

# Foot-and-Mouth Disease

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## January-March 2020

### Quarterly report

#### **FAST Reports**

Foot-and-mouth And Similar Transboundary animal diseases

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European Commission for the  
Control of Foot-and-Mouth Disease

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#### Maps within this document

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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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# 1. Highlights and Headlines

Welcome to the first “Quarterly Report” for 2020 which is also the first Joint report between EuFMD and the WRLFMD, replacing the former Global Monthly Report (GMR) which had been issued by the EuFMD for eight years. It is hoped that with time, more analysis of trends and developments will be provided in this format and new online tools are also planned to assist users to select and display results of most interest to them.

Twenty years ago, the work of the WRLFMD highlighted threats posed by the O-PanAsia strain, named for its history of unprecedented spread across Asia in the 1990s. This strain originated in South Asia (Pool 2), and subsequently spread to Pool 3 (West/Eurasia and the Middle-East) and Pool 1 (East Asia). The jumps from Pool 1 to FMD free countries raised concerns that this virus could be the first global “pandemic” strain, and countries were warned by EuFMD to review preparedness and increase stringency of controls. In 2000, outbreaks affected South Africa, and in February 2001, the United Kingdom, from where it spread to 3 other EU countries. The story has remarkable parallels to the COVID-19 emergence; from the warning signs to the overwhelming speed of the epidemic and demands upon health systems. The WRLFMD services, in tracking the emergence of new viruses provide vital information as well as critical thinking on why some viruses elude biosecurity barriers. Since 2001, with the formation of the OIE/FAO FMD Laboratory Network, international capacity to detect the signals of pandemic spread are stronger; but only still as good as the quality of surveillance and adequacy of sample submission and speed of the network to share vital viral intelligence.

This report highlights new FMD outbreaks in North Africa (Libya), from where the disease threatens the Maghreb countries; the detection of new serotype O lineages in Pool 2 (Sri Lanka) and the complexities of multiple serotype and topotype co-circulations in Pool 4 (East Africa) that indicate that more frequent and timely virus typing is required. Despite the enhanced surveillance work of the OIE/FAO FMD Laboratory Network, Figure 3 in this report highlights significant and concerning gaps in submissions from Pool 3 (countries in Middle-East and parts of Central Asia), Pool 5 countries in West Africa (Mali, Chad, Niger) and Pool 1 countries (Myanmar and Cambodia). There is also concern for the lack of typing of samples from Malawi given the southerly spread of FMDV from Pool 4 into Pool 3 during 2018-19 and potential for involvement with risk populations in southern Africa. This report also highlights technical improvements in the use of environmental sampling (swabbing) which enabled virus typing of FMDV from Cameroon. Further use of these approaches is encouraged as they allow sequence data to be generated from environments such as markets in the absence of reported disease. All colleagues reading this report are encouraged to assist to increase the submissions from these gap areas. We also welcome feedback on this new report format.

Best wishes, Keith Sumption (Rome) and Don King (Pirbright)

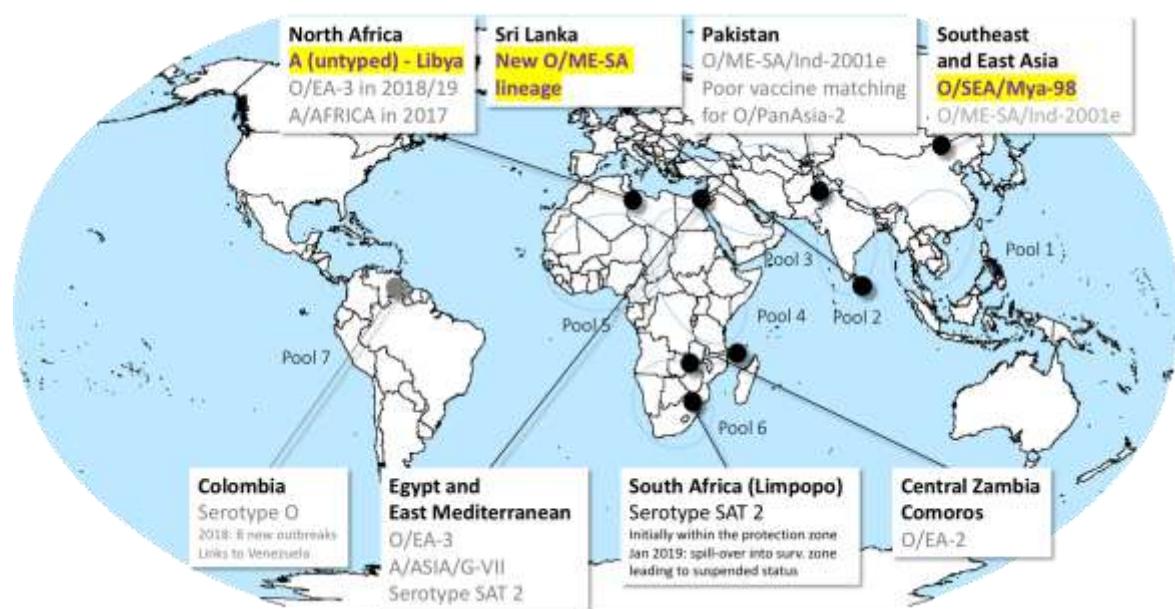


Figure 1: Recent and new headline events (Jan. to Mar. 2020)

## 2. General Overview

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

| POOL   | REGION/COUNTRIES   | SEROTYPES PRESENT                             |
|--|--|---|
| <b>SOUTHEAST ASIA/CENTRAL ASIA/EAST ASIA</b> |  |   |
| 1  | Cambodia, China, China (Hong Kong, SAR), Taiwan Province of China, Democratic People's Republic of Korea, Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, Russian Federation, Thailand, Viet Nam   | A, Asia 1 and O                               |
| <b>SOUTH ASIA</b>                            |  |   |
| 2  | Bangladesh, Bhutan, India, Mauritius, Nepal, Sri Lanka   | A, Asia 1 and O                               |
| <b>WEST EURASIA &amp; MIDDLE EAST</b>        |  |   |
| 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, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan      | A, Asia 1 and O<br>(SAT 2)*                   |
| <b>NORTH AFRICA</b>                          |  |   |
| 4  | Algeria, Egypt, Libya, Morocco, Tunisia  | A, O and SAT 2                                |
| <b>EASTERN AFRICA</b>                        |  |   |
| 5  | Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Uganda, United Republic of Tanzania, Yemen  | O, A, SAT 1, SAT 2 and SAT 3                  |
| <b>WEST/CENTRAL AFRICA</b>                   |  |   |
| 6  | Benin, Burkina Faso, Cabo Verde, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Democratic Republic of Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, Togo | O, A, SAT 1 and SAT 2                         |
| <b>SOUTHERN AFRICA</b>                       |  |   |
| 7  | Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe  | SAT 1, SAT 2 and SAT 3<br>(O, A) <sup>†</sup> |
| <b>SOUTH AMERICA</b>                         |  |   |
|  | Colombia, Venezuela (Bolivarian Republic of)   | O and A                                       |

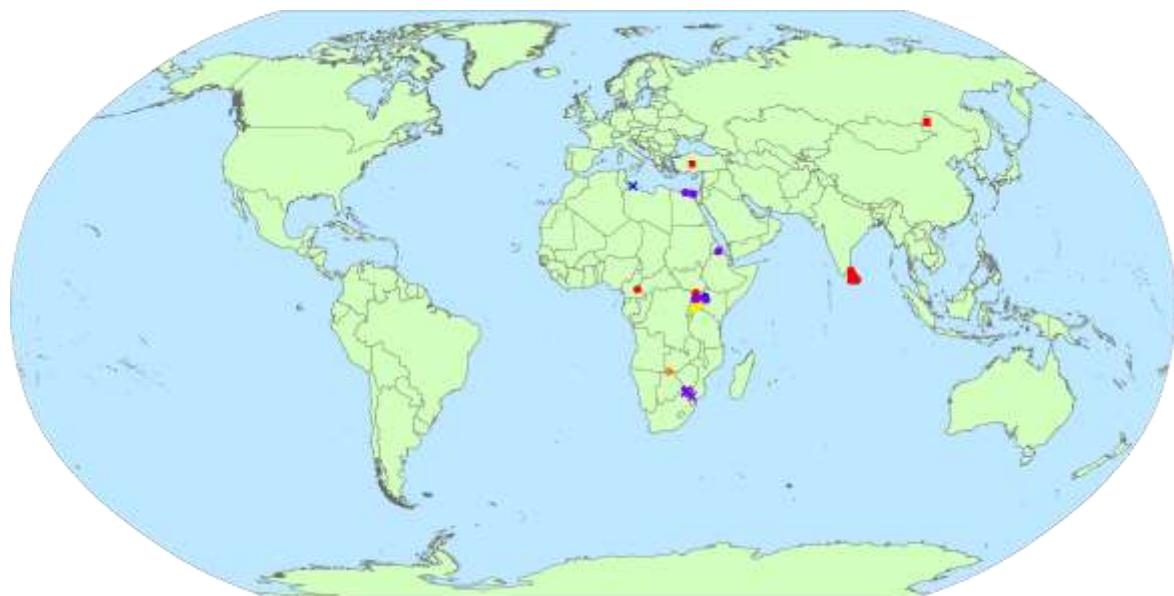
\* Reported only in Oman in 2017

<sup>†</sup> only in Angola and north Zambia as spill-over from pool 4

### 3. Summary of FMD outbreaks and Intelligence

#### 3.1. Global Overview of samples received and tested

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



**Figure 2:** Samples tested by WRLFMD or reported in this quarter (coloured spots define serotypes detected (O, A, C, Asia 1, SAT 1, SAT 2, SAT 3, untyped, negative). ● indicates samples analysed; X indicates new outbreaks reported to the OIE, but where results to define the genotype have not been reported; ■ indicated reports of FMD from other sources.

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

##### People's Republic of China



An outbreak of **FMD type O** was reported in cattle on 30<sup>th</sup> December 2019 at Yandun Animal Health Inspection and Disinfection Station along Highway G30, Yizhou District, Hami, Xinjiang. No genotyping has been reported.

### The Russian Federation



An outbreak due to **FMD type O** was reported in cattle on 27<sup>th</sup> January 2020 at Novotsurukhajtuj, Priargunsky, Zabajkal'Skij Kray. The suspected source of infection was a communal cattle watering point on the Argun river along which the national boundary between the Russian Federation and China runs. The VP1 sequence was received from FGI-ARRIAH and genotyping showed that it belonged to the SEA topotype, Mya-98 lineage (see below). [Immediate Notification and Follow up reports on WAHIS, OIE](#)

### 3.3. Pool 2 (South Asia)

#### The Democratic Socialist Republic of Sri Lanka



On 9<sup>th</sup> January 2020, 23 samples were received. They were collected from cattle (and one water buffalo) between May 2018 and December 2019. **FMD type O** virus was isolated from 15 of the samples, FMDV genome was detected in a further four samples and four were NVD. VP1 genotyping showed all 15 belonged to the ME-SA topotype. Twelve of these belonged to the Ind-2001d sublineage, while three belonged to the SA-2018 sublineage.

### 3.4. Pool 3 (West Eurasia and Middle East)

#### The Republic of Turkey



52 outbreaks were reported in the Anatolia region between January and March 2020 (Jan: 24 outbreaks, Feb: 21 outbreaks, Mar: 7 outbreaks); 82 outbreaks were reported in 2019. FMD is endemic in Anatolia. Currently, only serotype O (O/ME-SA/PanAsia-2/Qom-15) is circulating. Serotypes A and Asia-1 have not been detected since January 2018 and July 2015, respectively. The Thrace Region of Turkey has been free from FMD (with vaccination) since May 2010.

Reported by Turkish Veterinary Authority and VETBIS (Turkey)

#### The Islamic Republic of Pakistan



A batch of 50 samples was received on the 16<sup>th</sup> March 2020. Testing is in progress and results will be reported in the next quarterly report.

### 3.5. Pool 4 (North and Eastern Africa)

#### The Arab Republic of Egypt



Eleven **FMD type SAT 2 VP1** sequences were retrieved from GenBank. They were submitted by MEVAC (Cairo, Egypt) and consist of viruses from three locations, Alexandria, Ismailia and Sharqia, collected in 2018. Genotyping showed them all to belong to topotype VII, lineage Lib-12 (see below).

#### The State of Eritrea



A batch of 47 samples was received on 18<sup>th</sup> December 2019. Samples were collected from cattle, sheep and pigs between October 2015 and November 2019, but no locations were given. **FMD type O** virus was isolated from six samples, **FMD type A** virus from one sample and **FMD type SAT 2** virus from 15 samples. FMDV genome was detected in a further 16 samples and the remaining nine were NVD. VP1 genotyping reveals that the type O viruses belonged to the EA-3 topotype; the single type A virus belonged to the AFRICA topotype, G-IV lineage; and the SAT 2 viruses all belonged to topotype VII, Lib-12 lineage (see below).

#### State of Libya



An outbreak of FMD type A was reported to have occurred on 11th February 2020 in sheep in the Tarabulus Governorate. No genotyping has been reported. [Immediate Notification and Follow up reports on WAHIS, OIE](#)

#### The Republic of Uganda



On 18<sup>th</sup> January 2020, 158 FMDV VP1 sequences were retrieved from GenBank. They had been submitted by the PIADC and were from probang samples collected from cattle in 2016 and 2017. There were 67 **FMD type O**, 4 **FMD type A**, 54 **FMD type SAT 1** and 33 **FMD type SAT 2**. Sixty-five of the type O viruses belonged to the EA-2 topotype and two belonged to the EA-4 topotype. All four type A viruses belonged to the G-I lineage of the AFRICA topotype. The 54 SAT 1 viruses belonged to topotype I and are the first description of this topotype in Uganda. Two of the SAT 2 viruses belonged to topotype IV and 31 to topotype VII (see below).

### 3.6. Pool 5 (West/Central Africa)

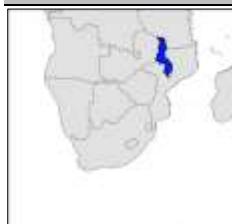
#### The Republic of Cameroon



An environmental sample, collected in Bertoua on 20<sup>th</sup> June 2019, was processed at the Pirbright Institute. The sample was taken as part of an EuFMD-funded project awarded to the Emerging Infectious Disease Research Association (EIDRA), based at the University of Buea, Cameroon. It was submitted to the WRLFMD for sequence analysis. Generation of sequence data using an Illumina MiSeq allowed the VP1 genotyping to be undertaken. The sample was shown to contain **FMD type O** virus which belonged to the EA-3 topotype (see below).

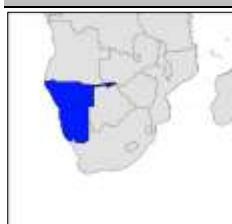
### 3.7. Pool 6 (Southern Africa)

#### The Republic of Malawi



An outbreak of **FMD** (so far untyped) was reported to have occurred on 6<sup>th</sup> February 2020 in cattle in the Ntcheu district, Central Region.

#### The Republic of Namibia



A single **FMD type SAT 3** VP1 sequence was submitted by the SSARRL (BVI) on 15<sup>th</sup> January 2020. This was derived from a sample collected from cattle in the Zambezi Region in 2019. Genotyping showed that the causal virus belonged to topotype II (see below).

#### The Republic of South Africa



During January 2020, a further four outbreaks due to **FMD type SAT 2** were reported in cattle in the municipalities of Polokwane, Makhado and Ba-Phalaborwa (Limpopo Province: [Immediate Notification and Follow up reports on WAHIS, OIE](#)). In March 2020, six outbreaks due to **FMD type SAT 2** were reported in cattle in Bushbuckridge, Mpumalanga Province [Immediate Notification and Follow up reports on WAHIS, OIE](#). All these outbreaks occurred in South Africa's FMD Protection Zone. Although detailed genotyping has not been reported, the OVI has stated that the two sets of outbreaks were caused by different FMD viruses.

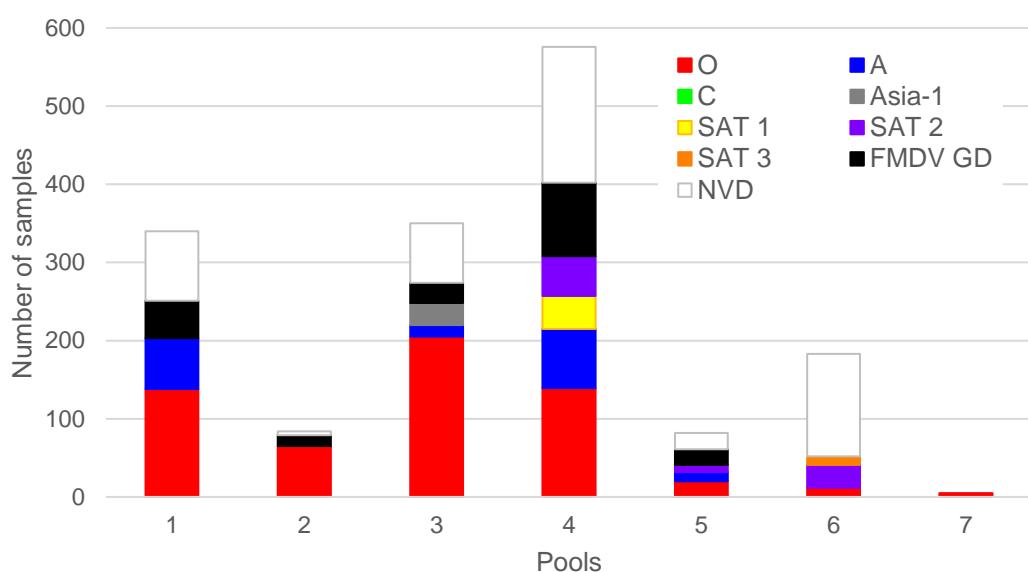
### 3.8. Pool 7 (South America)

No new outbreaks of FMD were reported in the continent.

### 3.9. Extent of global surveillance



**Figure 3:** Samples received during 2019 from FMD outbreaks. Draft data for sample testing undertaken by laboratories within the OIE/FAO FMD Reference Laboratory Network ([www.foot-and-mouth.org](http://www.foot-and-mouth.org))



**Figure 4:** Representation of different FMDV serotypes detected in samples tested from the FMD endemic pools by the OIE/FAO FMD Laboratory Network during 2019 (draft data)

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 regions (see Table 1, below).

**Table 1:** Conjectured relative prevalence of circulating FMD viral lineages in each Pool. For each of the regions, data represent the relative importance of each viral lineage [prevalence score estimated as a proportion (%) of total FMD cases that occur in domesticated hosts].

| Lineage           | Southeast / Central / East Asia<br>[Pool 1] | South Asia<br>[Pool 2] | West Eurasia & Middle East<br>[Pool 3] | North Africa<br>[Pool 4] | Eastern Africa<br>[Pool 5] | West / Central Africa<br>[Pool 6] | Southern Africa<br>[Pool 7] | South America |
|-------------------|---|------------------------|--|--------------------------|----------------------------|-----------------------------------|-----------------------------|---------------|
| O ME-SA PanAsia-2 |   |                        | 35                                     |                          |                            |                                   |                             |               |
| O ME-SA PanAsia   | 10  |                        |  |                          |                            |                                   |                             |               |
| O SEA Mya-98      | 33  |                        |  |                          |                            |                                   |                             |               |
| O ME-SA Ind2001   | 20  | 80                     | 6                                      | 10                       |                            |                                   |                             |               |
| O EA or O WA      |   |                        | 3                                      | 55                       | 55                         | 70                                |                             |               |
| O EURO-SA         |   |                        |  |                          |                            |                                   | 80                          |               |
| O CATHAY          | 10.5  |                        |  |                          |                            |                                   |                             |               |
| A ASIA Sea-97     | 25  |                        |  |                          |                            |                                   |                             |               |
| A ASIA Iran-05    | 0   |                        | 25.5                                   |                          |                            |                                   |                             |               |
| A ASIA G-VII      |   | 16                     | 17.5                                   |                          |                            |                                   |                             |               |
| A AFRICA          |   |                        |  | 25                       | 22                         | 15                                |                             |               |
| A EURO-SA         |   |                        |  |                          |                            |                                   | 20                          |               |
| Asia-1            | 1.5   | 4                      | 12.5                                   |                          |                            |                                   |                             |               |
| SAT 1             |   |                        |  | 0                        | 8                          | 5                                 | 27                          |               |
| SAT 2             |   |                        | 0.5                                    | 10                       | 14                         | 10                                | 57                          |               |
| SAT 3             |   |                        |  |                          | 1                          |                                   | 16                          |               |
| C                 |   |                        |  |                          |                            |                                   |                             |               |

A number of outbreaks have occurred where samples have not been sent to the WRLFMD or other laboratories in the OIE/FAO FMD Laboratory Network. An up-to-date list and reports of FMD viruses characterised by sequencing can be found at the following website: <http://www.wrlfmd.org/country-reports/country-reports-2020>.

Results from samples or sequences received at WRLFMD (status of samples being tested) are shown in Table 2 and a complete list of clinical sample diagnostics made by the WRLFMD from January to March 2020 is shown in Annex 1: (Summary of Submissions). A record of all samples received by WRLFMD is shown in Annex 1: (Clinical Samples).

**Table 2:** Status of sequencing of samples or sequences received by the WRLFMD from January to March 2020 (\* indicates a batch carried over from the previous quarter).

| WRLFMD Batch No.  | Date received | Country   | Serotype     | No. of samples | No. of sequences | Sequencing status |
|-------------------|---------------|-----------|--------------|----------------|------------------|-------------------|
|                   |               |           | O            | 6              | 6                | completed         |
| WRLFMD/2019/00031 | 18/12/2019    | Eritrea   | A            | 1              | 1                | completed         |
|                   |               |           | SAT2         | 15             | 15               | completed         |
| WRLMEG/2019/00044 | 28/10/2019    | Cameroon  | O            | 1              | 1                | completed         |
| WRLFMD/2020/00001 | 09/01/2020    | Sri Lanka | O            | 15             | 15               | completed         |
| WRLFMD/2020/00002 | 16/03/2020    | Pakistan  | pending      | 50             |                  | pending           |
|                   |               |           | <b>Total</b> | <b>88</b>      | <b>38</b>        |                   |

**Table 3:** VP1 sequences submitted by other FMD Network laboratories to the WRLFMD from January to March 2020 (\* indicates sequences retrieved from GenBank).

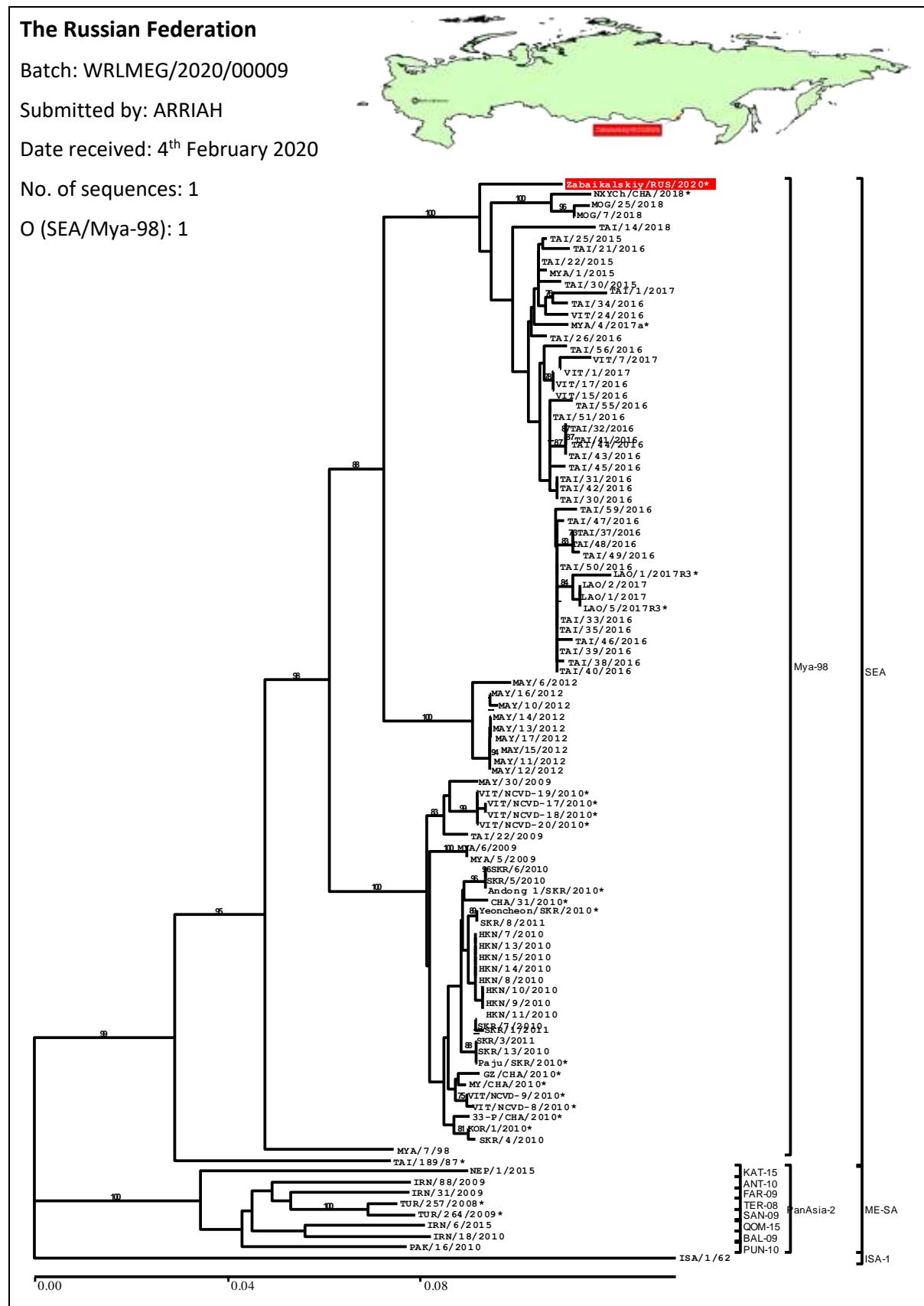
| WRLFMD Batch No.  | Date received | Country | Serotype     | Date Collected | No. of sequences | Submitting laboratory |
|-------------------|---------------|---------|--------------|----------------|------------------|-----------------------|
| WRLMEG/2020/00002 | 15/01/2020    | Namibia | SAT3         | 2019           | 1                | BVI                   |
| WRLMEG/2020/00003 | 18/01/2020    | Uganda  | O            | 2016           | 67               | PIADC*                |
|                   |               |         | A            | 2016           | 4                |                       |
|                   |               |         | SAT1         | 2016           | 54               |                       |
|                   |               |         | SAT2         | 2016-2017      | 33               |                       |
| WRLMEG/2020/00004 | 28/01/2020    | Egypt   | SAT2         | 2018           | 11               | MEVAC*                |
| WRLMEG/2020/00009 | 04/02/2020    | Russia  | O            | 2020           | 1                | ARRIAH                |
|                   |               |         | <b>Total</b> |                | <b>171</b>       |                       |

## 4. Detailed Analysis

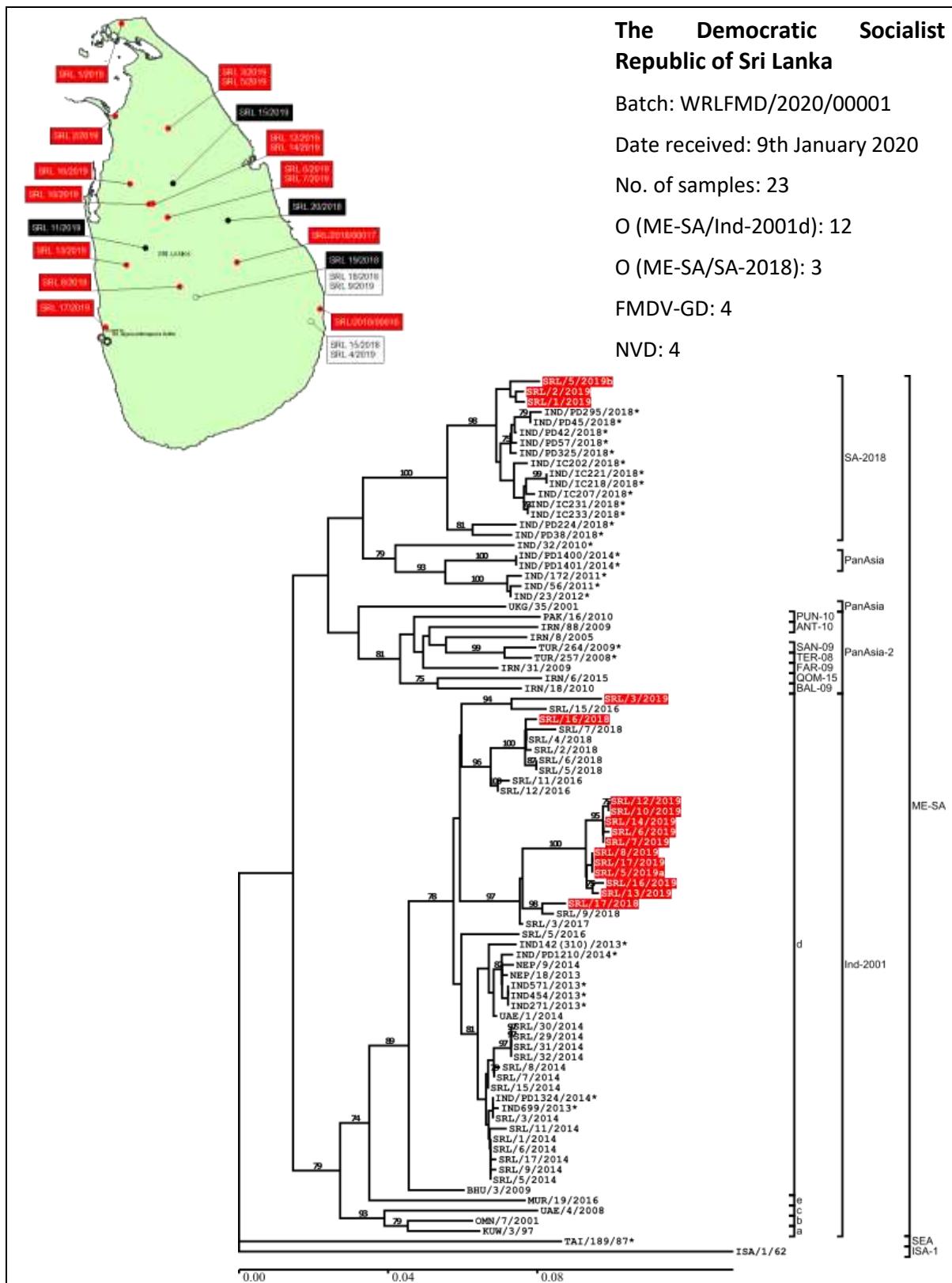
### Key for maps and trees

| Result of analysis            | Symbol        |
|-------------------------------|---------------|
| Serotype O                    | ● UKG 99/9999 |
| Serotype A                    | ● UKG 99/9999 |
| Serotype C                    | ● UKG 99/9999 |
| Serotype Asia-1               | ● UKG 99/9999 |
| Serotype SAT 1                | ● UKG 99/9999 |
| Serotype SAT 2                | ● UKG 99/9999 |
| Serotype SAT 3                | ● UKG 99/9999 |
| FMDV Genome Detected (FMD GD) | ● UKG 99/9999 |
| No Virus Detected (NVD)       | ○ UKG 99/9999 |

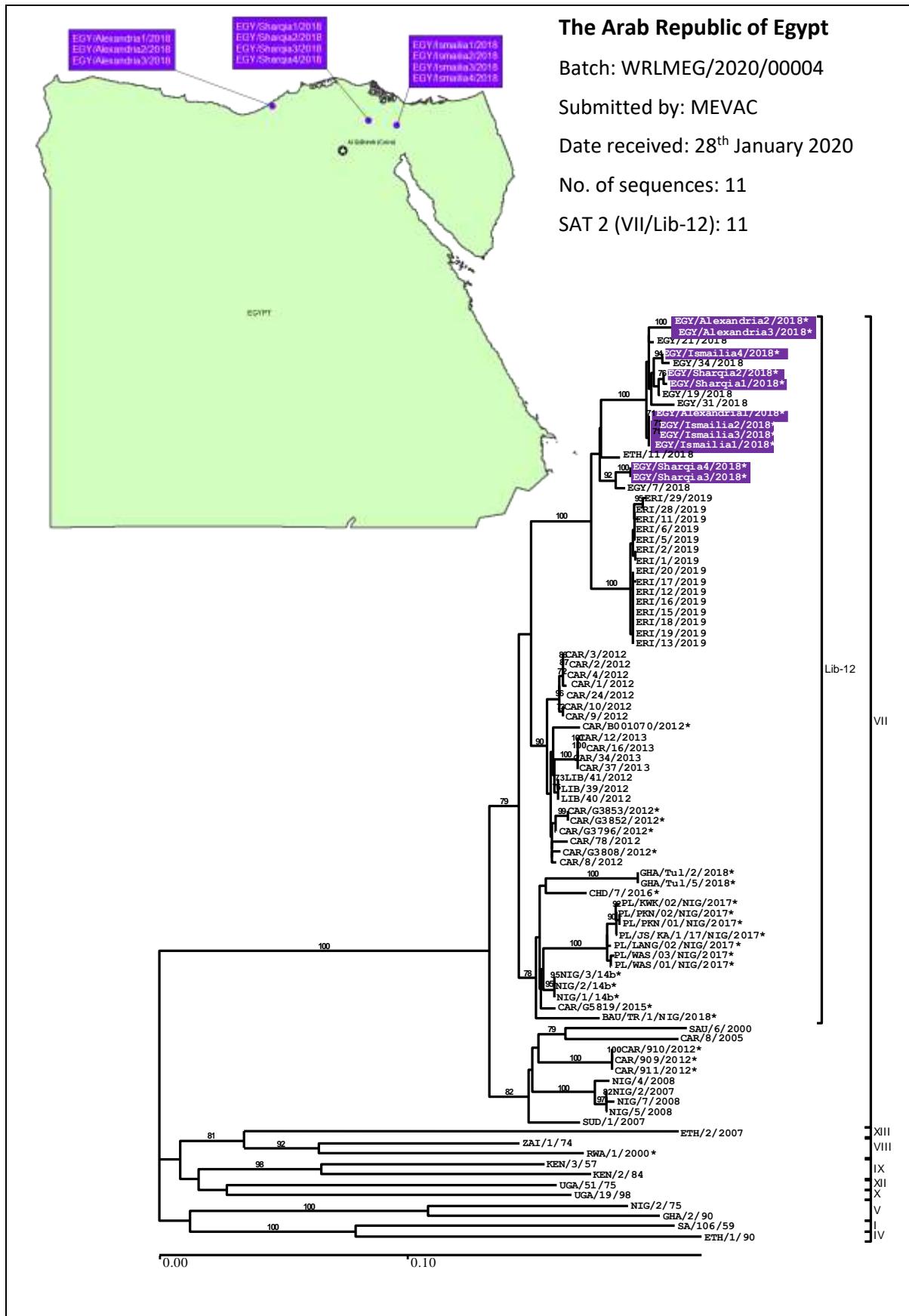
## 4.1. Pool 1 (Southeast Asia/Central Asia/East Asia)

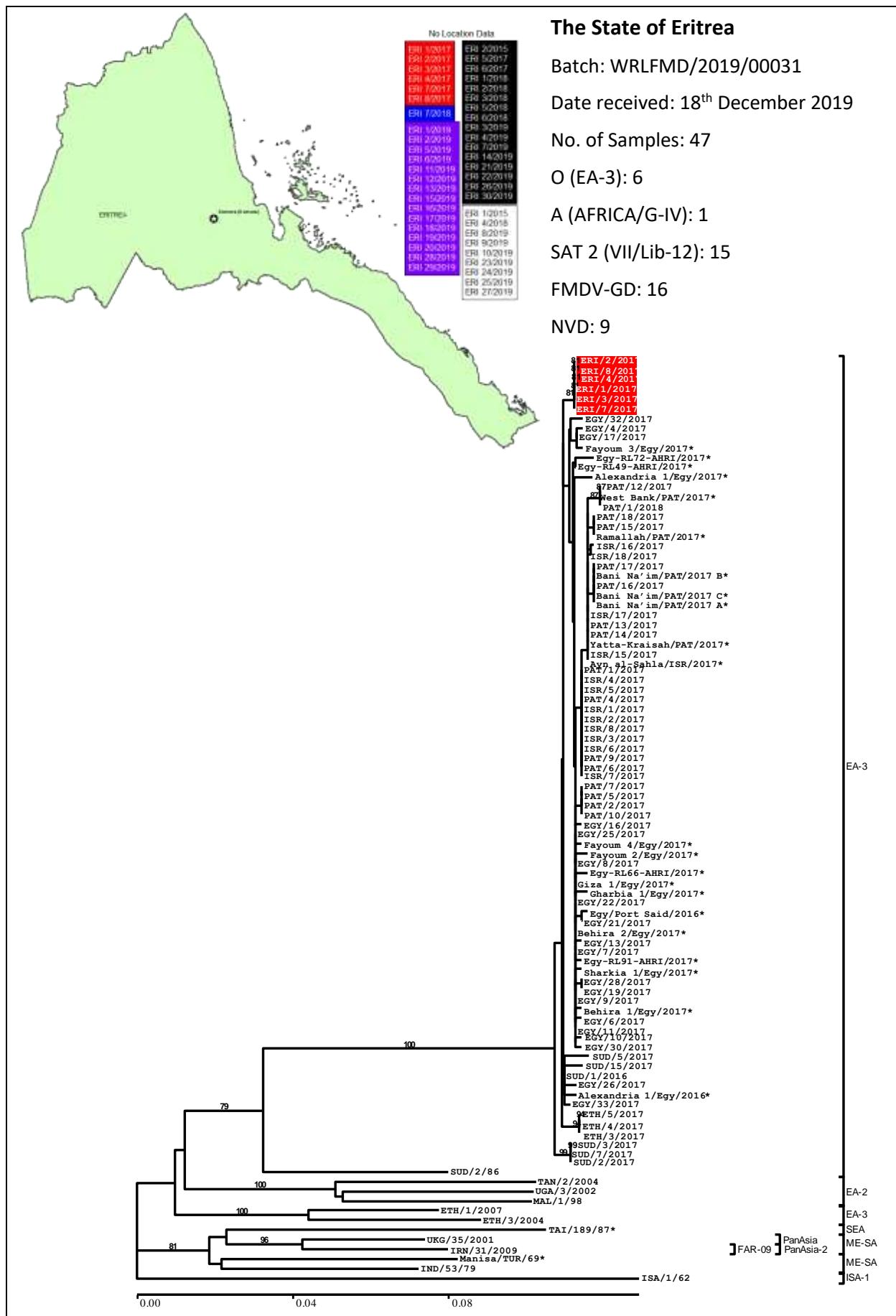


## 4.2. Pool 2 (South Asia)

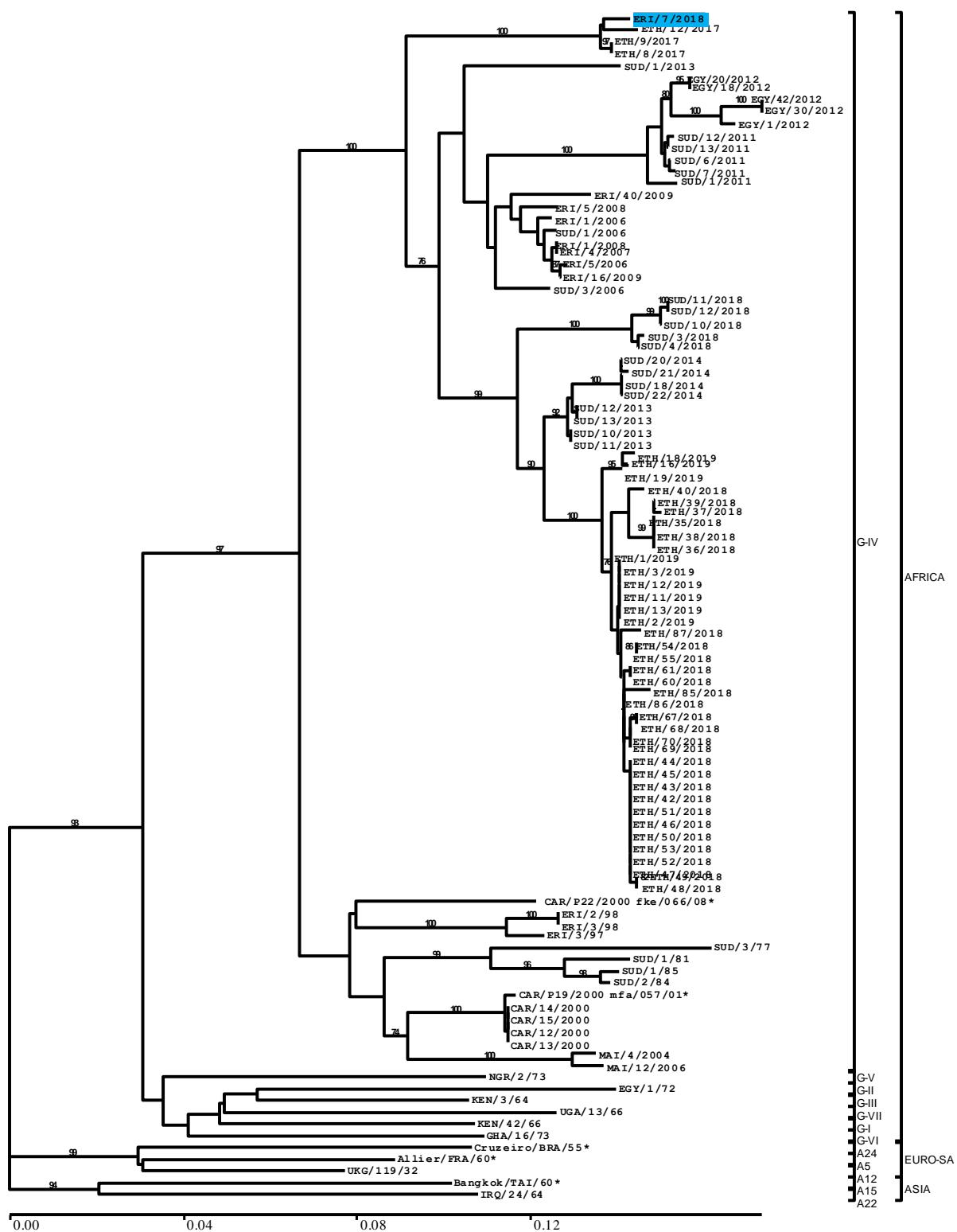


### **4.3. Pool 4 (North and Eastern Africa)**



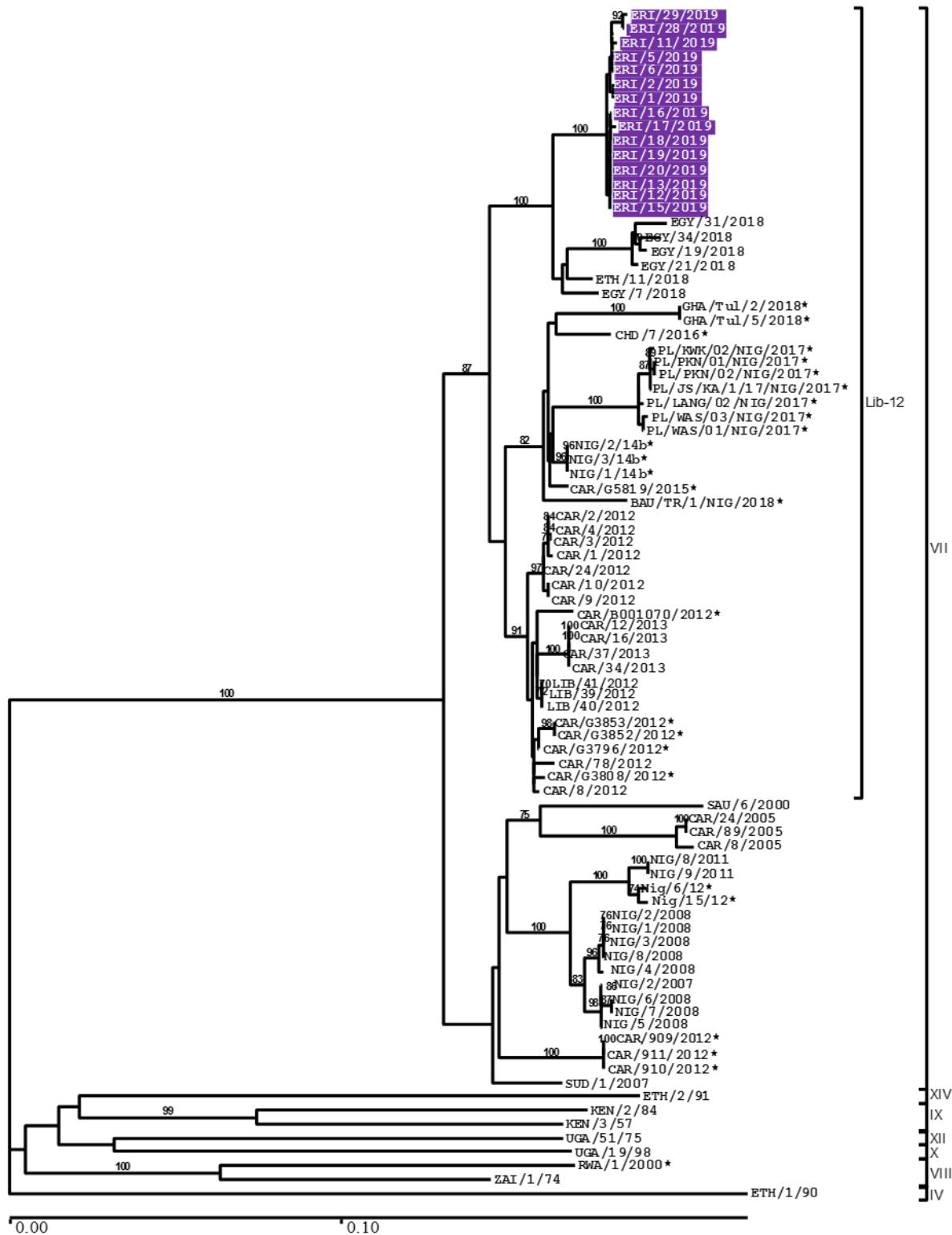


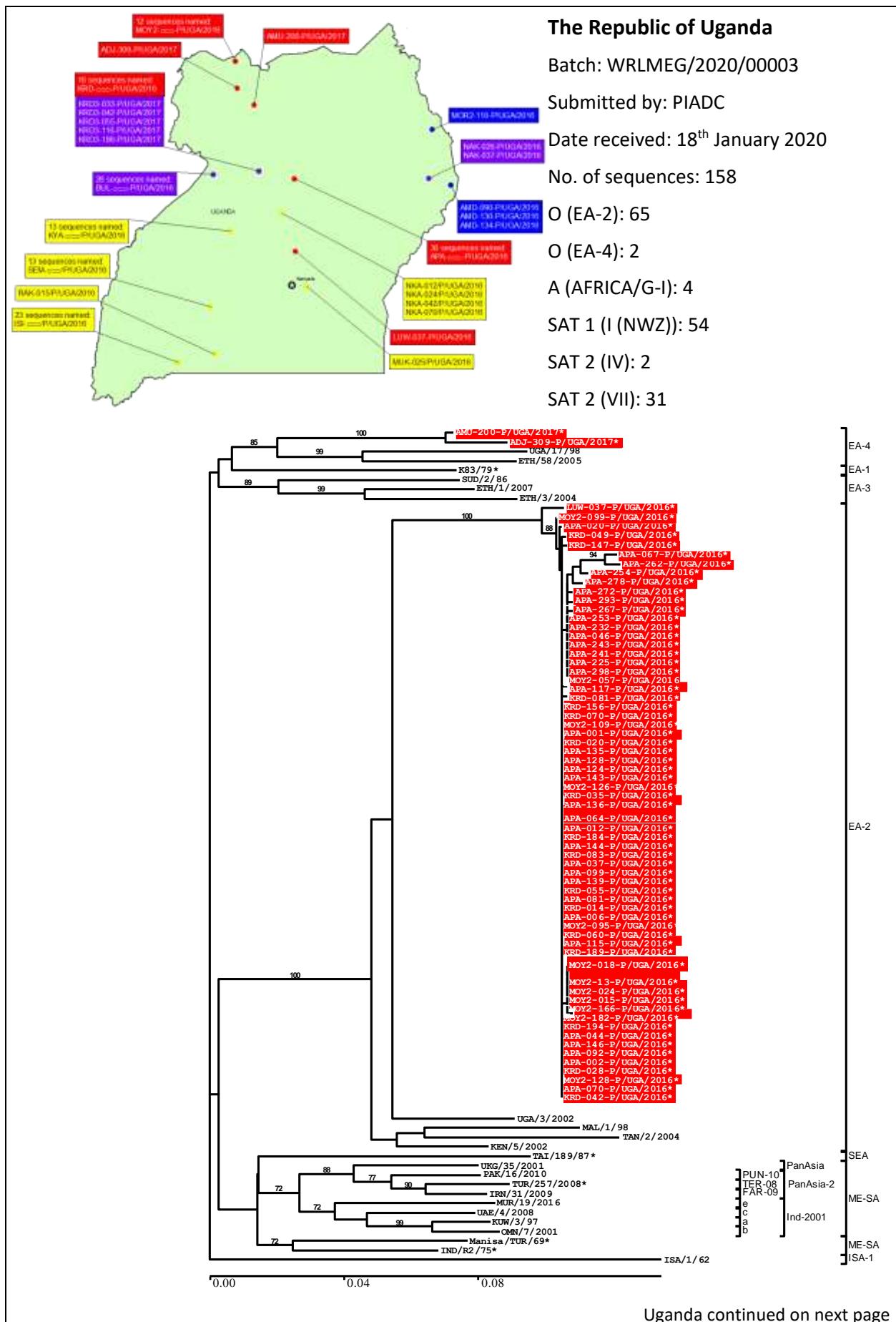
Eritrea continued



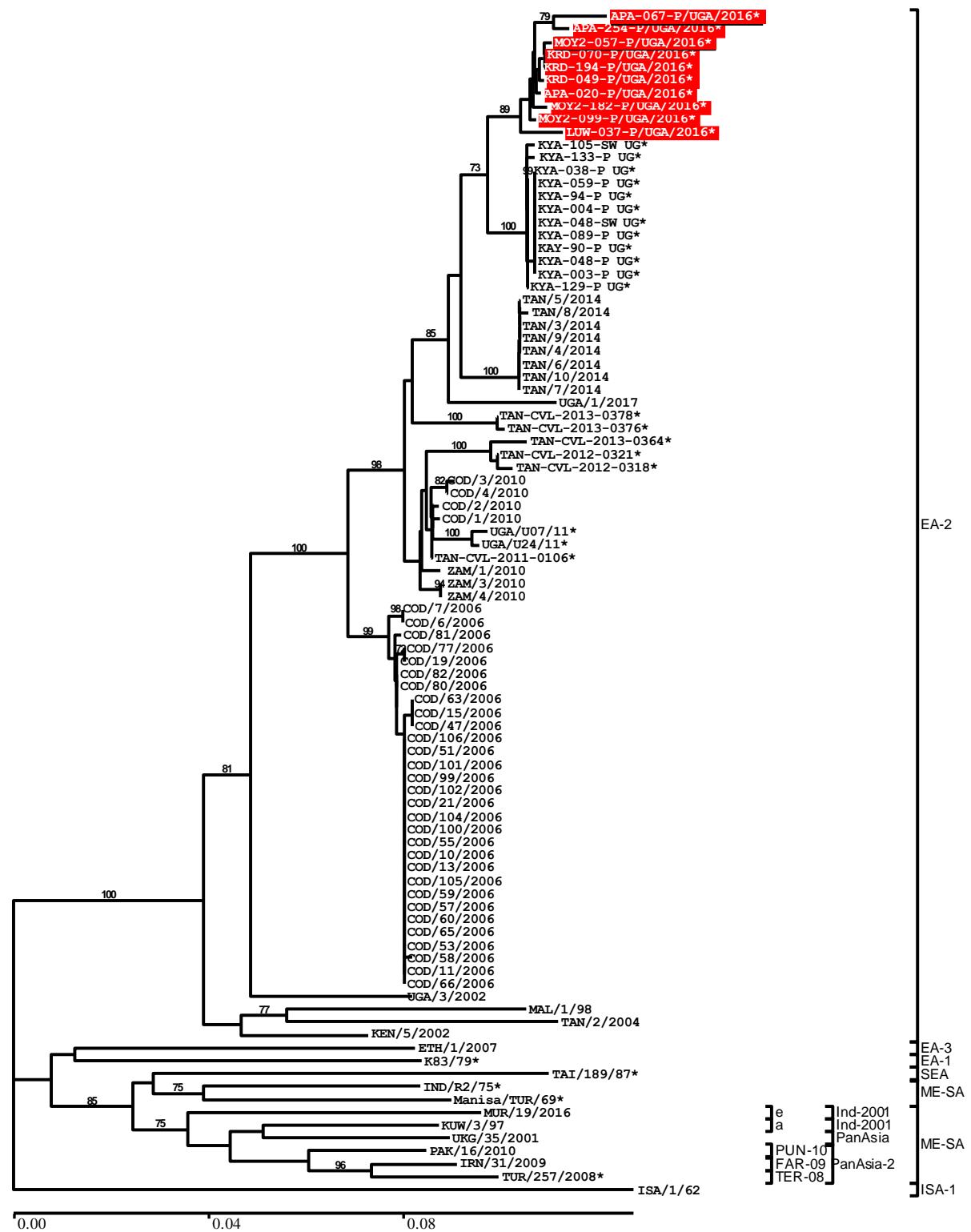
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Eritrea continued



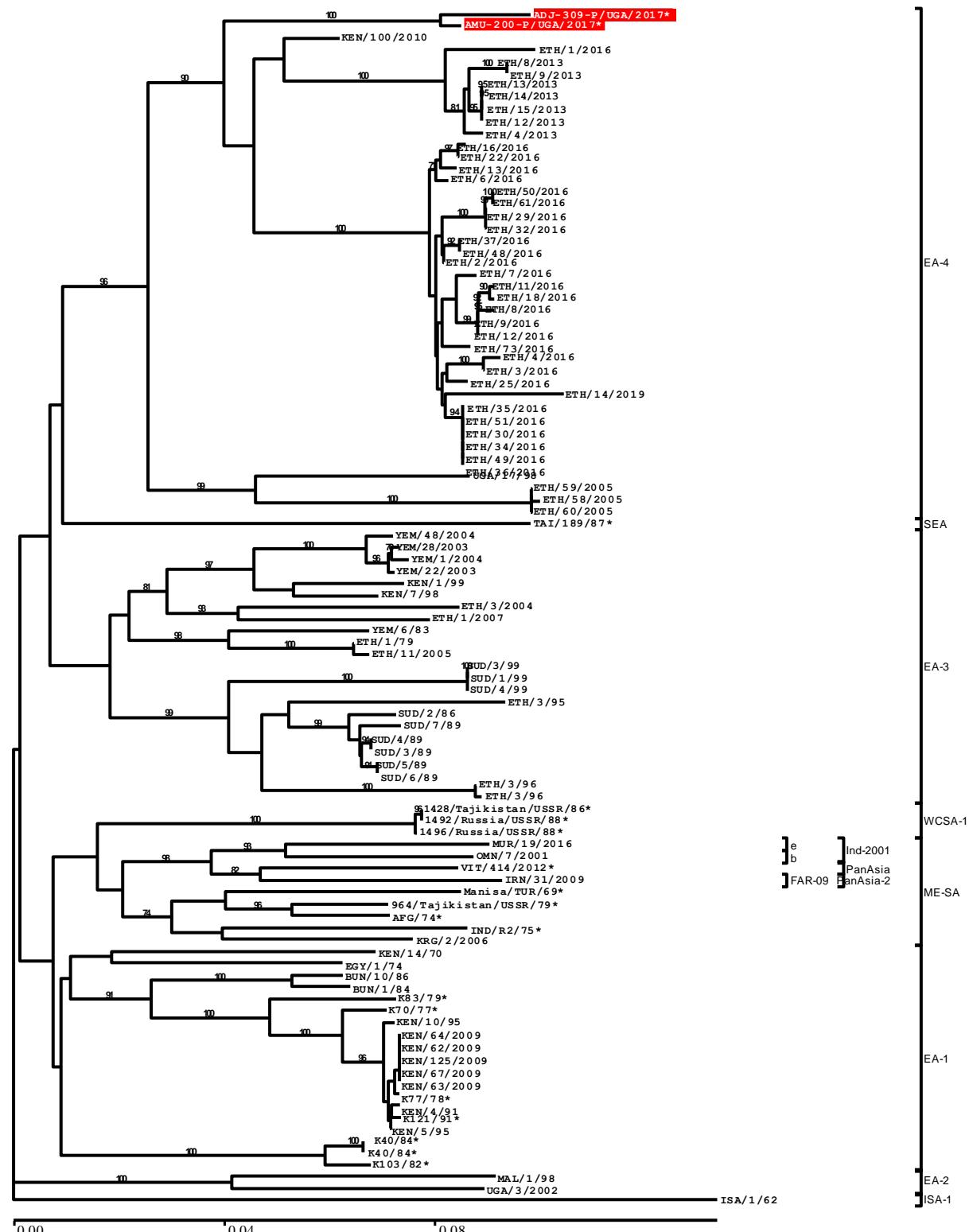


Uganda continued



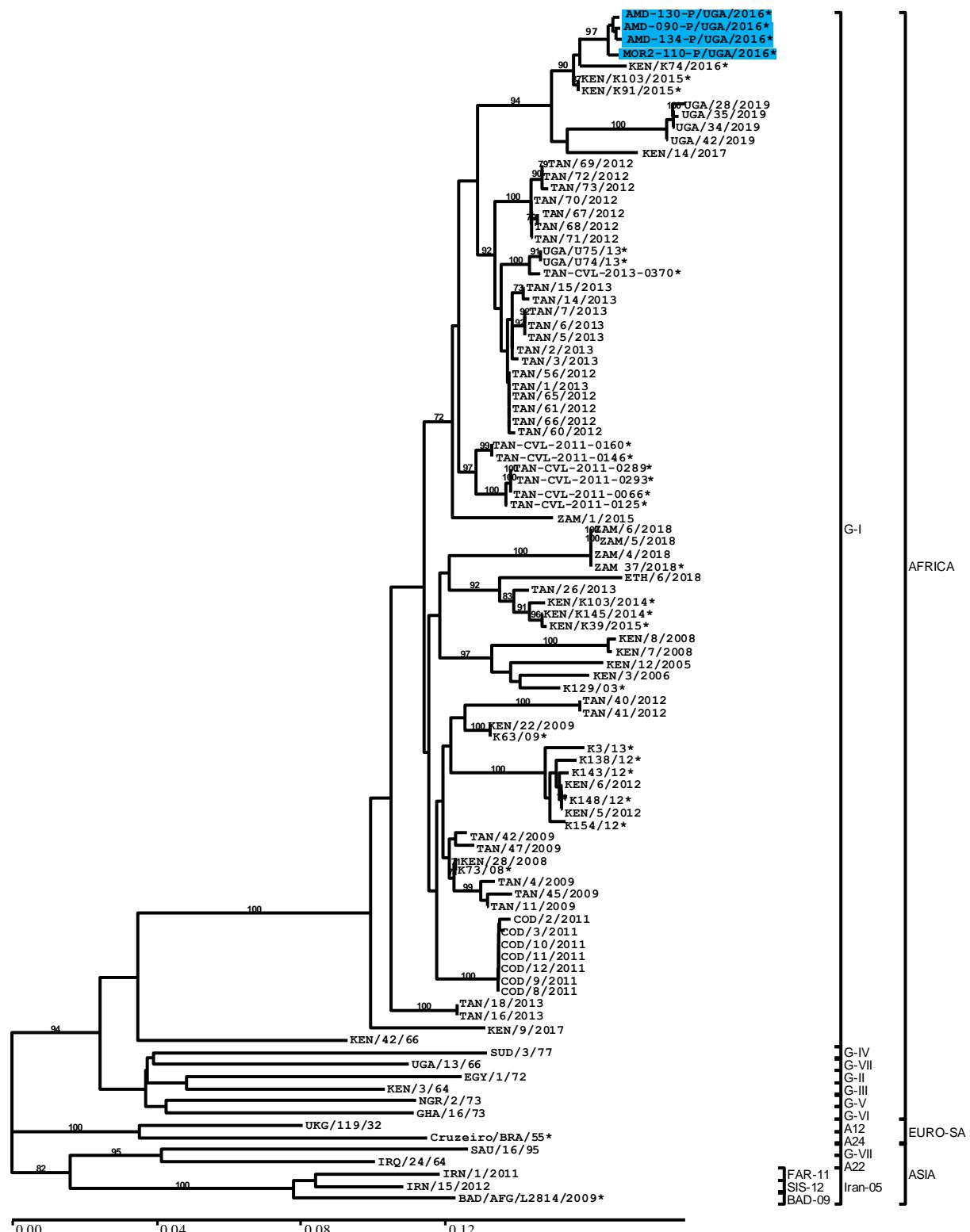
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Uganda continued



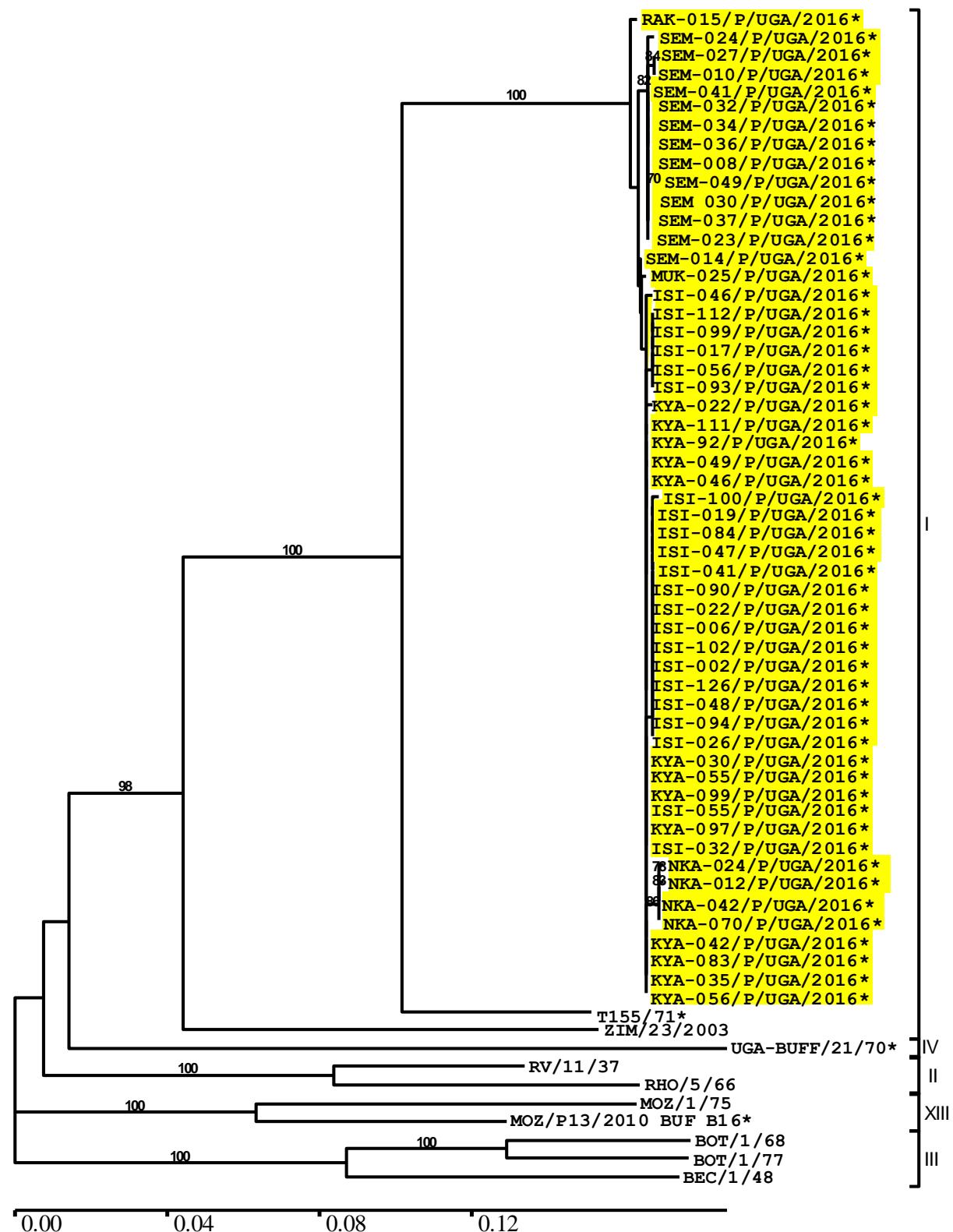
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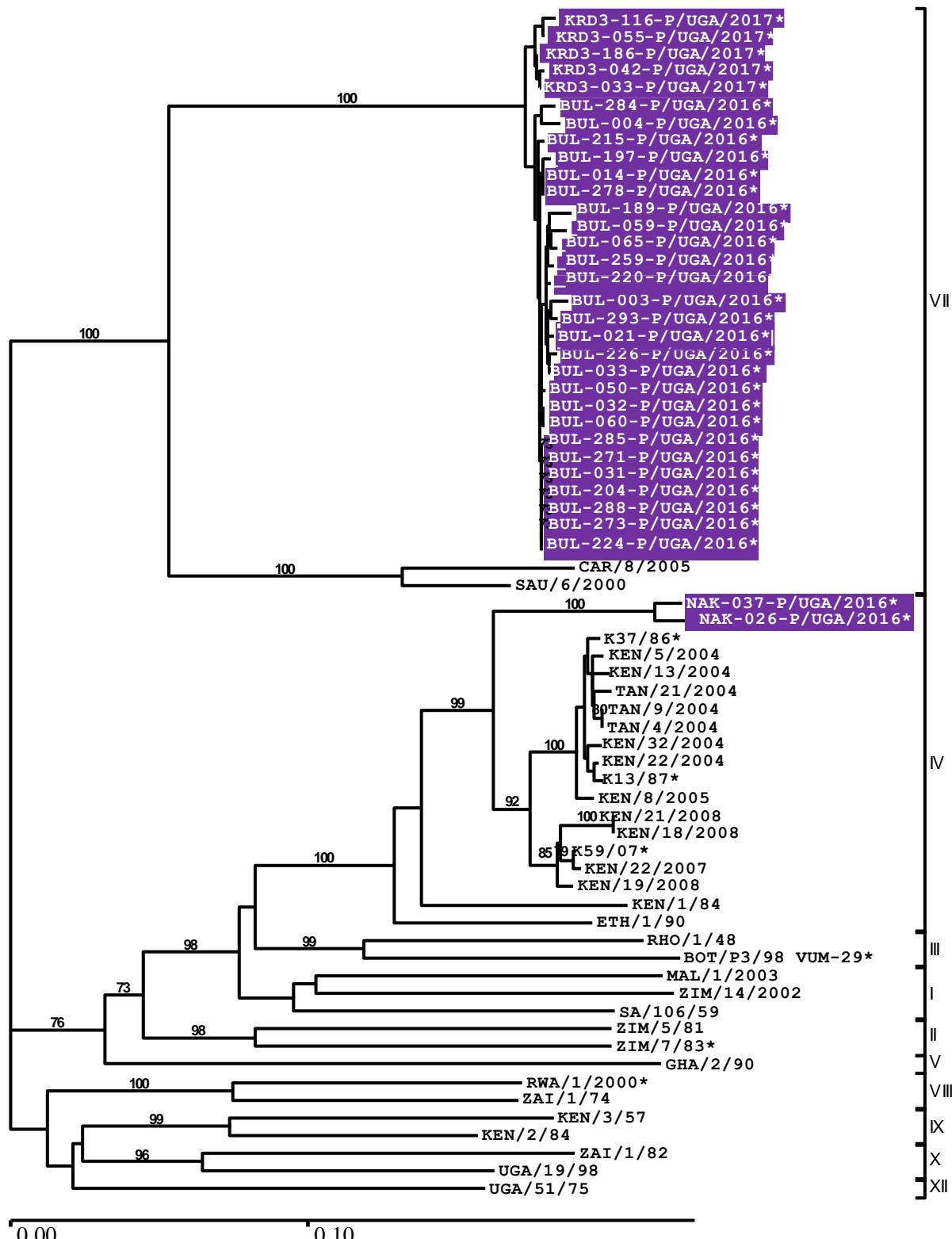
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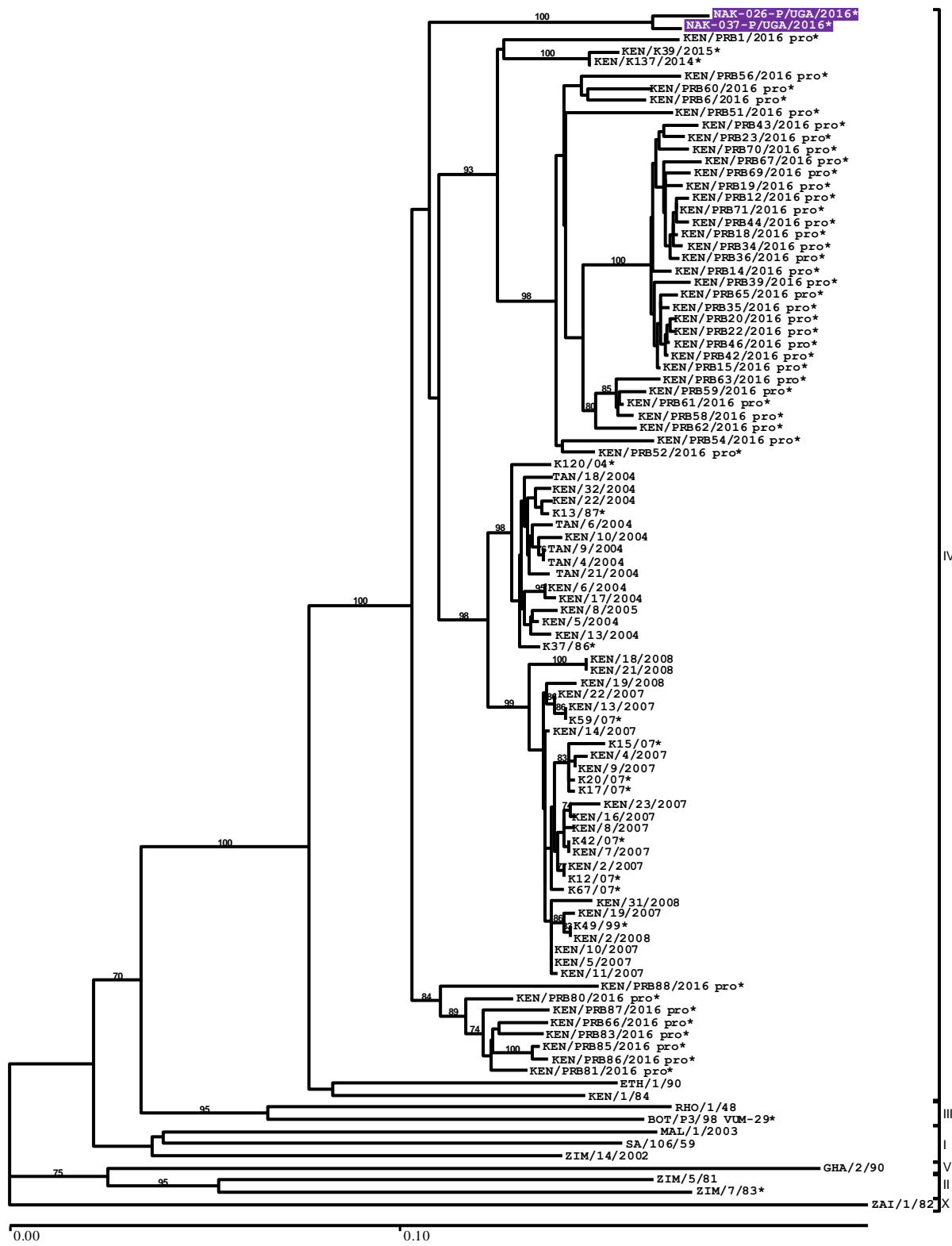
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## Uganda continued

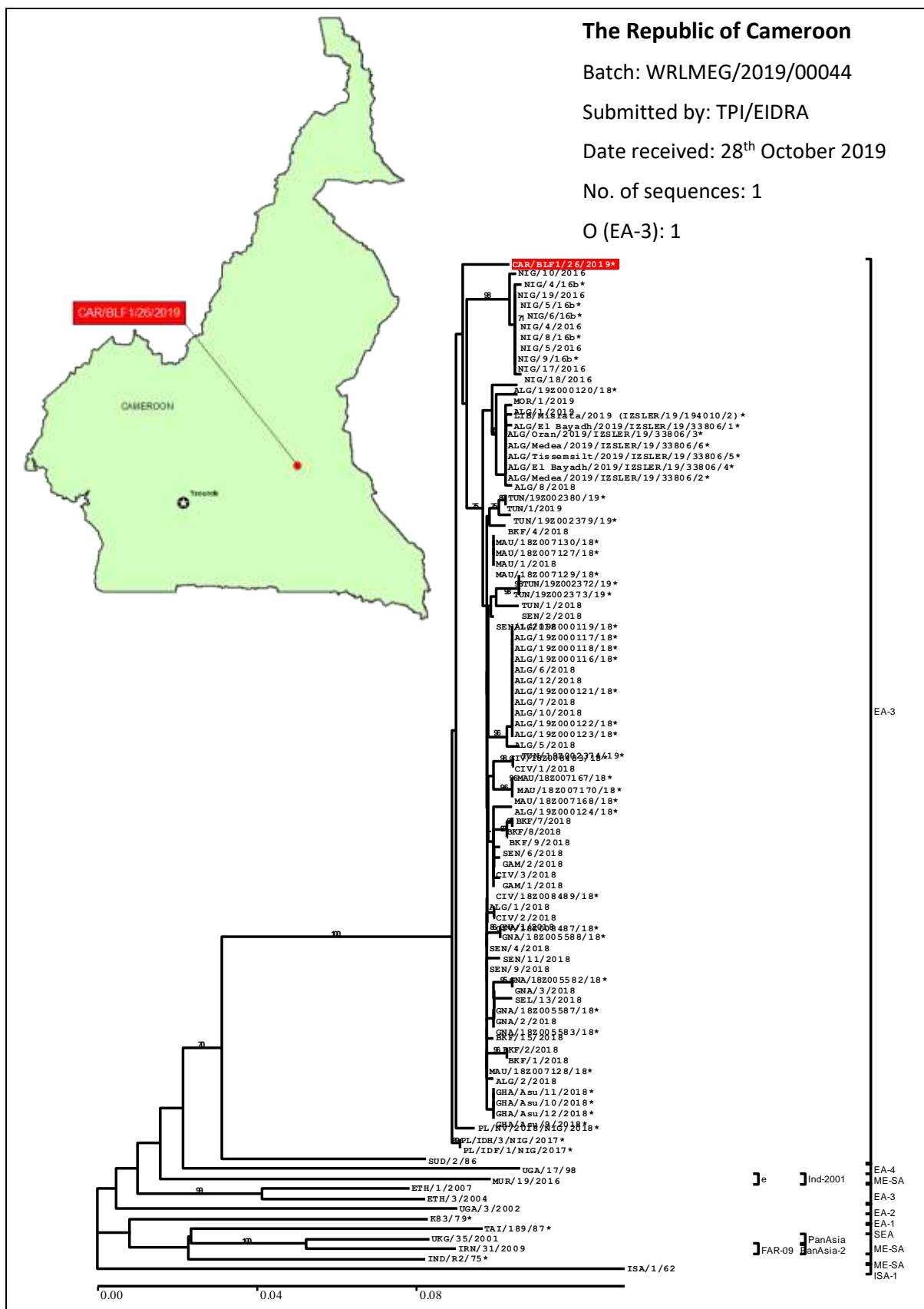


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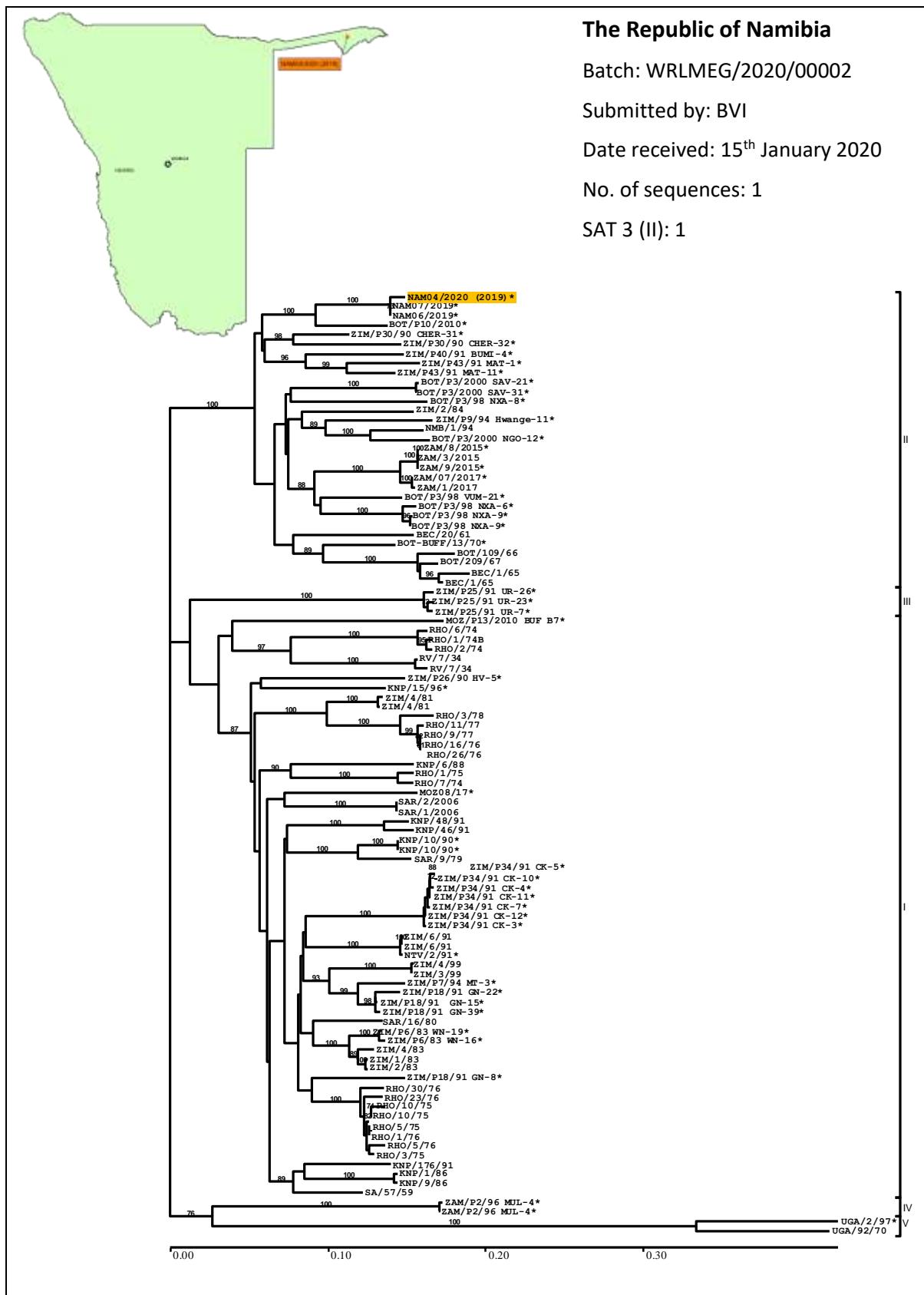
Uganda continued



#### 4.4. Pool 5 (West/Central Africa)



## 4.5. Pool 6 (Southern Africa)



## 4.6. Vaccine matching

Antigenic characterisation of FMD field isolates by matching with vaccine strains by 2dmVNT from January to March 2020. During this reporting period vaccine matching has been undertaken for 14 FMD virus field isolates. In addition, vaccine antigen A SAU/95, has been tested against recent isolates from Africa (Table 8, below).

**Table 4:** Summary of samples tested by vaccine matching

| Serotype     | O        | A        | C        | Asia-1   | SAT 1    | SAT 2    | SAT 3    |
|--------------|----------|----------|----------|----------|----------|----------|----------|
| Egypt        | 1        | 1        |          |          |          | 3        |          |
| Eritrea      | 2        | 1        |          |          |          | 2        |          |
| Sri Lanka    | 4        |          |          |          |          |          |          |
| <b>Total</b> | <b>7</b> | <b>2</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>5</b> | <b>0</b> |

### Abbreviations used in tables

|    |   |
|----|---|
| M  | Vaccine Match<br><i>r<sub>1</sub> = ≥ 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.</i> |
| N  | No Vaccine Match<br><i>r<sub>1</sub> = &lt; 0.3. Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect</i>  |
| B  | Borderline<br><i>Any r<sub>1</sub> values between 0.28 to 0.32</i>  |
| NT | Not tested against this vaccine   |

**Table 5:** Vaccine matching studies for A FMDV by VNT

| Strain     | Serotype | Topotype | Lineage | A/IIRN/05 |                      | A/TUR/20/06 |                      | A/22 IRAQ |                      | A/ERI/3/98 |                      | A/G-VII |                      | A/SAU/95 |                      |
|------------|----------|----------|---------|-----------|----------------------|-------------|----------------------|-----------|----------------------|------------|----------------------|---------|----------------------|----------|----------------------|
|            |          |          |         | neut      | r <sub>1</sub> value | neut        | r <sub>1</sub> value | neut      | r <sub>1</sub> value | neut       | r <sub>1</sub> value | neut    | r <sub>1</sub> value | neut     | r <sub>1</sub> value |
| EGY 2/2018 | A        | AFRICA   | G-IV    | 1.46      | 0.03                 | 0.96        | 0.11                 | 1.51      | 0.12                 | 2.18       | 0.42                 | 0.00    | 0.00                 |          |                      |
| ERI 7/2018 | A        | AFRICA   | G-IV    | 1.45      | 0.10                 | 0.77        | 0.07                 | 1.79      | 0.23                 |            |                      |         |                      | 1.26     | 0.08                 |

**Table 6:** Vaccine matching studies for O FMDV by VNT

| Strain      | Serotype | Topotype | Lineage  | O 3039 | O1 Manisa |      | O/TUR/5/2009 |      |          |
|-------------|----------|----------|----------|--------|-----------|------|--------------|------|----------|
|             |          |          |          | neut   | r1 value  | neut | r1 value     | neut | r1 value |
| EGY 34/2017 | O        | EA-3     | -        | 1.80   | 0.69      | 2.21 | 0.47         | 1.88 | 0.50     |
| ERI 3/2017  | O        | EA-3     | -        | 1.81   | 0.54      | 2.02 | 0.42         | 1.93 | 0.39     |
| ERI 8/2017  | O        | EA-3     | -        | 1.93   | 0.71      | 2.02 | 0.49         | 1.95 | 0.45     |
| SRL 16/2018 | O        | ME-SA    | -        | 1.75   | 0.59      | 1.94 | 0.34         | 2.04 | 0.62     |
| SRL 14/2019 | O        | ME-SA    | -        | 1.79   | 0.79      | 2.12 | 0.49         | 2.11 | 0.83     |
| SRL 1/2019  | O        | ME-SA    | Ind-2001 | 1.77   | 0.76      | 2.03 | 0.40         | 2.10 | 0.81     |
| SRL 17/2019 | O        | ME-SA    | Ind-2001 | 1.80   | 0.66      | 2.08 | 0.47         | 2.15 | 0.79     |

**Table 7:** Vaccine matching studies for SAT 2 FMDV by VNT

| Strain      | Serotype | Topotype | Lineage | SAT 2/ERI | SAT 2/ZIM |      |          |
|-------------|----------|----------|---------|-----------|-----------|------|----------|
|             |          |          |         | neut      | r1 value  | neut | r1 value |
| EGY 1/2018  | SAT 2    | VII      | Ghb-12  | 1.34      | 0.28      | 1.37 | 0.11     |
| EGY 7/2018  | SAT 2    | VII      | Lib-12  | 1.72      | 0.83      | 1.96 | 0.32     |
| EGY 34/2018 | SAT 2    | VII      | Lib-12  | 1.71      | 0.81      |      |          |
| ERI 19/2019 | SAT 2    | VII      | Lib-12  | 1.57      | 0.68      | 1.80 | 0.25     |
| ERI 28/2019 | SAT 2    | VII      | Lib-12  | 1.62      | 0.76      | 1.80 | 0.25     |

**Table 8:** Additional vaccine-matching undertaken for the A SAU/95 vaccine antigen with 14 recent serotype A viruses from Africa

| A SAU 95 |         |           |       |                |
|----------|---------|-----------|-------|----------------|
| Serotype | Lineage | Sample    | neut. | r <sub>1</sub> |
| A        | G-I     | KEN 14/17 | 1.76  | 0.24           |
| A        | G-I     | KEN 17/17 | 1.92  | 0.36           |
| A        | G-I     | ZAM 04/18 | 1.58  | 0.16           |
| A        | G-I     | ZAM 05/18 | 1.57  | 0.16           |
| A        | G-I     | UG28/19   | 1.67  | 0.21           |
| A        | G-I     | UG42/19   | 1.64  | 0.18           |
| A        | G-IV    | ALG 02/17 | 2.16  | 0.70           |
| A        | G-IV    | ALG 03/17 | 2.13  | 0.62           |
| A        | G-IV    | EGY 19/16 | 1.62  | 0.19           |
| A        | G-IV    | EGY 02/18 | 1.55  | 0.16           |
| A        | G-IV    | SUD 09/18 | 0.81  | 0.09           |
| A        | G-IV    | SUD 10/18 | 1.79  | 0.28           |
| A        | G-IV    | ETH 35/18 | 1.30  | 0.09           |
| A        | G-IV    | ETH 48/18 | 0.67  | 0.05           |

## Annex 1: Sample data

### Summary of Submissions

**Table 9:** Summary of samples collected and received to WRLFMD (January to March 2020)

| Country      | Nº of samples | Virus isolation in cell culture/ELISA |          |          |          |           |          |          |           | RT-PCR for FMD    |           |
|--------------|---------------|---------------------------------------|----------|----------|----------|-----------|----------|----------|-----------|-------------------|-----------|
|              |               | FMD virus serotypes                   |          |          |          |           |          |          |           | No Virus Detected | Positive  |
|              |               | O                                     | A        | C        | SAT 1    | SAT 2     | SAT 3    | ASIA-1   | Negative  |                   |           |
| Eritrea      | 47            | 6                                     | 1        | -        | -        | 15        | -        | -        | 25        | 38                | 9         |
| Sri Lanka    | 23            | 15                                    | -        | -        | -        | -         | -        | -        | 8         | 19                | 4         |
| <b>TOTAL</b> | <b>70</b>     | <b>21</b>                             | <b>1</b> | <b>0</b> | <b>0</b> | <b>15</b> | <b>0</b> | <b>0</b> | <b>33</b> | <b>57</b>         | <b>13</b> |

### 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                      |

### Clinical Samples

**Table 10:** Clinical sample diagnostics made by the WRLFMD® January to March 2020

| Country | Received                         | Reported                         | Date                              |        | Animal     | Date of Collection | VI/ELISA | Results |              |  |
|---------|----------------------------------|----------------------------------|-----------------------------------|--------|------------|--------------------|----------|---------|--------------|--|
|         |                                  |                                  | WRL for FMD Sample Identification |        |            |                    |          | RT-PCR  | Final report |  |
| Eritrea | 18 <sup>th</sup><br>Dec.<br>2019 | 27 <sup>th</sup><br>Jan.<br>2020 | ERI 1/2015                        | Bovine | 19/10/2015 | NEG                | NEG      | NVD     |              |  |
|         |                                  |                                  | ERI 2/2015                        | Bovine | 19/10/2015 | NEG                | POS      | FMDV GD |              |  |
|         |                                  |                                  | ERI 1/2017                        | Bovine | 22/03/2017 | O                  | POS      | O       |              |  |
|         |                                  |                                  | ERI 2/2017                        | Bovine | 22/03/2017 | O                  | POS      | O       |              |  |
|         |                                  |                                  | ERI 3/2017                        | Bovine | 22/03/2017 | O                  | POS      | O       |              |  |
|         |                                  |                                  | ERI 4/2017                        | Bovine | 22/03/2017 | O                  | POS      | O       |              |  |
|         |                                  |                                  | ERI 5/2017                        | Swine  | 27/03/2017 | NEG                | POS      | FMDV GD |              |  |
|         |                                  |                                  | ERI 6/2017                        | Swine  | 27/03/2017 | NEG                | POS      | FMDV GD |              |  |
|         |                                  |                                  | ERI 7/2017                        | Swine  | 27/03/2017 | O                  | POS      | O       |              |  |
|         |                                  |                                  | ERI 8/2017                        | Swine  | 27/03/2017 | O                  | POS      | O       |              |  |

| Country   | Date                            |                                  | WRL for FMD Sample Identification | Animal | Date of Collection | Results  |        |              |
|-----------|---------------------------------|----------------------------------|-----------------------------------|--------|--------------------|----------|--------|--------------|
|           | Received                        | Reported                         |                                   |        |                    | VI/ELISA | RT-PCR | Final report |
| Sri Lanka | 9 <sup>th</sup><br>Jan.<br>2020 | 24 <sup>th</sup><br>Jan.<br>2020 | ERI 1/2018                        | Bovine | 13/01/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 2/2018                        | Bovine | 13/01/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 3/2018                        | Bovine | 17/10/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 4/2018                        | Bovine | 17/10/2018         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 5/2018                        | Bovine | 17/10/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 6/2018                        | Bovine | 17/10/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 7/2018                        | Bovine | 17/10/2018         | A        | POS    | A            |
|           |                                 |                                  | ERI 1/2019                        | Bovine | 18/09/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 2/2019                        | Bovine | 18/09/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 3/2019                        | Bovine | 24/09/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 4/2019                        | Bovine | 24/09/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 5/2019                        | Bovine | 25/09/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 6/2019                        | Bovine | 25/09/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 7/2019                        | Bovine | 27/09/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 8/2019                        | Bovine | 27/09/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 9/2019                        | Bovine | 27/09/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 10/2019                       | Ovine  | 29/09/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 11/2019                       | Bovine | 29/09/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 12/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 13/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 14/2019                       | Bovine | 29/10/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 15/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 16/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 17/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 18/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 19/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 20/2019                       | Bovine | 29/10/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 21/2019                       | Bovine | 19/11/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 22/2019                       | Bovine | 19/11/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 23/2019                       | Bovine | 19/11/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 24/2019                       | Bovine | 19/11/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 25/2019                       | Bovine | 19/11/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 26/2019                       | Bovine | 25/11/2019         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | ERI 27/2019                       | Bovine | 25/11/2019         | NEG      | NEG    | NVD          |
|           |                                 |                                  | ERI 28/2019                       | Bovine | 25/11/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 29/2019                       | Bovine | 25/11/2019         | SAT 2    | POS    | SAT 2        |
|           |                                 |                                  | ERI 30/2019                       | Bovine | 25/11/2019         | NEG      | POS    | FMDV GD      |
| Sri Lanka | 9 <sup>th</sup><br>Jan.<br>2020 | 24 <sup>th</sup><br>Jan.<br>2020 | SRL 15/2018                       | Cattle | 09/05/2018         | NEG      | NEG    | NVD          |
|           |                                 |                                  | SRL 16/2018                       | Cattle | 23/05/2018         | O        | POS    | O            |
|           |                                 |                                  | SRL 17/2018                       | Cattle | 25/05/2018         | O        | POS    | O            |
|           |                                 |                                  | SRL 18/2018                       | Cattle | 02/08/2018         | NEG      | NEG    | NVD          |
|           |                                 |                                  | SRL 19/2018                       | Cattle | 02/08/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | SRL 20/2018                       | Cattle | 08/11/2018         | NEG      | POS    | FMDV GD      |
|           |                                 |                                  | SRL 1/2019                        | Cattle | 10/01/2019         | O        | POS    | O            |
|           |                                 |                                  | SRL 2/2019                        | Cattle | 14/02/2019         | O        | POS    | O            |

| Country      | Received | Reported | Date                                    |         | Results               |          |        |         |
|--------------|----------|----------|---|---------|-----------------------|----------|--------|---------|
|              |          |          | WRL for FMD<br>Sample<br>Identification | Animal  | Date of<br>Collection | VI/ELISA | RT-PCR |         |
|              |          |          | SRL 3/2019                              | Cattle  | 01/03/2019            | O        | POS    | O       |
|              |          |          | SRL 4/2019                              | Cattle  | 09/10/2019            | NEG      | NEG    | NVD     |
|              |          |          | SRL 5/2019                              | Cattle  | 04/11/2019            | O        | POS    | O       |
|              |          |          | SRL 6/2019                              | Cattle  | 13/11/2019            | O        | POS    | O       |
|              |          |          | SRL 7/2019                              | Cattle  | 13/11/2019            | O        | POS    | O       |
|              |          |          | SRL 8/2019                              | Cattle  | 21/11/2019            | O        | POS    | O       |
|              |          |          | SRL 9/2019                              | Buffalo | 21/11/2019            | NEG      | NEG    | NVD     |
|              |          |          | SRL 10/2019                             | Cattle  | 22/11/2019            | O        | POS    | O       |
|              |          |          | SRL 11/2019                             | Cattle  | 22/11/2019            | NEG      | POS    | FMDV GD |
|              |          |          | SRL 12/2019                             | Swine   | 22/11/2019            | O        | POS    | O       |
|              |          |          | SRL 13/2019                             | Cattle  | 24/11/2019            | O        | POS    | O       |
|              |          |          | SRL 14/2019                             | Cattle  | 26/11/2019            | O        | POS    | O       |
|              |          |          | SRL 15/2019                             | Cattle  | 16/12/2019            | NEG      | POS    | FMDV GD |
|              |          |          | SRL 16/2019                             | Cattle  | 16/12/2019            | O        | POS    | O       |
|              |          |          | SRL 17/2019                             | Cattle  | 17/12/2019            | O        | POS    | O       |
| <b>TOTAL</b> |          |          |   |         | <b>70</b>             |          |        |         |

#### 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   |

## Annex 2: FMD publications

Recent FMD Publications (January to March 2020) cited by Web of Science.

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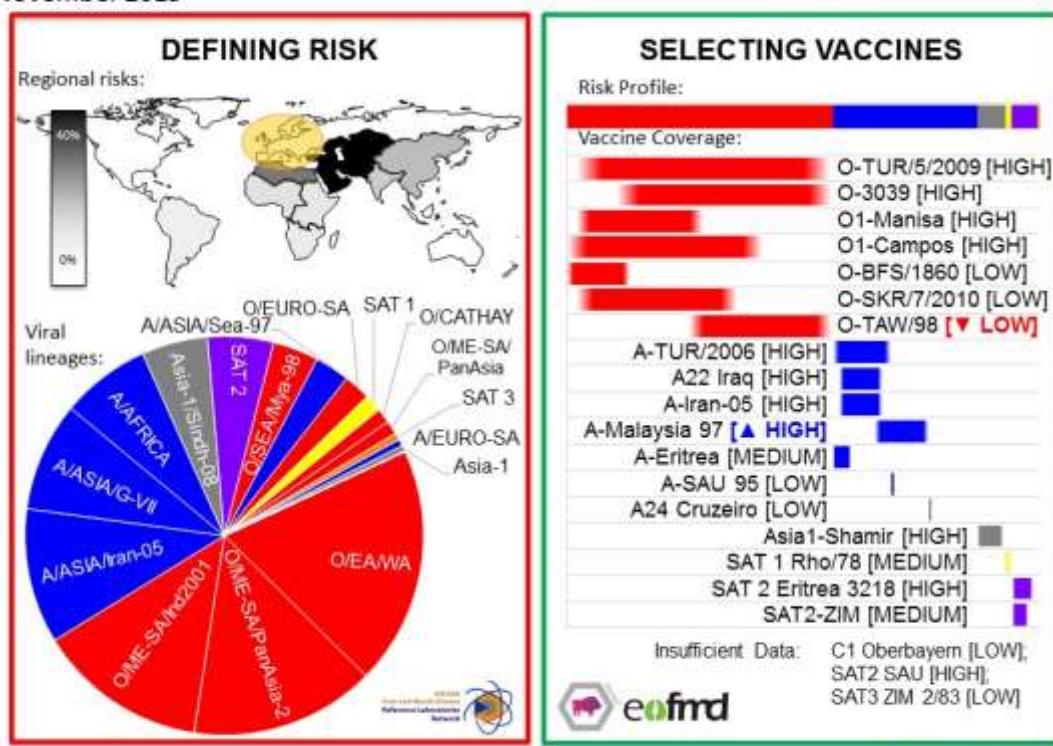
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## Annex 3: Vaccine Recommendations

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. These analyses accommodate the latest epidemiological data collected by the OIE FAO FMD Laboratory Network regarding FMDV lineages that are present in different *source regions* (see Table 1 in Section 3.9, above), as well as available *in vitro*, *in vivo* and field data to score the ability of vaccines to protect against these FMDV lineages.

### Vaccine Antigen Prioritisation: Europe

November 2019



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

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

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

### **Open Session of the EuFMD OS20**

"Livelihoods @ risk in a FASTer world"

27-30 October 2020. Marseille, France. <https://www.eufmd.info/os20faster>

The OS20 will be a multi-day meeting, with two distinct parts. The first focuses on Foot-and-mouth disease. The second considers how best we can use the intelligence on animal movements and drivers of disease spread for smarter and FASTer risk mitigation.

### **Courses**

- EuFMD's open access online courses provide convenient self-paced training which you may study anytime, anywhere, free of charge. There are currently 4 courses in English and 1 in Arabic:
  - Introduction to Foot-and-Mouth Disease
  - What is the Progressive Control Pathway?
  - Public Private Partnerships in the Veterinary Domain
  - Introduction to the Progressive Control Pathway

<https://eufmdlearning.works/mod/page/view.php?id=13130>
- The WRLFMD residential training course on FMD diagnostics (<https://www.pirbright.ac.uk/instructor-led-training/diagnosis-foot-and-mouth-disease>) scheduled for May 2020 has been postponed until later in the year

### **Podcasts**

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

### **Meetings**

Reports of the 2nd FMD Roadmap Meeting for the Foot-and-Mouth Disease Progressive Control Pathway in West Africa (Dakar, Senegal, 04-06 Sep 2019) and of the 8th West Eurasia Roadmap Meeting (Shiraz, Iran, 04-06 Mar 2019) have been published online on the GF-TADs website (available at: <http://www.gf-tads.org/fmd/fmd/en/>)

Three FMD Roadmap Meetings (RMMs) were originally planned in 2020 in Eastern Africa, in South Asia in collaboration with the South Asian Association for Regional Cooperation (SAARC) Secretariat, and in Southern Africa in collaboration with the Southern African Development Community (SADC) Secretariat. Due to the current global SARS-CoV-2

pandemic, the organization of these international events is being postponed and innovative strategies to support collaborative events at the regional levels are under development.

### **Proficiency test scheme organised by WRLFMD**

Sample panels for the Phase XXXII exercise are ready for dispatch and will be sent when international shipping resumes after the COVID-19 crisis. We will write to inform participating laboratories about any other changes that may be required to accommodate these events, and please feel free to contact WRLFMD if you have any questions.

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### Hold-FAST tools

GET PREPARED, E-learning, FMD-PCP, EuFMDIS,  
Pragmatist, Impact Risk Calculator, Virtual Learning Center,  
SMS Disease reporting, Global Vaccine Security,  
Outbreak investigation app, PCP-Support Officers,  
PCP Self-Evaluation tool, AESOP, Telegram, WhatsApp,  
Quarterly Global Reports, Real Time Training.

### EuFMD Committees

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

