Global Update

EuFMD Exec. Committee

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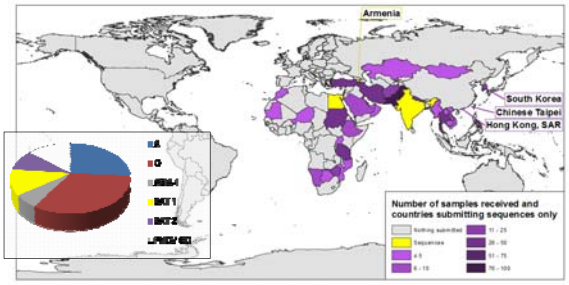
FMD Reference Laboratory

Submissions to Pirbright

January 2015 – March 2016



- Additional sequence exchange with Egypt, Russia, India and BVI
- Reports for these samples can be found at: www.wrlfmd.org

Recent submissions to WRLFMD Pirbright

Since last EuFMD Exec. Comm. (Monza, Sept 2015)

Reports for:

Armenia, Botswana, Cambodia, Hong Kong SAR, Iran, Kuwait, Laos, Morocco, Mozambique, Myanmar, Namibia, Niger, Palestinian Aut. Terr., Saudi Arabia, South Korea, Tanzania, Thailand, Turkey, UAE, Uganda, Vietnam, Zimbabwe

(22 countries)

Results pending for:

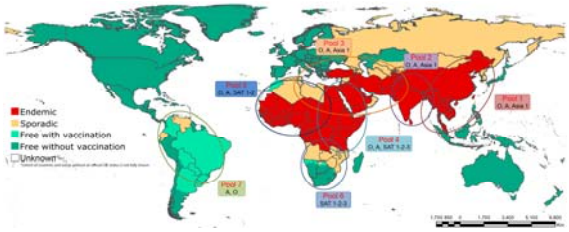
Israel, Ethiopia, Nepal, Pakistan, Sudan

Arranging shipments:

Nigeria, Laos

FMD: Conjectured global status

- Seven FMDV serotypes
- Seven endemic pools requiring tailored diagnostics and vaccines



- No FMD outbreaks in South America (almost 4 years)
- No outbreaks due to serotype C (~10 years)
- New FMD-free zone (without vaccination) established in **northern Kazakhstan**

Coordinating Global Networks

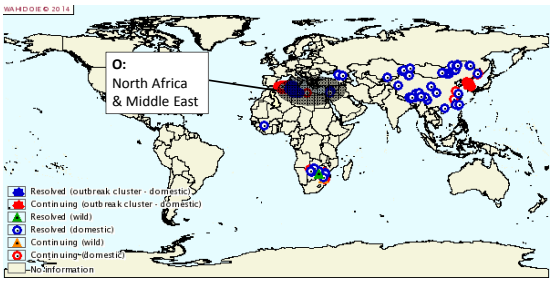
OIE/FAO FMD Laboratory Network

- OIE and FAO Reference Centres (+ affiliates)
  - Working Groups (nomenclature and PVM)
  - Recommendations for Serotype C
- **Global surveillance and changing patterns in risk pathways**
- **Harmonised and improved lab capacity**

Brussels, Belgium – November 2015

Viruses on the move:

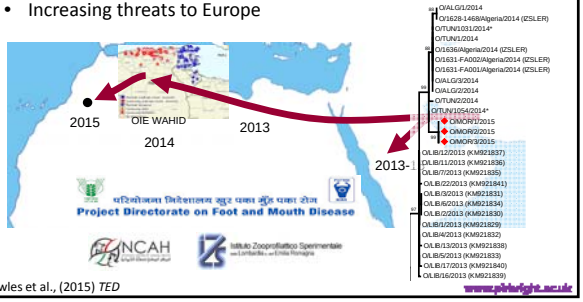
Changing epidemiological patterns and examples of data sharing between OIE and FAO FMD Reference Laboratories



Outbreaks reported to the OIE (change of epidemiological status):
http://www.oie.int/wahid-prod/public.php?page=home

Recent serotype O cases

- O/ME-SA/Ind2001 lineage from the Indian sub-continent
- Since 2013: FMD Outbreaks in **Saudi Arabia, UAE, Bahrain, Libya**, **Tunisia, Algeria**
- Transmission links unknown?
- Increasing threats to Europe



Knowles et al., (2015) *TED*

Vaccine matching for O/ME-SA/Ind-2001

26 field isolates:

	Vaccine strain		
Field Isolate	O-3039	O Manisa	O/TUR/5/09
LIB 1/2013			
LIB 7/2013			
LIB 17/2013			
LIB 22/2013			
NEP 13/2012		borderline	
NEP 6/2012	borderline		
NEP 21/2012			
NEP 6/2013			
NEP 18/2013			
NEP 1/2014			
NEP 6/2014			
SAU 1/2013			
SAU 4/2013			
SAU 6/2013			
SAU 7/2013			
SAU 1/2014	borderline		
SRL 1/2013			
SRL 1/2014		borderline	
UAE 1/2014		borderline	
UAE 2/2014		borderline	
ALG 1/2014	borderline		
TUN 1/2014	borderline		
BAR 8/2015			
BAR 14/2015			
MOR/1/2015			
MOR/2/2015			

Using VNT
r-value 0.3 cut-off

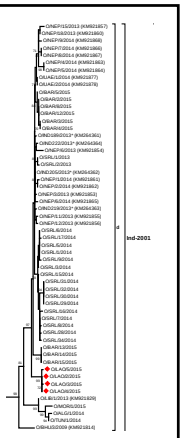
Matched

Not Matched

O/ME-SA/Ind-2001 in SEA

- O/ME-SA/Ind2001 lineage from the Indian sub-continent
- Spread to Laos PDR
- Samples collected in June 2015
- Genetically distinct to outbreaks in the Gulf States and North Africa
- Links to the Indian sub-continent not yet defined (imports of frozen tongues from India?)

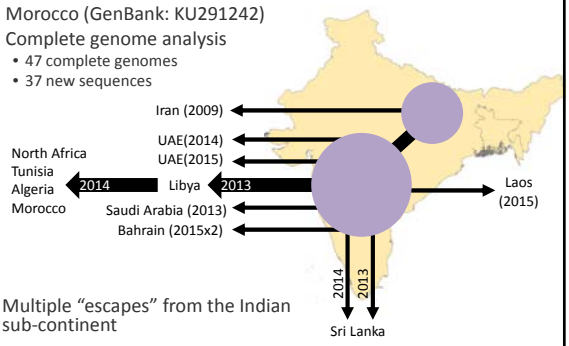
RRLSEA: Pakchong



O/ME-SA/Ind 2001

New full genome analysis

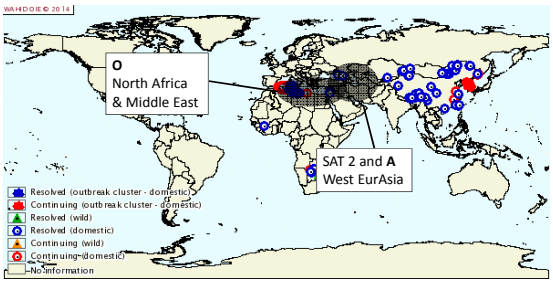
- Morocco (GenBank: KU291242)
- Complete genome analysis
  - 47 complete genomes
  - 37 new sequences



- Multiple "escapes" from the Indian sub-continent

Viruses on the move:

Changing epidemiological patterns



Outbreaks reported to the OIE (change of epidemiological status):
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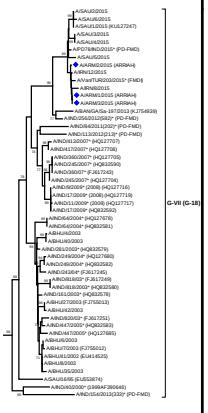
New serotype A outbreaks in West EurAsia

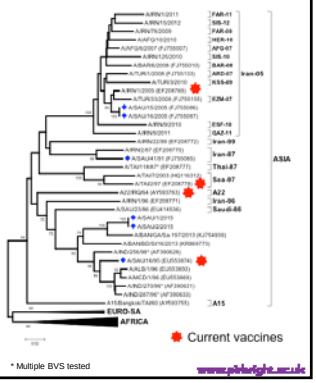
- Initial reports September 2015
- Saudi Arabia, Turkey, Iran, Armenia
- Originating from the Indian sub-continent
- A further example of new "unexpected" FMDV movement between endemic pools
- Impact upon vaccination?



A/ASIA/G-VII (G18)

Poor in-vitro match to many commercial vaccines

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



* Multiple BVS tested

A/ASIA/G-VII (G18)

genomeAnnouncements
Complete Genome Sequence of a Serotype A Foot-and-Mouth Disease Virus from an Outbreak in Saudi Arabia during 2015

- Full genome of A/SAU/2015 (GenBank: KU127247)
- Deletion in VP3[59]
- Amino acid differences in known antigenic sites in lineage A/ASIA/G-VII, isolates between three farms

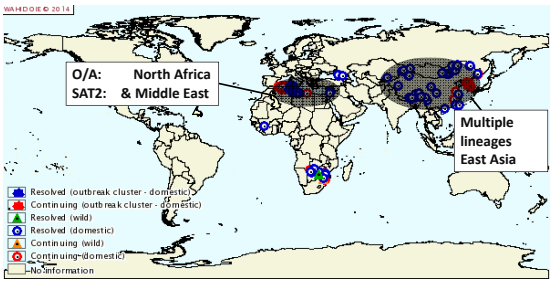
		Site 3 1043-1047	Site 1 1138-1154
Reference viruses	A/ERI/3/98	NSPTP	TSVSPRRGDLGALAARV
	A22/IRQ/24/64	QNLNP	AGGTGRRGDLGPLAARV
	A/MAY/97	KPVSP	TPGA-RRGDLGSLAARD
	A/IRN/31/2005	SPVSP	TTGNGRRGDLGPLAARV
	A/TUR/4/2006	SPVSP	TTGNGRRGDLGSLAARV
Field viruses	A/SAU/1/2015	VNVSP	AASGRTRGDQGQLAARV
	A/SAU/2/2015	VNVSP	AASGRTRGDQGQLAARV
	A/SAU/3/2015	VNVSP	AASGRARGDTGQLAARV
	A/SAU/4/2015	VNVSP	AASGRARGDTGQLAARV
	A/SAU/5/2015	VNVSP	AASGRARGDLEQLTARV
	A/SAU/6/2015	VNVSP	AASGRTRGDQGQLAARV

A/ASIA/G-VII (G18) – vaccine trial

- Monovalent vaccines not currently available from Merial
- Hexavalent vaccine
  - O-3039, O-Manisa, A-Iran-05, **A-Sau-95**, Asia-1, SAT 2
- PPG format
- Challenge at 21 dpv with A/IRN/2015
- Results expected at the beginning of April
- Serological and clinical data analysed in context of detailed information obtained from field cases in Saudi Arabia

Viruses on the move:

Changing epidemiological patterns



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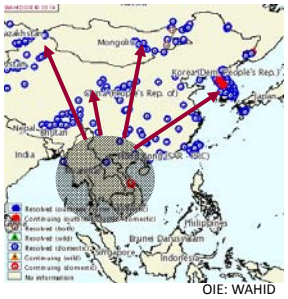
East Asia: outbreaks due to exotic FMDVs

FMD outbreaks since 2008

Spread of three FMD virus lineages from Southeast Asia:

- **O/ME-SA/PanAsia**
  China, Russia, Mongolia, Kazakhstan
- **O/SEA/Mya-98**
  China, Japan, South Korea, North Korea, Russia, **Mongolia 2015**, Taiwan
- **A/ASIA/Sea-97**
  South Korea, China, Kazakhstan, Mongolia, Russia, **Taiwan (2015)**

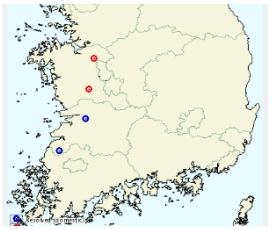


OIE: WAHID

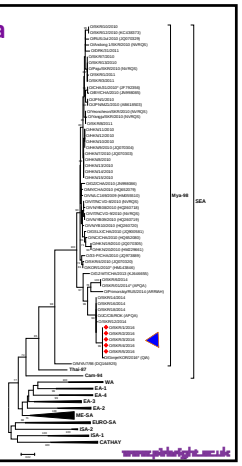
FMD Outbreaks in South Korea

December 2014 – on-going January 2016

- Further 4 outbreaks (O/SEA/Mya-98)



- Sequence data indicates continued circulation of FMD in SKR from 2014



Vaccine Bank Recommendations (March 2016)

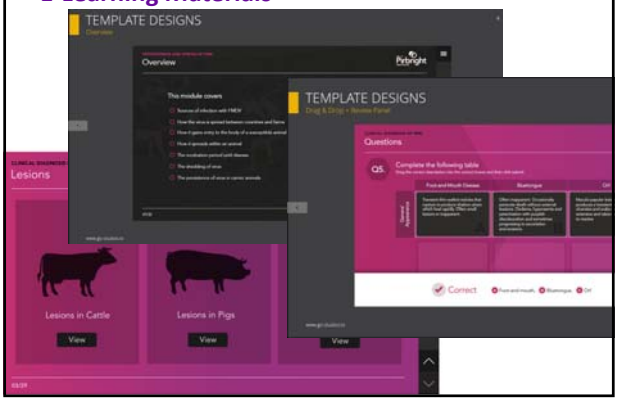
High Priority	**A/ASIA/G-VII(G-18)* O Manisa O PanAsia-2 (or equivalent) O BFS or Campos A24 Cruzeiro Asia 1 Shamir A Iran-05 (or A TUR 06) A22 Iraq SAT 2 Saudi Arabia (or equivalent i.e. SAT 2 Eritrea)**
Medium Priority	A Eritrea SAT 2 Zimbabwe SAT 1 South Africa A Malaysia 97 (or Thai equivalent such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

*Recent in-vitro data from WRLFMD for serotype A viruses from Saudi Arabia and Iran highlights an apparent gap in vaccine coverage. Work is urgently required to evaluate whether there is adequate in-vitro match with Indian vaccine strains (A/IND/40/2000) or whether in-vivo protection may be provided by high potency international vaccines.

Current WRLFMD Training Activities

- Annual Lab diagnosis training course
  - 2 weeks hands-on at Pirbright
  - November 2016
- E-learning modules under development to enhance pre-course preparation, for those that cannot attend and for TPI staff training
- Contribution of materials and trainers to EuFMD courses
- OIE twinning with National Animal Health and Diagnostic Investigation Centre, Ethiopia
- Field testing technology validation and transfer

National Funding Obtained for Upgrading of E-Learning Materials



Talk summary

- Epidemiology of FMD is very dynamic
  - Sampling of field outbreaks is critical
  - During 2015 - new unpredictable patterns in Asia (East and West) and North Africa
    - Established lineages within serotypes O, A, and Asia-1
    - Emerging lineages within serotypes O, A, and SAT 2
  - Threats to FMD-free countries in Europe and Turkish Thrace
  - Impact upon selection and deployment of vaccines
  - Multiple FMDV lineages may have different epidemiological features
- Importance of the sample collection from FMD outbreaks in the field– to feed real-time lab data back to FMD control programmes

Network report:

- www.wrlfmd.org
- Contributions and suggestions welcome

Acknowledgements

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

Benefits of vaccine field studies

Don King and Nick Lyons

- Always uncertainty about heterologous vaccine performance
  - A/ASIA/G-VII and Asia-1/Sindh-08
- Experimental "potency tests" are often performed
  - Expensive
  - Artificial exposure
  - Limited sample-size
- Field-based studies provide **real-life** picture of vaccine performance
  - See: previous projects from Nick Lyons and Theo Knight-Jones

Possible ideal study criteria/design to maximise impact for the EU

- Where possible, vaccines (or antigen components) should be equivalent and matched to those in the EU bank(s)
- Endemic setting where FMDV exposure can be anticipated
- Similar livestock production systems (and breeds) to Europe
- Access to farm records (herd and individual animal level)
- Good veterinary and transport infrastructure

- **Local enthusiasm for the project and benefit for the farmer**
- Data can be used:
  1. to optimise vaccine use in endemic settings
  2. to contribute to our understanding of vaccine use for "emergency" settings