

Genetic and antigenic evolution of H1 swine influenza A viruses isolated in Belgium and the Netherlands from 2014 through 2019

Sharon Chepkwony, Anna Parys, Elien Vandoorn, Wojciech Stadejek, Jiexiong Xie, Jacqueline King, Annika Graaf, Anne Pohlmann, Martin Beer, Timm Harder and Kristien Van Reeth

Supplementary Table S3. Antigenic distances between the H1 isolates and the reference viruses

		Reference viruses															
		EU H1av				EU H1hu				H1pdm09		US H1γ	US H1δ		Human H1		
		swFI82	swBE98	swG05	swG10	swSC94	swG99	swG02	swG12	CA09	SL15	swOH07	swIL10	swAL16	TW86	NC99	BR07
Reference viruses	A/swine/Finistere/2899/1982_H1N1_Clade_1C.1HA																
	A/swine/Belgium/1/1998_H1N1_Clade_1C.2HA	3.9															
	A/swine/Gent/132/2005_H1N1_Clade_1C.2.1HA	4.5	5.2														
	A/swine/Gent/28/2010_H1N1_Clade_1C.2.1HA	1.7	4.5	3.1													
	A/swine/Scotland/410440/1994_H1N2_Clade_1B.1HA	8.2	7.7	10.2	8.5												
	A/swine/Gent/7625/1999_H1N2_Clade_1B.1.2.1HA	9.6	8.2	11.6	10.1	2.5											
	A/swine/Gent/177/2002_H1N2_Clade_1B.1.2.1HA	9.3	8.2	11.5	9.7	1.9	0.7										
	A/swine/Gent/26/2012_H1N2_Clade_1B.1.2.1HA	9.9	9.2	12.2	10.3	2.1	2.0	1.4									
	A/California/04/2009_H1N1_Clade_1A.3.3.2HA	3.3	5.7	5.6	3.0	6.2	8.2	7.8	8.0								
	A/Slovenia/2903/2015_H1N1_Clade_1A.3.3.2HA	3.5	6.0	5.9	3.3	6.3	8.3	7.8	8.0	0.4							
	A/swine/Ohio/511445/2007_H1N1_Clade_1A.3.3.3HA	2.8	5.9	6.5	3.4	7.1	8.9	8.4	8.6	2.1	1.9						
	A/swine/Illinois/A01047020/2010_H1N2_Clade_1B.2.2.2HA	14.2	13.3	13.5	13.4	8.6	9.3	9.4	9.5	11.7	11.9	13.6					
	A/swine/Alabama/A01104091/2016_H1N2_Clade_1B.2.2.1HA	11.2	9.6	10.8	10.7	5.8	6.2	6.4	6.9	9.3	9.5	11.0	4.0				
	A/Taiwan/1/1986_H1N1_Clade_Other_human_1B.2HA	9.9	9.9	12.6	10.4	2.9	3.6	3.0	1.7	7.9	7.8	8.2	10.3	8.2			
	A/New_Caledonia/20/1999_H1N1_Clade_Other_human_1B.2HA	13.6	11.6	13.2	13.2	7.5	7.2	7.5	8.1	11.8	12.0	13.4	4.3	2.7	9.5		
A/Brisbane/59/2007_H1N1_Clade_Other_human_1B.2HA	14.8	13.4	13.9	14.0	9.1	9.4	9.6	9.8	12.6	12.8	14.4	1.8	3.8	10.9	3.1		
Virus isolates	A/swine/Netherlands/Gent_05/2014_H1N1_Clade_1C.2.1HA	6.3	3.4	4.8	6.1	9.7	10.1	10.2	11.3	7.8	8.2	8.6	13.1	9.6	12.3	11.4	13.0
	A/swine/Gent/16/2014_H1N1_Clade_1C.2.1HA	5.8	2.6	4.9	5.8	9.4	9.7	9.8	11.0	7.5	7.9	8.1	13.4	9.8	11.9	11.6	13.3
	A/swine/Gent/36/2014_H1N1_Clade_1C.2.1HA	5.5	2.8	4.2	5.4	9.8	10.3	10.3	11.4	7.3	7.7	7.9	13.7	10.2	12.3	12.1	13.6
	A/swine/Netherlands/Gent_46/2014_H1N1_Clade_1C.2.1HA	5.7	2.7	4.7	5.7	9.6	10.0	10.1	11.2	7.5	7.9	8.1	13.6	10.1	12.1	11.8	13.5
	A/swine/Netherlands/Gent_55/2014_H1N1_Clade_1C.2.1HA	4.3	4.5	2.5	3.0	7.9	9.4	9.2	10.0	4.1	4.5	5.6	11.2	8.5	10.4	10.9	11.7
	A/swine/Gent/61/2014_H1N1_Clade_1C.2.1HA	4.5	4.3	2.3	3.3	8.2	9.6	9.4	10.2	4.7	5.1	6.1	11.3	8.5	10.8	10.9	11.7
	A/swine/Gent/78/2014_H1N1_Clade_1C.2.1HA	4.6	3.1	2.7	4.0	9.0	9.9	9.9	10.9	5.9	6.3	6.9	12.7	9.5	11.6	11.6	12.8
	A/swine/Gent/121/2014_H1N1_Clade_1C.2.1HA	5.5	2.7	4.2	5.3	9.2	9.7	9.8	10.9	7.0	7.4	7.8	13.0	9.5	11.8	11.4	12.9
	A/swine/Gent/122/2014_H1N1_Clade_1C.2.1HA	5.5	2.7	4.2	5.3	9.2	9.7	9.8	10.9	7.0	7.4	7.8	13.0	9.5	11.8	11.4	12.9
	A/swine/Gent/48/2015_H1N1_Clade_1C.2.1HA	5.8	3.0	4.4	5.6	9.7	10.2	10.3	11.4	7.5	7.9	8.2	13.4	10.0	12.3	11.8	13.4
	A/swine/Netherlands/Gent_62/2015_H1N1_Clade_1C.2.1HA	5.9	2.8	4.7	5.8	9.6	10.0	10.1	11.2	7.6	8.0	8.2	13.5	9.9	12.1	11.7	13.4
	A/swine/Gent/173/2015_H1N1_Clade_1C.2.1HA	5.9	2.6	5.0	5.9	9.3	9.6	9.7	10.9	7.5	7.9	8.1	13.4	9.8	11.8	11.5	13.2

		Reference viruses															
		EU H1av				EU H1hu				H1pdm09		US H1γ	US H1δ		Human H1		
		swFI82	swBE98	swG05	swG10	swSC94	swG99	swG02	swG12	CA09	SL15	swOH07	swIL10	swAL16	TW86	NC99	BR07
A/swine/Gent/150/2016_H1N1_Clade1C.2.1HA	5.6	2.9	4.1	5.3	9.4	9.9	10.0	11.1	7.1	7.5	7.9	13.1	9.6	12.0	11.5	13.0	
A/swine/Gent/13/2017_H1N1_Clade1C.2.1HA	1.5	3.0	3.3	1.5	8.2	9.5	9.2	10.0	3.7	4.0	3.9	13.5	10.4	10.2	12.7	13.9	
A/swine/Gent/121/2017_H1avN2_Clade1C.2.1HA	4.6	4.2	3.9	3.7	6.6	8.0	7.9	8.6	3.9	4.3	5.5	10.2	7.2	9.2	9.7	10.6	
A/swine/Gent/138/2017_H1N1_Clade1C.2.1HA	5.5	2.8	4.6	5.1	7.5	8.2	8.2	9.3	6.1	6.5	7.2	11.3	7.8	10.2	9.7	11.3	
A/swine/Gent/180/2017_H1N1_Clade1C.2.1HA	4.9	3.3	3.9	4.3	7.1	8.1	8.1	9.1	5.0	5.5	6.4	10.7	7.5	9.8	9.7	10.9	
A/swine/Netherlands/Gent_8/2018_H1N1_Clade1C.2.1HA	1.2	3.8	3.4	0.8	8.3	9.8	9.5	10.1	3.3	3.6	3.4	13.7	10.7	10.3	13.1	14.2	
A/swine/Netherlands/Gent_9-p20/2018_H1N1_Clade_1C.2.1HA	5.0	3.9	3.7	4.1	7.1	8.3	8.2	9.1	4.7	5.1	6.2	10.4	7.3	9.8	9.6	10.6	
A/swine/Gent/127/2018_H1N1_Clade_1C.2.1HA	2.9	3.4	1.9	2.2	9.1	10.4	10.2	11.0	4.7	5.1	5.3	13.5	10.5	11.4	12.8	13.9	
A/swine/Gent/196/2018_H1N1_Clade_1C.2.1HA	6.5	3.6	4.8	6.2	9.4	9.8	10.0	11.1	7.7	8.1	8.7	12.6	9.1	12.1	10.9	12.4	
A/swine/Gent/241/2018_H1N1_Clade_1C.2.1HA	6.0	2.8	5.4	6.2	10.2	10.4	10.5	11.7	8.1	8.5	8.4	14.6	11.0	12.5	12.7	14.5	
A/swine/Gent/243/2018_H1N1_Clade_1C.2.1HA	3.3	3.9	1.4	2.2	9.4	10.7	10.5	11.3	4.8	5.2	5.5	13.4	10.5	11.7	12.9	13.8	
A/swine/Gent/05/2019_H1N1_Clade_1C.2.1HA	6.0	2.2	5.8	6.2	8.7	8.8	8.9	10.1	7.5	7.9	8.0	13.2	9.4	11.1	11.1	13.0	
A/swine/Gent/06/2019_H1N1_Clade_1C.2.1HA	6.3	2.4	6.7	6.8	8.7	8.6	8.7	10.0	8.0	8.3	8.3	13.6	9.7	11.0	11.2	13.3	
A/swine/Gent/09/2019_H1N2_Clade_1C.2.1HA	3.3	3.9	1.7	2.1	8.6	10.0	9.8	10.5	4.2	4.6	5.2	12.5	9.7	10.9	12.1	13.0	
A/swine/Gent/31/2019_H1N1_Clade_1C.2.1HA	5.4	2.9	3.8	5.0	9.2	9.9	9.9	11.0	6.8	7.2	7.7	12.8	9.5	11.8	11.4	12.8	
A/swine/Gent/54/2019_H1N2_Clade_1C.2.1HA	6.3	3.6	4.3	5.8	9.3	9.9	10.0	11.1	7.4	7.8	8.4	12.4	9.0	12.1	10.9	12.1	
A/swine/Gent/99/2019_H1N1_Clade_1C.2.1HA	5.3	2.8	3.8	4.9	9.2	9.8	9.9	11.0	6.8	7.2	7.6	12.9	9.6	11.8	11.5	12.3	
A/swine/Gent/124/2019_H1N2_Clade_1C.2.1HA	6.2	3.8	3.9	5.5	9.4	10.0	10.1	11.2	7.2	7.6	8.2	12.2	9.0	12.1	10.9	12.9	
A/swine/Gent/205/2019_H1N1_Clade_1C.2.1HA	7.0	3.8	5.6	6.7	8.8	9.0	9.2	10.4	7.9	8.3	8.9	11.8	8.2	11.5	9.8	11.5	
A/swine/Gent/208/2019_H1N1_Clade_1C.2.1HA	6.8	3.6	5.3	6.6	9.6	9.9	10.1	11.2	8.1	8.5	9.0	12.9	9.4	12.3	11.0	12.7	
A/swine/Gent/236/2019_H1N1_Clade_1C.2.1HA	5.7	2.9	4.6	5.7	10.1	10.5	10.6	11.7	7.7	8.1	8.2	14.2	10.7	12.6	12.5	14.2	
A/swine/Netherlands/Gent_157/2017_H1N1_Clade1C.2.2HA	1.5	4.0	3.0	0.7	8.8	10.2	9.9	10.6	3.5	3.8	3.8	13.8	10.9	10.7	13.4	14.4	
A/swine/Netherlands/Gent_31/2018_H1N1_Clade1C.2.2HA	1.8	3.6	2.7	1.2	8.8	10.1	9.9	10.6	3.9	4.3	4.2	13.8	10.8	10.9	13.2	14.2	
A/swine/Netherlands/Gent_32/2018_H1N1_Clade1C.2.2HA	1.1	4.1	3.8	0.9	7.9	9.4	9.1	9.6	2.6	2.9	2.8	13.3	10.5	9.7	12.9	13.9	
A/swine/Netherlands/Gent_103/2018_H1N1-Clade_1C.2.2HA	2.1	4.1	2.4	0.9	8.9	10.4	10.1	10.8	3.8	4.1	4.3	13.6	10.8	11.0	13.2	14.2	
A/swine/Gent/29/2019_H1N1_Clade_1C.2.2HA	5.2	1.7	5.0	5.3	8.2	8.6	8.7	9.8	6.6	7.0	7.2	12.7	9.1	10.7	10.9	12.6	
A/swine/Gent/184/2019_H1N1_Clade_1C.2.2HA	6.2	3.3	4.5	5.8	9.3	9.8	9.9	11.0	7.4	7.6	8.3	12.6	9.2	12.0	11.0	12.2	
A/swine/Netherlands/Gent_193/2019_H1N1_1C.2.2HA	4.3	4.3	3.5	3.3	6.9	8.4	8.2	8.9	3.7	7.8	5.3	10.5	7.6	9.5	10.1	12.5	
A/swine/Gent/202/2019_H1N1_Clade_1C.2.2HA	6.3	2.9	5.3	6.1	8.4	8.7	8.9	10.1	7.3	4.1	8.2	12.1	8.5	11.1	10.2	10.9	
A/swine/Gent/203/2019_H1N1_Clade_1C.2.2HA	5.1	2.4	4.3	4.8	7.6	8.3	8.3	9.4	5.9	7.7	6.9	11.6	8.1	10.3	10.1	11.9	
A/swine/Gent/204/2019_H1N1_Clade_1C.2.2HA	6.1	2.9	5.0	5.8	8.5	8.9	9.0	10.1	7.1	6.3	8.0	12.1	8.5	11.1	10.3	11.6	
A/swine/Gent/30/2014_H1N2_Clade_1B.1.2.1HA	11.4	9.7	13.6	12.0	4.6	2.2	2.7	3.3	10.3	10.4	10.7	10.6	7.6	4.7	7.9	10.4	
A/swine/Gent/35/2014_H1N2_Clade_1B.1.2.1HA	11.6	9.7	13.5	12.1	4.7	2.3	2.9	3.6	10.4	10.5	10.9	10.3	7.2	5.1	7.4	10.0	
A/swine/Gent/93/2014_H1N2	10.3	8.9	12.5	10.8	3.2	1.0	1.2	1.9	9.0	9.0	9.4	10.0	7.0	3.5	7.7	10.0	
A/swine/Gent/94/2014_H1N2_Clade_1B.1.2.1HA	10.2	9.7	12.1	10.3	2.0	2.9	2.4	1.5	7.9	7.9	8.7	8.2	6.1	2.2	7.4	8.7	

		Reference viruses															
		EU H1av				EU H1hu				H1pdm09		US H1γ	US H1δ		Human H1		
		swFI82	swBE98	swG05	swG10	swSC94	swG99	swG02	swG12	CA09	SL15	swOH07	swIL10	swAL16	TW86	NC99	BR07
	A/swine/Gent/175/2014_H1N2	10.7	9.2	12.8	11.2	3.4	1.2	1.5	2.1	9.3	9.3	9.8	9.8	6.8	3.7	7.5	9.7
	A/swine/Gent/36/2016_H1N2_Clade_1B.1.2.1HA	9.9	9.0	12.1	10.2	2.0	1.6	1.1	0.4	8.0	8.0	8.6	9.2	6.5	2.1	11.5	9.5
	A/swine/Gent/5/2017_H1N2_Clade1B.1.2.1HA	10.0	9.2	12.3	10.4	2.2	1.6	1.2	0.4	8.3	8.2	8.8	9.3	6.7	2.1	7.7	9.6
	A/swine/Netherlands/Gent_7/2018_H1N2_Clade1B.1.2.1HA	14.3	14.2	16.2	14.3	6.5	6.9	6.6	5.4	11.6	11.5	12.4	8.8	8.6	5.0	7.8	9.6
	A/swine/Netherlands/Gent_9-p18/2018_H1N2_Clade1B.1.2.1HA	11.3	9.3	12.7	11.6	4.3	2.4	3.0	3.9	10.0	10.1	10.9	8.4	5.2	5.6	9.1	8.0
	A/swine/Gent/77/2018_H1N2_Clade_1B.1.2.1HA	9.8	8.4	12.4	10.5	3.8	1.9	2.0	2.7	8.9	8.9	9.0	11.3	8.1	3.9	5.4	11.3
	A/swine/Gent/180/2018_H1N2_Clade_1B.1.2.1HA	9.6	8.3	12.0	10.2	2.9	1.1	1.1	1.9	8.3	8.4	8.7	10.4	7.3	3.3	8.9	10.5
	A/swine/Netherlands/Gent_185/2018_H1N2_Clade_1B.1.2.1HA	10.5	8.6	12.7	11.2	4.4	2.0	2.5	3.4	9.6	9.7	10.0	11.0	7.7	4.9	8.2	10.8
	A/swine/Gent/189/2018_H1N2_1B.1.2.1HA	12.0	8.9	13.0	12.5	7.6	5.5	6.2	7.4	11.8	12.0	12.4	11.4	7.7	6.1	8.2	10.5
	A/swine/Gent/216/2018_H1N2_Clade_1B.1.2.1	11.2	8.7	12.3	11.4	5.0	3.1	3.8	4.9	10.2	10.3	11.0	8.9	5.4	6.6	7.4	8.4
	A/swine/Gent/233/2018_H1N2_Clade_1B.1.2.1HA	11.4	11.3	13.1	11.3	3.8	5.0	4.5	3.5	8.7	8.6	9.6	7.6	6.6	3.3	5.5	8.4
	A/swine/Gent/28/2019_H1N2_Clade_1B.1.2.1HA	9.6	9.2	11.5	9.7	1.5	2.9	2.4	1.7	7.3	7.2	8.1	8.3	6.0	2.2	7.8	8.8
	A/swine/Gent/56/2019_H1N2_Clade_1B.1.2.1HA	10.2	8.6	12.1	10.6	3.0	0.6	1.3	2.3	8.8	8.9	9.5	9.3	6.2	4.0	7.5	9.3
	A/swine/Gent/76/2019_H1N2_Clade_1B.1.2.1HA	10.7	8.8	12.5	11.1	3.9	1.5	2.2	3.3	9.5	9.6	10.2	9.6	6.3	4.9	6.9	9.3
	A/swine/Gent/114/2019_H1N2_Clade_1B.1.2.1HA	10.4	8.9	12.7	11.0	3.6	1.3	1.7	2.4	9.2	9.3	9.6	10.4	7.3	3.8	6.7	10.4
	A/Swine/Gent/119/2019_H1N2_Clade_1B.1.2.1HA	10.2	9.0	12.3	10.6	2.6	0.9	0.9	1.4	8.7	8.7	9.2	9.4	6.5	3.1	7.4	9.5
	A/swine/Gent/178/2019_H1N2_Clade_1B.1.2.1HA	9.9	8.5	12.0	10.4	2.6	0.4	0.8	1.8	8.5	8.6	9.1	9.4	6.3	3.5	7.2	9.5
	A/swine/Gent/180/2019_H1N2_Clade_1B.1.2.1HA	10.1	8.7	12.2	10.5	2.7	0.6	0.8	1.7	8.6	8.7	9.2	9.5	6.5	3.4	7.3	9.5
	A/swine/Gent/206/2019_H1N2_Clade_1B.1.2.1HA	10.4	9.9	12.2	10.5	2.2	3.1	2.7	2.0	8.1	8.0	9.0	7.7	5.7	2.6	7.0	8.3
	A/Swine/Gent/228/2014_H1N2_Clade_1A.3.3.2HA	9.0	10.9	9.8	8.2	7.4	9.8	9.3	8.8	5.8	5.6	7.2	9.4	9.0	8.3	11.5	10.9
	A/swine/Gent/121/2018_H1N1_Clade_1A.3.3.2HA	3.2	6.0	5.2	2.6	7.1	9.1	8.7	8.9	0.9	1.0	2.2	12.3	9.9	8.7	12.5	13.1
	A/swine/Gent/53/2019_H1N1_Clade_1A.3.3.2HA	4.4	6.5	4.9	3.2	7.2	9.3	8.9	9.2	1.9	2.1	3.8	11.1	9.1	9.1	11.7	12.1
	A/swine/Gent/220/2019_H1N2_Clade_1A.3.3.2HA	7.5	9.4	6.9	6.2	10.0	10.7	10.3	10.3	4.8	4.9	6.6	9.9	9.0	10.1	11.6	11.1
	A/swine/Gent/235/2019_H1N2_Clade_1A.3.3.2HA	13.3	9.9	12.3	13.0	10.1	9.0	9.6	10.8	12.9	13.3	14.2	9.7	6.7	12.4	6.0	8.5