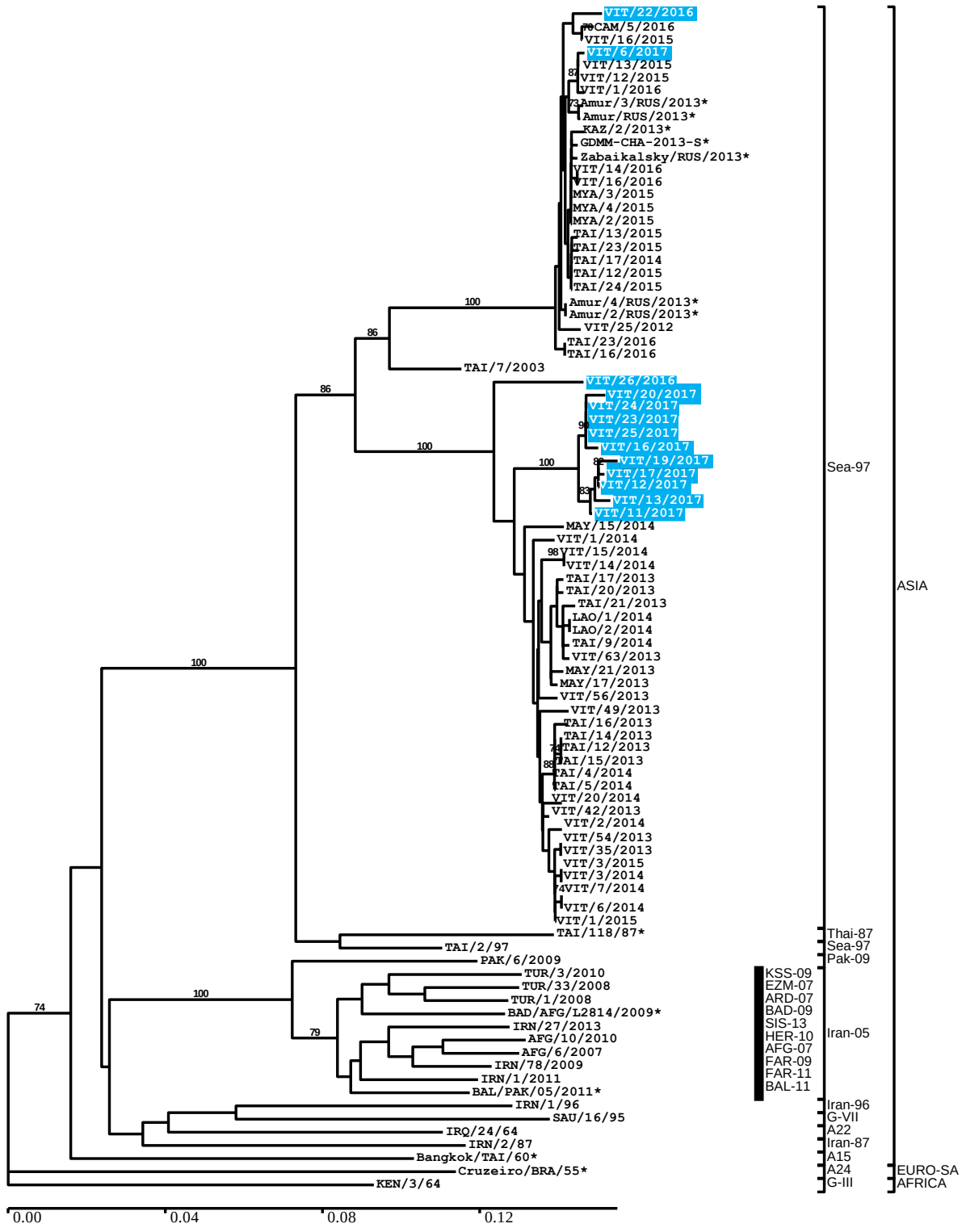
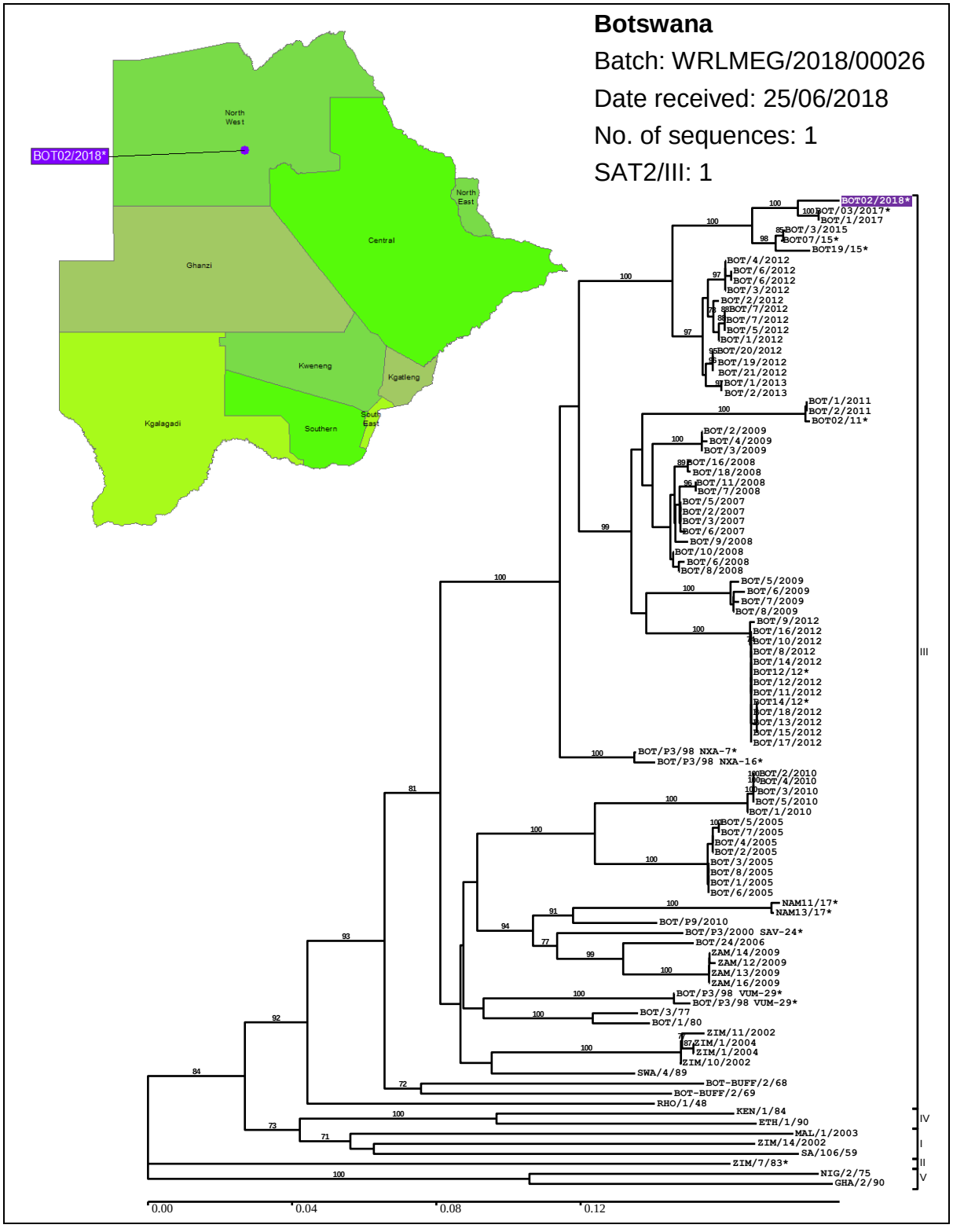
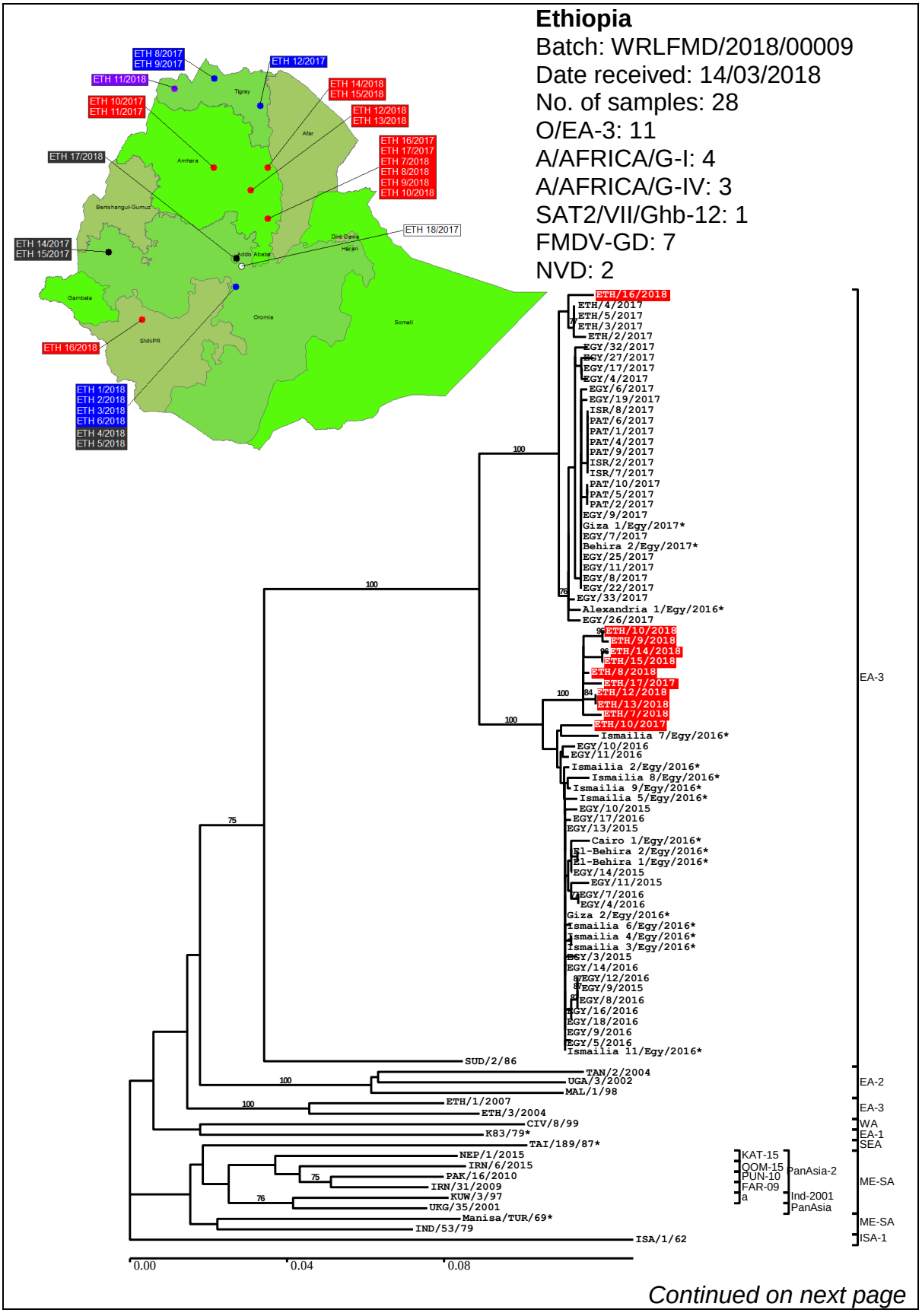
Vietnam continued



2.2. AFRICA





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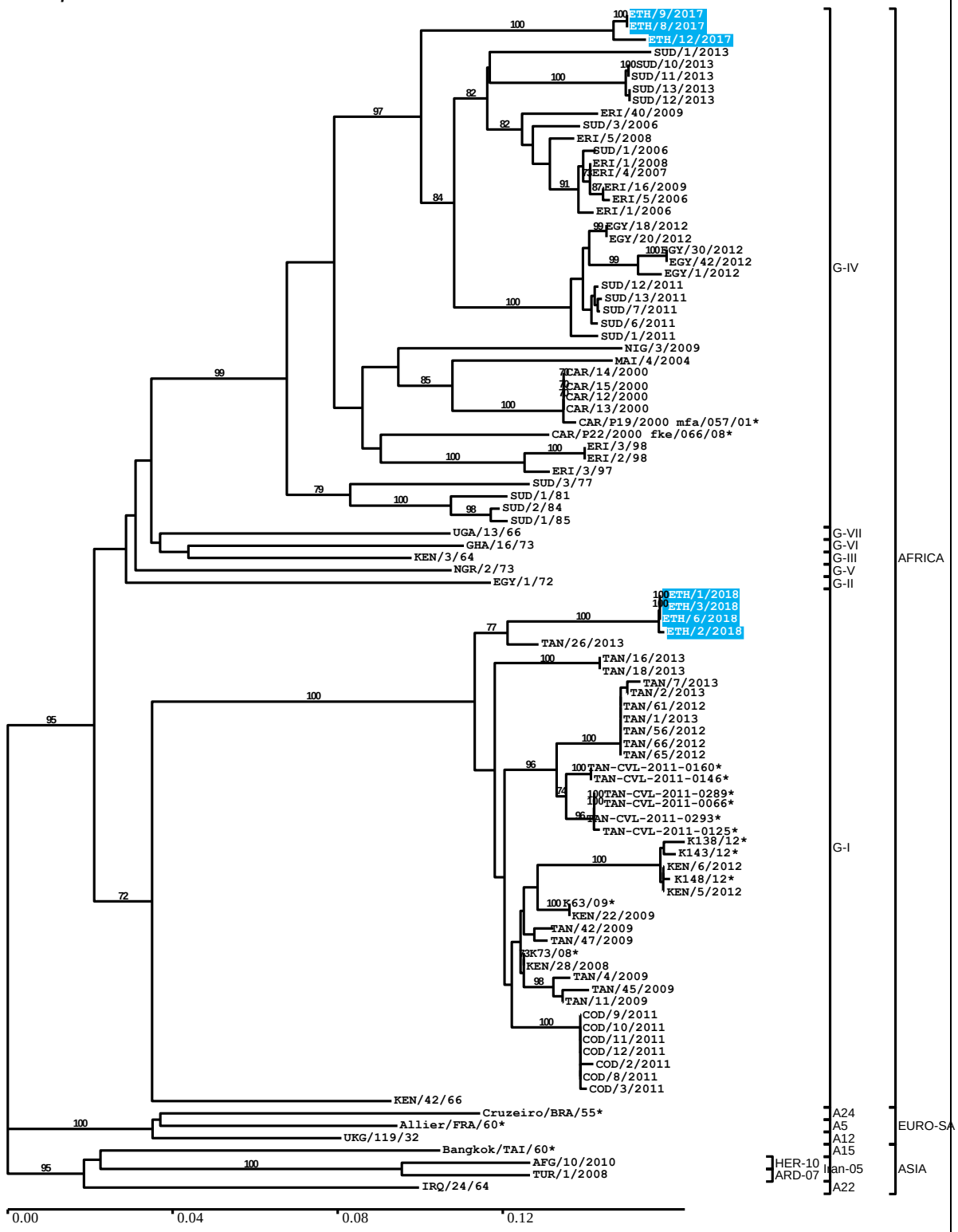
Ethiopia continued



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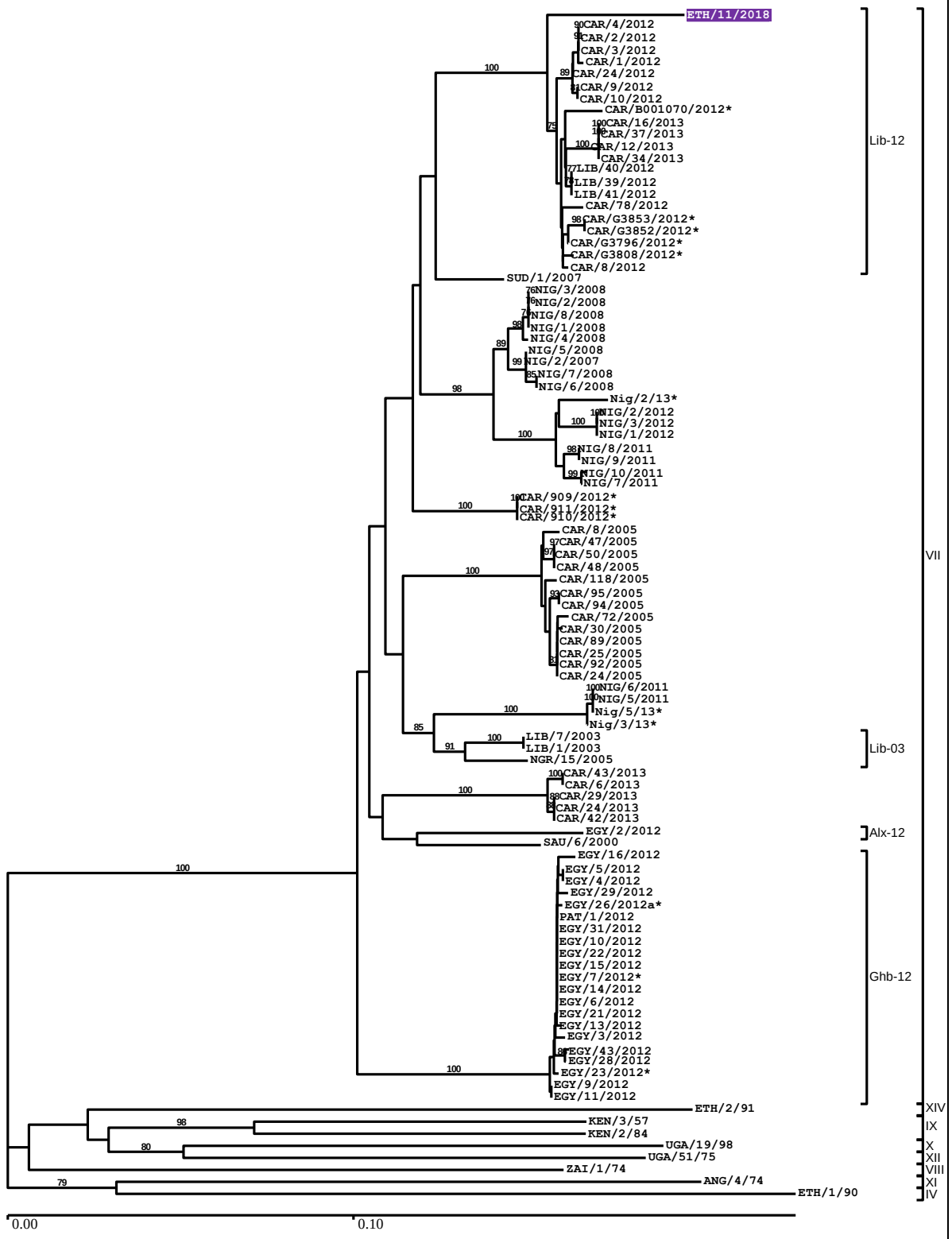

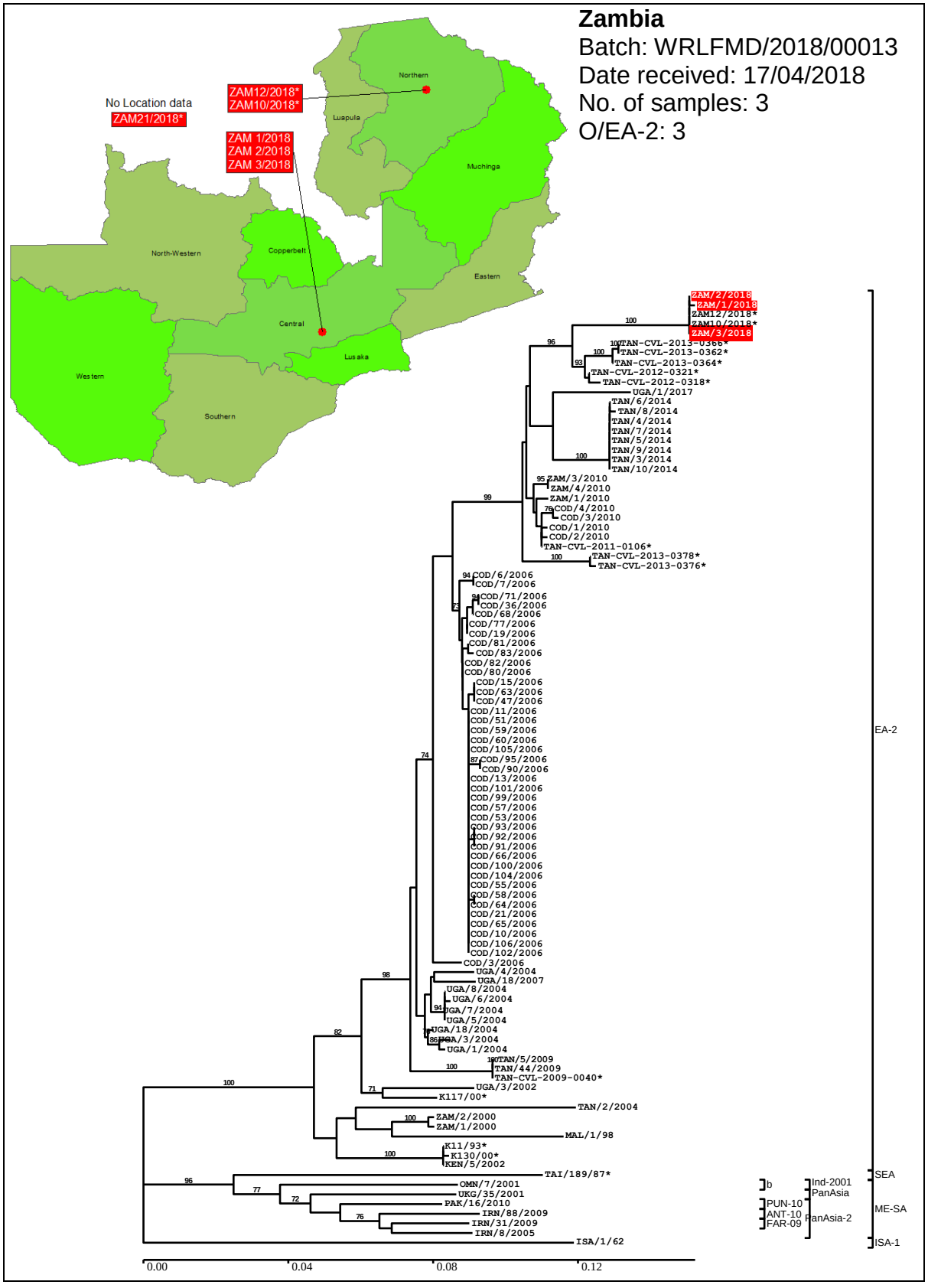

3. Vaccine matching

During this reporting period vaccine matching has been undertaken for 20 FMD virus field strains:

Table 2: Summary of samples tested by vaccine matching.

Serotype	O	A	C	Asia-1	SAT 1	SAT 2	SAT 3
Ethiopia	2	2				1	
Hong Kong	5						
Iran	2	3		2			
Israel	2						
Republic of Korea		1					
∑	**11**	**6**		**2**		**1**	

For individual data see Annex 1, section 3.3 (Antigenic Characterisation).

Annex 1: Sample data

3.1. Summary of Submissions

Table 3: Summary of samples collected and received to WRLFMD (April to June 2018)

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*
AFGHANISTAN	22	3	1	-	-	-	-	1	17	18	4
BHUTAN	11	4	3	-	-	-	-	-	4	8	3
ETHIOPIA	28	11	7	-	-	1	-	-	9	26	2
HONG KONG, SAR OF PRC	9	3	-	-	-	-	-	-	6	6	3
ISRAEL	4	4	-	-	-	-	-	-	-	4	-
IRAN	25	11	9	-	-	-	-	4	1	24	1
SOUTH KOREA	5	-	2	-	-	-	-	-	3	5	-
SRI LANKA	16	9	-	-	-	-	-	-	7	11	5
VIETNAM	40	20	13	-	-	-	-	-	7	39	1
ZAMBIA	3	3	-	-	-	-	-	-	-	3	-
TOTAL	**163**	**68**	**35**	**-**	**-**	**1**	**-**	**5**	**54**	**144**	**19**

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

3.2. Clinical Samples

Table 4: Clinical sample diagnostics made by the WRLFMD® April to June 2018

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
AFGHANISTAN	Apr 18	May 18	AFG 39/2017	BOVINE	16-Feb-17	NEG	POS	FMDV GD
			AFG 40/2017	BOVINE	20-Feb-17	NEG	POS	FMDV GD
			AFG 41/2017	BOVINE	31-May-17	NEG	POS	FMDV GD
			AFG 42/2017	BOVINE	12-Jun-17	NEG	POS	FMDV GD
			AFG 43/2017	BOVINE	18-Jun-17	NEG	POS	FMDV GD
			AFG 44/2017	BOVINE	23-Jun-17	O	POS	O
			AFG 45/2017	BOVINE	30-Jun-17	NEG	POS	FMDV GD
			AFG 46/2017	BOVINE	03-Jul-17	NEG	NEG	NVD
			AFG 47/2017	BOVINE	08-Jul-17	NEG	NEG	NVD
			AFG 48/2017	BOVINE	10-Jul-17	NEG	NEG	NVD
			AFG 49/2017	BOVINE	25-Jul-17	NEG	POS	FMDV GD
			AFG 50/2017	BOVINE	02-Aug-17	A	POS	A
			AFG 51/2017	BOVINE	02-Aug-17	NEG	POS	FMDV GD
			AFG 52/2017	BOVINE	06-Aug-17	O	POS	O
			AFG 53/2017	BOVINE	13-Aug-17	NEG	POS	FMDV GD
			AFG 54/2017	BOVINE	19-Aug-17	O	POS	O
			AFG 55/2017	BOVINE	21-Aug-17	NEG	POS	FMDV GD
			AFG 56/2017	BOVINE	04-Sep-17	ASIA-1	POS	ASIA-1
			AFG 57/2017	BOVINE	19-Sep-17	NEG	NEG	NVD
			AFG 58/2017	BOVINE	19-Oct-17	NEG	POS	FMDV GD
			AFG 59/2017	BOVINE	23-Oct-17	NEG	POS	FMDV GD
			AFG 60/2017	BOVINE	14-Nov-17	NEG	POS	FMDV GD
BHUTAN	May 18	May 18	BHU 23/2017	CATTLE	19-Jul-17	NEG	NEG	NVD
			BHU 24/2017	CATTLE	19-Jul-17	O	POS	O
			BHU 25/2017	CATTLE	19-Jul-17	O	POS	O
			BHU 26/2017	CATTLE	22-Sep-17	A	NEG	A
			BHU 27/2017	CATTLE	22-Sep-17	A	POS	A
			BHU 28/2017	CATTLE	22-Sep-17	A	POS	A
			BHU 29/2017	CATTLE	22-Sep-17	NEG	NEG	NVD
			BHU 1/2018	CATTLE	17-Apr-18	NEG	POS	FMDV GD
			BHU 2/2018	CATTLE	20-Apr-18	O	POS	O
			BHU 3/2018	CATTLE	20-Apr-18	O	POS	O
			BHU 4/2018	CATTLE	20-Apr-18	NEG	POS	FMDV GD
ETHIOPIA	Mar 18	Apr 18	ETH 8/2017	LOCAL ZEBU	27-Jun-17	A	POS	A
			ETH 9/2017	LOCAL ZEBU	27-Jun-17	A	POS	A
			ETH 10/2017	LOCAL ZEBU	24-Oct-17	O	POS	O
			ETH 11/2017	LOCAL ZEBU	24-Oct-17	NEG	POS	FMDV GD
			ETH 12/2017	LOCAL ZEBU	18-Nov-17	A	POS	A
			ETH 13/2017	LOCAL ZEBU	18-Nov-17	NEG	POS	FMDV GD
			ETH 14/2017	LOCAL ZEBU	18-Nov-17	NEG	POS	FMDV GD
			ETH 15/2017	LOCAL ZEBU	18-Nov-17	NEG	POS	FMDV GD
			ETH 16/2017	LOCAL ZEBU	20-Dec-17	NEG	NEG	NVD
			ETH 17/2017	LOCAL ZEBU	20-Dec-17	O	POS	O
			ETH 18/2017	LOCAL ZEBU	29-Dec-17	NEG	NEG	NVD
			ETH 1/2018	LOCAL ZEBU	05-Jan-18	A	POS	A

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
			ETH 2/2018	LOCAL ZEBU	05-Jan-18	A	POS	A
			ETH 3/2018	LOCAL ZEBU	05-Jan-18	A	POS	A
			ETH 4/2018	LOCAL ZEBU	05-Jan-18	NEG	POS	FMDV GD
			ETH 5/2018	LOCAL ZEBU	05-Jan-18	NEG	POS	FMDV GD
			ETH 6/2018	LOCAL ZEBU	05-Jan-18	A	POS	A
			ETH 7/2018	LOCAL ZEBU	24-Jan-18	O	POS	O
			ETH 8/2018	LOCAL ZEBU	24-Jan-18	O	POS	O
			ETH 9/2018	LOCAL ZEBU	24-Jan-18	O	POS	O
			ETH 10/2018	LOCAL ZEBU	24-Jan-18	O	POS	O
			ETH 11/2018	LOCAL ZEBU	25-Jan-18	SAT 2	POS	SAT 2
			ETH 12/2018	LOCAL ZEBU	31-Jan-18	O	POS	O
			ETH 13/2018	LOCAL ZEBU	31-Jan-18	O	POS	O
			ETH 14/2018	LOCAL ZEBU	31-Jan-18	O	POS	O
			ETH 15/2018	LOCAL ZEBU	31-Jan-18	O	POS	O
			ETH 16/2018	LOCAL ZEBU	01-Feb-18	O	POS	O
			ETH 17/2018	HOLSTEIN FRIESIAN	17-Feb-18	NEG	POS	FMDV GD
HONG KONG, SAR OF PRC	Apr 18	May 18	HKN 1/2018	PIG	12-Jan-18	NEG	NEG	NVD
			HKN 2/2018	PIG	28-Feb-18	NEG	POS	FMDV GD
			HKN 3/2018	PIG	28-Feb-18	NEG	POS	FMDV GD
			HKN 4/2018	PIG	28-Feb-18	O	POS	O
			HKN 5/2018	PIG	07-Mar-18	O	POS	O
			HKN 6/2018	PIG	07-Mar-18	O	POS	O
			HKN 7/2018	PIG	07-Mar-18	NEG	NEG	NVD
			HKN 8/2018	PIG	13-Mar-18	NEG	NEG	NVD
			HKN 9/2018	PIG	14-Mar-18	NEG	POS	FMDV GD
ISRAEL	Apr 18	May 18	ISR 1/2018	CATTLE	05-Apr-18	O	POS	O
			ISR 2/2018	CATTLE	05-Apr-18	O	POS	O
			ISR 3/2018	CATTLE	07-Apr-18	O	POS	O
			ISR 4/2018	CATTLE	07-Apr-18	O	POS	O
IRAN	Mar 18	Apr 18	IRN 1/2018	CATTLE	03-Jan-18	O	POS	O
			IRN 2/2018	CATTLE	06-Jan-18	A	POS	A
			IRN 3/2018	CATTLE	09-Jan-18	A	POS	A
			IRN 4/2018	CATTLE	14-Jan-18	A	POS	A
			IRN 5/2018	CATTLE	16-Jan-18	NEG	NEG	NVD
			IRN 6/2018	CATTLE	20-Jan-18	A	POS	A
			IRN 7/2018	CATTLE	21-Jan-18	ASIA-1	POS	ASIA-1
			IRN 8/2018	SHEEP	22-Jan-18	O	POS	O
			IRN 9/2018	CATTLE	24-Jan-18	A	POS	A
			IRN 10/2018	CATTLE	25-Jan-18	A	POS	A
			IRN 11/2018	CATTLE	26-Jan-18	O	POS	O
			IRN 12/2018	CATTLE	28-Jan-18	O	POS	O
			IRN 13/2018	CATTLE	28-Jan-18	O	POS	O
			IRN 14/2018	CATTLE	29-Jan-18	ASIA-1	POS	ASIA-1
			IRN 15/2018	SHEEP	31-Jan-18	O	POS	O
			IRN 16/2018	CATTLE	31-Jan-18	O	POS	O

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
			IRN 17/2018	CATTLE	01-Feb-18	ASIA-1	POS	ASIA-1
			IRN 18/2018	CATTLE	01-Feb-18	A	POS	A
			IRN 19/2018	CATTLE	04-Feb-18	ASIA-1	POS	ASIA-1
			IRN 20/2018	SHEEP	05-Feb-18	O	POS	O
			IRN 21/2018	CATTLE	10-Feb-18	O	POS	O
			IRN 22/2018	CATTLE	12-Feb-18	O	POS	O
			IRN 23/2018	CATTLE	12-Feb-18	A	POS	A
			IRN 24/2018	CATTLE	14-Feb-18	O	POS	O
			IRN 25/2018	CATTLE	23-Feb-18	A	POS	A
SOUTH KOREA	Apr 18	Apr 18	SKR 1/2018	PIG	26-Mar-18	NEG	POS	FMDV GD
			SKR 2/2018	PIG	26-Mar-18	NEG	POS	FMDV GD
			SKR 3/2018	PIG	26-Mar-18	NEG	POS	FMDV GD
			SKR 4/2018	PIG	26-Mar-18	A	POS	A
	May 18	May 18	SKR 5/2018	PIG	07-Apr-18	A	POS	A
SRI LANKA	May 18	Jun 18	SRL 4/2017	CATTLE	16-Aug-17	NEG	NEG	NVD
			SRL 5/2017	CATTLE	28-Nov-17	O	POS	O
			SRL 1/2018	CATTLE	09-Jan-18	O	POS	O
			SRL 2/2018	CATTLE	06-Feb-18	O	POS	O
			SRL 3/2018	CATTLE	15-Feb-18	NEG	POS	FMDV GD
			SRL 4/2018	CATTLE	15-Feb-18	O	POS	O
			SRL 5/2018	CATTLE	14-Mar-18	O	POS	O
			SRL 6/2018	CATTLE	14-Mar-18	O	POS	O
			SRL 7/2018	CATTLE	28-Mar-18	O	POS	O
			SRL 8/2018	ELEPHANT	16-Apr-18	NEG	NEG	NVD
			SRL 9/2018	CATTLE	16-Apr-18	O	POS	O
			SRL 10/2018	CATTLE	19-Apr-18	NEG	NEG	NVD
			SRL 11/2018	CATTLE	23-Apr-18	O	POS	O
			SRL 12/2018	CATTLE	23-Apr-18	NEG	NEG	NVD
			SRL 13/2018	CATTLE	23-Apr-18	NEG	NEG	NVD
			SRL 14/2018	CATTLE	03-May-18	NEG	POS	FMDV GD
VIETNAM	Feb 18	Apr 18	VIT 22/2016	BOVINE	10-Jun-16	A	POS	A
			VIT 23/2016	PIG	10-Jul-16	O	POS	O
			VIT 24/2016	BOVINE	18-Aug-16	O	POS	O
			VIT 25/2016	BOVINE	30-Sep-16	NEG	POS	FMDV GD
			VIT 26/2016	BOVINE	13-Oct-16	A	POS	A
			VIT 27/2016	BOVINE	14-Oct-16	O	POS	O
			VIT 1/2017	BUFFALO	07-Jan-17	O	POS	O
			VIT 2/2017	BOVINE	09-Jan-17	O	POS	O
			VIT 3/2017	PIG	11-Jan-17	O	POS	O
			VIT 4/2017	BOVINE	19-Feb-17	NEG	POS	FMDV GD
			VIT 5/2017	PIG	22-Feb-17	O	POS	O
			VIT 6/2017	BOVINE	27-Feb-17	A	POS	A
			VIT 7/2017	BUFFALO	07-Apr-17	O	POS	O
			VIT 8/2017	PIG	10-Apr-17	NEG	NEG	NVD
			VIT 9/2017	BOVINE	20-Apr-17	O	POS	O
			VIT 10/2017	PIG	06-Jun-17	NEG	POS	FMDV GD
			VIT 11/2017	BOVINE	09-Jun-17	A	POS	A
			VIT 12/2017	BOVINE	19-Jun-17	A	POS	A

Country	Date		WRL for FMD Sample Identification	Animal	Date of Collection	Results		
	Received	Reported				VI/ELISA	RT-PCR	Final report
			VIT 13/2017	BOVINE	30-Jun-17	A	POS	A
			VIT 14/2017	PIG	06-Jul-17	NEG	POS	FMDV GD
			VIT 15/2017	BOVINE	02-Aug-17	O	POS	O
			VIT 16/2017	BOVINE	05-Aug-17	A	POS	A
			VIT 17/2017	BOVINE	09-Aug-17	A	POS	A
			VIT 18/2017	BOVINE	21-Aug-17	O	POS	O
			VIT 19/2017	BOVINE	24-Aug-17	A	POS	A
			VIT 20/2017	BOVINE	29-Aug-17	A	POS	A
			VIT 21/2017	PIG	07-Sep-17	O	POS	O
			VIT 22/2017	PIG	09-Sep-17	O	POS	O
			VIT 23/2017	BUFFALO	11-Sep-17	A	POS	A
			VIT 24/2017	BUFFALO	11-Sep-17	A	POS	A
			VIT 25/2017	BUFFALO	11-Sep-17	A	POS	A
			VIT 26/2017	PIG	02-Oct-17	O	POS	O
			VIT 27/2017	PIG	06-Oct-17	O	POS	O
			VIT 28/2017	BOVINE	18-Oct-17	NEG	POS	FMDV GD
			VIT 29/2017	BOVINE	20-Oct-17	O	POS	O
			VIT 30/2017	BOVINE	26-Oct-17	O	POS	O
			VIT 31/2017	BOVINE	10-Nov-17	O	POS	O
			VIT 32/2017	BOVINE	25-Dec-17	O	POS	O
			VIT 1/2018	BOVINE	25-Jan-18	O	POS	O
			VIT 2/2018	PIG	30-Jan-18	NEG	POS	FMDV GD
			ZAM 1/2018	CATTLE	24-Mar-18	O	POS	O
			ZAM 2/2018	CATTLE	24-Mar-18	O	POS	O
ZAMBIA	Apr 18	Apr 18	ZAM 3/2018	CATTLE	02-Apr-18	O	POS	O
			TOTAL	**163**				

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

3.3. Antigenic Characterisation

Antigenic characterisation of FMD field isolates by matching with vaccine strains by 2dmVNT from April to June 2018.

Table 5: Vaccine matching studies for O FMDV by VNT

Strain	Serotype	Topotype	Lineage	O 3039	O1 Manisa	O/TUR/5/2009
ETH/13/2018	O	EA-3	PanAsia	0.34	0.21	0.38
ETH/16/2018	O	EA-3	-	0.21	0.15	0.31
HKN/4/2018	O	CATHAY	-	0.11	0.10	0.14
HKN/5/2018	O	CATHAY	-	0.13	0.14	0.13
HKN/8/2017	O	CATHAY	-	0.09	0.15	0.13
HKN/11/2017	O	CATHAY	-	0.09	0.15	0.14
HKN/12/2017	O	CATHAY	-	0.10	0.07	0.12
IRN/1/2018	O	ME-SA	PanAsia-2	0.58	0.37	0.34
IRN/12/2018	O	ME-SA	PanAsia-2	0.85	0.48	0.63
ISR/2/2018	O	ME-SA	PanAsia-2	0.32	0.30	0.48
ISR/4/2018	O	ME-SA	PanAsia-2	0.18	0.24	0.5

Table 6: Vaccine matching studies for A FMDV by VNT

Strain	Serotype	Topotype	Lineage	A/IRN/05	A/TUR/20/06	A22 IRAQ	A MAY 97	A/ASIA/GVII	A24 Cruz Merial	A24 Cruz PANAFTOSA
ETH/2/2018	A	AFRICA	G-I	0.29	0.02	0.29				
ETH/6/2018	A	AFRICA	G-I	0.45	0.02	0.45				
IRN/10/2018	A	ASIA	Iran-05	0.48	0.22	0.45		0.02		
IRN/23/2018	A	ASIA	Iran-05	0.19	0.36	0.33		0.02		
IRN/25/2018	A	ASIA	G-VII	0.01	0.01	0.14		0.71		
SKR/5/2018	A	ASIA	SEA-97	0.45	0.01	0.43	0.12	0.47	0.35	0.19

Table 7: Vaccine matching studies for Asia-1 FMDV by VNT

Strain	Serotype	Lineage	Asia 1 Shamir
IRN/7/2018	Asia 1	Sindh-08	0.48
IRN/19/2018	Asia 1	Sindh-08	0.39

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

Strain	Serotype	Topotype	Strain	SAT 2 ERI	SAT 2 ZIM
ETH/11/2018	SAT 2	VII	-	0.58	0.35

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

Annex 2: FMD publications

Recent FMD Publications (April to June 2018) cited by Web of Science (Pirbright Institute papers and authors are highlighted in **BOLD AND GREY**)

1. Abeyratne, S.A.E., S.S.C. Amarasekera, L.T. Ranaweera, T.B. Salpadoru, S. Thilakarathne, N.J. Knowles, J. Wadsworth, S. Puvanendiran, H. Kothalawala, B.K. Jayathilake, H.A. Wijithasiri, M. Chandrasena, and S. Sooriyapathirana (2018). The phylogenetic analysis of VP1 genomic region in *Foot-and-mouth disease virus* serotype O isolates in Sri Lanka reveals the existence of 'Sr1-97', a newly named endemic lineage (vol 13, e0194077, 2018). *Plos One*, **13**(4): 1.
2. Ali, W., M. Habib, R.S.A. Khan, M.A. Zia, M.U. Mazhar, A. Javed, M. Farooq, and M. Shah (2018). P1 Coding Region Diversity of Group VII (Sind-08) Serotype Asia-1 *Foot-and-Mouth Disease Virus*. *Kafkas Universitesi Veteriner Fakultesi Dergisi*, **24**(3): 341-347.
3. **Bachanek-Bankowska, K.**, **A. Di Nardo**, **J. Wadsworth**, **E.K.M. Henry**, U. Parlak, A. Timina, A. Mischenko, I.A. Qasim, D. Abdollahi, M. Sultana, M.A. Hossain, **D.P. King**, and **N.J. Knowles** (2018). Foot-and-Mouth Disease in the Middle East Caused by an A/ASIA/G-VII Virus Lineage, 2015-2016. *Emerging Infectious Diseases*, **24**(6): 1073-1078.
4. Bai, W.F., L. Li, T. Zhang, X.H. Su, Y.W. Wang, B.W. Zhao, T. Zhang, and H.M. Zhou (2018). Isolation and identification of bovine nasopharyngeal mucosal epithelial cells and establishment of cell models of acute infection by *Foot-and-mouth disease virus*. *In Vitro Cellular & Developmental Biology-Animal*, **54**(4): 287-294.
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6. Brito, B.P., J.K. Mohapatra, S. Subramaniam, B. Pattnaik, L.L. Rodriguez, B.R. Moore, and A.M. Perez (2018). Dynamics of widespread *Foot-and-mouth disease virus* serotypes A, O and Asia-1 in southern Asia: A Bayesian phylogenetic perspective. *Transboundary and Emerging Diseases*, **65**(3): 696-710.
7. de los Santos, T., F. Diaz-San Segundo, and L.L. Rodriguez (2018). The need for improved vaccines against foot-and-mouth disease. *Current Opinion in Virology*, **29**: 16-25.
8. De Vleeschauwer, A.R., X.C. Zhou, D.J. Lefebvre, A. Gamier, F. Watier, C. Pignon, S.A. Lacour, S. Zientara, L. Bakkali-Kassimi, K. De Clercq, and B. Klonjkowski (2018). A canine adenovirus type 2 vaccine vector confers protection against foot-and-mouth disease in guinea pigs. *Vaccine*, **36**(16): 2193-2198.
9. Deveci, H.A., A. Kukurt, G. Nur, M. Alpay, O. Merhan, K. Bozukluhan, V. Yilmaz, and M. Karapehlivan (2018). Serum paraoxonase activity and total

sialic acid in sheep with foot-and-mouth disease. *Medycyna Weterynaryjna*, **74**(3): 199-202.
10. Dill, V., B. Hoffmann, A. Zimmer, M. Beer, and M. Eschbaumer (2018). Influence of cell type and cell culture media on the propagation of *Foot-and-mouth disease virus* with regard to vaccine quality. *Virology Journal*, **15**: 11.
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19. **Lasecka-Dykes, L.**, C**.F. Wright**, **A. Di Nardo**, **G. Logan**, **V. Mioule**t, **T. Jackson**, **T.J. Tuthill**, **N.J. Knowles**, and **D.P. King** (2018). Full Genome Sequencing Reveals New Southern African Territories Genotypes Bringing Us Closer to Understanding True Variability of *Foot-and-Mouth Disease virus* in Africa. *Viruses-Basel*, **10**(4): 16.
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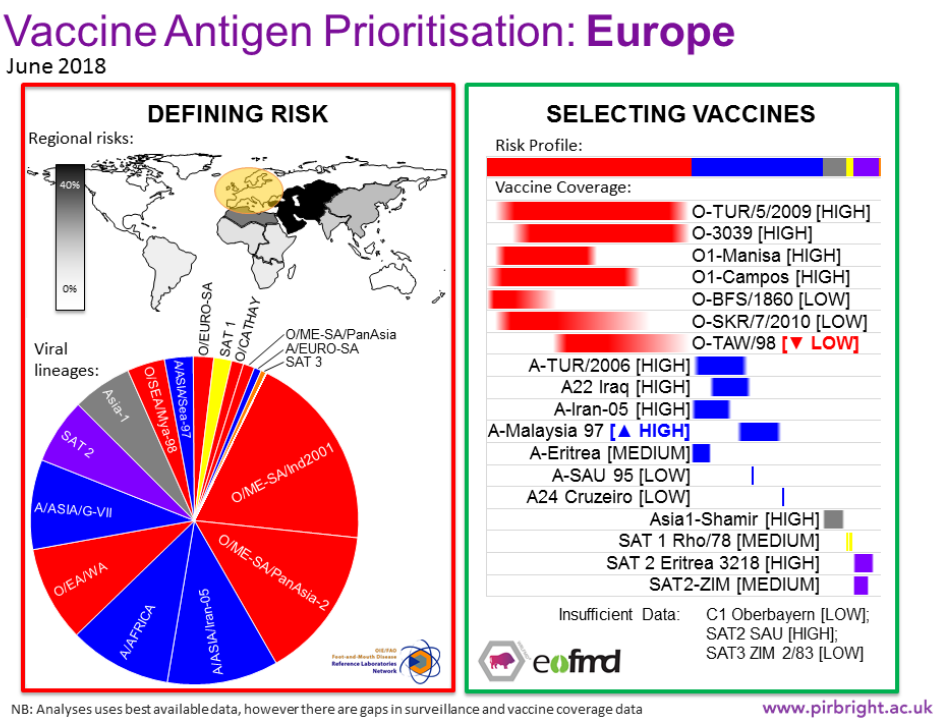
Annex 3: Vaccine Recommendations

This report showcases a new format for 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. 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 below), as well as available *in vitro, in vivo* and field data to score the ability of vaccines to protect against these FMDV lineages.

Lineage	West Eurasia	East Asia	North Africa	India and Southern Asia	East Africa	West and Central Africa	Southern Africa	South America
O ME-SA PanAsia-2	35	-	-	-	-	-	-	-
O ME-SA PanAsia	-	10	-	-	-	-	-	-
O SEA Mya-98	-	33	-	-	-	-	-	-
O ME-SA Ind2001	6	20	35	80	-	-	-	-
O EA or O WA	3	-	20	-	45	37	-	-
O EURO-SA	-	-	-	-	-	-	-	74
O CATHAY	-	10.5	-	-	-	-	-	-
A ASIA Sea-97	-	25	-	-	-	-	-	-
A ASIA Iran-05	25.5	-	-	-	-	-	-	-
A ASIA G-VII	17.5	-	-	16	-	-	-	-
A AFRICA	-	-	35	-	24	25	-	-
A EURO-SA	-	-	-	-	-	-	-	26
Asia-1	12.5	1.5	-	4	-	-	-	-
SAT 1	-	-	-	-	10	10	27	-
SAT 2	0.5	-	10	-	20	28	57	-
SAT 3	-	-	-	-	1		16	-
C	-	-	-	-	-	-	-	-



The table defines the relative distribution of FMDV lineages in each of the eight *source regions*, while the figure highlights the importance of these *source regions* for **Europe** (using data collected at the EU-RL Workshop); please contact WRLFMD 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: Other WRLFMD Activities

Summary of the current status of the laboratory Proficiency Testing Scheme organised by The Pirbright Institute on behalf of the EU, EuFMD and the OIE/FAO.

		Phase XXX (reported in 2018)
Total invited laboratories[1]		81
Total number of shipments[1]		70
Participants from European Union (funded by EURL for FMD)		27 (EU member states)
% of labs meeting target performance[4]	**Cat-1**	0 %
	Cat-2	0 %
	Cat-3	44 %
	Cat-4	56 %
Participants from Global Network Labs[2]		Argentina, Botswana, Brazil, Canada[3], Ethiopia, Kenya, Nigeria, Russia, South Africa, Thailand, USA[3].
% of labs meeting target performance[4]	**Cat-1**	0 %
	Cat-2	0 %
	Cat-3	73 %
	Cat-4	27 %
Participants from EuFMD Member states (non-EU)		Albania, Israel, FYR Macedonia, Norway, Georgia, Serbia, Switzerland, Turkey
% of labs meeting target performance[4]	**Cat-1**	0 %
	Cat-2	0 %
	Cat-3	75 %
	Cat-4	25 %
Participants from neighbourhood countries		Algeria, Armenia, Azerbaijan, Egypt, Jordan, Kosovo, Lebanon, Moldova, Morocco, Tunisia.
% of labs meeting target performance[4]	**Cat-1**	0 %
	Cat-2	0 %
	Cat-3	70 %
	Cat-4	30 %
Summary		
Panels shipped	**Panel 1**	22
	Panel 2	23
	Panel 3	25
	Panel 4	15
Total number of participants funded by EUFMD		25
Other Participants		Australia, Kazakhstan, Namibia, Pakistan, Senegal, Singapore, Swaziland, UAE, & Zambia
% of labs meeting target performance[4]	**Cat-1**	0 %
	Cat-2	0 %
	Cat-3	44 %
	Cat-4	56 %

[1] Additional laboratories (non-NRL) participate in the PTS at their own expense; [2] Not including IZSLER and CODA-CERVA who participate as European NRLs; [3] USA are self-funded; [4] Scored according criteria agreed by the NRLs within Europe, each laboratory receives a personalized anonymous feedback letter to highlight areas in which they could improve, and performance of each laboratory is broadly categorized into one of four groups: ***Category 1*** *to emphasize critical issues where immediate action is required that impact upon the laboratory to correctly identify FMD virus (virology tests) or FMDV infected animals (serological tests);* ***Category 2*** *laboratories with serious issues with the performance of individual tests that need to be addressed;* ***Category 3*** *to record additional observations which may need to be considered by the laboratory to improve the local performance of individual tests;* ***Category 4*** *laboratories whose tests which are fit for purpose and where no further action is required.*