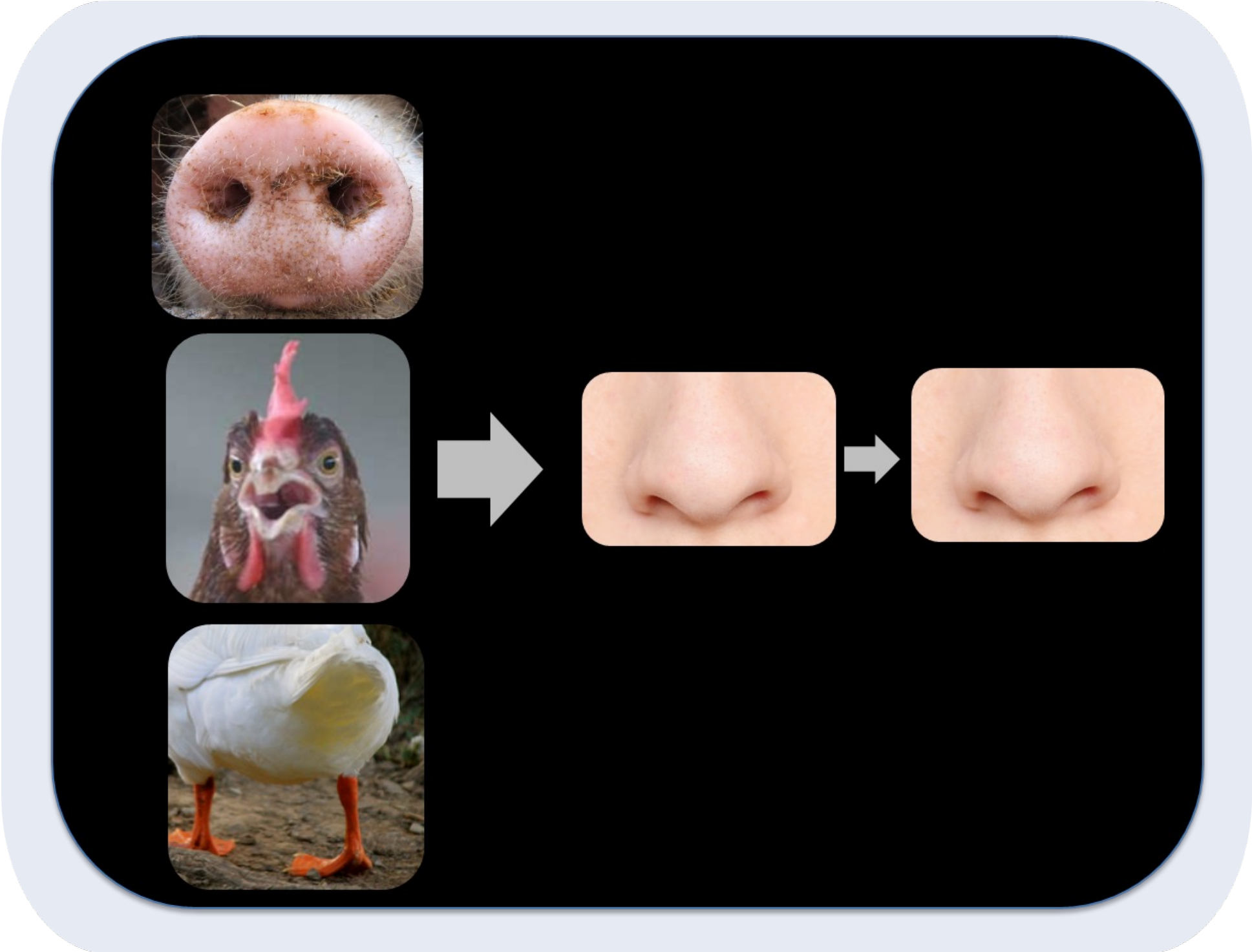




Avian influenza H5 and vaccine candidates

Richard Webby
WHO Collaborating Center for Studies on
the Ecology of Influenza in Animals
St Jude Children's Research Hospital
Memphis, US





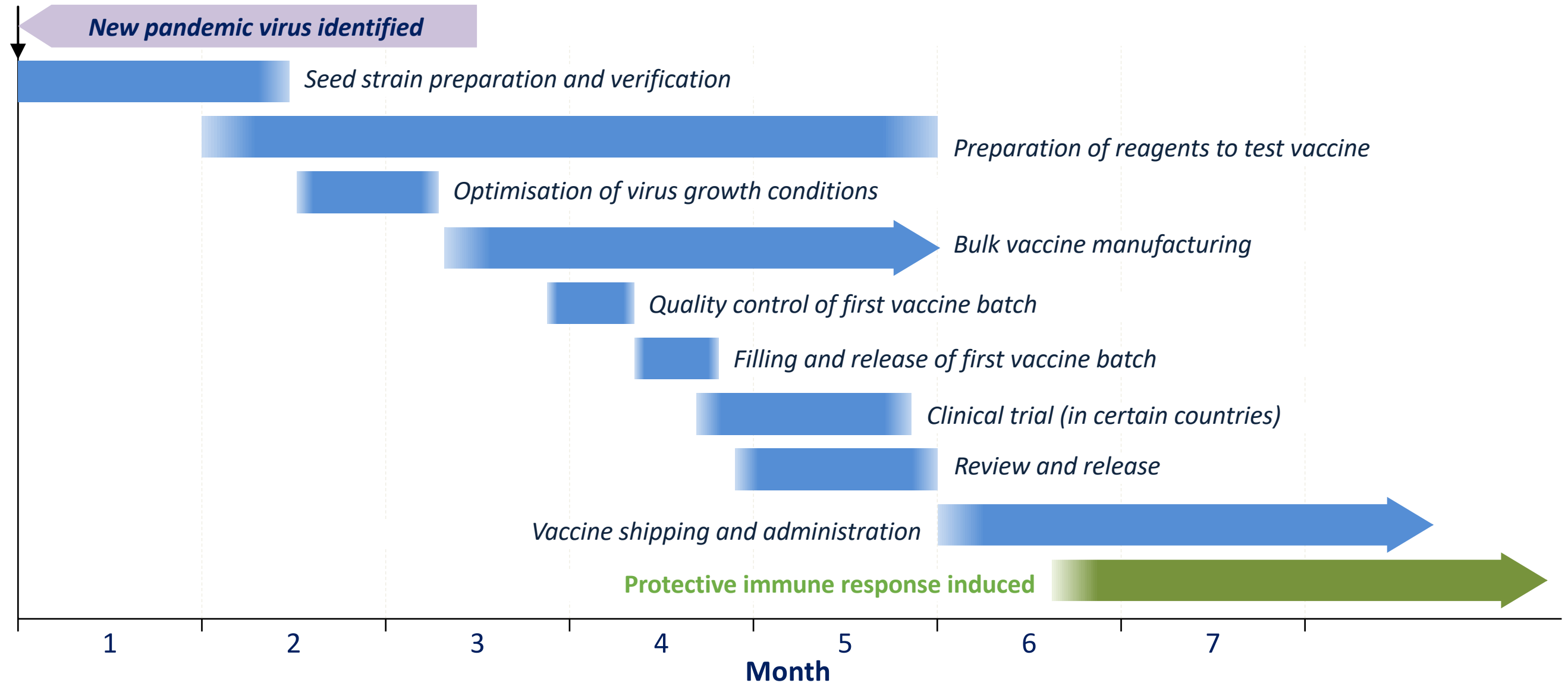


Zoonotic infections Sept 2020-Feb 2023



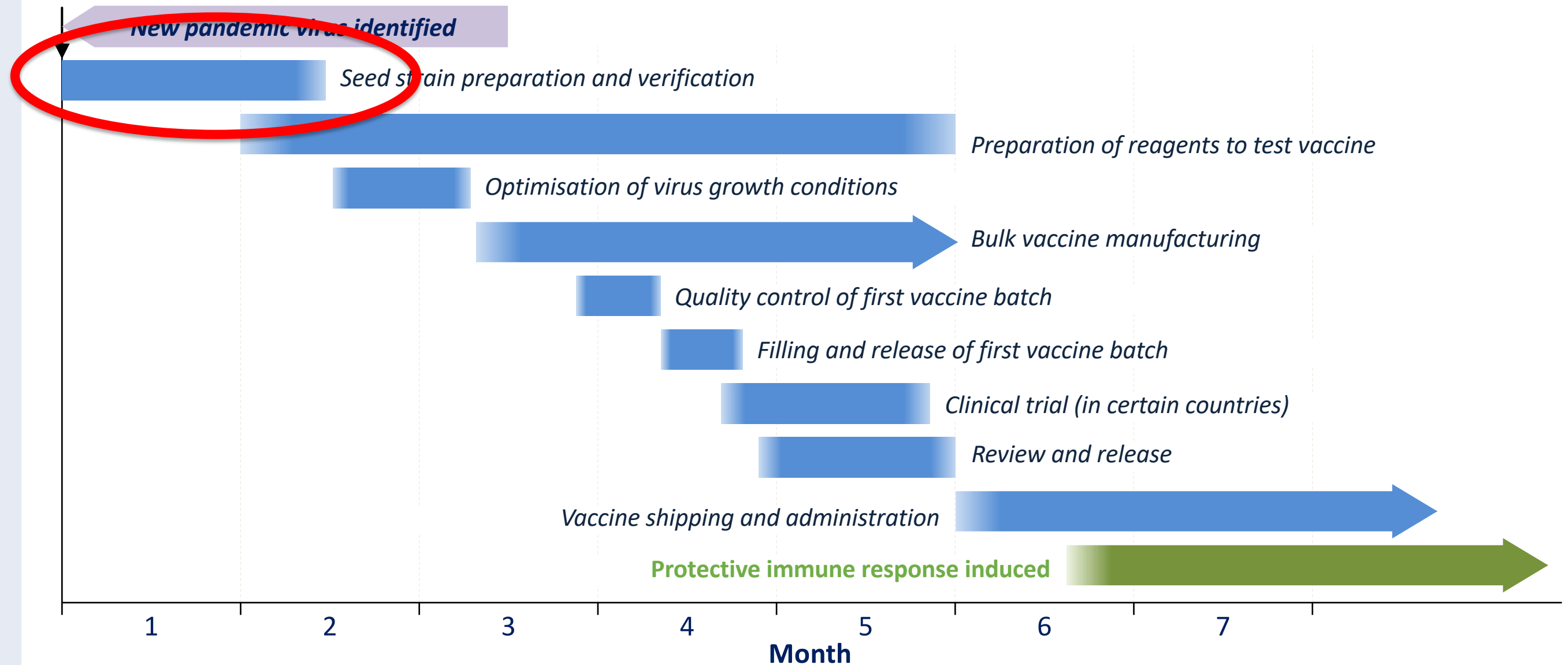


Pandemic influenza vaccine production





Pandemic influenza vaccine production





Candidate Vaccine Virus development

Table 3. 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	SJCRH	Yes
NIBRG-14 (A/Viet Nam/1194/2004)	1	NIBSC (MHRA)	Yes
NIBRG-88 (A/Cambodia/R0405050/2007)	1.1	NIBSC (MHRA)	Yes
IDCDC-RG34B (A/Cambodia/X0810301/2013)	1.1.2	CDC	Yes
SJRG-166614 (A/duck/Hunan/795/2002)	2.1.1	SJCRH/HKU	Yes
CDC-RG2 (A/Indonesia/5/2005)	2.1.3.2	CDC	Yes
NIIDRG-9 (A/Indonesia/NIHRD11771/2011)	2.1.3.2a	NIID	Yes
SJRG-163222 (A/bar-headed goose/Qinghai/1A/2005)	2.2	SJCRH/HKU	Yes
IBCDC-RG7 (A/chicken/India/NIV33487/2006)	2.2	CDC/NIV	Yes
SJRG-163243 (A/whooper swan/Mongolia/244/2005)	2.2	SJCRH	Yes
IDCDC-RG11 (A/Egypt/2321-NAMRU3/2007)	2.2.1	CDC	Yes
NIBRG-23 (A/turkey/Turkey/1/2005)	2.2.1	NIBSC (MHRA)	Yes
IDCDC-RG29 (A/Egypt/N03072/2010)	2.2.1	CDC	Yes
IDCDC-RG13 (A/Egypt/3300-NAMRU3/2008)	2.2.1.1	CDC	Yes
NIBRG-306 (A/Egypt/N04915/2014)	2.2.1.2	NIBSC (MHRA)	Yes
SJRG-166615 (A/common magpie/Hong Kong/5052/2007)	2.3.2.1	SJCRH/HKU	Yes
IDCDC-RG30 (A/Hubei/1/2010)	2.3.2.1a	CDC	Yes
SJ007 (A/duck/Bangladesh/19097/2013)	2.3.2.1a	SJCRH	Yes
SJ003 (A/barn swallow/Hong Kong/D10-1161/2010)	2.3.2.1b	SJCRH/HKU	Yes
NIBRG-301 (A/duck/Viet Nam/NCVD-1584/2012)	2.3.2.1c	NIBSC (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	SJCRH/HKU	Yes
IBCDC-RG6 (A/Anhui/1/2005)	2.3.4	CDC	Yes
CBER-RG1 (A/duck/Laos/3295/2006)	2.3.4	FDA	Yes
SJRG-164281 (A/Japanese white eye/Hong Kong/1038/2006)	2.3.4	SJCRH/HKU	Yes
IDCDC-RG36 (A/chicken/Bangladesh/11rs1984-30/2011)	2.3.4.2	CDC	Yes
IDCDC-RG35 (A/Guizhou/1/2013)	2.3.4.2	CDC/CCDC	Yes
IDCDC-RG42A (A/Sichuan/26221/2014) (H5N6)	2.3.4.4a	CDC/CCDC	Yes
IDCDC-RG71A (A/Astrakhan/3212/2020) (H5N8)	2.3.4.4b	CDC	Yes
CBER-RG8A (A/Astrakhan/3212/2020) (H5N8)	2.3.4.4b	FDA	Yes
IDCDC-RG43A (A/gyr Falcon/Washington/41088-6/2014) (H5N8)	2.3.4.4c	CDC	Yes
NIID-001 (A/duck/Hyogo/1/2016) (H5N6)	2.3.4.4e	NIID	Yes
SJRG-165396 (A/goose/Guiyang/337/2006)	4	SJCRH/HKU	Yes
IDCDC-RG12 (A/chicken/Vietnam/NCVD-016/2008)	7.1	CDC	Yes
IDCDC-RG25A (A/chicken/Vietnam/NCVD-03/2008)	7.1	CDC	Yes
IDCDC-RG65A (A/Guangdong/18SF020/2018) (H5N6)	2.3.4.4h	CDC	Yes
Candidate vaccine viruses in preparation			
IDCDC-RG63A (A/duck/Bangladesh/17D1012/2018-like)	2.3.2.1a	CDC	Pending
IDCDC-RG75A (A/chicken/Ghana/20/2015-like)	2.3.2.1f	CDC	Pending
A/chicken/Vietnam/NCVD-15A59/2015-like (H5N6)	2.3.4.4f	SJCRH	Pending
A/Guangdong/18SF020/2018-like (H5N6)	2.3.4.4h	CCDC	Pending
CNIC-HB29578 (A/Hubei/29578/2016-like) (H5N6)	2.3.4.4d	CCDC	Pending
CNIC-FJ21099 (A/Fujian-Sanyuan/21099/2017-like) (H5N6)	2.3.4.4b	CCDC	Pending
IDCDC-RG69A (A/ck/Vietnam/RAHO4-CD-20-421/2020-like) (H5N6)	2.3.4.4g	CDC	Pending
A/chicken/Ghana/AVL-76321VIR7050-39/2021-like	2.3.4.4b	To be determined	Pending

*All listed CVVs have been produced using reverse genetics

[†]Where not indicated, the virus subtype is H5N1

[‡]Centers developing and/or distributing the candidate vaccine viruses:

- Driven by zoonotic infections
- Purpose is to cover major risk groups of zoonotic viruses
- Available for process and vaccine development
- List gets longer as new antigenic groups of viruses emerge



Data used to support selection of CVVs

	Seasonal	Zoonotic
• Epidemiologic and clinical data	✓	✓
• Virus surveillance	✓	✓
• Genomic characterization of viruses	✓	✓
• Antigenic characterization of representative emerging viruses	✓	✓
• Data integration and comparison among WHO-CCs	✓	✓
• Post vaccination human serology studies	✓	✓
• Vaccine effectiveness studies	✓	✗
• Availability and characteristics of new candidate vaccine virus antigens	✓	✗
		Typically less data

Collaboration of additional partners

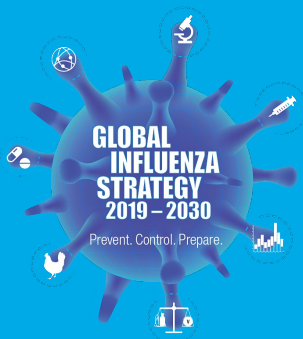


World Health
Organization

WHO Information Meeting on the composition of **influenza vaccines** for use in the **2023-2024** northern hemisphere influenza season

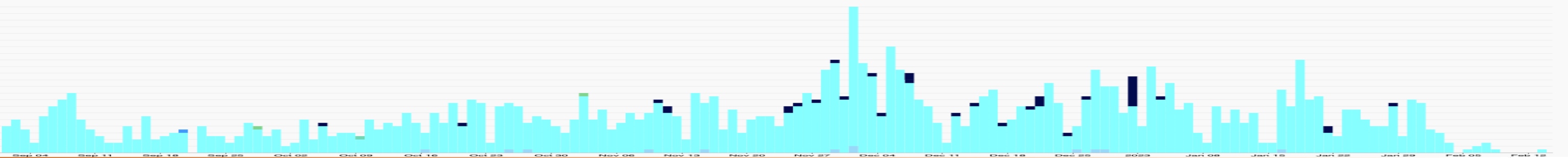
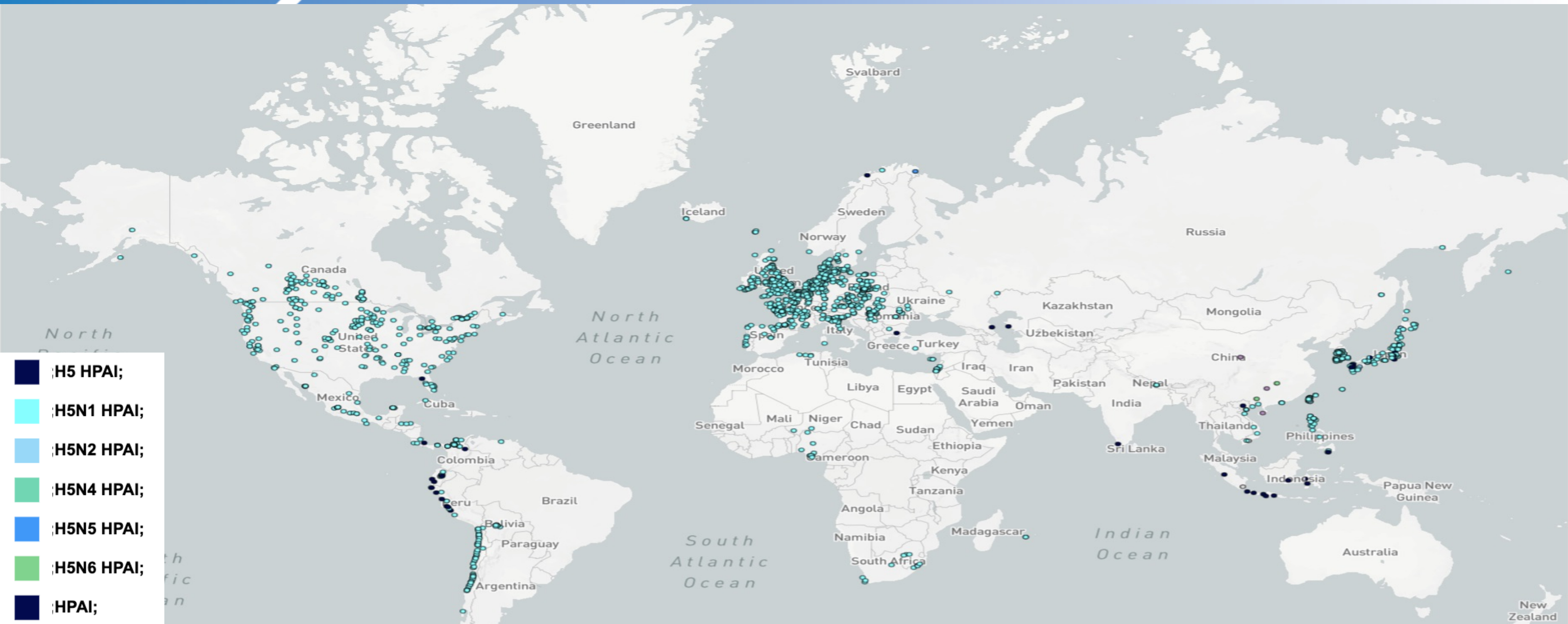
An in-person & virtual meeting

24 February 2023



Influenza A(H5)

A(H5) activity in birds



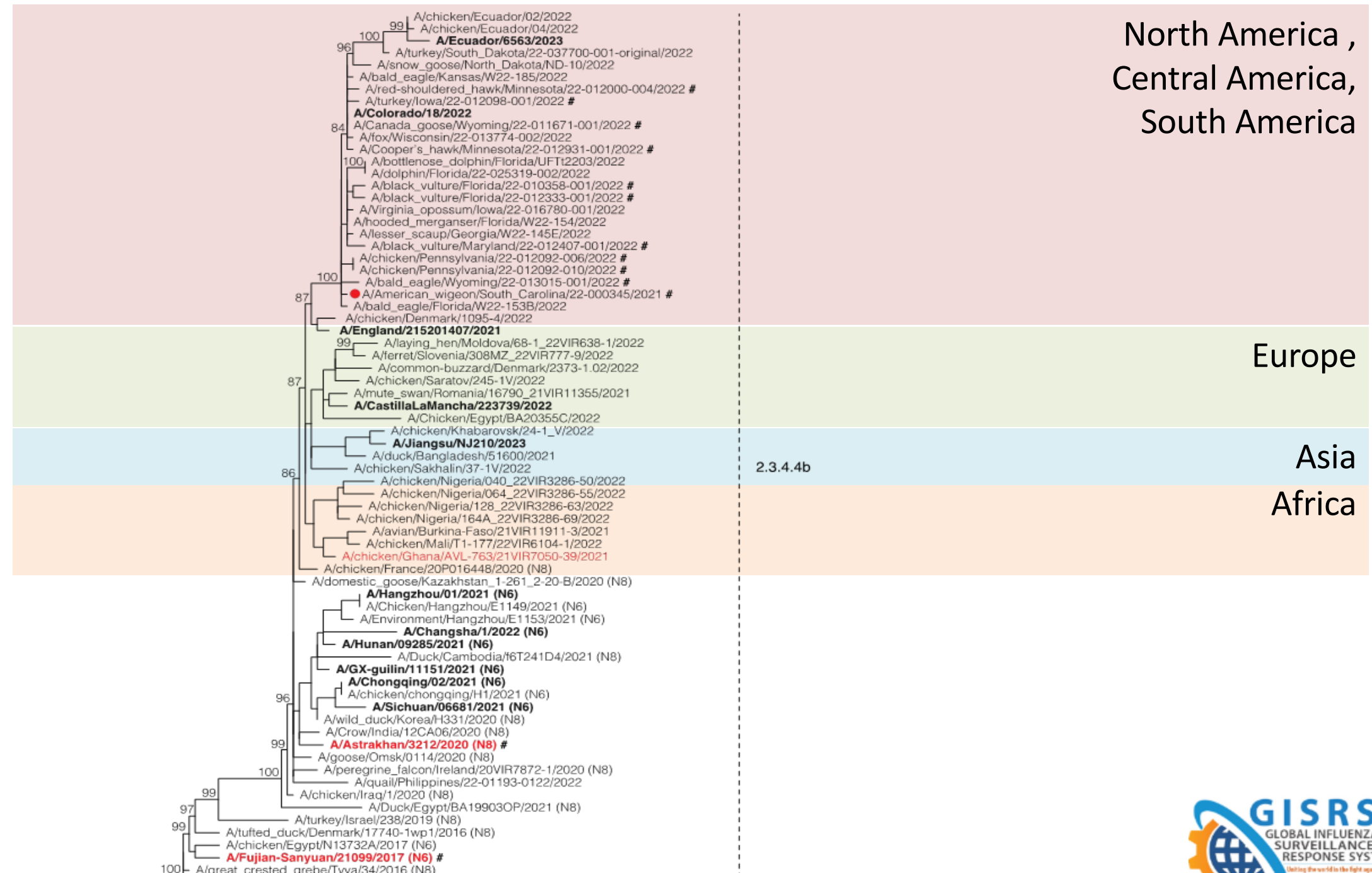
A(H5) activity in humans

Subtype / clade	Country	Jurisdiction	Illness Onset	Age	Gender	Exposure	Severity	Outcome
H5N1 / unknown	Viet Nam	Phu Tho	05.10.2022	4	F	Poultry (diseased)	Severe	Recovered
H5N1 / 2.3.4.4b	Ecuador	Bolivar	25.12.2022	9	F	Poultry (diseased)	Critical	Recovered
H5N1 / 2.3.4.4b	Spain	Guadalajara	23.09.2022	19	M	Poultry	Asymptomatic	Recovered
H5N1 / 2.3.4.4b		Guadalajara	13.10.2022	27	M	Poultry	Asymptomatic	Recovered
H5N1 / 2.3.4.4b	China	Guangxi	22.09.2022	38	F		Critical	Fatal
H5N1 / 2.3.4.4b		Jiangsu	31.01.2023	53	F	Poultry		
H5N6 / 2.3.3.4b		Guangxi	01.09.2022	3	M		Severe	
H5N6 / 2.3.4.4b		Hunan	02.11.2022	54	M		Critical	
H5N6 / pending		Guangdong	17.12.2022	49	M	Poultry	Severe	Recovered

Cumulative numbers:

3 A(H5), 7 A(H5N8), 84 A(H5N6) and 871 A(H5N1)

Geographic clustering of A(H5N1) 2.3.4.4b viruses



Antigenic properties of 2.3.4.4b viruses

Reference antigens	Clade	Subtype	SJRG-161052	CNIC-FJ21099	IDCDC-RG71A	Am wg/2021
SJRG-161052 (A/Vietnam/1203/2004-like)	1	H5N1	<u>2560</u>	<10	<10	<10
CNIC-FJ21099 (A/Fujian-Sanyuan/21099/2017-like)	2.3.4.4b	H5N6	10	<u>80</u>	160	<10
IDCDC-RG71A (A/Astrakhan/3212/2020-like)	2.3.4.4b	H5N8	<10	<10	<u>320</u>	<10
A/American wigeon/South Carolina/22-000345-001/2021	2.3.4.4b	H5N1	<10	<10	80	<u>80</u>
Test antigens						
A/red-shouldered hawk/Minnesota/22-012000-004/2022	2.3.4.4b	H5N1	<10	40	320	160
A/black vulture/Florida/22-010358-001/2022	2.3.4.4b	H5N1	<10	<10	160	80
A/chicken/Pennsylvania/22-012092-006/2022	2.3.4.4b	H5N1	<10	<10	160	160
A/black vulture/Florida/22-012331-001/2022	2.3.4.4b	H5N1	<10	<10	160	160
A/bald eagle/Wyoming/22-013015-001/2022	2.3.4.4b	H5N1	<10	<10	160	80
A/chicken/Pennsylvania/22-012092-010/2022	2.3.4.4b	H5N1	<10	<10	160	80
A/Canada goose/Wyoming/22-011671-001/2022	2.3.4.4b	H5N1	<10	<10	80	80
A/turkey/Iowa/22-012098-001/2022	2.3.4.4b	H5N1	<10	<10	80	80
A/black vulture/Florida/22-012333-001/2022	2.3.4.4b	H5N1	<10	<10	80	320
A/black vulture/Maryland/22-012407-001/2022	2.3.4.4b	H5N1	<10	<10	80	80
A/Cooper's hawk/Minnesota/22-012931-001/2022	2.3.4.4b	H5N1	<10	<10	40	40

Antigenic properties of 2.3.4.4b viruses

Reference antigens	Clade	Subtype	SJRG-161052	CNIC-FJ21099	IDCDC-RG71A	Am wg/2021
SJRG-161052 (A/Vietnam/1203/2004-like)	1	H5N1	<u>2560</u>	<10	<10	<10
CNIC-FJ21099 (A/Fujian-Sanyuan/21099/2017-like)	2.3.4.4b	H5N6	10	<u>80</u>	160	<10
IDCDC-RG71A (A/Astrakhan/3212/2020-like)	2.3.4.4b	H5N8	<10	<10	<u>320</u>	<10
A/American wigeon/South Carolina/22-000345-001/2021	2.3.4.4b	H5N1	<10	<10	80	<u>80</u>
Test antigens						
A/red-shouldered hawk/Minnesota/22-012000-004/2022	2.3.4.4b	H5N1	<10	40	320	160
A/black vulture/Florida/22-010358-001/2022	2.3.4.4b	H5N1	<10	<10	160	80
A/chicken/Pennsylvania/22-012092-006/2022	2.3.4.4b	H5N1	<10	<10	160	160
A/black vulture/Florida/22-012331-001/2022	2.3.4.4b	H5N1	<10	<10	160	160
A/bald eagle/Wyoming/22-013015-001/2022	2.3.4.4b	H5N1	<10	<10	160	80
A/chicken/Pennsylvania/22-012092-010/2022	2.3.4.4b	H5N1	<10	<10	160	80
A/Canada goose/Wyoming/22-011671-001/2022	2.3.4.4b	H5N1	<10	<10	80	80
A/turkey/Iowa/22-012098-001/2022	2.3.4.4b	H5N1	<10	<10	80	80
A/black vulture/Florida/22-012333-001/2022	2.3.4.4b	H5N1	<10	<10	80	320
A/black vulture/Maryland/22-012407-001/2022	2.3.4.4b	H5N1	<10	<10	80	80
A/Cooper's hawk/Minnesota/22-012931-001/2022	2.3.4.4b	H5N1	<10	<10	40	40

A new CVV antigenically-like A/American wigeon/South Carolina/22-000345-001/2021 is proposed



Summary

- Zoonotic CVV development integral part of vaccine composition meetings.
- Purpose is to cut 4-6 weeks off vaccine response.
- Process and data needs are similar to seasonal decisions.
- Strong partnership with OFFLU has developed.
- The zoonotic threat from influenza is not subsiding.



Acknowledgements