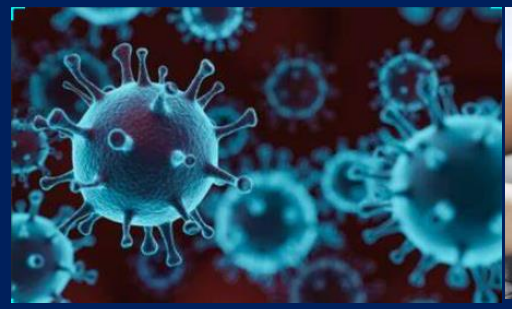
Global situation in humans

Dr Wenqing Zhang
Global Influenza Programme

14 November 2024

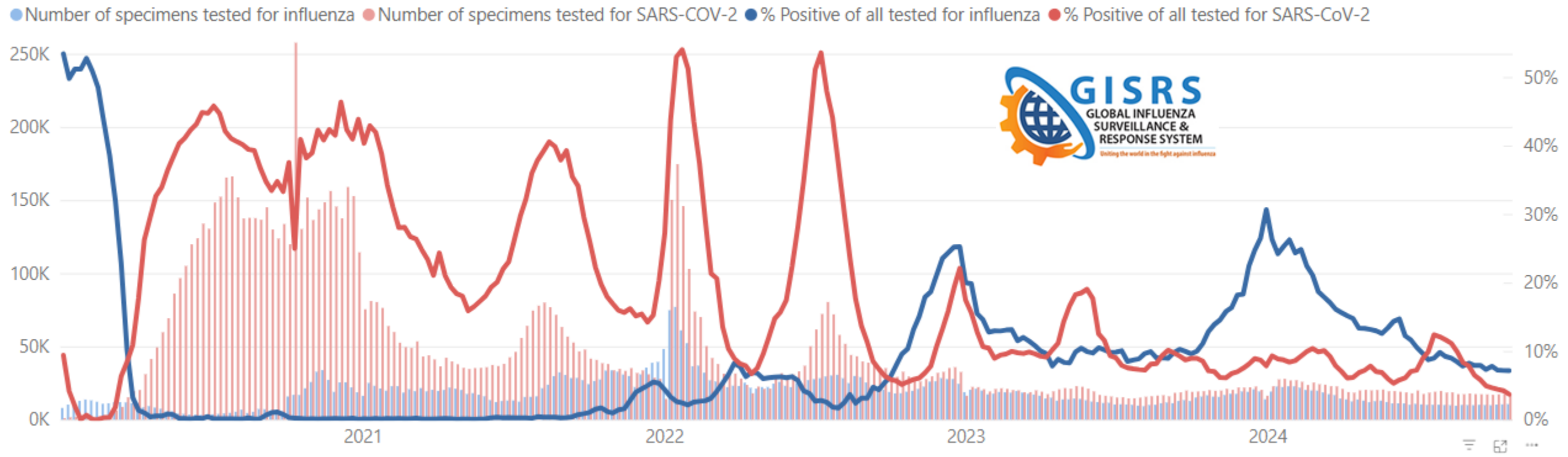
Preparing for containment and mitigation of pandemic H5N1 influenza
Uses of Statistical and Mathematical Modeling
- a virtual meeting

World Health Organization



Global co-circulation of influenza and SARS-CoV-2

2003 – 7 Nov 2024



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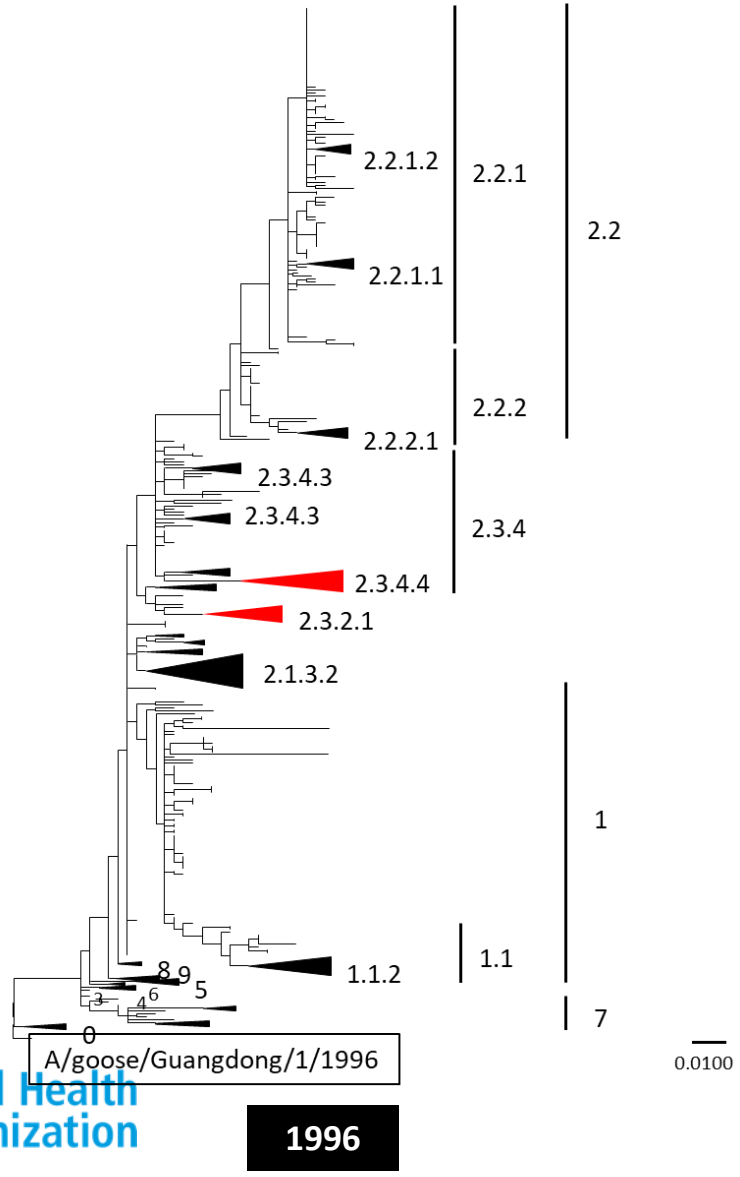
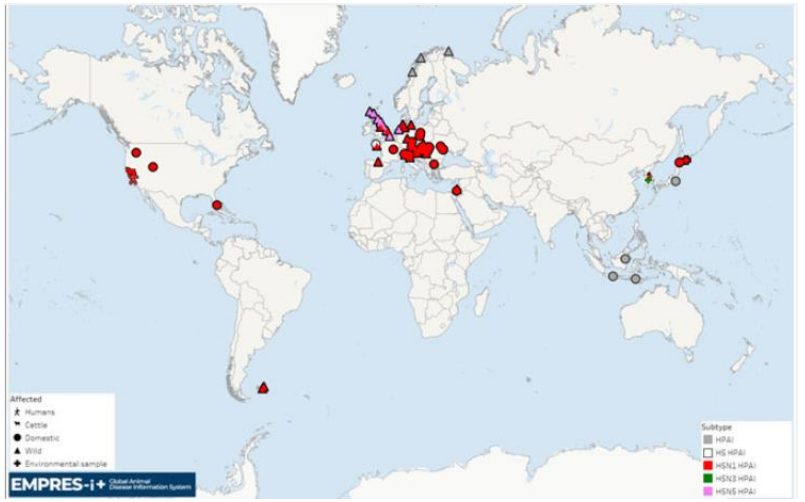
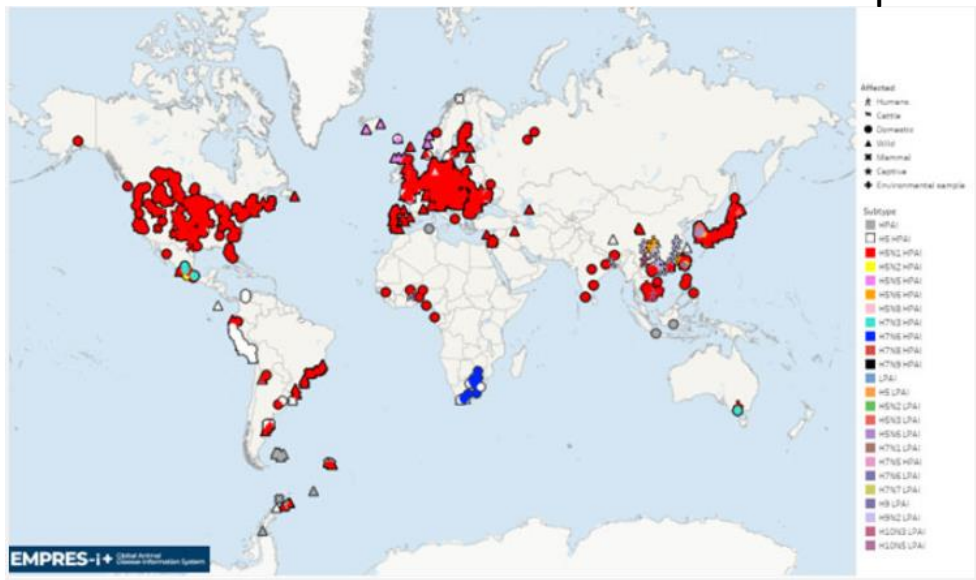
Evolution and spread of avian influenza viruses



Since 1 Oct 2024



1 Oct 2023 – 30 Sept 2024



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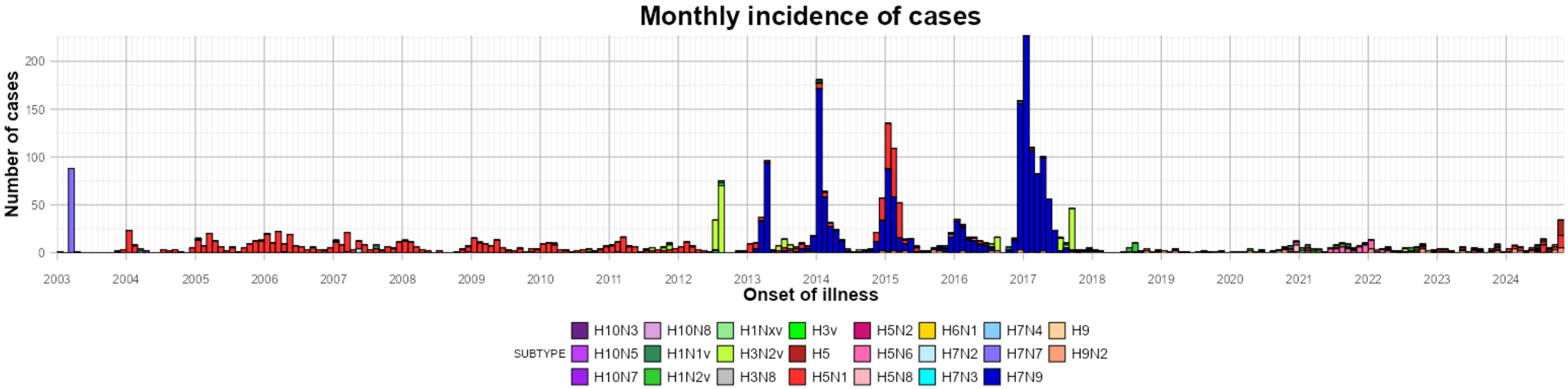
https://www.fao.org/animal-health/situation-updates/global-aiv-with-zoonotic-potential

Human infections* with zoonotic influenza A viruses

2003 to 7 Nov 2024



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*Not including H3N2v cases, USA, 2012 (309).

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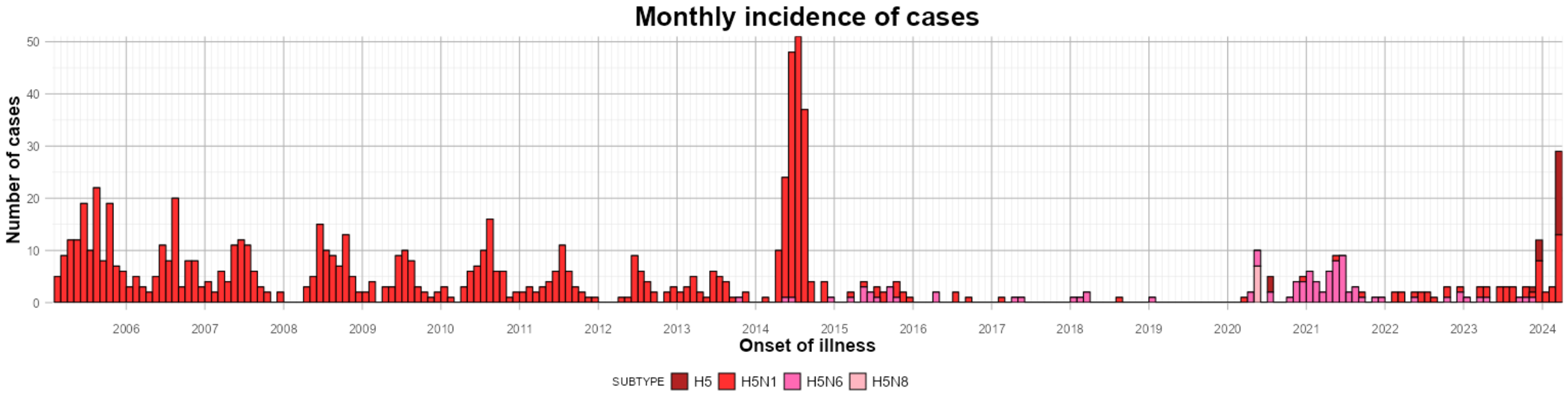
Human infections with zoonotic influenza A(H5) viruses

2003 to 2024



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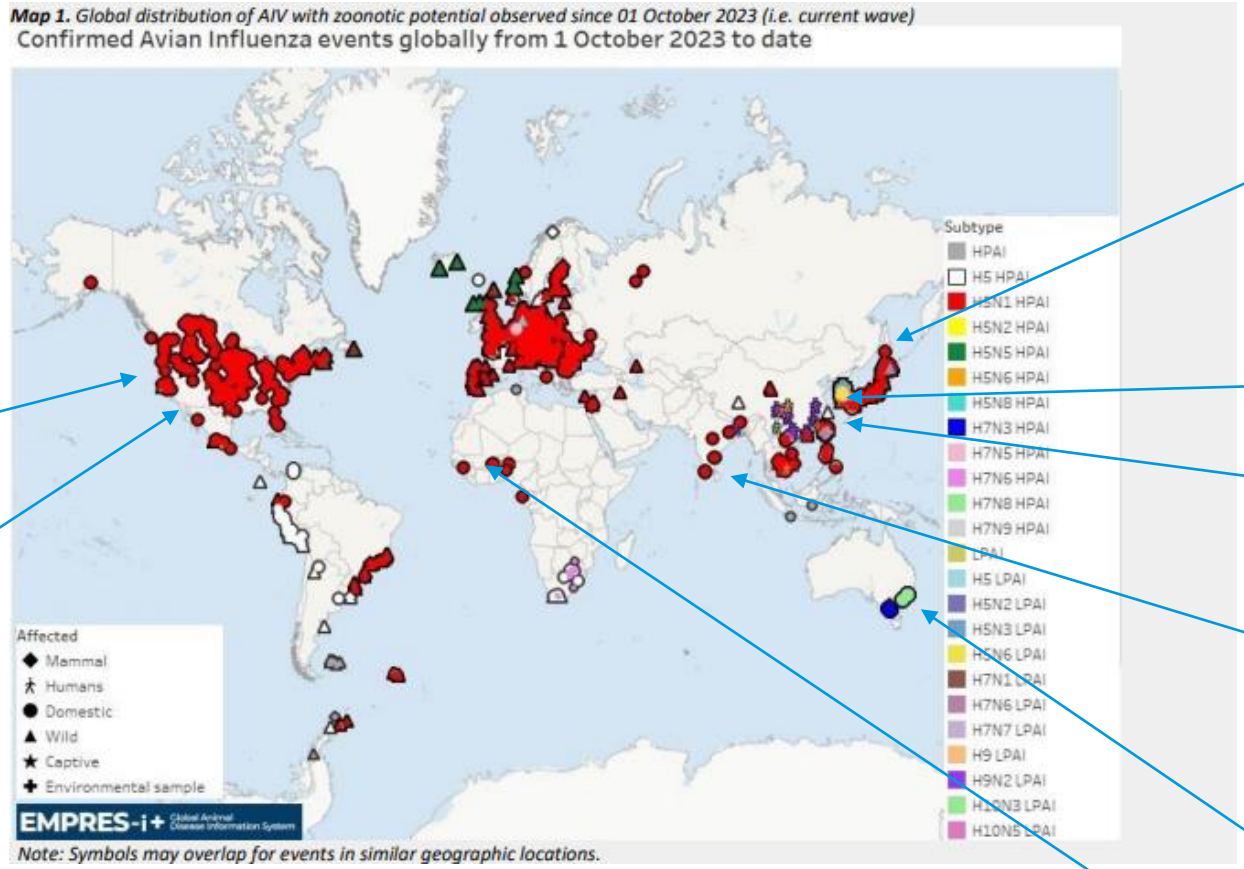
Avian influenza viruses with zoonotic potential and human cases

Oct 2023-2024



China:
H5N1 (1),
H5N6 (5),
H9N2 (19)
H10N3 (1),
H10N5 (1),

Cambodia:
H5N1 (14)

Viet Nam:
H5N1 (1)
H9N2 (1)

India:
H9N2 (1)

Australia:
H5N1 (1)

Ghana: H9N2 (1)

USA: H5 (46)

Mexico:
H5N2 (1)

https://www.fao.org/animal-health/situation-updates/global-aiv-with-zoonotic-potential

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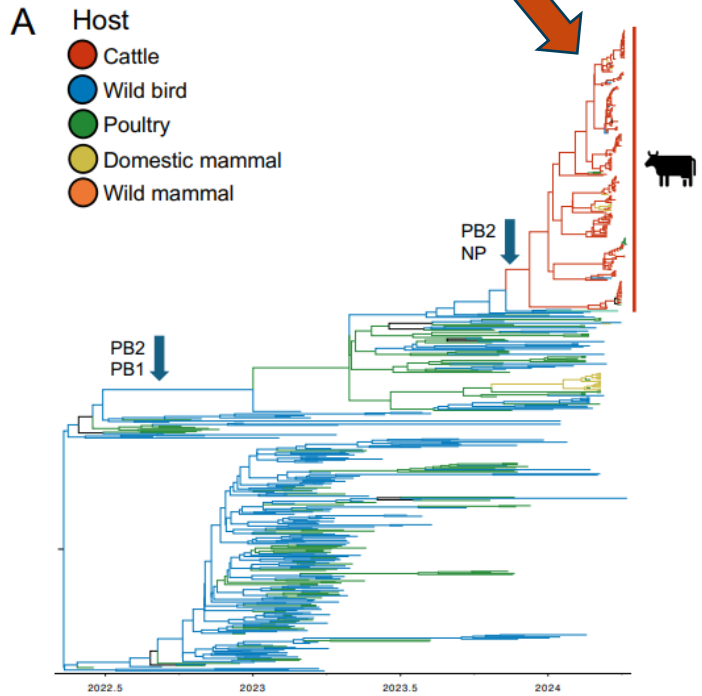
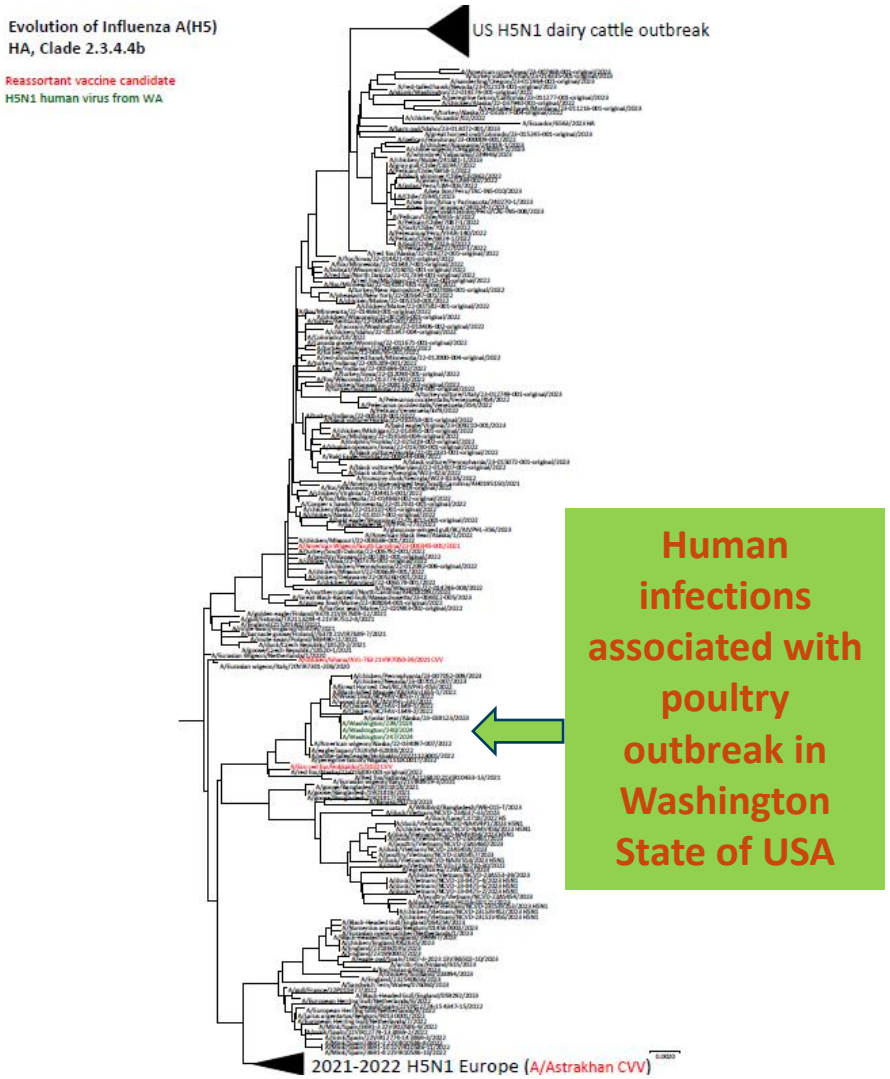
Genetic diversity of avian influenza viruses infecting humans
(2.3.4.4b)

Human infections associated with dairy cattle outbreak in USA





Human infections associated with poultry outbreak in Washington State of USA

Health officials in US conducted sero-surveys

- Recent HPAI A(H5) infections among dairy workers in two states.
- 7% of participating dairy workers had evidence of recent infection with HPAI A(H5) virus.
- All were either mild or no symptoms.
- None of the positive ones used respiratory protection.

Serologic Evidence of Recent Infection with Highly Pathogenic Avian Influenza A(H5) Virus Among Dairy Workers — Michigan and Colorado, June–August 2024 | MMWR

World Health Organization

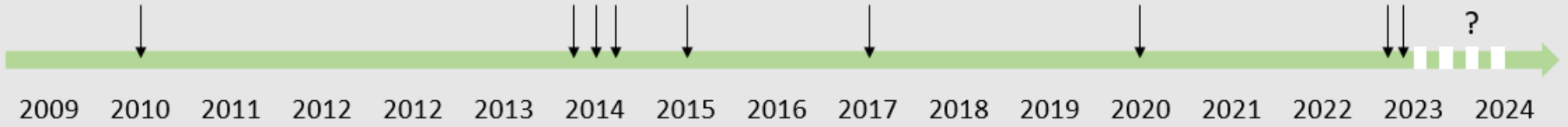
Nguyen et al bioRxiv https://doi.org/10.1101/2024.05.01.591751; t

Phylogenetic tree including WA cases – Courtesy of T. Davis

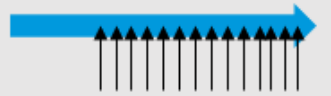
HEALTH EMERGENCIES programme

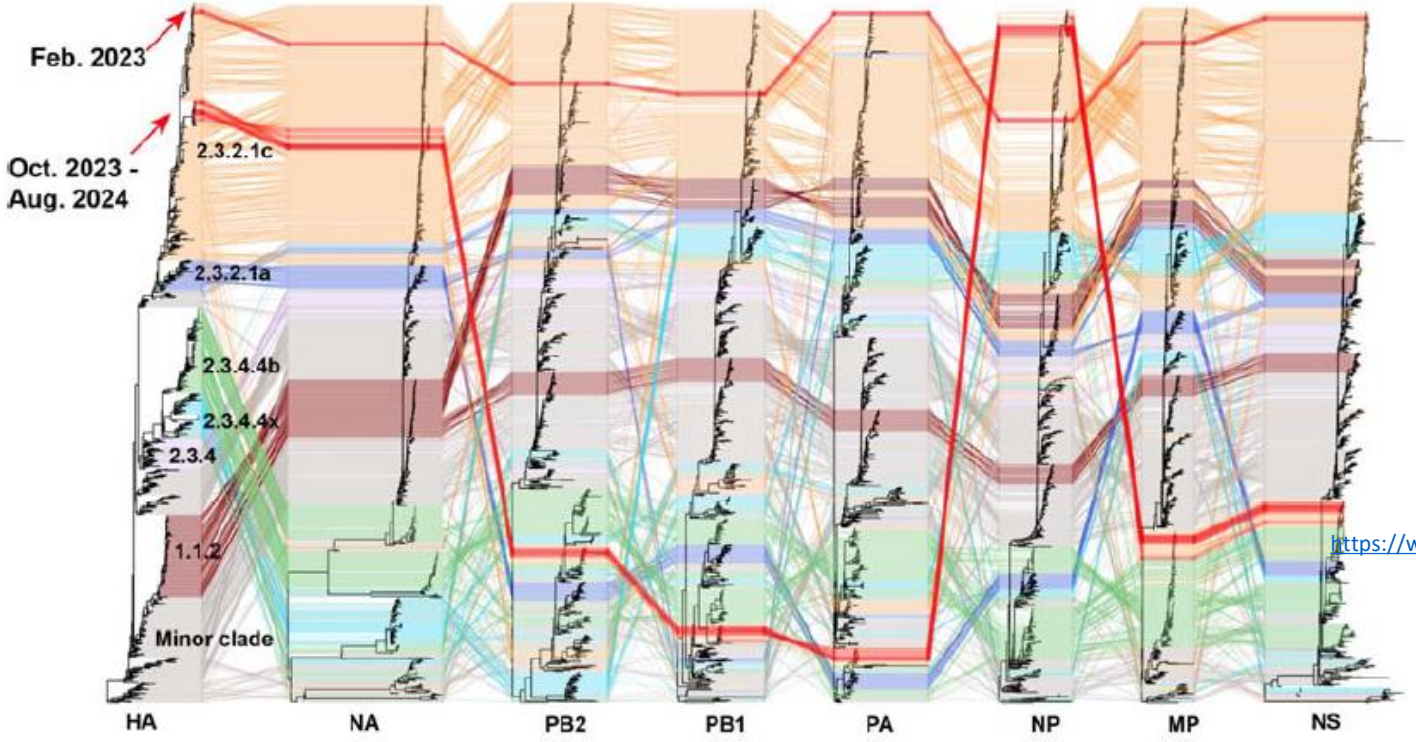
Genetic diversity of avian influenza viruses infecting humans
(2.3.2.1c)

1) Before introducing clade 2.3.4.4b A(H5)-derived gene segments



2) After introducing clade 2.3.4.4b A(H5)-reassortment (after Oct 2023)





https://www.medrxiv.org/content/10.1101/2024.11.04.24313747v1.full.pdf

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Antigenicity of avian influenza viruses and candidate vaccine viruses

(avian and swine zoonotic influenza viruses)

From WHO vaccine composition consultation Sept 2024:

2.3.4.4b

Haemagglutination inhibition assay of human derived A(H5) clade 2.3.4.4b viruses

Reference antigens	Subtype	Clade	Post-infection ferret antisera					
			VN/1203	CNIC-21099	IDCDC-RG71A	IDCDC-RG78A	IDCDC-RG80A	TX/37
A/Viet Nam/1203/2004	H5N1	1	**2560**	<10	<10	<10	<10	<10
CNIC-21099 (A/Fujian-Sanyuan/21099/2017)	H5N6	2.3.4.4b	20	**80**	160	80	1280	40
IDCDC-RG71A (A/Astrakhan/3212/2020-like)	H5N8	2.3.4.4b	10	80	**320**	160	1280	80
IDCDC-RG78A (A/American Wigeon/South Carolina/22-000345-001/2021)	H5N1	2.3.4.4b	10	80	640	**320**	1280	80
IDCDC-RG80A (A/chicken/Ghana/AVL-763_21VIR7050-39/2021)*	H5N1	2.3.4.4b	<10	10	80	40	**1280**	80
A/Texas/37/2024	H5N1	2.3.4.4b	10	40	320	160	1280	**80**
Test antigens								
A/Colorado/109/2024	H5N1	2.3.4.4	10	10	320	320	1280	80
A/Colorado/134/2024	H5N1	2.3.4.4	10	10	160	160	1280	80
A/Colorado/137/2024	H5N1	2.3.4.4	10	10	160	320	1280	80
A/Colorado/138/2024	H5N1	2.3.4.4	10	40	160	160	1280	80
A/Michigan/90/2024	H5N1	2.3.4.4	10	40	160	320	1280	80

Haemagglutination inhibition assay of A(H5) clade 2.3.2.1c viruses

Reference antigens	Subtype	Clade	Post-infection ferret antisera		
			SJ001	duck/VN/1584	NIBRG-301
SJ001 (A/duck/Bangladesh/19097/2013-like)	H5N1	2.3.2.1a	**80**	80	160
A/duck/Viet Nam/NCVD-1584/2012	H5N1	2.3.2.1c	20	**80**	160
NIBRG-301 (A/duck/Viet Nam/NCVD-1584/2012)	H5N1	2.3.2.1c	80	160	**640**
Test antigens					
A/Cambodia/24020155/2024 (January 2024)	H5N1	2.3.2.1c	<10	40	80
A/Cambodia/24020179/2024 (February 2024)	H5N1	2.3.2.1c	<10	20	80
A/Cambodia/SVH240441/2024 (July 2024)	H5N1	2.3.2.1c	<10	20	40
A/Viet Nam/Khanh Hoa/RV1-005/2024 x PR8	H5N1	2.3.2.1c	<10	20	80

2.3.2.1c

World Health Organization

HEALTH EMERGENCIES programme

Antigenicity of avian influenza viruses and candidate vaccine viruses

(avian and swine zoonotic influenza viruses)

H3N8

H9N2

H10Nx

H5Nx

H1Nx variant

H3N2 variant

H7Nx

Table 5. Status of influenza A(H5) candidate vaccine virus development*

Candidate vaccine viruses (like virus)†	Clade	Institution‡	Available
CDC-RG (A/Viet Nam/1203/2004)	1	CDC	Yes
SJRG-161052 (A/Viet Nam/1203/2004)	1		
NIBRG-14 (A/Viet Nam/1194/2004)	1		
NIBRG-88 (A/Cambodia/R0405050/2007)	1.1		
IDCDC-RG34B (A/Cambodia/X0810301/2013)	1.1.2		
SJRG-166614 (A/duck/Hunan/795/2002)	2.1.1		
CDC-RG2 (A/Indonesia/5/2005)	2.1.3.2		
NIIDRG-9 (A/Indonesia/NIHRD11771/2011)	2.1.3.2a		
SJRG-163222 (A/bar-headed goose/Qinghai/1A/2005)	2.2		
IBCDC-RG7 (A/chicken/India/NIV33487/2006)	2.2		
SJRG-163243 (A/whooper swan/Mongolia/244/2005)	2.2	SJCRH	Yes
IDCDC-RG11 (A/Eg	2.2.1	CDC	Yes
NIBRG-23 (A/	2.2.1	MHRA	Yes
IDCDC-RG			
IDCDC-R			
NIBRG-3			
SJRG-16			
IDCDC-R			
SJ007 (A/du			
IDCDC-RG63A			
SJ003 (A/barn swallow/			
NIBRG-301 (A/duck/Viet Nam/NCVD-1584/2012)	2.3.2.1c	MHRA	Yes
SJ009 (A/chicken/Guiyang/1153/2016)	2.3.2.1d	SJCRH/HKU	Yes
SJ002 (A/chicken/Hong Kong/AP156/2008)	2.3.4		Yes
IBCDC-RG6 (A/Anhui/1/2005)	2.3.4		
CBER-RG1 (A/duck/Laos/3295/2006)	2.3		
SJRG-164281 (A/Japanese white eye/Hong Kong/1038/2006)			
IDCDC-RG36 (A/chicken/Bangladesh/11rs1984-30/2011)			
IDCDC-RG35 (A/Guizhou/1/2013)			
IDCDC-RG42A (A/Sichuan/26221/2014) (H5N6)	2.3		
IDCDC-RG71A (A/Astrakhan/3212/2020) (H5N8)	2.3		
CBER-RG8A (A/Astrakhan/3212/2020) (H5N8)	2.3.4.4		
IDCDC-RG78A (A/Am. Wigeon/South Carolina/22-000345-001/2021)	2.3.4.4b		Yes
NIID-002 (A/Ezo red fox/			
IDCDC-RG43A (A/gyrfal			
NIID-001 (A/duck/Hyogo			
IDCDC-RG65A (A/Guan			
IDCDC-RG69A (A/ck/Vi			
SJRG-165396 (A/goose/G			
IDCDC-RG12 (A/chicken			
IDCDC-RG25A (A/chicken/Vietnam/NCVD-03/2008)	7.1	CDC	Yes
Candidate vaccine viruses in p			
A/Cambodia/SVH240441/2024			
IDCDC-RG75A (A/chicken/Gh			
CNIC-FJ21099 (A/Fujian-Sanyu			
A/chicken/Ghana/AVL-76321V			
CNIC-HB29578 (A/Hubei/295			
SJ010 (A/chicken/Vietnam/NC			
A/Guangdong/18SF020/2018-like (H5N6)	2.3.4.4h	CCDC	Pending

Table 12. Status of influenza A(H3N2)v candidate vaccine virus development

Candidate vaccine viruses (like viruses)	Lineage	Type	Institution*	Available
NYMC X-203 (A/Minnesota/11/2010)	3	Conventional	CDC	Yes
NYMC X-213 (A/Indiana/10/2011)		onal	CDC	Yes
CDC-RG55C (A/Ohio/28/201			CDC	Yes

idate vaccine viruses in paration			Institution	Availability
A/Ohio/13/2017-like	3.2010.1	Reverse Genetics	CDC	Pending
A/Ohio/28/2016-like	3.2010.1	Conventional	MHRA	Pending

Table 7. Status of influenza A(H10N3) candidate vaccine virus development

Candidate vaccine viruses (like virus)	Lineage		titution*	Available
A/Jiangsu/428/2021	Eurasian		CDC	Pending

Table 6. Status of influenza A(H9N2) candi

Candidate vaccine viruses (like virus)			on*	Available
A/Hong Kong/1073/99	G-l (G1)		MHRA	Yes
NIBRG-91 (A/chicken/Hong Kong/G9/97)	B-like (Y280/G9)	Reverse genetics	MHRA	Yes
IBCDC-2 (A/chicken/Hong Kong/G9/97)	B-like (Y280/G9)	Conventional	CDC	Yes
IDCDC-RG26 (A/Hong Kong/33982/2009)	G4 (G1)	Reverse genetics	CDC	Yes
adesh/994/2011)	G5.7 (G1)	Reverse genetics	CDC	Yes
8/2014)	B4.7 (Y280/G9)	Reverse genetics	SJCRH	Yes
ui-	B4.7.4 (Y280/G9)	Reverse genetics	CDC/CCDC	Yes
n/2747/2019)	G5.5 (G1)	Reverse genetics	CDC	Yes

Antigenic prototype	Clade	Type of virus or reassortant	Developing Institute	Available from
A/Henan /4-10CNIC/2022	Eurasian Lineage	Reverse genetics	CDC/CCDC	Pending

fluenza A(H1)v candidate vaccine virus development

ses (like viruses)	Clade	Type	Institution*	Available
2443/2015) (H1N1)v	1C.2.3	Conventional	CCDC	Yes
/9/2015) (H1N1)v	1A.3.3.3	Reverse genetics	CDC	Yes
igan/383/2018)	1B.2.1	Reverse genetics	CDC	Yes
4/2017) (H2N2)v			CDC	Yes

ses in preparation			Institution	Availability
092/2023-like			MHRA	Pending
3-like (H1N2)v			MHRA	Pending
2)v			CDC	Pending
therlands/3315/2016-like (H1N1)v	1C.2.1	Reverse genetics	MHRA	Pending
io/35/2017-like (H1N2)v				
therlands/10370-1b/2020 (H1N1				
124 (A/Hessen/47/2020) (H1N1				
etagne/24241/2021 (H1N2)v				
131 (A/Bretagne/24241/2021 (H				
isconsin/03/2021 (H1N1)v				
lifornia/71/2021 (H1N2)v				
talonia/NSAV198289092/2023 (				
gland/234600203/2023 (H1N2)v				

Subtype	Antigenic prototype	Clade	Candidate vaccine virus	Type of virus or reassortant	Developing Institute	Available from
H7N1	A/mallard/Netherlands/12/2000#	Eurasian	Wild type virus			WHO CCs
			NIBRG-63*	Reverse genetics	MHRA, UK	MHRA, UK
	A/turkey/Italy/3889/99	Eurasian	Wild type virus			MHRA, UK
H7N2	A/turkey/Virginia/4529/2002	American	Wild type virus			WHO CCs
			IBCDC-5*	Classical reassortant	CDC, USA	CDC, USA
	A/New York/107/2003	American	Wild type virus			WHO CCs
			NIBRG-109*	Reverse genetics	MHRA, UK	MHRA, UK
			Wild type virus			WHO CCs
H7N7	s/12/2000 and A/mallard/Netherlands/2/2000	Eurasian	IBCDC-1*	Classical reassortant	CDC, USA	CDC, USA

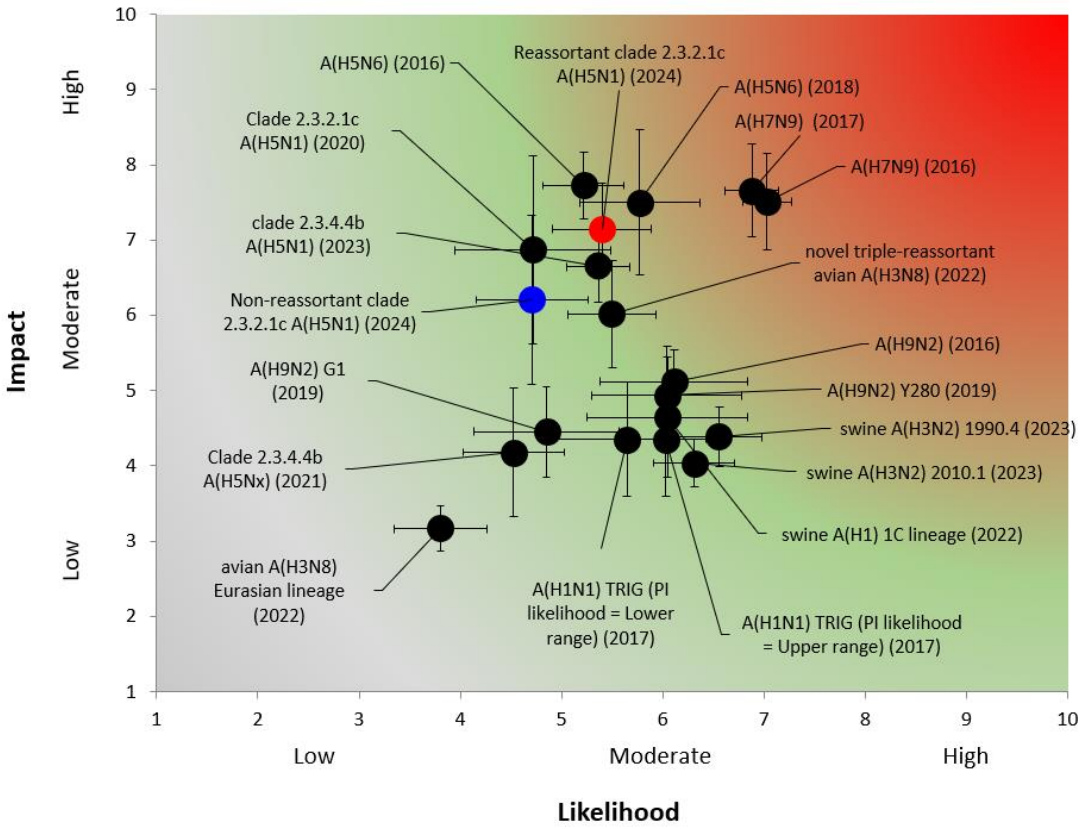
https://www.who.int/teams/global-influenza-programme/vaccines/who-recommendations/zoonotic-influenza-viruses-and-candidate-vaccine-viruses

GISRS-WHOHq@WHO.int

GISRS GLOBAL INFLUENZA SURVEILLANCE & RESPONSE SYSTEM

Assessment of risk associated with the viruses
(as of Nov 2024)

TIPRA results on 2.3.2.1c (2024)



Updated joint FAO/WHO/WOAH assessment of recent influenza A(H5N1) virus events in animals and people

- **Current risk**
  - **Low – global public health risk**
  - **Low-moderate – risk of infection for personnel with occupational exposure**
- **Human-to-human transmission**
  - **Current circulating viruses do not have such ability**

HEALTH EMERGENCIES programme

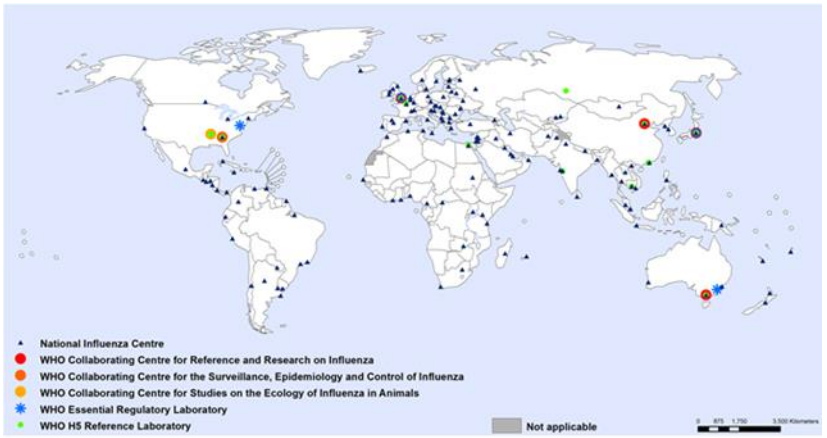
Summary of H5 human infections

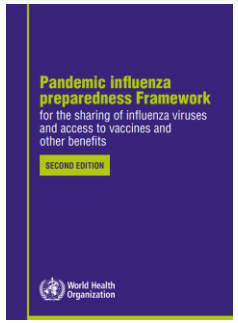
- **Sporadic** with direct or indirect **exposure** to infected animals or contaminated environments.
- Infections **range** from asymptomatic/mild, to severe and even fatal.
- Available genetic sequences of the virus from the human cases are similar to those from local **animals**.
- Based on evidence available to date, **no further spread** of the virus to close contacts and no cases detected in the community.
- **Situation can evolve quickly**
  - **Prompt & thorough investigations** are critical, **early identification** of any unusual events that could signal person-to-person transmission of the virus and **timely reporting** are key to optimal outcome of response.

WHO response & preparedness to avian & pandemic influenza

HEPR – health Emergency Preparedness, Response & Resilience Framework

Influenza specific resources





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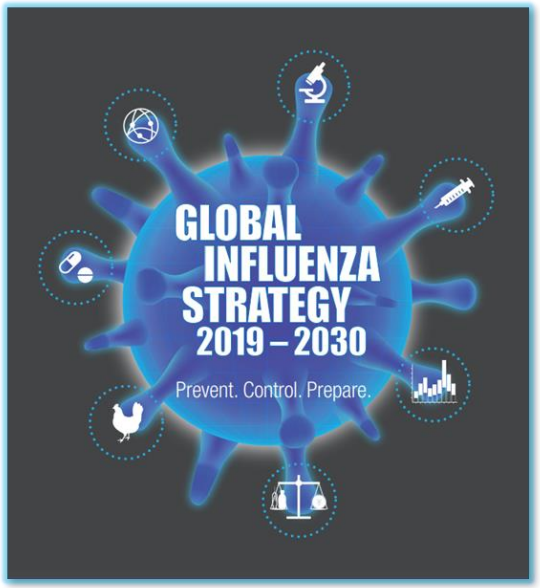
GLOBAL INFLUENZA SURVEILLANCE & RESPONSE SYSTEM
Uniting the world in the fight against influenza



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Thank you

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