



# **FMD Carrier state and role of carrier buffalo as source of transboundary spread in Southeast Asia and Eastern Asia**

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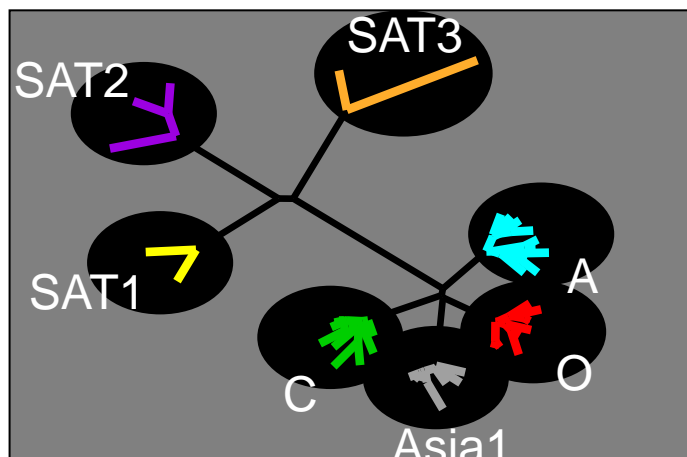
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- Highly contagious disease of all the major large animal livestock species and various wildlife
- Sequential infection possible from different variants



- Spread- Direct contact and airborne route
- **Due to wide antigenic variation of virus, disease is difficult to control**
- **Persistent infection: in ruminants**





## Carrier state in FMD

- Carrier state – asymptomatic persistent infection
- Duration of Persistence of FMDV varies among different species
  - Sheep and goat – 4 to 9 months
  - Cattle – 3.5 years
  - African Buffalo – 5 years
- Experimental transmission of virus from carrier cattle to naïve cattle and carrier sheep to naïve sheep failed at our end (**No excretion of carrier virus after acute phase of infection, Unpublished data**)
- Risk of transmission from carriers cannot be totally excluded
- African buffaloes have been shown to transmit FMDV to impala and livestock in close proximity (Vosloo *et al.*, 2006)
- Persistence of FMDV in Water buffalo has been widely reported (Barros *et al.*, 2007; Gomes *et al.*, 1997; Maddur *et al.*, 2009; Maroudam *et al.*, 2008)
  - Persistence of FMDV in SEA swamp Buffalo – Unknown





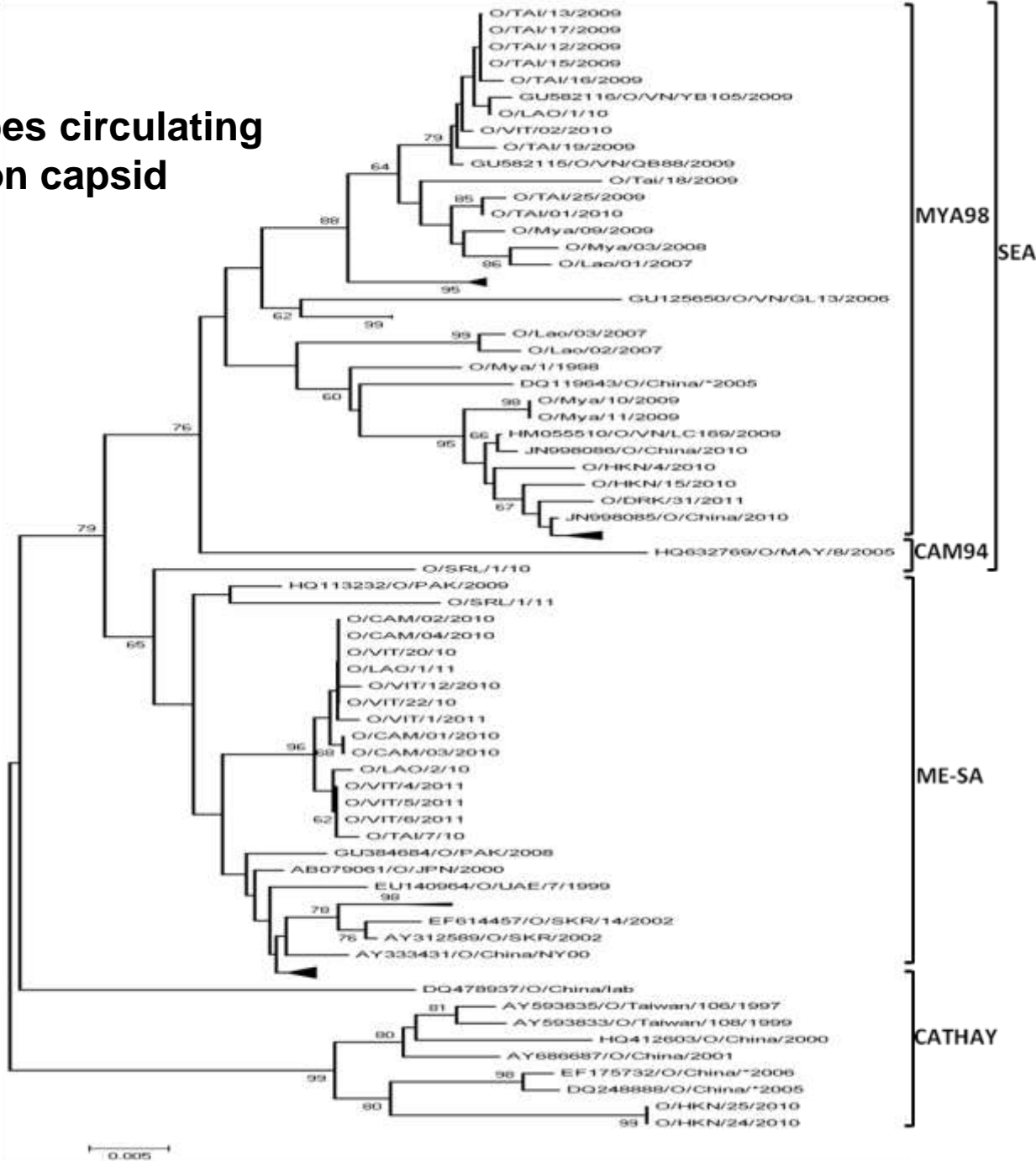


# Serotype O FMDV outbreaks reported in Southeast Asia and the Far east between 2009 and 2011

	2009				2010				2011				
	Jan -Mar	Apr - Jun	Jul - Sept	Oct - Dec	Jan -Mar	Apr - Jun	Jul - Sept	Oct - Dec	Jan -Mar	Apr - Jun	Jul - Sept	Oct - Dec	
<b>Cambodia</b>	†	†	†	†			†	†	†	†			
<b>China</b>					†	†	†	†	†	†			
<b>Democratic republic of Korea</b>									†				
<b>Hong Kong</b>					†			†	†				
<b>Japan</b>					+	+	+						
<b>Lao PDR</b>	†							†		†			
<b>Myanmar</b>	†	†	†	†	†			†					
<b>Malaysia</b>	†	†	†	†	†	†	†	†	†	†			
<b>South Korea</b>						†		†	+				
<b>Thailand</b>	†	†	†	†	†		†	†	†	†			
<b>Vietnam</b>	†	†	†	†	†	†	†	†	†		†		



## Serotype O FMDV topotypes circulating in Southeast Asia based on capsid sequence analysis





- Serotype O FMDV outbreak was reported during Jan – Feb 2009 in Magwe, Yangon and Sagaing divisions of Myamnar
- During November 2009, a total of 100 swamp buffaloes from Pwintphu Township in the Minbu district of Magway division were sampled for the oro-pharyngeal fluid and sera





# Summary of the real time RT-PCR, virus isolation and serotyping results of the probang samples collected from the swamp buffaloes of Magway division, Myanmar

Total number of samples	Total positives	Total negatives	Virus isolation	VI + RTPCR	ELISA
100	27	73	13	27	Type O



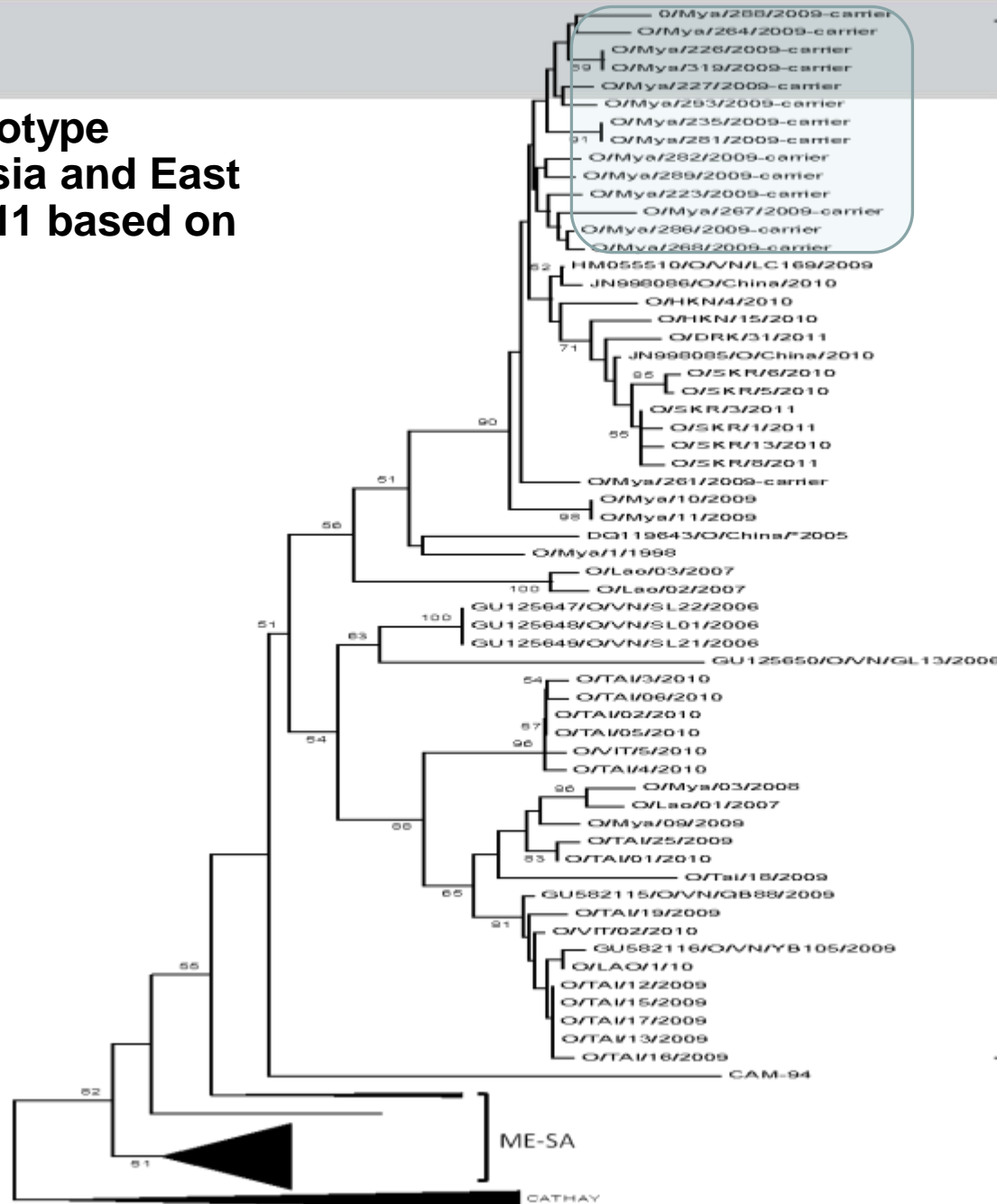


## SEA FMDV isolates sequenced for capsid in this study

S.No.	Viruses	Country	S.No.	Viruses	Country
1	O/Mya/3/2008	Myanmar	43	O/Lao/2/2008	Lao
2	O/Mya/9/2009		44	O/Lao/3/2008	
3	O/Mya/10/2009		45	O/Lao/1/2009	
4	O/Mya/11/2009		46	O/Lao/1/2010	
5	O/Mya223/2009/Carrier		47	O/Lao/2/2010	
6	O/Mya226/2009/Carrier		48	O/Lao/1/2011	
7	O/Mya227/2009/Carrier		49	O/VIT/1/2008	Vietnam
8	O/Mya235/2009/Carrier		50	O/VIT/2/2010	
9	O/Mya264/2009/Carrier		51	O/VIT/3/2010	
10	O/Mya267/2009/Carrier		52	O/VIT/4/2010	
11	O/Mya268/2009/Carrier		53	O/VIT/5/2010	
12	O/Mya281/2009/Carrier		54	O/VIT/6/2010	
13	O/Mya282/2009/Carrier		55	O/VIT/7/2010	
14	O/Mya286/2009/Carrier		56	O/VIT/20/2010	
15	O/Mya288/2009/Carrier		57	O/VIT/22/2010	
16	O/Mya289/2009/Carrier		58	O/VIT/12/2010	
17	O/Mya293/2009/Carrier		59	O/VIT/1/2011	
18	O/UKG/UV9/49dpc	Experimental infection at IAHL, Pirbright	60	O/VIT/4/2011	Cambodia
19	O/UKG/UV9/98dpc		61	O/VIT/5/2011	
20	O/UKG/UV13/49dpc		62	O/VIT/6/2011	
21	O/UKG/UV17/91dpc		63	O/CAM/1/2010	
22	O/UKG/UV19/91dpc		64	O/CAM/2/2010	
23	O/TAI/12/2009	Thailand	65	O/CAM/3/2010	Hong Kong
24	O/TAI/13/2009		66	O/CAM/4/2010	
25	O/TAI/15/2009		67	O/HKN/4/2010	
26	O/TAI/16/2009		68	O/HKN/15/2010	South Korea
27	O/TAI/17/2009		69	O/HKN/24/2010	
28	O/TAI/18/2009		70	O/HKN/25/2010	
29	O/TAI/19/2009		71	O/SKR/5/2010	
30	O/TAI/20/2009		72	O/SKR/6/2010	
31	O/TAI/21/2009		73	O/SKR/13/2010	
32	O/TAI/22/2009		74	O/SKR/1/2011	
33	O/TAI/23/2009		75	O/SKR/3/2011	
34	O/TAI/24/2009		76	O/SKR/8/2011	
35	O/TAI/25/2009		77	O/DRK/31/2011	Democratic republic of Korea
36	O/TAI/1/2010				
37	O/TAI/2/2010				
38	O/TAI/3/2010				
39	O/TAI/4/2010				
40	O/TAI/5/2010				
41	O/TAI/6/2010				
42	O/TAI/7/2011				



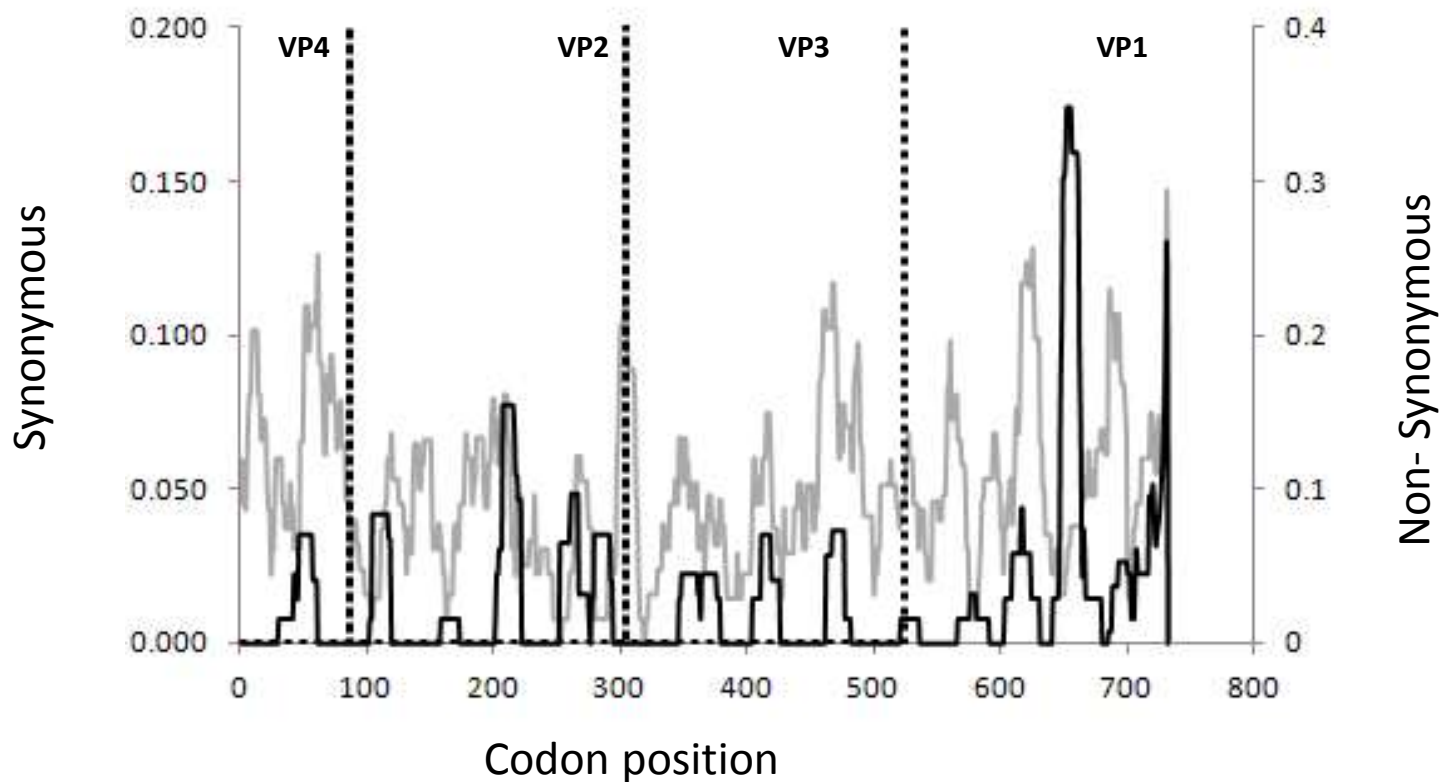
## Mya-98 lineage of SEA topotype circulating in Southeast Asia and East Asia between 2005 and 2011 based on capsid sequence analysis



MYA 98

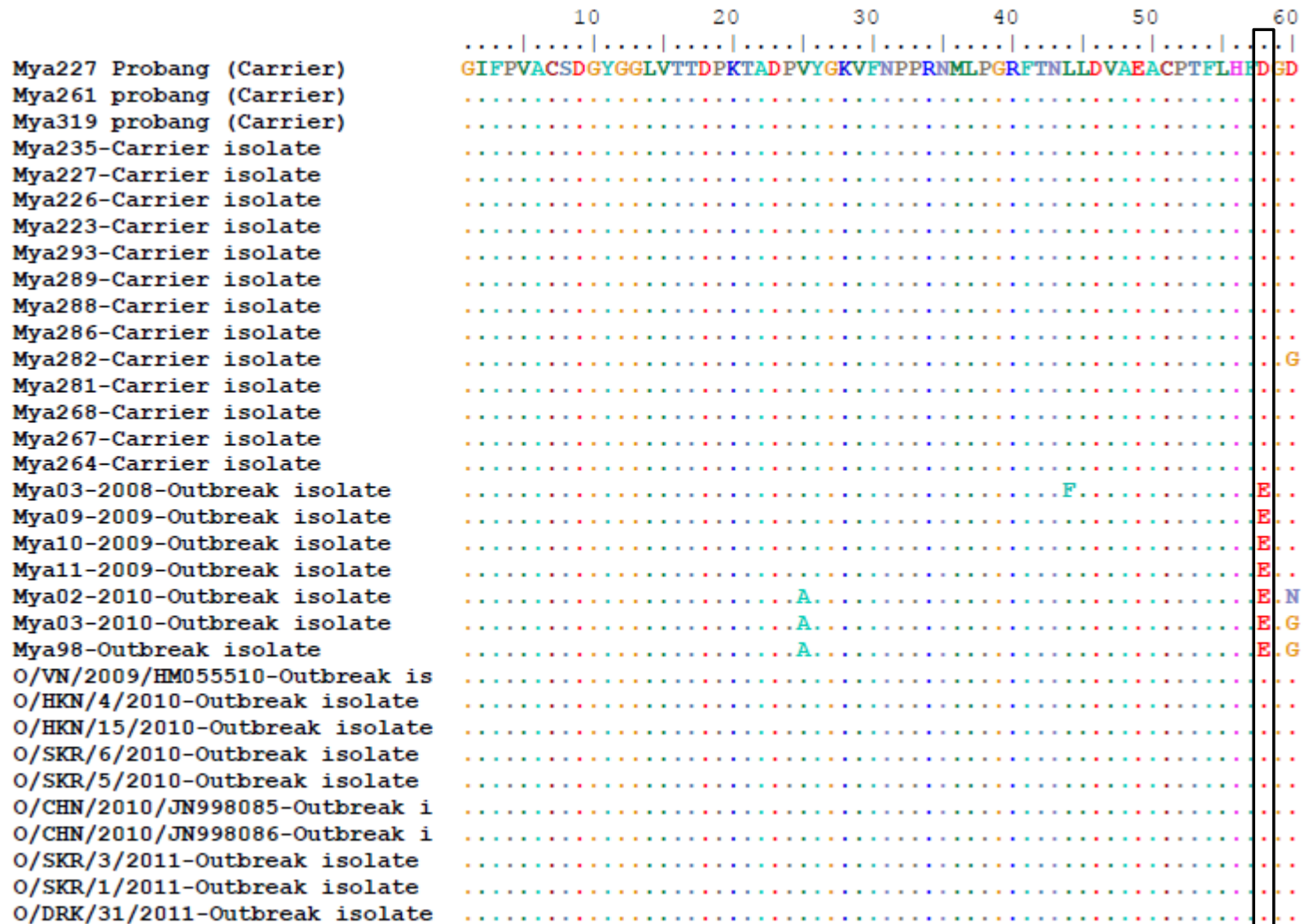


## Distribution of synonymous and non-synonymous nucleotide changes in the capsid gene of the carrier and outbreak isolates





## The isolates from carrier animals shows a consistent substitution of aspartic acid (D) at position 58 of VP3



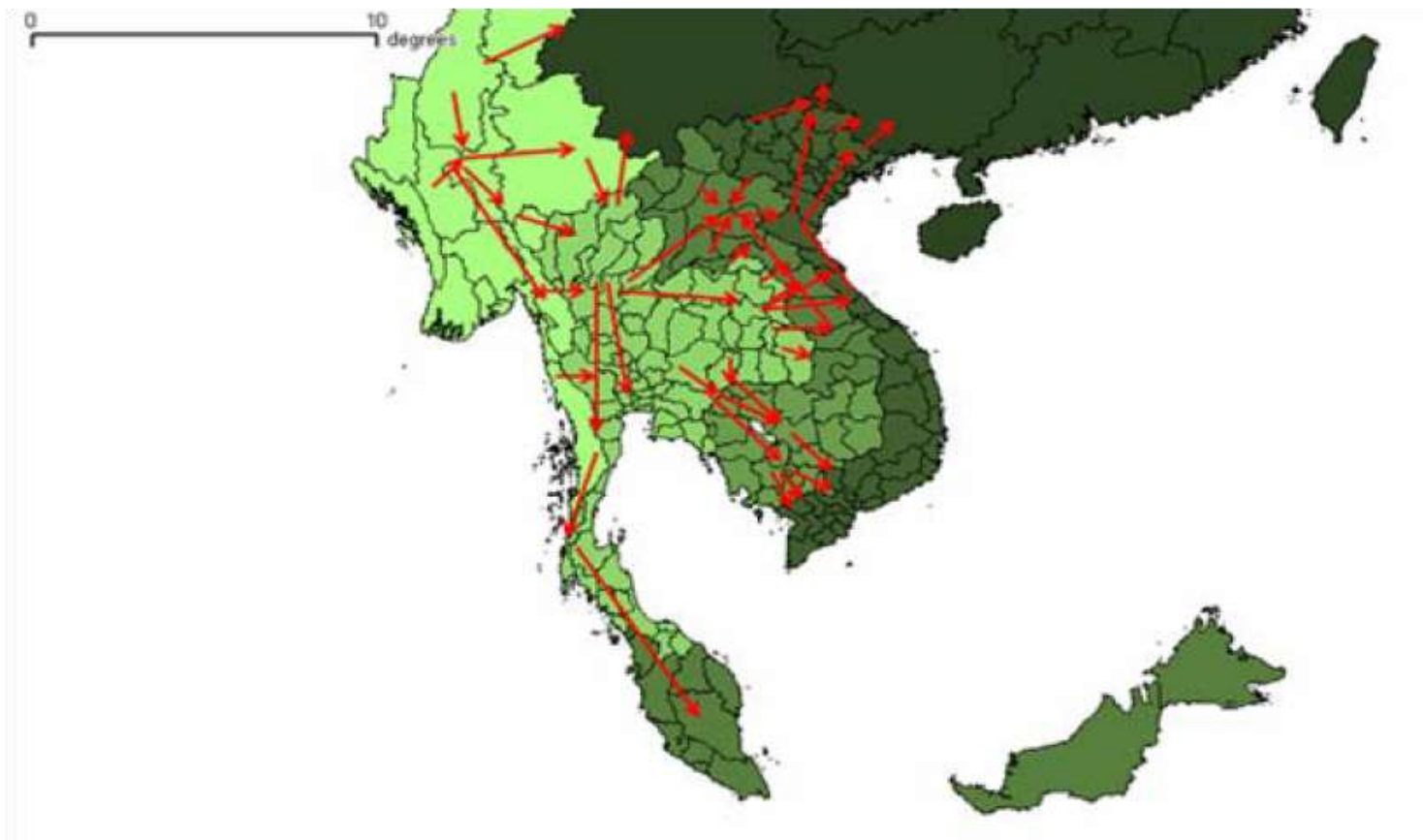


## The substitution of Y to H at VP2<sub>79</sub> is seen in both outbreak and carrier isolates





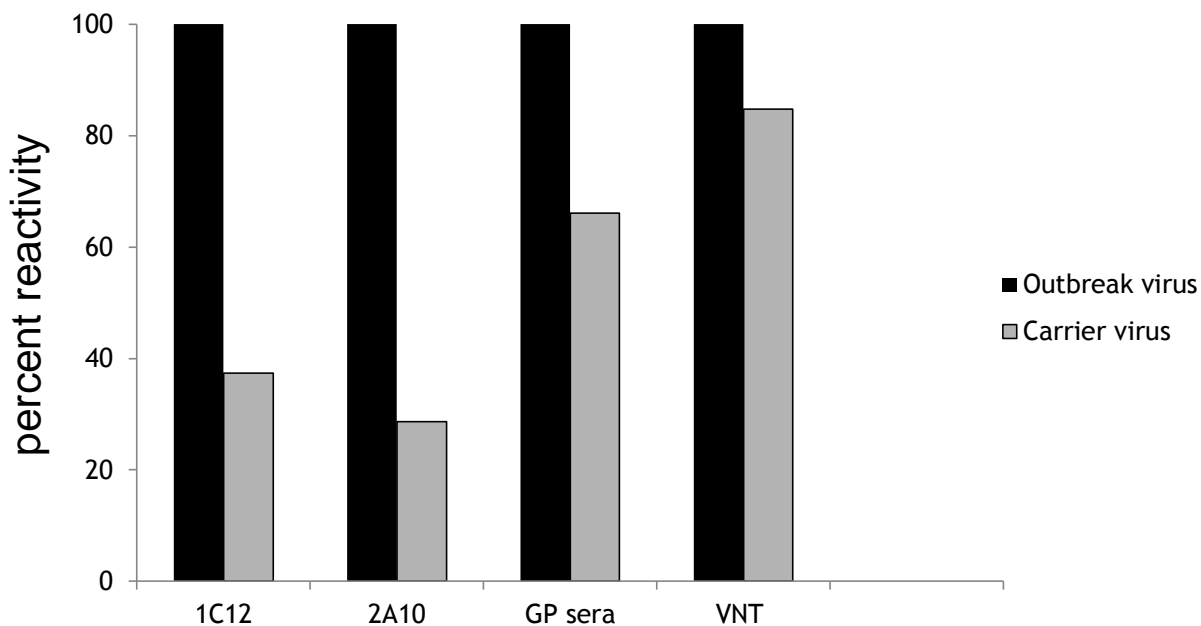
# Cross-border movement pathways of large ruminants in South-East Asia



Picture adapted from Cocks et. al., 2009 ,SEA OIE WEB



## Reduction in reactivity of serum and mAbs with the carrier isolates in ELISA and neutralization test





# Conclusions

- Carrier animals do not excrete viruses in natural mucosal secretions
- In stress/upon killing of carrier animals in field conditions there is chance of exposure of carrier virus that may cause new outbreaks
- Substitution of E to D at VP3 58 position in carrier viruses and subsequent outbreaks viruses suggest that SEA epidemics was initiated from carrier animals as it has not been seen as a spontaneous change in acute stage of infection in Myanmar 1998 or Myanmar 2009 outbreak viruses.
- As there is no consistent changes in carrier viruses except at position 58 of VP3 in Myanmar 98 virus and that change is not seen in carrier viruses analysed from ME-SA (O1 Manisa), viral determinants may not play as major role for causing persistence. May be host determinants are important for the cause of persistence?
- Phylogenetic analysis along with study on animal movement are robust tools for tracing the viruses in outbreaks
- As virus evolved, vaccine strain selection is important for control.



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