



World Reference Laboratory Global Update

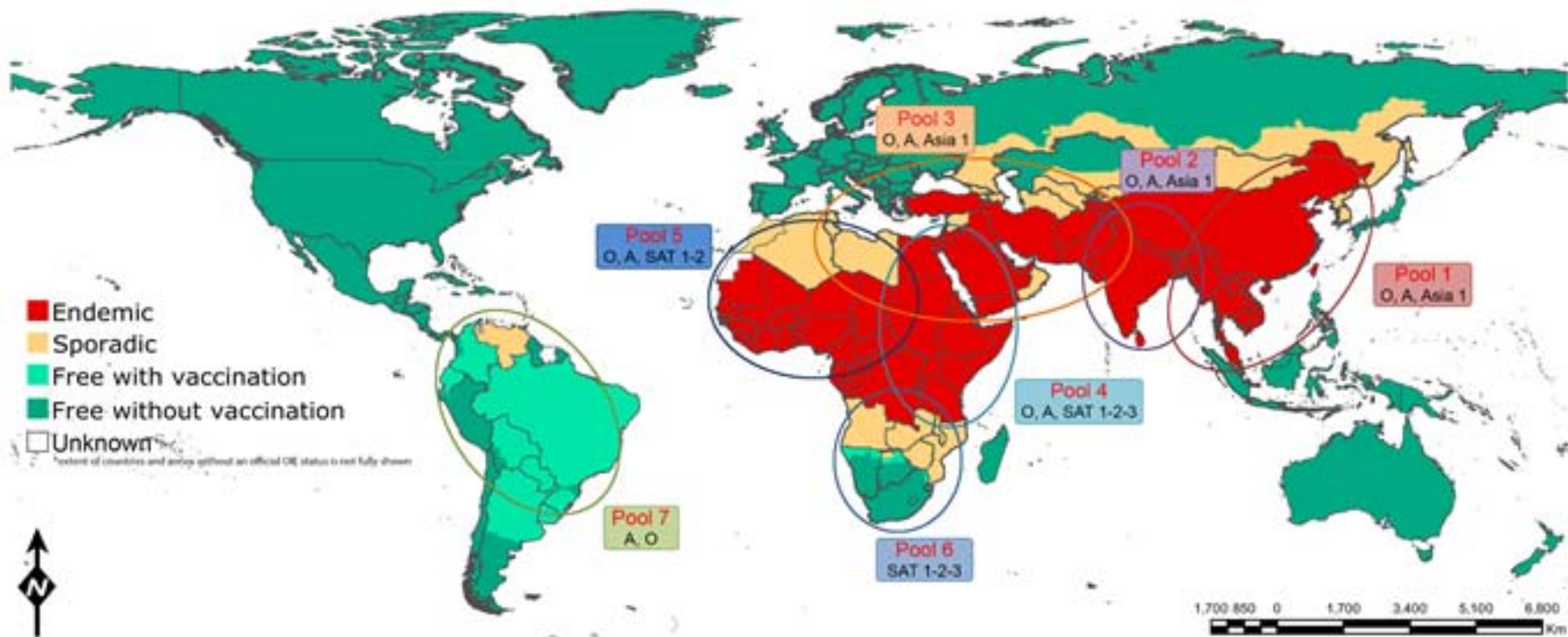
Recent outbreaks and patterns of virus spread

Kasia Bachanek-Bankowska on behalf of Donald King

WRLFMD Team: Valerie Mioulet, Nick Knowles, Anna Ludi, Ginette Wilsden, Bryony Armson, Pip Hamblin, Kasia Bachanek-Bankowska, Lissie Henry, Antonello Di Nardo, Beatriz Sanz-Bernardo, Hannah Baker, Emma Howson, Jemma Wadsworth, Clare Browning, Britta Wood, Bob Statham, Abid Bin-Tarif, Ashley Gray, Beth Johns, Mark Henstock, Alison Morris, David Paton, Nick Lyons, Mehreen Azhar, Dexter Wiseman, Julie Maryan, Sarah Belgrave

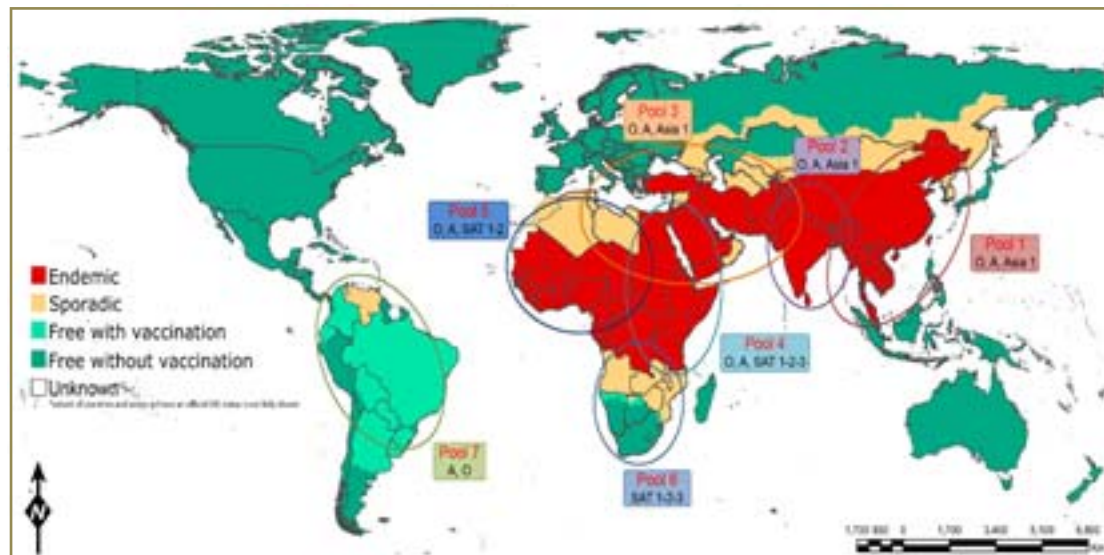
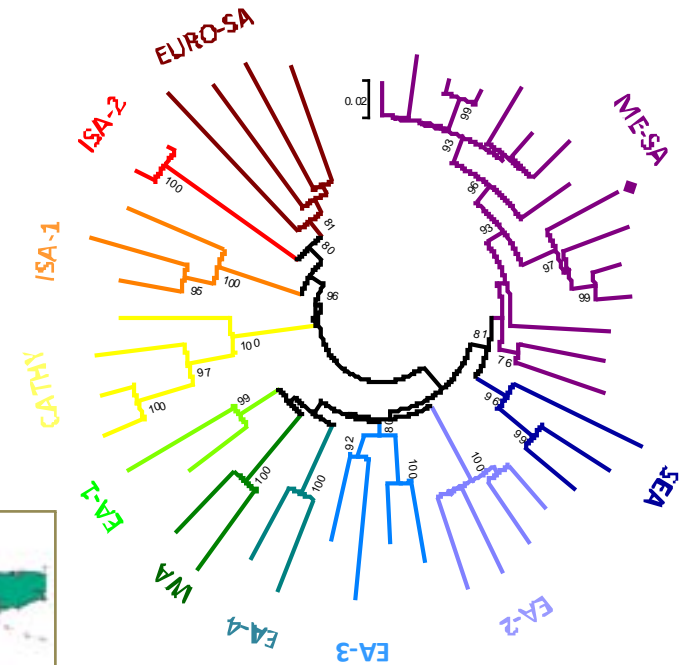


FMDV Pools



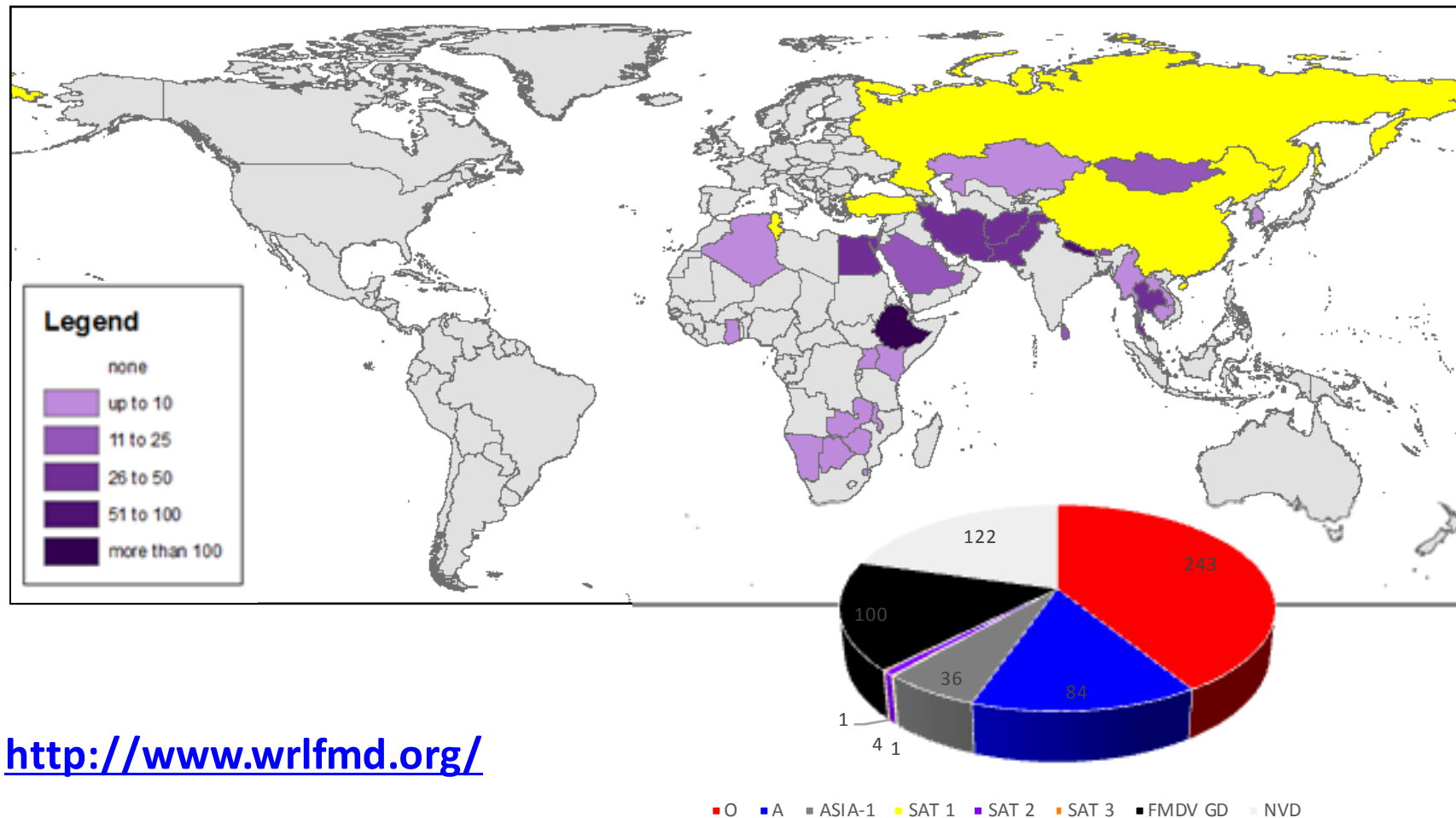
- Maintain specific FMD virus strains
- Control via (tailored) vaccination and supporting diagnostics

Virus movement tracing



Global surveillance: WRLFMD

584 Samples and sequences received between January 2017 to March 2018



<http://www.wrlfmd.org/>

Global surveillance:

OIE/FAO Laboratory Network

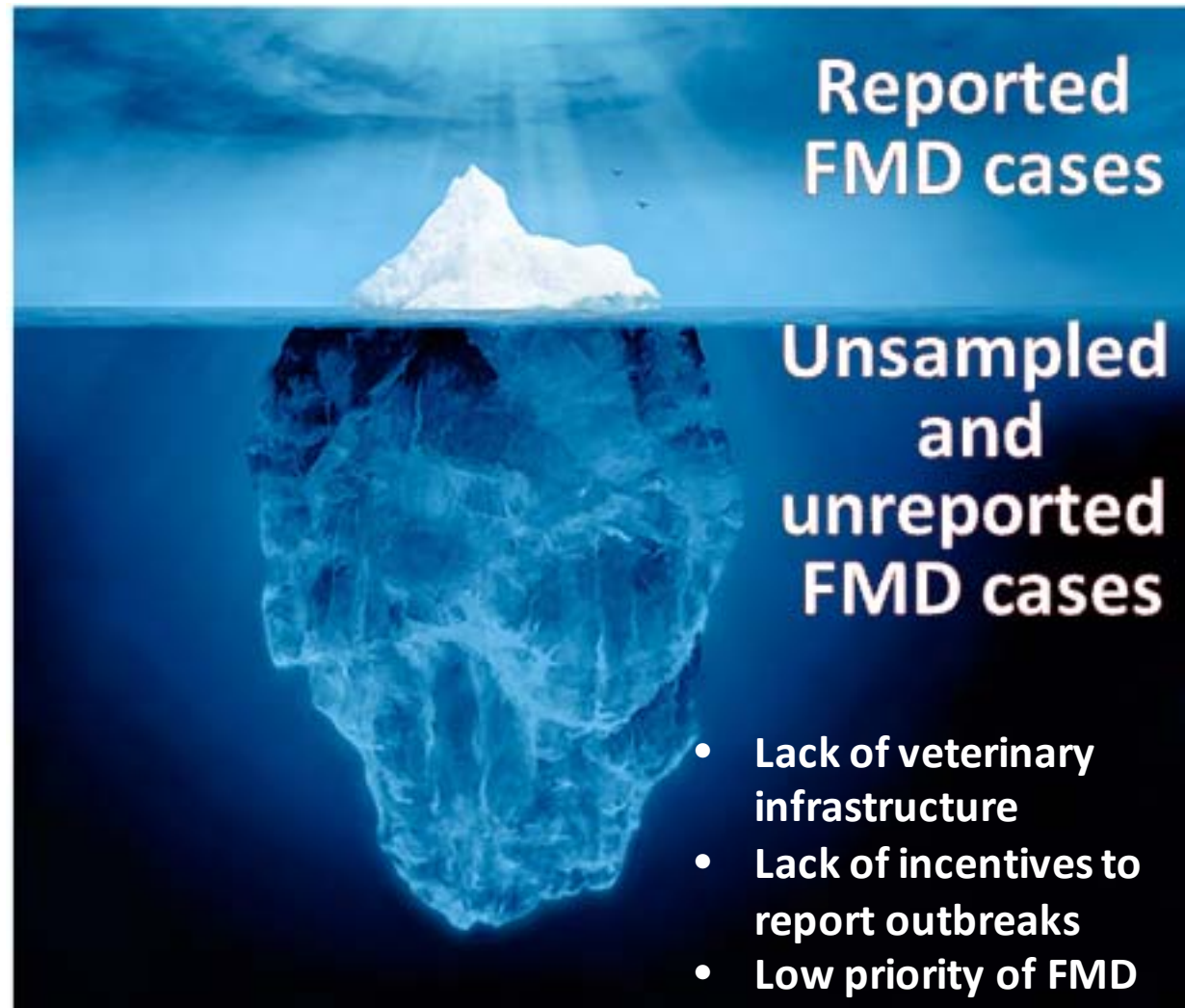
Collaborative effort of core member and affiliates countries in understanding global FMDV distribution and patterns in order to identify threats and make vaccine recommendations.



- Since 2014 more than **2000** virological samples per annum
- Gaps in surveillance remain in West/Central (and East Africa)

<https://www.foot-and-mouth.org/>

Does sampling provide an accurate picture of FMD in endemic pools?



Can we use historical data to provide an indication of the extent of under reporting?

2016:

Data for Southeast and East Asia

	No. Outbreaks
Cambodia	71
PR China	4
Lao PDR	36
Malaysia	69
Mongolia	1
Myanmar	27
Thailand	262
Viet Nam	54

SEACFMD (2017)

- Farm structure (size of epi. unit)
- Impact of vaccination to mask clinical disease
- Epidemic vs endemic circulation?

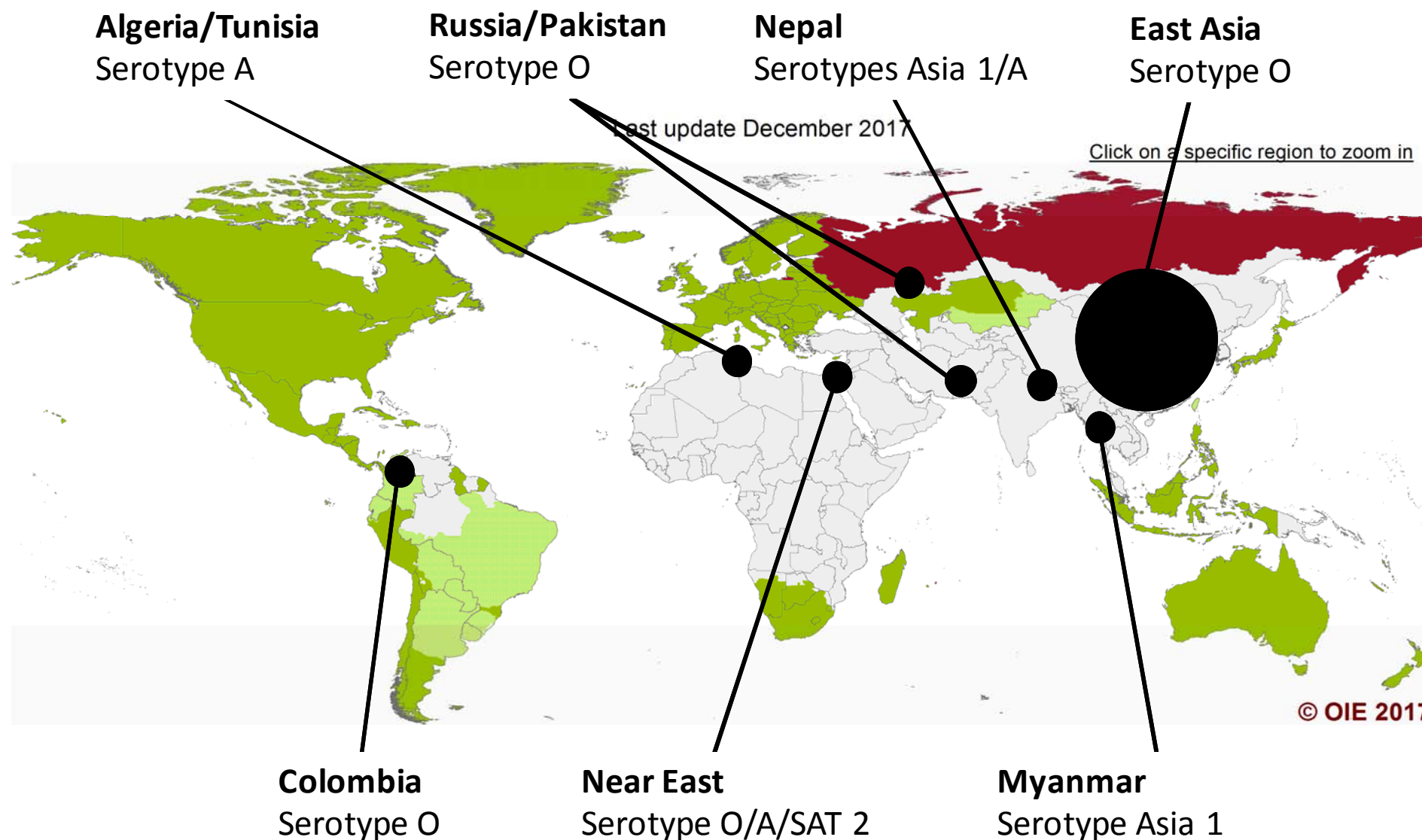
1937-39:

Data for Europe

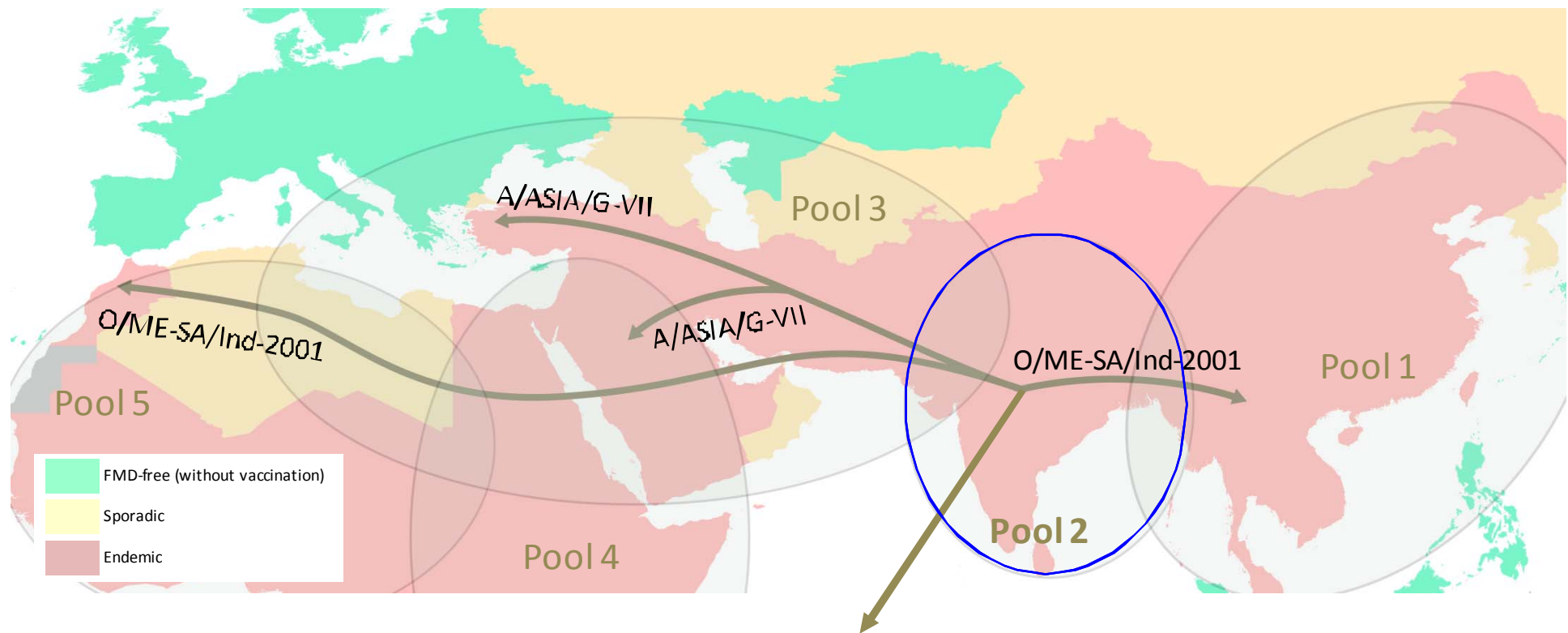
	No. Outbreaks
France	378,703
Belgium	102,763
Luxembourg	5,089
Netherlands	265,113
Germany	703,602
Denmark	105,910
Sweden	7,253
Switzerland	19,134
Poland	234,506
Czechoslovakia	240,118
Austria	38,474
Yugoslavia	17,588
Hungary	5,151
Rumania	20,961
Bulgaria	244
Italy	31,696

Fogedby Report – EuFMD (1961)

Global FMD situation in 2017/18: "highlights"



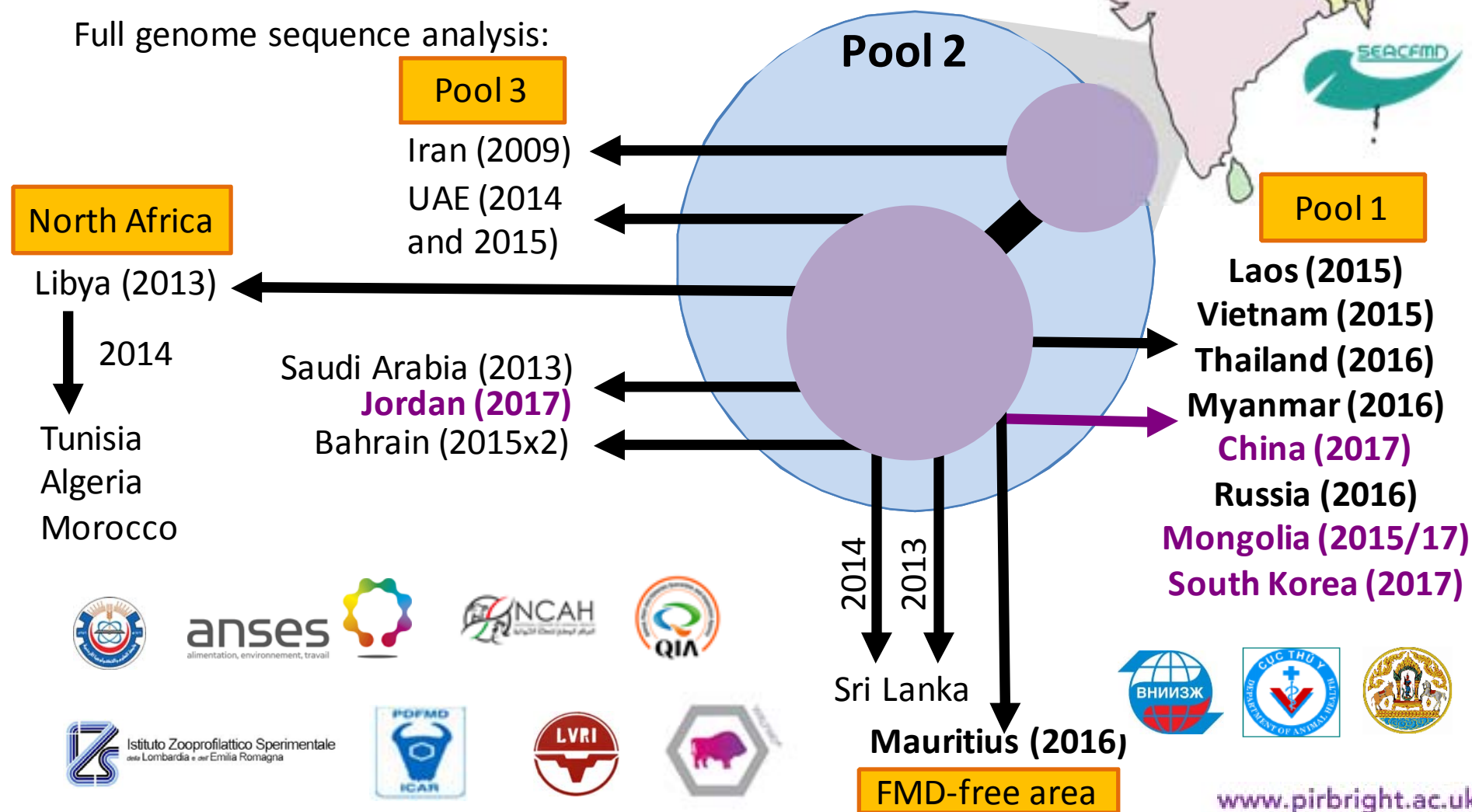
Long-distance “trans-pool” movements: O/ME-SA/Ind-2001



Spread of O/ME-SA/Ind-2001:

- Sequence data indicates that there have been multiple “escapes” from the Indian sub-continent

Full genome sequence analysis:

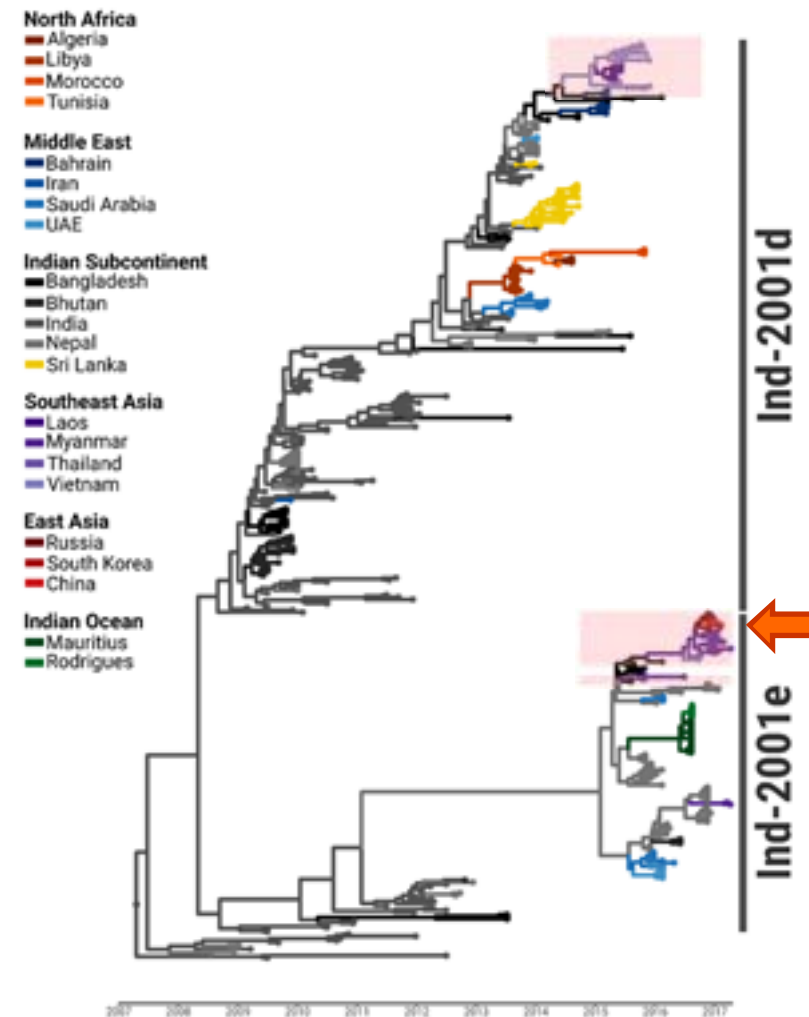


O/ME-SA/Ind-2001:

Onward transmission from POOL 1?

Full genome sequence analysis (limited sample/sequences access):

- Independent introductions of both genetic clades to South East Asia
- Virus movements into East Asia (Russia, South Korea, China and Mongolia)



Bachanek-Bankowska et.al., Scientific Reports. *In review*

Vaccine Potency Trial

O/ME-SA/Ind2001



- Experiments hosted by CVI-Lelystad
- Adopted protocol according to European Pharmacopeia
- O-Manisa vaccination (at least 6PD₅₀) with O/ALG/2014 challenge

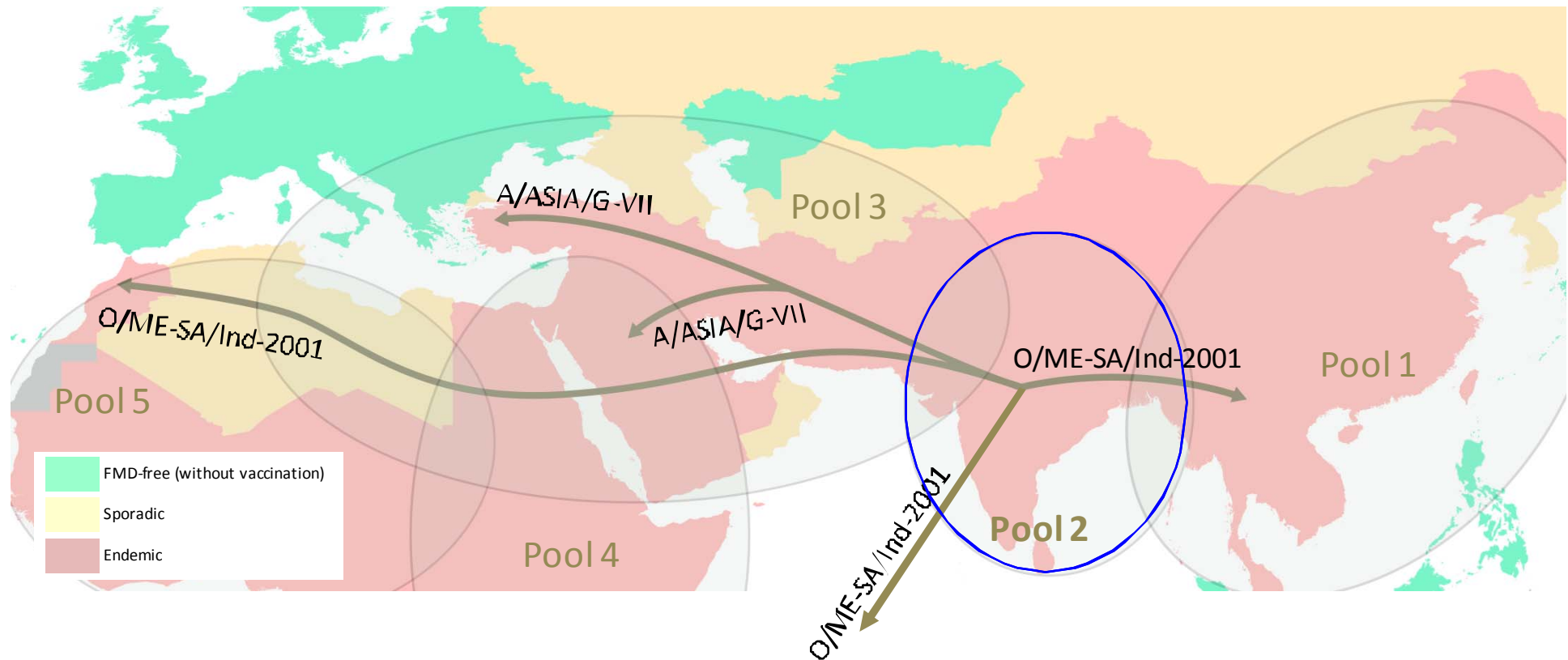
Vaccine Dose	Number Protected vs Vaccinated	Serological Results (O Manisa Log ₁₀ VNT mean 21DPV)
Full	3/5	2.65
1/4	4/5	2.67
1/16	0/5	1.68
Unvaccinated*	0/2	

- Estimated heterologous potency ~3 PD₅₀



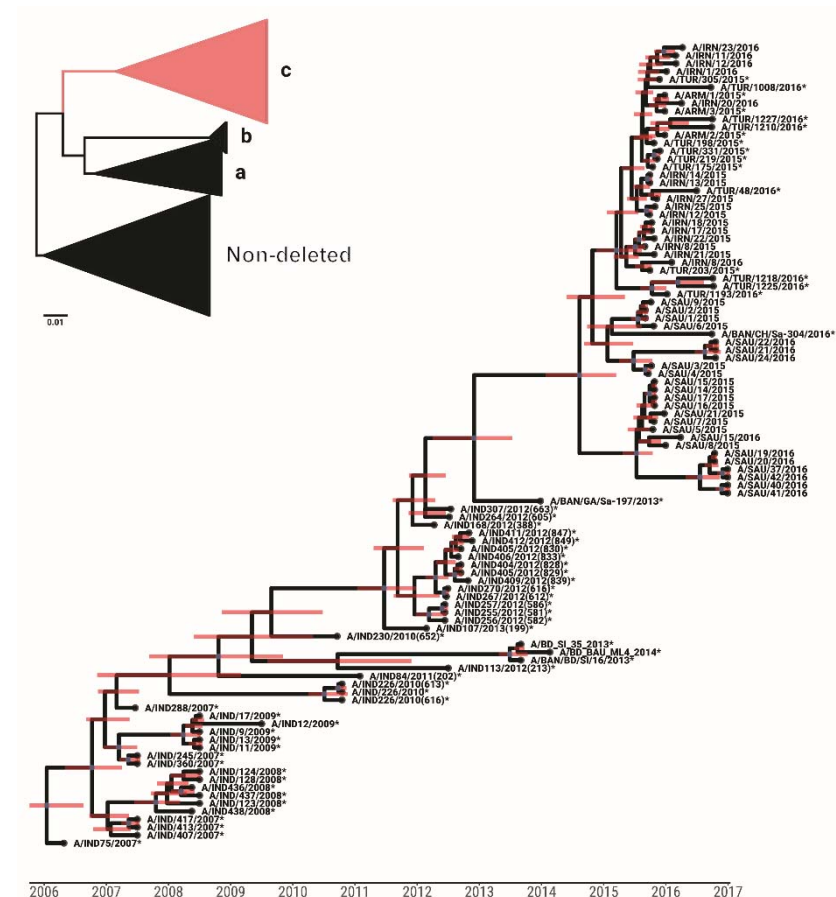
Fishbourne et al., 2017

Long-distance “trans-pool” movements A/ASIA/G-VII



A/ASIA/G-VII

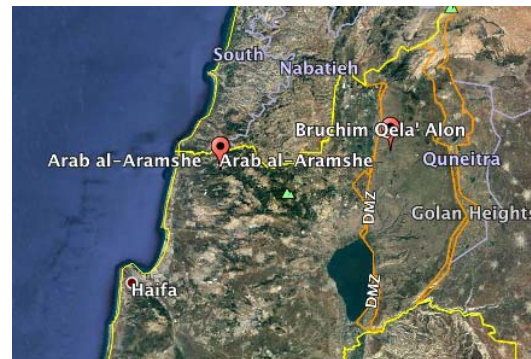
- Present in most countries within Pool 2.
- Historic outbreaks:
 - Saudi Arabia (1995),
 - Albania and the Republic of Macedonia (1996),
 - Myanmar (2010).
- Since 2015 outbreaks reported in
 - Saudi Arabia,
 - Armenia,
 - Iran,
 - Turkey.



Bachanek-Bankowska et.al., 2018
Emerging Infectious Diseases. *In print*

FMD cases in Northern Israel (A/ASIA/G-VII)

- Sequences and samples provided from the Kimron Veterinary Institute (Israel)
- Samples collected from Cattle (May 2017)
- Qela, Golan and Aramsha

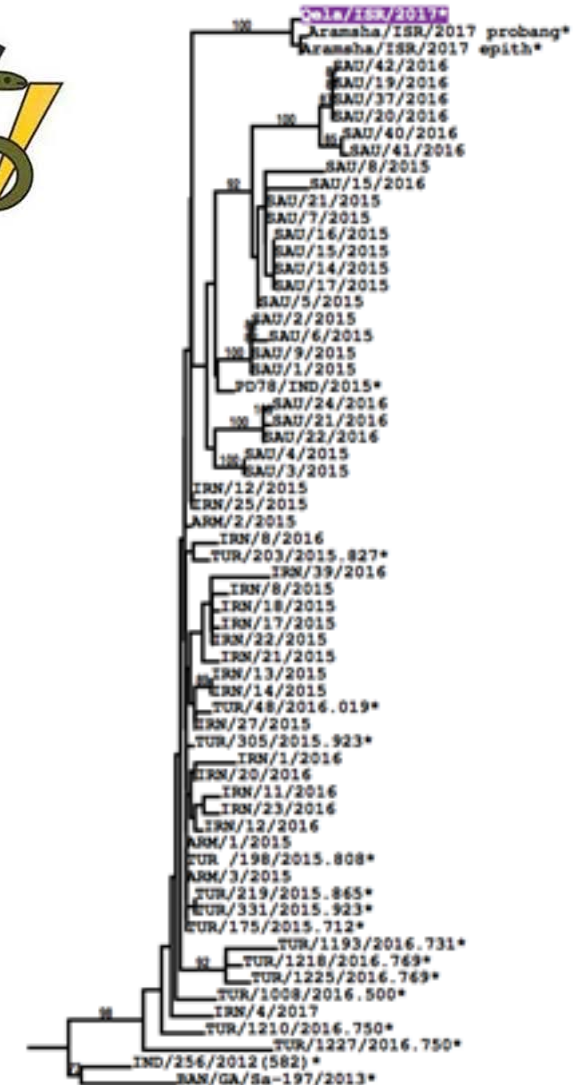


At the same time, in the south of the country..

- May 2017: O/EA-3
- 2017: reports of SAT 2 in Gaza Strip

And...

- April 2018: O/ME-SA/PanAsia-2^{QOM-15} in Southern Galilee



Poor vaccine protection for A/ASIA/G-VII

Summary of *in vitro* data and two *in vivo* studies

In-vitro vaccine matching data is not very encouraging

PPG study design

- Multivalent vaccine containing A-Sau-95 and A-Iran-05 (only **56% protection***)

Pilot trial to evaluate two additional monovalent FMDV vaccines (from Merial/BI)

- A22 (**28% protection**)
- A/May/97 (**72% protection***)

Recent PD50 study with A-Sea-97

- **>6PD50 – unexpected results?**

Vaccines

	A/SAU/1/2015	A/SAU/2/2015	A/IRN/8/2015	A/IRN/12/2015	A/IRN/25/2015
A-Iran-05	0	0	0	0	0
A-Tur-20-06	0.03	0.06	0.01	0.15	0.01
A-22	0.11	0.11	0.13	nd	0
A-Iran-87	0	0.04	nd	nd	nd
A-Iran-96	0.04	0.06	nd	nd	nd
A-Iran-99	0.01	0.01	nd	nd	nd
A-Sau-95*	0.20	0.19	0.26	0.16	nd
A-May-97	0.14	0.23	0.15	0.23	nd
A-Tur-11	0.01	nd	0.10	0.04	nd
A-Tur-14	0	nd	0	0	nd
A-IND-40-2000*	0.26	nd	0.03	0.24	nd



Waters et al., 2018

*OIE guidelines 75% is required



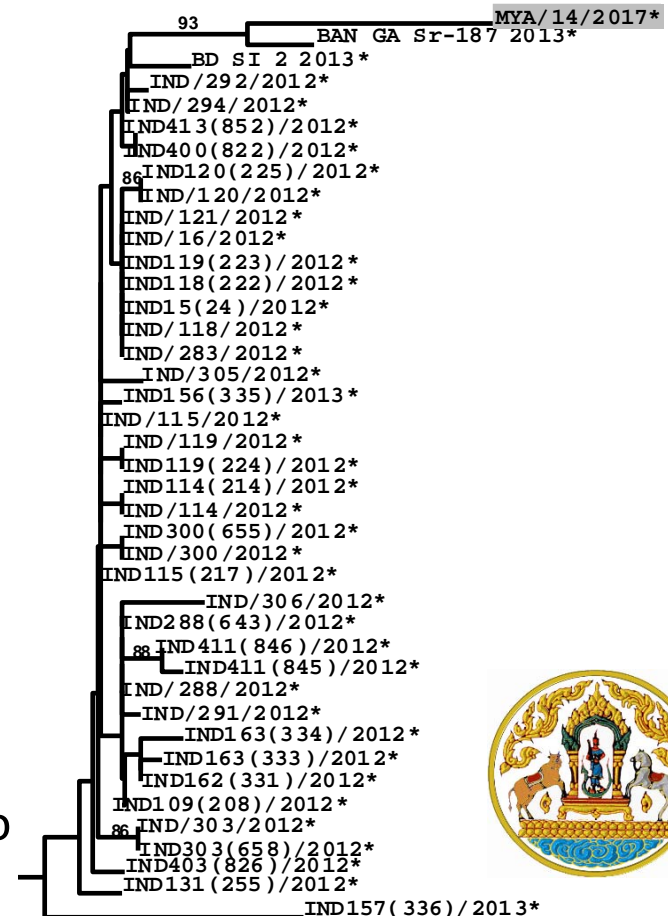
www.pu.bright.ac.uk

“Trans-pool” movement: Asia 1

- New introduction of the Asia 1 virus from Pool 2 to South East Asia.
- Serotype Asia 1 not reported in Southeast Asia since 2006/7(?)
- FMD outbreaks in cattle in Myanmar
- February 2017
- Sequence data from RRL-SEA in Pakchong, Thailand

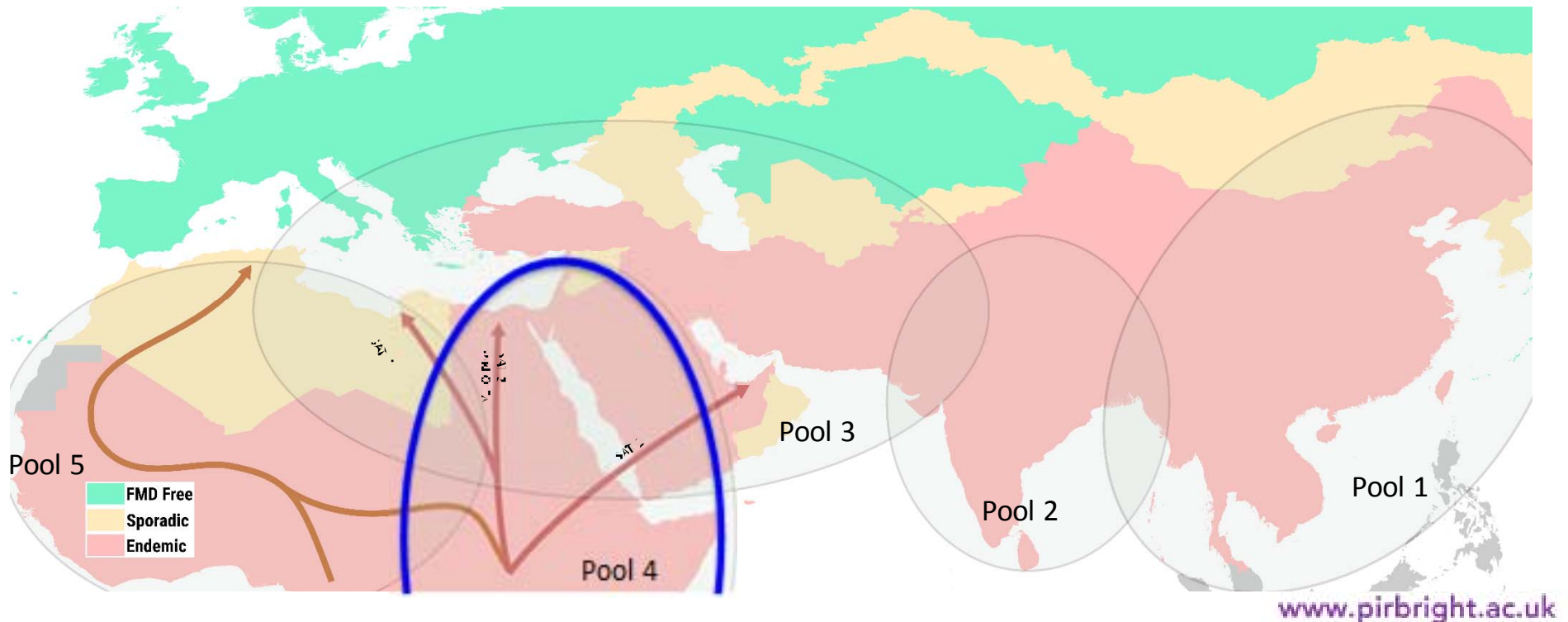
Huachun et al., (SEACFMD – 2017)

- ~500,000 head/year move from Myanmar into Yunnan Province
- 5% infected with FMDV



Additional examples of long-distance “trans-pool” movements

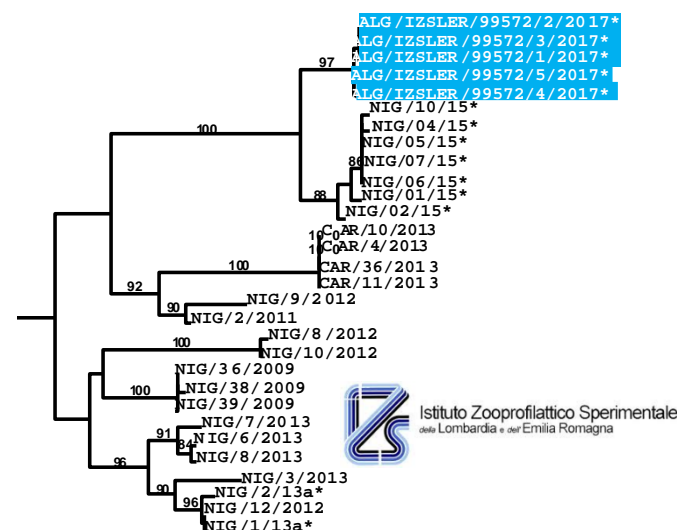
- SAT 2/VII Oman [2015], Egypt [since 2012]
- O/EA-3 Egypt [2016], Palestine [2017] and Israel [2017]
- A/AFRICA/G-IV Algeria and Tunisia [2017]



Recent FMD cases in Algeria and Tunisia

March/April 2017

- Outbreaks in cattle
- Due to a new FMD virus strain for the region (A/AFRICA/G-IV)
- Sequences from Algeria (March) and Tunisia (April) >99% identity
- First cases of Serotype A in the Maghreb > 30 years
 - Algeria 1977
 - Tunisia 1984
- *in-vitro* vaccine matching data for representative viruses provides candidates vaccines that now need testing
- Yet another new threat for Europe?



VACCINE STRAINS				
	A/ERI/3/98	A/TUR/20/06	A22/IRQ/64	A/IRN/05
ALG/2/2017	0.41	0.00	0.31	0.00
ALG/3/2017	0.32	0.00	0.32	0.00

“Trans-pool” movements 2017/18

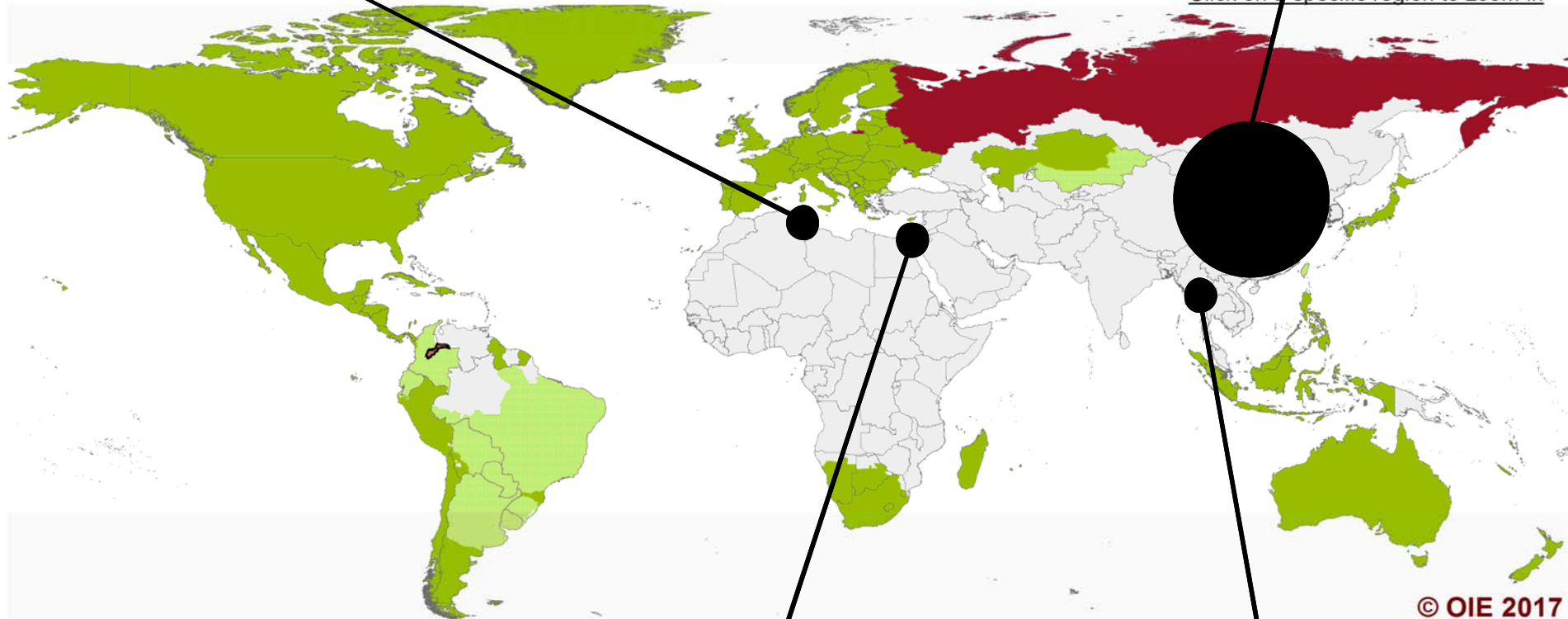


Algeria/Tunisia
Serotype A

East Asia
Serotype O

Last update December 2017

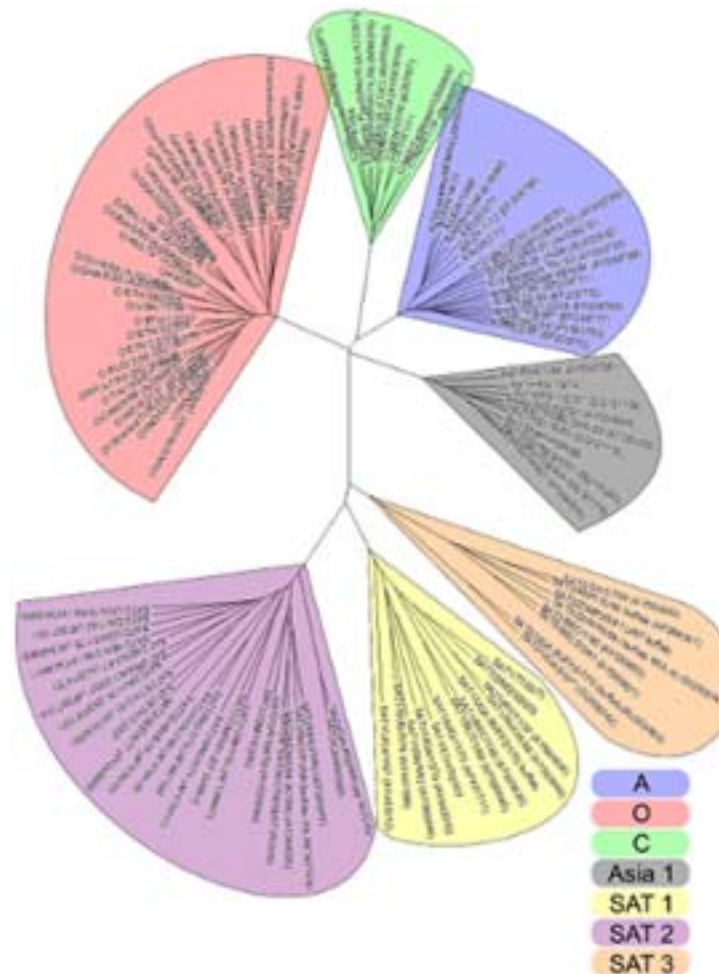
Click on a specific region to zoom in



Near East
Serotype O/A

Myanmar
Serotype Asia 1

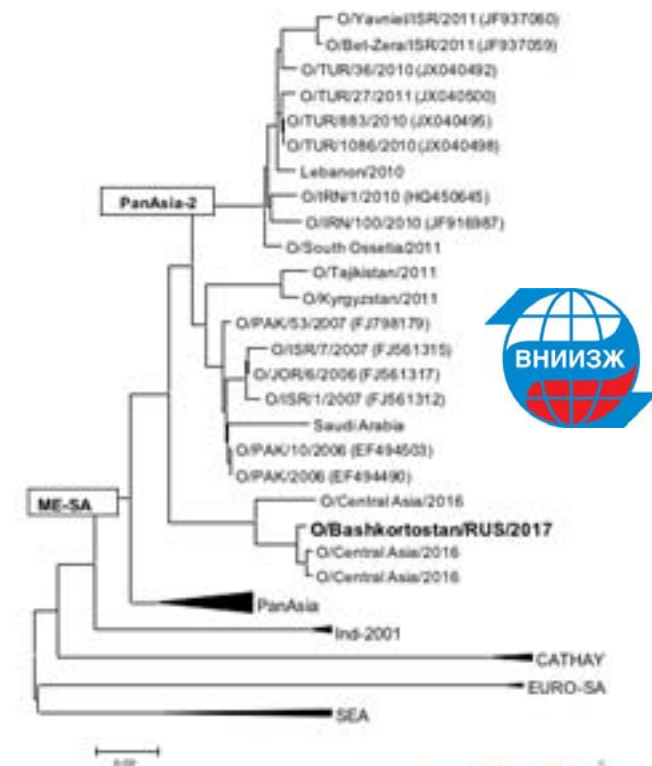
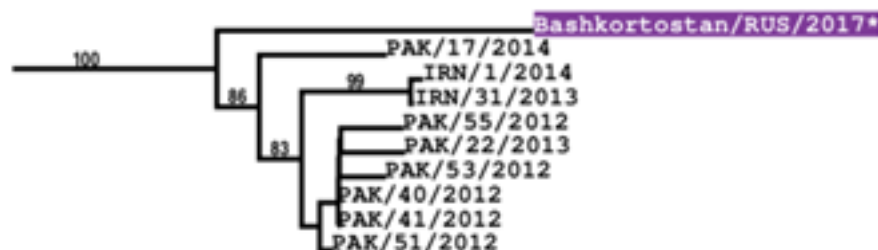
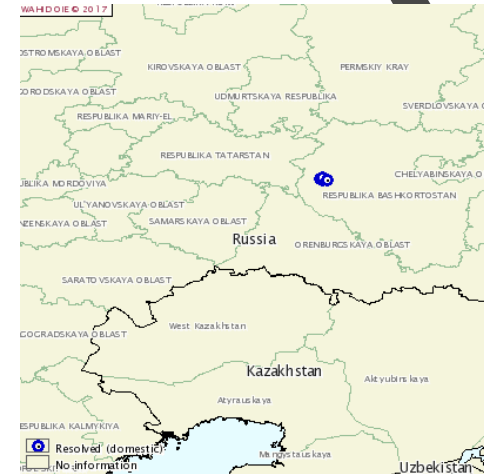
New lineages 2017/18



Russia: New O/ME-SA lineage

October 2017

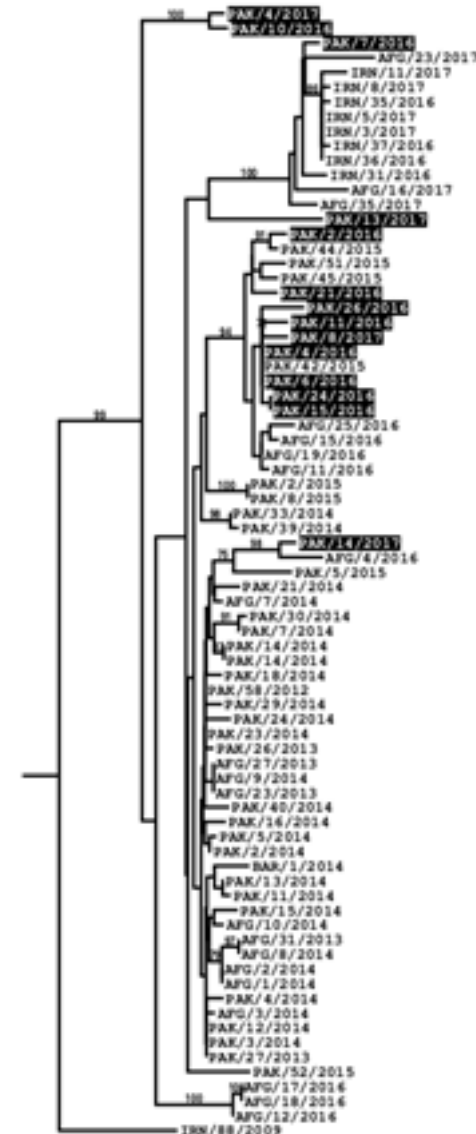
- 5 FMD outbreaks reported in **Bashkortostan** (in the FMD-free zone without vaccination)
- Reported cases in cattle, sheep and goats
- New FMDV lineage in ME-SA topotype (not PanAsia or PanAsia-2)
- Most closely related to FMD viruses in Pakistan and Iran (2014)
- Reporting of cases in “central Asia”?



Pakistan: a new serotype O lineage?

(Pool 3)

- Two isolates in a new genetic clade within O/ME-SA/PanAsia-2
- Discrete from other ANT-10 viruses
- Collected in Punjab, Pakistan (2016/17) from cattle and water buffalo
- No neutralization in VNT with BVS for O-Manisa, O-3039 or O-TUR-5-09
- **New antigenic variant?**
- **Spread of this lineage needs to be closely monitored** – esp. wrt evidence of vaccine failure in the field



Nepal: a new serotype Asia 1 lineage?

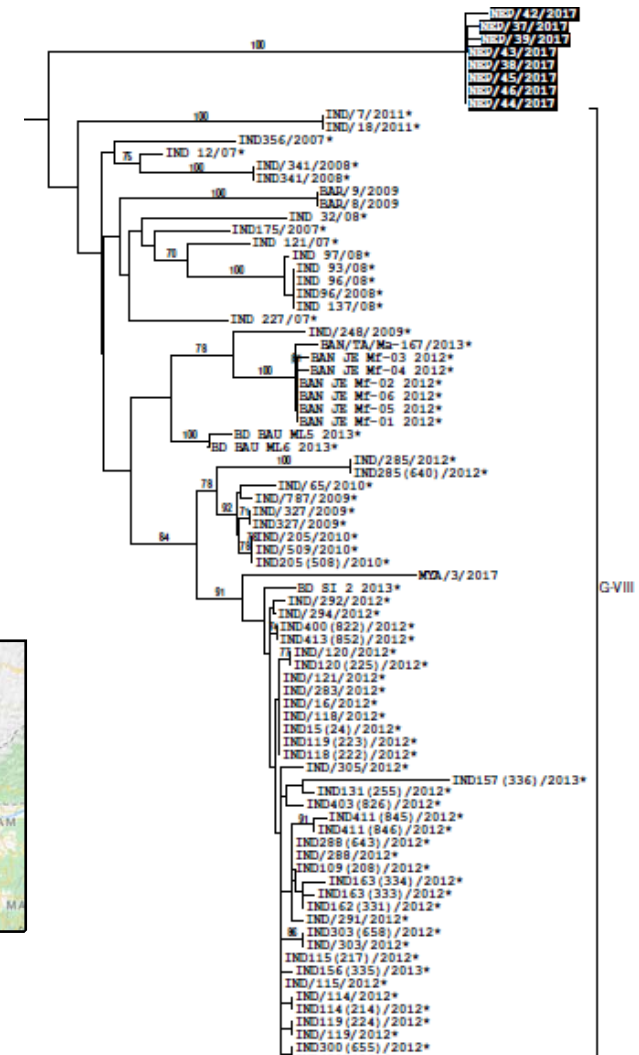
(Pool 2)

- Eight phylogenetically related isolates in a new genetic clade within Asia 1 serotype
- Discrete from other Asia 1 viruses
- Collected in Provinces no. 3 and 4, Nepal (December 2017) from cattle.
- A first report of Asia 1 virus in Nepal since 1997.
- Is it an previously unreported endemic virus or an introduction from another country?



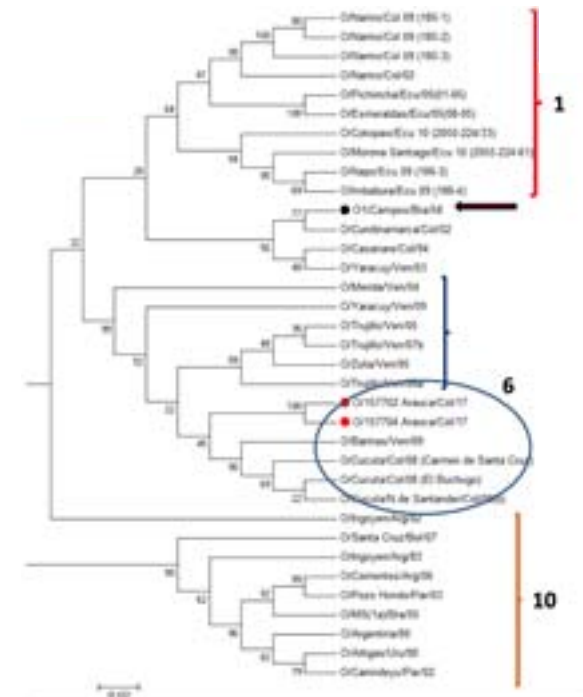
Serotype A: A/ASIA/G-VII

- First report of serotype A virus (2017) since 1997.

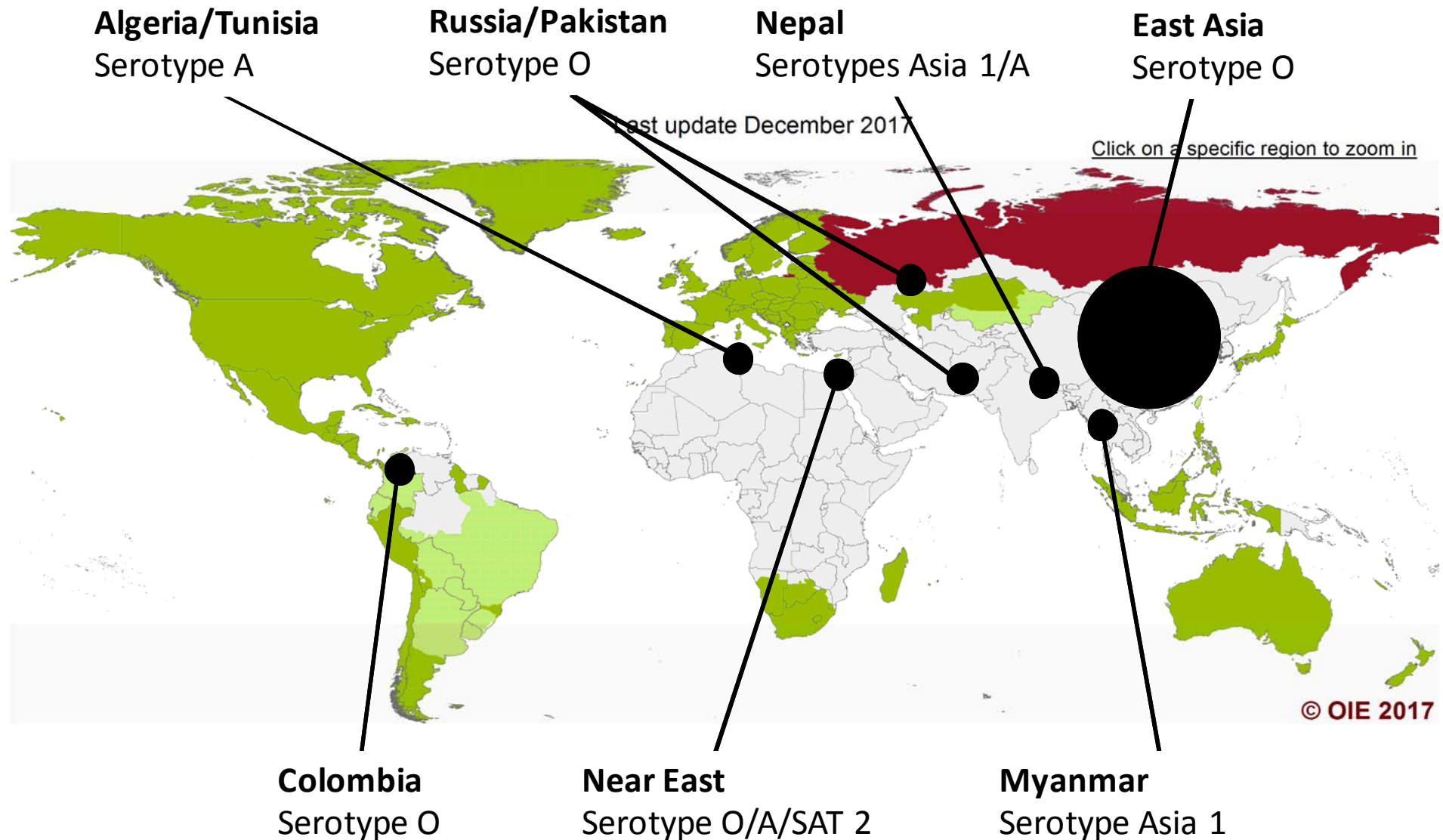


Virus re-occurrence: FMD Cases in Colombia

- First clinical case reported in South America since 2013 (Venezuela)
- Cases in vaccinated cattle
- Sequence data consistent with indigenous strains from the region
 - Lineage 6 described by Malirat et al., 2011



Global FMD situation in 2017/18: "highlights"



Long-distance “trans-pool” movements

Why?

Dynamic patterns, multiple factors:

- Changes to animal and animal products trade patterns due to increased demand
- Regional political unrest and conflicts
- Migration of people



Long-distance “trans-pool” movements



Is it a threat to South America?

- Exporter of animals and animal products
- Recent history of unexpected long distance virus movements
 - PanAsia in Europe and South Africa (2000/01)
 - O/Ind-2001 in Mauritius (2016)
- Indigenous viruses: are there still pockets of infections in remote areas in South America?



Thanks...

- Support for the WRLFMD and research projects
- Collaborating FMD Reference Laboratories and field teams
- Partners within the OIE/FAO FMD Lab Network

