

Game Plan

Lecture

- Epidemiology
- Disease terminology
- Classification of infectious disease
- Development of disease
- Case studies: flu and ebola

Lab

Complete Minor Unknown
(Extra credit due TH 10/25)

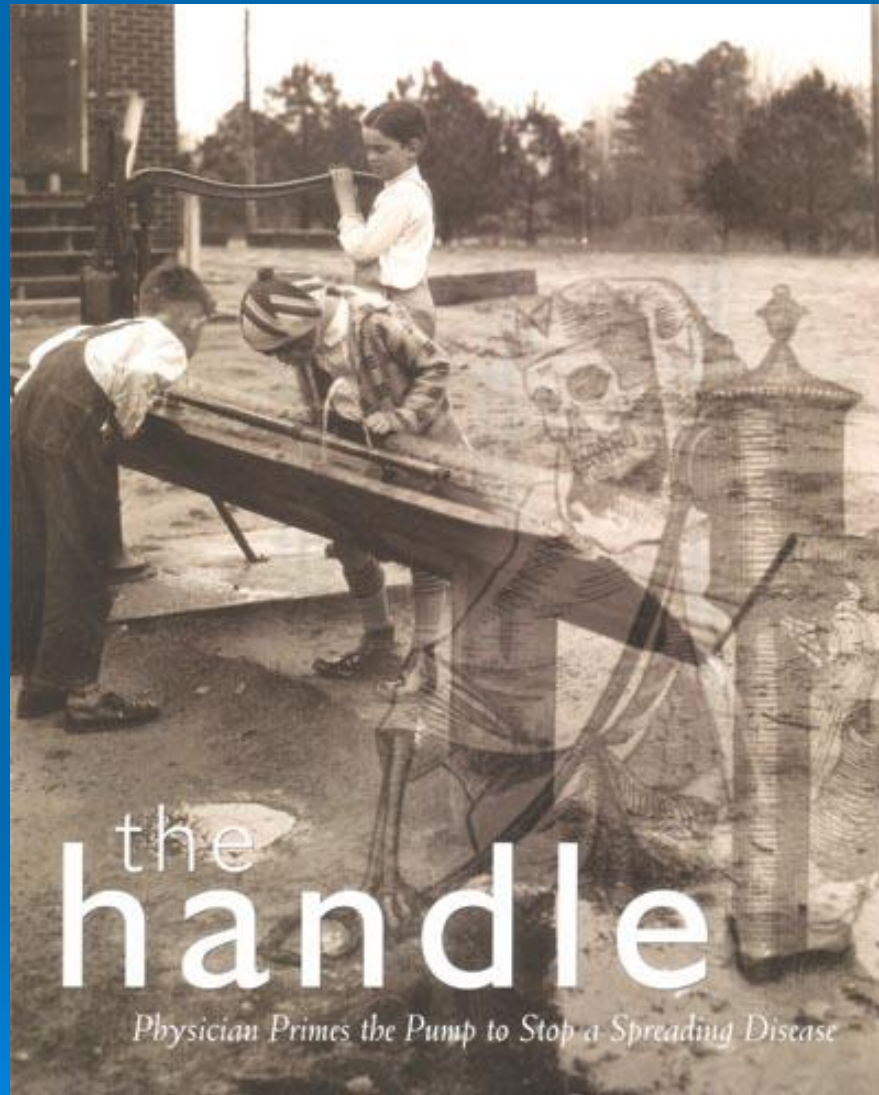
MOVE start of SSE to T 10/23

The origins of modern epidemiology



John Snow
Cholera epidemic in
London

The origins of modern epidemiology

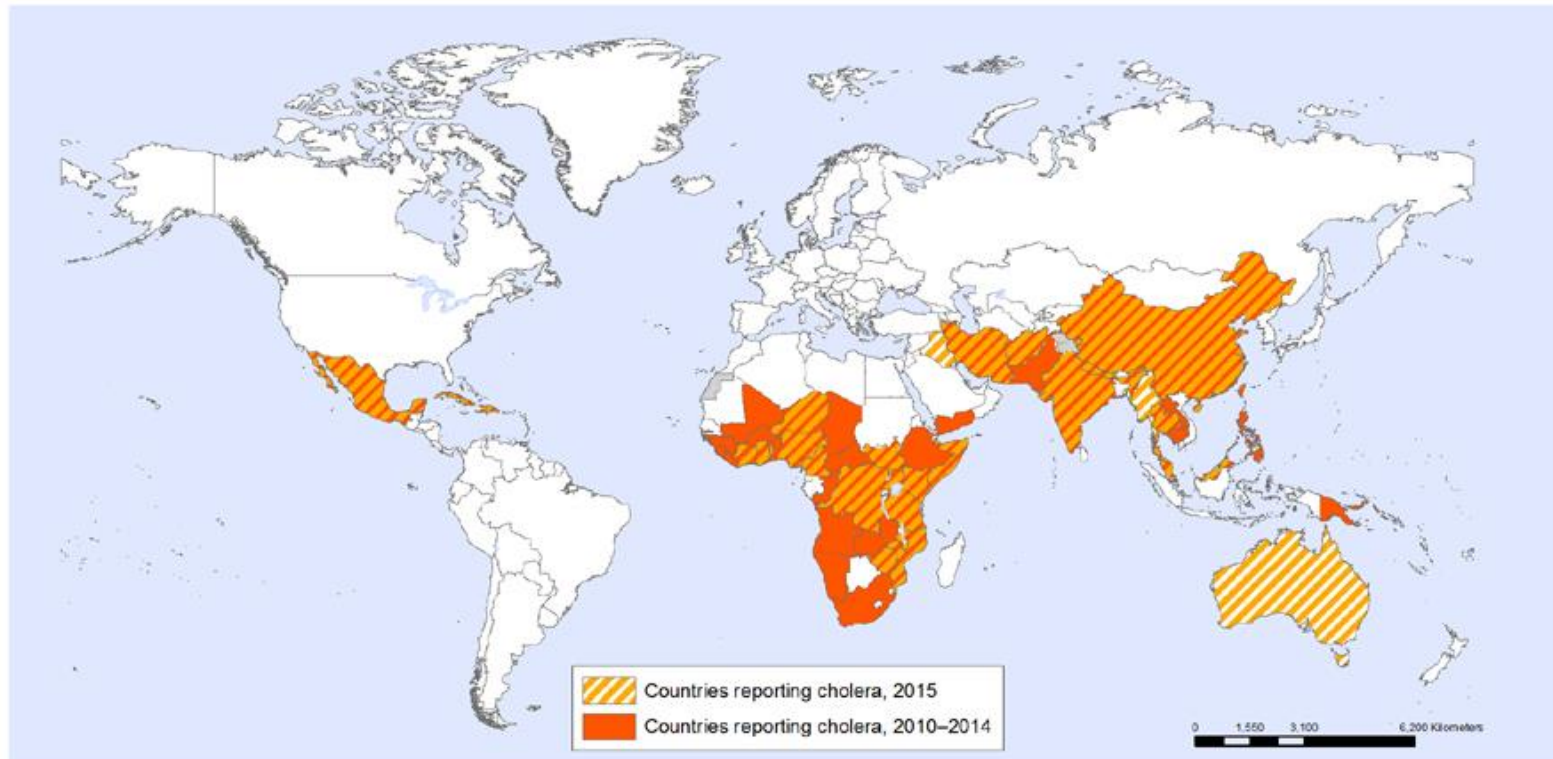


UCLA dedicated site to the life and history of Snow:

<http://www.ph.ucla.edu/epi/snow.html>

Cholera continues

Countries reporting cholera, 2010–2015



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Data Source: World Health Organization
Map Production: Information Evidence
and Research (IER)
World Health Organization



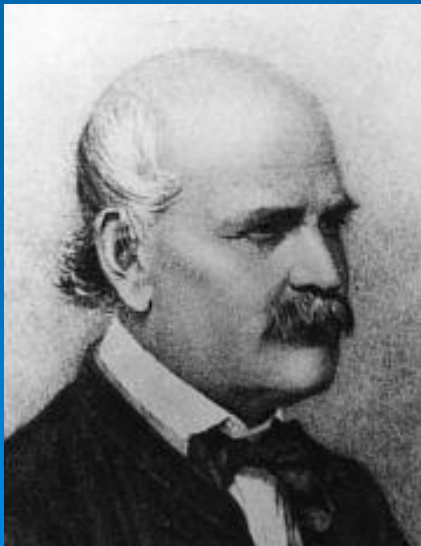
World Health
Organization

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The origins of modern epidemiology

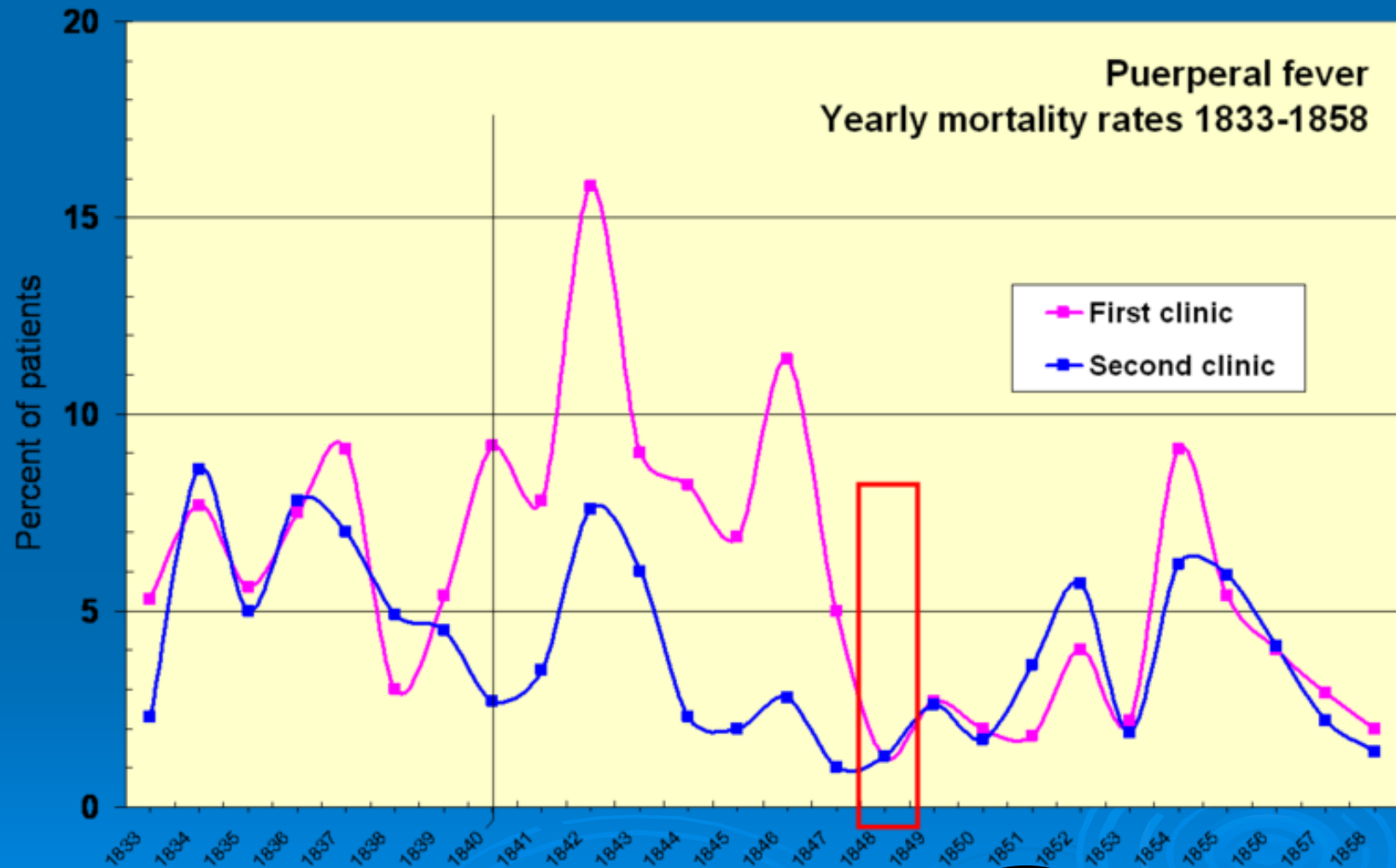


John Snow
Cholera epidemic in
London

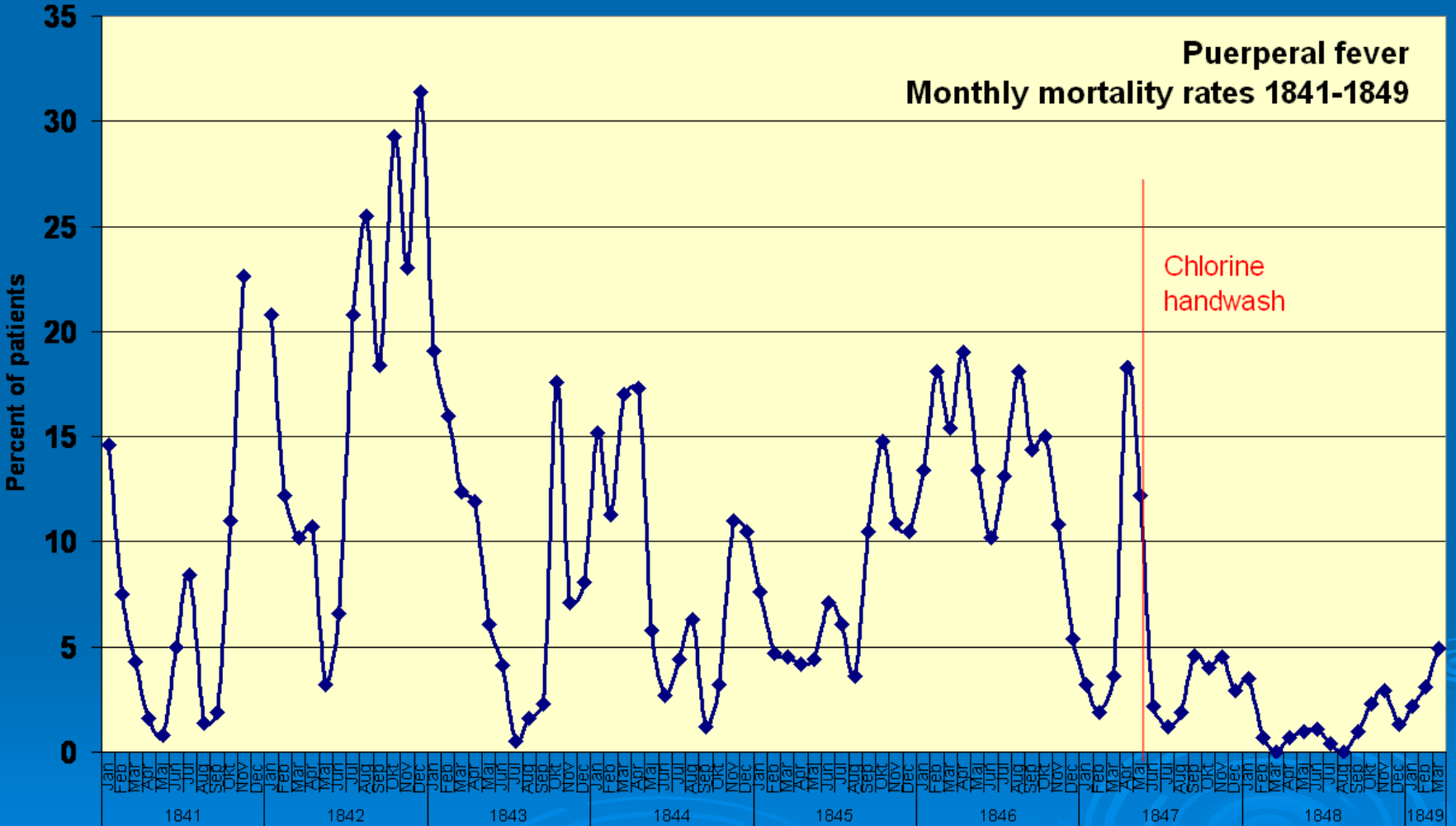


Ignaz Semmelweis
Puerperal fever in
hospitals

The origins of modern epidemiology



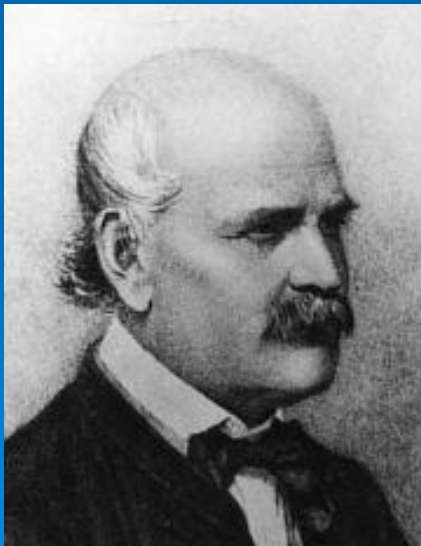
The origins of modern epidemiology



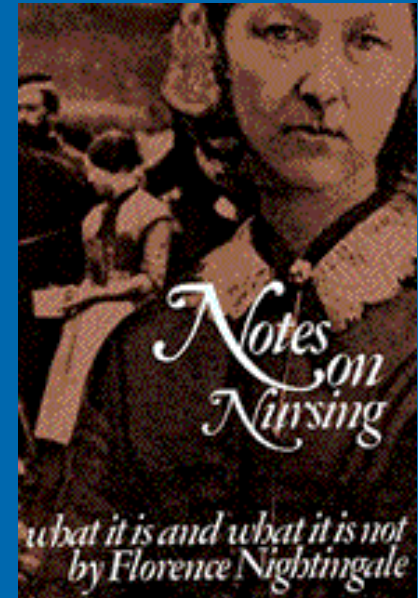
The origins of modern epidemiology



John Snow
Cholera epidemic in
London



Ignaz Semmelweis
Puerperal fever in
hospitals



Florence Nightingale
Death rates of Crimean War
soldiers

Terminology

Disease- in a state of not being healthy,
change from health

Infection- colonization or invasion of pathogens,
may be microbes in the wrong place

Pathogens- disease causing organisms

Etiology- study of the cause of a disease



Case Study 1: Influenza

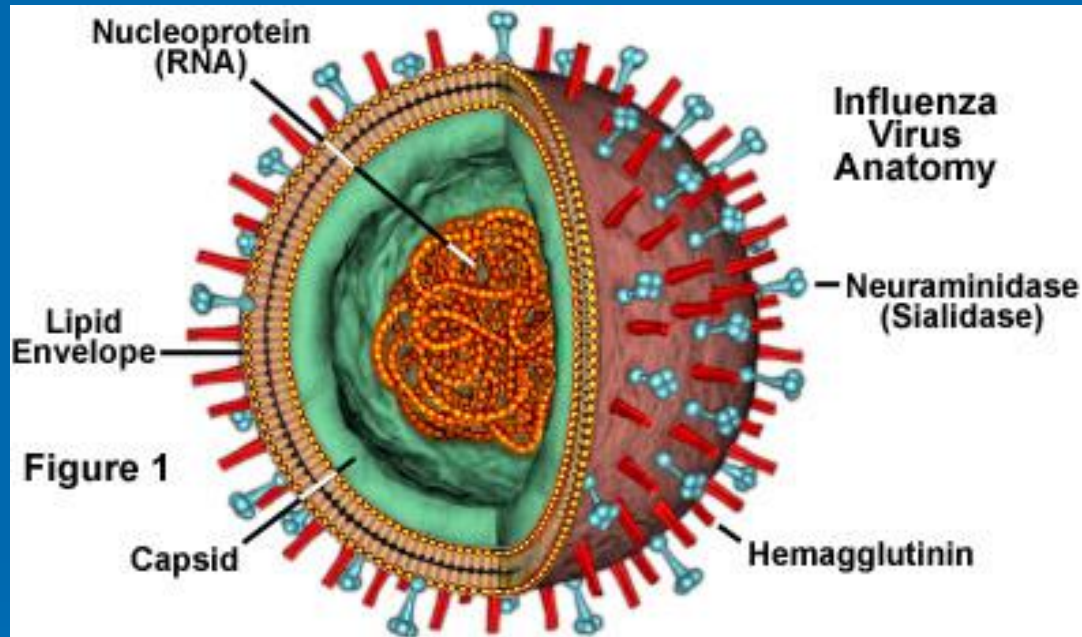
Influenza Type A - the most common and causes the most serious seasonal epidemics and pandemics infecting multiple species (people, birds, pigs, horses, cats...)

Influenza Type B - can cause seasonal epidemics, but the disease is less severe; generally infecting only humans

Influenza Type C - not connected with epidemics or pandemics; more mild symptoms infecting humans and swine



Influenza virus



Key features

- Orthomyxovirus (viral family)
- RNA virus, surrounded by capsid and envelope
- Envelope molecules
 - Hemagglutinin (HA)
 - Neuraminidase (N)

Influenza surface glycoproteins

Hemagglutinin (HA)

Binds to sialic acid residues on glycosylated receptor proteins of host

Fuses viral membrane to host cell (endosome) membrane

FUNCTION: releases viral RNA into cell

16 subtypes of HA

****Antigenic Drift:** Changes in 4 active sites in each subtype create diversity- allows for seasonal flu

Neuraminidase (N)

Cleaves sialic acid from host glycoproteins

FUNCTION: allows virus to enter/ leave cell

9 subtypes of N

The “bird flu”-

A case study in epidemiology

Seasonal flu- influenza virus (A or B) that causes respiratory illness; transferred from person to person; vaccines available, some immunity

Avian or bird flu (AI)- influenza (A) virus that infects wild birds can be transmitted from bird to human, no vaccine, no immunity

Pandemic flu- human influenza (A) virus on a global level, spread from human to human, no immunity

Recent Influenza A infections

Human infections with human influenza viruses

H1N1

H1N2

H3N2

CDC: The 2017-2018 trivalent influenza vaccine is made from the hemagglutinin of the following three viruses:

- A/Michigan/45/2015 (H1N1)pdm09–like virus
 - A/Hong Kong/4801/2014 (H3N2)-like virus
 - B/Brisbane/60/2008–like virus.
-
- The CDC also recommended a quadrivalent vaccine containing a B/Phuket/3073/2013–like virus (Yamagata lineage)

WHY VACCINATE?...

HERD IMMUNITY



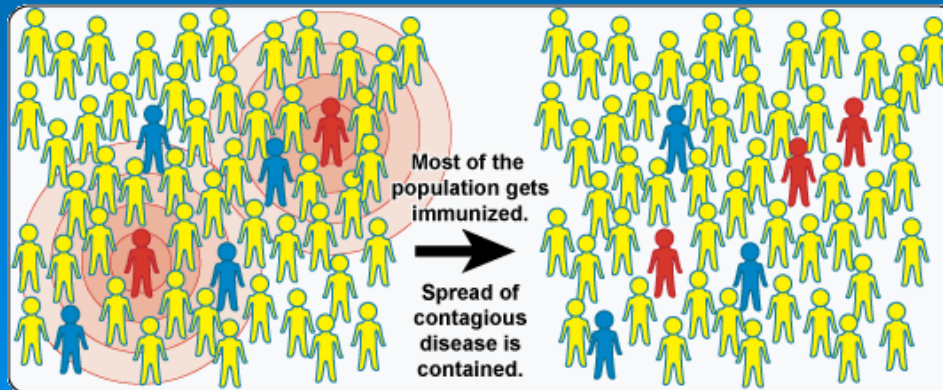
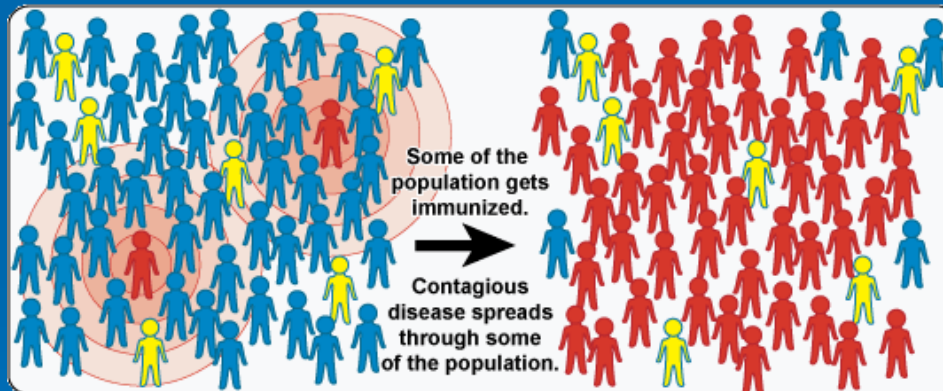
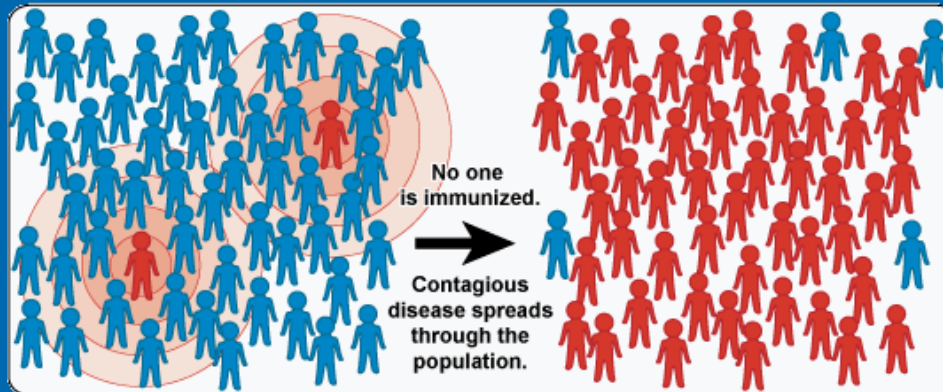
= not immunized but
still healthy



= immunized and
healthy



= not immunized,
sick, and contagious



HERD IMMUNITY



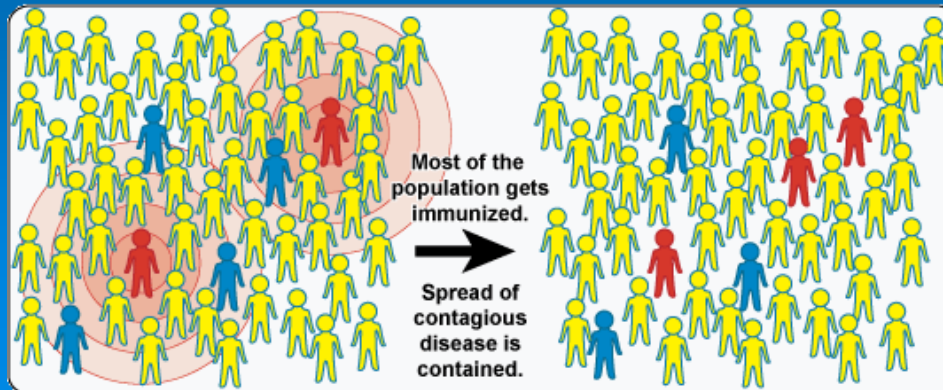
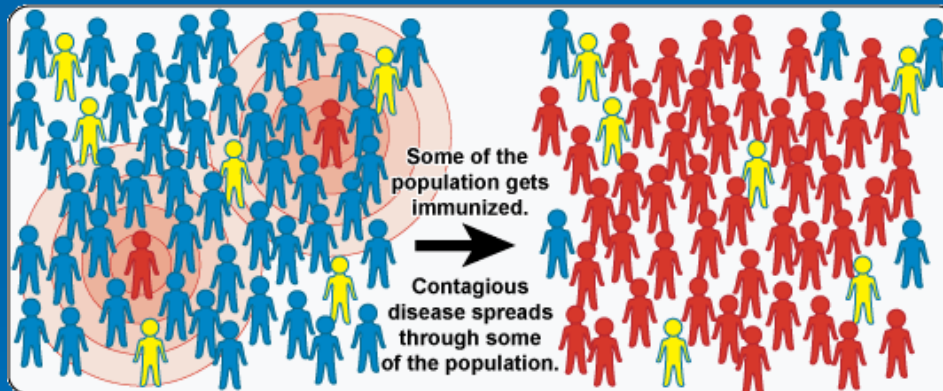
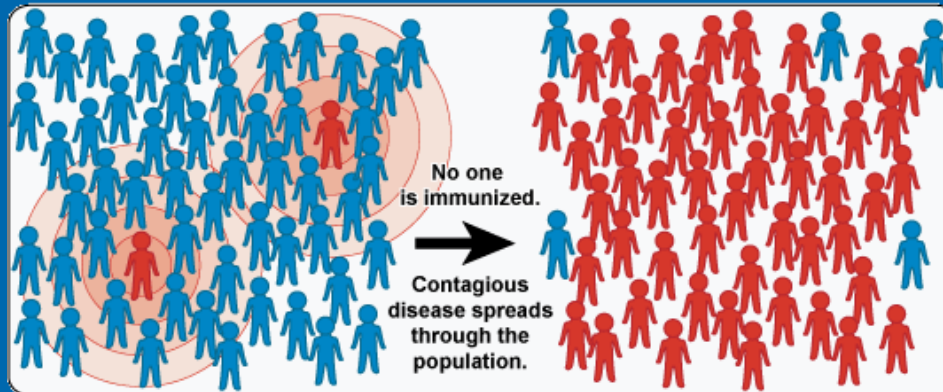
= not immunized but
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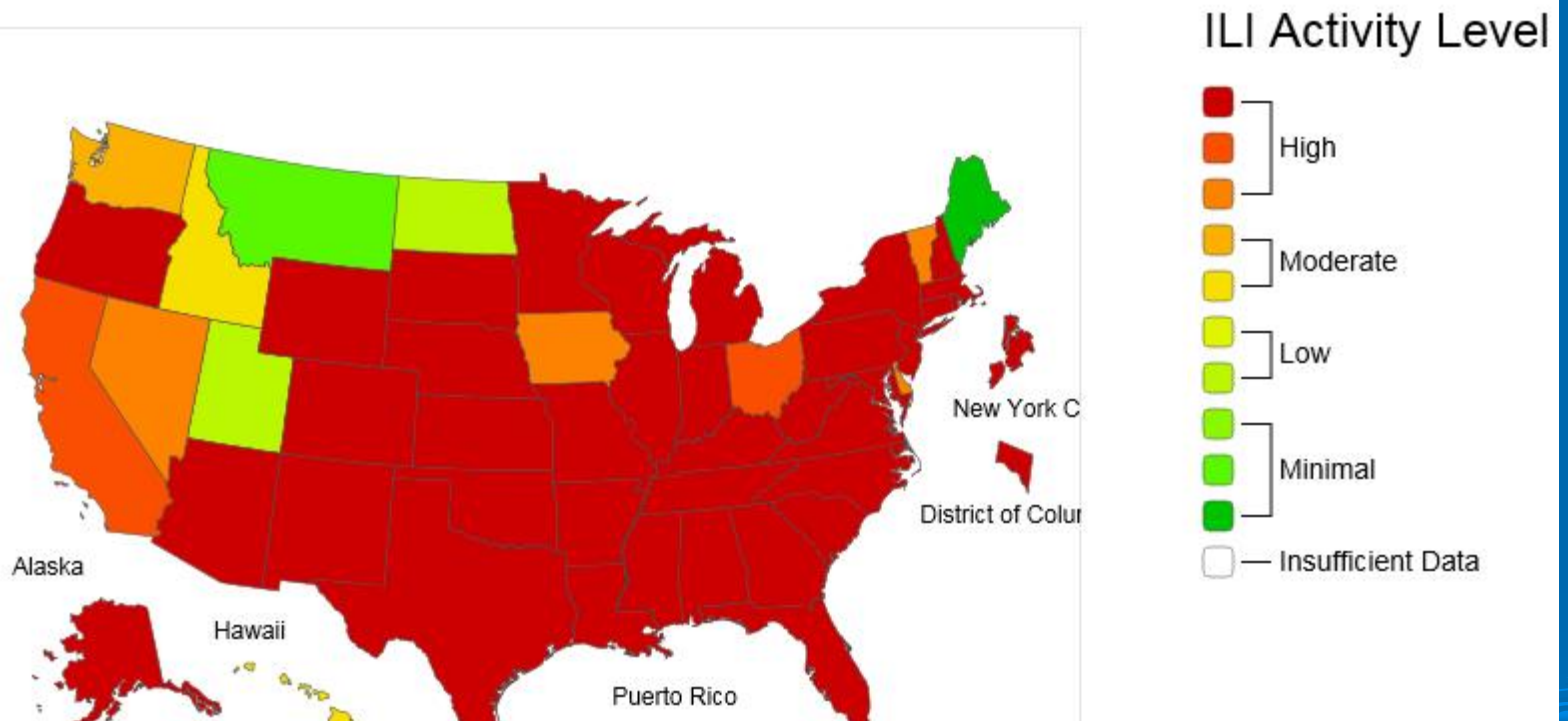


= not immunized,
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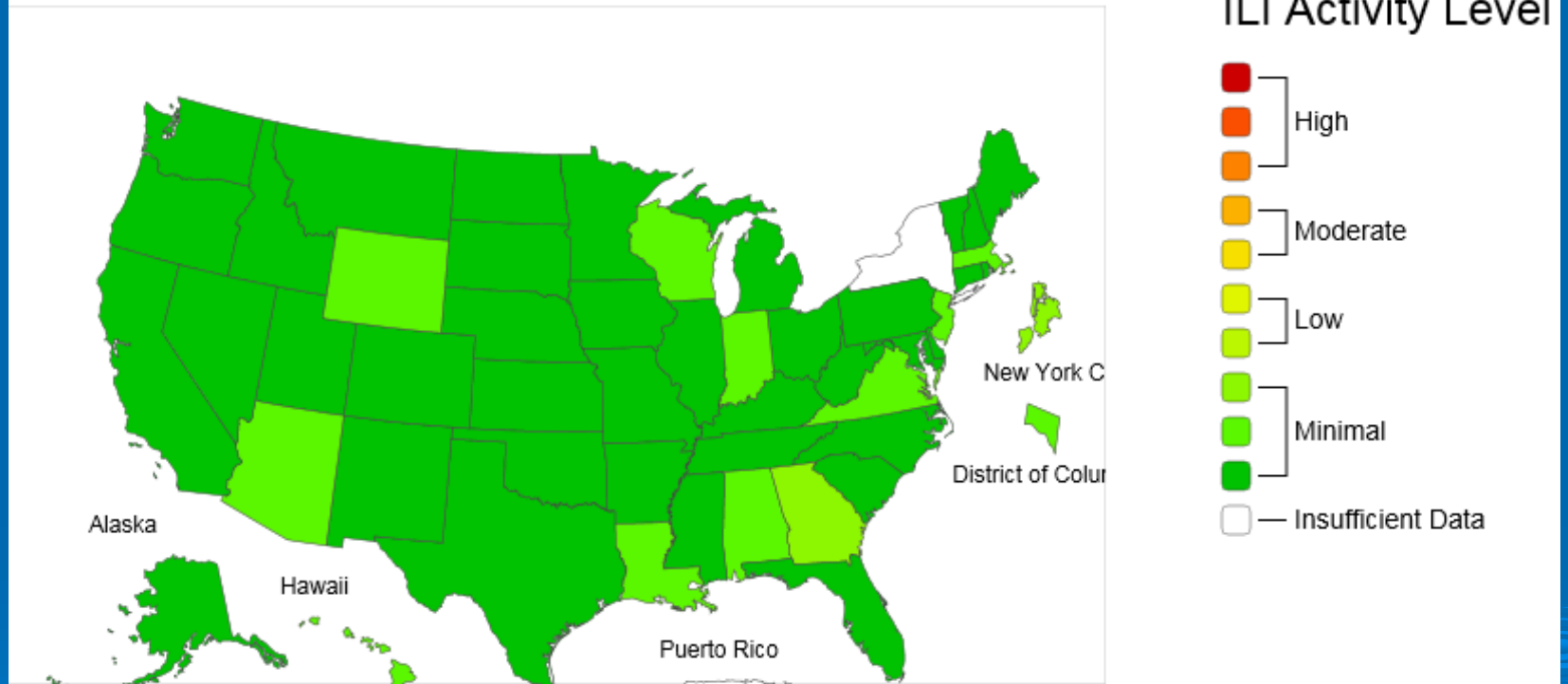
2017-2018 US Flu Activity

2017-18 Influenza Season Week 5 ending Feb 03, 2018



2018-2019 US Flu Activity

2018-19 Influenza Season Week 40 ending Oct 06, 2018

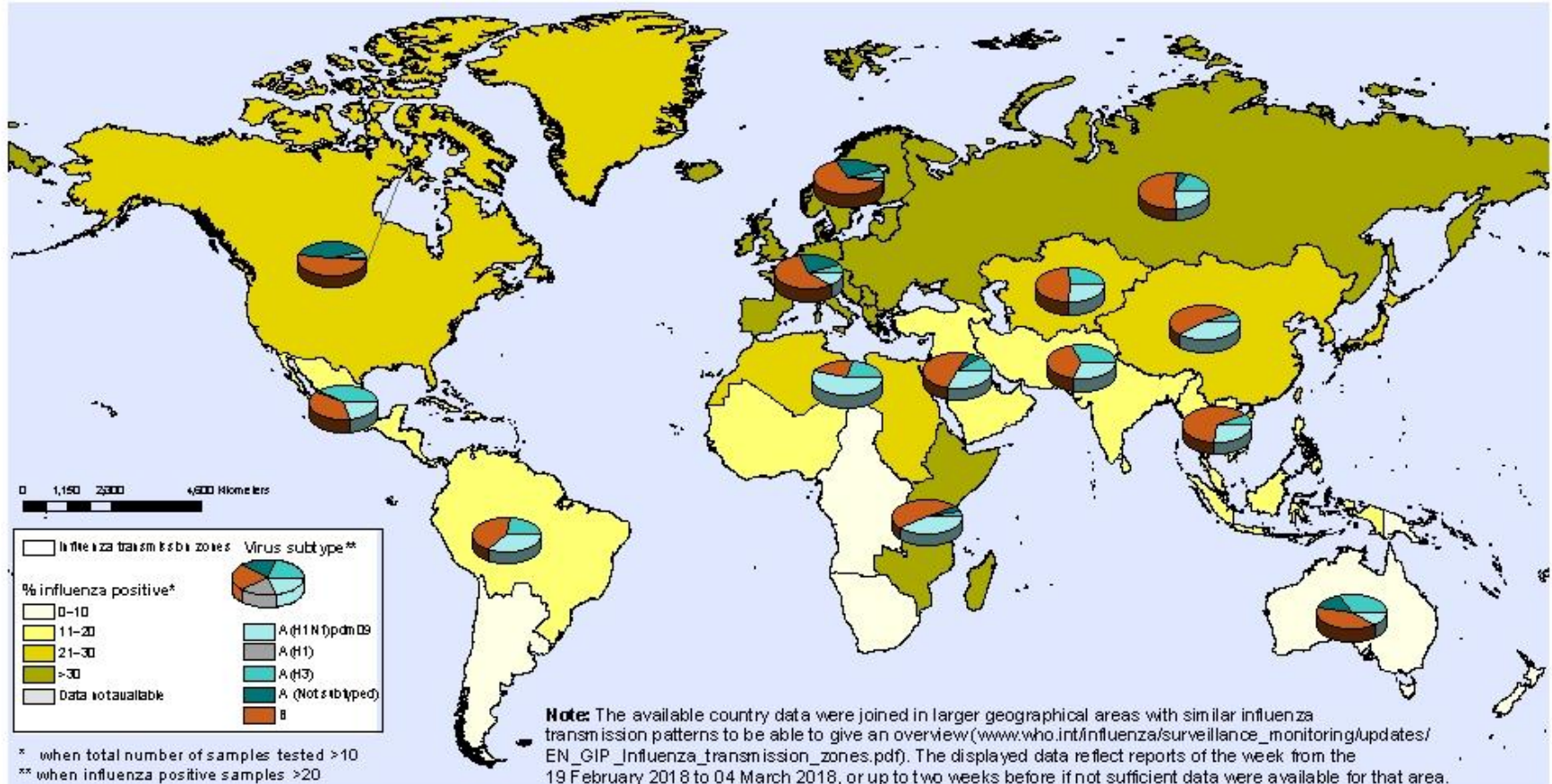


the proportion of outpatient visits to healthcare providers for influenza-like illnesses to measure the ILI activity level within a state. It does not, however,

2017-2018 International seasonal flu

Percentage of respiratory specimens that tested positive for influenza By influenza transmission zone

Status as of 16 March 2018



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Data Source: Global Influenza Surveillance and Response System (GISRS), FluNet (www.who.int/flu-net).

 **World Health Organization**
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Avian flu

Cumulative number of confirmed human cases for avian influenza A(H5N1) reported to WHO, 2003-2018

Country	2003-2009*		2010-2014**		2015		2016		2017		2018		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Azerbaijan	8	5	0	0	0	0	0	0	0	0	0	0	8	5
Bangladesh	1	0	6	1	1	0	0	0	0	0	0	0	8	1
Cambodia	9	7	47	30	0	0	0	0	0	0	0	0	56	37
Canada	0	0	1	1	0	0	0	0	0	0	0	0	1	1
China	38	25	9	5	6	1	0	0	0	0	0	0	53	31
Djibouti	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Egypt	90	27	120	50	136	39	10	3	3	1	0	0	359	120
Indonesia	162	134	35	31	2	2	0	0	1	1	0	0	200	168
Iraq	3	2	0	0	0	0	0	0	0	0	0	0	3	2
Lao People's Democratic Republic	2	2	0	0	0	0	0	0	0	0	0	0	2	2
Myanmar	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Nigeria	1	1	0	0	0	0	0	0	0	0	0	0	1	1
Pakistan	3	1	0	0	0	0	0	0	0	0	0	0	3	1
Thailand	25	17	0	0	0	0	0	0	0	0	0	0	25	17
Turkey	12	4	0	0	0	0	0	0	0	0	0	0	12	4
Viet Nam	112	57	15	7	0	0	0	0	0	0	0	0	127	64
Total	468	282	233	125	145	42	10	3	4	2	0	0	860	454

* 2003-2009 total figures. Breakdowns by year available on subsequent tables.

** 2010-2014 total figures. Breakdowns by year available on subsequent tables.

Total number of cases includes number of deaths.
WHO reports only laboratory cases.
All dates refer to onset of illness.

Source: WHO/GIP, data in HQ as of 2 March 2018



Flu pandemics

Pandemics Death Toll Since 1900



1918-1919: The Spanish Flu

U.S....	675,000+
Worldwide...	50,000,000+

1957-1958: The Asian Flu

U.S....	70,000+
Worldwide....	1-2,000,000

1968-1969: The Hong Kong Flu

U.S....	34,000+
Worldwide...	700,000+

2009-2010 Swine Flu

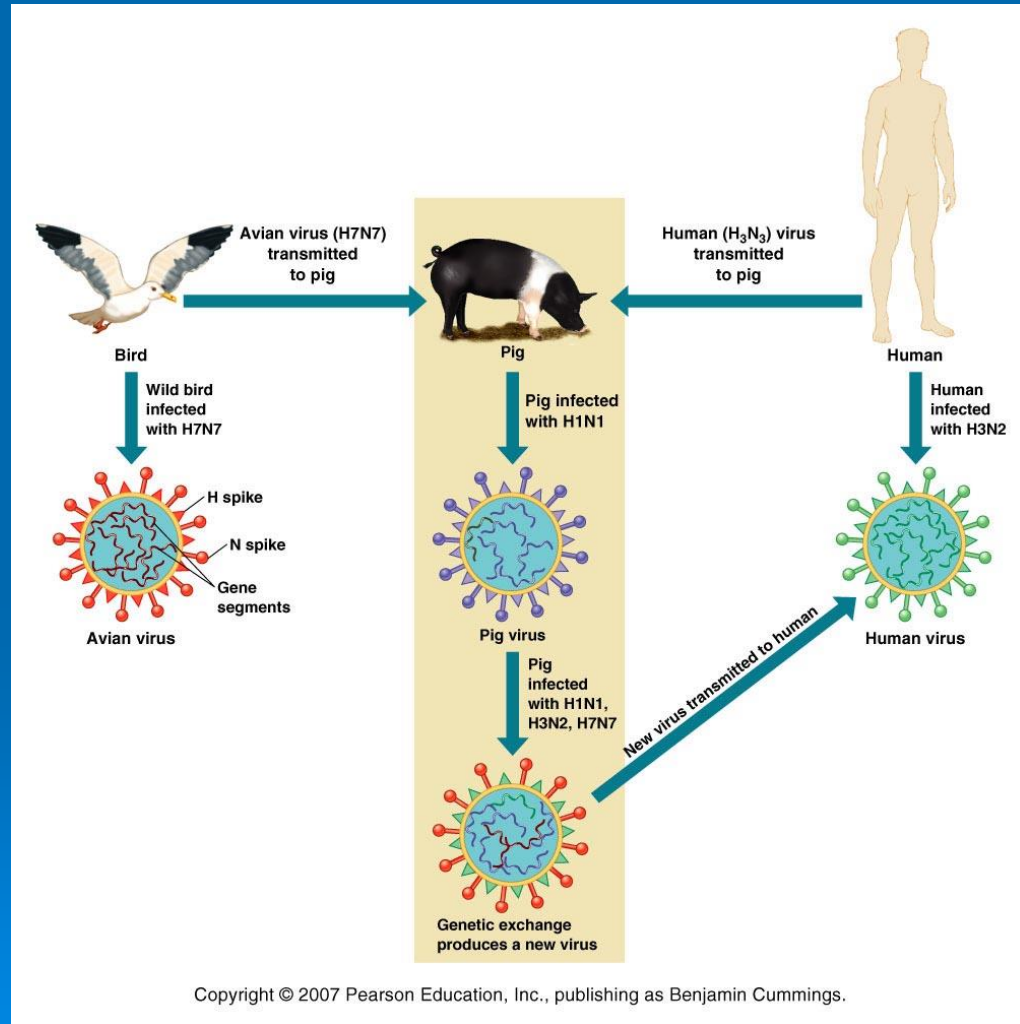
U.S.....	13,000+
Worldwide...	200,000+

How would a pandemic flu arise?

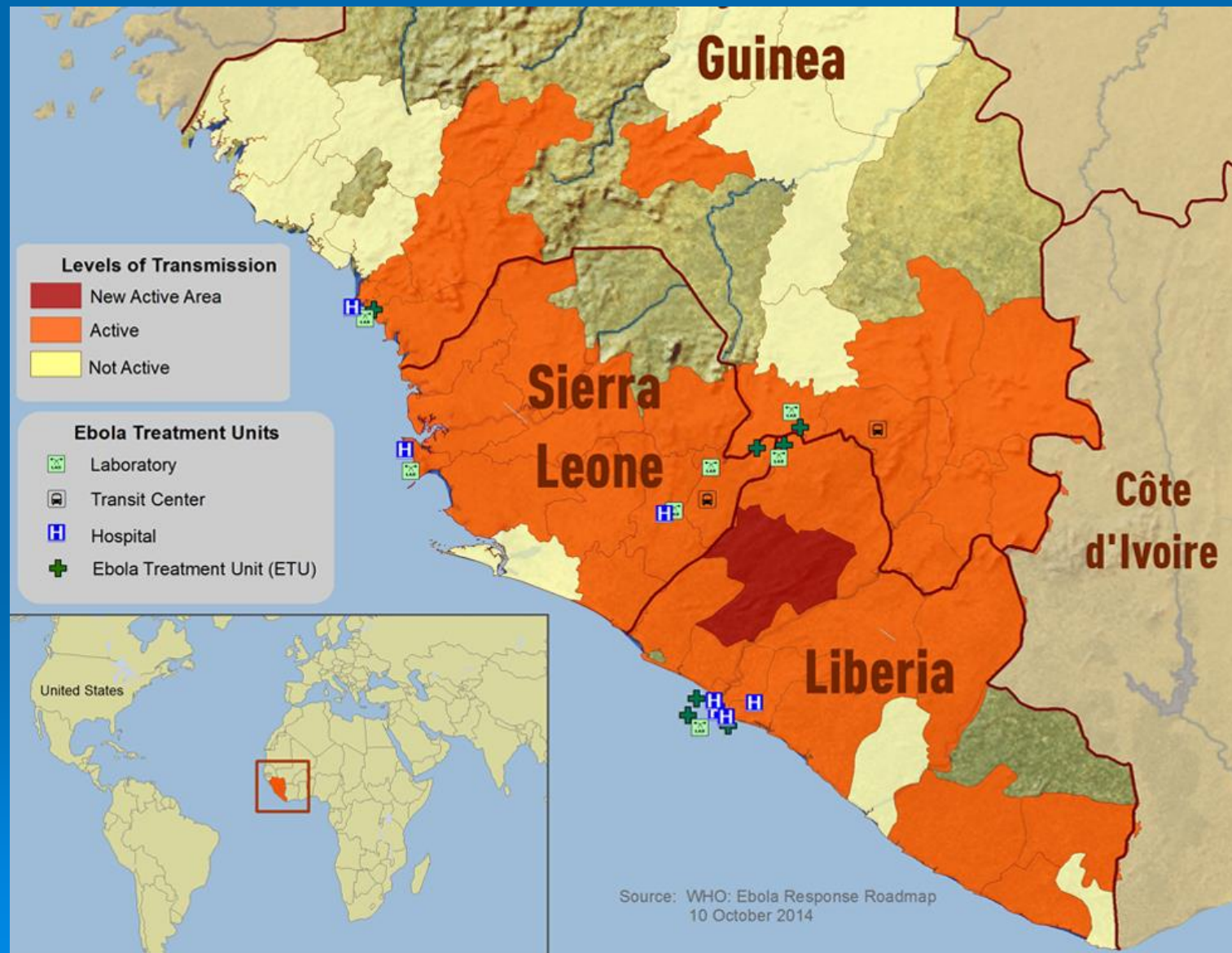
Animation of antigenic drift, shift and pandemics



Antigenic shift: the source of pandemic flu



Case study 2: Ebola



Ebola virus



- Family Filoviridae
- Negative sense RNA virus with **capsid** and envelope
- Cylindrical/ helical

Ebola sub-types

- Ebola virus disease is caused by four of five viruses in the genus Ebolavirus:
 - Bundibugyo virus (BDBV)
 - Sudan virus (SUDV)
 - Tai Forest virus (TAFV)
 - Ebola virus (EBOV, formerly Zaire Ebola virus)

History of Ebola outbreaks



E. Ervin, CDC/ASPB, 2014

EBOLAVIRUS OUTBREAKS BY SPECIES AND SIZE, 1976 - 2014

Species

- Zaire ebolavirus
- Sudan ebolavirus
- Tai Forest ebolavirus
- Bundibugyo ebolavirus

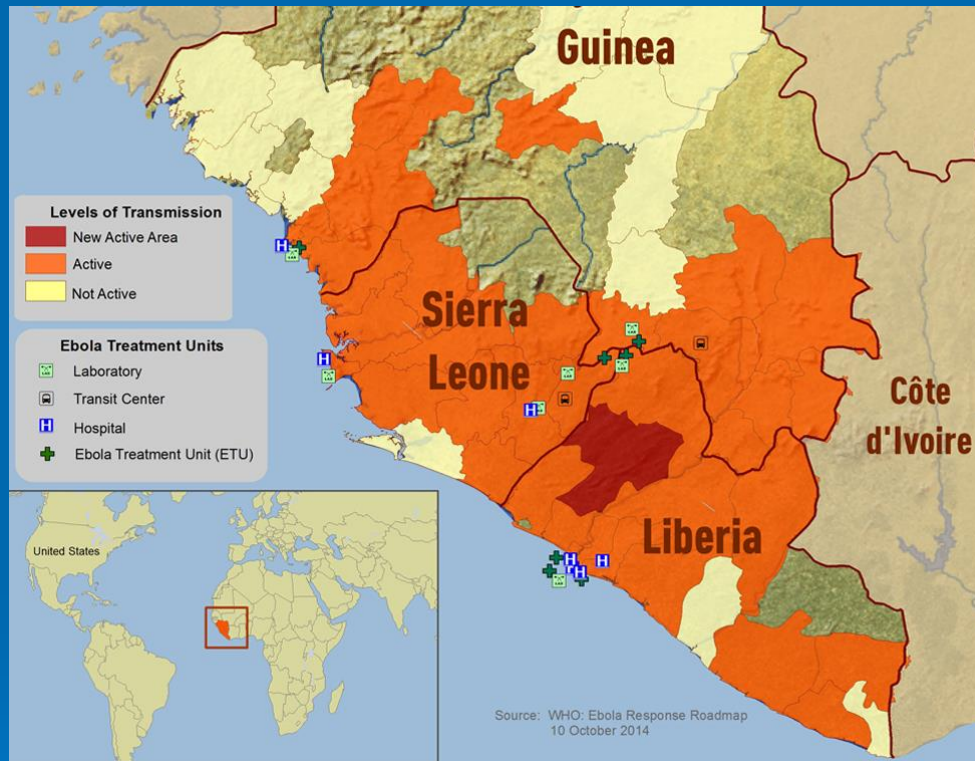
Number of Cases

- 1 - 10
- 11 - 100
- 101 - 300
- Greater than 300 reported cases



0 245 490 980 Miles

2014 outbreak totals (as of 10/14/14)



Location	Total	Deaths
Guinea	1519	862
Liberia	4249*	2484*
Sierra Leone	3410	1200
Senegal	1	0
Spain	1	0
Nigeria	20	8
US	3	1
Democratic Republic of the Congo (unrelated to ongoing West African Outbreak)	68	49
TOTALS:	9271	4604 (50%)

What is contact tracing?

Contact tracing can stop an Ebola outbreak in its tracks



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

Contact tracing is finding everyone who comes in direct contact with a sick Ebola patient. Contacts are watched for signs of illness for 21 days from the last day they came in contact with the Ebola patient. If the contact develops a fever or other Ebola symptoms, they are immediately isolated, tested, provided care, and the cycle starts again—all of the new patient's contacts are found and watched for 21 days. **Even one missed contact can keep the outbreak going.**



How does one characterize a disease?

Symptom: a change in body function that is felt by a patient (achy, tired, sore throat...)

Sign: a change in body that can be measured or observed (fever, rash, inflammation...)



Syndrome:
a specific group of signs and symptoms



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Syndrome: a specific group of signs and symptoms

Flu syndrome: ranges from respiratory illness, muscle aches, high fever, head ache, chills, fatigue, dry cough and runny/stuffy nose, acute pneumonia, severe diarrhea, encephalitis...

Ebola syndrome: characterized by fever, severe headache, muscle pain, weakness, diarrhea, vomiting, abdominal (stomach) pain, unexplained hemorrhage (bleeding or bruising)

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Stages of a disease

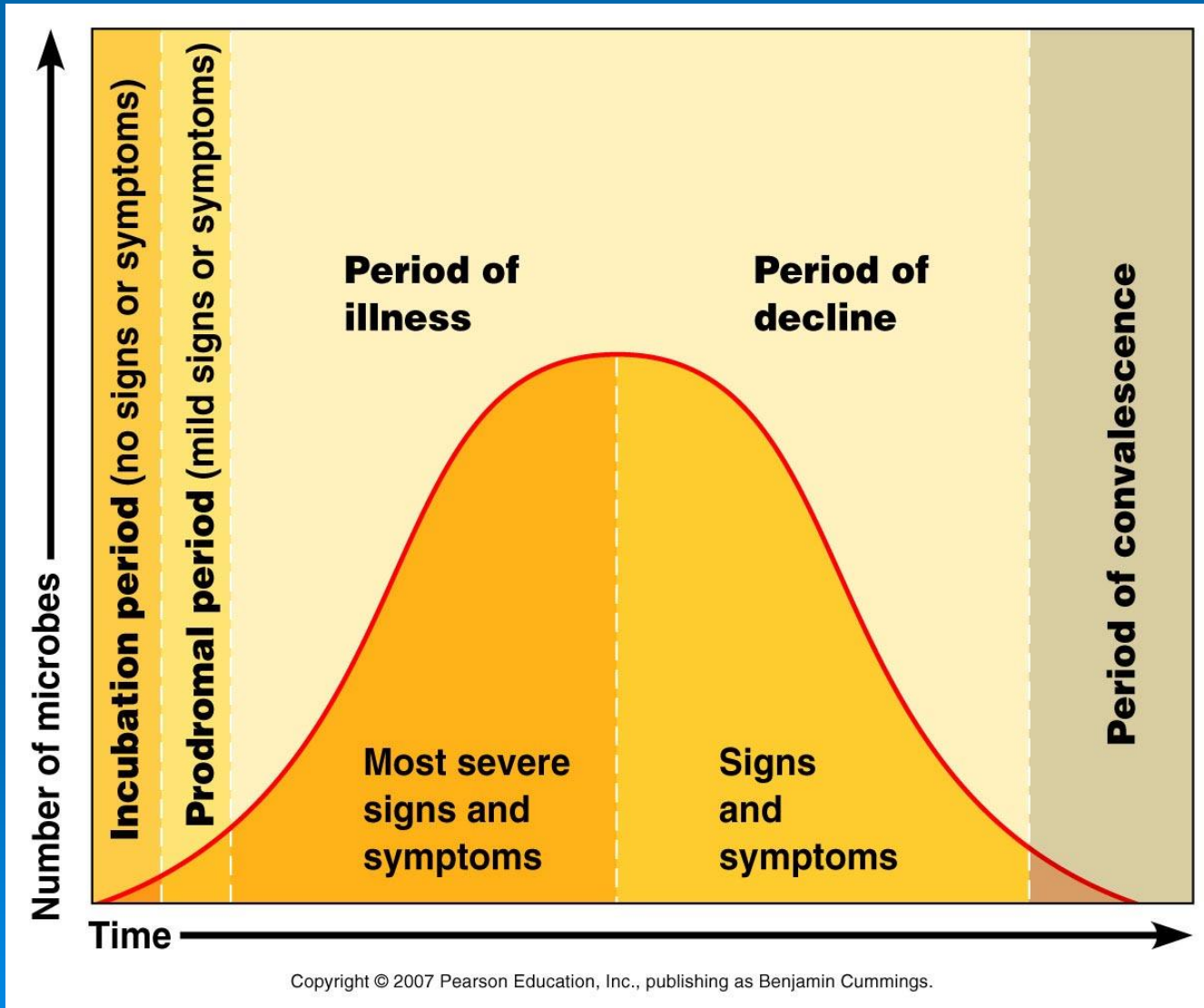
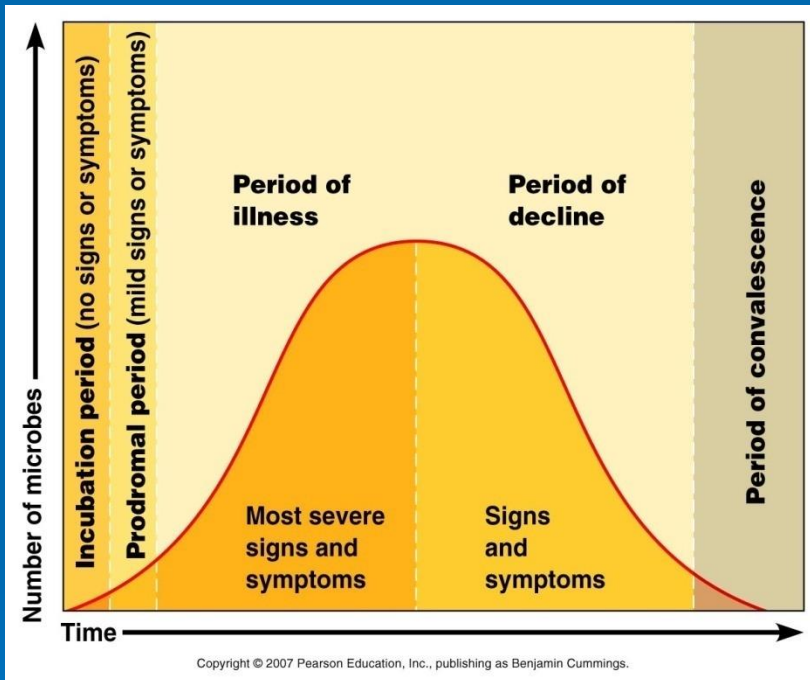


Figure 14.5

Disease treatment and prevention



Pre-illness period (flu):

Vaccines
(seasonal vaccines;
pandemic vaccine would be
1 year out)

Pre-illness period (ebola):

Vaccine
VSV-EBOV

Disease treatment and prevention

Post-infection (flu):

Post-infection (ebola):

- **Neuraminidase inhibitors:**
Tamiflu (oseltamivir), Relenza (zanamivir), Rapivab (peramivir)
- **Inhibition of viral attachment:**
Fludase (Ph II)
ParaDase (Ph II)
- **Antisense DNA interference:**
Neugene (Pre)

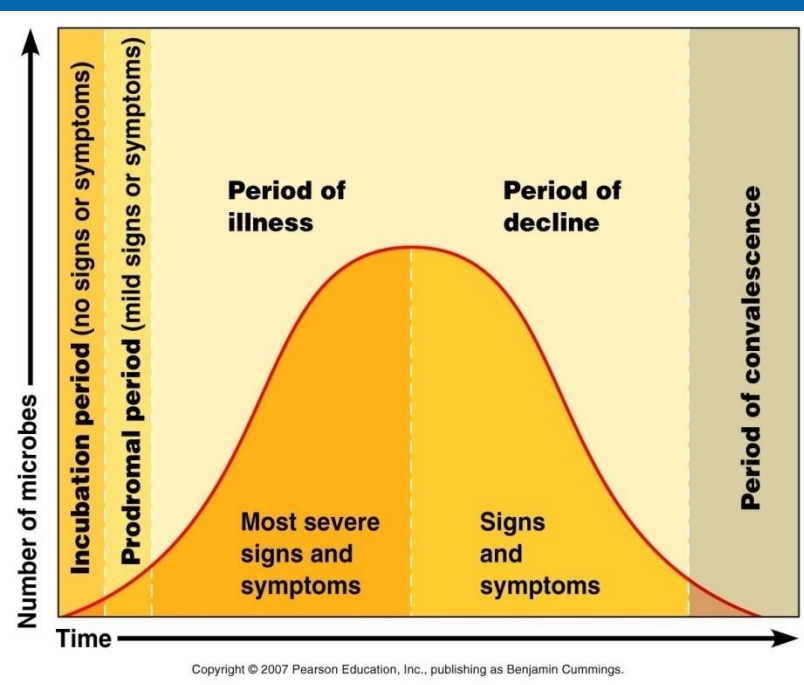
- **Nucleotide analog:**
Brincidofovir (currently under development against all 5 DNA viral families against humans)
- **Antisense DNA interference:**
Neugene (Pre)

www.chimerix.com

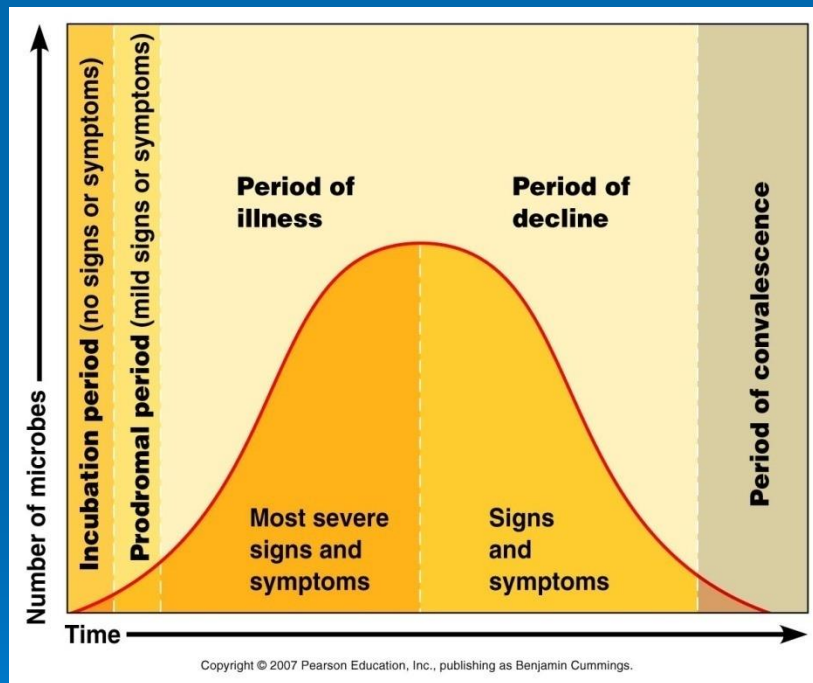
➤ **Supportive care:**

- Providing intravenous fluids (IV) and balancing electrolytes (body salts)
- Maintaining oxygen status and blood pressure
- Treating other infections if they occur

www.Pandemicflu.gov
www.Avianflu.gov



Disease treatment and prevention



All periods:

Prevent disease transmission!

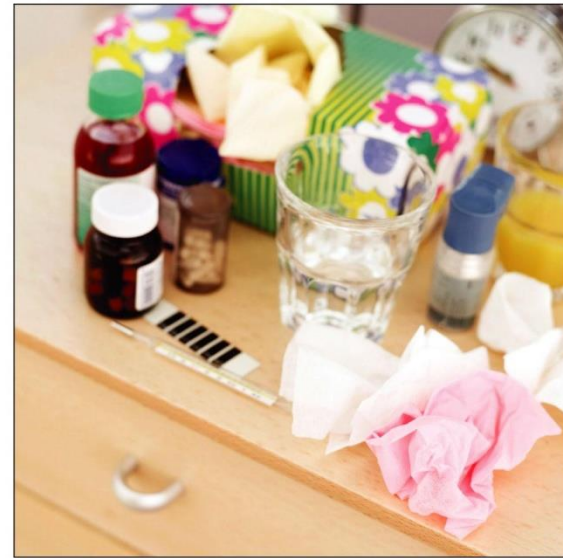
Contact transmission



(a)

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Direct



(c)

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Indirect



(d)

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Droplet

Vehicle transmission



(a)

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(b)

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Vector transmission



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Mechanical



Biological

Nosocomial infections

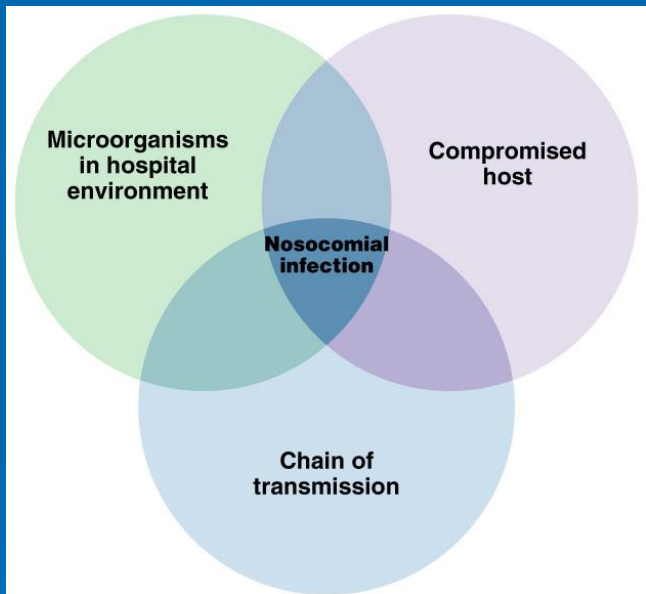


Figure 14.9

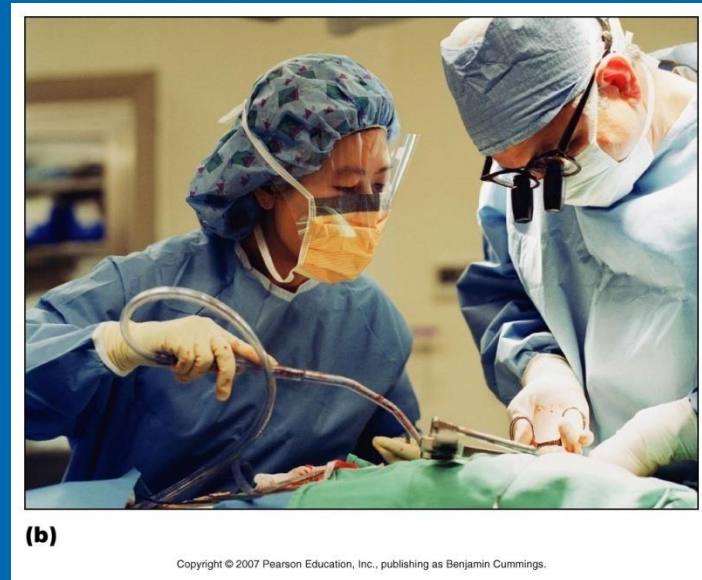


Figure 14.6b

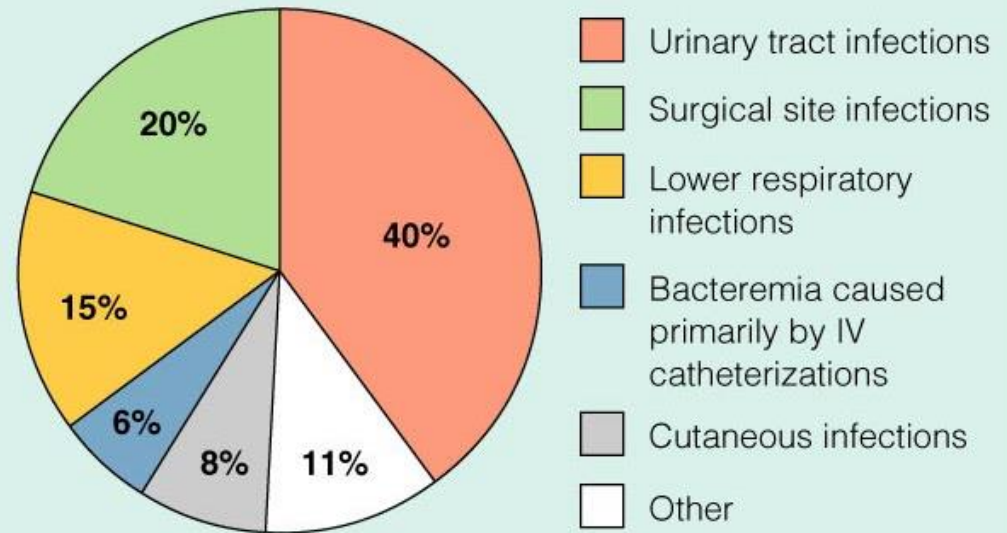


Table 14.5 (2 of 2)

**What is the transmission mode for
influenza and ebola?**



Facts *about*
Ebola
in the U.S.

You can't get Ebola
through air



You can't get Ebola
through water

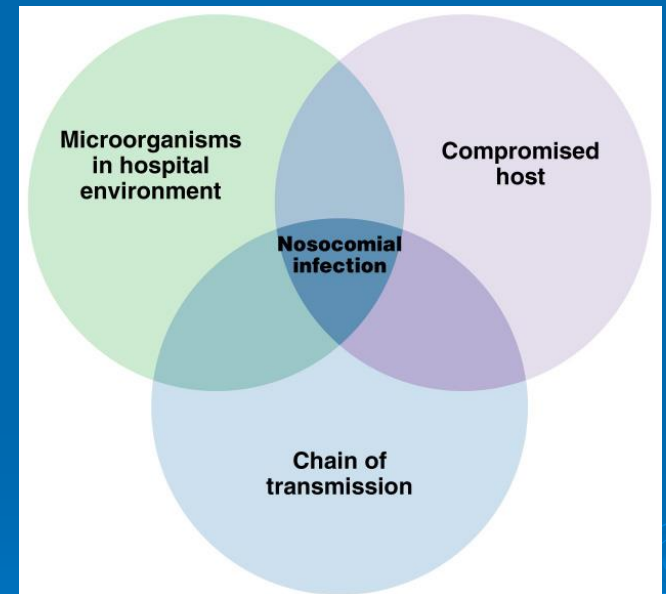


You can't get Ebola
through food



Ebola infections in the US

	Community acquired	Nosocomial
Thomas Duncan	√	
Nurse 1		√
Nurse 2		√



Independent study

1. Define the following terms, used to classify a disease by:

Transmission

1. Communicable disease
2. Contagious disease
3. Noncommunicable disease

Severity

1. Acute disease
2. Chronic disease
3. Subacute disease
4. Latent disease

Host involvement

1. Local infection
2. Systemic infection
3. Primary infection
4. Secondary infection