



**WORLDWIDE INFLUENZA CENTRE**  
**WHO CC for Reference & Research on Influenza**  
**THE FRANCIS CRICK INSTITUTE**  
**1 MIDLAND ROAD**  
**LONDON NW1 1AT**

**Report prepared for the WHO annual consultation on  
the composition of influenza vaccine for the Northern  
Hemisphere 2018-2019**

**19<sup>th</sup> – 21<sup>st</sup> February 2018**

**The Crick Worldwide Influenza Centre (WIC)  
WHO CC for Reference & Research on Influenza**  
**The Francis Crick Institute  
1Midland Road  
London, NW1 1AT**

**Dr. John McCauley (Director)**  
**Dr. Rodney Daniels (Deputy Director)**  
**Dr. Yi Pu Lin (Assistant Director)**  
Dr. Zheng Xiang  
Ms Victoria Gregory  
Ms Lynne Whittaker  
Ms Chandrika Halai  
Dr. Karen Cross  
Ms Aine Rattigan  
Ms Burcu Ermetal  
Ms Mian Dai  
Dr. Stephen Wharton  
Mr Michael Bennett

Tel (1): 020 3796 1520 (J McC)  
Tel (2): 020 3796 24444 (R D)  
Tel (3): 020 3796 0563 (WIC)

Email: [john.mccauley@crick.ac.uk](mailto:john.mccauley@crick.ac.uk); [rod.daniels@crick.ac.uk](mailto:rod.daniels@crick.ac.uk);  
[whocc@crick.ac.uk](mailto:whocc@crick.ac.uk)

### **Acknowledgements**

We thank all who have contributed information, clinical specimens and viruses, and associated data, to the WHO Global Influenza Surveillance and Response System (GISRS), which provide the basis for our current understanding of recently circulating influenza viruses, and this summary.

The epidemiological section of this report was prepared using data reported to the European Surveillance System (TESSy) and presented in Flu New Europe (<http://www.fluneweurope.org>) the joint ECDC-WHO Europe weekly influenza update, with the assistance of members of the Influenza and Other Respiratory Pathogens Group at the WHO European Office:

Dr. Piers Mook  
Dr. Dmitriy Pereyaslov  
Dr. Caroline Brown

## CONTENTS

	Page
<b>Influenza activity in WHO European Region .....</b>	<b>4</b>
<b>Influenza specimens received .....</b>	<b>11</b>
<b>Influenza A(H1N1) Viruses</b>	
<b>Summary.....</b>	<b>16</b>
<b>Antigenic characterisation .....</b>	<b>18</b>
<b>Genetic characterisation .....</b>	<b>28</b>
<b>Influenza A(H3N2) Viruses</b>	
<b>Summary.....</b>	<b>35</b>
<b>Antigenic characterisation .....</b>	<b>43</b>
<b>Genetic characterisation .....</b>	<b>56</b>
<b>Influenza B Viruses</b>	
<b>Summary.....</b>	<b>63</b>
<b>Influenza B Viruses (<i>Victoria-lineage</i>)</b>	
<b>Antigenic characterisation .....</b>	<b>67</b>
<b>Genetic characterisation .....</b>	<b>75</b>
<b>Influenza B Viruses (<i>Yamagata-lineage</i>)</b>	
<b>Antigenic characterisation .....</b>	<b>82</b>
<b>Genetic characterisation .....</b>	<b>90</b>
<b>Antiviral resistance testing.....</b>	<b>96</b>

**WHO Vaccine Recommendation Meeting for the Northern Hemisphere 2018-2019 influenza season.**

**WHO CC, London: Final Report for WHO meeting: 19 - 21 February 2018.**

**Influenza Activity in the WHO European Region, October 2017 – February 2018**

Weekly reporting to the European Surveillance System (TESSy) on influenza activity started in week 40/2017. The course of the 2017-2018 season, to week 05/2018, has been characterised by a later increase in levels of transmission compared to the 2016-2017 season, but earlier than the 2013-2014 to 2015-2016 seasons (**Figure E1-A**), with countries in the west of the Region typically reporting earlier activity than most of those in more eastern areas (**Figure E2**). Influenza B viruses have predominated, accounting for 66% of all sentinel detections, and the great majority (97%) of those ascribed to a lineage were B/Yamagata viruses.

The overall proportion of sentinel respiratory specimens from patients presenting with influenza-like illness (ILI) or acute respiratory infection (ARI) symptoms that tested positive for influenza virus exceeded 10% in week 48/2016 and has been increasing since, reaching 57% in week 05/2018, indicative of increased influenza activity in the WHO European Region. The increase in activity started slightly later than in the 2016/17 season (week 46) but earlier than in the 2013-2014 to 2015-2016 seasons (weeks 50 or 51) (**Figure E1-A**). Increasing trends in ILI and ARI were reported by at least one country in each sub-region by week 50/2017 except for central Asia (Week 04/2008) and each sub-region has experienced at least one week of high or very high intensity of influenza activity to date. However, there have been no sustained periods of high or very high intensity in western or central Asian parts of the region (**Figure E2**).

For the whole WHO European Region, over 98,000 influenza detections have been reported to TESSy - with type B detections (58%) predominating over type A (42%) (**Table E1**). This number of influenza detections is similar to that observed at the same time last season and both seasons started earlier than all other seasons since the 2009 pandemic. Among subtyped influenza A viruses, A(H3N2) (61%) detections have predominated among non-sentinel source specimens, while A(H1N1)pdm09 (63%) detections have predominated among sentinel source specimens (**Figure E1-B & C**). Of type B viruses ascribed to a lineage, regardless of specimen source, across the Region at least 97% were of the Yamagata lineage (**Table E1**). To date this season, influenza type B viruses have predominated in the majority of Member States (n=30/40) with dominance in a Member State being assigned when 60% or more of viruses detected in a week fall within a particular type when a weekly total of at least 10 viruses were detected. Among these, the Yamagata lineage was dominant in 22 Member States and the remainder reported co-dominance between the lineages (between 40% and 60%). Six member states had co-dominant influenza type A and type B viruses and four reported dominance of influenza type A viruses (all A(H3N2) subtype). Proportions of circulating viruses varied between subregions and individual countries within the WHO European Region (**Figures E2 & E3**).

Since week 40/2017, 12 Member States (Czech Republic, Denmark, Finland, France, Ireland, the Netherlands, Romania, the Russian Federation, Slovakia, Spain, Sweden and the United Kingdom) have reported a total of 9342 laboratory-confirmed hospitalised influenza cases (4102 cases from ICUs and 5240 from other hospital wards) with cases from ICU peaking over the new year period (**Figure E4-A**). Among cases admitted to

ICUs, influenza type A virus was detected in 55% and type B in 45%. Of subtyped influenza A viruses, 57% were A(H1N1)pdm09 viruses and 43% A(H3N2) viruses. Only 10 influenza B viruses from these cases were ascribed to a lineage and nine were B/Yamagata viruses. Among cases admitted to other wards, the majority were infected with influenza type B (65%) and no viruses from these cases were ascribed to a lineage. Of subtyped influenza A viruses, 69% were A(H3N2) and 31% A(H1N1)pdm09 viruses. The difference in distribution of virus types and subtypes between ICU and non-ICU wards might reflect differences in disease severity caused by the subtypes as a factor affecting admission to ICU or non-ICU wards. For hospitalised patients where age was reported, those aged 55 years and over accounted for the greatest number of cases admitted to ICUs and influenza B viruses were dominant in most age groups (**Figure E4-B**).

Since week 40/2017, 15 European countries, territories or areas (Albania, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kosovo\*, Kyrgyzstan, Montenegro, the Russian Federation, Serbia, Tajikistan, The former Yugoslav Republic of Moldova, Ukraine and Uzbekistan) with surveillance systems for severe acute respiratory infection (SARI) have reported a total of 19,679 cases. Of 5,709 cases tested for influenza virus, 598 (10%) were positive. Type B viruses (65%) predominated over type A (35%); of the influenza A viruses subtyped, the majority (64%) were A(H1N1)pdm09 and of the influenza B viruses ascribed to a lineage the great majority (93%) were B/Yamagata.

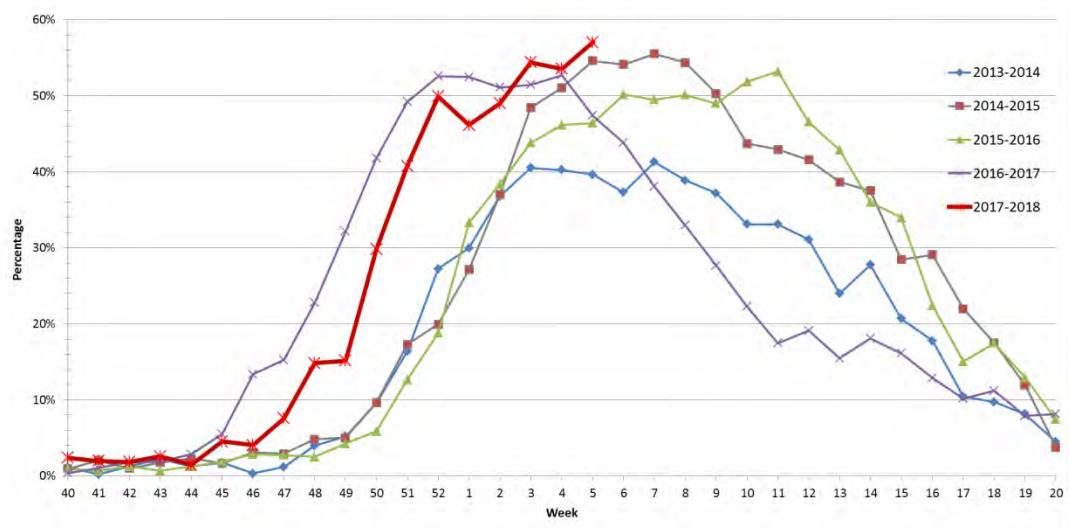
Neuraminidase inhibitor susceptibility has been assessed for 925 viruses to date this season; 483 type B, 254 A(H3N2), and 188 A(H1N1)pdm09 with collection dates since week 40/2017. One A(H3N2) virus showed evidence of reduced inhibition by both oseltamivir and zanamivir, one A(H1N1)pdm09 showed evidence of reduced inhibition by oseltamivir and two type B virus showed evidence of reduced inhibition by zanamivir.

Data reported from the 18 Member States (Belgium, Denmark, Estonia, Finland, France, Germany (Berlin), Greece, Hungary, Ireland, Italy, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom (England, Northern Ireland, Scotland and Wales)) participating in the European project for monitoring excess mortality for public health action (EuroMOMO – <http://www.euromomo.eu>) indicated that there has been significantly increased all-cause excess mortality among the elderly aged 65 years and older in recent weeks in Europe.

\*in accordance with. United Nations Security Council. Resolution 1244 (1999).

**Figure E1. Influenza Activity in the WHO European Region 2017-2018 (weeks 40/2017–05/2018)**

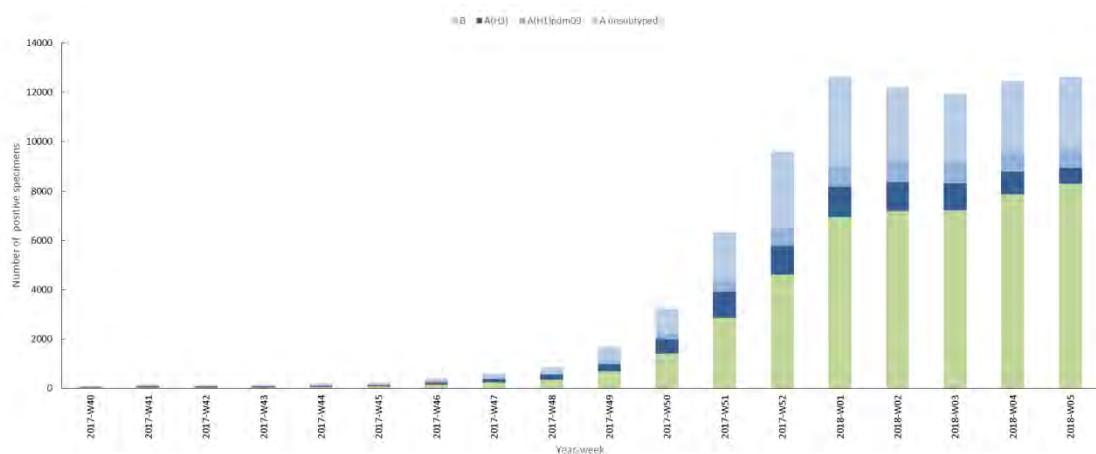
**A. Percentage of sentinel ILI/ARI specimens testing positive for influenza by season**



**B. Sentinel Influenza Detections 2017-2018 season**



**C. Non-sentinel Influenza Detections 2017-2018 season**



Source: European Centre for Disease Prevention and Control/WHO Regional Office for Europe. Flu News Europe, Joint ECDC–WHO/Europe weekly influenza update

**Figure E2. Development of the 2017-2018 Influenza Season in the WHO European Region**

**Intensity of Influenza Activity and Dominant Virus (sub)type**

C, T or A <sup>a</sup>	Week	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ireland	-	-	-	-	-	-	-	-	-	-	B/AH3	B/AH3	B/AH3	B/AH3	B/AH3	B/AH3	B/AH3	B/AH3	B/AH3
Portugal	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	A/B	A/B	
Spain	-	-	-	B	B	B	B	B	B	B	B	B	B	B	B	B	B/AH3	B/AH3	
United Kingdom (Northern Ireland)	A/B	A/B	A	AH3	A	-	AH3	A	B/AH3	A	A	AH3	A	B/AH3	A	B/AH3	B/AH3	B/AH3	
United Kingdom (Wales)	-	B/AH3	B/AH3	-	AH3	AH3	-	B/AH3	B/AH3	B/AH1H3	B/AH1H3	B/AH1H3	B/AH1H3	B/AH1H3	B/AH3	B/AH3	B/AH3	B/AH3	
United Kingdom (Scotland)	A	A	A/B	-	A	A/B	A	AH3	AH3	AH3	AH3	AH3	A	A	A	A	A/B	A/B	
United Kingdom (England)	-	A	-	A	A	A	-	A	A	A	A/B	B	A/B	A/B	B	B	B	A/B	
France	-	-	-	-	-	-	-	A	A	A	AH1	AH1	AH1	AH1	AH1	A/B	AH1	B	
Belgium	-	-	-	-	-	-	-	-	-	-	-	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	-	
Netherlands	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B	B	B	
Luxembourg	-	-	-	-	-	-	-	-	-	B	AH1	AH1	B/AH1	AH1	B/AH1	B/AH1	B/AH1	B/AH1	
Switzerland	-	A	A/B	-	-	A	A/B	A/B	A/B	B	B	B	B	B	B	B	B	B	
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Denmark	-	-	-	-	-	-	-	-	-	A/B	B	B	B	B	B	B	B	B	
Norway	AH3	B/AH3	AH3	AH3	AH3	AH3	AH3	AH3	B/AH3	B/AH3	B/AH3	B/AH3	B/AH3	B	B	B	B	B	
Italy	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B/AH1	
Austria	-	-	-	-	-	-	-	-	-	A/B	B	B	B	B	B	B	B	B	
Malta	-	AH3	AH3	AH3	B/AH3	B	-	B	B	B	B	B	B	B	B	B	B	-	
Slovenia	-	-	-	-	-	-	-	-	-	-	A	A	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	B	
Sweden	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B	
Croatia	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	-	B	-	
Czech Republic	-	-	-	-	-	-	-	-	-	-	-	-	B	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	
Bosnia and Herzegovina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Slovakia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Albania	-	-	-	-	-	-	-	-	-	-	-	-	-	B/AH1	B/AH1	-	-	-	
Hungary	-	-	-	-	-	-	-	B	-	B	-	B	B	B	B	B	B	B	
Poland	-	-	-	-	A	-	A	B	-	B/AH3	B	B	B	B	B	B	B	B	
Montenegro	-	-	-	-	-	-	-	-	-	B	-	A	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	-	
Serbia	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B	
Kosovo <sup>b</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-	A/B	A/B	A/B	A/B	A/B	
The former Yugoslav Republic of Macedonia	-	-	-	-	-	-	-	-	-	-	-	-	-	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	
Greece	-	-	-	-	-	-	-	-	-	-	-	-	-	B/AH1	-	B	B	B	
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	
Bulgaria	-	-	-	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	
Latvia	-	-	-	-	-	-	-	-	-	-	A	-	B	B	B	B	B	A/B	
Romania	-	-	-	-	-	-	-	-	-	-	B	-	A	B	B	B	B	B	
Estonia	-	-	-	-	-	-	-	A	B	B	A/B	B	B	B	AH1H3	B	B	B	
Finland	-	-	-	-	-	B	B	B/AH3	B/AH3	B	B/AH3	B/AH3	B	B	B/AH3	B/AH3	B/AH3	B	
Belarus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Republic of Moldova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	
Ukraine	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B	
Cyprus	-	-	-	-	-	-	-	-	A	A	A	A	A	AH1	A/B	A/B	A/B	-	
Israel	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	B	
Turkey	-	-	-	-	-	-	AH1	AH1	AH1	AH1	AH1	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	B/AH1	-	
Georgia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Armenia	-	-	-	-	-	-	-	B	B	B	B	-	-	B	B	B	B	B	
Azerbaijan	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	-	-	B	
Turkmenistan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Uzbekistan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AH1	AH1	B	-	
Kazakhstan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Russian Federation	-	-	-	-	-	-	-	-	-	-	-	AH3	-	AH3	AH3	A	A	A	
Tajikistan	A	A/B	A	A/B	-	-	-	-	A	A	B	-	A/B	B	-	-	-	-	
Kyrgyzstan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

WEST

EAST



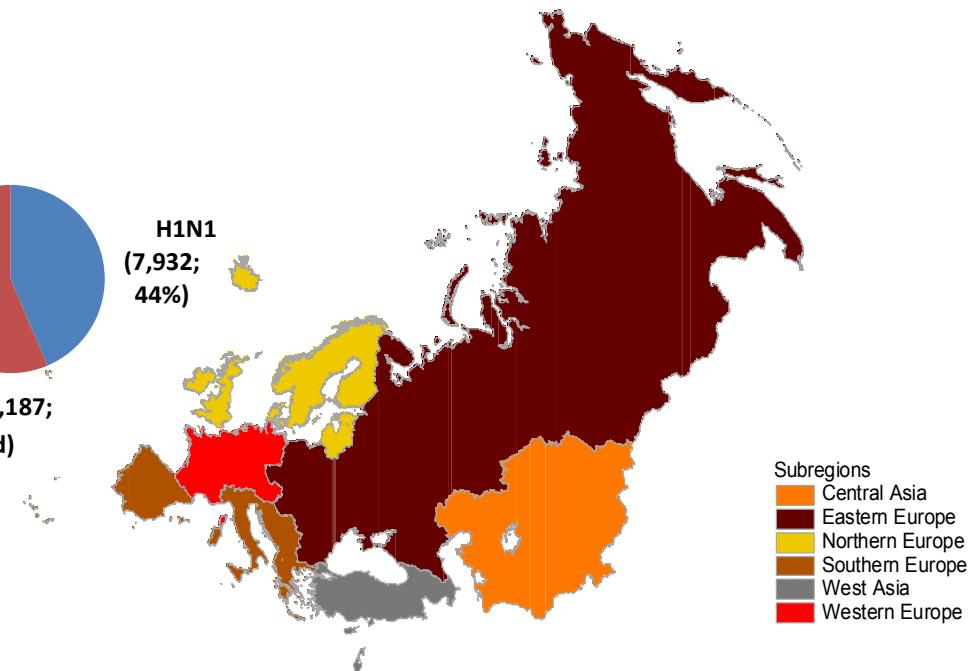
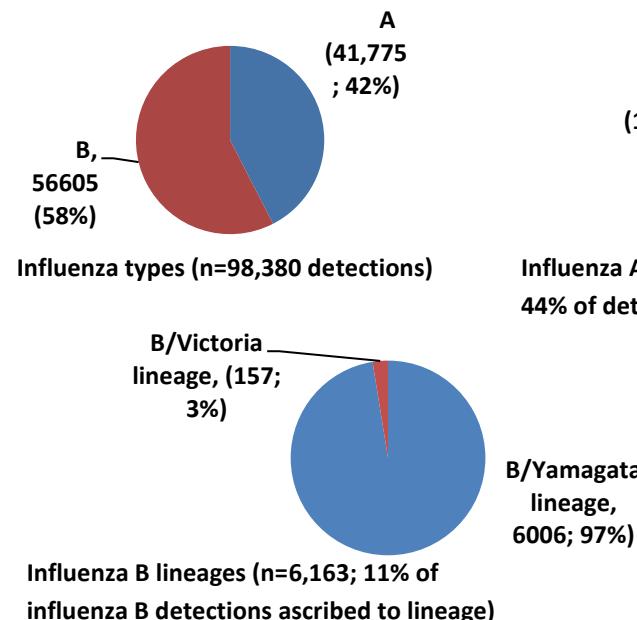
\* Baseline influenza activity is the level at which clinical influenza activity remains throughout the summer and most of the winter.

<sup>a</sup> Country, territory or area

<sup>b</sup> in accordance with United Nations Security Council. Resolution 1244 (1999).

**Table E1. Distribution of Influenza Detections in the WHO European Region<sup>1</sup>: 2017-2018 Season (weeks 40/2017-05/2018)**

Proportions of Influenza Types/Subtypes/Lineages based  
on combined sentinel and non-sentinel detections

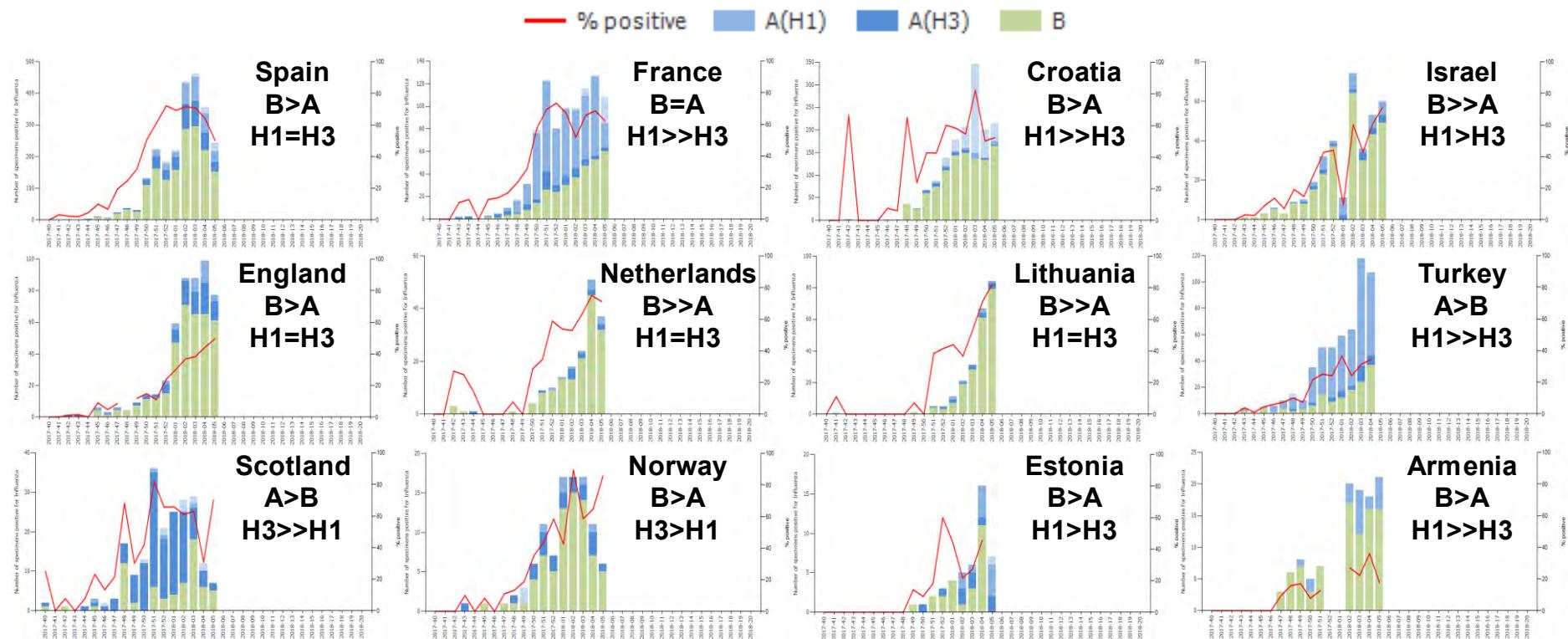


Influenza Detections*	Southern Europe		Western Europe		Eastern Europe		Northern Europe		West Asia		Central Asia		WHO European Region	
<b>Influenza A</b>	<b>6307</b> <b>35%</b>		<b>11189</b> <b>49%</b>		<b>847</b> <b>37%</b>		<b>22208</b> <b>42%</b>		<b>1125</b> <b>51%</b>		<b>99</b> <b>59%</b>		<b>41775</b> <b>42%</b>	
Influenza A subtyped	4370		3435		613		8628		1047		94		18187	
<i>A (H1N1)pdm09</i>	2514		2839		291		1311		941		36		7932	
<i>A (H3N2)</i>	1856		596		322		7317		106		58		10255	
<b>Influenza B</b>	<b>11738</b> <b>65%</b>		<b>11441</b> <b>51%</b>		<b>1424</b> <b>63%</b>		<b>30838</b> <b>58%</b>		<b>1094</b> <b>49%</b>		<b>70</b> <b>41%</b>		<b>56605</b> <b>58%</b>	
B lineage determined	1744		1864		572		1835		132		16		6163	
<i>B/Yamagata lineage</i>	1694		1839		549		1777		132		15		6006	
<i>B/Victoria lineage</i>	50		25		23		58		0		1		157	
<b>Total</b>	<b>18045</b>		<b>22630</b>		<b>2271</b>		<b>53046</b>		<b>2219</b>		<b>169</b>		<b>98380</b>	

\*combined ILI, ARI sentinel and non-sentinel respiratory specimens positive for influenza

<sup>1</sup> WHO European Region Member States grouped into sub-regions according to United Nations geographic composition. Available from: <http://unstats.un.org/UNSD/METHODS/M49/M49REGIN.HTM>

**Figure E3. Patterns of Influenza Type and Subtype Circulation in the WHO European Region (Sentinel Surveillance)**

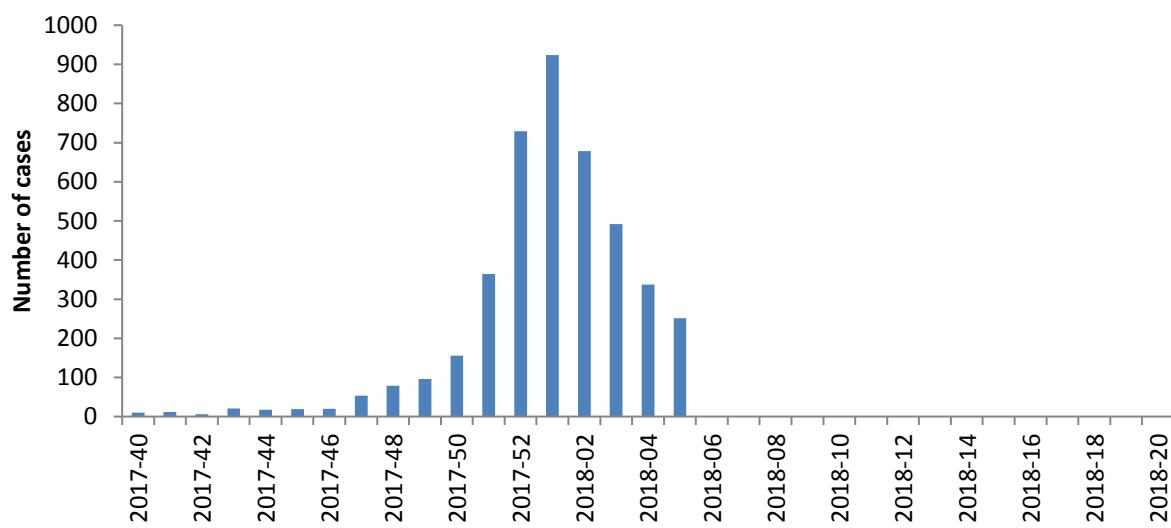


= represents similar ratio; > represents a ratio of at least 1.5:1 but less than 5:1; >> represents a ratio of ≥5:1

Source: European Centre for Disease Prevention and Control/WHO Regional Office for Europe. Flu News Europe, Joint ECDC–WHO/Europe weekly influenza update

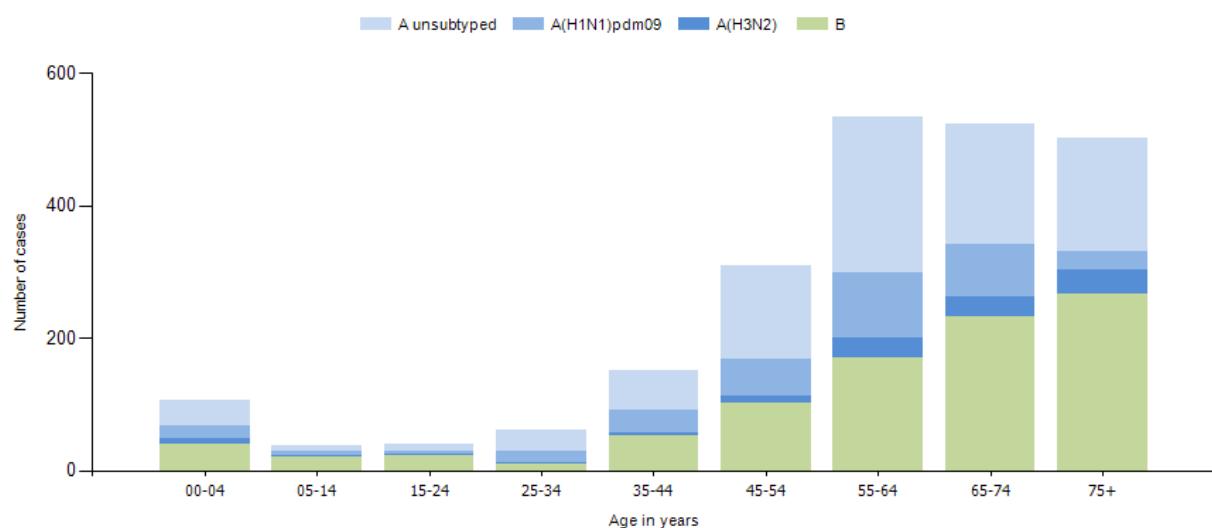
**Figure E4. Hospitalized influenza cases**

**A. Laboratory-confirmed cases admitted to ICU by week\***



\* Czech Republic, Denmark, Finland, France, Ireland, the Netherlands, Romania, the Russian Federation, Slovakia, Spain, Sweden and the United Kingdom

**B. Distribution of virus (sub)type by age group in laboratory-confirmed hospitalized cases (ICU)\***



\* Czech Republic, Denmark, Finland, France, Ireland, the Netherlands, Romania, the Russian Federation, Slovakia, Spain, Sweden and the United Kingdom

Source: European Centre for Disease Prevention and Control/WHO Regional Office for Europe. Flu News Europe, Joint ECDC–WHO/Europe weekly influenza update

## Influenza specimens received at the Francis Crick Institute.

Since 2017-09-01 a total of 93 packages have been received from 66 countries in Europe, Africa, the Middle East, the Indian Ocean, Central Asia, South America and the Far East. The packages contained 1269 seasonal influenza-positive clinical specimens (CS) and 982 virus isolates (V), with 286 being CS/V pairs. Of these samples, 1685 had collection dates after 2017-08-31 and approximately 57% were type A viruses, with influenza A(H1N1)pdm09 viruses outnumbering A(H3N2) viruses at a ratio of ~1.7:1 (**Table 1**). Of the type B viruses, viruses of the B/Yamagata lineage predominated over those of the B/Victoria lineage at a ratio of ~6:1.

**Table 2** shows the recovery/isolation rates from samples received with collection dates after 2017-08-31. Viruses were recovered efficiently with recoveries of between 67% and 88% from samples sent as clinical specimens, depending on virus subtype or lineage, and of  $\geq 95\%$  for samples sent as virus isolates, irrespective of subtype or virus lineage. For A(H3N2) viruses, efficient recovery was obtained as assessed by detection of virus neuraminidase activity using the MUNANA sialidase assay, but only a minority (approximately 25%) of these could be assessed by HI assay as the majority of viruses had low HA titres (<4 HA units in the presence of 20nM oseltamivir).

**Table 3** summarises the reactivity of A(H1N1)pdm09, A(H3N2) and viruses of the B/Victoria and B/Yamagata lineages with post-infection ferret antisera raised against vaccine viruses or reference viruses in HI assays. For A(H3N2) viruses, the reactivity of test viruses in plaque reduction neutralisation assays (PRNA) is also summarised. Numbers and percentages of viruses showing  $\leq 2$ -, 4- and  $\geq 8$ -fold reductions in titres relative to the titres of the antisera with their respective homologous reference/vaccine viruses are shown. For A(H1N1)pdm09 test viruses the HI titres of an antiserum raised against the vaccine virus, egg-propagated A/Michigan/45/2015, were compared to the homologous titre (that with the vaccine virus). For A(H3N2) test viruses the HI titres of antisera raised against egg-propagated A/Hong Kong/4801/2014, egg-propagated A/Singapore/INFIMH-16-0019/2016 and tissue culture-propagated A/Hong Kong/4801/2014 were compared to the titres of the antisera with their homologous viruses. For the A(H3N2) test viruses assessed by PRNA the 50% neutralising titres of antisera raised against egg-propagated A/Hong Kong/4801/2014, egg-propagated A/Singapore/INFIMH-16-0019/2016 and tissue culture-propagated A/Hong Kong/7295/2014 (A/Hong Kong/4801/2014-like) were compared to the titres of the antisera with their homologous viruses. For Influenza B viruses of the B/Victoria lineage the HI titres of test viruses with antisera raised against at least one of three tissue culture-propagated B/Brisbane/60/2008-like equivalents (B/Hong Kong/514/2009, B/Ireland/3154/2016 and B/Nordrhein-Westfalen/1/2016) were compared to the titres of the antisera with their homologous viruses. For Influenza B viruses of the B/Yamagata lineage the HI titres of test viruses with an antiserum raised against the egg-propagated vaccine virus, B/Phuket/3073/2013, were compared to the titre of the antiserum with the homologous virus.

**Table 1. Summary of clinical samples and virus isolates received, with collection dates after 2017-08-31, by country\***

MONTH Country		A		H1N1pdm09		H3N2		B		B Victoria lineage		B Yamagata lineage	
		Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>2</sup>	Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>1</sup>
<b>2017</b>													
<b>SEPTEMBER</b>													
Argentina	9												
Cameroon	46			27	in process	19	in process			3	3	6	in process
Egypt	3			3	3								
Finland	2					2	0	2					
France	4			2	in process								
Gambia	7												
Germany	1												
Ghana	1												
Iran	4												
Jordan	2			1	in process	1	in process			1	1	1	1
Mauritius	2											2	2
Netherlands	1												
Norway	2											1	1
Oman	1			1	1								
Palestine	4			1	0							2	1
Qatar	4					4	0	3					
Russia	1			1	1								
Senegal	5										5	5	
Spain	1			1	1								
Sweden	1					1	0	1					
United Kingdom	2					1	0	1	0	1	1		
Zambia	5			1	in process	3	0	0					
<b>OCTOBER</b>													
Argentina	5												
Belgium	1			1	in process								
Cameroon	27			20	in process	7	in process						
Croatia	2					2	0	2					
Denmark	2					2	in process						
Finland	1					1	0	1					
France	12			4	4	7	in process						
Gambia	10			1	in process	1	in process			5	in process	2	in process
Ghana	4			3	3	1	0	1					
Hong Kong	1					1	0	1				1	1
Iran	1					1	0	1					
Ireland	4			2	in process	1	in process						
Israel	1					1	in process						
Jordan	1					1	in process						
Madagascar	5					1	in process						
Mayotte	3					1	in process						
Netherlands	3					1	in process					2	in process
Norway	21			3	2	15	in process					3	in process
Oman	13			13	11								
Palestine	1			1	1								
Qatar	22			6	5	6	0	5		3	0	1	1
Reunion	1			1	in process	6	in process					6	6
Senegal	8					1	0	1					
Slovakia	1					1	0	1					
Slovenia	1					1	1	0					
Spain	7			1	1	5	0	5				1	in process
Sweden	3					3	2	1					
Switzerland	1					1	1	0					
Tajikistan	16			3	in process	7	in process			6	in process		
Turkey	5			2	in process	2	0	2		1	in process	2	in process
United Kingdom	7			2	2	3	0	3		1	1	1	1
<b>NOVEMBER</b>													
Algeria	1												
Argentina	2			1	in process								
Armenia	5					2	0	2					
Austria	3			1	0					1	in process		
Belgium	1											1	in process
Bosnia & Herzegovina	10								10	0			
Croatia	4					1	in process					4	4
Denmark	2					1	in process					1	in process
Estonia	1					1	in process						
Finland	7			7	in process	10	in process			1	in process	1	1
France	23			2	2	2	0	2				2	2
Gambia	3			9	in process	1	0	1				3	2
Germany	6					1	0	1				2	2
Ghana	13					1	0	1				6	6
Greece	2											1	in process
Hong Kong	1												
Hungary	1												
Iran	5			1	1	4	0	4					
Ireland	5			1	in process	2	0	2					
Israel	11			3	in process	1	in process			1	in process		
Italy	1					5	in process						
Jordan	5												
Kazakhstan	3					1	1	0		2	in process		
Latvia	2					1	1	0		1	in process		
Madagascar	5					3	in process						
Mayotte	3					3	3						
Netherlands	3					1	in process	2	in process				
Norway	24			3	3	10	in process			2	in process	9	in process
Oman	15			15	13							1	1
Palestine	2			1	1								
Portugal	4					1	0	1		1	1	2	in process
Russia	6			1	in process	5	in process					1	in process
Senegal	4			2	2					1	1	1	in process
Slovakia	1			1	1							1	1
Slovenia	1												
Spain	30			1	in process	9	in process			7	in process	5	in process
Sweden	7					5	1	4				2	2
Switzerland	4					1	0	1				3	in process
Tajikistan	3			1	0	1	0	0		1	0		
Turkey	19			13	in process					6	in process		
Ukraine	8					3	0	3		1	1	1	1
United Kingdom	5					1	0	1					
Zambia	1												

MONTH Country		A		H1N1pdm09		H3N2		B		B Victoria lineage		B Yamagata lineage	
		Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>2</sup>	Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>1</sup>	Number received	Number propagated <sup>1</sup>
<b>DECEMBER</b>													
Albania	2			1	in process							1	in process
Algeria	8			6	in process							1	1
Argentina	1											6	in process
Armenia	10			2	in process							6	6
Austria	37			18	in process	7	0	7	6			5	0
Azerbaijan	5											11	in process
Belgium	19			7	in process	1	0	1				1	1
Bosnia & Herzegovina	3			2	in process				2			1	in process
Bulgaria	3					3	1	2				1	in process
Croatia	6			3	3								
Cyprus	3	3	In process									1	1
Czech Republic	1					9	in process					8	in process
Denmark	17					2	in process					1	in process
Estonia	5	2	In process			1	0	1					
Finland	1											12	in process
France	36			12	in process	11	in process					7	7
Germany	17			5	5	5	0	5					
Ghana	10			10	in process							6	6
Greece	2			1	in process	1	0	1				10	10
Hong Kong	28			6	6	6	in process					5	in process
Hungary	6			1	1							7	in process
Iceland	15			1	1	8	in process					8	in process
Ireland	13			1	in process	5	in process					9	in process
Israel	50	1	In process	12	in process	9	in process						
Italy	25			12	in process	2	in process						
Jordan	59			56	in process								
Kazakhstan	13					3	in process						
Latvia	2			2	2							2	in process
Lebanon	6	1	0	3	in process							4	in process
Lithuania	8			3	in process							1	in process
Macedonia	1					17	in process						
Madagascar	23						1	in process					
Malta	1											1	in process
Moldova	1						1	0				1	1
Montenegro	2						1	in process				14	in process
Netherlands	16			1	in process	1	in process					13	in process
Norway	35			5	in process	15	in process						
Poland	9	1	0	2	2				4	in process	2	2	
Portugal	30			2	2	3	0	3			6	6	
Romania	9			4	in process	2	in process		2	in process		19	in process
Russia	2					1	1	0				1	1
Serbia	4								1	in process		3	in process
Slovakia	5											5	in process
Slovenia	12			4	4	3	1	2			3	2	
Spain	52			18	in process	8	0	3	5	in process	6	6	
Switzerland	42			10	in process	3	in process					29	in process
Tajikistan	2			1	0	1	0	0					
Tunisia	13			9	in process	2	in process		2	in process		1	in process
Turkey	47			35	in process	3	in process				16	in process	8
Ukraine	19										3	3	
United Kingdom	6											6	in process
<b>2018</b>													
<b>JANUARY</b>													
Albania	10			5	in process							5	in process
Algeria	11			7	in process	3	in process		1	in process			
Armenia	3			3	in process							8	in process
Belgium	25			12	in process	5	in process		5	in process		6	in process
Bosnia & Herzegovina	7			1	in process	1	in process						
Bulgaria	10			3	2	1	0	0					
Cyprus	8	4	In process						4	in process			
Czech Republic	1			1	1							4	in process
Denmark	4					3	In process	2	0	1		5	in process
Estonia	14	3	In process	2	2	1	0	1	1	in process			
France	4			2	2							1	1
Georgia	3					8	in process	2	in process			3	in process
Greece	21											11	in process
Hungary	7	1	In process	2	2							4	in process
Iceland	6			1	in process	2	2	0	1	in process		3	3
Ireland	13			1	in process	4	in process						
Israel	10			1	1	2	0	2	5	0		2	2
Italy	12			4	in process	2	0	2	4	in process		2	2
Jordan	17			16	in process				1	in process			
Kazakhstan	4					2	in process	1				7	in process
Kyrgyzstan	10					2	in process					3	in process
Lebanon	5					2	in process					9	in process
Lithuania	16						3	in process				7	in process
Macedonia	11						4	in process					
Malta	39						3	in process					
Moldova	5						3	in process					
Montenegro	6						3	in process					
Netherlands	7						1	1					
Norway	15			5	in process	6	in process						
Poland	1											4	in process
Portugal	6											5	in process
Romania	9			3	in process				5	in process		1	1
Russia	2			1	1	1	0	1					
Serbia	4			1	in process				2	in process		1	1
Slovakia	1			1	1								
Slovenia	19			7	in process	2	0	2				7	in process
Spain	5			3	in process	2	in process						
Switzerland	12			3	in process	1	in process					1	in process
Tunisia	7			7	in process							7	in process
Turkey	6			3	in process	3	1	2					
Ukraine	7												
	1685	30	0	576	100	349	14	92	214	0	73	52	443 73
<b>66 Countries</b>													
							34.2%	20.7%				4.3%	26.3%
							56.7%					43.3%	

1. Propagated to sufficient titre to perform HI assay (the totalled number does not include any from batches that are in process)

2. Propagated to sufficient titre to perform HI assay in the presence of 20μM oseltamivir (the totalled number does not include any from batches that are in process)

Numbers in red indicate viruses recovered but with insufficient HA titre to permit HI assay

\* As of 2018-02-09

**Table 2. Isolation rates for specimens collected after 2017-08-31**

	Clinical sample			Virus isolate		
	Number processed	Number propagated <sup>1</sup>	Percent recovered	Number processed	Number propagated <sup>1</sup>	Percent recovered
H1	55	37	67%	125	121	97%
H3	65	2 <sup>2</sup> 52 <sup>3</sup>	1% 83% (4%) <sup>4</sup> 80%	112	28 <sup>2</sup> 82 <sup>3</sup>	25% 98% (34%) <sup>4</sup> 73%
B Victoria	16	14	88%	46	44	96%
B Yamagata	47	32	68%	107	102	95%

1. Propagated to sufficient HA titre to perform HI assay

2. Propagated to sufficient HA titre in the presence of 20nM oseltamivir to allow HI assay

3. Viruses recovered (NA activity by MUNANA-based assay) but with insufficient HA titre to allow HI assay

4. The percentages for viruses recovered that could be assayed by HI are shown in parentheses

**Table 3. Summary of isolates with collection dates after 2017-08-31 showing reduction in reactivity with antisera raised against**

Virus type/subtype	Number tested	≤2-fold <sup>a</sup>	4-fold <sup>a</sup>	≥8-fold <sup>a</sup>
H1 <sup>1</sup>	158	157 (99.4%)	1 (0.6%)	0 (0%)
H3 <sup>2a</sup>	30	25 (83.3%)	5 (16.7%)	0 (0%)
H3 <sup>2b</sup>	30	0 (0%)	0 (0%)	30 (100%)
H3 <sup>2c</sup>	30	5 (16.7%)	14 (46.7%)	11 (36.6%)
H3 <sup>3a</sup>	100	63 (63.0%)	25 (25.0%)	12 (12.0%)
H3 <sup>3b</sup>	100	11 (11.0%)	29 (29.0%)	60 (60.0%)
H3 <sup>3c</sup>	100	2 (2.0%)	15 (15.0%)	83 (83.0%)
B/Victoria <sup>4</sup>	58	27 (46.6%)	2 (3.4%)	29 (50%)
B/Yamagata <sup>5</sup>	134	84 (62.7%)	31 (23.1%)	19 (14.2%)

a. Reduction in titre, compared to the homologous titre with post-infection ferret antisera indicated below:

1. Compared to homologous titres for ferret antiserum raised against vaccine virus A/Michigan/45/2015
- 2a. Compared to homologous titres for ferret antiserum raised against tissue culture-propagated A/Hong Kong/5738/2014 (genetic subgroup 3C.2a)
- 2b. Compared to homologous titres for ferret antiserum raised against egg-propagated A/Hong Kong/4801/2014 (genetic subgroup 3C.2a [NYK])
- 2c. Compared to homologous titres for ferret antiserum raised against egg-propagated A/Singapore/INFIMH-16-0019/2016 (genetic subgroup 3C.2a1)
  - 3a. Compared to homologous titres for ferret antiserum raised against tissue culture-propagated A/Hong Kong/7295/2014 (genetic subgroup 3C.2a) in plaque-reduction neutralisation assays
  - 3b. Compared to homologous titres for ferret antiserum raised against egg-propagated A/Hong Kong/4801/2014 (genetic subgroup 3C.2a [NYK]) in plaque-reduction neutralisation assays
  - 3c. Compared to homologous titres for ferret antiserum raised against egg-propagated A/Singapore/INFIMH-16-0019/2016 (genetic subgroup 3C.2a1) in plaque-reduction neutralisation assays
4. Compared to homologous titres for ferret antisera raised against at least one of three tissue-culture propagated B/Brisbane/60/2008-like equivalents (B/Hong Kong/514/2009, B/Ireland/3154/2016 & B/Perth/16/2009)
5. Compared to homologous titres for ferret antiserum raised against egg-propagated vaccine virus B/Phuket/3073/2013

## Influenza A(H1N1)pdm09 virus analyses.

Influenza A(H1N1)pdm09 viruses have been received from NICs in 39 countries or administrative regions in four WHO Regions: African (2: Ghana and Senegal), Eastern Mediterranean (6: Egypt, Iran, Lebanon, Oman, Palestine and Qatar), European (30 countries or overseas territories) and Western Pacific (1: Hong Kong SAR). **Table 4** summarises the antigenic (HI) results for viruses, recovered from clinical specimens with collection dates after 2017-08-31, that were propagated successfully at the Francis Crick Institute. The vast majority (>99%) were antigenically indistinguishable from the egg-propagated vaccine virus, A/Michigan/45/2015. A single virus known to be collected since 2017-08-31, A/Bretagne/002/2018, was recognised at a titre 4-fold lower than the titre of the antiserum raised against A/Michigan/45/2015 with the homologous virus; all other test viruses were recognised at titres within 2-fold of the homologous titre.

**Tables 5-1 to 5-11** show the results of HI assays of H1N1 viruses carried out since our September 2017 report. Test viruses in each table are sorted by date of collection and viruses with collection dates after 2017-08-31 are shown below red lines in **Tables 5-3 to 5-11**. The collection dates for four viruses in **Table 5-9** are not known. A full summary of the HI results for viruses with collection dates after 2017-08-31 is shown in **Table 5-12**.

Antisera raised against A/California/7/2009, A/Bayern/69/2009, A/Astrakhan/1/2011, A/St Petersburg/27/2011, A/St Petersburg/100/2011, A/Hong Kong/5659/2012, A/South Africa/3626/2013, A/Slovenia/2903/2015, A/Paris/ 1447/2017 and A/Israel/Q-504/2015 (a virus in clade 6B.2) recognised 94% or more of the test viruses with known collection dates after 2017-08-31 at titres within 2-fold of the titres of the antisera with their homologous viruses (**Table 5-12**). The antiserum raised against A/Lviv/N6/2009 recognised only ~53% of test viruses at titres within 2-fold of the titre of the antiserum with the homologous virus but 94% of the test viruses were recognised at titres within 4-fold of the homologous titre. A/Lviv/N6/2009 is an unusual virus/antiserum combination with A/Lviv/N6/2009 encoding HA1 amino acid substitutions of G155G/E, with E predominating, and D225G. One virus with an unknown collection date (A/Oman/5532/2017) was poorly recognised by the panel of antisera, with the exception of the antisera raised against A/Bayern/69/2009 and A/Lviv/N6/2009, and carried HA1 G155E amino acid substitution.

All test viruses for which the genetic group or subgroup were known, with collection dates after 2017-08-31, fell into clade 6B.1. **Figure 1** shows a phylogenetic tree for the HA genes of representative H1N1 viruses. The predominant genetic group is clade 6B.1 which is defined by the substitutions **S84N**, **S162N (+CHO)** and **I216T** in **HA1**. Within this subgroup the majority of viruses cluster into a genetic subgroup defined by the **HA1** amino acid substitutions **S74R**, **S164T** (which alters the glycosylation motif at residues **162 to 164**) and **I295V**. Other clusters within this subgroup include viruses encoding the **HA1** substitutions **T120A** or **S183P**.

An amino acid sequence alignment of the HAs for representative H1N1 viruses is shown in **Figure 2**; the vaccine virus is shown in red, reference viruses are coloured blue,

glycosylation motifs are highlighted, the genetic group/subgroup is shown in green and the HA1/HA2 proteolytic-processing site is highlighted.

**Figure 3** illustrates the location of amino acid residues on an H1-HA structure defining genetic group 6.B1 and the substitutions defining the major genetic subgroup within the 6B.1 clade (**S74R**, **S164T** and **I295V** in **HA1**).

**Figure 4** shows a phylogenetic tree for NA genes of the same representative set of H1N1 viruses as used in **Figure 1**. The HA and NA phylogenetic trees are generally congruent.

**Figure 5** shows a NA amino acid alignment for the same representative set of these viruses as used in **Figure 2**, annotated as **Figure 2** but lacking a proteolytic-processing site.

### **Antiviral resistance.**

Phenotypic testing to assess susceptibility to oseltamivir and zanamivir was performed on 164 viruses with collection dates after 2017-08-31. All but one of the viruses tested showed normal inhibition (NI) by both neuraminidase inhibitors (**Table 14**). The exception was A/Bretagne/002/2018 which showed reduced inhibition (RI) by both oseltamivir and zanamivir and its NA gene encoded the substitution I223R.

### **Conclusion.**

The vast majority of A(H1N1)pdm09 viruses received were antigenically similar to the vaccine virus A/Michigan/45/2015 and also retained susceptibility to oseltamivir and zanamivir.

**Table 4. Summary of influenza A(H1N1)pdm09 viruses analysed, collected after 2017-08-31**

MONTH	H1N1pdm09					
	Country	Number received <sup>1</sup>	Number propagated <sup>2</sup>	Fold reduction in HI titre		
				≤2 fold <sup>3</sup>	4 fold <sup>3</sup>	≥8 fold <sup>3</sup>
<b>2017</b>						
<b>SEPTEMBER</b>						
Egypt	3	3	3	3		
Norway	1	1	1	1		
Oman	1	1	1	1		
Palestine	2	0				
Russia	1	1	1	1		
Spain	1	1	1	1		
<b>OCTOBER</b>						
France	4	4	4	4		
Ghana	3	3	3	3		
Norway	3	2	2	2		
Oman	13	11	11	11		
Palestine	1	1	1	1		
Qatar	6	5	5	5		
Spain	1	1	1	1		
United Kingdom	2	2	2	2		
<b>NOVEMBER</b>						
France	7	6	6	6		
Germany	2	2	2	2		
Ghana	9	5	5	5		
Iran	1	1	1	1		
Latvia	1	1	1	1		
Mayotte	3	3	3	3		
Norway	3	3	3	3		
Oman	15	13	13	13		
Palestine	1	1	1	1		
Senegal	2	2	2	2		
Slovakia	1	1	1	1		
Tajikistan	1	0				
<b>DECEMBER</b>						
Austria	18	7	7	7		
Belgium	7	2	2	2		
Croatia	3	3	3	3		
France	12	4	4	3		
Germany	5	5	5	5		
Ghana	10	3	3	3		
Hong Kong	6	6	6	6		
Hungary	1	1	1	1		
Iceland	1	1	1	1		
Israel	12	5	5	5		
Latvia	2	2	2	2		
Lebanon	3	2	2	2		
Lithuania	3	1	1	1		
Norway	5	1	1	1		
Poland	2	2	2	2		
Portugal	2	2	2	2		
Romania	4	3	3	3		
Slovenia	4	4	4	4		
Spain	18	2	2	2		
Switzerland	10	4	4	4		
Tajikistan	1	0				
Turkey	35	3	3	3		
<b>2018</b>						
<b>JANUARY</b>						
Belgium	12	1	1	1		
Bulgaria	3	2	2	2		
Czech Republic	1	1	1	1		
Estonia	3	2	2	2		
France	2	2	2	2		
Greece	8	1	1	1		
Hungary	2	2	2	2		
Israel	1	1	1	1		
Italy	4	3	3	3		
Montenegro	3	1	1	1		
Netherlands	1	1	1	1		
Russia	1	1	1	1		
Slovakia	1	1	1	1		
Slovenia	7	2	2	2		
<b>39 Countries</b>		301	158	157 99.4%	1 0.6%	0 0.0%

1. Numbers shown in red indicate that not all of the specimens received had been propagated at the time this report was prepared

2. Propagated to sufficient titre to perform HI assays

3. Reduction in HI titre with post-infection ferret antiserum raised against A/Michigan/45/2015 (egg grown vaccine virus)







**Table 5-7. Antigenic analyses of influenza A(H1N1)pdm09 viruses (2018-01-10)**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre												
				Post-infection ferret antisera												
				A/Mich 45/15 Egg	A/Cal 7/09 Egg	A/Bayern 69/09 MDCK	A/Lviv N6/09 MDCK	A/Astrak 1/11 MDCK	A/St. P 27/11 Egg	A/St. P 100/11 Egg	A/HK 5659/12 MDCK	A/Sth Afr 3626/13 Egg	A/Slov 2903/2015 Egg	A/Israel Q-504/15 MDCK		
				NIB F42/16 <sup>1</sup>	F06/16 <sup>1</sup>	F09/15 <sup>1</sup>	F14/13 <sup>1</sup>	F22/13 <sup>1</sup>	F26/14 <sup>1</sup>	F24/11 <sup>1</sup>	F30/12 <sup>1</sup>	F03/14 <sup>1</sup>	F02/16 <sup>2</sup>	F08/16 <sup>2</sup>		
			Genetic group	6B.1				5	6	7	6A	6B	6B.1	6B.2		
<b>REFERENCE VIRUSES</b>																
A/Michigan/45/2015	clone38-32	6B.1	2015-09-07	E3/E3	1280	640	640	320	640	640	2560	640	1280	2560	1280	1280
A/California/7/2009		2009-04-09	E3/E3	1280	1280	1280	1280	1280	1280	5120	1280	1280	5120	1280	1280	1280
A/Bayern/69/2009		2009-07-01	MDCK5/MDCK1	<	40	640	320	40	40	80	40	40	80	40	80	< 80
A/Lviv/N6/2009		2009-10-27	MDCK4/SIAT1/MDCK3	40	80	640	640	80	80	80	80	80	80	160	80	80
A/Astrakhan/1/2011		5	2011-02-28	MDCK1/MDCK5	640	640	640	1280	1280	1280	2560	1280	1280	2560	1280	1280
A/St. Petersburg/27/2011		6	2011-02-14	E1/E3	640	640	640	1280	1280	1280	2560	640	640	2560	1280	1280
A/St. Petersburg/100/2011		7	2011-03-14	E1/E4	640	640	640	640	640	320	2560	640	640	1280	640	640
A/Hong Kong/5659/2012		6A	2012-05-21	MDCK4/MDCK2	160	160	160	80	320	160	640	320	320	640	160	160
A/South Africa/3626/2013		6B	2013-06-06	E1/E3	640	320	640	640	640	640	1280	320	320	640	1280	640
A/Slovenia/2903/2015		clone 37	6B.1	E4/E2	640	320	320	1280	1280	1280	2560	640	640	2560	1280	1280
A/Israel/Q-504/2015		6B.2	2015-12-15	C1/MDCK2	1280	640	640	320	1280	320	2560	640	640	2560	1280	1280
<b>TEST VIRUSES</b>																
A/Stockholm/34/2017		6B.1	2017-06-01	MDCK1/MDCK1	640	320	320	320	640	320	1280	640	640	1280	640	640
A/Andalucia/2283/2017		6B.1	2017-09-13	SIAT1/MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	2560	1280	1280
A/England/75/2017		6B.1	2017-10-06	SIAT1/MDCK1	640	640	640	160	640	320	2560	640	640	2560	640	640
A/Ghana/739/2017		6B.1	2017-10-13	C2/MDCK1	1280	1280	640	320	1280	640	2560	1280	640	2560	1280	1280
A/Ghana/3120/2017		6B.1	2017-10-13	C2/MDCK1	640	320	320	320	640	320	1280	320	640	1280	640	640
A/Ghana/3164/2017		6B.1	2017-10-18	C1/MDCK1	640	640	640	320	640	320	2560	640	640	2560	640	640
A/Andalucia/2280/2017		6B.1	2017-10-26	SIAT1/MDCK1	1280	1280	640	640	1280	640	2560	1280	1280	2560	1280	1280
A/Ghana/3344/2017		6B.1	2017-11-01	C1/MDCK1	640	640	320	320	1280	640	2560	1280	1280	2560	1280	1280
A/Ghana/3370/2017			2017-11-03	C2/MDCK1	1280	640	640	320	1280	640	2560	1280	1280	2560	1280	1280
A/Mayotte/2177/2017		6B.1	2017-11-06	MDCK2/MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	2560	1280	1280
A/Lyon/2044/2017			2017-11-06	MDCK2/MDCK1	640	640	320	320	640	320	1280	640	640	2560	640	640
A/Mayotte/2132/2017		6B.1	2017-11-07	MDCK2/MDCK1	1280	640	640	640	1280	640	2560	1280	1280	2560	1280	1280
A/Oman/7871/2017		6B.1	2017-11-10	SIAT1/MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	2560	1280	1280
A/Oman/7873/2017		6B.1	2017-11-11	SIAT1/MDCK1	640	640	640	320	1280	640	2560	1280	1280	2560	1280	1280
A/Oman/7960/2017		6B.1	2017-11-12	SIAT1/MDCK1	640	640	320	320	640	320	2560	640	640	2560	1280	1280
A/Oman/7994/2017		6B.1	2017-11-12	SIAT1/MDCK1	1280	1280	640	640	1280	640	2560	1280	1280	2560	1280	1280
A/Clermont-Ferrand/2061/2017		6B.1	2017-11-13	MDCK2/MDCK1	640	640	640	320	1280	320	2560	640	1280	2560	1280	1280
A/Oman/8079/2017		6B.1	2017-11-13	SIAT1/MDCK1	2560	2560	1280	640	2560	1280	5120	1280	1280	5120	1280	1280
A/Mayotte/2168/2017		6B.1	2017-11-16	MDCK2/MDCK1	640	640	640	320	640	320	2560	640	640	2560	640	640
A/Norway/3498/2017		6B.1	2017-11-16	MDCK1/MDCK1	1280	640	640	320	1280	640	2560	640	640	2560	1280	1280
A/Bourgoin-Jallieu/2175/2017		6B.1	2017-11-17	MDCK2/MDCK1	640	1280	1280	640	1280	640	2560	1280	1280	2560	1280	1280
A/Ghana/3512/2017		6B.1	2017-11-17	C1/MDCK1	2560	1280	1280	640	1280	640	5120	1280	1280	2560	1280	1280
A/Ghana/3514/2017		6B.1	2017-11-17	C1/MDCK1	640	640	640	320	640	320	2560	640	640	2560	1280	1280
A/Latvia/11-082656/2017		6B.1	2017-11-30	MDCK1/MDCK1	640	640	640	320	640	320	1280	640	640	1280	1280	1280
A/Latvia/12-027589/2017		6B.1	2017-12-11	MDCK1/MDCK1	1280	640	640	320	1280	640	2560	640	640	2560	1280	1280
A/Latvia/12-027887/2017		6B.1	2017-12-11	MDCK1/MDCK1	640	640	640	320	640	320	1280	640	640	2560	1280	1280

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used)

Vaccine

1 < = <40; 2 < = <80

Sequences in phylogenetic trees

**Table 5-8. Antigenic analyses of influenza A(H1N1)pdm09 viruses (2018-01-17)**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre															
				Post-infection ferret antisera															
				A/Mich 45/15 Egg	A/Cal 7/09 Egg	A/Bayern 69/09 MDCK	A/Lviv N6/09 MDCK	A/Astrak 1/11 MDCK	A/St. P 27/11 Egg	A/St. P 100/11 Egg	A/HK 5659/12 MDCK	A/Sth Afr 3626/13 Egg	A/Slov 2903/2015 Egg	A/Israel Q-504/15 MDCK					
				NIB F42/16 <sup>1</sup>	F06/16 <sup>1</sup>	F09/15 <sup>1</sup>	F14/13 <sup>1</sup>	F22/13 <sup>1</sup>	F26/14 <sup>1</sup>	F24/11 <sup>1</sup>	F30/12 <sup>1</sup>	F03/14 <sup>1</sup>	F02/16 <sup>2</sup>						
Passage history				6B.1					5	6	7	6A	6B	6B.1	6B.2				
Ferret number																			
Genetic group																			
<b>REFERENCE VIRUSES</b>																			
A/Michigan/45/2015	clone38-32	6B.1	2015-09-07	E3/E3	640	640	320	320	1280	320	2560	1280	640	2560	1280	1280			
A/California/7/2009			2009-04-09	E3/E3	640	640	320	320	1280	320	2560	640	640	1280	640	640			
A/Bayern/69/2009		G155E	2009-07-01	MDCK5/MDCK1	<	40	320	320	40	40	80	80	40	80	40	40			
A/Lviv/N6/2009		G155E, D222G	2009-10-27	MDCK4/SIAT1/MDCK3	40	80	640	640	80	80	160	160	80	320	80	80			
A/Astrakhan/1/2011		5	2011-02-28	MDCK1/MDCK5	640	640	640	320	1280	640	2560	1280	640	1280	1280	1280			
A/St. Petersburg/27/2011		6	2011-02-14	E1/E4	640	640	640	640	1280	640	2560	1280	640	2560	1280	1280			
A/St. Petersburg/100/2011		7	2011-03-14	E1/E4	320	320	320	320	640	320	1280	640	640	1280	640	640			
A/Hong Kong/5659/2012	clone 37	6A	2012-05-21	MDCK4/MDCK2	160	160	80	80	320	80	640	320	320	640	160	160			
A/South Africa/3626/2013		6B	2013-06-06	E1/E3	640	320	320	640	640	640	1280	640	640	640	1280	640			
A/Slovenia/2903/2015		6B.1	2015-10-26	E4/E2	640	640	320	320	1280	640	2560	1280	640	2560	1280	1280			
A/Israel/Q-504/2015		6B.2	2015-12-15	C1/MDCK2	640	640	320	320	1280	320	2560	1280	640	2560	1280	1280			
<b>TEST VIRUSES</b>																			
A/Sachsen-Anhalt/101/2017		6B.1	2017-11-06	C1/MDCK1	640	320	320	160	640	160	1280	640	640	1280	640	640			
A/Norway/3433/2017		6B.1	2017-11-10	MDCK1	640	640	640	320	1280	640	2560	1280	1280	2560	1280	1280			
A/Norway/3499/2017		6B.1	2017-11-11	MDCK1	1280	1280	640	320	1280	640	5120	1280	1280	2560	1280	1280			
A/Baden-Wurttemberg/252/2017		6B.1	2017-11-20	C1/MDCK1	640	640	320	320	640	320	2560	1280	1280	2560	1280	1280			
A/Ghana/3674/2017		6B.1	2017-11-29	MDCK1	320	640	320	160	640	320	1280	640	640	1280	640	640			
A/Bayern/95/2017		6B.1	2017-12-04	C1/MDCK1	640	640	640	320	1280	640	2560	1280	1280	2560	1280	1280			
A/Ghana/7/2017		6B.1	2017-12-05	MDCK1	320	640	320	160	640	320	1280	640	640	1280	640	640			
A/Ghana/13/2017		6B.1	2017-12-05	MDCK2	640	640	320	320	640	320	2560	640	640	1280	2560	1280			
A/Ghana/14/2017		6B.1	2017-12-05	MDCK1	320	320	320	160	640	160	1280	640	640	1280	640	640			
A/Switzerland/0007/2017		6B.1	2017-12-05	MDCK1	640	320	320	160	640	320	1280	640	640	1280	640	640			
A/Norway/3787/2017		6B.1	2017-12-07	MDCK1	640	640	320	160	640	320	2560	640	640	1280	640	640			
A/Hong Kong/4979/2017		6B.1	2017-12-10	MDCK1/MDCK1	320	320	320	160	640	320	1280	640	640	1280	640	640			
A/Rheinland-Pfalz/52/2017		6B.1	2017-12-11	C1/MDCK1	640	640	320	320	640	320	1280	640	640	1280	640	640			
A/Thuringen/170/2017		6B.1	2017-12-11	C2/MDCK1	640	640	640	320	1280	320	2560	1280	640	2560	1280	1280			
A/Hong Kong/4982/2017		6B.1	2017-12-12	MDCK1/MDCK1	1280	640	640	320	1280	320	2560	1280	1280	2560	1280	1280			
A/Navarra/2488/2017		6B.1	2017-12-13	MDCK1	640	640	320	160	640	320	2560	640	640	1280	640	640			
A/Hong Kong/4981/2017		6B.1	2017-12-13	MDCK1/MDCK1	640	640	320	320	640	320	2560	640	640	1280	640	640			
A/Hong Kong/4989/2017		6B.1	2017-12-17	MDCK1/MDCK1	640	640	320	320	640	320	1280	640	640	1280	640	640			
A/Hong Kong/4990/2017		6B.1	2017-12-18	MDCK1/MDCK1	640	640	320	320	640	320	2560	1280	640	2560	1280	1280			
A/Bayern/96/2017		6B.1	2017-12-18	C2/MDCK1	1280	640	640	640	1280	320	2560	1280	1280	2560	1280	1280			
A/Hong Kong/4985/2017		6B.1	2017-12-19	MDCK1/MDCK1	640	640	320	160	640	320	1280	640	640	1280	640	640			
A/Galicia/2443/2017		6B.1	2017-12-20	MDCK1	640	640	320	320	1280	320	2560	1280	640	2560	1280	1280			
A/Switzerland/3330/2017		6B.1	2017-12-20	MDCK1	640	640	640	320	1280	320	2560	1280	640	2560	1280	1280			
A/Austria/1030576/2017		6B.1	2017-12-20	SIAT2/MDCK1	1280	640	640	640	1280	640	2560	1280	1280	2560	1280	1280			
A/Switzerland/3191/2017		6B.1	2017-12-21	MDCK2	640	320	320	160	640	320	1280	640	640	1280	640	640			
A/Switzerland/2656/2017		6B.1	2017-12-21	MDCK1	640	640	320	320	640	320	1280	640	640	1280	640	640			
A/Saarland/25/2017		6B.1	2017-12-21	C2/MDCK1	320	320	320	320	640	320	1280	640	640	1280	640	640			
A/Austria/1031030/2017		6B.1	2017-12-21	SIAT1/MDCK1	320	320	320	320	640	160	1280	640	640	1280	640	640			
A/Austria/1031031/2017		6B.1	2017-12-21	SIAT1/MDCK1	1280	640	640	640	1280	640	2560	1280	1280	2560	1280	1280			
A/Austria/1031040/2017		6B.1	2017-12-21	SIAT1/MDCK1	640	640	320	320	640	320	2560	640	640	1280	640	640			
A/Austria/1031039/2017		6B.1	2017-12-22	SIAT1/MDCK1	320	320	320	160	640	160	1280	640	640	1280	640	640			
A/Austria/1031050/2017		6B.1	2017-12-24	SIAT1/MDCK1	640	640	640	320	1280	320	2560	1280	640	2560	640	640			

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used)

1 < = <40; 2 < = <80

Sequences in phylogenetic trees

Vaccine



**Table 5-10. Antigenic analyses of influenza A(H1N1)pdm09 viruses (2018-01-30)**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre															NEW	
				Post-infection ferret antisera																
				A/Michigan/45/1947/Egg/F42/16/1	A/Cal/7/09/Egg/F06/16/1	A/Bayern/69/09/MDCK/F09/15/1	A/Lviv/6/09/MDCK/F14/13/1	A/Astrakhan/1/11/MDCK/F22/13/1	A/St. P/27/11/Egg/F26/14/1	A/St. P/100/11/Egg/F24/11/1	A/HK/5659/12/MDCK/F30/12/1	A/St. Afr/3626/13/Egg/F03/14/1	A/Slov/2903/2015/Egg/F02/16/2	A/Israel/Q-504/15/MDCK/F08/16/2	A/Paris/1447/17/MDCK/F03/18/2					
			Ferret number	6B.1	F06/16/1	F09/15/1	F14/13/1	F22/13/1	F26/14/1	F24/11/1	F30/12/1	F03/14/1	F02/16/2	F08/16/2	F03/18/2	6B.1	6B.2	6B.1		
REFERENCE VIRUSES																				
A/Michigan/45/1947		6B.1	2015-09-07	E3/E3	1280	1280	640	320	1280	320	2560	1280	640	2560	1280	2560	1280	2560	2560	
A/California/7/2009	clone38-32		2009-04-09	E3/E3	1280	640	640	640	1280	320	2560	1280	640	2560	640	2560	640	2560	2560	
A/Bayern/69/2009		G155E	2009-07-01	MDCK5/MDCK1	<	80	640	320	80	40	80	80	80	80	80	80	80	40	320	
A/Lviv/6/2009		G155E, D222G	2009-10-27	MDCK4/SIAT1/MDCK3	80	160	1280	1280	160	80	160	160	80	160	80	320	80	80	640	
A/Astrakhan/1/2011		5	2011-02-28	MDCK1/MDCK5	640	640	640	320	640	320	2560	1280	640	1280	640	1280	640	1280	1280	
A/St. Petersburg/27/2011		6	2011-02-14	E1/E3	1280	1280	1280	640	1280	640	2560	1280	1280	2560	1280	2560	1280	2560	2560	
A/St. Petersburg/100/2011		7	2011-03-14	E1/E4	320	320	640	320	320	320	320	1280	320	320	320	640	320	640	640	640
A/Hong Kong/5659/2012		6A	2012-05-21	MDCK4/MDCK2	160	320	160	80	320	160	640	320	320	320	640	320	640	320	640	640
A/South Africa/3626/2013		6B	2013-06-06	E1/E3	1280	1280	1280	1280	1280	640	2560	1280	1280	1280	1280	2560	1280	2560	2560	2560
A/Slovenia/2903/2015	clone 37	6B.1	2015-10-26	E4/E2	640	640	640	320	320	640	320	1280	640	640	640	640	1280	640	640	1280
A/Israel/Q-504/2015		6B.2	2015-12-15	C1/MDCK2	1280	1280	640	320	1280	320	2560	1280	640	640	640	640	2560	1280	1280	2560
A/Paris/1447/2017		6B.1	2017-10-20	MDCK1/MDCK2	1280	640	640	320	640	320	2560	640	640	2560	640	2560	640	2560	640	2560
TEST VIRUSES																				
A/Rostov-on-Don/3196/2017		6B.1	2017-09-22	MDCK1/MDCK1	1280	640	320	320	640	320	2560	1280	1280	2560	1280	1280	>5120	1280	>5120	>5120
A/Oman/8907/2017		6B.1	2017-10-26	MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	2560	1280	1280	1280	2560	1280	>5120
A/Partizanske/44/2017		6B.1	2017-11-30	MDCK1/MDCK1	640	640	320	320	640	320	2560	1280	640	640	640	640	2560	1280	1280	>5120
A/Croatia/3609/2017		6B.1	2017-12-12	MDCKx/MDCK1	1280	1280	640	640	1280	640	5120	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Poland/3986/2017		6B.1	2017-12-19	SIAT1	2560	2560	640	640	2560	640	5120	1280	1280	1280	1280	5120	2560	2560	>5120	
A/Croatia/3774/2017		6B.1	2017-12-19	MDCKx/MDCK1	2560	2560	1280	640	2560	640	5120	1280	2560	2560	2560	2560	2560	2560	2560	>5120
A/Poland/4005/2017		6B.1	2017-12-21	SIAT1	640	1280	640	320	1280	320	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Portugal/SU114/2017		6B.1	2017-12-27	MDCK2/MDCK1	640	640	640	320	1280	320	2560	1280	640	640	640	640	2560	1280	>5120	
A/Bretagne/1964/2017		6B.1	2017-12-27	MDCK1/MDCK1	320	320	320	160	640	160	160	1280	640	640	640	640	2560	640	2560	2560
A/Ankara/1325/2017		6B.1	2017-12-27	SIAT1/MDCK1	1280	640	640	320	640	320	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Yozgat/1335/2017		6B.1	2017-12-28	SIAT1/MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Lebanon/4-18/2017		6B.1	2017-12-29	MDCK1	640	640	320	320	640	320	2560	1280	640	640	640	640	2560	1280	1280	>5120
A/Iceland/145/2017		6B.1	2017-12-31	MDCK1/MDCK1	640	640	640	640	640	640	320	1280	640	640	640	640	2560	1280	1280	>5120
A/Bretagne/002/2018		6B.1	2018-01-02	MDCK2/MDCK1	1280	640	640	320	1280	320	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Centre/043/2018		6B.1	2018-01-02	MDCK1/MDCK1	640	640	320	320	640	320	1280	1280	1280	1280	1280	640	2560	1280	>5120	
A/Komarno/75/2018		6B.1	2018-01-04	MDCKx/MDCK1	1280	1280	640	640	1280	640	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Slovenia/59/2018		6B.1	2018-01-05	SIAT1	1280	1280	640	320	1280	640	2560	1280	640	640	2560	1280	1280	2560	1280	>5120
A/Montenegro/59/2018		6B.1	2018-01-05	MDCKx/MDCK1	640	1280	640	320	640	320	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Bulgaria/053/2018		6B.1	2018-01-08	MDCK1	1280	640	640	320	1280	320	2560	1280	640	640	2560	1280	1280	>5120		
A/Bulgaria/049/2018		6B.1	2018-01-08	MDCK1	1280	1280	640	320	1280	640	2560	1280	1280	1280	1280	2560	1280	1280	>5120	
A/Hungary/4/2018		6B.1	2018-01-09	MDCK1/MDCK1	1280	1280	640	640	1280	640	2560	1280	1280	1280	1280	2560	1280	1280	>5120	

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used)

Vaccine

Sequences in phylogenetic trees

**Table 5-11. Antigenic analyses of influenza A(H1N1)pdm09 viruses (2018-02-07)**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre															
				Post-infection ferret antisera															
				A/Mich 45/15 Egg	A/Cal 7/09 Egg	A/Bayern 69/09 MDCK	A/Lviv N6/09 MDCK	A/Astrak 1/11 MDCK	A/St. P 27/11 Egg	A/HK 5659/12 MDCK	A/Sth Afr 3626/13 Egg	A/Slov 2903/2015 Egg	A/Israel Q-504/15 MDCK	A/Paris 1447/17 MDCK					
				NIB F42/16 <sup>1</sup>	F06/16 <sup>1</sup>	F09/15 <sup>1</sup>	F14/13 <sup>1</sup>	F22/13 <sup>1</sup>	F26/14 <sup>1</sup>	F30/12 <sup>1</sup>	F03/14 <sup>1</sup>	F02/16 <sup>2</sup>	F08/16 <sup>2</sup>						
			Genetic group	6B.1					5	6	6A	6B	6B.1	6B.2					
<b>REFERENCE VIRUSES</b>																			
A/California/7/2009	clone38-32 G155E G155E, D222G	6B.1	2015-09-07	E3/E3	640	1280	320	320	1280	320	1280	640	1280	1280	2560				
A/Bayern/69/2009			2009-04-09	E3/E3	640	640	640	320	640	320	640	640	1280	640	2560				
A/Lviv/N6/2009			2009-07-01	MDCK5/MDCK1	<	40	640	320	40	<	40	40	80	40	40	80	40	160	
A/Astrakhan/1/2011		5	2011-02-28	MDCK4/SIAT1/MDCK3	40	160	1280	640	80	80	160	80	160	80	160	80	160	640	
A/St. Petersburg/27/2011		6	2011-02-14	MDCK1/MDCK4	640	1280	1280	640	1280	640	1280	640	1280	640	1280	640	1280	2560	
A/Hong Kong/5659/2012		6A	2012-05-21	MDCK4/MDCK2	160	160	160	80	320	80	320	160	320	160	320	160	320	160	
A/South Africa/3626/2013		6B	2013-06-06	E1/E3	640	640	640	640	640	320	640	640	640	640	640	640	640	2560	
A/Slovenia/2903/2015		clone 37	6B.1	2015-10-26	C1/MDCK2	640	640	320	160	640	320	1280	640	1280	640	1280	640	1280	2560
A/Israel/Q-504/2015		6B.2	2015-12-15	MDCK1/MDCK2	640	640	320	160	640	320	640	320	1280	640	1280	640	1280	640	2560
A/Paris/1447/2017		6B.1	2017-10-20																
<b>TEST VIRUSES</b>																			
A/Dakar/19/2017		P55	2017-11-02	C0/MDCK1	640	640	640	320	640	320	640	640	1280	1280	1280	>5120			
A/Dakar/18/2017		P55	2017-11-07	C0/MDCK1	640	640	320	160	640	160	640	640	1280	640	1280	640	2560		
A/Poitiers/2380/2017		P55	2017-12-05	MDCK2/MDCK1	320	640	320	160	640	160	640	640	320	1280	640	2560			
A/Lebanon/NS2/2017		6B.1	2017-12-09	MDCK3	640	1280	320	320	640	320	640	640	2560	1280	>5120				
A/Toulon/2336/2017		P55	2017-12-11	MDCK2/MDCK1	640	640	320	160	640	320	640	640	1280	640	1280	640	2560		
A/Lyon/2376/2017		P55	2017-12-12	MDCK2/MDCK1	640	1280	320	320	640	320	1280	640	1280	640	2560	1280	2560		
A/Croatia/3750/2017		6B.1	2017-12-18	MDCKx/MDCK1	1280	2560	1280	640	1280	640	1280	1280	2560	2560	>5120				
A/Bucuresti/221745/2017		6B.1	2017-12-20	MDCK1/MDCK1	640	640	320	320	640	320	640	640	320	1280	640	2560			
A/Bucuresti/221744/2017		6B.1	2017-12-20	MDCK1/MDCK1	640	640	320	320	640	320	640	640	1280	640	1280	640	2560		
A/Bucuresti/221746/2017		6B.1	2017-12-20	MDCK1/MDCK1	640	1280	640	320	1280	320	1280	1280	1280	2560	1280	>5120			
A/Belgium/G0003/2018		6B.1	2017-12-22	SIAT1/MDCK1	640	640	320	320	640	320	640	640	1280	640	1280	640	2560		
A/Portugal/SU11/2017		6B.1	2017-12-27	MDCK2/MDCK1	640	640	320	160	640	160	640	640	1280	640	1280	640	2560		
A/Lithuania/36856/2017		6B.1	2017-12-27	MDCK2/MDCK1	640	640	320	320	640	320	640	640	1280	640	1280	640	2560		
A/Kutahya/1346/2017		6B.1	2017-12-28	SIAT1/MDCK2	640	640	640	320	640	320	640	320	1280	1280	2560	1280	>5120		
A/Hungary/2/2018		6B.1	2017-12-28	MDCK1/MDCK1	320	80	320	320	320	80	320	320	320	1280	640	1280	640	1280	
A/Belgium/G0008/2018		6B.1	2017-12-28	MDCK1/MDCK1	640	640	320	160	640	320	640	640	1280	640	1280	640	2560		
A/Belgium/G0014/2018		6B.1	2018-01-02	SIAT1/MDCK1	640	1280	320	320	640	320	640	640	1280	2560	1280	2560			
A/Padova/3/2018		P55	2018-01-02	MDCK2/MDCK1	640	640	320	320	640	320	640	640	320	640	2560	1280	2560		
A/Pavia/2/2018		6B.1	2018-01-03	MDCK2/MDCK1	640	1280	640	320	1280	320	1280	1280	640	2560	1280	>5120			
A/Padova/11/2018		6B.1	2018-01-04	MDCK2/MDCK1	640	640	320	160	640	160	640	640	1280	640	1280	640	2560		
A/Athens.GR/39/2018		6B.1	2018-01-05	MDCK1	640	1280	640	320	1280	320	1280	1280	640	2560	1280	>5120			
A/Hungary/5/2018		6B.1	2018-01-05	MDCK1/MDCK1	640	640	640	320	640	320	640	320	640	1280	1280	1280	>5120		
A/Estonia/11272/2018		6B.1	2018-01-05	MDCK1/MDCK1	640	1280	320	320	640	320	640	320	640	640	1280	1280	1280	2560	
A/Netherlands/10010/2018		P55	2018-01-05	(MDCK/ SIAT)1/MDCK2	640	640	320	320	640	320	640	320	640	640	1280	640	1280	>5120	
A/Estonia/111324/2018		6B.1	2018-01-08	MDCK1/MDCK1	640	640	320	160	640	160	640	640	1280	640	1280	640	2560		
A/Czech Republic/85/2018		P55	2018-01-09	MDCK1/MDCK1	640	640	320	160	640	320	640	640	1280	640	1280	1280	2560		
A/Moscow/1/2018		P55	2018-01-10	MDCK1/MDCK1	640	1280	640	320	1280	640	1280	640	1280	640	2560	1280	2560		

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used)

1 < = <40; 2 < = <80

Sequences in phylogenetic trees

**Table 5-12. Antigenic analyses of influenza A(H1N1)pdm09 viruses with collection dates after 2017-08-31 - Summary**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre																		
				Post-infection ferret antisera																		
				A/Mich 45/15 Egg	A/Cal 7/09 Egg	A/Bayern 69/09 MDCK	A/Lviv N6/09 MDCK	A/Astrak 1/11 MDCK	A/St. P 27/11 Egg	A/St. P 100/11 Egg	A/HK 5659/12 MDCK	A/Sth Afr 3626/13 Egg	A/Slov 2903/2015 Egg	A/Israel Q-504/15 MDCK	A/Paris 1447/17 MDCK							
				F42/16 <sup>-1</sup>	F06/16 <sup>-1</sup>	F09/15 <sup>-1</sup>	F14/13 <sup>-1</sup>	F22/13 <sup>-1</sup>	F26/14 <sup>-1</sup>	F24/11 <sup>-1</sup>	F30/12 <sup>-1</sup>	F03/14 <sup>-1</sup>	F02/16 <sup>-2</sup>	F08/16 <sup>-2</sup>	F03/18 <sup>-2</sup>							
Passage history				6B.1					5	6	7	6A	6B	6B.1	6B.2	6B.1						
Ferret number																						
Genetic group																						
<b>REFERENCE VIRUSES</b>																						
A/Michigan/45/2015	clone38-32	6B.1	2015-09-07	E3/E3	1280	1280	640	320	1280	320	2560	1280	640	2560	1280	2560						
A/California/7/2009		2009-04-09	E3/E3	1280	640	640	640	1280	320	2560	1280	640	2560	640	2560							
A/Bayern/69/2009		2009-07-01	MDCK5/MDCK1	<	80	640	320	80	40	80	80	80	80	80	80	40	320					
A/Lviv/N6/2009		2009-10-27	MDCK4/SIAT1/MDCK3	80	160	1280	1280	160	80	160	160	80	80	320	80	640						
A/Astrakhan/1/2011		5	MDCK1/MDCK5	640	640	640	320	640	320	2560	1280	640	1280	640	1280	640	1280					
A/St. Petersburg/27/2011		6	E1/E3	1280	1280	1280	640	1280	640	2560	1280	1280	1280	2560	1280	2560						
A/St. Petersburg/100/2011		7	E1/E4	320	320	640	320	320	320	1280	320	320	640	320	640	320	640					
A/Hong Kong/5659/2012		6A	MDCK4/MDCK2	160	320	160	80	320	160	640	320	320	320	640	320	640	320	640				
A/South Africa/3626/2013		6B	E1/E3	1280	1280	1280	1280	1280	640	2560	1280	1280	1280	2560	1280	2560	1280	2560				
A/Slovenia/2903/2015		6B.1	E4/E2	640	640	320	320	640	320	1280	640	640	640	1280	640	1280	640	1280				
A/Israel/Q-504/2015	clone 37	6B.2	C1/MDCK2	1280	1280	640	320	1280	320	2560	1280	640	2560	1280	2560	1280	2560					
A/Paris/1447/2017		6B.1	MDCK1/MDCK2	1280	640	640	320	640	320	2560	640	640	640	2560	640	2560	640	2560				
<b>TEST VIRUSES</b>																						
Number of viruses tested*					158	158	158	158	158	158	131	158	158	158	158	158	158	158	48			
No with titre reduction ≤2-fold					157	153	158	84	157	149	131	158	157	158	157	158	157	48				
%					99.4	96.8	100.0	53.2	99.4	94.3	100.0	100.0	99.4	100.0	99.4	100.0	99.4	100.0	100.0			
No with titre reduction =4-fold					1	4		65	1	9			1		1		1					
%					0.6	2.6		41.1	0.6	5.7			0.6		0.6		0.6					
No with titre reduction ≥8-fold								1		9												
%								0.6		5.7												

\* Of those with available HA sequence (X), all were clade 6B.1

Vaccine

Reference virus results are taken from an individual table as an example. Summaries for each antiserum are based on fold-reductions observed on the days that HI assays were performed.

# Figure 1. Phylogenetic comparison of A(H1N1)pdm09 HA genes

Vaccine virus

Reference viruses

Collection date

Oct 2017

Nov 2017

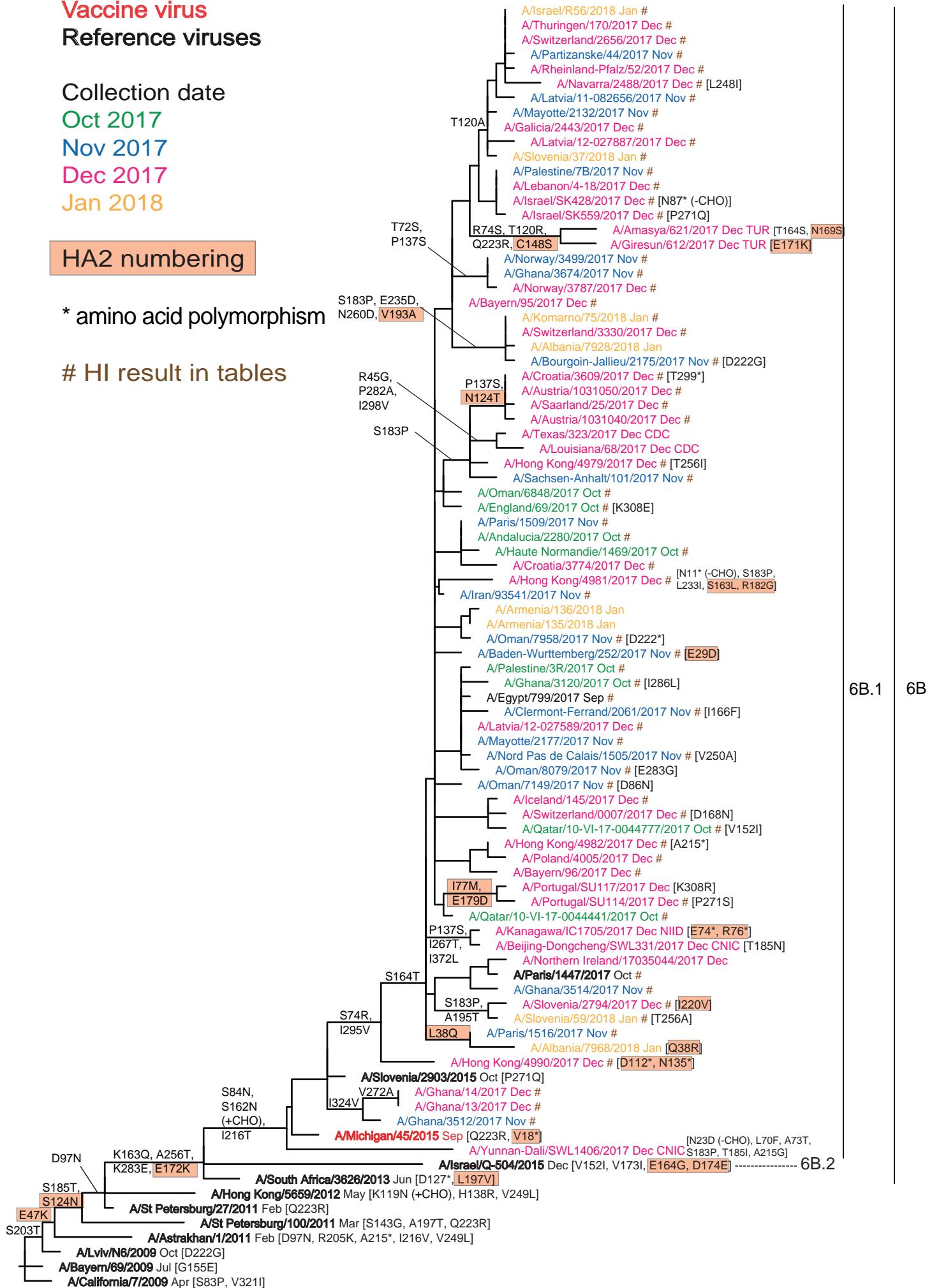
Dec 2017

Jan 2018

HA2 numbering

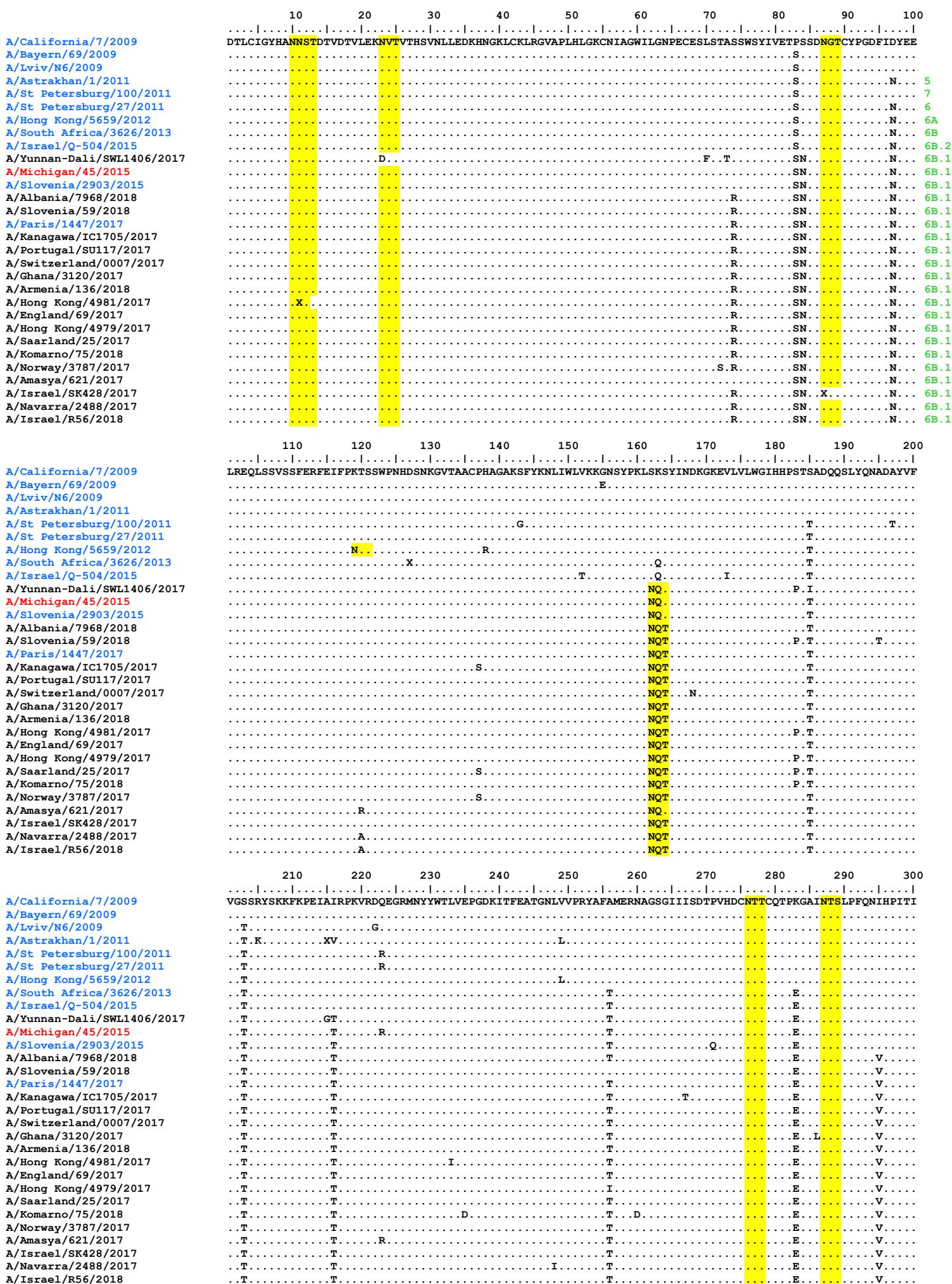
\* amino acid polymorphism

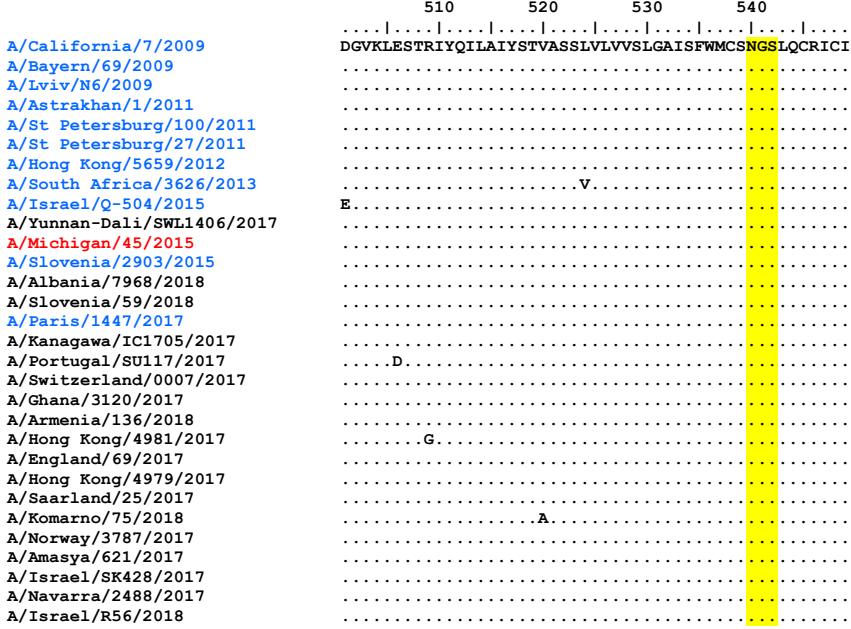
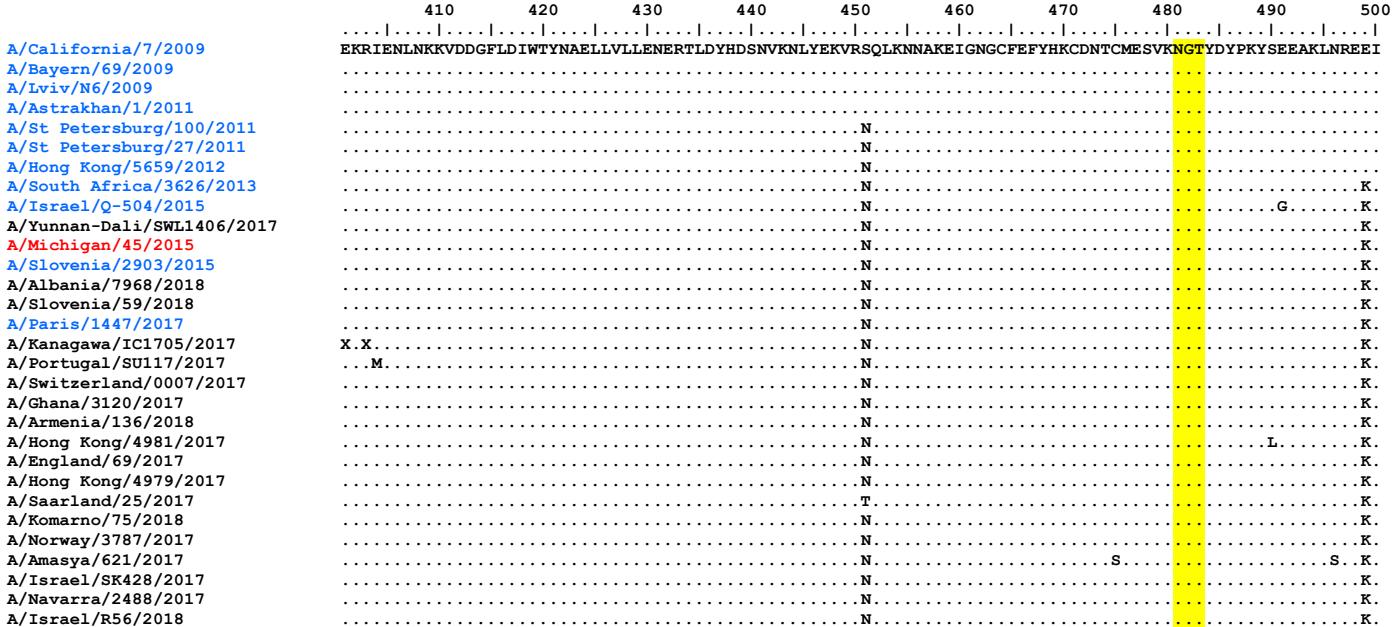
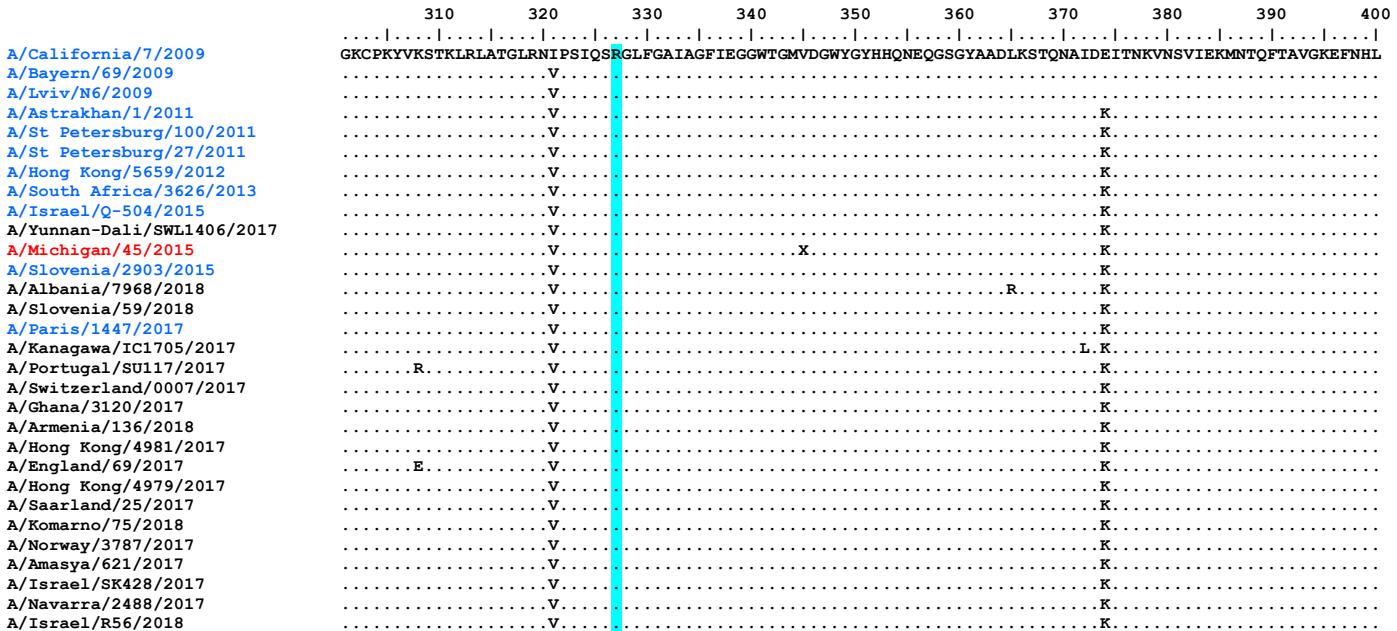
# HI result in tables



## Figure 2. HA protein alignment for influenza A(H1N1)pdm09 viruses

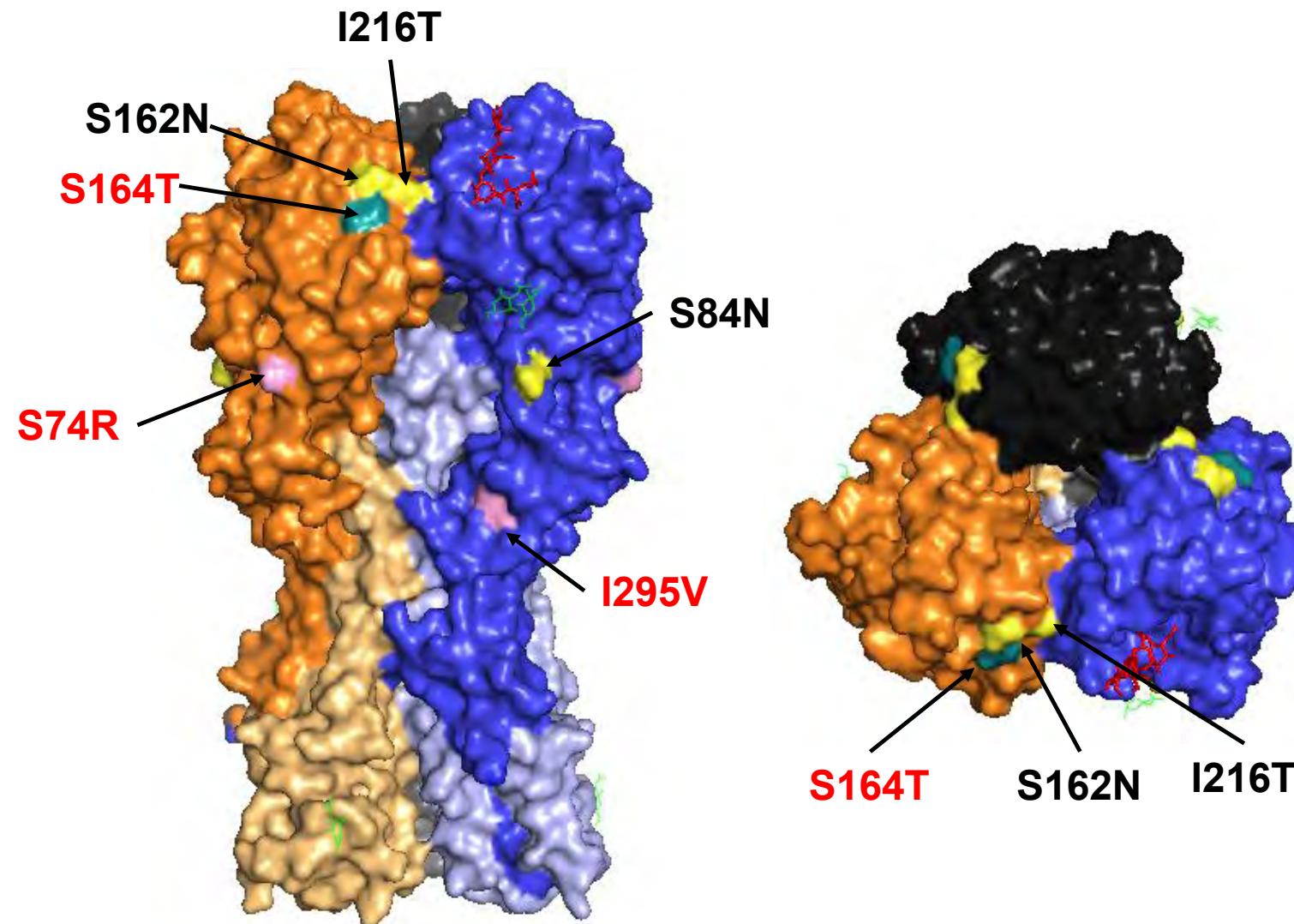
Vaccine virus: Reference virus: Genetic group: HA1/HA2 boundary: Potential N-linked glycosylation site





Vaccine virus: Reference virus: Genetic group: **HA1/HA2 boundary**: Potential N-linked glycosylation site

**Figure 3. H1 HA locations of amino acids substitutions defining recently circulating clade 6B.1 viruses**



Amino acid substitutions that define clade 6B.1 viruses are shown – those in red define the recently emerged subgroup

# Figure 4. Phylogenetic comparison of A(H1N1)pdm09 NA genes

**Vaccine virus**  
**Reference viruses**

Collection date

Oct 2017

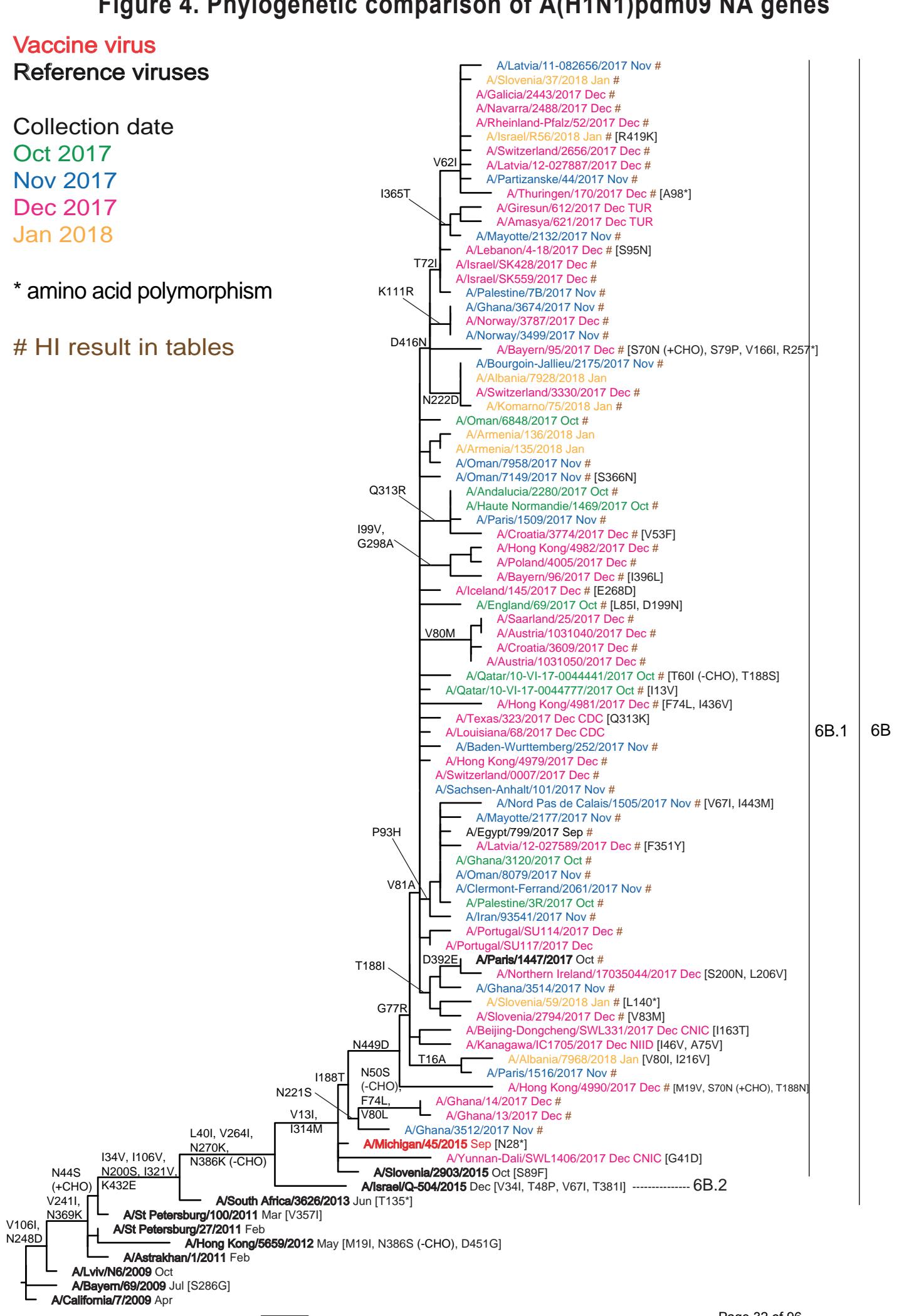
Nov 2017

Dec 2017

Jan 2018

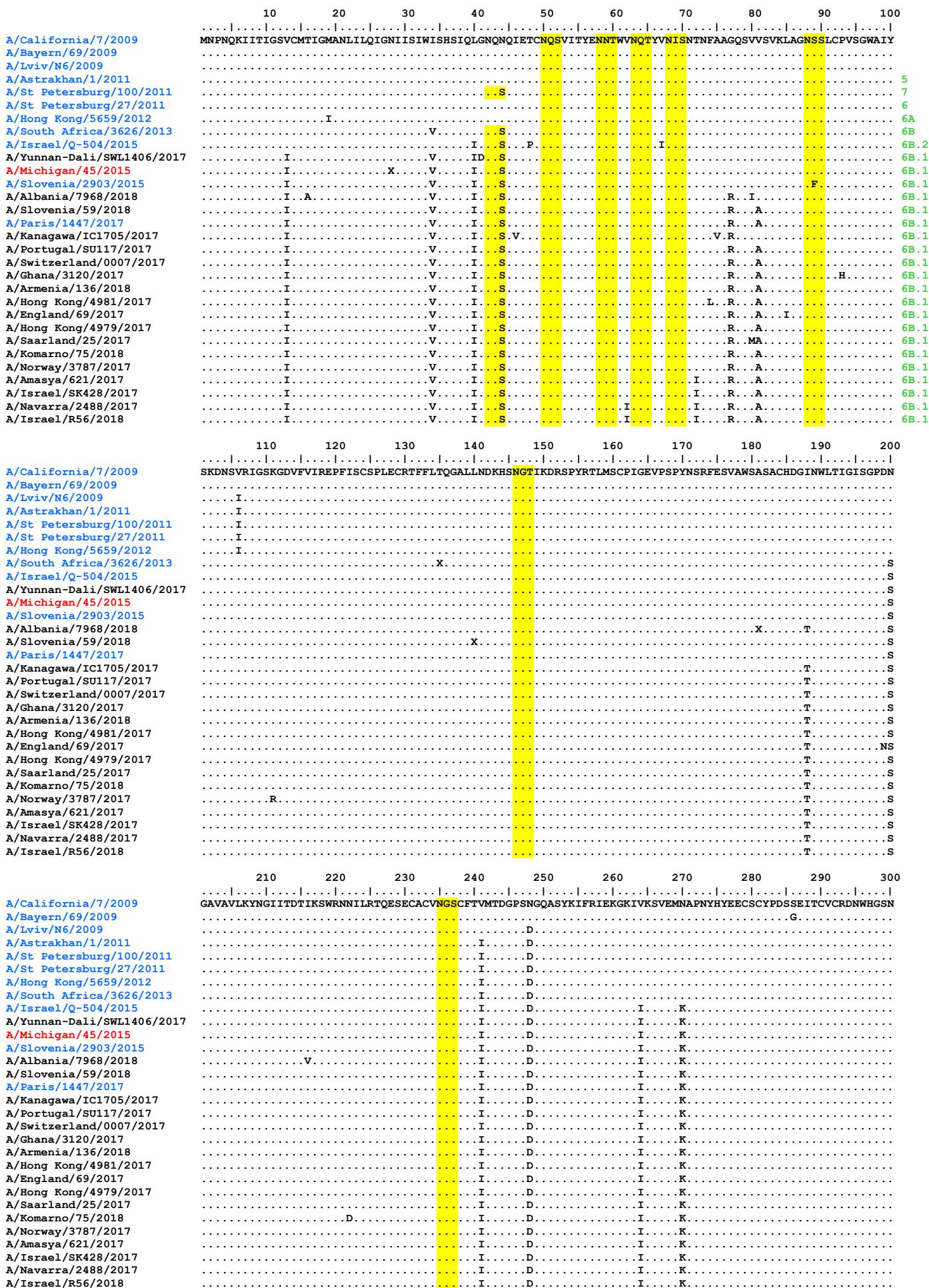
\* amino acid polymorphism

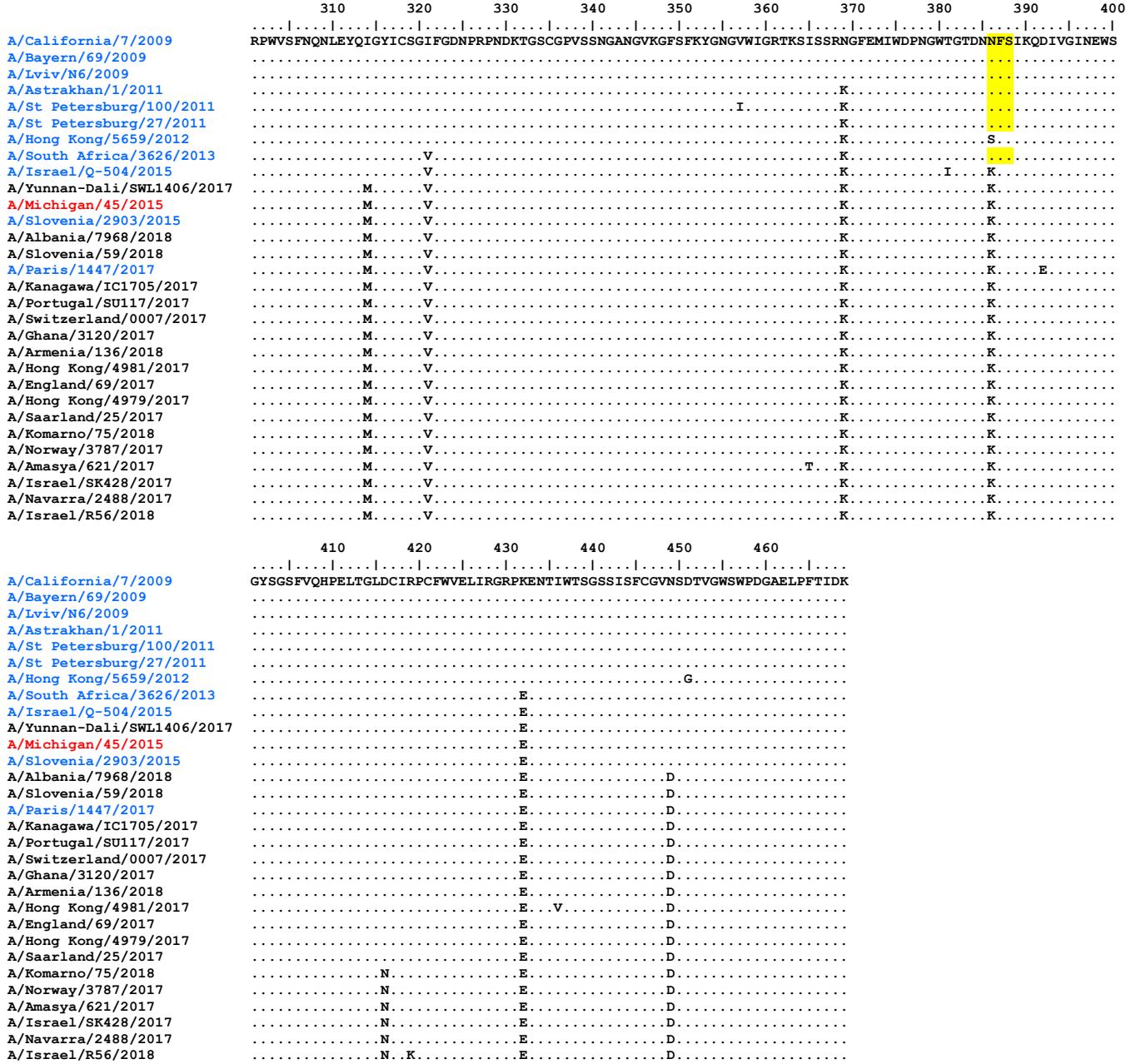
# HI result in tables



# Figure 5. NA protein alignment for influenza A(H1N1)pdm09 viruses

Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site





Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site

## Influenza A(H3N2) virus analyses.

Influenza A(H3N2) viruses collected since 2017-08-31 have been received from NICs in 29 countries or administrative regions in three WHO Regions: African (2: Ghana and Zambia), Eastern Mediterranean (2: Iran and Qatar) and European (25 countries).

Influenza A(H3N2) viruses have become increasingly difficult to characterise antigenically by HI assay due to either the variable agglutination of red blood cells (RBCs) from guinea pig, turkey and humans or the loss of the ability of viruses to agglutinate any of these RBCs. Of the successfully propagated viruses with collection dates since 2017-08-31, 25% had sufficient HA titre to be analysed by HI assays using guinea pig RBCs in the presence of 20nM oseltamivir, added to circumvent NA-mediated binding to the RBCs (**Tables 1, 2, 6 & 7**), this being a decrease over the proportion seen in September 2017. The remainder were unable to agglutinate guinea pig RBCs at all (**Tables 2 & 6**), or were unable to agglutinate RBCs in the presence of 20nM oseltamivir.

### **HI analyses.**

A total of 124 viruses with collection dates after 2017-08-31 could be analysed by HI assay and summaries of the HI results are shown in **Tables 2 and 7**. Individual HI results are shown in **Tables 8-1 to 8-10**. Test viruses in each table are sorted by genetic subclade and by date of clinical specimen collection and those below the red horizontal lines in the tables are viruses with collection dates after 2017-08-31 (**Tables 8-4 and 8-6 to 8-10**). The HA genetic group is indicated for those viruses that have been sequenced and those included in phylogenetic trees are highlighted. All of the viruses sequenced with collection dates after 2017-08-31 fell into clade 3C.2a or subclade 3C.2a1.

A summary of the HI results for viruses collected since 2017-08-31 with antisera raised against the egg-propagated cultivar of A/Hong Kong/4801/2014, the currently used vaccine virus, cell culture-propagated A/Hong Kong/5738/2014, a 3C.2a clade virus, and egg-propagated A/Singapore/INFIMH-16-0019/2016, the 3C.2a1 virus recommended for use in vaccines for the Southern Hemisphere 2018, is shown in **Table 7**. A more detailed summary of the recognition of the viruses by the full panel of antisera together with a breakdown based on gene sequencing for viruses in clades 3C.2a and subclade 3C.2a1 are shown in **Table 8-11**.

The antiserum raised against A/Hong Kong/5738/2014 recognised all of the test viruses collected after 2017-08-31 at titres within 4-fold of the titre of the antiserum with the homologous virus, 83% within 2-fold of the homologous titre. Viruses in genetic subgroups within clade 3C.2a, those with the **HA1** substitutions **N121K** with **S144K** or with the **HA1** substitutions **T131K, R142K** and **R261Q**, were all recognised by this antiserum at titres within 4-fold of the titre of the antiserum for the homologous virus and, respectively, 100% and 90% at titres within 2-fold of the

homologous titre. The test viruses in subclade 3C.2a1 were recognised in similar proportions: all at titres within 4-fold of the titre of the antiserum for the homologous virus and 75% at titres within 2-fold of the homologous titre.

Antisera raised against two cell culture-propagated cultivars of clade 3C.3a viruses, A/Stockholm/6/2014 and A/Switzerland/9715293/2013, recognised somewhat fewer of the test viruses but still recognised 90% and 75%, respectively, of the test viruses at titres within 4-fold of the titres of the antisera with their homologous viruses, and 37% and 69%, respectively, at titres within 2-fold of the homologous titres of the antisera.

Antisera raised against the egg-propagated cultivar of A/Hong Kong/4801/2014, the vaccine virus used for the Northern Hemisphere 2017-2018, recognised none of the test viruses at a titre within 4-fold of the titre of the antiserum for the homologous virus; however, the antiserum raise against the egg-propagated cultivar of A/Singapore/INFIMH-16-0019/2016 ( $10^{-4}$  with a predominance of glycine at HA1 position 225 [225G]), recommended for use in the Southern Hemisphere 2018, recognised 67% of the test viruses at titres within 4-fold of the homologous titre of the antiserum, but only 17% at titres within 2-fold of the homologous titre.

Antisera against three subclade 3C.2a1 viruses were also used in the tests although no homologous titres are available for the antisera since the viruses were unable to agglutinate RBCs. These antisera, raised against A/Oman/2585/2016, A/Norway/4436/2016 and A/Greece/4/2017 recognised 60%, 80% and 73%, respectively, of the test viruses collected after 2017-08-31 at titres  $\geq 160$ , a titre similar to the titre of these antisera for most of the reference viruses.

Two antisera were raised against viruses in clade 3C.2a, A/Bretagne/1413/2017 and A/Nantes/1441/2017, in the subgroup with the **HA1** substitutions **T131K, R142K** and **R261Q**. Both were used in **Table 8-9** and the antiserum raised against A/Bretagne/1413/2017 was also used in **Table 8-10**. The antiserum raised against A/Bretagne/1413/2017 recognised 52% of viruses at titres within 4-fold of the titre of the antiserum with the homologous virus, 48% at titres within 2-fold; the antiserum raised against A/Nantes/1441/2017 recognised three of the four viruses analysed with this antiserum at titres within 4-fold of the titre of the antiserum for the homologous virus and one a titre within 2-fold of the homologous titre. Gene sequence data are available for some of the test viruses that were recognised efficiently by these antisera and all shared the **HA1** substitutions **T131K, R142K** and **R261Q**.

Antisera raised against recent egg-propagated viruses and several high yield (growth) reassortant (HY(G)R) viruses have been generated and compared with the parent and other egg-propagated viruses. The results are shown in **Table 8-5**.

### **Virus Neutralisation.**

Plaque reduction neutralisation assays (PRNA) were used to complement HI tests and allowed antigenic characterisation of representative viruses for the many that could not be assayed by HI. **Tables 9-1 to 9-9** show the results of the plaque reduction assays performed since the September 2017 VCM. All test viruses have collection dates after 2017-08-31 with a total of 100 viruses analysed and the genetic clade/subclade to which the viruses belonged was determined for all but three viruses. The final column shows the specific amino acid substitutions in HA1 of the reference and test viruses. The results in **Tables 9-1 to 9-9** show the neutralisation titres as estimated by the software used to score the neutralisation titres and these numbers are shown 'rounded' to the nearest value in a 2-fold dilution series, analogous to the HI assay.

Selected antisera which were raised against five egg-propagated viruses, each of which encode the HA1 egg-adaptive substitutions **T160K (-CHO)** and **L194P**: A/Hong Kong/4801/2014 (clade 3C.2a), the currently used vaccine virus, and two egg-adapted cultivars of A/Singapore/INFIMH-0016-0019/2016, that identified as Egg 10<sup>-4</sup> had a predominance of **D225G** in **HA1** and was used in all the PRNA Tables while that identified as Egg 10<sup>-6</sup> was a mixture (**D225D/G**) and was used in **Tables 9-4 to 9-9**. Antisera raised against the egg-propagated cultivars of A/Norway/4849/2016 (used in **Tables 9-1 to 9-3** only), A/Norway/4465/2017 and A/Norway/3806/2016 (both used in all Tables) were also used. A/Norway/4849/2016 is a clade 3C.2a virus with **HA1** substitutions **N121K** and **S144K** and the additional **HA1** egg-adaptive substitution **D225G**; A/Norway/4465/2017 is also a clade 3C.2a virus but with **HA1** substitutions **T131K**, **R142K** and **R261Q** and the additional egg adaptive substitution of **T203I**; A/Norway/3806/2016 is a subclade 3C.2a1 virus with the **HA1** substitutions **N121K**, **I140M** and **N171K** with no additional egg-adaptive substitutions.

Antisera raised against five cell culture-propagated viruses, three in clade 3C.2a - A/Hong Kong/7295/2014, A/Cote d'Ivoire/544/2016 (with **HA1** substitutions **N121K**, **S144K** and **S198P**) and the cell culture-propagated cultivar of A/Norway/4465 (with **HA1** substitutions **T131K**, **R142K** and **R261Q**), and two in subclade 3C.2a1 - A/Greece/4/2017 (with **HA1** substitutions of **G78D**, **N122D** resulting in the loss of a glycosylation motif at residue **122** and **T135K** resulting in the loss of glycosylation at residue **133**) and A/Singapore/INFIMH-0016-0019/2016, were used.

Test viruses were selected to represent genetic groups within clade 3C.2a and subclade 3C.2a1.

The PRNA results are summarised in **Table 9-6** in which the numbers and percentages of viruses, with the specified amino acid substitutions, recognised by the antisera raised against the reference viruses at titres ≤ 4-fold of the titres of the antisera for their respective homologous viruses are shown.

The summary shows that antisera raised against the reference viruses propagated in eggs recognised the test viruses to various degrees. The antisera raised against egg-propagated A/Hong Kong/4801/2014, the two egg-adapted cultivars of A/Singapore/INFIMH-0016-0019/2016 and egg-propagated A/Norway/3806/2016 recognised 11%, 3%, 3% and 10% of the test viruses at titres within 4-fold of the titres of the antisera with their homologous viruses. However, the antiserum raised against egg-propagated A/Norway/4849/2016, albeit with a low titre for the homologous virus, recognised 24 of the 32 viruses tested with this antiserum at titres within 4-fold of the homologous titre of the antiserum. The antiserum raised against egg-propagated A/Norway/4465/2016 recognised 38% of the test viruses at titres within 4-fold of the titre of the antiserum with the homologous virus, corresponding to 77% of the viruses that carried **HA1** substitutions **N131K**, **R142K** and **R261Q**; viruses that did not carry these substitutions were not recognised well by this antiserum.

Antisera raised against cell culture-propagated A/Hong Kong/7295/2014 (3C.2a), A/Singapore/INFIMH-0016-0019/2016 (3C.2a1) and A/Greece/4/2017 (3C.2a1) recognised the test viruses propagated in cell culture well, recognising 85%, 92% and 93%, respectively, of the test viruses at titres within 4-fold of the titres of the antisera with the homologous viruses. The antiserum raised against A/Cote d'Ivoire/544/2016, with **HA1** substitutions **N121K**, **S144K** and **S198P**, recognised only 66% of the test viruses at titres within 4-fold of the titre of the antiserum for the homologous virus and the antiserum raised against cell culture-propagated A/Norway/4465/2016, with **HA1** substitutions **T131K**, **R142K** and **R261Q**, recognised only 43% of the test viruses at titres within 4-fold of the titre of the antisera with the homologous virus. When assessed by genetic subgroup, the antiserum raised against A/Cote d'Ivoire/544/2016 recognised approximately 60% of the test viruses in clade 3C.2a with the substitutions **T131K**, **R142K** and **R261Q** in **HA1**, all other clade 3C.2a (n=15) viruses and 63% of subclade 3C.2a1 viruses at titres within 4-fold of the titres of the antiserum with the homologous virus. The antiserum raised against A/Norway/4465/2016 recognised 90% of the test viruses in clade 3C.2a with the **HA1** substitutions **T131K**, **R142K** and **R261Q** at titres within 4-fold of the titre of the antiserum for the homologous virus but none of the other clade 3C.2a (n=15) viruses or the subclade 3C.2a1 viruses were recognised well.

### ***Genetic analyses.***

Phylogenetic analysis of the HA genes of representative recently circulating H3N2 viruses is shown in **Figure 6**. The HA genes fell within clade 3C.2a and subclade 3C.2a1 and into different genetic groups within these clades/subclades.

- Clade **3C.2a** viruses are defined by **L3I**, **N128T** (resulting in the gain of a potential glycosylation site), **N144S** (resulting in the loss of a potential glycosylation site), **N145S**, **F159Y**, **K160T** (resulting in the gain of a potential glycosylation site at residue 158), **P198S**, **F219S**, **N225D** and **Q311H** in **HA1**,

e.g. A/Hong Kong/5738/2014. Several subgroups have emerged within clade 3C.2a with HA substitutions:

- **N121K** and **S144K** in **HA1**, with further subgroups of viruses that carry HA genes that encode **N122D** (resulting in the loss of a glycosylation motif at residues **122-124**) and **S262N** in **HA1**, or the substitution **R261Q** in **HA1**, **subclade 3C2a3**
- **T131K, R142K** and **R261Q** in **HA1**, **subclade 3C2a2**
- **N31S, D53N, R142G, S144R, N171K, I192T, Q197H, A304T** in **HA1** and **S113A** in **HA2**, **subclade 3C2a4**
- Subclade **3C.2a1** viruses are defined by the same amino acid substitutions as **3C.2a** viruses but most additionally encode **N121K, N171K** in **HA1** and **I77V** and **G155E** in **HA2**. Several subgroups have emerged within subclade 3C.2a1 with HA substitutions:
  - **K92R** and **H311Q** in **HA1**, with further subgroups of viruses that carry HA genes that encode **I58V** in **HA1**, or **R142G** in **HA1** with further substitutions **E62G** and **T135K** (resulting in the loss of a potential glycosylation site) in **HA1**, **subclade 3C2a1b**
  - **T135K** (resulting in the loss of a potential glycosylation site) in **HA1** and **G150E** in **HA2**, **subclade 3C2a1a**

**Figure 7** shows an HA amino acid sequence alignment for a representative selection of the viruses used to generate the phylogeny. The vaccine viruses A/Hong Kong/4801/2014 and A/Singapore/INFIMH-0016-0019/2016 are shown in red, glycosylation motifs are highlighted, the reference viruses are coloured blue and the HA1/HA2 proteolytic cleavage site is highlighted. The group/subclade to which each of the sequences belongs is also shown.

**Figure 8** shows the location on a 2005 H3 HA structure of amino acid substitutions that define the main genetic subgroups of clade 3C.2a and subclade 3C.2a1 viruses compared with the vaccine virus A/Hong Kong/4801/2014.

**Figure 9** shows a NA phylogenetic tree for representative viruses with their HA genetic groups indicated. **Figure 10** shows a NA amino acid sequence alignment for a representative selection of these viruses. As above, the vaccine virus is shown in red, glycosylation motifs are highlighted, the reference viruses are coloured blue and the clade/subclade to which the corresponding HA gene sequences belong is also shown.

The NA gene sequences of recent viruses with HA genes in genetic clusters within clade 3C.2a and 3C.2a subclades, and in subclade 3C.2a1 and its genetic groups, show similar subclade clustering. There are several subgroups defined by amino acid substitutions:

- **G93D, D339N, P468L**, associated with many **3C2a3** viruses,

- **P468H** with the additional substitution **D339N** are associated with the majority of viruses in genetic groups **3C2a1a**, **3C2a1b**, **3C2a2** and **3C2a4**. The NA gene of the majority of viruses in **3C2a2** have the substitutions **I176M**, **N329S** (resulting in the loss of a glycosylation motif) and **P386S**, and those in **3C2a1** are defined by **K220N**, **V303I** and also **N329S (-CHO)**, with many also carrying the substitution **P126L**.

### **Antiviral resistance**

Phenotypic testing to assess susceptibility to oseltamivir and zanamivir was performed on 154 viruses with collection dates after 2017-08-31. Two viruses showed reduced inhibition by oseltamivir, one of which also showed reduced inhibition by zanamivir (**Table 14**). A/England/74000497/2014 was recovered from an immunocompromised patient who had received antiviral treatment; the NA gene encoded a deletion of four amino acids (**Δ 244-247**) that resulted in highly reduced inhibition (HRI) by oseltamivir and reduced inhibition (RI) by zanamivir. The NA gene of A/Switzerland/822/2017 encoded substitutions of **N329S (-CHO)**, **S334R** and **P386S** and the virus showed RI by oseltamivir.

### **Conclusion.**

Viruses in clade 3C.2a and subclade 3C.2a1 were predominant and just 25% of recovered viruses were able to agglutinate RBCs in the presence of oseltamivir such that they could be characterised by HI assay.

In HI assays that could be carried out, the antiserum raised against a cell culture-propagated clade 3C.2a virus (genetically similar to the vaccine virus A/Hong Kong/4801/2014) recognised test viruses in clade 3C.2a and subclade 3C.2a1 very well. An antiserum raised against the egg-propagated vaccine virus A/Hong Kong/4801/2014 recognised no test viruses at titres within 4-fold of its homologous titre but an antiserum raised against an egg-propagated cultivar of A/Singapore/INFIMH-0016-0019/2016 recognised a majority of viruses more efficiently.

In PRNA, clade 3C.2a and subclade 3C.2a1 test viruses were recognised very well by antisera raised against three clade 3C.2a cell culture-propagated viruses; a virus genetically similar to the A/Hong Kong/4801/2014 vaccine virus, A/Hong Kong/7295/2014, and three recent reference viruses in subclade 3C.2a1 (A/Norway/4465/2016, A/Singapore/INFIMH-0016-0019/2016 and A/Greece/4/2017). An antiserum raised against another recent clade 3C.2a virus, A/Côte d'Ivoire/544/2016, showed somewhat reduced recognition of the test viruses in each genetic clade/subclade. Two antisera raised against cell culture-propagated viruses in clade 3C.2a with the HA1 substitutions **T131K**, **R142K** and **R261Q** recognised test viruses sharing these substitutions well.

In PRNA, antisera raised against the egg-propagated vaccine virus A/Hong Kong/4801/2014 (3C.2a) and the two egg-adapted cultivars of A/Singapore/INFIMH-0016-0019/2016 (3C.2a1) and egg-propagated A/Norway/3806/2016 (3C.2a1) recognised a small minority of the test viruses at titres within 4-fold of the titres of the antisera with the homologous viruses. However, the antisera raised against egg-propagated A/Norway/4849/2016 and A/Norway/4465/2016 (both 3C.2a) recognised a higher proportion of the test viruses; notably the antiserum raised against A/Norway/4465/2016 recognised test viruses with the **HA1** substitutions **T131K**, **R142K** and **R261Q** efficiently.

**Table 6. A(H3N2) viruses recovered from specimens collected after 2017-08-31, as assessed by NA activity (MUNANA-based assay)**

Situation at the time of the February 2018 VCM (viruses with collection dates Sep 2017-Jan 2018)

RBC binding phenotype <sup>1</sup>			HI assay possible	Number of isolates	Number sequenced <sup>2</sup>	Number in clade 3C.3a	Number in clade 3C.2a	Number in clade 3C.2a1
Turkey	Guinea pig	Guinea pig + 20nM oseltamivir						
+	+	+	Yes	23	13 (57%)	1	8	4
-	+	+	Yes	7	5 (71%)	0	3	2
-	-	+	Yes	0	0	0	0	0
+	-	+	Yes	0	0	0	0	0
			<b>Totals</b>	<b>30</b>	<b>18 (60%)</b>	<b>1</b>	<b>11</b>	<b>6</b>
+	+	-	No	16	6 (38%)	0	5	1
+	-	-	No	0	0	0	0	0
-	+	-	No	8	5 (63%)	0	5	0
-	-	-	No	141	103 (73%)	0	61	42
			<b>Totals</b>	<b>165</b>	<b>114 (69%)</b>	<b>0</b>	<b>71</b>	<b>43</b>
			<b>Totals</b>	<b>195</b>	<b>132</b>	<b>1</b>	<b>82</b>	<b>49</b>

1. Negative (-) corresponds to HA titres of <4, while positive (+) corresponds to HA titres of ≥4

2. As of 2018-02-13: a number are still in process

Situation at the time of the September 2017 VCM (viruses with collection dates Jan-Aug 2017)

RBC binding phenotype <sup>1</sup>			HI assay possible	Number of isolates	Number sequenced <sup>2</sup>	Number in clade 3C.3a	Number in clade 3C.2a	Number in clade 3C.2a1
Turkey	Guinea pig	Guinea pig + 20nM oseltamivir						
+	+	+	Yes	49	43 (88%)	5	22	16
-	+	+	Yes	75	46 (61%)	0	17	29
-	-	+	Yes	0	0	0	0	0
+	-	+	Yes	0	0	0	0	0
			<b>Totals</b>	<b>124</b>	<b>89 (72%)</b>	<b>5</b>	<b>39</b>	<b>45</b>
+	+	-	No	21	17 (81%)	0	9	8
+	-	-	No	0	0	0	0	0
-	+	-	No	23	13 (57%)	0	6	7
-	-	-	No	131	104 (79%)	0	58	46
			<b>Totals</b>	<b>175</b>	<b>134 (77%)</b>	<b>0</b>	<b>73</b>	<b>61</b>
			<b>Totals</b>	<b>299</b>	<b>223</b>	<b>5</b>	<b>112</b>	<b>106</b>

1. Negative (-) corresponds to HA titres of <4, while positive (+) corresponds to HA titres of ≥4

2. As of 2017-09-13: a number were still in process

**Table 7. Summary of influenza A(H3N2) viruses analysed, collected after 2017-08-31**

MONTH	Country	Number received <sup>1</sup>	Number propagated <sup>2</sup>	H3N2			Cell-propagated A/Hong Kong/5738/2014 (3C.2a)			Egg-propagated A/Singapore/INFIMH-16-0019/2016 (3C.2a1)					
				Egg-propagated A/Hong Kong/4801/2014 (3C.2a)			Cell-propagated A/Hong Kong/5738/2014 (3C.2a)			Egg-propagated A/Singapore/INFIMH-16-0019/2016 (3C.2a1)					
				≤2 fold <sup>3</sup>	4 fold <sup>3</sup>	≥8 fold <sup>3</sup>	≤2 fold <sup>4</sup>	4 fold <sup>4</sup>	≥8 fold <sup>4</sup>	≤2 fold <sup>5</sup>	4 fold <sup>5</sup>	≥8 fold <sup>5</sup>			
<b>2017</b>															
<b>SEPTEMBER</b>															
Finland		2	0				1	1		1					
Ghana		1	1												
Iran		3	0												
Qatar		4	0												
Sweden		1	0												
United Kingdom		1	0												
Zambia		3	0												
<b>OCTOBER</b>															
Croatia		2	0												
Finland		1	0												
France		7	6				6	5	1		5	1			
Ghana		1	0												
Iran		1	0												
Qatar		6	0												
Slovakia		1	0												
Slovenia		1	1				1	1				1			
Spain		5	0												
Sweden		3	2				2	2							
Switzerland		1	1				1	1		2		1			
United Kingdom		3	0												
<b>NOVEMBER</b>															
Austria		2	0												
Finland		3	0												
France		10	1				1	1			1				
Germany		2	0												
Ghana		1	0												
Iran		4	0												
Ireland		2	0												
Kazakhstan		1	1				1	1							
Latvia		1	1				1	1			1	1			
Portugal		1	0												
Russia		5	1				1		1		1				
Sweden		5	1				1	1			1				
Switzerland		1	0												
Tajikistan		1	0												
United Kingdom		3	0												
Zambia		1	0												
<b>DECEMBER</b>															
Austria		7	0												
Belgium		1	0								1				
Croatia		3	1				1	1							
Finland		1	0												
France		11	2				2	1	1		1	1			
Germany		5	0												
Greece		1	0												
Iceland		8	1				1	1			1				
Israel		9	1				1	1				1			
Kazakhstan		3	1				1	1							
Montenegro		1	0												
Portugal		3	0								1				
Russia		1	1				1	1							
Slovenia		3	1				1	1							
Spain		8	0												
Tajikistan		1	0												
<b>2018</b>															
<b>JANUARY</b>															
Bulgaria		1	0												
Estonia		2	0												
France		1	0												
Iceland		2	2				2	1	1		1	1			
Ireland		4	1				2	1	1						
Israel		2	0												
Italy		2	0												
Norway		6	2				2	2			2				
Russia		1	0												
Slovenia		2	0												
Turkey		3	1				1	1				1			
		182	30	0	0	30		25	5	0	5	14	11		
<b>29 Countries</b>				0.0%	0.0%	100.0%		83.3%	16.7%	0.0%	16.7%	46.7%	36.7%		

1. Numbers shown in red indicate that not all of the specimens received had been propagated at the time this report was prepared

2. Propagated to sufficient titre to perform HI assay in presence of 20nM oseltamivir

3. Compared to homologous titres for ferret antisera raised against egg-propagated A/Hong Kong/4801/2014 (3C.2a)

4. Compared to homologous titres for ferret antisera raised against tissue culture-propagated A/Hong Kong/5738/2014 (3C.2a)

5. Compared to homologous titres for ferret antisera raised against egg-propagated A/Singapore/INFIMH-16-0019/2016 (3C.2a1)

**Table 8-1. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2017-09-22**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre								
				Post-infection ferret antisera								
				A/Stock 6/14 SIAT F14/14 <sup>1</sup> 3C.3a	A/Switz 9715293/13 SIAT F18/15 <sup>1</sup> 3C.3a	A/HK 5738/14 MDCK F30/14 <sup>1</sup> 3C.2a	A/HK 4801/14 MDCK F43/15 <sup>1</sup> 3C.2a	A/HK 4801/14 Egg F12/15 <sup>1</sup> 3C.2a	A/Oman 2585/16 NIB F50/16 <sup>1</sup> 3C.2a1	A/Nor 4436/16 SIAT F03/17 <sup>1</sup> 3C.2a1	A/Greece 4/17 SIAT F27/17 <sup>1</sup> 3C.2a1	
<b>REFERENCE VIRUSES</b>												
A/Stockholm/6/2014	3C.3a	2014-02-06	SIAT1/SIAT2	640	160	160	320	80	320	320	320	160
A/Switzerland/9715293/2013	3C.3a	2013-12-06	SIAT1/SIAT3	640	160	160	160	80	160	320	320	160
A/Hong Kong/5738/2014	3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	80	160	320	160	320	320	320	160
A/Hong Kong/4801/2014	3C.2a	2014-02-26	MDCK4/MDCK2	320	80	160	640	160	320	320	320	320
A/Hong Kong/4801/2014	isolate 1	3C.2a	2014-02-26	E6/E2	80	80	320	640	160	320	160	320
<b>TEST VIRUSES</b>												
A/Hong Kong/2991/2017	3C.2a1	2017-06-27	Cx/SIAT1	320	80	160	160	80	160	320	320	320
A/Hong Kong/3857/2017	3C.2a1	2017-07-22	Cx/SIAT1	160	40	80	160	80	80	80	80	160
A/Hong Kong/4085/2017	3C.2a	2017-07-28	Cx/SIAT1	320	80	320	320	160	320	320	320	320
A/Hong Kong/4181/2017	3C.2a	2017-08-03	Cx/SIAT1	160	40	40	160	80	80	160	160	160

**Table 8-2. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2017-09-27**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre								
				Post-infection ferret antisera								
				A/Stock 6/14 SIAT F14/14 <sup>1</sup> 3C.3a	A/Switz 9715293/13 SIAT F18/15 <sup>1</sup> 3C.3a	A/HK 5738/14 MDCK F30/14 <sup>1</sup> 3C.2a	A/HK 4801/14 MDCK F43/15 <sup>1</sup> 3C.2a	A/HK 4801/14 Egg F12/15 <sup>1</sup> 3C.2a	A/Oman 2585/16 NIB F50/16 <sup>1</sup> 3C.2a1	A/Nor 4436/16 SIAT F03/17 <sup>1</sup> 3C.2a1	A/Greece 4/17 SIAT F27/17 <sup>1</sup> 3C.2a1	
<b>REFERENCE VIRUSES</b>												
A/Stockholm/6/2014	3C.3a	2014-02-06	SIAT1/SIAT2	320	160	80	160	80	160	160	160	160
A/Switzerland/9715293/2013	3C.3a	2013-12-06	SIAT1/SIAT3	160	160	80	80	40	160	160	160	160
A/Hong Kong/5738/2014	3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	80	160	320	160	160	320	320	160
A/Hong Kong/4801/2014	3C.2a	2014-02-26	MDCK4/MDCK2	160	80	80	160	80	160	160	160	320
A/Hong Kong/4801/2014	isolate 1	3C.2a	2014-02-26	E6/E2	160	80	320	640	320	640	320	640
<b>TEST VIRUSES</b>												
A/Oman/20/2016	3C.2a1	2016-12-28	SIAT1/SIAT1	40	<	40	40	<	40	40	40	80
A/Oman/47/2016	3C.2a1	2016-12-28	SIAT1/SIAT1	<	<	<	40	<	40	40	80	40
A/Oman/74/2016	3C.2a	2016-12-28	SIAT1/SIAT1	160	40	80	80	40	80	80	160	160
A/Oman/4/2016	3C.2a1	2016-12-29	SIAT1/SIAT1	80	<	80	80	80	40	80	80	80
A/Oman/24/2016	3C.2a1	2016-12-29	SIAT1/SIAT1	<	<	<	<	<	<	40	<	80
A/Oman/57/2017	3C.2a	2017-01-02	SIAT1/SIAT1	160	80	160	160	80	160	160	160	320
A/Oman/182/2017	3C.2a	2017-01-08	SIAT2/SIAT1	160	40	80	80	40	80	80	80	160
A/Oman/223/2017	3C.2a1	2017-01-08	SIAT2/SIAT1	<	<	40	40	<	40	40	40	80
A/Oman/473/2017	3C.2a1	2017-01-19	SIAT1/SIAT1	80	<	40	80	40	80	80	80	80
A/Hong Kong/4119/2017	3C.2a1	2017-07-28	Cx/SIAT1	160	80	80	80	80	80	160	160	160

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used) <sup>1</sup> < = <40

Sequences in phylogenetic trees

Vaccine  
NH 2017-18

**Table 8-3. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2017-10-24**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre								
				Post-infection ferret antisera								
				A/Stock 6/14 SIAT F14/14 <sup>1</sup> 3C.3a	A/Switz 9715293/13 SIAT F18/15 <sup>1</sup> 3C.3a	A/HK 5738/14 MDCK F30/14 <sup>1</sup> 3C.2a	A/HK 4801/14 MDCK F43/15 <sup>1</sup> 3C.2a	A/HK 4801/14 Egg F12/15 <sup>1</sup> 3C.2a	A/Oman 2585/16 SIAT NIB F50/16 <sup>1</sup> 3C.2a1	A/Nor 4436/16 SIAT F03/17 <sup>1</sup> 3C.2a1	A/Greece 4/17 SIAT F27/17 <sup>1</sup> 3C.2a1	
<b>REFERENCE VIRUSES</b>												
A/Stockholm/6/2014		3C.3a	2014-02-06	SIAT1/SIAT2	320	160	160	160	80	320	160	320
A/Switzerland/9715293/2013		3C.3a	2013-12-06	SIAT1/SIAT3	320	160	160	80	40	160	160	160
A/Hong Kong/5738/2014		3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	80	160	640	160	320	320	320
A/Hong Kong/4801/2014		3C.2a	2014-02-26	MDCK4/MDCK3	320	160	160	320	80	320	320	320
A/Hong Kong/4801/2014	isolate 1	3C.2a	2014-02-26	E6/E2	80	40	320	640	640	640	160	640
<b>TEST VIRUSES</b>												
A/Mauritius/621/2017		3C.2a	2017-06-24	MDCKx /SIAT1	<	<	80	160	<	160	160	80
A/Cote D'Ivoire/870/2017		3C.2a	2017-06-30	C2/SIAT1	160	80	160	160	40	160	160	320
A/Cote D'Ivoire/960/2017		3C.2a	2017-07-20	C2/SIAT1	160	80	160	320	40	160	160	320
A/Cote D'Ivoire/1040/2017		3C.2a	2017-07-28	C2/SIAT1	<	<	80	80	<	160	80	160
A/Cote D'Ivoire/1045/2017		3C.2a	2017-07-31	C2/SIAT1	160	80	160	320	80	320	160	320
Vaccine NH 2017-18												

**Table 8-4. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2017-11-17**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre								
				Post-infection ferret antisera								
				A/Stock 6/14 SIAT F14/14 <sup>1</sup> 3C.3a	A/Switz 9715293/13 SIAT F18/15 <sup>1</sup> 3C.3a	A/HK 5738/14 MDCK F30/14 <sup>1</sup> 3C.2a	A/HK 4801/14 MDCK F43/15 <sup>1</sup> 3C.2a	A/HK 4801/14 Egg F42/15 <sup>1</sup> 3C.2a	A/Oman 2585/16 SIAT NIB F50/16 <sup>1</sup> 3C.2a1	A/Nor 4436/16 SIAT F03/17 <sup>1</sup> 3C.2a1	A/Greece 4/17 SIAT F27/17 <sup>1</sup> 3C.2a1	A/Sing 0019/16 Egg 10 <sup>-4</sup> F41/17 <sup>1</sup> 3C.2a1
<b>REFERENCE VIRUSES</b>												
A/Stockholm/6/2014		3C.3a	2014-02-06	SIAT1/SIAT2	320	160	160	160	80	320	160	320
A/Switzerland/9715293/2013		3C.3a	2013-12-06	SIAT1/SIAT3	320	160	160	80	40	160	160	ND
A/Hong Kong/5738/2014		3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	80	160	640	160	320	320	ND
A/Hong Kong/4801/2014		3C.2a	2014-02-26	MDCK4/MDCK3	320	160	160	320	80	320	320	ND
A/Hong Kong/4801/2014	isolate 1	3C.2a	2014-02-26	E6/E2	80	40	320	640	1280	640	320	2560
A/Singapore/INFIMH-16-0019/2016		3C.2a1	2016-06-14	E5/E2	<	ND	80	320	320	80	320	1280
<b>TEST VIRUSES</b>												
A/Armenia/11/2017		3C.2a1	2016-12-02	MDCKx/SIAT1	80	80	80	160	40	80	160	160
A/Armenia/12/2017		3C.2a1	2016-12-02	MDCK1/SIAT1	160	80	80	320	40	80	160	320
A/Armenia/1/2017		3C.2a1	2016-12-06	MDCK1/SIAT1	160	80	80	320	40	160	160	320
A/Armenia/10/2017		3C.2a1	2016-12-23	MDCK1/SIAT1	320	80	160	320	80	160	320	320
A/Armenia/4/2017		3C.2a	2016-12-27	MDCK1/SIAT1	160	80	160	160	40	160	320	160
A/Armenia/3/2017		3C.2a1	2016-12-28	MDCK1/SIAT1	320	160	160	320	80	320	320	320
A/Switzerland/882/2017		3C.2a	2017-10-11	SIAT1	320	160	160	320	40	160	160	40
* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used) <sup>1</sup> < = <40									Vaccine NH 2017-18			
ND = Not Done									Vaccine SH 2018			
Sequences in phylogenetic trees									Vaccine SH 2018			

**Table 8-5. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2017-11-17**

Viruses	Other information	Passage history Ferret number Genetic group	Collection date	Passage history	Haemagglutination inhibition titre												
					Post-infection ferret antisera												
					A/HK 4801/14 Egg F42/15 <sup>1</sup> 3C.2a	A/Norway 3806/16 Egg NIB F45/16 <sup>1</sup> 3C.2a1	NYMC X-295 (A/Nor/3806/16) Egg F17/17 <sup>1</sup> 3C.2a1	A/HK 50/16 Egg NIB F44/16 <sup>1</sup> 3C.2a1	NYMC X-297 (A/HK/50/16) Egg F19/17 <sup>1</sup> 3C.2a1	A/Greece 4/17 Egg F28/17 <sup>1</sup> 3C.2a1	NYMC X-303 (A/Greece/4/17) Egg F43/17 <sup>1</sup> 3C.2a1	A/Sing 0019/16 Egg 10 <sup>-4</sup> F41/17 <sup>1</sup> 3C.2a1	A/Sing 0019/16 Egg 10 <sup>-6</sup> F42/17 <sup>1</sup> 3C.2a1	NIB 104 A/Sing/19/16 Egg F12/17 <sup>1</sup> 3C.2a1			
<b>REFERENCE VIRUSES</b>																	
A/Hong Kong/4801/2014	isolate 1	3C.2a	2014-02-26	E6/E2	1280	320	2560	160	5120	2560	2560	5120	5120	640	320		
ANorway/3806/2016	isolate 1 clone 25	3C.2a1	2016-06-13	E9	1280	320	1280	160	10240	2560	5120	5120	5120	640	320		
NIB-103 (ANorway/3806/2016)		3C.2a1	2016-06-13	Ex	1280	320	2560	160	5120	1280	5120	5120	5120	640	160		
NYMC X-295 (ANorway/3806/2016)		3C.2a1	2016-06-13	Ex	1280	320	1280	ND	ND	1280	ND	2560	640	ND			
A/Hong Kong/50/2016	clone 38	3C.2a1	2015-12-30	E9	1280	320	2560	160	2560	1280	1280	5120	640	320	320		
NYMC X-297 (A/Hong Kong/50/2016)		3C.2a1	2015-12-30	Ex	640	320	640	160	2560	640	640	1280	640	160			
A/Greece/4/2017	clone 49	3C.2a1	2017-01-02	E9	640	320	640	160	5120	2560	2560	2560	2560	320	320		
NYMC X-303 (hy A/Greece/4/2017)		3C.2a1	2017-01-02	Ex	1280	320	2560	320	2560	2560	2560	2560	2560	320	320		
NYMC X-303A (hy A/Greece/4/2017)		3C.2a1	2017-01-02	Ex	640	320	2560	160	2560	5120	5120	2560	320	320			
A/Singapore/INFIMH-16-0019/2016	10 <sup>-4</sup>	3C.2a1	2016-06-14	E5/E2	320	160	640	80	1280	640	640	1280	1280	320	160		
A/Singapore/INFIMH-16-0019/2016	10 <sup>-6</sup>	3C.2a1	2016-06-14	E5/E2	640	320	640	80	5120	640	2560	2560	640	160			
NIB 104 (ASingapore/INFIMH-16-0019/2016)	AUS	3C.2a1	2016-06-14	E8/E1	320	160	640	80	1280	640	640	1280	320	160			
IVR 186 (ASingapore/INFIMH-16-0019/2016)	AUS	3C.2a1	2016-06-14	E5/D7/E1	640	320	640	80	1280	640	640	2560	640	160			
Vaccine NH 2017-18												Vaccine SH 2018					

**Table 8-6. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2017-12-15**

Viruses	Other information	Passage history Ferret number Genetic group	Collection date	Passage history	Haemagglutination inhibition titre													
					Post-infection ferret antisera													
					A/Stock 6/14 SIAT F14/14 <sup>1</sup> 3C.3a	A/Switz 9715293/13 SIAT F18/15 <sup>1</sup> 3C.3a	A/HK 5738/14 SIAT F30/14 <sup>1</sup> 3C.2a	A/HK 4801/14 Egg F42/15 <sup>1</sup> 3C.2a	A/Oman 2585/16 SIAT NIB F50/16 <sup>1</sup> 3C.2a1	A/Nor 4436/16 SIAT F03/17 <sup>1</sup> 3C.2a1	A/Greece 4/17 SIAT F27/17 <sup>1</sup> 3C.2a1	A/Sing 0019/16 Egg 10 <sup>-4</sup> F41/17 <sup>1</sup> 3C.2a1						
<b>REFERENCE VIRUSES</b>																		
A/Stockholm/6/2014		3C.3a	2014-02-06	SIAT1/ SIAT2	320	160	160	80	160	320	160	160	160	160	160	160		
A/Switzerland/9715293/2013		3C.3a	2013-12-06	SIAT1/ SIAT3	320	160	80	40	160	160	160	160	160	80	80			
A/Hong Kong/5738/2014		3C.2a	2014-04-30	CK1/MDCK2/ SIAT3	160	80	160	80	160	160	320	160	160	320	320	320		
A/Hong Kong/4801/2014	isolate 1	3C.2a	2014-02-26	E6/E2	80	40	320	1280	640	320	640	320	640	2560	2560			
A/Singapore/INFIMH-16-0019/2016		3C.2a1	2016-06-14	E5/E2	40	40	40	320	160	80	160	80	160	160	640			
<b>TEST VIRUSES</b>																		
A/Iran/75924/2017			2017-01-22	SIAT2/ SIAT1	80	80	80	40	80	160	160	160	160	160	160	160		
A/Iran/78090/2017			2017-02-12	SIAT2/ SIAT2	<	<	40	<	80	80	80	80	160	<				
A/Bretagne/1413/2017		3C.2a	2017-10-09	MDCK1/ SIAT1	160	80	160	40	160	160	160	160	160	160	160	160	160	
A/Nantes/1441/2017		3C.2a	2017-10-10	MDCK2/ SIAT1	80	80	80	40	160	160	160	160	160	160	160	160	160	
Vaccine NH 2017-18												Vaccine SH 2018						

\* Superscripts refer to antisera properties (< relates to the lowest dilution of antisera used) <sup>1</sup> < = <40

ND = Not Done

Sequences in phylogenetic trees

**Table 8-7. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2018-01-09**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre																	
				Post-infection ferret antisera																	
				A/Stock 6/14	A/Switz 9715293/13	A/HK 5738/14	A/HK 4801/14	A/Oman 2585/16	A/Nor 4436/16	A/Greece 4/17	A/Sing 0019/16	A/Nor 4293/17	A/Nor 4465/17	A/Nor 4465/17	A/HK 4018/17						
				SIAT	SIAT	MDCK	Egg	SIAT	SIAT	SIAT	Egg 10 <sup>-4</sup>	SIAT	SIAT	SIAT	SIAT						
<b>REFERENCE VIRUSES</b>				F14/14 <sup>1</sup>	F18/15 <sup>1</sup>	F30/14 <sup>1</sup>	F42/15 <sup>1</sup>	NIB F50/16 <sup>1</sup>	F03/17 <sup>1</sup>	F27/17 <sup>1</sup>	F41/17 <sup>1</sup>	F04/17 <sup>1</sup>	F11/17 <sup>1</sup>	F12/17 <sup>1</sup>	F48/17 <sup>1</sup>						
<i>A/Stockholm/6/2014</i>				3C.3a	3C.3a	3C.2a	3C.2a	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a	3C.2a	3C.2a	3C.2a						
<i>A/Switzerland/9715293/2013</i>				3C.3a	3C.3a	320	160	160	320	320	160	320	80	40	<	160					
<i>A/Hong Kong/5738/2014</i>				3C.2a	3C.2a	320	80	320	320	320	160	320	320	160	80	320					
<i>A/Hong Kong/4801/2014</i>				isolate 1	3C.2a	2014-02-26	E6/E2	40	320	640	320	160	320	2560	640	320	1280				
<i>A/Singapore/INFIMH-16-0019/2016</i>				3C.2a1	2016-06-14	E5/E2	<	40	160	160	80	160	640	40	40	320	80				
<i>A/Norway/4465/2016</i>				3C.2a	2016-11-07	E6	<	<	160	640	320	160	640	2560	2560	2560	2560				
<i>A/Bretagne/1413/2017</i>				For ferrets	3C.2a	2017-10-09	MDCK1/SIAT3	320	80	160	80	320	320	160	320	640	1280				
<i>A/Nantes/1441/2017</i>				For ferrets	3C.2a	2017-10-10	MDCK2/SIAT2	320	80	160	80	320	320	160	320	640	160				
<b>TEST VIRUSES</b>																					
<i>A/Ghana/2717/2017</i>				3C.2a	2017-09-15	C2/SIAT1	320	80	160	80	320	320	160	320	160	40	160				
<i>A/Uppsala/2/2017</i>				3C.2a1	2017-10-03	MDCK1/SIAT1	160	80	160	40	160	320	160	320	160	160	<	160			
<i>A/Stockholm/43/2017</i>				3C.2a1	2017-10-17	MDCK2/SIAT1	160	80	160	80	160	160	160	320	80	160	40	160			
<i>A/Latvia/11-002559/2017</i>				3C.2a	2017-11-01	MDCK2/SIAT1	160	80	160	80	160	160	160	160	640	640	160	640			
<i>A/Stockholm/44/2017</i>				3C.2a1	2017-11-03	MDCK1/SIAT1	160	80	160	40	160	160	160	320	80	40	<	80			
<i>A/Astrakhan/32/2017</i>				3C.2a1	2017-11-08	MDCK1/SIAT1	80	40	80	<	80	80	160	320	40	<	<	40			

**Table 8-8. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2018-01-19**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre															
				Post-infection ferret antisera															
				SIAT	SIAT	MDCK	Egg	SIAT	SIAT	SIAT	Egg 10 <sup>-4</sup>	SIAT	SIAT	SIAT	SIAT				
				F14/14 <sup>1</sup>	F18/15 <sup>1</sup>	F30/14 <sup>1</sup>	F42/15 <sup>1</sup>	NIB F50/16 <sup>1</sup>	F03/17 <sup>1</sup>	F27/17 <sup>1</sup>	F41/17 <sup>1</sup>	F04/17 <sup>1</sup>	F11/17 <sup>1</sup>	F12/17 <sup>1</sup>	F48/17 <sup>1</sup>				
<b>REFERENCE VIRUSES</b>				3C.3a	3C.3a	320	160	160	80	320	320	320	320	320	320	320			
<i>A/Stockholm/6/2014</i>				3C.3a	2014-02-06	SIAT1/SIAT3	320	160	160	80	320	320	320	320	160	160			
<i>A/Switzerland/9715293/2013</i>				3C.3a	2013-12-06	SIAT1/SIAT3	320	160	80	40	160	320	160	160	160	160			
<i>A/Hong Kong/5738/2014</i>				3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	320	80	160	160	320	320	320	320	640	640			
<i>A/Hong Kong/4801/2014</i>				isolate 1	3C.2a	2014-02-26	E6/E2	160	80	320	1280	640	320	640	5120	5120			
<i>A/Singapore/INFIMH-16-0019/2016</i>				3C.2a1	2016-06-14	E5/E2	40	40	320	320	160	160	320	320	1280	1280			
<b>TEST VIRUSES</b>																			
<i>A/Kanagawa/ZC1617/2017</i>				3C.2a1	2017-02-23	NIID-MDCK3/E3/E1	40	<	160	40	160	320	80	320	320	320			
<i>A/Slovenia/2269/2017</i>				3C.2a1	2017-10-06	SIATx/SIAT1	160	40	80	40	80	160	160	160	160	160			
<i>A/Israel/SK521/2017</i>				3C.2a	2017-12-24	C1/SIAT1	80	40	80	40	160	160	80	80	80	80			
<i>A/Slovenia/2792/2017</i>				3C.2a	2017-12-29	SIATx/SIAT1	40	40	80	40	160	160	80	80	160	160			

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used)  
1 < = <40  
Sequences in phylogenetic trees

Vaccine  
NH 2017-18

Vaccine  
SH 2018

**Table 8-9. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2018-01-26 + 2018-02-02**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera								NEW			
				A/Stock 6/14 SIAT	A/Switz 9715293/13 SIAT	A/HK 573B/14 MDCK	A/HK 480/14 Egg	A/Oman 2585/16 SIAT	A/Nor 4436/16 SIAT	A/Greece 4/17 SIAT	A/Sing 0019/16 Egg 10 <sup>4</sup>	A/Bretagne 1413/17 F41/17 <sup>1</sup>	A/Nantes F01/18 <sup>1</sup>		
<b>REFERENCE VIRUSES</b>															
A/Stockholm/6/2014	isolate 1	3C.3a	2014-02-06	SIAT1/SIAT3	320	80	160	80	160	160	160	160	80	80	80
A/Switzerland/9715293/2013		3C.3a	2013-12-06	SIAT1/SIAT3	320	80	80	40	160	160	160	80	80	80	80
A/Hong Kong/573B/2014		3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	40	160	80	160	160	160	80	160	160	160
A/Hong Kong/480/2014		3C.2a	2014-02-26	E6/E2	40	40	320	640	320	160	320	2560	640	320	ND
A/Singapore/INFIMH-16-0019/2016		3C.2a1	2016-06-14	E5/E2	<	<	40	160	80	80	80	160	640	80	80
A/Bretagne/1413/2017		3C.2a	2017-10-09	MDCK1/SIAT4	160	40	160	80	160	160	160	320	1280	640	640
A/Nantes/1441/2017		3C.2a	2017-10-10	MDCK2/SIAT3	320	80	160	160	320	320	160	320	1280	1280	1280
<b>TEST VIRUSES</b>															
A/Croatia/3608/2017		3C.2a	2017-12-12	MDCKx/SIAT2	80	40	80	40	160	160	160	160	640	320	
A/Toulon/2533/2017		3C.2a	2017-12-18	MDCK2/SIAT2	80	ND	40	<	40	80	160	80	40	ND	
A/Novosibirsk/265/2017		3C.2a1	2017-12-24	MDCK1/SIAT1	160	ND	80	40	80	160	160	160	80	ND	
A/Iceland/136/2017		3C.2a	2017-12-27	MDCK1/SIAT1	160	40	80	40	160	160	160	160	640	320	
A/Iceland/03/2018		3C.2a	2018-01-02	MDCK1/SIAT1	80	40	80	40	160	160	160	80	640	640	
A/Ankara/22/2018		3C.3a	2018-01-03	SIAT1/SIAT1	160	ND	80	40	80	160	160	80	80	ND	
A/Iceland/08/2018		3C.2a	2018-01-04	MDCK1/SIAT1	80	<	40	<	80	160	80	80	320	160	
												Vaccine NH 2017-18	Vaccine SH 2018		

**Table 8-10. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) 2018-02-09**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera								NEW			
				A/Stock 6/14 SIAT	A/HK 573B/14 MDCK	A/HK 480/14 Egg	A/Bretagne 1413/17 SIAT	A/Oman 2585/16 SIAT	A/Nor 4436/16 SIAT	A/Greece 4/17 SIAT	A/Sing 0019/16 Egg 10 <sup>4</sup>	A/Bretagne 1413/17 F41/17 <sup>1</sup>	A/Nor 4/17 F03/17 <sup>1</sup>	A/Greece 27/17 <sup>1</sup> F27/17 <sup>1</sup>	A/Sing 3C.2a1
<b>REFERENCE VIRUSES</b>															
A/Stockholm/6/2014	isolate 1	3C.3a	2014-02-06	SIAT1/SIAT2	320	160	80	160	160	320	160	160	160	160	160
A/Hong Kong/573B/2014		3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	160	80	160	320	320	320	160	320	320	ND
A/Hong Kong/480/2014		3C.2a	2014-02-26	E6/E2	40	320	640	640	640	320	320	320	320	1280	
A/Bretagne/1413/2017		3C.2a	2017-10-09	MDCK1/SIAT4	160	80	80	640	160	320	160	160	160	160	
A/Singapore/INFIMH-16-0019/2016		3C.2a1	2016-06-14	E5/E1	40	40	160	80	160	160	160	160	160	640	
<b>TEST VIRUSES</b>															
A/Wisconsin/19/2017		P55	2017-01-23	SIAT2/SIAT1	160	160	40	320	320	320	320	160	80	80	
A/Wisconsin/19/2017		P55	2017-01-23	E6/E1	<	80	160	1280	160	80	160	160	640		
A/Zhejiang-Nanhu/1745/2017		P55	2017-09-11	C2/S1/SIAT1	160	80	40	80	80	160	160	160	160	160	
A/Fujian-Licheng/1729/2017		P55	2017-09-11	C2/S1/SIAT1	40	40	<	40	40	40	40	40	40	40	
A/Lyon/CHU/R17.50.96/2017		P57	2017-10-06	MDCK2/SIAT1	80	80	40	40	80	80	80	80	80	80	
A/Lyon/CHU/R17.52.95/2017		P57	2017-10-06	MDCK2/SIAT1	80	40	<	40	40	40	40	80	80	160	
A/Liaoning-Yinzhou/1399/2017		P55	2017-10-06	C2/S1/SIAT1	80	80	40	320	160	160	160	160	160	80	
A/Desgenettes/194/2017		P57	2017-10-08	MDCK4/SIAT1	160	80	40	40	80	80	80	80	160	160	
A/Poitiers/2028/2017		P57	2017-10-20	MDCK2/SIAT1	160	160	80	640	160	160	160	160	160	160	
A/Marseille/2195/2017		P55	2017-11-16	MDCK3/SIAT1	80	80	<	40	80	80	80	80	160	160	
A/Uralsk/496/2017		P55	2017-11-23	MDCKx/SIAT1	40	80	40	320	160	160	160	80	80	80	
A/Aubenas/2399/2017		P55	2017-12-11	MDCK3/SIAT1	80	80	40	320	160	160	160	160	160	160	
A/Akmolinsk/145/2017		P55	2017-12-25	MDCKx/SIAT1	80	80	<	320	80	160	160	160	160	80	
A/Ireland/01234/2018		P55	2018-01-02	SIAT3	80	40	<	80	80	160	160	80	80	80	
A/Norway/234/2018		P57	2018-01-08	SIAT1/SIAT1	160	160	40	640	160	320	320	160	160	160	
A/Norway/279/2018		P57	2018-01-13	MDCK1/SIAT1	160	160	40	320	320	320	320	320	320	160	
												Vaccine NH 2017-18	Vaccine SH 2018		

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used) <sup>1</sup> < = <40

ND = Not Done

Sequences in phylogenetic trees

Table 8-11. Antigenic analyses of influenza A(H3N2) viruses (Guinea Pig RBC with 20nM Oseltamivir) with collection dates after 2016-08-31 - Summary

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				A/Stock 6/14	A/Switz 9715293/13	A/HK 5738/14	A/HK 4801/14	A/Oman 2585/16	A/Nor 4436/16	A/Greece 4/17	A/Sing 0019/16	A/Bret 1413/17	A/Nantes 1441		
				SIAT	SIAT	MDCK	Egg	SIAT	SIAT	SIAT	Egg 10 <sup>4</sup>	SIAT	SIAT		
	Passage history			F14/14 <sup>1</sup>	F18/15 <sup>1</sup>	F30/14 <sup>1</sup>	F42/15 <sup>1</sup>	NIB F50/16 <sup>1</sup>	F03/17 <sup>1</sup>	F27/17 <sup>1</sup>	F41/17 <sup>1</sup>	F01/18 <sup>1</sup>	F02/18 <sup>1</sup>		
	Ferret number			3C.3a	3C.3a	3C.2a	3C.2a	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a	3C.2a		
	Genetic group														
<b>REFERENCE VIRUSES</b>															
A/Stockholm/6/2014	3C.3a	2014-02-06	SIAT1/SIAT3	320	80	160	80	160	160	160	160	80	80		
A/Switzerland/9715293/2013	3C.3a	2013-12-06	SIAT1/SIAT3	320	80	80	40	160	160	160	80	80	80		
A/Hong Kong/5738/2014	3C.2a	2014-04-30	MDCK1/MDCK2/SIAT3	160	40	160	80	160	160	160	80	80	160	160	
A/Hong Kong/4801/2014 isolate 1	3C.2a	2014-02-26	E6/E2	40	40	320	640	320	160	320	2560	640	320		
A/Singapore/INFIMH-16-0019/2016	3C.2a1	2016-06-14	E5/E2	<	<	40	160	80	80	160	640	80	80		
A/Bretagne/1413/2017	3C.2a	2017-10-09	MDCK1/SIAT4	160	40	160	80	160	160	160	320	1280	1280		
A/Nantes/1441/2017	3C.2a	2017-10-10	MDCK2/SIAT3	320	80	160	160	320	320	160	320	1280	1280		
<b>TEST VIRUSES</b>															
<b>Number of viruses tested</b>				30	16	30	30	30*	30*	30*	30	21	4		
No with titre reduction ≤2-fold				11	11	25		18	24	22	5	10	1		
%				36.7	68.8	83.3		60.0	80.0	73.3	16.7	47.6	25.0		
No with titre reduction =4-fold				16	1	5					15	1	2		
%				53.3	6.2	17.7					50.0	4.8	50.0		
No with titre reduction ≥8-fold				3	4		30				10	10	1		
%				10.0	25.0		100.0				33.3	47.6	25.0		
<b>Number of clade 3C.2a viruses tested</b>				12	10	12	12	12*	12*	12*	12				
No with titre reduction ≤2-fold				4	8	10		10	11	8	1				
%				33.3	80.0	83.3		83.3	91.7	66.7	8.3				
No with titre reduction =4-fold				7		2					7				
%				58.3		16.7									
No with titre reduction ≥8-fold				1	2		12				4				
%				8.3	20.0		100								
<b>Number of clade 3C.2a1 viruses tested</b>				6	5	6	6	6*	6*	6*	6				
No with titre reduction ≤2-fold				2	3	5		3	5	6	4				
%				33.3	60.0	83.3		50.0	83.3	100.0	66.7				
No with titre reduction =4-fold				3	1	1					1				
%				50	20.0	16.7					16.7				
No with titre reduction ≥8-fold				1	1		6				1				
%				16.7	20.0		100.0				16.7				

Vaccine  
NH 2017-18

Vaccine  
SH 2018

\* Homologous HI titres not available - only results for viruses yielding HI titres of ≥160 with the respective antisera are shown

Reference virus results are taken from individual tables as exampleS. Summaries for each antiserum are based on fold-reductions observed on the days that HI assays were performed.

Table 9-1. Antigenic analysis of influenza A(H3N2) viruses - Plaque Reduction Neutralisation (MDCK-SIAT) 2018-01-11 + 2018-01-15

Viruses	Collection Date	Passage History	Neutralisation titre <sup>1</sup>																HA1 substitutions for 3C.2a(1) viruses compared to A/Hong Kong/4801/2014: Egg adaptation HA substitutions compared to the corresponding cell isolate				
			Post-infection ferret antisera																				
			A/HK 4801/14		A/HK 7295/14		A/Côte d'Ivoire SIAT		A/Norway 4849/16		A/Norway 4465/16		A/Norway 4465/16		A/Singapore INFIMH-16-0019/16		A/Singapore INFIMH-16-0019/16		A/Greece 4/17				
			Egg F42/15	3C.2a	Egg F02/15	3C.2a	NIB F54/16	3C.2a	Egg F23/17	3C.2a	Egg F11/17	3C.2a	Egg F12/17	3C.2a	Egg 10 <sup>-4</sup> F41/17	3C.2a1	SIAT F45/17	3C.2a1	SIAT F27/17	3C.2a1	Egg NIB F45/16	3C.2a1	
			2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read				
<b>REFERENCE VIRUSES</b>																							
A/Hong Kong/4801/2014	3C.2a	2014-02-26	E7	320	469	320	306	160	170	640	900	640	501	2560	3525	5120	4838	640	888	640	535	640	619
A/Hong Kong/7295/2014	3C.2a	2014-08-07	SIAT2	40	55	640	484	320	451	80	100	640	696	80	62	320	262	2560	2055	1280	1695	80	115
A/Côte d'Ivoire/544/2016	3C.2a	2016-04-06	P1/SIAT3	40	40	640	676	640	938	320	364	640	900	80	67	160	195	1280	1539	1280	1797	160	129
A/Norway/4849/2016 (cl29)	3C.2a	2016-12-02	E7	40	44	40	41	40	54	160	132	40	20	160	148	640	524	40	50	80	66	80	67
A/Norway/4465/2016	3C.2a	2016-11-07	SIAT2	80	109	320	409	320	470	80	75	5120	6662	2560	1982	80	73	1280	1173	1280	1024	80	94
A/Norway/4465/2016	3C.2a	2016-11-07	E6	160	235	320	272	160	134	320	378	2560	2149	2560	2642	1280	1124	320	242	320	311	160	205
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-4</sup> )	3C.2a1	2016-06-14	E5/E2	80	80	80	72	40	34	160	135	40	40	640	737	1280	1676	320	268	320	247	160	238
A/Singapore/INFIMH-16-0019/2016	3C.2a1	2016-06-14	MDCK1/SIAT6	<	7	640	501	160	157	40	40	640	742	40	40	80	95	2560	2429	2560	2067	80	72
A/Greece/4/2017	3C.2a1	2017-01-02	SIAT4	40	40	160	215	80	102	40	40	640	795	40	41	80	77	1280	1173	1280	1632	80	75
A/Norway/3806/2016	3C.2a1	2016-06-13	E9	640	504	320	386	160	230	320	445	320	243	2560	2448	5120	4937	1280	1109	640	579	640	612
<b>TEST VIRUSES</b>																							
A/Norway/3375/2017		2017-11-01	SIAT1	40	20	640	663	640	704	80	96	1280	1545	160	129	640	576	2560	2723	2560	2194	160	154
A/Skovde/2/2017	3C.2a	2017-09-29	MDCK0/SIAT1	40	59	320	377	160	211	80	65	5120	6737	1280	1493	80	73	1280	1474	640	556	80	67
A/Norway/3242/2017	3C.2a	2017-10-06	SIAT1/SIAT1	80	66	320	297	160	231	40	40	2560	3751	640	930	80	80	1280	1009	640	640	40	40
A/Nantes/1441/2017	3C.2a	2017-10-10	MDCK2/SIAT2	40	20	80	78	40	57	40	40	1280	1002	320	289	80	72	320	314	80	115	40	49
A/Karlstad/5/2017	3C.2a	2017-10-10	MDCK1/SIAT1	40	20	80	93	40	52	40	40	1280	1193	640	488	80	101	320	384	160	124	40	51
A/Norway/3278/2017	3C.2a	2017-10-15	SIAT1	40	57	320	304	320	291	40	51	2560	3470	640	687	80	68	1280	1128	640	747	40	40
A/Norway/3353/2017	3C.2a	2017-10-23	SIAT1	80	68	160	236	320	264	40	40	2560	3712	640	864	80	79	1280	1152	1280	1376	40	40
A/Norway/3305/2017	3C.2a	2017-10-25	SIAT1	80	76	640	610	640	853	80	60	5120	4960	1280	1047	80	73	2560	2184	2560	2095	40	43
A/Eskilstuna/1/2017	3C.2a	2017-11-19	MDCK0/SIAT1	40	47	320	254	160	157	40	55	2560	3632	640	800	80	98	1280	1358	640	491	80	69
A/Eskilstuna/2/2017	3C.2a	2017-11-20	MDCK0/SIAT1	80	74	320	450	320	256	40	56	5120	4459	2560	2133	160	154	1280	1506	640	800	80	64
A/Bretagne/1487/2017	3C.2a	2017-11-06	MDCK2/SIAT2	80	74	80	112	160	134	80	67	1280	1707	640	524	80	86	640	640	320	386	80	70
A/Bretagne/1413/2017	3C.2a	2017-10-09	MDCK2/SIAT2	40	40	80	60	40	57	40	48	1280	1219	320	283	80	102	320	250	80	60	40	58
A/Switzerland/882/2017	3C.2a	2017-10-11	SIAT1	40	49	80	94	80	76	40	56	2560	2038	640	585	80	77	640	500	320	434	80	68
A/Qatar/10-VI-17-0044907/2017	3C.2a	2017-10-15	SIAT1	40	20	320	251	320	453	<	5	1280	996	40	57	80	117	1280	1387	1280	1067	160	146
A/Qatar/10-VI-17-0045513/2017	3C.2a	2017-10-17	SIAT2	80	71	320	270	640	715	160	140	640	720	40	58	80	72	640	853	640	924	160	120
A/Norway/3297/2017	3C.2a	2017-10-17	SIAT1	40	40	320	247	1280	989	80	76	1280	960	<	10	80	80	1280	1391	1280	1873	160	180
A/Qatar/16-VI-17-0044877/2017	3C.2a1	2017-10-14	SIAT1	40	40	320	293	640	615	<	10	640	788	40	57	80	79	2560	1984	1280	1886	160	125
A/Qatar/10-VI-17-0044920/2017	3C.2a1	2017-10-15	SIAT2	40	20	160	130	160	215	<	5	640	568	40	53	80	77	1280	1391	640	711	160	129
A/Norway/3318/2017	3C.2a1	2017-10-23	SIAT1	40	41	320	252	640	823	<	10	640	614	40	56	320	256	1280	1694	1280	1501	160	151
A/Norway/3241/2017	3C.2a1	2017-10-06	SIAT1/SIAT1	40	40	320	267	640	608	160	153	1280	1336	40	53	160	221	1280	1590	1280	1457	320	391
A/Iran/90998/2017	3C.2a1	2017-11-04	SIAT2/SIAT1	40	40	320	257	640	528	40	20	1280	1031	40	58	80	65	1280	1646	1280	1159	80	102
A/Iran/91529/2017	3C.2a1	2017-11-06	SIAT2/SIAT1	40	40	320	255	1280	1024	<	1	1280	1501	40	42	320	253	2560	1920	2560	2414	640	587
A/Iran/93702/2017	3C.2a1	2017-11-15	SIAT1/SIAT1	40	55	320	347	1280	1030	<	3	1280	1227	80	77	320	293	2560	2286	2560	2251	320	262
			Vaccine NH 2017-18													Vaccine SH 2018							
			Sequences in phylogenetic trees																				

<sup>1</sup> Antisera dilution value (2-fold), equivalent to HI reading, closest to the actual computer read value from a digitized image (Read) causing 50% reduction in plaque formation



**Table 9-3. Antigenic analysis of influenza A(H3N2) viruses - Plaque Reduction Neutralisation (MDCK-SIAT) 2018-01-25 + 2018-01-29**

Viruses	Collection Date	Passage History	Neutralisation titre <sup>1</sup>																				HA1 substitutions for 3C.2a(1) viruses compared to A/Hong Kong/4801/2014: Egg adaptation HA substitutions compared to the corresponding cell isolate		
			Post-infection ferret antisera																						
			A/HK 480/1/14		A/HK T295/14		A/Côte d'Ivoire		A/Norway		A/Singapore		A/Singapore		A/Singapore		A/Greece		A/Norway						
			2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read			
<b>REFERENCE VIRUSES</b>																									
A/Hong Kong/4801/2014	3C.2a	2014-02-26	E7	320	469	320	306	160	170	640	501	2560	3525	5120	4838	640	815	640	888	640	535	640	619	N96S, T160K (-CHO), L194P	
A/Hong Kong/7295/2014	3C.2a	2014-08-07	SIAT2	40	55	640	484	320	451	640	696	80	62	320	262	80	77	2560	2055	1280	1695	80	115	NONE	
A/Côte d'Ivoire/544/2016	3C.2a	2016-04-06	P1/SIAT3	40	40	640	676	640	938	640	900	80	67	160	195	40	40	1280	1539	1280	1797	160	129	N121K, S144K, S198P	
A/Norway/4465/2016	3C.2a	2016-11-07	SIAT2	80	109	320	409	320	470	5120	6662	2560	1982	80	73	40	40	1280	1173	1280	1024	80	94	T131K, R142K, R261Q	
A/Norway/4465/2016	3C.2a	2016-11-07	E6	160	235	320	272	160	134	2560	2149	2560	2642	1280	1124	80	68	320	242	320	311	160	205	T131K, R142K, T160K (-CHO), L194P, T203I, R261Q	
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-4</sup> )	3C.2a1	2016-06-14	E5/E2	80	80	80	72	40	34	40	40	640	737	1280	1676	320	257	320	268	320	247	160	238	N121K, R142G, T160K (-CHO), N171K, L194P, D225G	
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-4</sup> )	3C.2a1	2016-06-14	E5/E2	160	169	160	120	80	66	80	62	1280	1018	1280	1641	320	404	320	391	320	287	320	248	N121K, R142G, T160K (-CHO), N171K, L194P, D225X	
A/Singapore/INFIMH-16-0019/2016	3C.2a1	2016-06-14	MDCK1/SIAT6	<	7	640	501	160	157	640	742	40	40	80	95	40	20	2560	2429	2560	2067	80	72	N121K, R142G, N171K	
A/Greece/4/2017	3C.2a1	2017-01-02	SIAT4	40	40	160	215	80	102	640	795	40	41	80	77	40	20	1280	1173	1280	1632	80	75	G78D, N121K, N122D (-CHO), T135K, N171K	
A/Norway/3806/2016	3C.2a1	2016-06-13	E9	640	504	320	386	160	230	320	243	2560	2448	5120	4937	640	890	1280	1109	640	579	640	612	N121K, I140M, T160K (-CHO), N171K, L194P	
<b>TEST VIRUSES</b>																									
A/Norway/3240/2017	3C.2a	2017-10-01	SIAT1/SIAT1	80	70	320	292	320	300	5120	4131	1280	1543	80	90	<	17	1280	1433	1280	1142	80	60	T131K, R142K, R261Q	
A/Norway/3784/2017	3C.2a	2017-12-08	SIAT1	80	68	320	258	160	146	2560	3482	1280	977	80	72	40	40	640	939	640	898	<	10	T131K, R142K, R261Q	
A/Navarra/2486/2017	3C.2a	2017-12-11	SIAT1	80	70	320	274	320	251	5120	4160	1280	1428	80	80	40	49	1280	1189	1280	1244	80	69	T131K, R142G, R261Q	
A/Finland/800/2017	3C.2a	2017-11-24	SIAT1	80	71	320	307	320	259	5120	4459	1280	1402	160	132	80	61	1280	1209	1280	1152	80	85	Y94H, T131K, R142K, R261Q	
A/Switzerland/8060/2017	3C.2a	2017-12-21	SIAT1	160	207	640	711	640	811	5120	5689	2560	2916	160	172	40	52	2560	2112	1280	1728	80	67	N96S, T131K, R142K, R261Q	
A/Switzerland/2159/2017	3C.2a	2017-11-08	SIAT1	40	56	320	313	160	185	5120	4625	1280	1341	80	80	<	10	1280	1189	1280	960	40	20	T131K, R142K, D175E, R261Q	
A/Finland/789/2017	3C.2a	2017-09-20	SIAT1	40	57	160	193	160	125	2560	2166	640	698	80	67	<	10	640	599	640	567	80	89	P21S, K92R, T131K, R142K, R261Q, R299K	
A/Finland/788/2017	3C.2a	2017-11-09	SIAT1	40	53	160	222	160	260	2039	640	533	40	56	40	40	640	594	640	602	40	44	P21S, K92R, T131K, R142K, R261Q, R299K		
A/Ghana/832/2017	3C.2a	2017-11-22	SIAT1	40	56	640	676	640	737	640	720	80	68	320	280	80	60	2560	2258	1280	1807	320	267	S9N, N121K, T128A (-CHO), S144K	
A/Hong Kong/4986/2017	3C.2a	2017-12-13	MDCK1/SIAT1	40	40	160	217	640	626	640	604	<	10	80	72	<	10	1280	1141	1280	1493	80	64	N121K, T135K (-CHO), S144K, R150K, R261Q	
A/Hong Kong/4995/2017	3C.2a	2017-12-18	MDCK1/SIAT1	<	10	160	190	640	774	640	782	40	40	80	80	40	43	1280	988	1280	1396	80	60	N121K, T135K (-CHO), S144K, R150K, R261Q	
A/Ghana/3149/2017	3C.2a	2017-10-18	SIAT1	40	40	320	269	640	701	320	427	40	59	80	86	40	40	1280	1513	2560	2176	80	75	F79L, N121K, N122D (-CHO), T128I (-CHO), T135K (-CHO), S144K	
A/Galicia/2467/2017	3C.2a1	2017-12-04	SIAT1	40	45	320	301	320	249	640	677	80	75	160	229	80	76	1280	1625	1280	1156	80	88	I58V, K92R, N121K, N171K, Q197R, H311Q	
A/Norway/3824/2017	3C.2a1	2017-12-08	SIAT1	<	10	160	226	80	80	640	455	40	20	40	40	<	10	1280	1147	1280	1390	40	40	E62G, K92R, N121K, T135K (-CHO), R142G, N171K, H311Q	
A/Hong Kong/4977/2017	3C.2a1	2017-12-10	MDCK1/SIAT1	<	0	160	149	80	112	640	741	<	1	40	50	<	0	1280	1224	1280	1336	<	10	E62G, K92R, N121K, T135K (-CHO), R142G, N171K, H311Q	
A/Hong Kong/4984/2017	3C.2a1	2017-12-18	MDCK1/SIAT1	<	0	80	74	80	60	640	604	<	0	80	61	40	20	640	890	640	830	40	40	E62G, K92R, N121K, T135K (-CHO), R142G, N171K, H311Q	
A/Baleares/2476/2017	3C.2a1	2017-12-03	SIAT1	<	5	80	119	80	72	320	302	40	20	40	47	<	5	640	790	1280	1000	40	20	E62G, K92R, N121K, T135K (-CHO), R142G, N171K, V309X, H311Q	
A/Hong Kong/4996/2017	3C.2a1	2017-12-18	MDCK1/SIAT1	<	0	80	100	80	69	320	283	<	18	40	40	<	0	640	935	1280	1019	<	1	E62G, G78D, K92R, N121K, T128A (-CHO), T135K (-CHO), R142G, N171K, H311Q	
A/Finland/797/2017	3C.2a1	2017-10-10	SIAT1	<	0	160	233	160	189	640	569	40	40	80	61	40	20	1280	1092	1280	996	40	53	K92R, N121K, T135N (-CHO), N171K, H311Q	
A/Finland/804/2017	3C.2a1	2017-12-02	SIAT1	40	20	160	153	320	391	640	873	40	40	80	97	40	56	1280	1251	1280	1182	80	72	K92R, N121K, T135N (-CHO), N171K, H311Q	
A/Norway/3247/2017	3C.2a1	2017-10-02	SIAT1	<	10	160	174	320	469	640	943	40	50	80	66	40	20	1280	1160	1280	1200	40	46	E62G, K92R, N121K, T135N (-CHO), N171K, V309X, H311Q	
			Vaccine NH 2017-18																			Vaccine SH 2018			

<sup>1</sup>Antiserum dilution value (2-fold), equivalent to HI reading, closest to the actual computer read value from a digitized image (Read) causing 50% reduction in plaque formation

Sequences in phylogenetic trees

Table 9-4. Antigenic analysis of influenza A(H3N2) viruses - Plaque Reduction Neutralisation (MDCK-SIAT) 2018-02-01 + 2018-02-05

Viruses	Collection Date	Passage History	Neutralisation titre <sup>1</sup>																HA1 substitutions for 3C.2a(1) viruses compared to A/Hong Kong/4801/2014: Egg adaptation HA substitutions compared to the corresponding cell isolate		
			Post-infection ferret antisera																		
			A/HK 4801/14 Egg F42/15		A/HK 7295/14 SIAT F02/15		A/Cote d'Ivoire 544/16 NIB F54/16		A/Norway 4465/16 SIAT F11/17		A/Norway 4465/16 Egg F12/17		A/Singapore INFIMH-16-0019/16 Egg 10 <sup>-4</sup> F41/17		A/Singapore INFIMH-16-0019/16 Egg 10 <sup>-6</sup> F42/17		A/Singapore INFIMH-16-0019/16 Egg F45/17 F27/17		A/Greece 4/17		
			2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read	2-fold Read			
<b>REFERENCE VIRUSES</b>																					
A/Hong Kong/4801/2014	3C.2a	2014-02-26	E7	320	469	320	306	160	170	640	501	2560	3525	5120	4838	640	815	640	888	N96S, T160K (-CHO), L194P	
A/Hong Kong/7295/2014	3C.2a	2014-08-07	SIAT2	40	55	640	484	320	451	640	696	80	62	320	262	80	77	2560	2055	NONE	
A/Cote d'Ivoire/544/2016	3C.2a	2016-04-06	P1/SIAT3	40	40	640	676	640	938	640	900	80	67	160	195	40	40	1280	1539	N121K, S144K, S198P	
A/Norway/4465/2016	3C.2a	2016-11-07	SIAT2	80	109	320	409	320	470	5120	6662	2560	1982	80	73	40	40	1280	1173	T131K, R142K, R261Q	
A/Norway/4465/2016	3C.2a	2016-11-07	E6	160	235	320	272	160	134	2560	2149	2560	2642	1280	1124	80	68	320	242	T131K, R142K, T160K (-CHO), L194P, T203I, R261Q	
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-4</sup> )	3C.2a1	2016-06-14	E5/E2	80	80	80	72	40	34	40	40	640	737	1280	1676	320	257	320	268	N121K, R142G, T160K (-CHO), N171K, L194P, D225G	
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-5</sup> )	3C.2a1	2016-06-14	E5/E2	160	169	160	120	80	66	80	62	1280	1018	1280	1641	320	404	320	391	N121K, R142G, T160K (-CHO), N171K, L194P, D225X	
A/Singapore/INFIMH-16-0019/2016	3C.2a1	2016-06-14	MDCK1/SIAT6	<	7	640	501	160	157	640	742	40	40	80	95	40	20	2560	2429	N121K, R142G, N171K, L194P, D225X	
A/Greece/4/2017	3C.2a1	2017-01-02	SIAT4	40	40	160	215	80	102	640	795	40	41	80	77	40	20	1280	1173	G78D, N121K, N122D (-CHO), T135K, N171K	
A/Norway/3806/2016	3C.2a1	2016-06-13	E9	640	504	320	386	160	230	320	243	2560	2448	5120	4937	640	890	1280	1109	N121K, I140M, T160K (-CHO), N171K, L194P	
<b>TEST VIRUSES</b>																					
A/Austria/1028327/2017		2017-12-11	SIAT1/SIAT1	160	155	640	517	320	306	5120	6400	2560	2304	160	184	80	75	1280	1110	A1028327/2017	
A/Austria/1025657/2017	3C.2a	2017-11-24	SIAT1/SIAT1	80	76	320	435	320	510	5446	2560	2036	80	76	40	40	1280	1145	T131K, R142K, R261Q		
A/Slovenia/2606/2017	3C.2a	2017-12-06	SIATx/SIAT1	160	143	320	446	320	343	5120	5953	2560	2296	80	104	40	53	1280	1235	T131K, R142K, R261Q	
A/Austria/1029095/2017	3C.2a	2017-12-12	SIAT1/SIAT1	160	120	320	431	320	284	5120	7111	2560	2492	160	190	80	62	1280	1132	T131K, R142K, R261Q	
A/Austria/1030580/2017	3C.2a	2017-12-18	SIAT2	80	95	320	270	160	200	5120	5120	1280	1820	80	104	40	44	1280	1188	T131K, R142K, R261Q	
A/Austria/1030401/2017	3C.2a	2017-12-20	SIAT1/SIAT1	160	173	320	340	320	310	5120	5565	1280	1792	80	117	40	57	1280	1066	A1030401/2017	
A/Israel/C9037/2017	3C.2a	2017-12-20	C1/SIAT1	80	75	320	300	320	344	5120	5952	2560	1920	160	149	80	80	1280	1843	T131K, R142K, R261Q	
A/Slovenia/2739/2017	3C.2a	2017-12-22	SIATx/SIAT1	160	134	640	546	640	488	5120	7111	2560	2560	80	114	80	61	1280	1564	T131K, R142K, R261Q	
A/Brandenburg/4/2017	3C.2a	2017-11-30	C1/SIAT1	160	144	640	614	640	557	5120	5565	2560	2347	320	299	160	133	2560	2816	P103S, T131K, R142K, R261Q	
A/Austria/1031294/2017	3C.2a	2017-12-27	SIAT1/SIAT1	160	131	640	622	640	597	5120	3968	2560	1960	320	217	40	56	1280	1829	T131K, R142K, A212T, R261Q	
A/Bremen/28/2017	3C.2a	2017-12-18	C1/SIAT1	320	460	320	389	640	501	640	488	40	54	80	68	<	5	1280	1109	T131K, R142K, S144R, R261Q	
A/Niedersachsen/187/2017	3C.2a	2017-11-30	C1/SIAT1	80	65	1280	1481	1280	986	1280	1280	960	320	298	160	131	2560	2336	T131K, R142K, S143F, S144R, R261Q		
A/Validadolid/180/2017	3C.2a	2017-10-08	SIAT1/SIAT1	80	77	320	300	320	364	5120	3891	1280	1877	80	91	40	40	1280	1321	S124N (-CHO), T131K, R142K, E172G, R261Q	
A/Nordrhein-Westfalen/134/2017	3C.2a	2017-12-08	C2/SIAT1	<	1	320	249	640	764	640	496	40	47	80	73	<	1	1280	1257	N121K, T135K (-CHO), R142G, S144K, R150K, R261Q	
A/Spain/93936/2017	3C.2a	2017-10-23	SIAT1/SIAT1	<	10	640	586	640	914	640	832	<	1	80	73	<	5	2560	1938	N31S, D53N, R142G, S144R, N171K, H192T, Q197H, A304T	
A/Validadolid/181/2017	3C.2a	2017-10-23	SIAT1/SIAT1	40	20	1280	991	1280	1132	640	811	<	0	80	94	40	20	2560	2005	N31S, D53N, R142G, S144R, N171K, H192T, Q197H, A304T	
A/Validadolid/182/2017	3C.2a	2017-10-24	SIAT1/SIAT1	<	10	640	937	1280	1141	640	693	<	0	80	115	40	40	1280	1677	N31S, D53N, R142G, S144R, N171K, H192T, Q197H, A304T	
A/Nordrhein-Westfalen/132/2017	3C.2a1	2017-12-04	C1/SIAT1	40	20	320	379	320	299	640	640	40	56	80	91	40	49	1280	1600	S46L, N121K, T135K (-CHO), N171K, H192T, Q197H, A304T	
A/Austria/1030866/2017	3C.2a1	2017-12-20	SIAT1/SIAT1	<	0	160	145	80	108	640	610	<	20	40	44	<	10	1280	1257	K92R, N121K, T135N (-CHO), N171K, H311Q	
A/Austria/1026040/2017	3C.2a1	2017-11-24	SIAT1/SIAT1	40	45	160	217	320	341	640	864	40	53	160	234	40	49	1280	1280	K92R, N121K, T135N (-CHO), N171K, H311Q	
A/Brandenburg/45/2017	3C.2a1	2017-12-08	C1/SIAT1	<	1	320	288	640	853	640	800	80	72	320	259	80	69	1280	1451	K92R, N121K, T135N (-CHO), N171K, H311Q	
A/Israel/C9362/2017	3C.2a1	2017-12-26	C1/SIAT1	40	20	320	273	640	640	1280	1005	80	100	160	177	80	106	1280	1645	K92R, N121K, T135N (-CHO), N171K, H311Q	

Vaccine  
NH 2017-18Vaccine  
SH 2018<sup>1</sup> Antiserum dilution value (2-fold), equivalent to HI reading, closest to the actual computer read value from a digitized image (Read) causing 50% reduction in plaque formation

Sequences in phylogenetic trees

**Table 9-5. Antigenic analysis of influenza A(H3N2) viruses - Plaque Reduction Neutralisation (MDCK-SIAT) 2018-02-05**

Viruses	Collection Date	Passage History	Neutralisation titre <sup>1</sup>																HA1 substitutions for 3C.2a(1) viruses compared to A/Hong Kong/4801/2014: Egg adaptation HA substitutions compared to the corresponding cell isolate					
			Post-infection ferret antisera																					
			A/HK 4801/14		A/HK 7295/14		A/Côte d'Ivoire SIAT		A/Norway 4465/16		A/Norway 4465/16		A/Singapore INFIMH-16-0019/16		A/Singapore Egg 10 <sup>-4</sup>		A/Singapore INFIMH-16-0019/16		A/Greece F45/17					
			2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read				
<b>REFERENCE VIRUSES</b>																								
A/Hong Kong/4801/2014	3C.2a	2014-02-26	E7	320	469	320	306	160	170	640	501	2560	3525	5120	4838	640	815	640	888	640	535	640	619	N96S, T160K (-CHO), L194P
A/Hong Kong/7295/2014	3C.2a	2014-08-07	SIAT2	40	55	640	484	320	451	640	696	80	62	320	262	80	77	2560	2055	1280	1695	80	115	NONE
A/Côte d'Ivoire/544/2016	3C.2a	2016-04-06	P1/SIAT3	40	40	640	676	640	938	640	900	80	67	160	195	40	40	1280	1539	1280	1797	160	129	N121K, S144K, S198P
A/Norway/4465/2016	3C.2a	2016-11-07	SIAT2	80	109	320	409	320	470	5120	6662	2560	1982	80	73	40	40	1280	1173	1280	1024	80	94	T131K, R142K, R261Q
A/Norway/4465/2016	3C.2a	2016-11-07	E6	160	235	320	272	160	134	2560	2149	2560	2642	1280	1124	80	68	320	242	320	311	160	205	T131K, R142K, T160K (-CHO), L194P, T203I, R261Q
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-4</sup> )	3C.2a1	2016-06-14	E5/E2	80	80	80	72	40	34	40	40	640	737	1280	1676	320	257	320	268	320	247	160	238	N121K, R142G, T160K (-CHO), N171K, L194P, D225G
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-3</sup> )	3C.2a1	2016-06-14	E5/E2	160	169	160	120	80	66	80	62	1280	1018	1280	1641	320	404	320	391	320	287	320	248	N121K, R142G, T160K (-CHO), N171K, L194P, D225X
A/Singapore/INFIMH-16-0019/2016	3C.2a1	2016-06-14	MDCK1/SIAT6	< 7	640	501	160	157	640	742	40	40	80	95	40	20	2560	2429	2560	2067	80	72	N121K, R142G, N171K	
A/Greece/4/2017	3C.2a1	2017-01-02	SIAT4	40	40	160	215	80	102	640	795	40	41	80	77	40	20	1280	1173	1280	1632	80	75	G78D, N121K, N122D (-CHO), T135K, N171K
A/Norway/3806/2016	3C.2a1	2016-06-13	E9	640	504	320	386	160	230	320	243	2560	2448	5120	4937	640	890	1280	1109	640	579	640	612	N121K, I140M, T160K (-CHO), N171K, L194P
<b>TEST VIRUSES</b>																								
A/Ireland/62518/2017	3C.2a	2017-11-17	C2/SIAT1	80	102	320	296	320	280	5120	5447	1280	1600	160	130	80	97	1280	1374	1280	1246	40	54	T131K, R142K, R261Q
A/Israel/C8812/2017	3C.2a	2017-12-13	SIAT1	160	126	320	407	320	411	5120	4480	2560	1997	160	190	80	80	1280	1777	1280	1257	80	85	T131K, R142K, R261Q
A/Iceland/135/2017	3C.2a	2017-12-27	MDCK1/SIAT1	40	20	40	42	40	40	59	640	686	160	153	40	43	40	20	320	411	320	313	< 1	T131K, R142K, R261Q
A/Portugal/EVA43/2017	3C.2a	2017-12-29	SIAT1/SIAT1	80	79	320	253	160	220	5120	4149	1280	1493	160	140	80	88	1280	1338	1280	1097	80	70	T131K, R142K, R261Q
A/Israel/R80/2018	3C.2a	2018-01-02	SIAT1	80	75	320	406	320	411	5120	4707	1280	1621	80	73	40	20	1280	1886	1280	1493	40	47	T131K, R142K, R261Q
A/Ireland/01288/2018	3C.2a	2018-01-04	SIAT1	80	97	320	467	320	358	2560	3765	1280	1707	80	74	40	45	1280	1067	1280	1001	40	40	T131K, R142K, R261Q
A/Israel/C9025/2017	3C.2a	2017-12-20	C1/SIAT1	80	74	320	313	160	149	5120	6095	2560	2088	80	96	40	40	2560	2067	1280	1255	40	20	T131K, R142K, R261Q, G263X
A/Ireland/61097/2017	3C.2a	2017-11-14	C2/SIAT1	160	123	640	840	640	620	10240	8000	2560	2080	320	258	80	79	2560	2116	2560	2160	160	168	T131K, R142K, A212T, R261Q
A/Iceland/133/2017	3C.2a	2017-12-19	MDCK1/SIAT1	< 10	80	103	160	125	1280	1792	640	613	80	74	< 10	10	640	608	640	489	< 1	1	T131K, R142K, A212T, R261Q	
A/Croatia/3737/2017	3C.2a	2017-12-18	MDCKx/SIAT1	80	114	320	457	320	411	5120	5689	2560	2004	80	101	80	86	1280	1242	1280	1208	40	53	P21S, N22K (-CHO), K92R, T131K, R142K, S219F, R261Q
A/Israel/R25/2018	3C.2a1	2018-01-01	SIAT1	40	20	160	202	320	258	640	585	40	40	80	102	80	70	1280	1706	1280	1792	80	110	K92R, N121K, N122D (-CHO), T135N (-/+CHO), N171K, H311Q
A/Croatia/3256/2017	3C.2a1	2017-10-20	MDCKx/SIAT1	40	20	160	167	320	363	640	613	40	40	80	114	40	58	1280	1659	1280	1621	80	118	K92R, N121K, T135N (-/+CHO), N171K, H311Q
A/Croatia/3255/2017	3C.2a1	2017-10-20	MDCKx/SIAT1	40	20	160	204	640	546	1280	1195	80	75	160	202	80	60	1280	1765	2560	2040	160	146	K92R, N121K, T135N (-/+CHO), N171K, H311Q

<sup>1</sup> Antiserum dilution value (2-fold), equivalent to HI reading, closest to the actual computer read value from a digitized image (Read) causing 50% reduction in plaque formation

Sequences in phylogenetic trees

**Table 9-6. Antigenic analysis of influenza A(H3N2) viruses - Plaque Reduction Neutralisation (MDCK-SIAT) - Summary**

Viruses	Passage history Ferret number Genetic group	Neutralisation titre <sup>1</sup> Post-infection ferret antisera																			
		A/HK 4801/14 Egg F42/15		A/HK 7295/14 SIAT F02/15		A/Côte d'Ivoire 544/16 SIAT NIB F54/16		A/Norway 4465/16 SIAT F11/17		A/Norway 4465/16 Egg F12/17		A/Singapore INFIMH-16-0019/16 Egg 10 <sup>-4</sup> F41/17		A/Singapore INFIMH-16-0019/16 Egg 10 <sup>-6</sup> F42/17		A/Singapore INFIMH-16-0019/16 SIAT F45/17		A/Greece 4/17 SIAT F27/17		A/Norway 3806/16 Egg NIB F45/16	
		3C.2a	3C.2a	3C.2a	3C.2a	3C.2a	3C.2a	3C.2a	3C.2a	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1	3C.2a1
		2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read	2-fold	Read
<b>REFERENCE VIRUSES</b>																					
A/Hong Kong/4801/2014	3C.2a	320	469	320	306	160	170	640	501	2560	3525	5120	4838	640	815	640	888	640	535	640	619
A/Hong Kong/7295/2014	3C.2a	40	55	640	484	320	451	640	696	80	62	320	262	80	77	2560	2055	1280	1695	80	115
A/Côte d'Ivoire/544/2016	3C.2a	40	40	640	676	640	938	640	900	80	67	160	195	40	40	1280	1539	1280	1797	160	129
A/Norway/4465/2016	3C.2a	80	109	320	409	320	470	5120	6662	2560	1982	80	73	40	40	1280	1173	1280	1024	80	94
A/Norway/4465/2016	3C.2a	160	235	320	272	160	134	2560	2149	2560	2642	1280	1124	80	68	320	242	320	311	160	205
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-4</sup> )	3C.2a1	80	80	80	72	40	34	40	40	640	737	1280	1676	320	257	320	268	320	247	160	238
A/Singapore/INFIMH-16-0019/2016 (10 <sup>-6</sup> )	3C.2a1	160	169	160	120	80	66	80	62	1280	1018	1280	1641	320	404	320	391	320	287	320	248
A/Singapore/INFIMH-16-0019/2016	3C.2a1	<	7	640	501	160	157	640	742	40	40	80	95	40	20	2560	2429	2560	2067	80	72
A/Greece/4/2017	3C.2a1	40	40	160	215	80	102	640	795	40	41	80	77	40	20	1280	1173	1280	1632	80	75
A/Norway/3806/2016	3C.2a1	640	504	320	386	160	230	320	243	2560	2448	5120	4937	640	890	1280	1109	640	579	640	612
<b>Genetic subgroup</b>	<b>No tested</b>	<b>Number and % of viruses reacting ≤4-fold reduced compared to the homologous titre</b>																			
3C.2a (T131K, R142K, R261Q)	48	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
3C.2a (other)	15	10	20.8%	40	83.3%	29	60.4%	43	89.6%	37	77.1%	1	2.1%			42	87.5%	44	91.7%	3	6.3%
3C.2a1	35	0	0.0%	15	100.0%	15	100.0%	0	0.0%	0	0.0%	0	0.0%			15	100.0%	15	100.0%	3	20.0%
3C.2a (T131K, R142K, R261Q)	35															0	0.0%				
3C.2a (other)	11															0	0.0%				
3C.2a1	21															2	5.7%				
Vaccine NH 2017-18				Vaccine SH 2018																	

<sup>1</sup> Antiserum dilution value (2-fold), equivalent to HI reading, closest to the actual computer read value from a digitized image (Read) causing 50% reduction in plaque formation

# Figure 6. Phylogenetic comparison of A(H3N2) HA genes

Vaccine viruses

Reference viruses

Collection date

Oct 2017

Nov 2017

Dec 2017

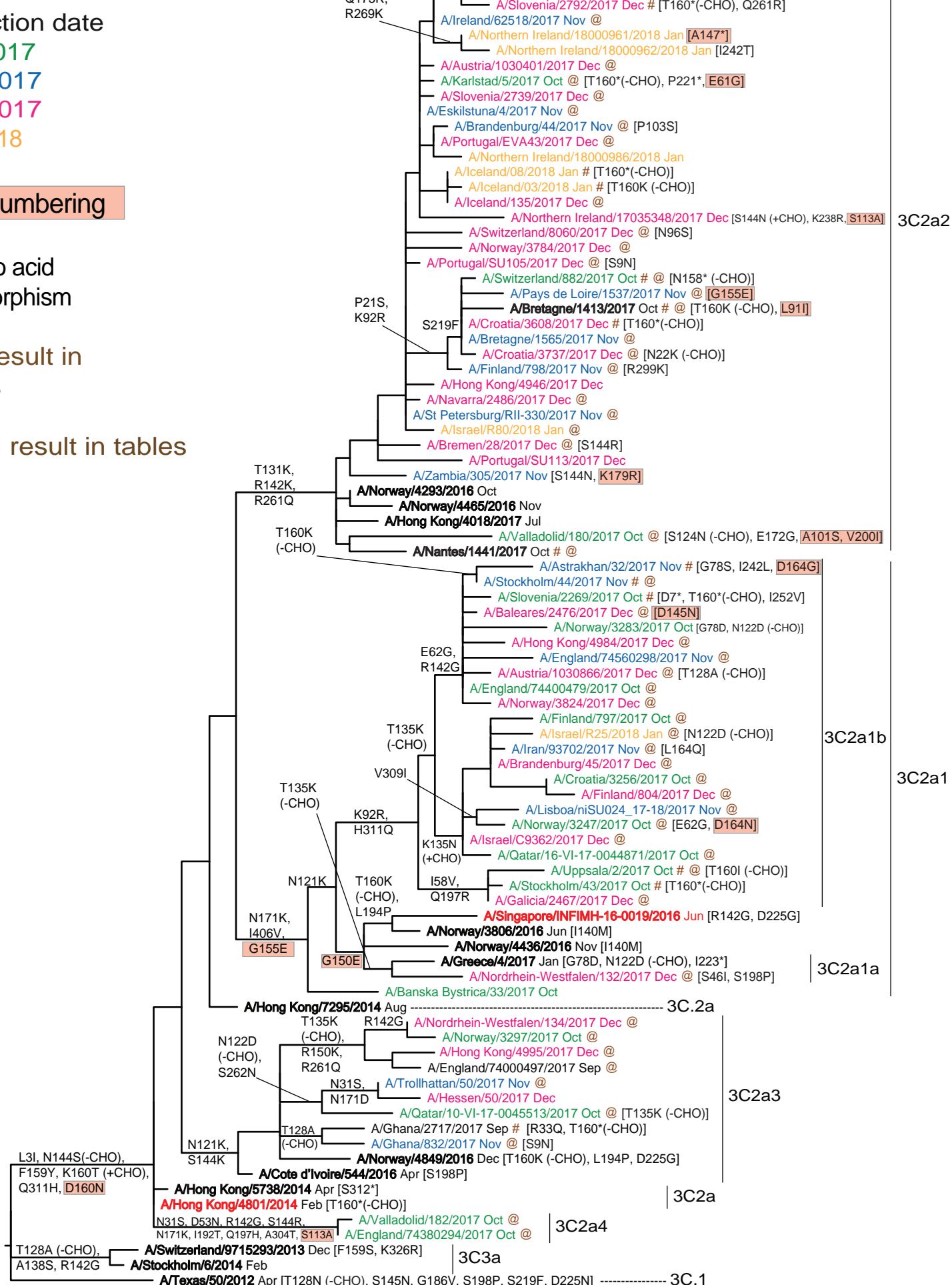
Jan 2018

HA2 numbering

\* amino acid polymorphism

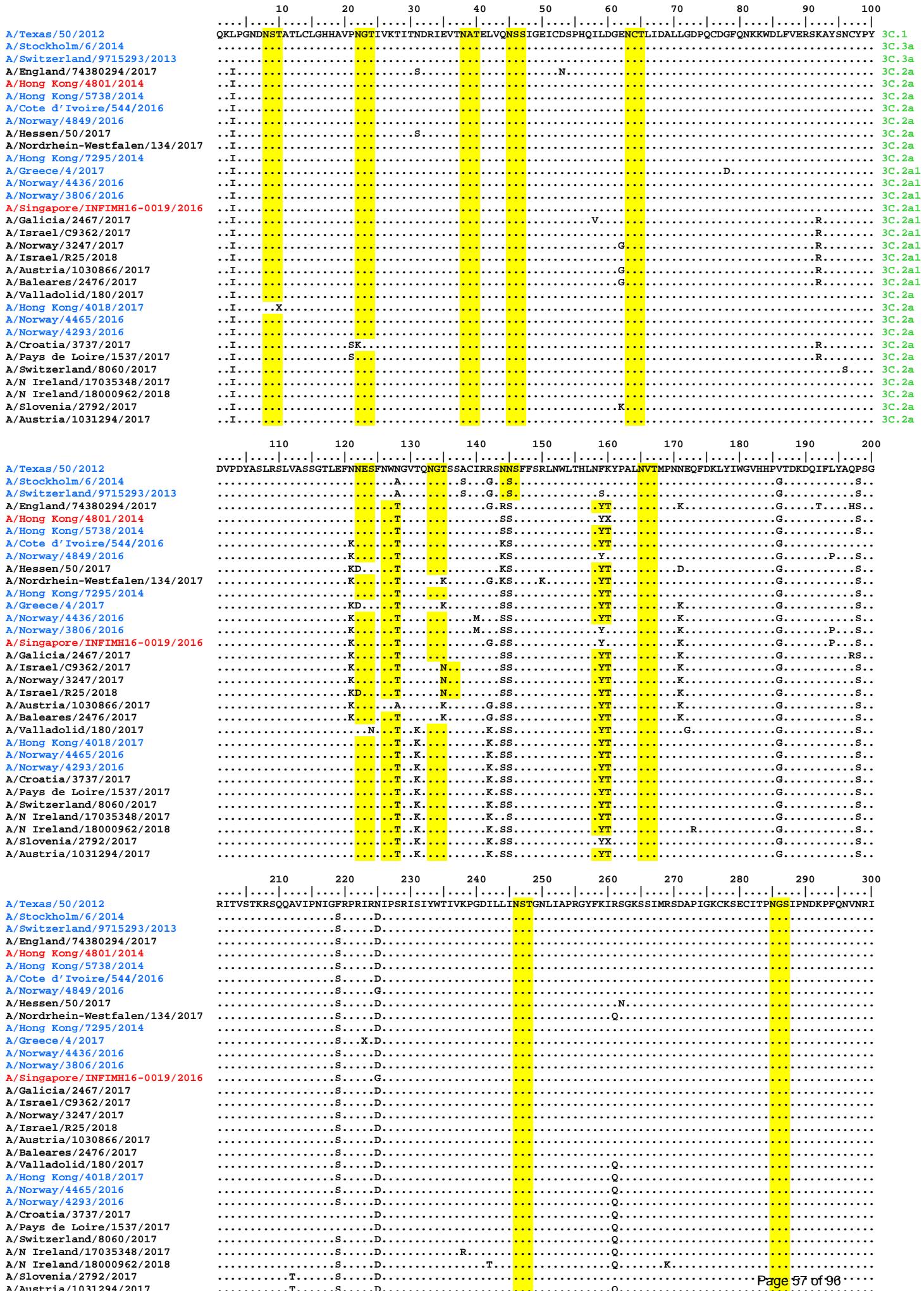
# HI result in tables

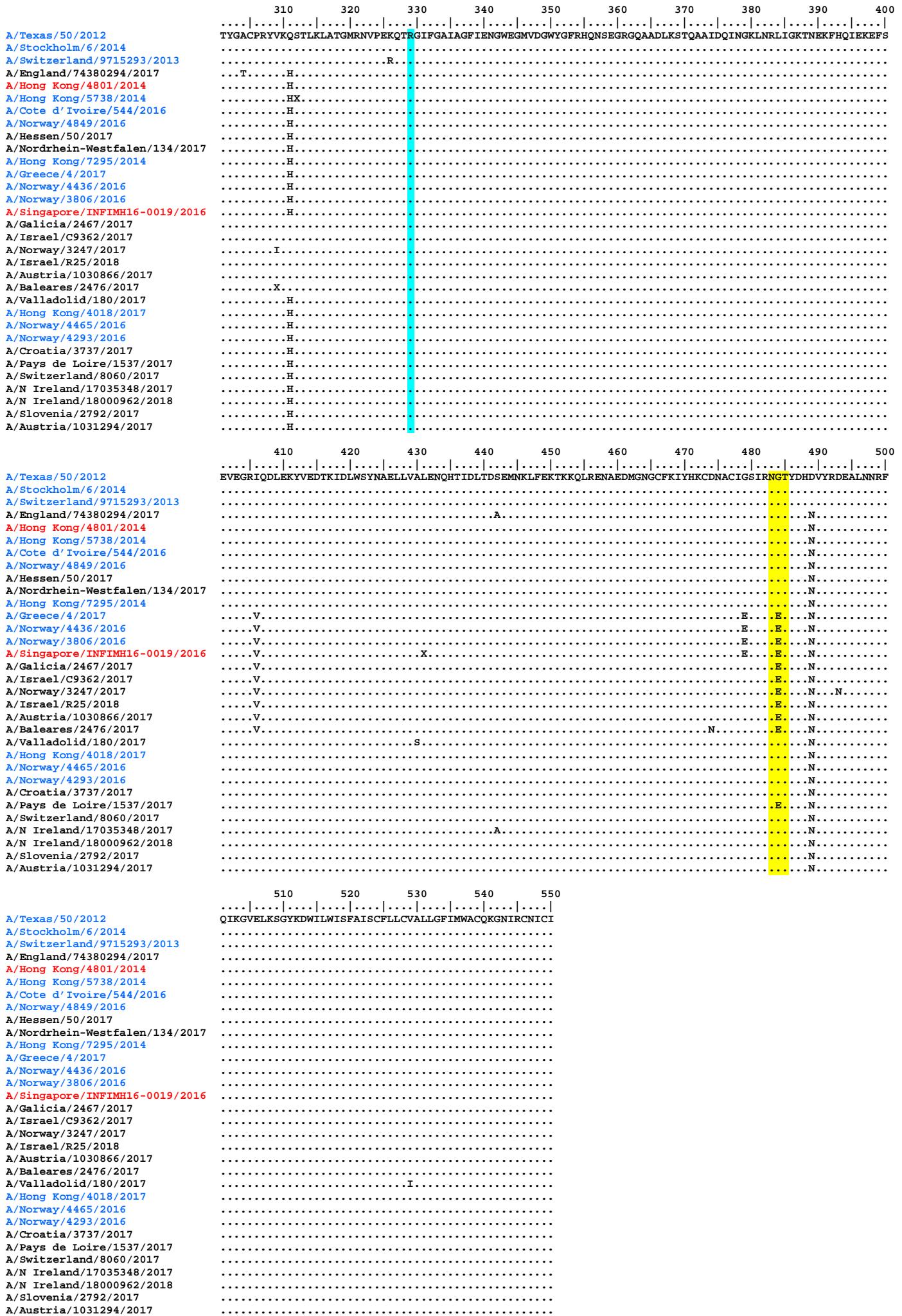
@ VN result in tables



# Figure 7. HA protein alignment for influenza A(H3N2) viruses

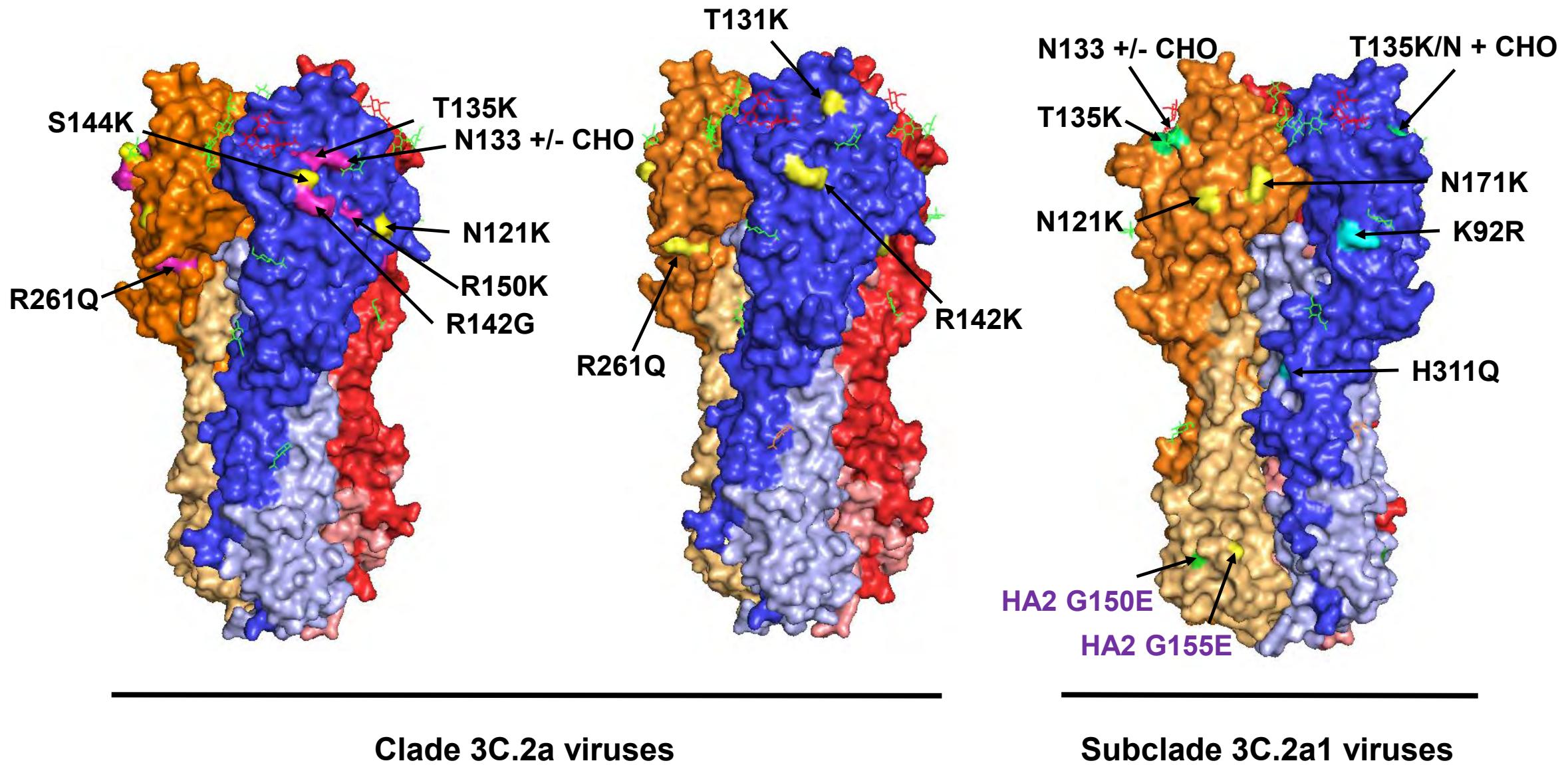
Vaccine virus: Reference virus: Genetic group: HA1/HA2 boundary: Potential N-linked glycosylation site





Vaccine virus: Reference virus: Genetic group: **HA1/HA2 boundary: Potential N-linked glycosylation site**

Figure 8. H3 HA locations of amino acid substitutions defining subgroups of clade 3C.2a viruses



# Figure 9. Phylogenetic comparison of A(H3N2) NA genes

## Vaccine viruses

## Reference viruses

Collection date

Oct 2017

Nov 2017

Dec 2017

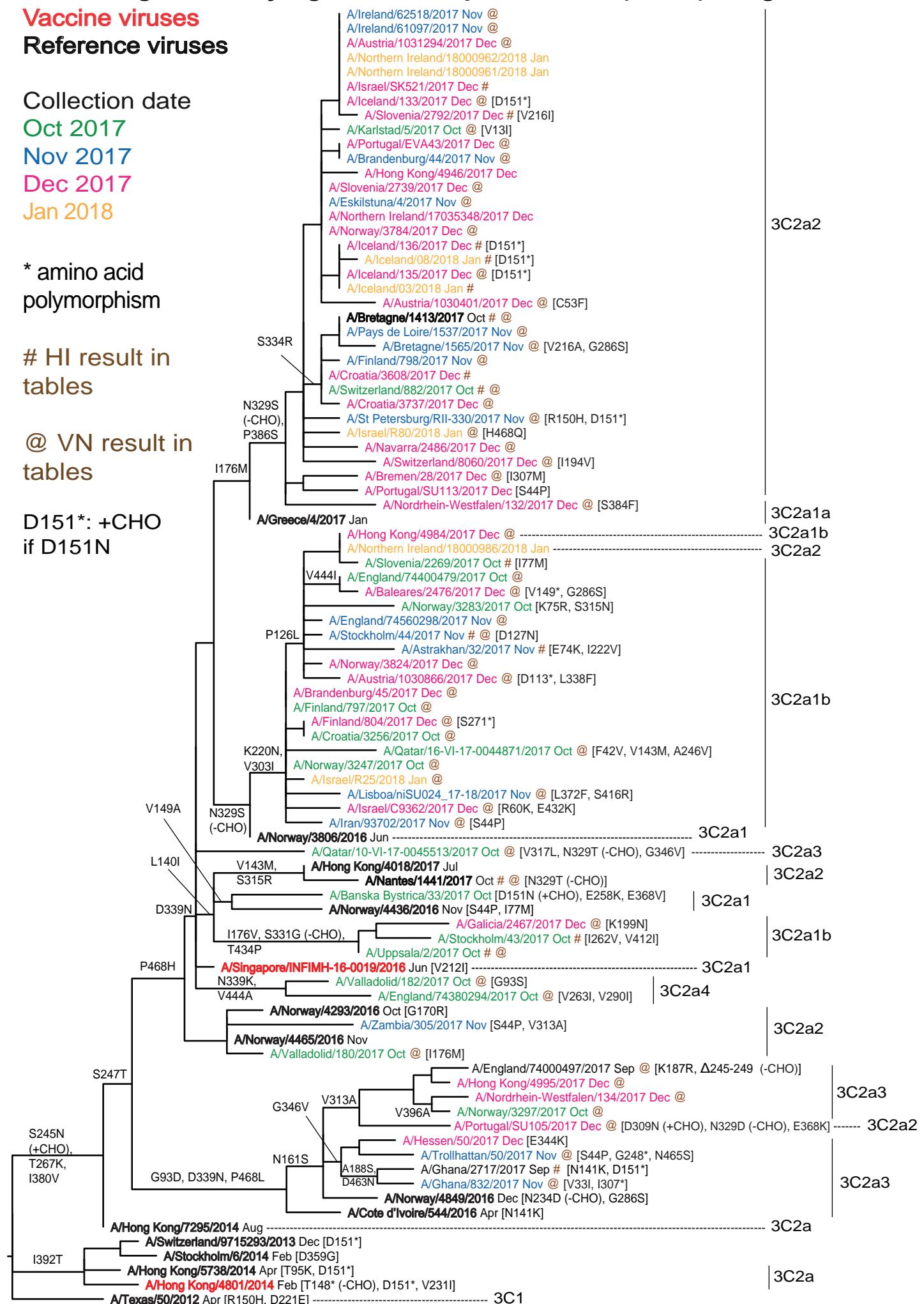
Jan 2018

\* amino acid polymorphism

# HI result in tables

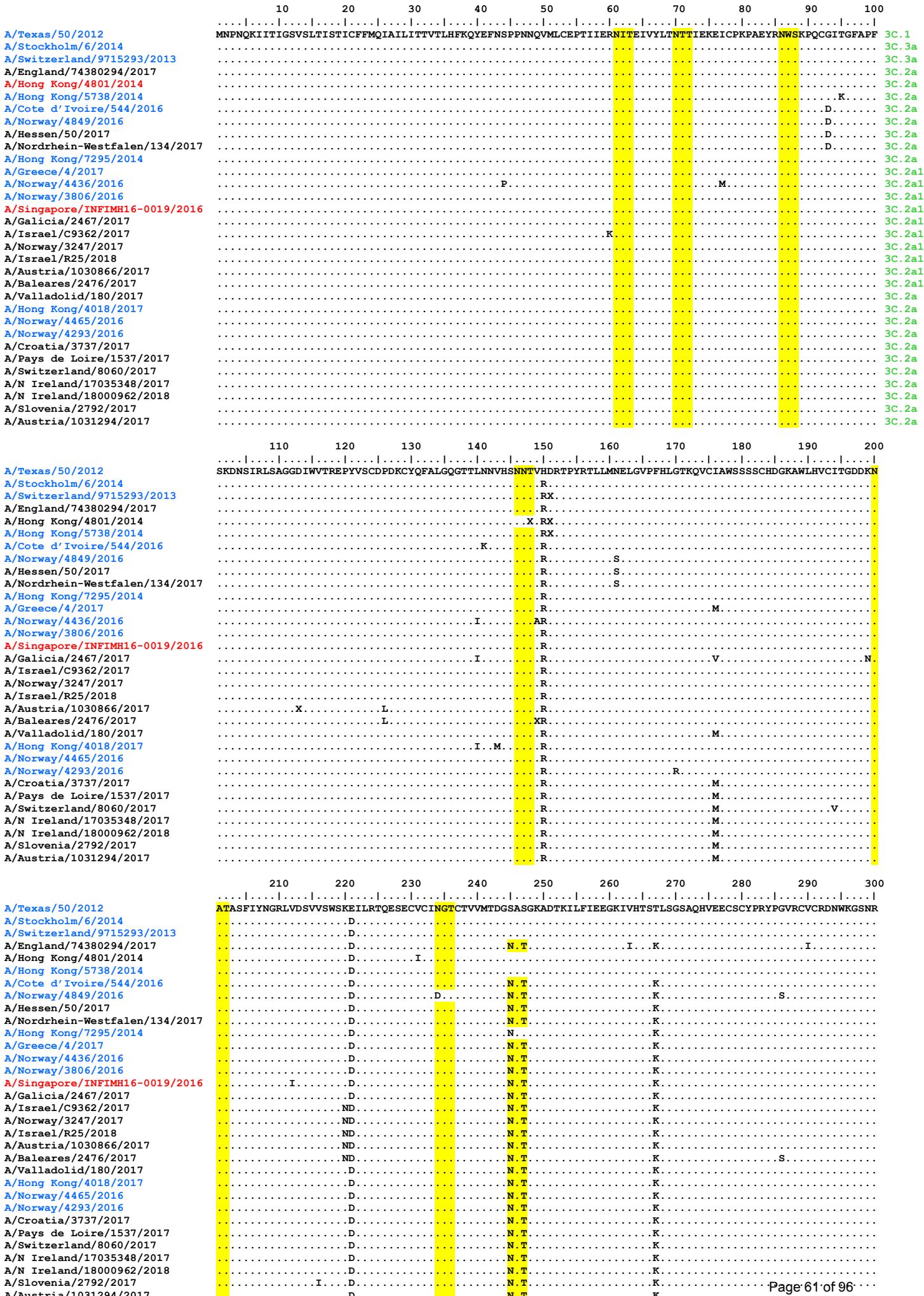
@ VN result in tables

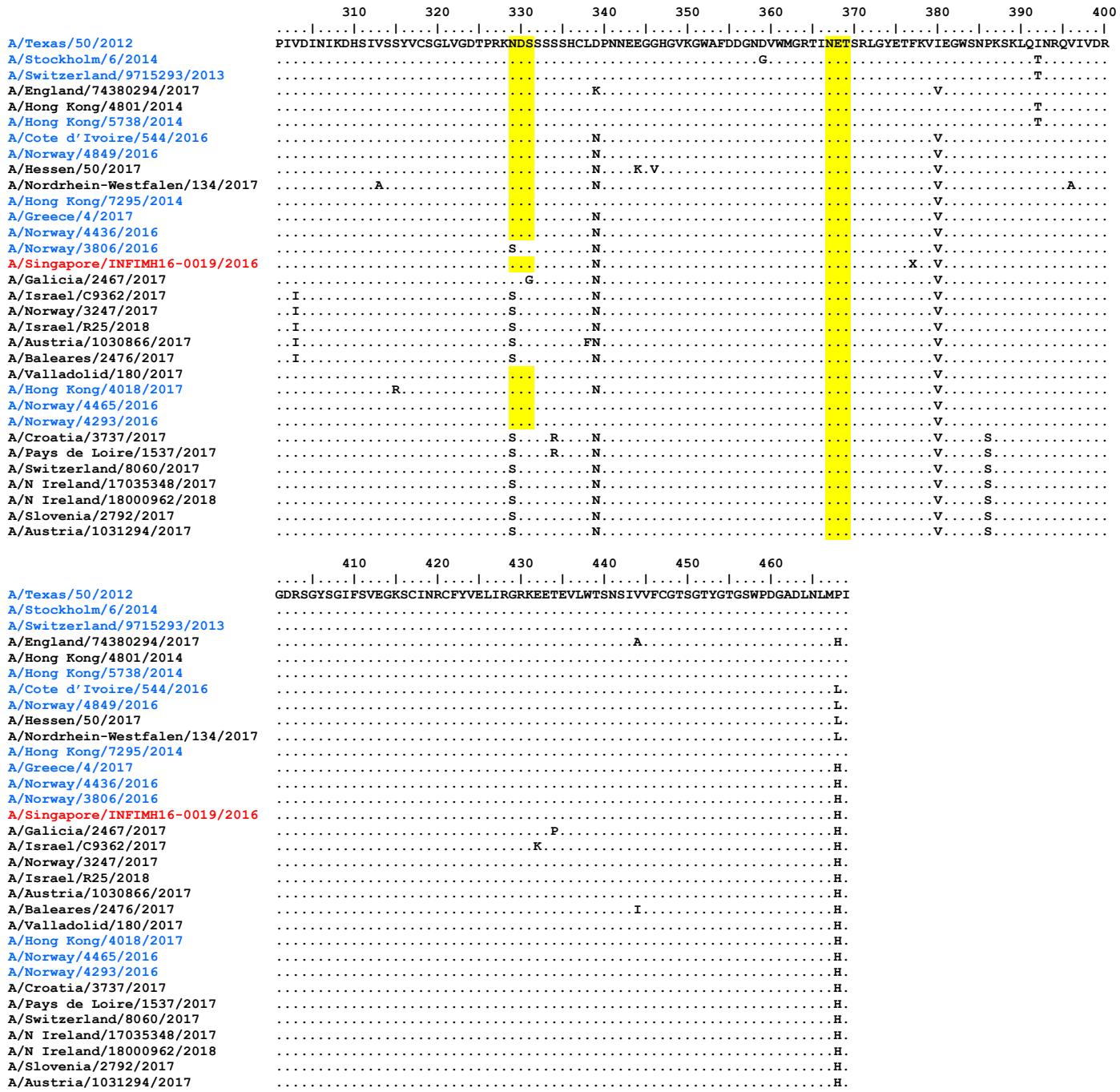
D151\*: +CHO  
if D151N



# Figure 10. NA protein alignment for influenza A(H3N2) viruses

Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site





Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site

## Influenza B virus analyses.

Influenza B viruses represented 43% of the samples received with collection dates after 2017-08-31 (**Table 1**). B/Yamagata lineage viruses predominated over those of the B/Victoria lineage at a ratio of approximately 6:1.

### *B/Victoria lineage.*

Influenza B viruses of the B/Victoria lineage were received from 16 countries or administrative regions in four WHO Regions (**Table 10**): African (1: Senegal), American (1: Argentina), European (12), Eastern Mediterranean (1: Qatar) and Western Pacific (1: Hong Kong SAR). The collection details and summary results for viruses that were recovered and assayed by HI are shown in **Table 10**.

HI results for the propagated viruses are shown in **Tables 11-1 to 11-11**: test viruses in each table are sorted by date of collection and those below the red horizontal lines in **Tables 5-6 to 5-11** are those with collection dates after 2017-08-31. The HA genetic group is indicated for those viruses that have been sequenced and those included in phylogenetic trees are highlighted. A summary of the recognition of the test viruses collected after 2017-08-31 is shown in **Table 11-12**. Two distinct patterns of antigenicity were detected.

Approximately 95% of the 58 test viruses were recognised at titres greater than 4-fold reduced compared to the homologous titre of the post-infection ferret antiserum raised against egg-propagated vaccine virus, B/Brisbane/60/2008, and only 3 (5%) test viruses were recognised at titres within 4-fold of the homologous titre of this antiserum. Test viruses were very poorly recognised by post-infection ferret antisera raised against other egg-propagated reference viruses (B/Malta/636714/2011, B/Johannesburg/3964/2012, B/South Australia/81/2012) with between 83% (with the antiserum raised against B/Malta/636714/2011) and 98% (with the antiserum raised against B/Johannesburg/3964/2012) of the test viruses being recognised at titres greater than 4-fold reduced compared to the homologous titres of these antisera.

In contrast, the recognition of viruses with antisera raised against cell culture-propagated viruses differentiated two distinct antigenic groups. The antisera raised against cell culture-propagated B/Formosa/V2367/2012, B/Hong Kong/514/2009, B/Ireland/3154/2016 and B/Nordrhein-Westfalen/1/2016 recognised approximately 50% of the test viruses at titres within 4-fold of the titres with the corresponding homologous viruses. The antiserum raised against cell culture-propagated B/Norway/2409/2017, the HA gene of which encodes a **deletion** in **HA1** at residues **162** and **163** (**Δ162-163**) (**Figure 11**), recognised 48% of the test viruses at titres within 2-fold of the titre with the homologous virus; the viruses recognised all fell into a clade designated **1A(Δ2)**. B/Hong Kong/930/2017 (**Table 11-8**) was poorly recognised by all the antisera; the HA gene of B/Hong Kong/930/2017 encodes a **deletion** in **HA1** of three amino acids at residues **162**, **163** and **164** (**Δ162-164**).

We showed in our September 2017 report that viruses with deletions  $\Delta$ 162-163 and  $\Delta$ 162-164 are both antigenically distinct from the majority of viruses in clade 1A and the  $\Delta$ 162-163 and  $\Delta$ 162-164 variants are antigenically distinct from each other.

A small number of viruses, despite propagation in cell culture, showed polymorphism at residues 197-199 in HA1, affecting the glycosylation motif frequently lost on adaptation of B/Victoria lineage viruses to eggs.

Phylogenetic analysis of the HA genes of representative B/Victoria lineage viruses is shown in **Figure 11** and an alignment of the HA glycoproteins of a selection of these viruses is shown in **Figure 12**. All recently circulating viruses analysed carried HA genes that fell into genetic group 1A, the B/Brisbane/60/2008 genetic group, the vast majority falling into a genetic group defined by two **HA1** amino acid substitutions compared with B/Brisbane/60/2008: **I117V** and **N129D**. Two new virus clusters have emerged within clade 1A both with deletions in HA1. A substantial proportion of viruses have HA genes that encode the two amino acid deletion in **HA1  $\Delta$ 162-163** in combination with a substitution **I180V** in **HA1** and **R151K** in **HA2**, with many also showing **HA1 D129G** substitution. The HA genes of most viruses that have a three amino acid deletion in **HA1  $\Delta$ 162-164** also encode substitutions **I180T** and **K209N** in **HA1** and these viruses appear to be less widespread.

**Figure 14** shows a phylogenetic tree for the NA gene and **Figure 15** shows a corresponding amino acid sequence alignment for a selection of NA glycoproteins. The NA gene phylogeny is largely congruent with the HA phylogeny.

#### **B/Yamagata lineage.**

Influenza B viruses of the B/Yamagata lineage were received from 41 countries or administrative regions in four WHO Regions (**Table 12**): African (2: Ghana and Mauritius), American (1: Argentina), Eastern Mediterranean (4: Iran, Lebanon, Palestine and Qatar), European (33) and Western Pacific (1: Hong Kong SAR). The collection details and summary results for viruses that were recovered and assayed by HI are shown in **Table 12**.

The results of HI analyses for propagated viruses of the B/Yamagata lineage are shown in **Tables 13-1 to 13-10**. Test viruses in each table are sorted by date of collection and those below the red horizontal lines in **Tables 13-2 to 13-10** are viruses with collection dates after 2017-08-31. The clade into which the HA gene falls is shown, and viruses for which gene sequences are included in phylogenetic trees are highlighted. A summary of recognition of test viruses by all of the post-infection ferret antisera is shown in **Table 13-11**.

Post-infection ferret antiserum raised against the egg-propagated vaccine virus B/Phuket/3073/2013, recommended for use in quadrivalent vaccines for the Northern Hemisphere 2017-2018 season and in vaccines for the Southern Hemisphere 2018, recognised 86% of the test viruses collected after 2017-08-31 at titres within 4-fold of the titre with the homologous virus, 63% within 2-fold. A post-infection ferret antiserum raised against a cell culture-propagated cultivar of B/Phuket/3073/2013 recognised 97%

of the recently collected test viruses at titres within 4-fold, and 82% within 2-fold, of its titre with the homologous virus.

Antisera raised against other viruses from the B/Phuket/3073/2013 clade (clade 3), egg-propagated B/Wisconsin/1/2010, B/Stockholm/12/2011, B/Hong Kong/3417/2014 and cell culture-propagated B/Mauritius/1791/2017 recognised 99%, 85%, 96% and 93%, respectively, of the test viruses collected after 2017-08-31 at titres within 4-fold of the titres of the antisera with their homologous viruses, and 79%, 49%, 62% and 42%, respectively, of these recent test viruses at titres within 2-fold of the homologous titres of the antisera.

An antiserum raised against egg-propagated B/Massachusetts/02/2012 recognised only 12% of recently collected test viruses at titres within 4-fold of the titre of the antiserum with the homologous virus, and less than 5% at titres within 2-fold of the homologous titre. An antiserum raised against the cell culture-propagated cultivar of B/Massachusetts/02/2012 recognised 35% of recently collected test viruses at titres within 4-fold, and 12% within 2-fold, of its homologous titre. Test viruses were recognised no better by an antiserum raised against cell culture-propagated B/Estonia/55669/2011, another virus from the B/Massachusetts/02/2012 clade (clade 2), with 24% of viruses being recognised at titres 4-fold lower than the titre of the antiserum for the homologous virus and only 4% at titres within 2-fold of the homologous titre.

**Figure 16** shows a phylogenetic analysis of the HA genes of representative B/Yamagata lineage viruses and an amino acid sequence alignment of a selection of the HA glycoproteins is shown in **Figure 17**. All tested viruses and the vast majority of recently circulating viruses fall in clade 3, the B/Phuket/3073/2013 clade, with most falling into a genetic group defined by two HA1 amino acid substitutions compared with B/Phuket/3073/2013: **L172Q** and **M251V**.

**Figure 18** shows a phylogenetic tree for NA genes of the same viruses represented in the HA phylogeny and **Figure 19** shows a corresponding amino acid sequence alignment for selected NA glycoproteins. As for the HA gene, the vast majority of NA genes of recently collected viruses fell into the B/Phuket/3073/2013 clade (clade 3) with a majority of viruses carrying **NA D342N** and **K373Q** amino acid substitutions compared to the B/Phuket/3073/2013 sequence, with many also carrying **I49M**, **I171M** and **N342K** substitutions and a subset of these having NAs with the substitutions **R65H** and **S402P**.

### **Antiviral Analysis.**

Susceptibility to the neuraminidase inhibitors zanamivir and oseltamivir was assessed phenotypically and by full NA gene sequencing, for 175 influenza B viruses with collection dates after 2017-08-31 (**Table 14**). All viruses showed normal inhibition (no reduced susceptibility) by both antivirals.

### **Conclusion.**

Viruses of the B/Yamagata lineage have outnumbered those of the B/Victoria lineage by a ratio of ~6:1. Viruses of the B/Yamagata lineage fell within genetic clade 3, the B/Phuket/3073/2013 clade, and the majority were recognised well by antisera raised against egg-propagated clade 3 vaccine/reference viruses. Viruses of the B/Victoria lineage fell into two main antigenic groups; each group was detected in similar numbers. One of the predominant clusters had HA genes encoding a **deletion** of two amino acids in **HA1, Δ162-163**. A small number of viruses had HAs with a three amino acid deletion in **HA1, Δ162-164**. Viruses with either deletion are antigenically distinct from the other viruses in clade 1A, and the Δ162-163 and Δ162-164 variants are antigenically distinct from each other.

**Table 10. Summary of influenza B (Victoria-lineage) viruses analysed, collected after 2017-08-31**

MONTH	B Victoria lineage					
	Country	Number received <sup>1</sup>	Number propagated <sup>2</sup>	≤2 fold <sup>3</sup>	4 fold <sup>3</sup>	≥8 fold <sup>3</sup>
<b>2017</b>						
<b>SEPTEMBER</b>						
Argentina	3	3				3
France	1	1				1
Senegal	5	5		5		
United Kingdom	1	1		1		
<b>OCTOBER</b>						
Argentina	1	1				1
Hong Kong	1	1		1		
Qatar	1	1		1		
United Kingdom	1	1			1	
<b>NOVEMBER</b>						
Argentina	2	2				2
Finland	1	0				
France	1	1			1	
Hong Kong	1	1				1
Norway	2	1		1		
Portugal	1	1		1		
Senegal	1	1		1		
Spain	5	3				3
United Kingdom	1	1				1
<b>DECEMBER</b>						
France	1	1				1
Hong Kong	6	6		5		1
Lithuania	1	1		1		
Poland	2	2				2
Portugal	6	6		6		
Slovenia	3	2				2
Spain	6	6				6
Turkey	1	1		1		
Ukraine	3	3		2		1
<b>2018</b>						
<b>JANUARY</b>						
Lithuania	2	1				1
Poland	1	1				1
Switzerland	1	1				1
Ukraine	1	1		1		
<b>16 Countries</b>	<b>63</b>	<b>57</b>	<b>27</b>	<b>2</b>	<b>28</b>	
			<b>47.4%</b>	<b>3.5%</b>	<b>49.1%</b>	

1. Numbers shown in red indicate that not all of the specimens received had been propagated at the time this report was prepared

2. Propagated to sufficient titre to perform HI assay

3. Compared to homologous titres for ferret antisera raised against at least one of three tissue-culture grown B/Brisbane/60/2008-like equivalents (B/Hong Kong/514/2009, B/Ireland/3154/2016 & B/Nordrhein-Westfalen/1/2016)

Deletion 162-163 ( $\Delta 2$ )

Deletion 162-164 ( $\Delta 3$ )



**Table 11-3. Antigenic analyses of influenza B viruses (Victoria lineage) 2017-10-17**

Viruses	Other information <sup>s</sup>	Collection date	Passage history	Haemagglutination inhibition titre												
				Post-infection ferret antisera												
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Sth Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK			
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>2</sup>	NIB F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>4</sup>	F09/16 <sup>2</sup>	F41/13 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>			
REFERENCE VIRUSES			Genetic group		1A		1A	1A	1A	1A	1A	1B	1A			
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	640	320	160	40	160	160	20	<	<			
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	320	1280	320	320	640	640	80	80	20			
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	160	640	160	160	640	640	80	40	20			
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	640	1280	1280	1280	640	1280	320	160	160			
B/Formosa/2367/2012	1A	2012-08-06	MDCK1/MDCK3	2560	40	640	320	80	640	320	80	80	40			
B/South Australia/81/2012	1A	2012-11-28	E4/E1	2560	160	640	320	160	320	640	80	40	20			
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK1	5120	<	40	80	40	320	80	160	160	80			
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK3	5120	<	40	40	40	160	80	80	80	40			
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK3	2560	<	40	40	40	640	80	80	80	80			
TEST VIRUSES																
B/Niger/135/2010	1A	2010-01-26	MDCK1	5120	<	40	80	40	640	160	80	80	80			
B/Niger/372/2010	1A	2010-03-24	MDCK1	5120	10	80	80	40	320	160	80	80	80			
B/Niger/4555/2017	1A	2017-01-26	MDCK1	2560	<	40	40	40	160	80	40	40	40			
B/Niger/4582/2017	1A	2017-02-07	MDCK1	2560	10	40	40	40	320	80	80	80	80			
B/Niger/4661/2017	1A	2017-02-08	MDCK1	2560	<	10	10	20	80	20	40	40	20			
B/Niger/4619/2017	NE(A/T)	2017-02-16	MDCK1	5120	80	640	320	160	640	640	80	80	40			
B/Niger/4681/2017	1A	2017-02-22	MDCK1	5120	10	<	80	<	40	160	80	80	80			
B/Niger/4674/2017	1A	2017-02-24	MDCK1	5120	10	80	40	40	320	160	80	80	40			

**Table 11-4. Antigenic analyses of influenza B viruses (Victoria lineage) 2017-11-01 + 2017-11-15 + 2017-12-12**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre												
				Post-infection ferret antisera												
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/Jhb 3964/12 MDCK	B/For V2367/12 Egg	B/Sth Aus 81/12 MDCK	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK		
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>2</sup>	NIB F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>4</sup>	F52/16 <sup>4</sup>	F09/16 <sup>2</sup>	F41/13 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>		
REFERENCE VIRUSES			Genetic group												NEW	
B/Malaysia/2506/2004		2004-12-06	E3/E6	1280	320	160	80	40	ND	80	160	10	<	<		
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	1280	160	640	320	160	640	320	640	40	40	40		
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	80	640	320	160	ND	320	640	40	40	40		
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	640	1280	1280	1280	1280	1280	1280	320	320	320		
B/Formosa/2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	40	320	320	80	ND	ND	320	40	40	40		
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	160	640	320	160	ND	ND	320	640	40	40		
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	2560	<	20	40	20	ND	160	40	80	80	80		
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	2560	<	20	20	20	ND	80	40	40	80	80		
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	1280	<	20	20	20	ND	160	40	40	40	40		
TEST VIRUSES																
B/Côte D'Ivoire/76/2017	1A	2017-01-09	C2/MDCK1	1280	<	20	40	20	ND	80	40	40	40	80		
B/Lebanon/2531/2017		2017-02-15	SIAT1	5120	<	80	80	80	40	160	80	80	160	160		
B/Armenia/9/2017	1A	2017-03-03	MDCK1/MDCK1	2560	<	40	40	40	ND	160	80	40	80	80		
B/Armenia/7/2017	1A	2017-03-30	MDCK1/MDCK1	5120	10	80	80	80	ND	320	160	80	80	160		
B/Armenia/8/2017	1A	2017-03-31	MDCK1/MDCK1	2560	<	40	40	40	ND	160	80	40	80	80		
B/Côte D'Ivoire/681/2017	1A	2017-05-17	C2/MDCK1	2560	<	40	40	40	ND	160	80	40	80	160		
B/Côte D'Ivoire/795/2017	1A	2017-06-15	C2/MDCK1	2560	<	40	40	40	ND	80	40	40	40	40		
B/Côte D'Ivoire/798/2017	1A	2017-06-16	C2/MDCK1	2560	20	40	20	20	ND	80	40	40	40	40		
B/Côte D'Ivoire/1089/2017	1A	2017-08-10	C0/MDCK1	1280	<	20	10	20	ND	40	20	20	40	40		
B/Côte D'Ivoire/1106/2017	1A	2017-08-14	C0/MDCK2	2560	<	40	20	40	ND	80	40	40	80	80		

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

<sup>1</sup> < = <40; <sup>2</sup> < = <10; <sup>3</sup> hyperimmune sheep serum; <sup>4</sup> < = <20

<sup>s</sup> Status of the 197-199 glycosylation site (polymorphic/lost)

ND = Not Done

Sequences in phylogenetic trees

**Table 11-5. Antigenic analyses of influenza B viruses (Victoria lineage) 2017-11-28**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre												
				Post-infection ferret antisera												
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Sth Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK	B/Nor 2409/17 MDCK		
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>1,2</sup>	NIB F52/16 <sup>1,2</sup>	F29/13 <sup>1,2</sup>	F04/16 <sup>1,2</sup>	F09/16 <sup>1,2</sup>	F41/13 <sup>1,2</sup>	F09/13 <sup>1,2</sup>	F15/16 <sup>1,2</sup>	F16/16 <sup>1,2</sup>	F26/17 <sup>1,2</sup>		
<b>REFERENCE VIRUSES</b>				1A	1A	1A	1A	1A	1A	1A	1A	1B	1A	1A	1A(Δ2)	
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	320	160	80	40	80	160	10	<	<	20		
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	160	640	320	160	320	640	80	40	40	20		
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	80	640	320	160	160	320	40	40	40	10		
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	640	1280	1280	1280	1280	1280	320	320	320	80		
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	40	640	320	160	320	640	80	80	80	20		
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	160	640	320	160	320	640	40	40	40	20		
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	2560	10	40	40	40	320	80	80	80	80	20		
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	2560	<	40	20	40	80	80	80	80	80	20		
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	1280	<	40	20	40	160	40	80	80	80	20		
B/Norway/2409/2017	1A(Δ2)	2017-04-27	MDCK1/MDCK2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	320	
<b>TEST VIRUSES</b>																
B/Norway/2957/2017	1A(Δ2)	2017-06-07	MDCK1	80	<	<	<	<	<	<	<	<	<	<	320	
B/Norway/2977/2017	1A(Δ2)	2017-06-21	MDCK1	80	<	<	<	<	<	<	<	<	<	<	160	

**Table 11-6. Antigenic analyses of influenza B viruses (Victoria lineage) 2017-12-19**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre												
				Post-infection ferret antisera												
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Sth Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK	B/HK 269/17 Egg		
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>1,2</sup>	NIB F52/16 <sup>1,2</sup>	F29/13 <sup>1,2</sup>	F04/16 <sup>1,2</sup>	F09/16 <sup>1,2</sup>	F41/13 <sup>1,2</sup>	F09/13 <sup>1,2</sup>	F15/16 <sup>1,2</sup>	F16/16 <sup>1,2</sup>	F50/17 <sup>1,2</sup>		
<b>REFERENCE VIRUSES</b>				1A	1A	1A	1A	1A	1A	1A	1A	1B	1A	1A	1A(Δ3)	
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	640	160	80	40	80	160	10	<	<	40		
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	320	640	640	320	320	640	80	80	80	40		
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	80	1280	640	160	160	320	40	80	80	40		
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	640	1280	1280	1280	1280	1280	320	320	320	320		
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	40	640	320	160	320	640	80	80	80	20		
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	160	1280	320	320	320	640	80	80	80	40		
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	2560	10	80	40	40	320	80	80	160	80	160		
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	2560	<	40	20	40	80	80	80	160	80	ND		
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	2560	<	40	40	80	160	40	80	160	80	<		
B/Hong Kong/269/2017	isolate 2 clon	1A(Δ3)	2017-05-24	E6	1280	320	160	80	40	160	160	10	<	<	320	
<b>TEST VIRUSES</b>																
B/Qatar/47-VI-17-0044392/2017	1A	2017-10-11	MDCK1	5120	20	80	80	80	320	160	80	160	160	<		
B/Centre/1582/2017	1A	2017-11-27	MDCK1	2560	10	40	40	80	160	80	40	80	80	<		

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

<sup>1</sup> < = <40; <sup>2</sup> < = <10; <sup>3</sup> hyperimmune sheep serum; <sup>4</sup> < = <20

ND = Not Done

Sequences in phylogenetic trees

**Table 11-7. Antigenic analyses of influenza B viruses (Victoria lineage) 2018-01-10**

Viruses	Other information <sup>s</sup>	Collection date	Passage history	Haemagglutination inhibition titre													
				Post-infection ferret antisera													
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Stk Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK	B/Nor 2409/17 MDCK			
			Passage history														
			Ferret number	Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>2</sup>	NIB F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>2</sup>	F09/16 <sup>2</sup>	F42/16 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>	F40/17 <sup>2</sup>			
			Genetic group		1A		1A	1A	1A	1A	1A	1B	1A	1A	1A(Δ2)		
<b>REFERENCE VIRUSES</b>																	
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	640	320	80	40	160	80	20	<	<	<	<	<	<
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	160	640	320	320	320	640	80	80	80	80	80	80	<
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	160	640	320	160	320	320	40	40	40	40	40	40	<
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	640	1280	1280	1280	1280	1280	320	320	320	320	320	320	20
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	80	640	320	160	320	320	80	80	80	80	80	80	<
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	160	640	320	320	320	640	80	80	80	80	80	80	<
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	2560	10	80	80	80	320	40	160	160	160	160	160	160	<
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	2560	<	40	40	80	160	40	40	40	40	40	40	40	<
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	1280	<	40	40	40	160	10	40	40	80	80	80	80	<
B/Norway/2409/2017	1A(Δ2)	2017-04-27	MDCK1/MDCK2	160	<	<	<	<	<	<	10	<	20	20	20	160	
<b>TEST VIRUSES</b>																	
B/Clermont-Ferrand/1894/2017	1A(Δ2)	2017-09-12	MDCK2/MDCK1	160	<	<	<	<	<	10	<	10	10	10	10	80	
B/England/66/2017	1A	2017-09-12	SIAT1/MDCK1	2560	10	80	40	80	160	20	80	80	80	80	80	80	<
B/England/71/2017	NK(A/T)	2017-10-11	SIAT1/MDCK1	5120	80	640	160	160	160	320	40	80	80	40	80	40	<
B/Galicia/2465/2017	1A(Δ2)	2017-12-02	SIAT1/MDCK1	160	<	<	<	<	<	10	<	10	10	10	10	80	

**Table 11-8. Antigenic analyses of influenza B viruses (Victoria lineage) 2018-01-19**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre														
				Post-infection ferret antisera														
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Stk Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK	B/Nor 2409/17 MDCK				
			Passage history															
			Ferret number	Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>2</sup>	NIB F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>2</sup>	F09/16 <sup>2</sup>	F25/16 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>	F40/17 <sup>2</sup>				
			Genetic group		1A		1A	1A	1A	1A	1A	1B	1A	1A	1A	1A(Δ2)		
<b>REFERENCE VIRUSES</b>																		
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	640	320	160	40	160	160	20	<	<	<	<	<	<	
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	320	640	160	160	160	640	40	40	40	40	40	40	<	
B/Malta/636714/2011	1A	2011-03-07	E4/E1	2560	160	640	320	160	320	640	40	40	40	40	40	40	<	
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	640	1280	1280	1280	1280	1280	160	160	160	160	160	160	20	
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	80	320	320	160	320	640	80	80	80	80	80	80	<	
B/South Australia/81/2012	1A	2012-11-28	E4/E2	5120	320	1280	320	160	320	1280	80	80	80	80	80	80	<	
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	2560	20	80	80	80	320	80	80	80	80	80	80	80	<	
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	2560	<	40	40	40	80	40	40	40	40	40	40	40	<	
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	2560	<	20	20	20	40	40	40	40	40	40	40	40	<	
B/Norway/2409/2017	1A(Δ2)	2017-04-27	MDCK1/MDCK2	80	<	<	<	<	<	<	<	<	<	<	<	40		
<b>TEST VIRUSES</b>																		
B/Hong Kong/695/2017	1A	2017-10-09	MDCK1/MDCK1	5120	<	40	40	80	320	80	40	160	160	160	160	160	<	
B/Hong Kong/930/2017	1A(Δ3)	2017-11-29	MDCK1/MDCK1	320	<	<	<	<	<	<	<	10	<	<	<	<	<	
B/Galicia/2465/2017	1A(Δ2)	2017-12-02	E1/E1	1280	<	160	80	40	160	80	80	<	<	<	<	40		
B/Castilla La Mancha/2439/2017	1A(Δ2)	2017-12-04	MDCK1	160	<	<	<	<	<	<	20	<	<	<	10	10	80	
B/Hong Kong/1118/2017	1A	2017-12-17	MDCK1/MDCK1	5120	<	40	40	80	160	80	40	160	160	160	160	160	<	
B/Hong Kong/1111/2017	1A	2017-12-17	MDCK1/MDCK1	2560	<	40	40	80	160	80	40	160	160	160	160	160	<	
B/Hong Kong/1094/2017	1A	2017-12-18	MDCK1/MDCK1	2560	<	40	40	80	320	80	40	160	160	160	160	160	<	
B/Hong Kong/1089/2017	1A	2017-12-18	MDCK1/MDCK1	2560	<	20	20	40	160	80	40	40	80	80	80	80	<	
B/Hong Kong/1143/2017	1A	2017-12-19	MDCK1/MDCK1	5120	<	40	<	40	160	80	40	80	80	80	80	80	<	
B/Hong Kong/1095/2017	1A(Δ3)	2017-12-19	MDCK1/MDCK1	320	<	<	<	<	<	<	<	10	<	<	<	10		

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

Vaccine

<sup>1</sup> < = <40; <sup>2</sup> < = <10; <sup>3</sup> hyperimmune sheep serum

<sup>s</sup> Status of the 197-199 glycosylation site (polymorphic/lost)

Sequences in phylogenetic trees

**Table 11-9. Antigenic analyses of influenza B viruses (Victoria lineage) 2018-01-24**

Viruses	Other information <sup>§</sup>	Collection date	Passage history	Haemagglutination inhibition titre												
				Post-infection ferret antisera												
				B/Bris 60/08	B/Mal 2506/04	B/Bris 60/08	B/Malta 636714/11	B/Jhb 3964/12	B/For V2367/12	B/Stk Aus 81/12	B/HK 514/09	B/Ireland 3154/16	B/Nord-West 1/16	B/Nor 2409/17		
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	Egg	Egg	NIB	F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>2</sup>	F09/16 <sup>2</sup>	F25/16 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>	F40/17 <sup>2</sup>
			Ferret number		F41/14 <sup>2</sup>											
			Genetic group	1A		1A										
<b>REFERENCE VIRUSES</b>																
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	640	160	80	40	80	80	20	<	<	<	<	<
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	160	640	320	160	320	640	80	40	40	40	40	<
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	80	640	320	160	320	320	40	40	40	40	40	<
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E3	5120	320	1280	1280	640	640	1280	160	80	80	80	80	<
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	40	320	320	80	320	640	80	80	80	80	80	<
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	320	640	320	320	320	320	640	80	80	80	80	<
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	2560	<	40	20	40	320	80	80	80	80	80	80	<
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	2560												
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	1280	<	40	20	20	80	20	40	80	80	80	80	<
B/Norway/2409/2017	1A <sup>(Δ2)</sup>	2017-04-27	MDCK1/MDCK2	40	<	<	<	<	<	<	<	<	<	<	<	40
<b>TEST VIRUSES</b>																
B/Iwate/34/2017	1A	2017-03-24	MDCK1/MDCK2/MDCK1	2560	<	40	40	<	160	80	80	80	80	80	80	<
B/Laos/F1664/2017	1A <sup>(Δ3)</sup>	2017-05-26	MDCK1/MDCK2/MDCK1	1280	<	<	<	<	<	20	<	<	<	<	<	<
B/Shizuoka/63/2017	1A	2017-10-23	MDCK2/MDCK2/MDCK1	5120	80	320	160	80	320	640	80	80	80	80	80	<
B/Galicia/2407/2017	NE(A/T)	2017-11-17	MDCK3	80	<	<	<	<	<	<	<	<	<	<	<	20
B/Spain/107178/2017	1A <sup>(Δ2)</sup>	2017-12-04	MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	40
B/Spain/107764/2017	1A <sup>(Δ2)</sup>	2017-12-04	MDCK2	40	<	<	<	<	<	<	<	<	<	<	10	10
B/Spain/108127/2017	1A <sup>(Δ2)</sup>	2017-12-07	MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	40
B/Slovenia/2654/2017	1A <sup>(Δ2)</sup>	2017-12-12	SIATx/MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	40

**Table 11-10. Antigenic analyses of influenza B viruses (Victoria lineage) 2018-01-31**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre													
				Post-infection ferret antisera													
				B/Bris 60/08	B/Mal 2506/04	B/Bris 60/08	B/Malta 636714/11	B/Jhb 3964/12	B/For V2367/12	B/Stk Aus 81/12	B/HK 514/09	B/Ireland 3154/16	B/Nord-West 1/16	B/Nor 2409/17			
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	Egg	Egg	NIB	F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>2</sup>	F09/16 <sup>2</sup>	F25/16 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>	F40/17 <sup>2</sup>	
			Ferret number		F41/14 <sup>2</sup>												
			Genetic group	1A		1A		1A		1A		1A		1B		1A	1A <sup>(Δ2)</sup>
<b>REFERENCE VIRUSES</b>																	
B/Malaysia/2506/2004		2004-12-06	E3/E6	5120	640	160	160	40	80	160	20	<	<	<	<	<	
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	1280	80	320	320	80	160	320	40	20	20	20	20	<	
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	80	320	640	80	160	320	40	20	20	20	20	<	
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E3	5120	320	1280	1280	640	640	1280	160	80	80	80	80	<	
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	40	320	640	160	320	640	80	80	80	80	80	<	
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	160	640	320	160	320	640	80	80	80	80	80	<	
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	5120	10	40	160	80	160	80	80	80	80	80	80	<	
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	5120	10	20	80	40	80	40	40	40	80	80	80	<	
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	2560	<	20	80	40	80	20	40	40	80	80	80	<	
B/Norway/2409/2017	1A <sup>(Δ2)</sup>	2017-04-27	MDCK1/MDCK2	40	<	<	<	<	<	<	<	<	<	<	<	80	
<b>TEST VIRUSES</b>																	
B/Santa Fe/859/2017	1A <sup>(Δ2)</sup>	2017-09-13	MDCK1/MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	40	
B/Buenos Aires/1680619/2017	1A <sup>(Δ2)</sup>	2017-09-13	MDCK1/MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	40	
B/Neuquen/28066/2017	1A <sup>(Δ2)</sup>	2017-09-15	MDCK1/MDCK1	80	<	<	<	10	<	<	<	<	<	<	<	80	
B/Buenos Aires/1693016/2017	1A <sup>(Δ2)</sup>	2017-10-06	MDCK1/MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	40	
B/Buenos Aires/383802/2017	1A <sup>(Δ2)</sup>	2017-11-06	MDCK1/MDCK1	40	<	<	<	10	<	<	<	<	<	<	<	40	
B/Valladolid/183/2017	1A <sup>(Δ2)</sup>	2017-11-13	MDCK1/MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	80	
B/Buenos Aires/1926546/2017	1A <sup>(Δ2)</sup>	2017-11-15	MDCK1/MDCK1	80	<	<	<	10	<	<	<	<	<	<	<	80	
B/Lisboa/ISU039_17-18/2017	1A	2017-11-29	MDCK3/MDCK1	2560	80	20	80	40	80	40	40	40	80	80	80	<	
B/Valladolid/196/2017	1A <sup>(Δ2)</sup>	2017-12-07	MDCK1/MDCK1	40	<	<	<	<	<	<	<	<	<	<	<	80	
B/Ankara/1110/2017	TET	2017-12-08	SIAT1/MDCK1	5120	80	320	640	160	160	640	80	80	40	40	<	40	
B/Poland/31396/2017	1A <sup>(Δ2)</sup>	2017-12-19	MDCK2	40	<	<	<	<	<	<	<	<	<	<	<	40	
B/Portugal/SU12/2017	1A	2017-12-27	SIAT1/MDCK1	2560	10	20	160	40	80	40	40	80	80	80	80	<	
B/Slovenia/2786/2017	1A <sup>(Δ2)</sup>	2017-12-28	MDCK2	80	<	<	<	10	<	<	<	<	<	<	<	40	
B/Portugal/SU13/2017	1A	2017-12-28	SIAT1/MDCK1	2560	<	20	80	40	80	40	40	40	80	80	80	<	
B/Portugal/SU130/2017	1A	2017-12-28	SIAT1/MDCK1	2560	10	20	80	40	160	40	40	80	80	80	80	<	
B/Portugal/SU146/2017	1A	2017-12-29	SIAT1/MDCK1	2560	<	40	80	40	160	40	40	80	80	80	80	<	
B/Portugal/SU144/2017	1A	2017-12-29	SIAT1/MDCK1	2560	<	40	80	40	160	40	40	80	80	80	80	<	
B/Portugal/SU138/2017	1A	2017-12-29	SIAT2/MDCK1	2560	<	20	80	40	160	40	40	80	80	80	80	<	

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used);

<sup>1</sup> < = <40; <sup>2</sup> < = <10; <sup>3</sup> hyperimmune sheep serum

<sup>§</sup> Status of the 197-199 glycosylation site (polymorphic/lost)

Sequences in phylogenetic trees

**Table 11-11. Antigenic analyses of influenza B viruses (Victoria lineage) 2018-02-06**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Bris 60/08 Egg	B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Stk Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK	B/Nor 2409/17 MDCK	
				Sh 539, 540, 543, 544, 570, 571, 574 <sup>1,3</sup>	F41/14 <sup>2</sup>	NIB F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>2</sup>	F09/16 <sup>2</sup>	F25/16 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>	F40/17 <sup>2</sup>	
			Passage history	1A		1A	1A	1A	1A	1A	1A	1B	1A	1A	
			Ferret number												
			Genetic group												
<b>REFERENCE VIRUSES</b>															
B/Malaysia/2506/2004		2004-12-06	E3/E6	2560	320	160	160	40	160	160	20	<	<	<	<
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	2560	160	640	320	160	320	640	80	40	40	40	<
B/Malta/636714/2011	1A	2011-03-07	E4/E1	1280	80	320	320	80	320	320	40	20	40	40	<
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	5120	320	1280	1280	640	1280	1280	160	80	160	160	<
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	5120	40	320	320	80	320	640	80	80	80	80	<
B/South Australia/81/2012	1A	2012-11-28	E4/E2	2560	160	640	320	160	320	640	80	40	40	40	<
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	5120	10	40	160	160	320	40	160	80	160	160	<
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	5120	<	20	40	10	80	40	80	80	160	160	<
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	2560	<	20	40	40	80	<	80	80	80	80	<
B/Norway/2409/2017	1A(Δ2)	2017-04-27	MDCK1/MDCK2	80	<	<	<	<	<	<	<	<	<	<	80
<b>TEST VIRUSES</b>															
B/Dakar/11/2017	P55	2017-06-16	C0/MDCK1	2560	<	20	20	20	40	20	40	80	80	80	<
B/Dakar/16/2017	P55	2017-09-05	C0/MDCK1	2560	<	20	40	20	40	20	80	80	80	80	<
B/Dakar/14/2017	P55	2017-09-06	C0/MDCK1	2560	<	20	40	40	80	<	80	80	80	80	<
B/Dakar/15/2017	P55	2017-09-11	C0/MDCK1	5120	<	40	80	40	160	40	80	160	160	160	<
B/Dakar/13/2017	P55	2017-09-12	C0/MDCK1	2560	10	20	40	40	80	20	80	80	80	80	<
B/Dakar/12/2017	P55	2017-09-12	C0/MDCK1	5120	10	40	80	40	160	40	160	160	160	160	<
B/Dakar/18/2017	P55	2017-11-01	C0/MDCK1	2560	40	20	40	40	80	40	80	80	80	160	<
B/Norway/3574/2017	1A	2017-11-23	MDCK1/MDCK1	2560	10	40	80	80	160	40	80	80	160	160	<
B/England/103/2017	1A(Δ2)	2017-11-23	SIAT2/MDCK1	80	<	<	<	<	<	<	<	<	<	<	80
B/Spain/106811/2017	1A(Δ2)	2017-11-29	MDCK1	80	10	<	<	<	<	<	<	<	<	<	80
B/Hubei-Jiangan/1974/2017	P55	2017-12-04	C2/MDCK1	160	<	<	<	<	<	<	<	<	<	<	<
B/Hunan-Yuhua/11986/2017	P55	2017-12-04	C2/MDCK1	2560	<	<	<	40	<	<	<	80	40	20	<
B/Lithuania/36282/2017	P55	2017-12-17	MDCK1	2560	<	20	80	40	80	40	80	80	160	160	<
B/Lyon/2452/2017	1A(Δ2)	2017-12-18	MDCK3/MDCK1	80	<	<	<	<	<	<	<	<	<	<	80
B/Kyiv/367/2017	P55	2017-12-18	SIAT1/MDCK1	80	<	<	<	<	<	<	<	<	<	<	80
B/Poland/31392/2017	1A(Δ2)	2017-12-18	MDCK2	80	<	<	<	<	<	<	<	<	<	<	40
B/Kharkiv/382/2017	P55	2017-12-23	SIAT2/MDCK1	2560	10	20	80	40	160	40	80	80	160	160	<
B/Kyiv/375/2017	P55	2017-12-31	SIAT2/MDCK1	2560	10	40	80	40	160	80	80	80	160	160	<
B/Poland/7/2018	1A(Δ2)	2018-01-02	MDCK2	80	<	<	<	<	<	<	<	<	<	<	80
B/Switzerland/952/2018	1A(Δ2)	2018-01-05	SIAT1/MDCK1	80	<	<	<	<	<	<	<	<	<	<	80
B/Lithuania/1547/2018	P55	2018-01-15	MDCK1	40	<	<	<	<	<	<	<	<	<	<	80
B/Kyiv/46/2018	P55	2018-01-16	SIAT1/MDCK1	5120	<	20	80	40	160	40	80	80	160	<	

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

<sup>1</sup> < = <40; <sup>2</sup> < = <10; <sup>3</sup> hyperimmune sheep serum

Vaccine

Sequences in phylogenetic trees

**Table 11-12. Antigenic analyses of influenza B viruses (Victoria lineage) with collection dates after 2017-08-31 - Summary**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre														
				Post-infection ferret antisera														
				B/Mal 2506/04 Egg	B/Bris 60/08 Egg	B/Malta 636714/11 Egg	B/Jhb 3964/12 Egg	B/For V2367/12 MDCK	B/Sth Aus 81/12 Egg	B/HK 514/09 MDCK	B/Ireland 3154/16 MDCK	B/Nord-West 1/16 MDCK	B/Nor 2409/17 MDCK					
				F41/14 <sup>2</sup>	NIB F52/16 <sup>2</sup>	F29/13 <sup>2</sup>	F04/16 <sup>2</sup>	F09/16 <sup>2</sup>	F25/16 <sup>2</sup>	F09/13 <sup>2</sup>	F15/16 <sup>2</sup>	F16/16 <sup>2</sup>	F40/17 <sup>2</sup>					
Genetic group				1A	1A	1A	1A	1A	1A	1B	1A	1A	1A(Δ2)					
<b>REFERENCE VIRUSES</b>																		
B/Malaysia/2506/2004		2004-12-06	E3/E6	320	160	160	40	160	160	20	<	<	<					
B/Brisbane/60/2008	1A	2008-08-04	E4/E4	160	640	320	160	320	640	80	40	40	40		<			
B/Malta/636714/2011	1A	2011-03-07	E4/E1	80	320	320	80	320	320	40	20	40						
B/Johannesburg/3964/2012	1A	2012-08-03	E1/E2	320	1280	1280	640	1280	1280	160	80	160						
B/Formosa/V2367/2012	1A	2012-08-06	MDCK1/MDCK3	40	320	320	80	320	640	80	80	80						
B/South Australia/81/2012	1A	2012-11-28	E4/E2	160	640	320	160	320	640	80	40	40						
B/Hong Kong/514/2009	1B	2009-10-11	MDCK1/MDCK2	10	40	160	160	320	40	160	80	160			<			
B/Ireland/3154/2016	1A	2016-01-14	MDCK1/MDCK4	<	20	40	10	80	40	80	160	160						
B/Nordrhein-Westfalen/1/2016	1A	2016-01-04	C2/MDCK2	<	20	40	40	80	<	80	80	80	80		<			
B/Norway/2409/2017	1A(Δ2)	2017-04-27	MDCK1/MDCK2	<	<	<	<	<	<	<	<	<	<		80			
<b>TEST VIRUSES</b>																		
Number of viruses tested*				58	58	58	58	58	58	58	58	58	58	58	56			
No with titre reduction ≤2-fold					2	2		22	2	27	29	29	29	27				
%					3.4	3.4		37.9	3.4	46.6	50.0	50.0	50.0	48.2				
No with titre reduction =4-fold					1	8	1	7	1	2								
%					1.8	13.8	1.7	12.1	1.8	3.4								
No with titre reduction ≥8-fold				58	55	48	57	29	55	29	29	29	29	29	29			
%				100.0	94.8	82.8	98.3	50.0	94.8	50.0	50.0	50.0	50.0	50.0	51.8			

\* All viruses sequenced carried HA genes that fell in the B/Brisbane/60/2008 clade (clade 1A)

Vaccine

B/Galicia/2465/2017 (1AΔ2) was tested as cell- and egg-isolated viruses

Reference virus results are taken from an individual table as an example. Summaries for each antiserum are based on fold-reductions observed on the days that HI assays were performed.

# Figure 11. Phylogenetic comparison of influenza B (Victoria-lineage) HA genes

Vaccine virus

Reference viruses

Collection date

Oct 2017

Nov 2017

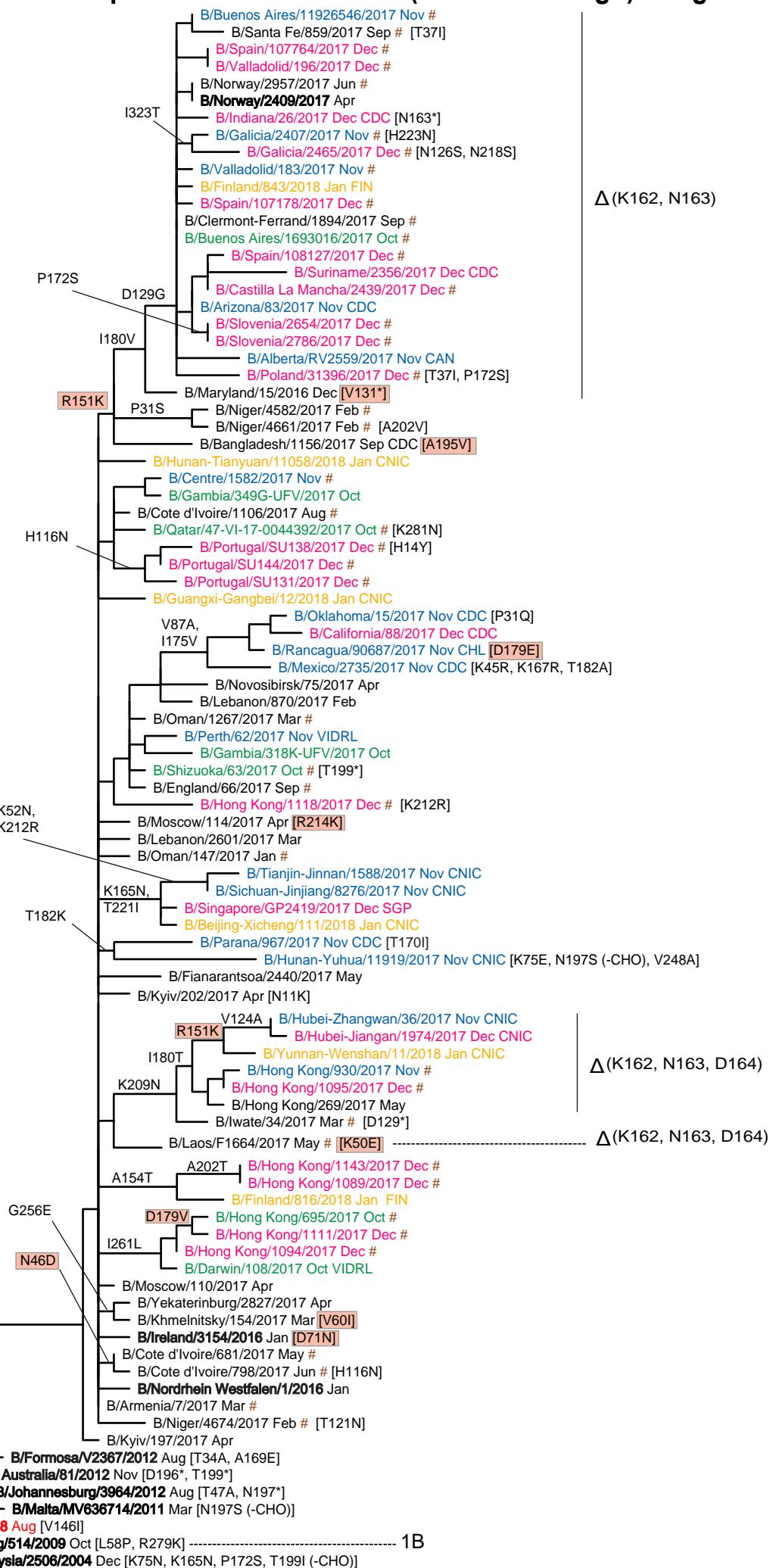
Dec 2017

Jan 2018

HA2 numbering

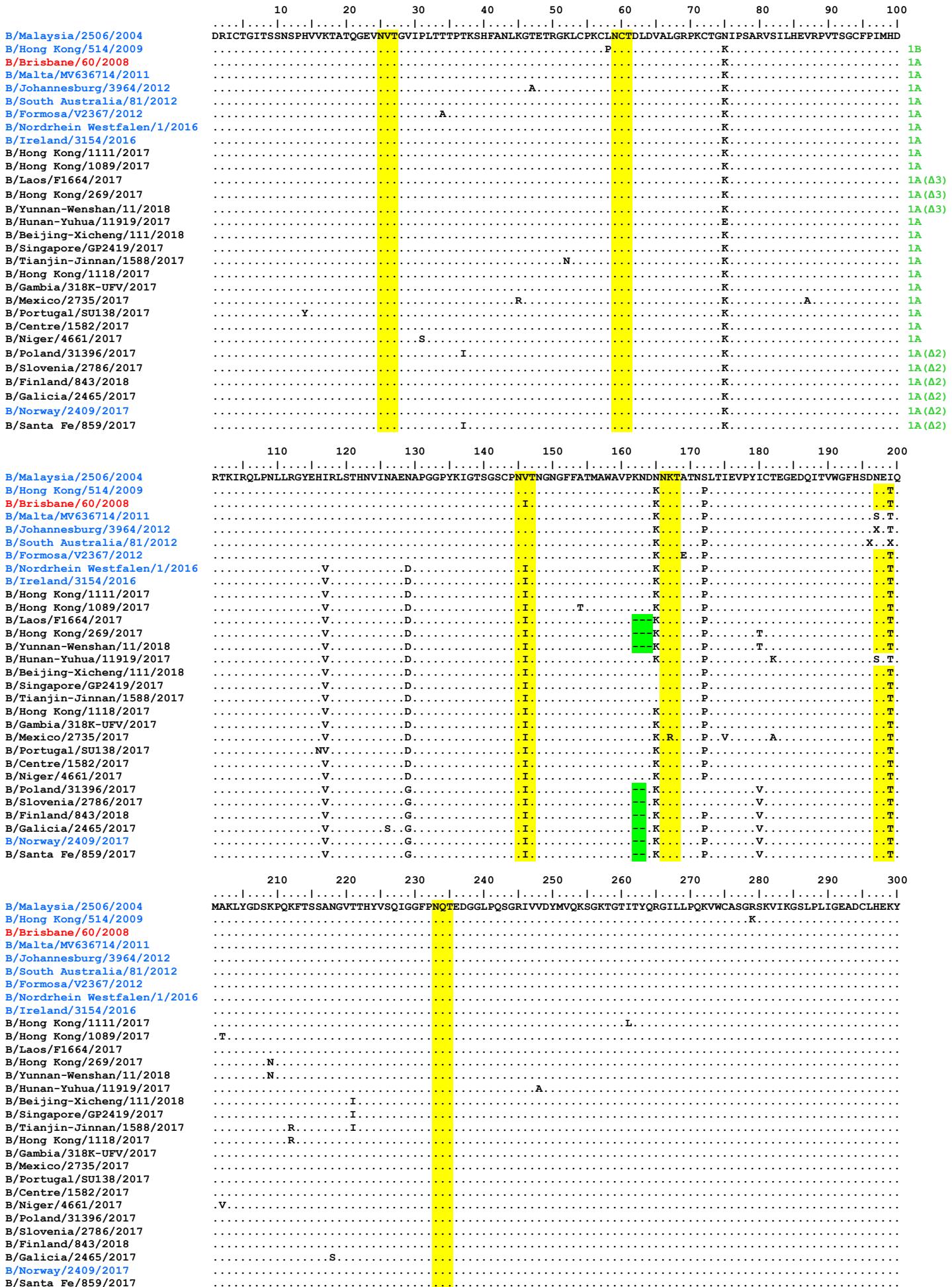
\* amino acid polymorphism  
N197\*/T199\* (-/+CHO)

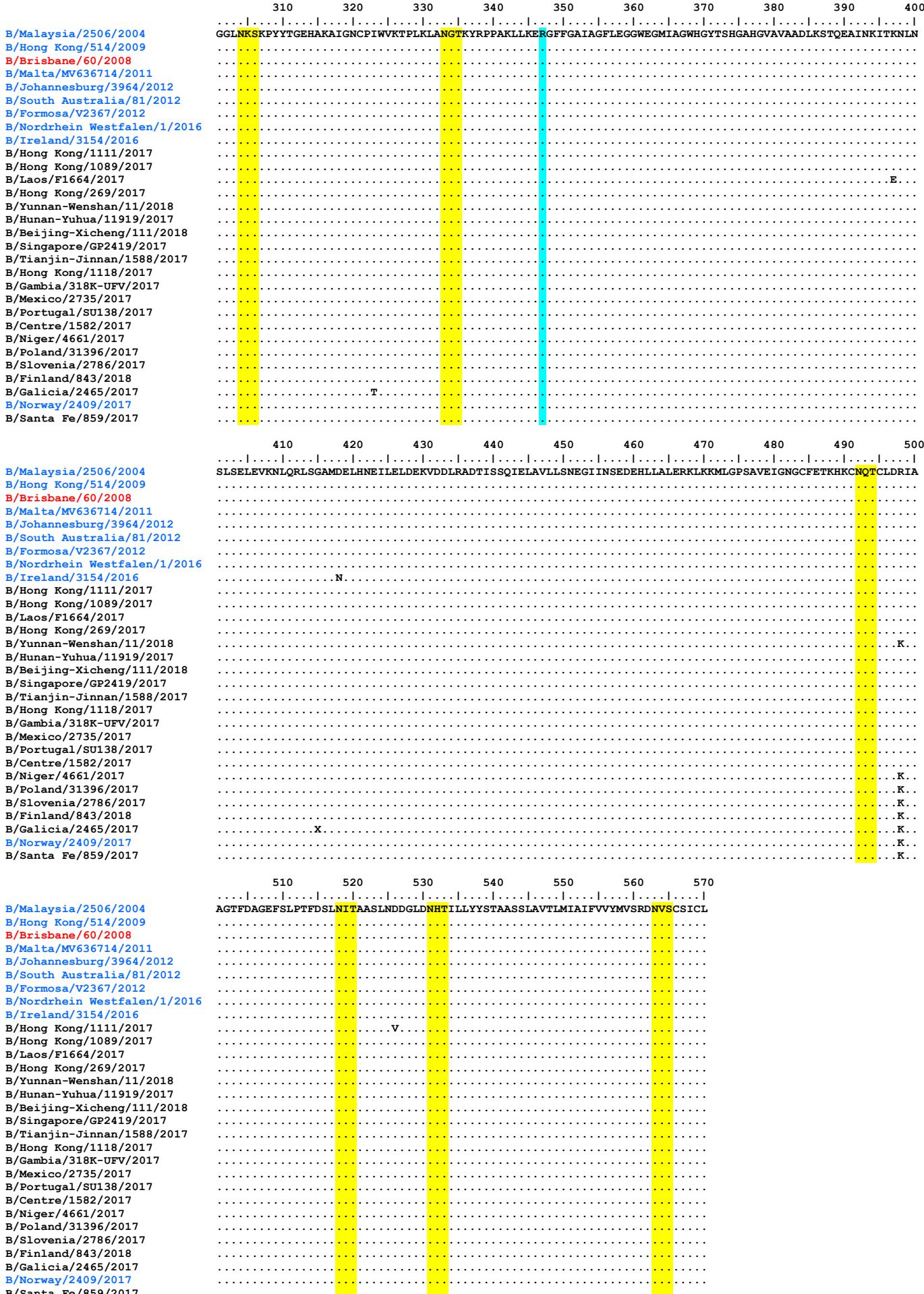
# HI result in tables



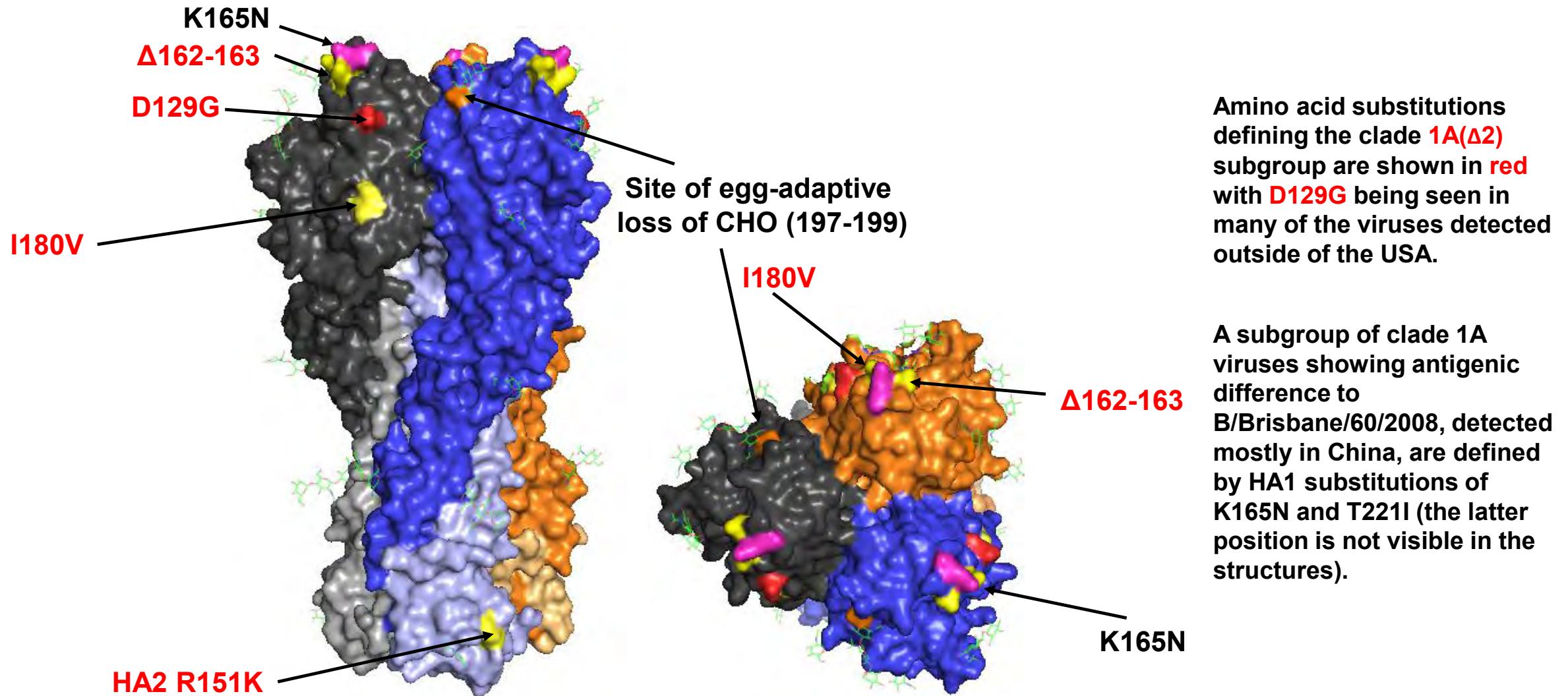
# Figure 12. HA protein alignment for B (Victoria-lineage) viruses

Vaccine virus: Reference virus: Genetic group: HA1/HA2 boundary: Potential N-linked glycosylation site





**Figure 13. B/Victoria lineage HA amino acid substitutions associated with emergence of antigenic variants**



# Figure 14. Phylogenetic comparison of influenza B (Victoria-lineage) NA genes

Vaccine virus  
Reference viruses

Collection date

Oct 2017

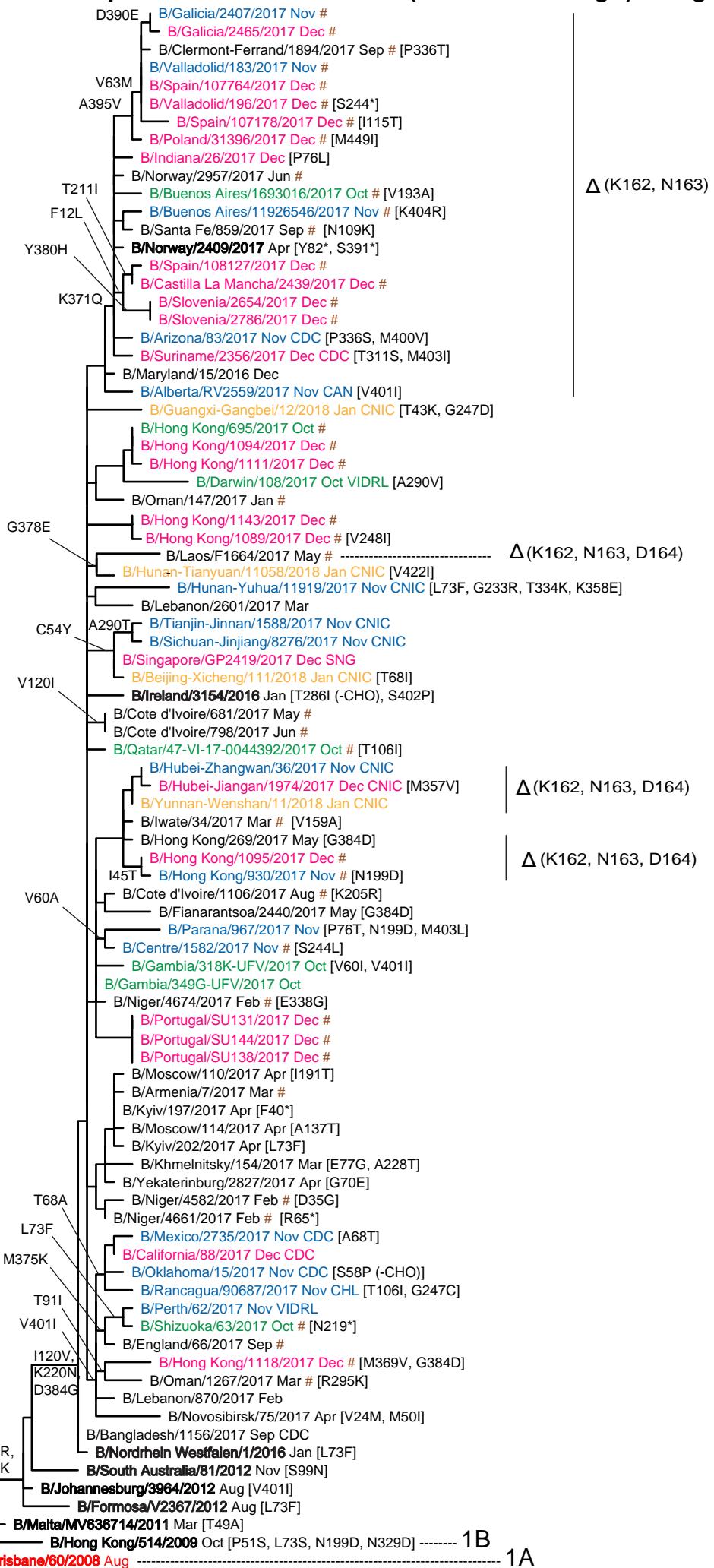
Nov 2017

Dec 2017

Jan 2018

\* amino acid polymorphism

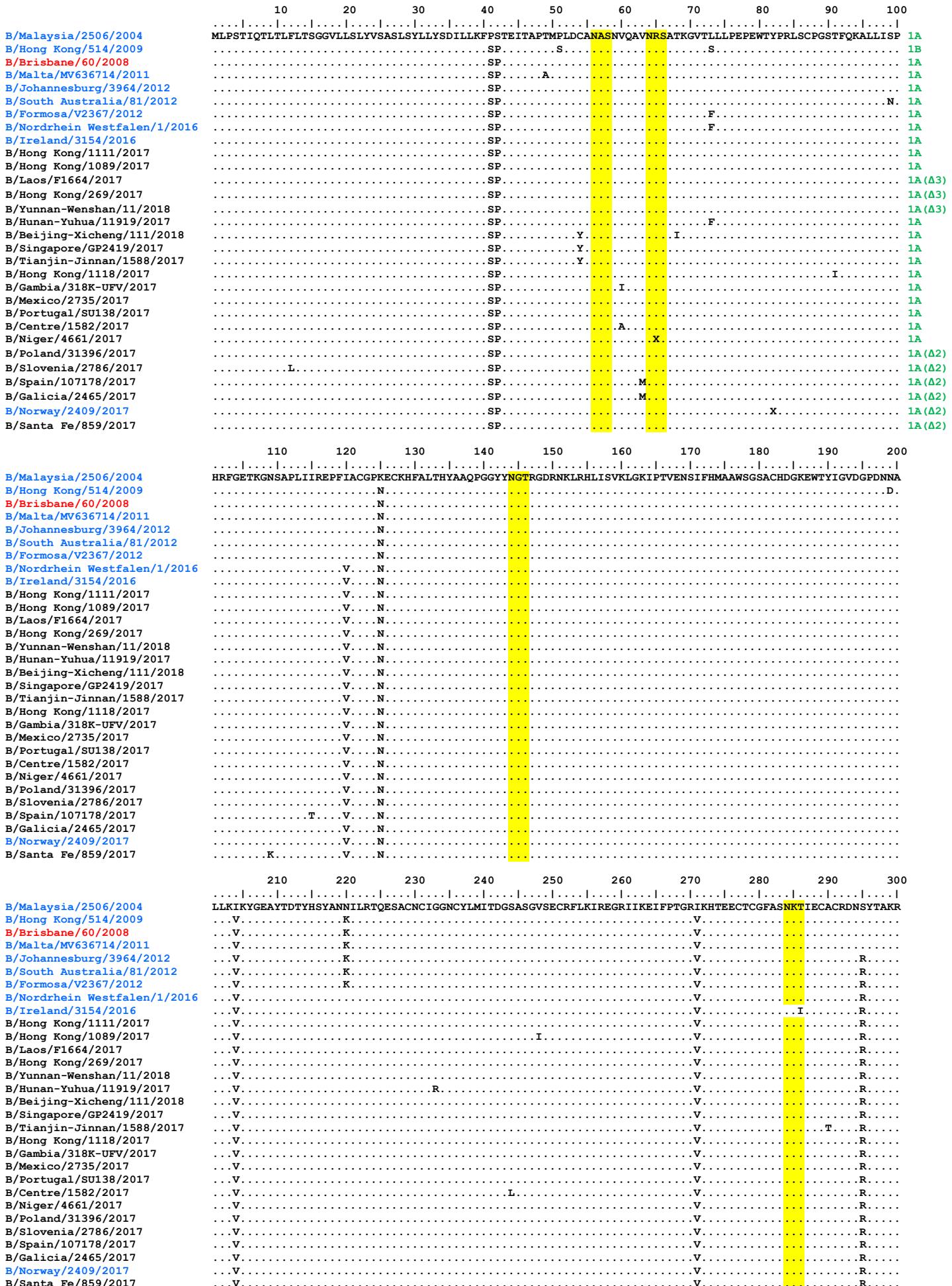
# HI result in tables



0.003

# Figure 15. NA protein alignment for B (Victoria-lineage) viruses

Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site



	310	320	330	340	350	360	370	380	390	400
B/Malaysia/2506/2004	.	.	.	.	.	E.	.	E.	.	.
B/Hong Kong/514/2009	D.	.	.	.	.	E.	.	E.	.	.
B/Brisbane/60/2008	D.	N.	.	.	.	E.	.	E.	.	.
B/Malta/MV636714/2011	D.	N.	.	D.	.	K.	.	E.	.	.
B/Johannesburg/3964/2012	D.	N.	.	D.	.	K.	.	E.	.	.
B/South Australia/81/2012	D.	N.	.	D.	.	K.	.	E.	.	.
B/Formosa/V2367/2012	D.	N.	.	D.	.	K.	.	E.	.	.
B/Nordrhein Westfalen/1/2016	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Ireland/3154/2016	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Hong Kong/1111/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Hong Kong/1089/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Laos/F1664/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Hong Kong/269/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Yunnan-Wenshan/11/2018	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Hunan-Yuhua/11919/2017	D.	N.	K.	D.	.	E.	.	E.	.	G.
B/Beijing-Xicheng/111/2018	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Singapore/GP2419/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Tianjin-Jinnan/1588/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Hong Kong/1118/2017	D.	N.	.	D.	.	K.	.	V.	E.	.
B/Gambia/318K-UVF/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Mexico/2735/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Portugal/SU138/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Centre/1582/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Niger/4661/2017	D.	N.	.	D.	.	K.	.	E.	.	G.
B/Poland/31396/2017	D.	N.	.	D.	.	K.	.	Q.	E.	.
B/Slovenia/2786/2017	D.	N.	.	D.	.	K.	.	Q.	E.	H.
B/Spain/107178/2017	D.	N.	.	D.	.	K.	.	Q.	E.	G.
B/Galicia/2465/2017	D.	N.	.	D.	.	K.	.	Q.	E.	E.
B/Norway/2409/2017	D.	N.	.	D.	.	K.	.	Q.	E.	X.
B/Santa Fe/859/2017	D.	N.	.	D.	.	K.	.	Q.	E.	.

	410	420	430	440	450	460
B/Malaysia/2506/2004	.	.	.	.	.	.
B/Hong Kong/514/2009	K.	.	.	.	.	D.
B/Brisbane/60/2008	K.	.	.	.	.	D.
B/Malta/MV636714/2011	I.	K.	.	.	.	D.
B/Johannesburg/3964/2012	I.	K.	.	.	.	D.
B/South Australia/81/2012	K.	.	.	.	.	D.
B/Formosa/V2367/2012	K.	.	.	.	.	D.
B/Nordrhein Westfalen/1/2016	K.	.	.	.	.	D.
B/Ireland/3154/2016	P.K.	.	.	.	.	D.
B/Hong Kong/1111/2017	K.	.	.	.	.	D.
B/Hong Kong/1089/2017	K.	.	.	.	.	D.
B/Laos/F1664/2017	K.	.	.	.	.	D.
B/Hong Kong/269/2017	K.	.	.	.	.	D.
B/Yunnan-Wenshan/11/2018	K.	.	.	.	.	D.
B/Hunan-Yuhua/11919/2017	K.	.	.	.	.	D.
B/Beijing-Xicheng/111/2018	K.	.	.	.	.	D.
B/Singapore/GP2419/2017	K.	.	.	.	.	D.
B/Tianjin-Jinnan/1588/2017	K.	.	.	.	.	D.
B/Hong Kong/1118/2017	I..K.	.	.	.	.	D.
B/Gambia/318K-UVF/2017	I..K.	.	.	.	.	D.
B/Mexico/2735/2017	I..K.	.	.	.	.	D.
B/Portugal/SU138/2017	K.	.	.	.	.	D.
B/Centre/1582/2017	K.	.	.	.	.	D.
B/Niger/4661/2017	K.	.	.	.	.	D.
B/Poland/31396/2017	K.	.	.	I.	.	D.
B/Slovenia/2786/2017	K.	.	.	.	.	D.
B/Spain/107178/2017	K.	.	.	.	.	D.
B/Galicia/2465/2017	K.	.	.	.	.	D.
B/Norway/2409/2017	K.	.	.	.	.	D.
B/Santa Fe/859/2017	K.	.	.	.	.	D.

Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site

**Table 12. Summary of influenza B (Yamagata-lineage) viruses analysed, collected after 2017-08-31**

MONTH	B Yamagata lineage					
	Country	Number received <sup>1</sup>	Number propagated <sup>2</sup>	≤2 fold <sup>3</sup>	4 fold <sup>3</sup>	≥8 fold <sup>3</sup>
<b>2017</b>						
<b>SEPTEMBER</b>						
France	1	1			1	
Germany	1	1		1		
Iran	1	1		1		
Mauritius	2	2			2	
Norway	1	1			1	
Palestine	2	1			1	
<b>OCTOBER</b>						
Argentina	4	2				2
France	1	1	1			1
Ireland	1	1				
Norway	3	2		2		
Qatar	6	6		6		
United Kingdom	1	1			1	
<b>NOVEMBER</b>						
Croatia	4	4	1			3
Finland	3	3	1		2	
France	5	3	3			
Germany	2	2	2			
Ghana	3	2	2			
Ireland	2	1				1
Norway	9	2	1		1	
Palestine	1	1	1			
Slovenia	1	1	1			
Sweden	2	2	1		1	
United Kingdom	1	1			1	
<b>DECEMBER</b>						
Argentina	1	1			1	
Austria	6	6	6			
Azerbaijan	5	0				
Belgium	11	2	2			
Bosnia & Herzegovina	1	1	1			
Czech Republic	1	1			1	
Denmark	8	4	4			
France	12	5	2		2	
Germany	7	7	3		4	
Hong Kong	10	10	10			
Israel	8	1			1	
Italy	9	1	1			
Lebanon	2	1			1	
Lithuania	4	2	1		1	
Montenegro	1	1				1
Norway	13	1	1			
Romania	1	1	1			
Russia	1	1	1			
Serbia	3	2	2			
Slovakia	5	3				3
Slovenia	2	2	1			1
Spain	15	5	4		1	
Switzerland	29	6	6			
Turkey	8	2	1			1
<b>2018</b>						
<b>JANUARY</b>						
Belgium	8	1	1			
Bulgaria	6	1				1
Estonia	5	3	1		2	
France	1	1				1
Greece	11	2	2			
Hungary	4	2				2
Iceland	3	3	2		1	
Israel	2	2			2	
Italy	2	2	2			
Montenegro	3	2			1	1
Netherlands	6	1	1			
Portugal	5	2			2	
Romania	1	1	1			
Serbia	1	1	1			
Slovenia	7	1	1			
<b>41 Countries</b>	<b>285</b>	<b>133</b>	<b>83</b>	<b>31</b>	<b>19</b>	
			<b>62.4%</b>	<b>23.3%</b>	<b>14.3%</b>	

1. Numbers shown in red indicate that not all of the specimens received had been propagated at the time this report was prepared

2. Propagated to sufficient titre to perform HI assay

3. Reduction in HI titre with ferret antiserum raised against B/Phuket/3073/2013 (egg-grown vaccine virus)

**Table 13-1. Antigenic analyses of influenza B viruses (Yamagata lineage) 2017-10-03**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre													
				Post-infection ferret antisera													
				B/Phuket 3073/13	B/FI 4/06	B/Bris 3/07	B/Estonia 55669/11	B/Mass 02/12	B/Mass 02/12	B/Wis 1/10	B/Stock 12/11	B/Phuket 3073/13	B/Phuket 3073/13	B/HK 3417/14	Egg	Egg	
				Egg	Egg	Egg	MDCK	MDCK	Egg	Egg	Egg	MDCK	Egg	NIB	F51/16* <sup>2</sup>	St Judes F715/14* <sup>2,4</sup>	
<b>REFERENCE VIRUSES</b>																	
B/Florida/4/2006	1	2006-12-15	E7	5120	1280	1280	320	320	1280	320	320	80	1280	320			
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	1280	1280	160	160	1280	160	320	80	1280	320			
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	2560	160	80	320	320	160	80	10	80	80	80			
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK4	2560	640	640	640	640	640	320	160	160	640	320			
B/Massachusetts/02/2012	2	2012-03-13	E3/E4	1280	640	1280	160	80	1280	160	160	40	640	320			
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	5120	640	320	40	20	640	160	160	160	1280	320			
B/Stockholm/12/2011	3	2011-03-28	EX/E2	1280	160	80	20	<	160	80	80	20	160	80			
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK2	5120	160	160	160	160	320	320	160	320	640	160			
B/Phuket/3073/2013	3	2013-11-21	E4/E3	2560	160	160	20	<	160	80	40	40	320	80			
B/Hong Kong/3417/2014	3	2014-06-04	E4/E1	1280	80	40	10	<	80	40	20	20	80	160			
<b>TEST VIRUSES</b>																	
B/Oman/1704/2017	3	2017-03-26	MDCK1/MDCK1	5120	160	80	80	80	160	80	20	160	160	320			
B/Oman/1791/2017	3	2017-03-29	MDCK1/MDCK1	5120	80	40	40	40	<	40	10	80	40	160			
B/Oman/3156/2017	3	2017-06-07	MDCK2/MDCK1	2560	80	40	40	20	80	40	10	40	40	160			
B/Oman/3228/2017	3	2017-06-08	MDCK2/MDCK1	5120	320	320	640	640	640	160	160	640	640	320			
B/Oman/3176/2017	3	2017-06-09	MDCK2/MDCK1	2560	80	40	40	20	80	40	20	80	80	160			
B/Oman/3297/2017	3	2017-06-13	MDCK2/MDCK1	2560	80	80	40	40	160	80	20	80	80	160			

**Table 13-2. Antigenic analyses of influenza B viruses (Yamagata lineage) 2017-10-10 + 2017-10-25 + 2017-11-15**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre													NEW		
				Post-infection ferret antisera															
				B/Phuket 3073/13	B/FI 4/06	B/Bris 3/07	B/Estonia 55669/11	B/Mass 02/12	B/Mass 02/12	B/Wis 1/10	B/Stock 12/11	B/Phuket 3073/13	B/Phuket 3073/13	B/HK 3417/14	B/Estonia 55669/11	MDCK			
				Egg	Egg	Egg	MDCK	MDCK	Egg	Egg	Egg	MDCK	Egg	NIB	F51/16* <sup>2</sup>	St Judes F715/14* <sup>2,4</sup>			
<b>REFERENCE VIRUSES</b>																			
B/Florida/4/2006	1	2006-12-15	E7/E1	2560	640	1280	160	80	1280	320	320	40	1280	320					
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	1280	640	80	80	1280	160	320	80	640	160					
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	1280	80	80	320	160	160	80	10	80	40	80					
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK4	5120	640	320	640	640	640	320	160	160	640	320					
B/Massachusetts/02/2012	2	2012-03-13	E3/E4	1280	640	640	80	80	1280	160	160	40	640	160					
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	5120	320	320	40	20	320	160	80	80	640	160					
B/Stockholm/12/2011	3	2011-03-28	EX/E2	2560	160	80	20	10	160	80	80	40	160	80					
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK2	5120	160	160	160	160	320	320	80	320	320	160					
B/Phuket/3073/2013	3	2013-11-21	E4/E3	1280	160	80	10	10	320	80	40	40	320	80					
B/Hong Kong/3417/2014	3	2014-06-04	E4/E1	1280	40	40	10	<	80	40	20	20	40	80					
<b>TEST VIRUSES</b>																			
B/Niger/4557/2017	3	2017-01-20	MDCK1	2560	80	80	40	40	160	80	20	80	80	160	20				
B/Niger/4558/2017	3	2017-01-25	MDCK1	2560	80	40	40	40	80	80	20	80	80	80	10				
B/Niger/4637/2017	3	2017-02-20	MDCK1	2560	160	80	40	40	160	160	40	80	160	160	20				
B/Switzerland/901/2017	3	2017-04-06	MDCK1	1280	40	20	20	10	40	20	10	40	40	40	80	ND			
B/Mauritius/1596/2017		2017-07-18	MDCK 3/MDCK 1	5120	160	160	80	80	320	320	80	160	160	320	160	ND			
B/Mauritius/1712/2017	3	2017-09-11	MDCK 2/MDCK 1	2560	80	80	80	80	80	80	40	80	80	160	160	ND			
B/Mauritius/1791/2017	3	2017-09-20	MDCK 1/MDCK 1	2560	40	40	40	20	80	40	20	80	80	80	160	ND			

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

1 < = <40; 2 < = <10; 3 hyperimmune sheep serum; 4 RDE serum pre-adsorbed with TRBC

ND = Not Done

# B/Yamagata-lineage virus recommended for use in quadrivalent vaccines NH 2017-18

Sequences in phylogenetic trees

Vaccine<sup>#</sup>

**Table 13-3. Antigenic analyses of influenza B viruses (Yamagata lineage) 2017-11-28**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Phuket 3073/13 Egg	B/Fl 4/06 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 NIB	B/HK 3417/14 Egg	
				SH614 <sup>1,3</sup>	F17/13 <sup>1</sup>	F38/14 <sup>2</sup>	F27/13 <sup>2</sup>	F05/15 <sup>2</sup>	F16/14 <sup>1</sup>	F36/15 <sup>2</sup>	F06/15 <sup>2</sup>	F27/15 <sup>2</sup>	F51/16 <sup>2</sup>	F715/14 <sup>2,4</sup>	
<b>REFERENCE VIRUSES</b>				3	1	2	2	2	2	3	3	3	3	3	3
B/Florida/4/2006	1	2006-12-15	E7/E1	1280	640	640	80	80	1280	160	160	40	640	160	
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	1280	1280	160	160	1280	160	320	40	1280	320	
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	1280	40	40	320	80	80	40	20	40	40	80	
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK4	5120	320	320	640	640	640	320	160	160	640	320	
B/Massachusetts/02/2012	2	2012-03-13	E3/E4	1280	640	640	80	80	1280	160	160	20	640	160	
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	2560	160	160	20	10	320	160	80	40	640	160	
B/Stockholm/1/2011	3	2011-03-28	EX/E2	2560	160	80	20	<	160	80	160	40	320	80	
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK2	5120	160	160	160	160	320	160	320	640	160		
B/Phuket/3073/2013	3	2013-11-21	E4/E3	1280	80	80	10	<	160	80	80	20	320	80	
B/Hong Kong/3417/2014	3	2014-06-04	E4/E3	1280	80	40	10	<	80	80	40	20	160	160	
<b>TEST VIRUSES</b>															Vaccine <sup>#</sup>
B/Norway/2924/2017	3	2017-06-08	MDCK1	2560	80	40	40	20	80	80	40	40	160	80	
B/Norway/3098/2017	3	2017-07-28	MDCK1/MDCK1	2560	80	40	40	40	80	80	80	80	160	80	
B/Norway/3157/2017	3	2017-09-01	MDCK1	2560	40	40	40	20	80	40	40	40	80	80	
B/Norway/3244/2017	3	2017-10-02	MDCK1	2560	80	40	20	40	80	80	40	80	160	160	
B/Norway/3387/2017	3	2017-10-30	MDCK1	2560	80	40	40	40	80	80	40	80	320	160	

**Table 13-4. Antigenic analyses of influenza B viruses (Yamagata lineage) 2017-12-12**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Phuket 3073/13 Egg	B/Fl 4/06 Egg	B/Fl 4/06 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 NIB	B/HK 3417/14 Egg
				SH614 <sup>1,3</sup>	F17/13 <sup>1</sup>	F51/17 <sup>4</sup>	F38/14 <sup>2</sup>	F27/13 <sup>2</sup>	F05/15 <sup>2</sup>	F16/14 <sup>1</sup>	F36/15 <sup>2</sup>	F06/15 <sup>2</sup>	F27/15 <sup>2</sup>	F51/16 <sup>2</sup>	F716/14 <sup>2</sup>
<b>REFERENCE VIRUSES</b>				3	1	1	2	2	2	2	3	3	3	3	3
B/Florida/4/2006	1	2006-12-15	E7/E1	2560	640	1280	640	160	160	1280	160	320	40	1280	80
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	1280	1280	1280	160	160	1280	160	320	40	1280	160
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	1280	80	80	80	640	160	80	80	20	40	80	
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK3	2560	320	640	320	640	320	640	160	160	80	640	160
B/Massachusetts/02/2012	2	2012-03-13	E3/E3	1280	320	640	320	160	80	640	160	80	20	320	80
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	2560	160	320	160	40	20	320	160	80	40	640	80
B/Stockholm/1/2011	3	2011-03-28	EX/E2	1280	160	160	80	40	<	160	80	160	20	160	40
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK2	5120	160	320	160	320	320	320	320	160	320	640	80
B/Phuket/3073/2013	3	2013-11-21	E4/E3	2560	160	160	160	40	<	160	160	80	40	320	40
B/Hong Kong/3417/2014	3	2014-06-04	E4/E3	1280	80	80	40	40	<	80	80	40	20	160	80
<b>TEST VIRUSES</b>															Vaccine <sup>#</sup>
B/Lebanon/2441/2017	3	2017-02-03	SIAT1	2560	80	160	80	160	80	160	160	80	80	160	20
B/Lebanon/2553/2017	3	2017-02-06	SIAT1	5120	160	<	160	320	320	320	320	160	160	320	80
B/Lebanon/2548/2017	3	2017-02-14	MDCK1	2560	80	320	40	160	80	80	80	40	80	160	20
B/Lebanon/2652/2017	3	2017-03-15	SIAT1	2560	80	ND	80	160	160	160	160	80	80	320	40
B/Lebanon/2656/2017	3	2017-03-19	SIAT1	5120	160	320	160	320	320	320	320	160	320	640	80
B/Iran/82141/2017	3	2017-04-05	SIAT2/MDCK1	2560	80	80	80	160	80	80	80	40	80	160	20
B/Iran/82492/2017	3	2017-04-10	SIAT2/MDCK1	2560	80	160	80	160	80	80	160	40	80	160	20
B/Palestine/4H/2017	3	2017-09-17	MDCK1	2560	40	<	40	80	40	80	80	40	80	80	20
B/Iran/88763/2017	3	2017-09-20	SIAT2/MDCK1	5120	160	160	160	320	20	320	320	80	320	320	40
B/Paris/1429/2017	3	2017-10-14	MDCK1/MDCK1	2560	80	80	40	160	40	80	80	40	80	160	20
B/Palestine/6B/2017	3	2017-11-02	MDCK1	2560	80	160	80	160	80	160	160	80	80	160	40
B/Paris/1502/2017	3	2017-11-03	MDCK1/MDCK1	2560	80	<	40	160	40	80	80	<	40	80	160
B/Lorraine/1510/2017	3	2017-11-09	MDCK2/MDCK1	2560	80	160	40	160	80	160	<	40	80	160	20

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

1 < = <40; 2 < = <10; 3 hyperimmune sheep serum; 4 < = <80

ND = Not Done

<sup>#</sup> B/Yamagata-lineage virus recommended for use in quadrivalent vaccines NH 2017-18

Sequences in phylogenetic trees

Vaccine<sup>#</sup>

**Table 13-5. Antigenic analyses of influenza B viruses (Yamagata lineage) 2017-12-19**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Phuket 3073/13 Egg	B/Fl 4/06 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 Egg	B/HK 3417/14 Egg	
				SH614 <sup>1,3</sup>	F17/13 <sup>1</sup>	F38/14 <sup>2</sup>	F27/13 <sup>2</sup>	F05/15 <sup>2</sup>	F16/14 <sup>2</sup>	F36/15 <sup>2</sup>	F06/15 <sup>2</sup>	F27/15 <sup>2</sup>	F51/16 <sup>2</sup>	NIB	St Judes F716/14 <sup>2</sup>
<b>REFERENCE VIRUSES</b>				3	1	2	2	2	2	3	3	3	3	3	3
B/Florida/4/2006	1	2006-12-15	E7/E1	2560	640	640	160	160	1280	160	320	40	1280	80	
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	1280	640	160	160	1280	320	320	40	1280	160	
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	1280	80	80	640	160	80	80	20	40	80	40	
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK3	2560	320	320	640	320	640	160	160	80	640	160	
B/Massachusetts/02/2012	2	2012-03-13	E3/E3	1280	320	320	160	80	320	160	80	20	320	80	
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	2560	160	160	40	20	320	160	80	40	640	80	
B/Stockholm/12/2011	3	2011-03-28	E2/E2	1280	160	80	40	<	160	80	160	20	160	40	
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK2	5120	160	160	320	320	320	320	160	320	640	80	
B/Phuket/3073/2013	3	2013-11-21	E4/E3	1280	160	80	40	20	160	160	80	40	320	20	
B/Hong Kong/3417/2014	3	2014-06-04	E4/E3	1280	80	40	40	20	80	80	40	20	160	80	
<b>TEST VIRUSES</b>															Vaccine <sup>#</sup>
B/Qatar/10-VI-17-0044302/2017	3	2017-10-11	MDCK1	2560	40	40	80	40	80	80	40	40	160	20	
B/Qatar/10-VI-17-0044875/2017	3	2017-10-14	MDCK1	2560	80	80	80	80	160	160	80	80	320	40	
B/Qatar/10-VI-17-0044801/2017	3	2017-10-14	MDCK1	2560	80	80	80	80	160	160	40	80	160	40	
B/Qatar/15-VI-17-0044897/2017	3	2017-10-15	MDCK1	5120	80	80	160	80	160	160	40	80	320	40	
B/Qatar/10-VI-17-0045051/2017	3	2017-10-15	MDCK1	2560	40	40	80	40	80	80	40	40	160	20	
B/Qatar/10-VI-17-0045735/2017	3	2017-10-18	MDCK1	5120	160	160	160	160	160	320	80	160	320	40	
B/Paris/1531/2017	3	2017-11-20	MDCK1	2560	40	40	80	40	80	80	40	40	160	20	

**Table 13-6. Antigenic analyses of influenza B viruses (Yamagata lineage) 2018-01-10**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Phuket 3073/13 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 Egg	B/HK 3417/14 Egg		
				SH614 <sup>1,3</sup>	F38/14 <sup>2</sup>	F27/13 <sup>2</sup>	F05/15 <sup>2</sup>	F16/14 <sup>2</sup>	F36/15 <sup>2</sup>	F06/15 <sup>2</sup>	F27/15 <sup>2</sup>	F51/16 <sup>2</sup>	NIB	St Judes F716/14 <sup>2</sup>	3
<b>REFERENCE VIRUSES</b>				3	2	2	2	2	3	3	3	3	3	3	3
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	640	320	320	1280	320	320	40	1280	80		
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	1280	1280	640	320	160	80	20	40	80	20		
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK3	2560	320	640	640	1280	320	160	80	640	80		
B/Massachusetts/02/2012	2	2012-03-13	E3/E3	1280	640	160	80	640	80	80	20	320	40		
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	2560	160	40	20	320	160	80	40	640	40		
B/Stockholm/12/2011	3	2011-03-28	E4/E1	1280	80	40	10	160	80	80	20	160	20		
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK3	5120	80	160	160	160	160	80	160	20	320	40	
B/Phuket/3073/2013	3	2013-11-21	E4/E3	2560	80	40	20	160	160	80	20	640	20		
B/Hong Kong/3417/2014	3	2014-06-04	E4/E3	1280	40	40	10	80	80	40	20	160	80		
<b>TEST VIRUSES</b>															Vaccine <sup>#</sup>
B/La Reunion/1946/2017	3	2017-08-07	MDCK2/MDCK1	2560	80	80	80	160	160	40	80	320	40		
B/Lyon-Croix-Rousse/1919/2017	3	2017-09-24	MDCK2/MDCK1	2560	80	80	40	80	160	40	80	160	20		
B/England/7/0/2017	3	2017-10-04	MDCK1/MDCK1	2560	80	80	80	80	160	40	80	160	20		
B/Norway/3416/2017	3	2017-11-07	MDCK1/MDCK1	2560	80	160	80	160	160	40	80	320	20		
B/Ghana/3408/2017	3	2017-11-08	C1/MDCK1	5120	160	160	160	320	320	80	320	640	80		
B/Stockholm/16/2017	3	2017-11-09	MDCK1/MDCK1	2560	80	160	80	80	160	40	160	320	40		
B/England/74/2017	3	2017-11-14	SIAT1/MDCK1	2560	40	80	40	80	160	40	80	160	20		
B/Finland/79/2017	3	2017-11-15	MDCK1/MDCK1	2560	80	80	80	80	160	40	80	160	20		
B/Navarra/2484/2017	3	2017-11-16	SIAT1/MDCK1	2560	40	160	80	80	160	40	80	160	20		
B/Finland/807/2017	3	2017-11-18	MDCK1/MDCK1	2560	80	80	40	80	160	40	80	160	20		
B/Falun/1/2017	3	2017-11-20	MDCK0/MDCK1	2560	40	80	40	80	80	40	80	160	20		
B/Norway/3550/2017	3	2017-11-22	MDCK1/MDCK1	2560	40	80	40	80	160	40	40	160	20		
B/Navarra/2483/2017	3	2017-12-05	SIAT1/MDCK1	2560	40	80	40	80	80	40	40	160	20		
B/Navarra/2482/2017	3	2017-12-06	SIAT1/MDCK1	2560	40	160	80	80	160	40	80	320	20		

\* Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

1 < = <40; 2 < = <10; 3 hyperimmune sheep serum

# B/Yamagata-lineage virus recommended for use in quadrivalent vaccines NH 2017-18

Sequences in phylogenetic trees

Vaccine<sup>#</sup>

**Table 13-7. Antigenic analyses of influenza B viruses (Yamagata lineage) 2018-01-19**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Phuket 3073/13 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 Egg	B/HK 3417/14 Egg		
				SH614 <sup>1,3</sup>	F38/14 <sup>2</sup>	F27/13 <sup>2</sup>	F05/15 <sup>2</sup>	F16/14 <sup>2</sup>	F36/15 <sup>2</sup>	F06/15 <sup>2</sup>	F27/15 <sup>2</sup>	NIB F51/16 <sup>2</sup>			
<b>REFERENCE VIRUSES</b>															
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	1280	320	160	1280	320	320	40	1280	320		
B/Estonia/55669/2011	2	2011-03-14	MDCK2/C2/MDCK3	1280	160	640	320	80	80	20	40	40	10		
B/Massachusetts/02/2012	2	2012-03-13		1280	640	640	320	640	160	80	40	640	320		
B/Massachusetts/02/2012	2	2012-03-13	E3/E4	2560	640	160	80	1280	160	160	20	640	160		
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	2560	320	40	20	320	160	80	40	320	80		
B/Stockholm/12/2011	3	2011-03-28	E4/E1	1280	160	40	10	160	80	80	20	160	40		
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK3	2560	80	160	80	80	80	40	80	80	80		
B/Phuket/3073/2013	3	2013-11-21		2560	160	40	10	160	160	80	40	320	80		
B/Hong Kong/3417/2014	3	2014-06-04	E4/E3	2560	80	40	20	80	80	40	20	160	160		
<b>TEST VIRUSES</b>															
B/Rheinland-Pfalz/4/2017	3	2017-09-29	C1/MDCK1	2560	160	160	160	160	160	40	160	160	80		
B/Ghana/3550/2017	3	2017-11-20	MDCK1	2560	160	80	40	80	160	40	80	160	80		
B/Finland/811/2017	3	2017-11-20	MDCK1	2560	160	160	80	80	160	80	160	320	160		
B/Nordrhein-Westfalen/15/2017	3	2017-11-21	C1/MDCK1	2560	80	80	40	80	80	40	80	160	20		
B/Niedersachsen/54/2017	3	2017-11-27	C2/MDCK1	2560	80	80	40	80	80	40	40	160	80		
B/Norway/3817/2017	3	2017-12-08	MDCK1	5120	160	80	80	80	160	40	80	320	160		
B/CastillaLaMancha/2485/2017	3	2017-12-09	MDCK1	2560	160	80	80	80	80	40	80	160	160		
B/Navarra/2487/2017	3	2017-12-11	MDCK1	5120	80	80	80	80	160	40	80	160	160		
B/Bayern/25/2017	3	2017-12-11	C1/MDCK1	5120	320	160	160	160	320	80	160	320	160		
B/Navarra/2489/2017	3	2017-12-12	MDCK1	2560	80	80	40	80	80	40	80	160	80		
B/Austria/1028919/2017	3	2017-12-13	SIAT1/MDCK1	5120	320	160	160	160	320	80	160	320	160		
B/Sachsen-Anhalt/8/2017	3	2017-12-14	C2/MDCK1	2560	80	80	80	80	160	40	80	160	80		
B/Bayern/26/2017	3	2017-12-15	C1/MDCK1	2560	80	80	80	80	80	40	80	80	80		
B/Austria/1029615/2017	3	2017-12-15	SIAT1/MDCK1	5120	320	320	1280	320	640	160	160	320	640	320	
B/Hong Kong/1087/2017	3	2017-12-16	MDCK1/MDCK1	2560	160	80	40	80	160	40	80	160	80		
B/Austria/1029652/2017	3	2017-12-16	SIAT2/MDCK1	5120	320	320	640	320	320	160	320	640	320		
B/Hong Kong/1092/2017	3	2017-12-17	MDCK1/MDCK1	2560	160	160	80	80	160	40	80	160	80		
B/Hong Kong/1091/2017	3	2017-12-17	MDCK1/MDCK1	2560	160	160	80	160	160	80	80	160	80		
B/Hong Kong/1090/2017	3	2017-12-18	MDCK1/MDCK1	2560	160	80	80	160	160	40	80	160	80		
B/Hessen/3/2017	3	2017-12-18	C1/MDCK1	2560	80	80	80	80	80	40	80	80	80	160	
B/Austria/1029753/2017	3	2017-12-18	SIAT1/MDCK1	5120	160	80	80	80	80	40	80	80	320	40	
B/Austria/1029757/2017	3	2017-12-18	SIAT2/MDCK1	2560	80	80	80	80	80	40	80	80	160	40	
B/Austria/1029921/2017	3	2017-12-18	SIAT1/MDCK1	5120	160	160	80	80	160	80	80	320	80		
B/Hong Kong/1145/2017	3	2017-12-19	MDCK1/MDCK1	2560	80	80	160	80	160	40	80	80	160	80	
B/Hong Kong/1102/2017	3	2017-12-19	MDCK1/MDCK1	2560	80	80	40	80	80	40	80	80	160	80	
B/Hong Kong/1101/2017	3	2017-12-19	MDCK1/MDCK1	2560	80	80	40	80	160	40	80	80	160	10	
B/Hong Kong/1100/2017	3	2017-12-19	MDCK1/MDCK1	2560	80	80	40	80	80	40	80	80	160	10	
B/Switzerland/2945/2017	3	2017-12-20	MDCK1	2560	160	80	80	80	160	40	80	160	160		
B/Switzerland/2911/2017	3	2017-12-20	MDCK1	2560	80	80	40	80	80	40	80	160	160		
B/Switzerland/2779/2017	3	2017-12-20	MDCK1	2560	160	80	40	80	80	40	80	160	160		
B/Hong Kong/1144/2017	3	2017-12-20	MDCK1/MDCK1	2560	160	80	80	80	160	40	80	160	160		
B/Hong Kong/1103/2017	3	2017-12-20		5120	160	80	80	160	160	80	160	320	160		
B/Switzerland/3147/2017	3	2017-12-21	MDCK1	2560	160	80	40	80	80	40	80	80	160	160	
B/Switzerland/3106/2017	3	2017-12-21	MDCK1	2560	160	80	80	160	160	80	80	80	320	160	
B/Switzerland/2959/2017	3	2017-12-21	MDCK1	2560	80	80	40	80	80	40	80	80	160	80	
B/Baden-Wurttemberg/11/2017	3	2017-12-21	C1/MDCK1	2560	80	80	40	80	80	40	80	80	80	10	
B/Niedersachsen/55/2017	3	2017-12-21	C1/MDCK1	5120	80	80	40	80	80	40	80	80	80	40	
B/Sachsen/12/2017	3	2017-12-21	C1/MDCK1	2560	160	80	40	80	160	40	80	160	80		

Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

1 < = <40; 2 < = <10; 3 hyperimmune sheep serum

B/Yamagata-lineage virus recommended for use in quadrivalent vaccines NH 2017-18

Sequences in phylogenetic trees

Vaccine<sup>#</sup>



**Table 13-10. Antigenic analyses of influenza B viruses (Yamagata lineage) 2018-02-06**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre											
				Post-infection ferret antisera											
				B/Phuket 3073/13 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 Egg	B/Maur 1791/17 MDCK		
	Passage history	Ferret number	Genetic Group	SH614* <sup>1,3</sup>	F38/14* <sup>2</sup>	F27/13* <sup>2</sup>	F05/15* <sup>2</sup>	F16/14* <sup>2</sup>	F36/15* <sup>2</sup>	F06/15* <sup>2</sup>	F27/15* <sup>2</sup>	NIB F51/16* <sup>2</sup>	F04/18* <sup>1</sup>		
<b>REFERENCE VIRUSES</b>															
B/Brisbane/3/2007	2	2007-09-03	E2/E2	2560	640	160	160	1280	320	160	40	640	<		
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	2560	160	640	1280	320	320	40	160	80	160		
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK3	1280	320	320	320	640	320	80	80	320	<		
B/Massachusetts/02/2012	2	2012-03-13	E3/E3	1280	640	160	160	1280	160	160	40	320	<		
B/Wisconsin/I/2010	3	2010-02-20	E3/E2	2560	320	40	40	640	160	80	80	320	80		
B/Stockholm/I/2011	3	2011-03-28	E4/E1	2560	160	40	20	320	160	160	40	160	<		
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK3	5120	80	160	160	160	160	40	160	80	160		
B/Phuket/3073/2013	3	2013-11-21	E4/E3	1280	160	40	20	320	160	80	40	160	<		
B/Mauritius/1791/2017	3	2017-10-13	MDCK1/C2/MDCK2	5120	160	160	160	320	160	80	160	320	320		
<b>TEST VIRUSES</b>															
B/Czech Republic/28/2018	P55	2017-12-02	MDCK1/MDCK1	1280	40	80	40	80	80	20	80	40	80		
B/Lyon/2319/2017	P55	2017-12-05	MDCK2/MDCK1	2560	80	80	40	80	80	40	80	80	160		
B/Bosnia & Herzegovina/36/2017	3	2017-12-06	MDCK1	2560	80	80	20	80	80	20	80	80	80		
B/Grenoble/2382/2017	P55	2017-12-07	MDCK2/MDCK1	1280	40	80	20	80	80	20	80	40	80		
B/Lyon/2369/2017	P55	2017-12-11	MDCK2/MDCK1	2560	40	80	40	80	80	20	80	80	80		
B/Denmark/11/2017	3	2017-12-13	SIAT3/MDCK1	2560	80	160	80	80	80	40	160	80	320		
B/Serbia/8531/2017	3	2017-12-14	C2/MDCK1	1280	40	80	40	80	80	20	80	80	80		
B/Serbia/8530/2017	3	2017-12-14	C2/MDCK1	1280	40	80	40	80	80	20	80	80	80		
B/Lithuania/36447/2017	3	2017-12-18	MDCK2/MDCK1	1280	20	40	40	40	40	20	160	40	40		
B/Lithuania/36278/2017	3	2017-12-19	MDCK2/MDCK1	5120	160	160	160	160	160	40	160	160	320		
B/Denmark/21/2017	3	2017-12-19	SIAT3/MDCK1	5120	80	160	160	160	160	40	160	160	320		
B/Iasi/221737/2017	3	2017-12-20	MDCK1/MDCK1	2560	80	80	80	80	80	20	160	80	160		
B/Denmark/23/2017	3	2017-12-20	SIAT3/MDCK1	2560	40	80	40	80	80	20	80	80	160		
B/Moscow/123/2017	P55	2017-12-21	MDCK1/MDCK1	2560	80	80	40	80	80	20	80	80	80		
B/Denmark/45/2017	3	2017-12-24	SIAT3/MDCK1	5120	80	160	160	160	160	40	160	160	320		
B/Belgium/G0013/2018	3	2017-12-29	MDCK1/MDCK1	2560	40	80	40	80	80	20	80	80	80		
B/Belgium/G0012/2018	3	2017-12-29	SIAT1/MDCK1	2560	80	80	40	80	80	40	80	80	80		
B/Parma/26/2017	P55	2017-12-29	MDCK2/MDCK1	2560	80	80	80	160	160	80	160	160	320		
B/Belgium/G0019/2018	3	2018-01-02	MDCK1/MDCK1	2560	40	80	40	80	80	20	80	80	160		
B/Serbia/94/2018	3	2018-01-03	C2/MDCK1	2560	40	80	80	80	80	20	80	80	160		
B/Estonia/111255/2018	3	2018-01-03	MDCK1/MDCK1	1280	40	80	20	40	80	20	40	40	80		
B/Padova/3/2018	3	2018-01-03	MDCK2/MDCK1	2560	80	80	80	160	80	40	80	80	160		
B/Netherlands/10011/2018	3	2018-01-04	(MDCK/SIAT)1/MDCK1	5120	160	160	320	160	160	40	320	80	320		
B/Padova/2/2018	3	2018-01-04	MDCK2/MDCK1	5120	320	320	640	320	640	160	320	320	640		
B/Estonia/111203/2018	3	2018-01-05	MDCK1/MDCK1	2560	40	80	40	80	80	20	80	80	80		
B/Olt/222073/2018	3	2018-01-08	MDCK1/MDCK1	2560	80	80	40	80	80	20	160	80	80		
B/Estonia/111442/2018	3	2018-01-12	SIAT1/MDCK1	1280	40	80	40	80	80	20	80	40	80		
B/Athens.GR/132/2018	3	2018-01-16	MDCK1	1280	40	80	40	80	80	20	80	80	80		
B/Athens.GR/131/2018	3	2018-01-16	MDCK1	1280	80	80	40	80	80	20	80	80	80		

Superscripts refer to antiserum properties (< relates to the lowest dilution of antiserum used):

1 < = <40; 2 < = <10; 3 hyperimmune sheep serum; 4 < = <20

B/Yamagata-lineage virus recommended for use in quadrivalent vaccines NH 2017-18

Sequences in phylogenetic trees

Vaccine\*

**Table 13-11. Antigenic analyses of influenza B viruses (Yamagata lineage) with collection dates after 2017-08-31 - Summary**

Viruses	Other information	Collection date	Passage history	Haemagglutination inhibition titre														
				Post-infection ferret antisera														
				B/FI 4/06 Egg	B/Bris 3/07 Egg	B/Estonia 55669/11 MDCK	B/Mass 02/12 MDCK	B/Mass 02/12 Egg	B/Wis 1/10 Egg	B/Stock 12/11 Egg	B/Phuket 3073/13 MDCK	B/Phuket 3073/13 NIB F51/16 <sup>2</sup>	B/HK 3417/14 Egg	B/Maur 1791/17 MDCK				
				F17/13 <sup>1</sup>	F38/14 <sup>2</sup>	F27/13 <sup>2</sup>	F05/15 <sup>2</sup>	F16/14 <sup>2</sup>	F36/15 <sup>2</sup>	F06/15 <sup>2</sup>	F27/15 <sup>2</sup>	St Judes F716/14 <sup>4</sup>	3417/14 Egg	F04/18 <sup>1</sup>				
Genetic Group				1	2	2	2	2	3	3	3	3	3	3	3			
<b>REFERENCE VIRUSES</b>																		
B/Florida/4/2006	1	15/12/2006	E7/E1	640	640	160	160	1280	160	320	40	1280	80	ND				
B/Brisbane/3/2007	2	2007-09-03	E2/E2	1280	640	160	80	1280	160	160	20	640	80	<				
B/Estonia/55669/2011	2	2011-03-14	MDCK2/MDCK3	80	160	1280	640	160	160	40	160	160	<	160				
B/Massachusetts/02/2012	2	2012-03-13	MDCK1/C2/MDCK3	320	640	640	320	640	320	160	160	320	160	160				
B/Massachusetts/02/2012	2	2012-03-13	E3/E4	320	640	160	80	1280	160	160	40	640	80	<				
B/Wisconsin/1/2010	3	2010-02-20	E3/E2	160	160	40	20	320	160	80	40	320	40	20				
B/Stockholm/12/2011	3	2011-03-28	E4/E1	160	80	20	10	160	80	80	40	160	20	20				
B/Phuket/3073/2013	3	2013-11-21	MDCK2/MDCK3	160	80	80	80	80	80	40	160	80	20	160				
B/Phuket/3073/2013	3	2013-11-21	E4/E3	160	160	20	10	320	80	80	40	320	40	20				
B/Hong Kong/3417/2014	3	2014-06-04	E4/E3	80	80	20	<	80	40	20	10	40	40	20				
B/Mauritius/1791/2017	3		MDCK1/C2/MDCK2	ND	160	80	80	160	80	40	160	160	40	320				
<b>TEST VIRUSES</b>																		
Number of viruses tested*				18	134	134	134	134	134	134	134	134	134	105	59			
No with titre reduction ≤2-fold					1	5	16	6	106	66	110	84	65	25				
%					0.7	3.7	12.0	4.4	79.1	49.3	82.1	62.7	61.9	42.4				
No with titre reduction =4-fold				2	12	28	31	10	26	48	20	31	36	30				
%				11.1	9.0	20.9	23.1	7.5	19.4	35.8	14.9	23.1	34.3	50.8				
No with titre reduction ≥8-fold				16	121	101	87	118	2	20	4	19	4	4				
%				88.9	90.3	75.4	64.9	88.1	1.5	14.9	3.0	14.2	3.8	6.8				

\* All viruses sequenced in time for the VCM fell in clade 3

Vaccine<sup>#</sup>

# B/Yamagata-lineage virus recommended for use in quadrivalent vaccines

Reference virus results are taken from an individual table as an example. Summaries for each antiserum are based on fold-reductions observed on the days that HI assays were performed.

# Figure 16. Phylogenetic comparison of influenza B (Yamagata-lineage) HA genes

Vaccine virus

Reference viruses

Collection date

Oct 2017

Nov 2017

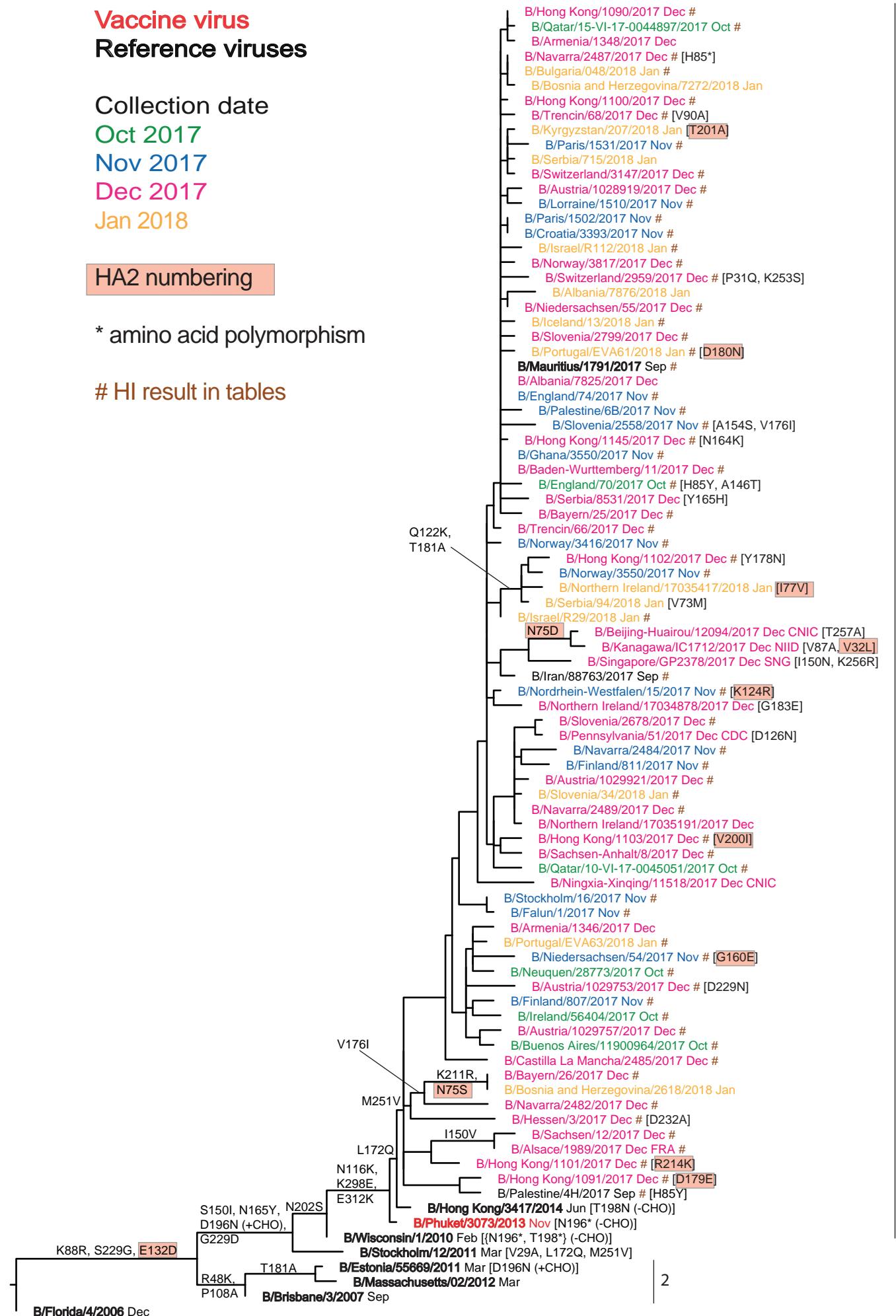
Dec 2017

Jan 2018

HA2 numbering

\* amino acid polymorphism

# HI result in tables

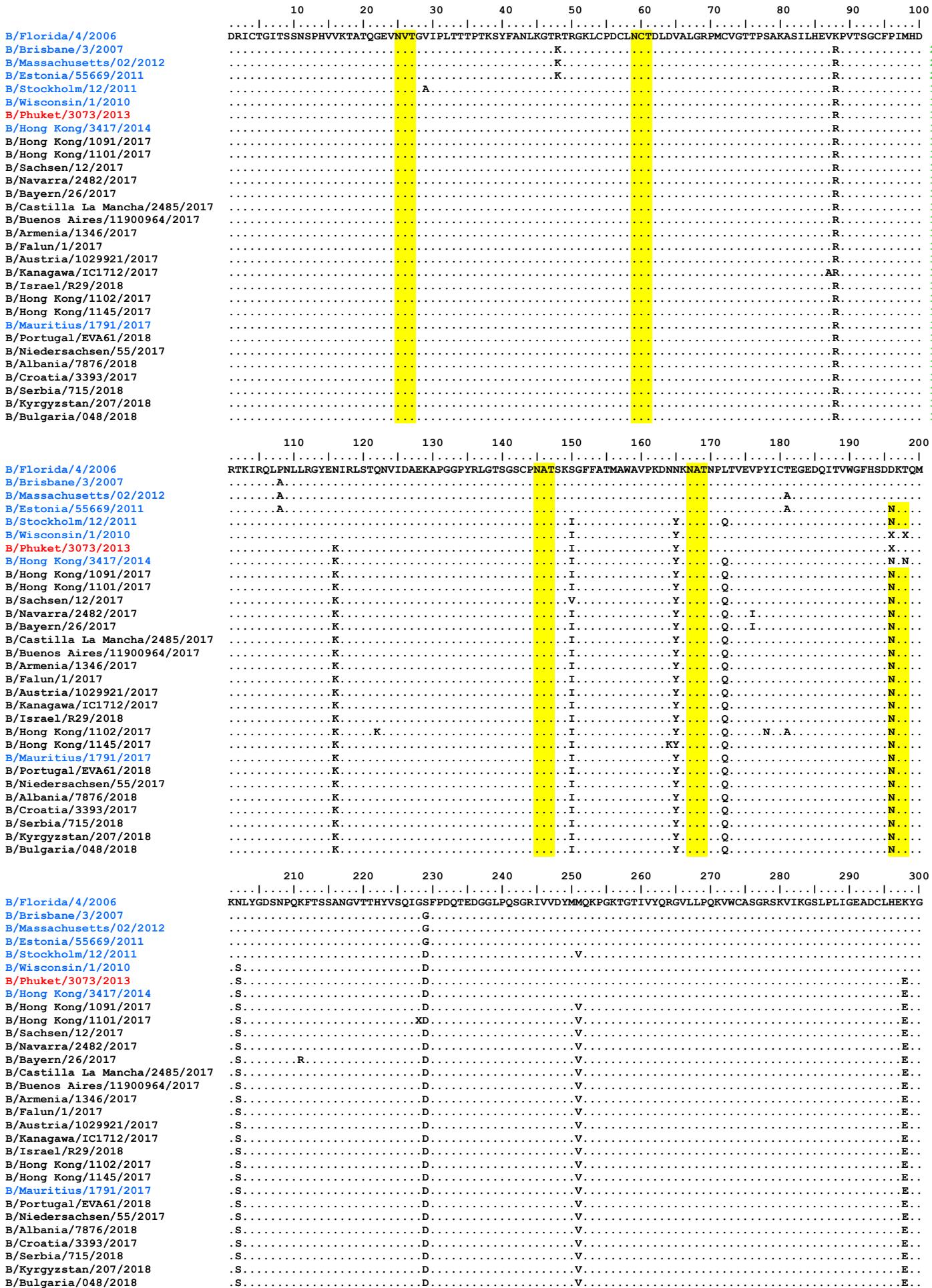


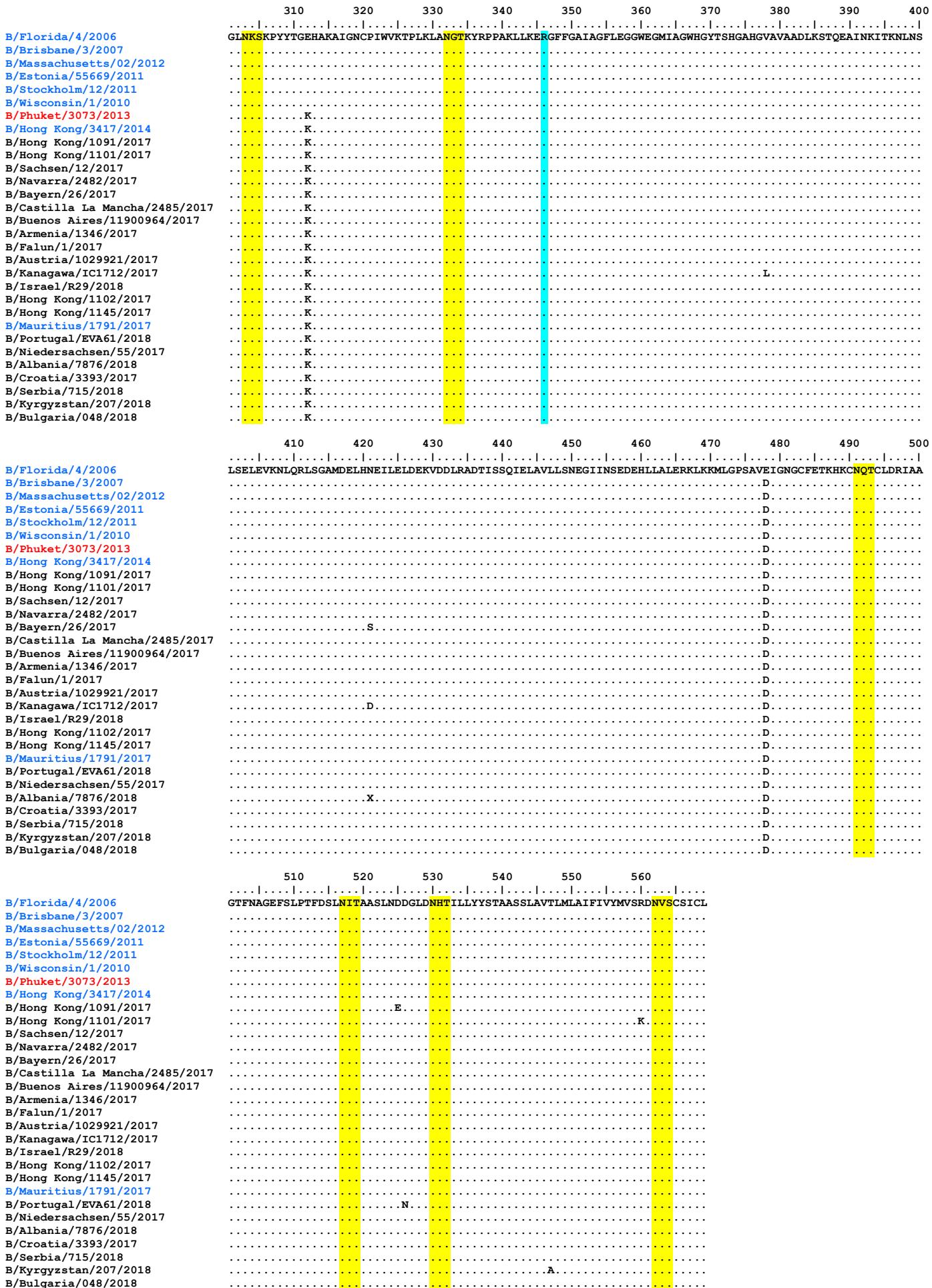
3

2

# Figure 17. HA protein alignment for B (Yamagata-lineage) viruses

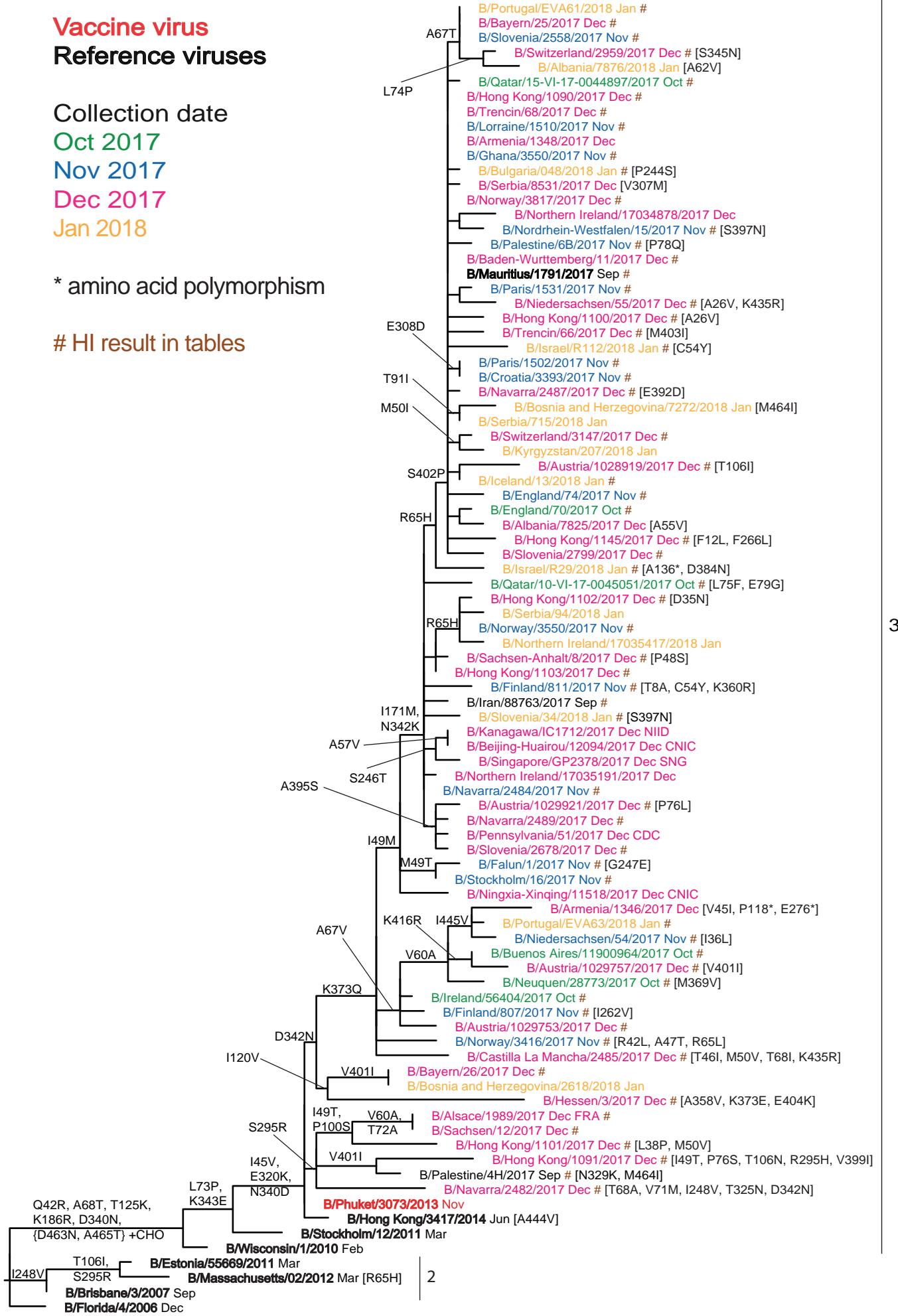
Vaccine virus: Reference virus: Genetic group: HA1/HA2 boundary: Potential N-linked glycosylation site





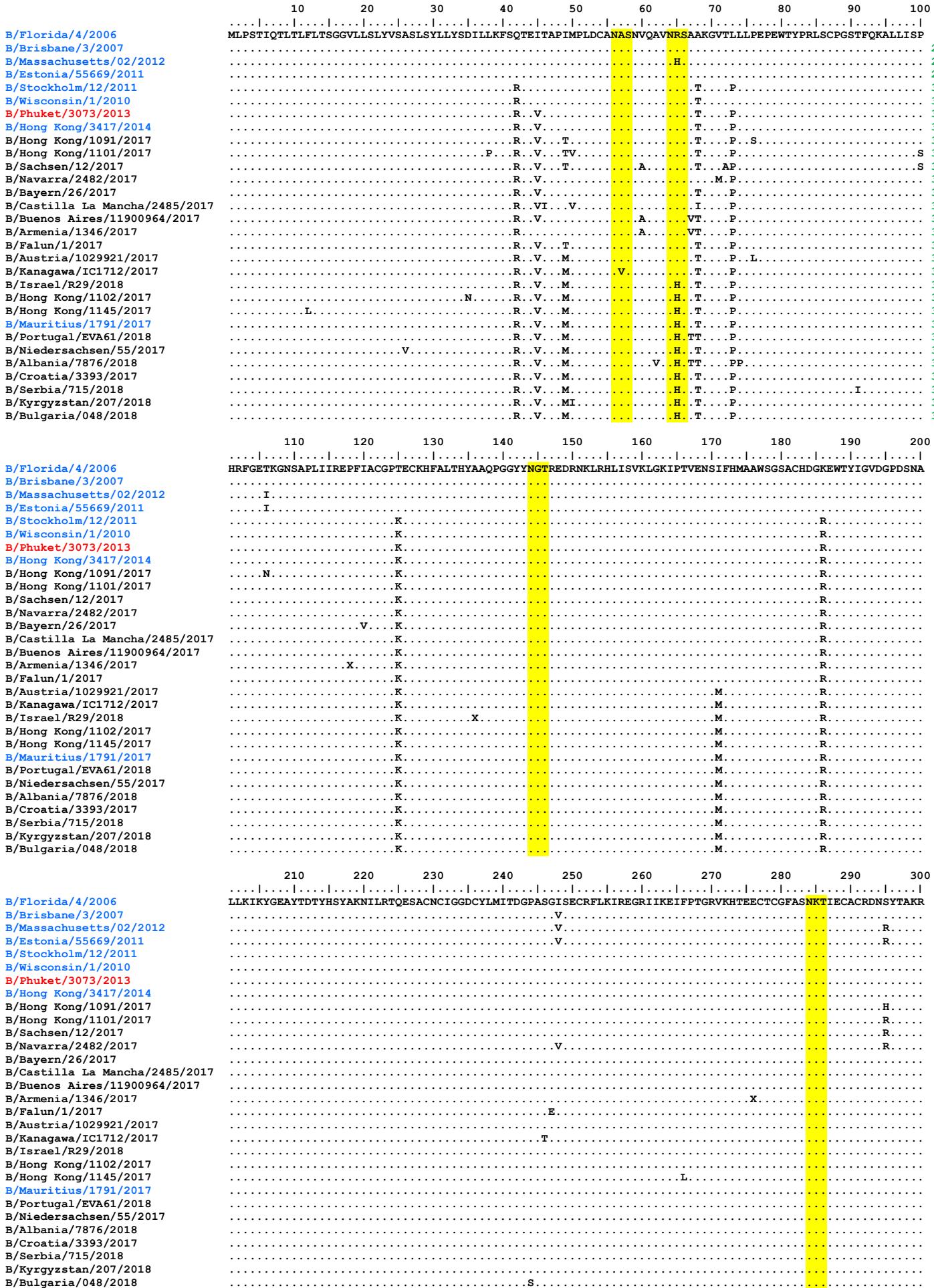
Vaccine virus: Reference virus: Genetic group: HA1/HA2 boundary: Potential N-linked glycosylation site

**Figure 18. Phylogenetic comparison of influenza B (Yamagata-lineage) NA genes**



# Figure 19. NA protein alignment for B (Yamagata-lineage) viruses

Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site



	310	320	330	340	350	360	370	380	390	400
B/Florida/4/2006										
B/Brisbane/3/2007	PFVKLNVETDTAEIRLMCTETYLDTPRPNDSITGPCESDGDKSGGGIKGGFVHQRMASKIGRWYSRTMSKTKRGMGLYVKYDGPWTDSLALSGVM									
B/Massachusetts/02/2012										
B/Estonia/55669/2011										
B/Stockholm/12/2011										
B/Wisconsin/1/2010				N..E.						
B/Phuket/3073/2013				N.						
B/Hong Kong/3417/2014				K..			E..			
B/Hong Kong/1091/2017				K..			E..			I..
B/Hong Kong/1101/2017				K..			E..			
B/Sachsen/12/2017				K..			E..			
B/Navarra/2482/2017				K..N..			NE..			
B/Bayern/26/2017				K..			NE..			
B/Castilla La Mancha/2485/2017				K..			NE..		Q..	
B/Buenos Aires/11900964/2017				K..			NE..		Q..	
B/Armenia/1346/2017				K..			NE..		Q..	
B/Falun/1/2017				K..			NE..		Q..	
B/Austria/1029921/2017				K..			KE..		Q..	S..
B/Kanagawa/IC1712/2017				K..			KE..		Q..	
B/Israel/R29/2018				K..			KE..		Q..	N..
B/Hong Kong/1102/2017				K..			KE..		Q..	
B/Hong Kong/1145/2017				K..			KE..		Q..	
B/Mauritius/1791/2017				K..			KE..		Q..	
B/Portugal/EVA61/2018				K..			KE..		Q..	
B/Niedersachsen/55/2017				K..			KE..		Q..	
B/Albania/7876/2018				K..			KE..		Q..	
B/Croatia/3393/2017			D..	K..			KE..		Q..	
B/Serbia/715/2018				K..			KE..		Q..	
B/Kyrgyzstan/207/2018				K..			KE..		Q..	
B/Bulgaria/048/2018				K..			KE..		Q..	
	410	420	430	440	450	460				
B/Florida/4/2006										
B/Brisbane/3/2007	VSMEEPGWYSFGFEIKDKKCDVPCIGIEMVHDGGKTTWHSAAATAIYCLMGSQOLLWDTVTGVDMAL									
B/Massachusetts/02/2012										
B/Estonia/55669/2011										
B/Stockholm/12/2011										
B/Wisconsin/1/2010							N.T.			
B/Phuket/3073/2013							N.T.			
B/Hong Kong/3417/2014						V..	N.T.			
B/Hong Kong/1091/2017	I..						N.T.			
B/Hong Kong/1101/2017							N.T.			
B/Sachsen/12/2017							N.T.			
B/Navarra/2482/2017							N.T.			
B/Bayern/26/2017	I..						N.T.			
B/Castilla La Mancha/2485/2017				R..			N.T.			
B/Buenos Aires/11900964/2017			R..				N.T.			
B/Armenia/1346/2017					V..		N.T.			
B/Falun/1/2017						N.T.				
B/Austria/1029921/2017							N.T.			
B/Kanagawa/IC1712/2017					X..		N.T.			
B/Israel/R29/2018							N.T.			
B/Hong Kong/1102/2017							N.T.			
B/Hong Kong/1145/2017	P..						N.T.			
B/Mauritius/1791/2017	P..						N.T.			
B/Portugal/EVA61/2018	P..						N.T.			
B/Niedersachsen/55/2017	P..			R..			N.T.			
B/Albania/7876/2018	P..						N.T.			
B/Croatia/3393/2017	P..						N.T.			
B/Serbia/715/2018	P..						N.T.			
B/Kyrgyzstan/207/2018	P..						N.T.			
B/Bulgaria/048/2018	P..						N.T.			

Vaccine virus: Reference virus: Genetic group: Potential N-linked glycosylation site

**Table 14. Antiviral (NAI) testing of isolates with collection dates after 2017-08-31\***

Month of Collection	Number of viruses tested for phenotype <sup>1</sup>								
	A(H1N1)pdm09		A(H3N2)		Influenza B-Victoria		Influenza B-Yamagata		
	NI	RI/HRI	NI	RI/HRI	NI	RI/HRI	NI	RI/HRI	
<b>2017</b>									
September	9		7	1	5		7		29
October	30		33	1	4		13		81
November	39		33		11		23		106
December	64		58		25		61		208
<b>2018</b>									
January	21	1	21		2		24		69
<b>Totals</b>	<b>163</b>	<b>1</b>	<b>152</b>	<b>2</b>	<b>47</b>	<b>0</b>	<b>128</b>	<b>0</b>	<b>493</b>

<sup>1</sup> Phenotype: NI (normal inhibition), RI (reduced inhibition), HRI (highly reduced inhibition) as defined in WHO Wkly. Epidemiol. Rec. (2012) 87, 369-374

\* As of 2018-02-12

Virus name	Subtype/ Lineage	Collection date	Fold difference		NA substitution
			Oseltamivir	Zanamivir	
A/Bretagne/002/2018	A(H1N1)pdm09	2018-01-02	14.9(RI)	14.3(RI)	I223R
A/England/74000497/2017	A(H3N2)	2017-09-24	126.9(HRI)	16.4(RI)	△ 244-247
A/Switzerland/882/2017	A(H3N2)	2017-10-11	12.2(RI)	6.5	N329S (-CHO), S334R, P386S
<b>Outliers</b>					
A/England/69/2017	A(H1N1)pdm09	2017-10-01	4.7	1.5	D199N
A/Paris/1458/2017	A(H1N1)pdm09	2017-10-17	3.6	2.3	S247N
A/Norway/3333/2017	A(H1N1)pdm09	2017-10-20	3.9	3.3	K102R