

Supplementary Materials

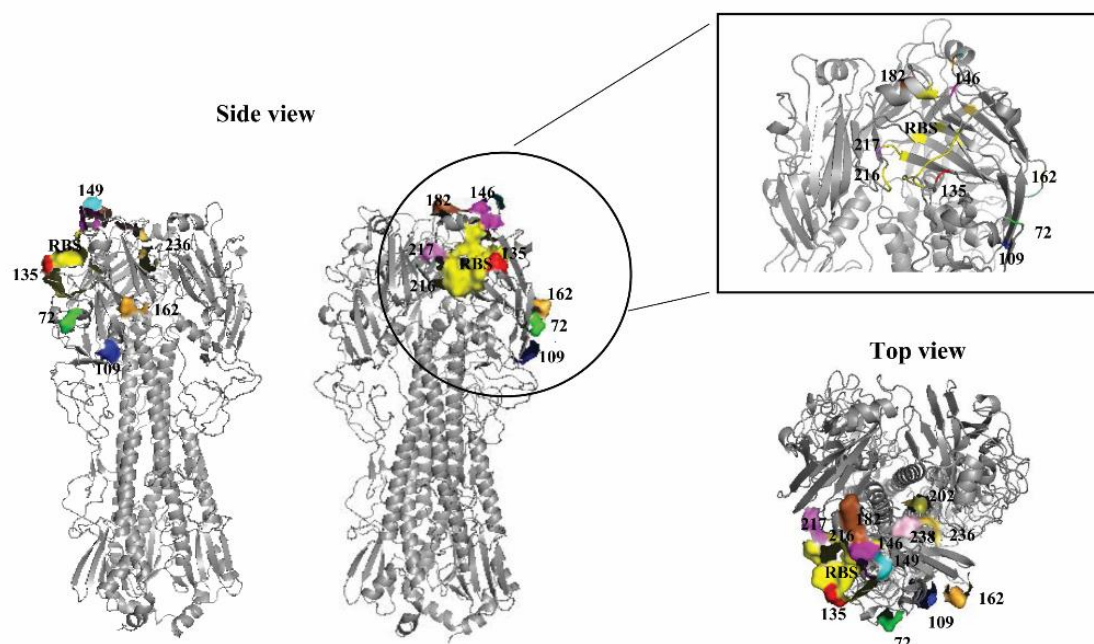


Figure S1. Position of the selected amino acids in HA 3D trimer structure. The 3D structure of the HA protein trimer was drawn with PyMOL. The receptor binding site was yellow. Position 72 was marked as green, position 109 was blue, position 135 was red, position 146 was purple, position 149 was cyan, position 162 was deep brown, position 182 was brown, position 202 was deep olive, position 216 was deep blue, position 217 was violet, position 236 was yellow orange, position 238 was light pink.

Table S1. The branches of H9N2 HA proteins each year in China from 1994 to 2019.

Year	Total Number	Clade						
		h9.4.2.1	h9.4.2.2	h9.4.2.3	h9.4.2.4	h9.4.2.5	h9.4.2.6	Unknown
1994	2	0	2	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	6	2	4	0	0	0	0	0
1997	7	1	3	2	0	0	0	1
1998	16	5	1	1	4	0	0	4
1999	22	5	2	7	8	0	0	0
2000	32	5	0	6	17	2	0	2
2001	40	3	5	14	14	3	0	1
2002	23	5	1	3	10	4	0	0
2003	19	2	4	3	4	5	0	1
2004	12	0	2	1	7	0	0	2
2005	27	0	0	17	4	3	0	3
2006	25	0	0	4	10	10	0	1
2007	107	1	1	6	36	57	0	6
2008	57	4	0	2	23	26	0	2
2009	94	0	0	1	5	85	1	2

2010	154	1	0	2	3	136	10	2
2011	224	1	0	5	2	149	59	8
2012	156	2	0	1	0	125	11	17
2013	456	5	0	1	1	439	4	7
2014	204	0	0	0	0	196	1	7
2015	548	0	0	0	0	547	1	0
2016	738	1	0	0	0	736	1	0
2017	742	2	0	0	1	738	0	1
2018	1402	0	0	0	0	1402	0	0
2019	25	0	0	0	0	25	0	0
Sum	5138	40	25	76	149	4688	88	67

Table S2. The space dynamics of the H9N2 HA protein in China from 1994 to 2019.

Province	Total Number	Clade						
		h9.4.2.1	h9.4.2.2	h9.4.2.3	h9.4.2.4	h9.4.2.5	h9.4.2.6	Unknown
Jiangxi	797	0	0	3	13	780	0	1
Jiangsu	603	19	7	6	2	563	0	6
Guizhou	520	0	0	0	0	515	5	0
Guangdong	505	4	3	5	11	523	62	3
Shandong	396	3	5	9	38	336	0	5
Shanghai	378	5	0	13	9	347	2	2
Zhejiang	237	1	0	0	0	236	0	0
Anhui	231	1	0	0	3	218	4	5
Yunnan	225	0	0	3	10	210	2	0
Hubei	195	1	0	0	2	191	1	0
Ningxia	181	0	0	0	1	180	0	0
Fujian	171	2	2	0	3	162	2	0
Guangxi	166	0	0	25	8	122	5	6
Qinghai	110	0	0	0	0	110	0	0
Hunan	94	0	0	0	1	69	1	23
Xizang	85	0	0	0	0	85	0	0
Henan	68	1	0	10	15	40	0	2
Beijing	40	0	2	0	3	30	0	5
Hebei	37	2	1	0	12	18	0	4
Sichuan	23	0	0	0	2	20	0	1
Jilin	13	0	0	0	3	9	1	0
Liaoning	13	0	0	0	4	7	2	0
Tianjin	11	0	2	0	0	9	0	0
Heilongjiang	9	1	1	0	2	3	0	2
Shanxi	8	0	0	0	0	8	0	0
Xinjiang	6	0	0	0	0	6	0	0
Chongqing	4	0	0	0	0	4	0	0
Shaanxi	3	0	0	0	0	3	0	0
Hainan	3	0	0	0	0	2	1	0
Gansu	3	1	0	0	1	1	0	0
Taiwan	3	0	0	0	0	3	0	0
Inner Mongolia	0	0	0	0	0	0	0	0

Table S3. The different amino acids of HA sequences around 2006.

Group	Residue (H9 numbering)																							
	72		109		135		146		149		162		182		202		216		217		236		238	
1994-2006 (230)	E	G	R	S	G	D	R	Q	G	N	Q	R	R	T	I	T	L	Q	M	Q	K	R	D	N
	0.9%		1.3%		0.4%		0%		0.4%		3.1%		0%		0%		44.3%		0%		0.9%		7.9%	
	98.7%		96.9%		97.4%		95.6%		98.7%		93.0%		97.8%		99.1%		53.9%		99.1%		99.1%		91.7%	
2007-2019 (4910)	E	G	R	S	G	D	R	Q	G	N	Q	R	R	T	I	T	L	Q	M	Q	K	R	D	N
	64.4%		86.2%		55.2%		56.7		59.6%		92.4%		53.7%		73.4%		97.0%		85.8%		81.9%		77.8%	
	35.2%		10.7%		39.0%		41.3%		37.2.%		6.2%		38.7%		20.4%		2.8%		14.0%		17.6%		21.9%	
GX/55	G		S		D		Q		N		R		T		T		L		Q		R		N	
18325	E		R		G		R		G		Q		R		I		L		M		K		D	
19027	E		R		S		R		G		Q		R		I		L		M		K		D	
19166	E		R		G		R		G		Q		R		I		L		M		K		D	

Table S4. Results of cross hemagglutination inhibition test.

Strains	Antiserum								
	Mut-Mut/PR8	R-WT/PR8	WJ57	18325	HN98	F98	SD96	19027	19166
R-Mut/PR8	2048	256	128	128	256	512	32	256	512
R-WT/PR8	32	1024	1024	8	1024	2048	256	8	8
WJ57	128	2048	2048	64	1024	2048	256	64	64
18325	512	256	512	4096	256	512	128	2048	2048
HN98	4	256	512	4	256	256	32	4	4
F98	128	1024	2048	64	1024	4096	256	32	64
SD96	16	256	512	8	256	512	256	8	8
19027	256	128	64	1024	256	512	128	4096	1024
19166	256	32	64	256	128	128	64	1024	4096