Emerging influenza viruses in the animal world: should humans be worried?

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Epidemic = BAD

Pandemic = REALLY BAD (usually)



*Per 100,000 population per year.

MMWR 1999;48:no. 29



- 16 HA subtypes (and variation within subtype)
- 9 NA subtypes
- Little cross reactivity
- Evolves through drift and shift









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H1			· · ·
H2			*
Нз	2	and the second s	+
H4	2		+
H5			†
H6			
H7		Provide the second s	
H8			Ť
H9			
H10			
H11			
H12			
H13			
H14			
H15			-+
H16			



Can we predict what's next?



- Exposure to infected host
- Population immunity
- Population susceptibility
- Receptor preference

Receptors as host range barrier





Not quite as simple



Shinya Nature 2006









- Virus halted in 1997 but.....
- Endemic in avian populations in some countries (Asia/Africa)
- Sporadic infection in many others
- Highly pathogenic in avian (up to 100%) and mammalian hosts
- Chances for eradication are slim to none
- Poorly transmissible in mammals

Human cases continue



How strong are the barriers?

Barrier	Avian H5
Exposure to infected host	\mathbf{V}
Population immunity	\mathbf{V}
Population susceptibility	?
Receptor preference	^



- Swine are uniquely susceptible to avian and mammalian viruses (contain both receptors but evolve to 2-6)
- Viruses sporadically pass between humans and swine
- Reservoir for limited diversity of viruses similarly to humans
- More reassortment in swine

Pre-1998







Triple reassortants can infect humans

Table 1. Demographic and Exposure Characteristics of 11 Patients Infected with Triple-Reassortant Swine Influenza A (H1) Viruses.							
Patient No.	Age	Sex	State of Residence	Date of Illness Onset	Estimated Incubation Period	Exposure*	III Swine Present
1	17 yr	M	WI	Dec. 2005	3 days	Butchered a pig (direct contact)	Not known
2	7 yr	м	MO	Jan. 2006	Not known	Reported no contact with a pig (unknown contact)	Not known
3	4 yr	F	IA	Nov. 2006	7–10 days	Had contact with patient with sus- pected case of swine influenza (epidemiologically linked contact)	Yes
4	10 yr	F	он	Aug. 2007	3-4 days	Exhibited swine at fair, handled pigs (direct contact)	Yes
5	36 yr	м	ОН	Aug. 2007	3-4 days	Exhibited swine at fair, handled pigs (direct contact)	Yes
6	48 yr	F	IL	Aug. 2007	7 days	Visited fair, did not stop at pigpen (near vicinity)	Yes
7	16 mo	м	MI	Aug. 2007	7 days	Visited fair, came within 1 m of pigs (close proximity)	Yes
8	2 yr	м	IA	Nov. 2007	1–10 days	Lived on swine farm, came within 1 m of pigs (close proximity)	Yes
9	26 yr	F	MN	Jan. 2008	9 days	Visited live-animal market, came with- in 1 m of pigpen (close proximity)	Not known
10	14 yr	м	TX	Oct. 2008	3 days	Visited a swine farm, brought home and handled a pig (direct contact)	Yes
11	3 уг	м	IA	Feb. 2009	1-10 days	Visited swine farm owned by his fami- ly, touched pigs (direct contact)	Yes

* Direct contact refers to touching or handling a pig; close proximity refers to standing within 1.83 m (6 ft) of a pig, without known direct contact; near vicinity refers to presence of pigs on the premises but not in close proximity; epidemiologically linked refers to a person who is epidemiologically linked to another person with a confirmed or suspected infection; and unknown refers to unknown contact or unavailable contact information.



Genesis of a pandemic virus









Lots of heterogeneity











Reporting States	H3N2v
Indiana	2
Iowa	3
Maine	2
Pennsylvania	3
West Virginia	2









How strong are the barriers?

Barrier	Swine H3
Exposure to infected host	←
Population immunity	^
Population susceptibility	\checkmark
Receptor preference	♦

Barrier	Avian H5	Swine H3
Exposure to infected host	♦	←
Population immunity	♦	∧
Population susceptibility	?	♦
Receptor preference	^	♦

Transmissible H5N1 would be a game changer

Is it important to find out???

Scientists Created Bird Flu Superbug that Could Set Off Next Global Pandemic



Scary science, national security, and open-source research

BY MAGGIE KOERTH-BAKER AT 11 42 AM FEIDAYI JAN 13



Beware the scientists who tinker with flu bug viruses

BY GEOFFOLSON, VANCOUVER COURIER JANUARY 13, 2012

One night last week my partner and I, battered by a persistent cold, decided to rent a movie online. We chose the plague thriller Contagion. (If you have to be sick, what's more fun than watching characters even sicker than you?)





- Yes, pandemic flu can be catastrophic
- *But*, I cant yet tell you how worried to be.
- We need to understand more about flu in all hosts
- There are many more possibilities than just H3 and H5

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