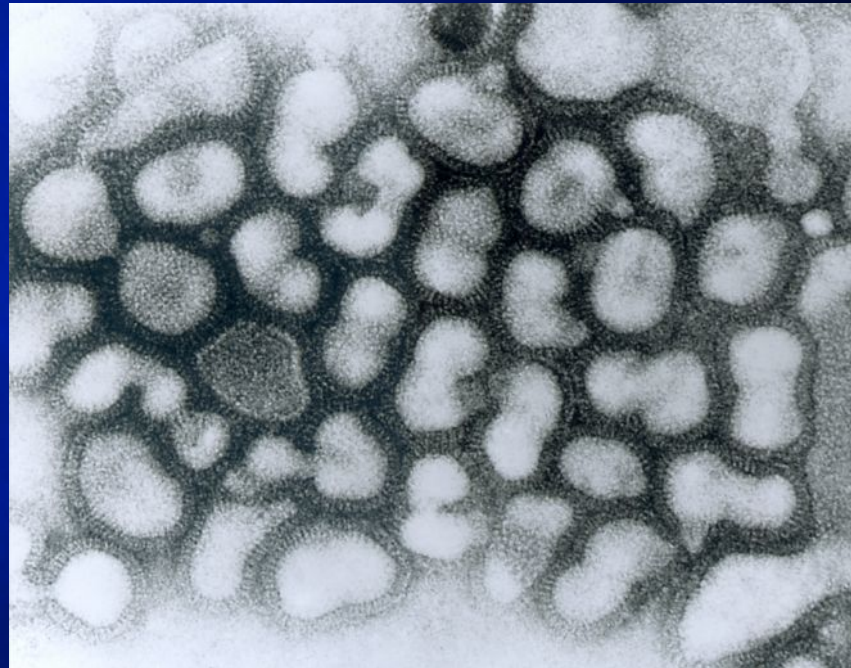


Avian and Pandemic Influenza: Infection Control Perspectives



Learning Objectives

- Discuss the principles of infection control
- Identify routes of transmission
- Describe standard precautions and transmission-based precautions
- Describe how to prevent transmission of avian or pandemic influenza

Presentation Outline

- Principles of infection control
- Transmission based precautions
- Infection control for influenza
 - Seasonal
 - Human infection with avian viruses
 - Pandemic

Principles of Infection Control

Disease Transmission

To cause disease, a pathogenic organism must:

Leave original host



Survive in transit



Be delivered to a susceptible host



Reach a susceptible part of the host



Escape host defenses

Multiply and cause tissue damage



Routes of Transmission

- **Contact**—Infections spread by direct or indirect contact with patients or the patient-care environment (e.g., shigellosis, MRSA, *C. difficile*)
- **Droplet**—Infections spread by large droplets generated by coughs, sneezes, etc. (e.g., *Neisseria meningitidis*, pertussis, influenza)
- **Airborne (droplet nuclei)**—Infections spread by particles that remain infectious while suspended in the air (TB, measles, varicella, variola)

Precautions to Prevent Transmission of Infectious Agents

- Standard Precautions

Apply to ALL patients

- Transmission-based Precautions

Used in addition to Standard Precautions

- Contact

- Droplet

- Airborne

Standard Precautions

- Hand hygiene
- Respiratory hygiene and cough etiquette
- Personal protective equipment (PPE)
Based on risk assessment to avoid contact with blood, body fluids, excretions, secretions
- Safe injection practices
- Environmental control
- Patient placement

Hand Hygiene: Cornerstone of Infection Control

- Use alcohol-based hand sanitizers or wash hands with soap and water
 - Wash hands if visibly soiled
- Steps
 - Wet hands with water, apply soap, rub hands together for at least 15 seconds
 - Rinse with clean water
 - Dry with disposable towel or air dry
 - Use towel to turn off faucet



Hand Hygiene Prevents Respiratory Infections

Among Navy recruits (Am J Prev Med 2001;21:79-83)

- Handwashing program implemented at a Navy training center
- 45% reduction in outpatient visits for respiratory illness
- Frequent hand washers had fewer respiratory illnesses

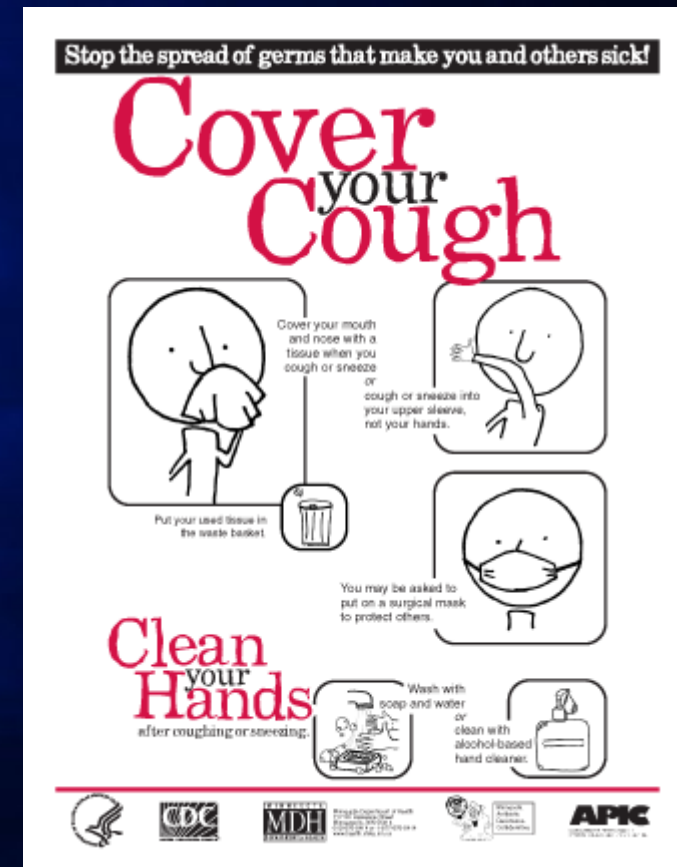
Among students in residence halls (Am J Infect Control 2003;31:364-70)

- College dorms were randomized to having alcohol hand rubs in various locations vs. not
- Hand rub groups had:
 - 15%-40% reduction in respiratory illnesses
 - 43% fewer sick days

Respiratory Hygiene/Cough Etiquette

Educate persons with respiratory symptoms:

- Cover cough/sneezes
- Use tissues and dispose in waste containers
- Perform hand hygiene after contact with respiratory secretions
- Wear a surgical mask if tolerated, or distance oneself > 3 ft from others



PPE for Standard Precautions

- **Gloves** – when touching blood, body fluids, secretions, excretions, mucous membranes, non-intact skin, contaminated items
- **Gowns** – during procedures or patient-care activities when anticipating contact with blood, body fluids, secretions, excretions
- **Mask, eye protection (goggles or face shield)** – during procedures or patient care activities likely to generate splashes or sprays

Review Question #1

What are the routes of transmission?

Answer: Contact, Droplet, Airborne

Review Question #2

What are the standard precautions?

Answer:

Hand hygiene

Respiratory hygiene and cough etiquette

PPE

Safe injection practices

Environmental control

Patient placement

Transmission-based Precautions

Contact Precautions

- Patient placement
 - Single room or cohort with patients with same infection
 - If neither is possible, ensure patients are separated by at least 3 ft (1 m)
Change PPE and perform hand hygiene between patient contacts regardless of whether one or both are on contact precautions
- PPE - Gown and gloves
 - Don upon entry to room
 - Remove and discard before leaving the room
 - Perform hand hygiene after removal
- Environmental measures/patient care equipment
 - Clean patient room daily using a hospital disinfectant, (bed rails, bedside tables, lavatory surfaces, blood pressure cuff, equipment surfaces).
 - Use dedicated equipment if possible (e.g., stethoscopes, bp cuffs)

Droplet Precautions

- Patient placement
 - Single room or cohort with patients with same infection
 - If neither is possible, ensure patients are separated by at least 3 ft (1 meter)
 - Surgical mask on patient when outside of patient room
 - Negative pressure or airborne isolation rooms *not* required
- PPE – surgical mask
 - Don upon entry into room
- Standard precautions: Eye protection (goggles or face shield) if needed

Distance at Risk for Droplet Transmission

- Historically < 3 feet (1 m)
- Based on data of epidemic meningococcal disease in a classroom

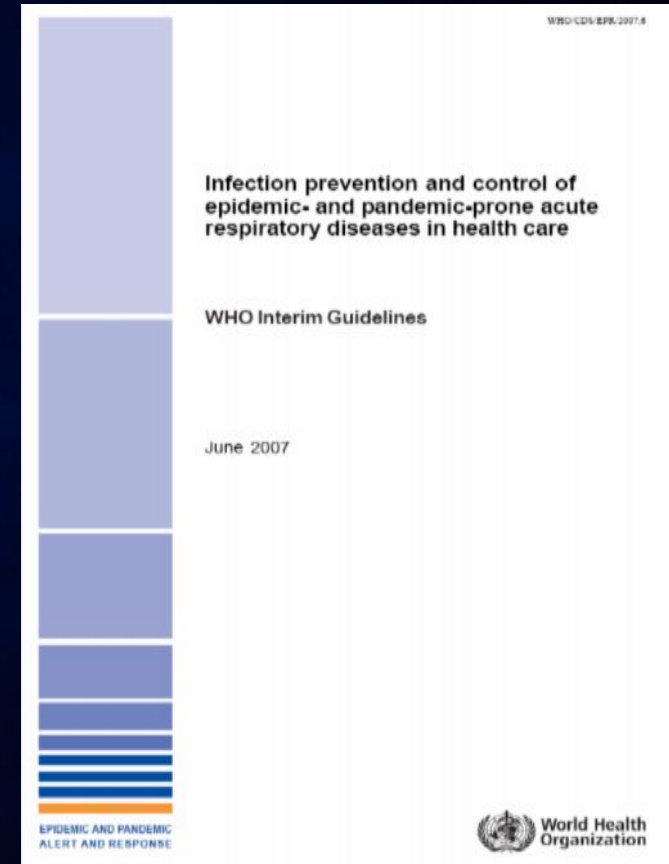
Distance between chairs	Percentage of carriers or cases
<102 cm	27% (20/73)*
>102 cm	7% (5/71)* *P=0.0001

New Engl J Med 1982;307:1255-7

- Source, pathogen, and environmental factors may affect distance
- Prudent to don mask upon room entry

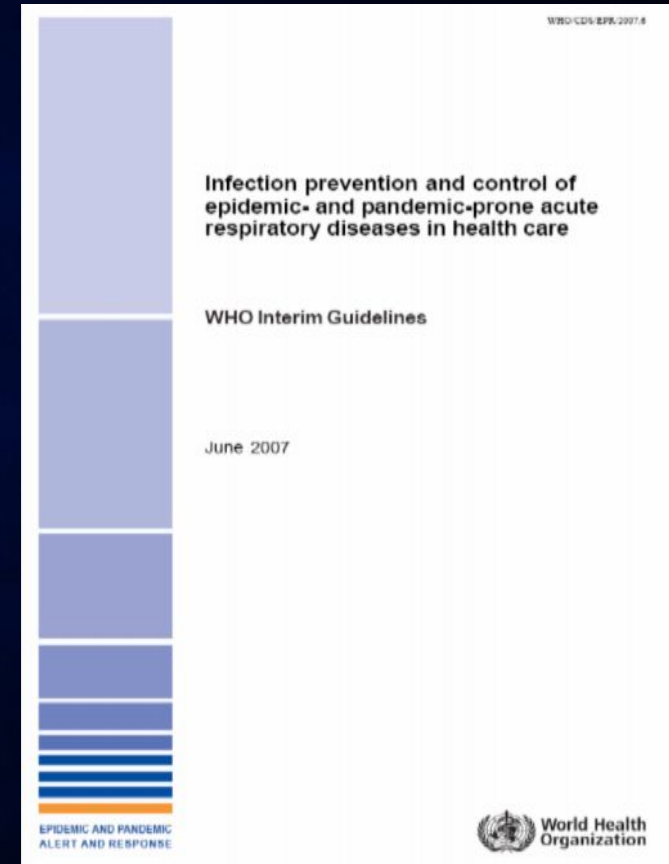
Airborne Isolation – WHO Interim Guidelines for Epidemic and Pandemic-Prone Diseases, 2007

- Emphasis on resource poor settings
- Scope
 - Epidemic- and pandemic-prone diseases
 - International Health Regulation (2005)
 - SARS
 - New influenza subtype
 - New organisms
 - Plague
 - MDR TB



Airborne Isolation – WHO Interim Guidelines for Epidemic and Pandemic-Prone Diseases, 2007

- Airborne precaution room
 - Ventilation rate ≥ 12 exchanges/hour
 - Mechanically or naturally ventilated
 - Controlled airflow direction
- Adequately ventilated single room
 - Ventilation rate ≥ 12 exchanges/hour
 - Mechanically or naturally ventilated
- Cohorting when necessary



Airborne Isolation--CDC Guidelines for Isolation Precautions, 2007

- Emphasis on United States
- Scope: New pathogens
 - SARS
 - Avian influenza in humans
 - Evolving known pathogens
 - Gene Therapy
 - Bioweapons

Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings 2007

Jane D. Siegel, MD; Emily Rhinehart, RN MPH CIC; Marguerite Jackson, PhD; Linda Chiarello, RN MS; the Healthcare Infection Control Practices Advisory Committee

Acknowledgement: The authors and HICPAC gratefully acknowledge Dr. Larry Strausbaugh for his many contributions and valued guidance in the preparation of this guideline.

Suggested citation: Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, June 2007
<http://www.cdc.gov/nceid/od/ohsp/pdf/isolation2007.pdf>



Airborne Isolation – CDC Guidelines for Isolation Precautions, 2007

- Airborne infection isolation room (AIIR)*
 - Monitored negative air pressure in relation to corridor
 - 6-12 air exchanges/hour
 - Air exhausted outside away from people or recirculated by HEPA filter
 - Surgical mask on patient when not in AIIR (limit movement)
- PPE – filtering facepiece respirator
 - For all personnel inside negative pressure room

● Natural ventilation alone or combined with mechanical ventilation may be a practical alternative in some settings.

Summary of Precautions

	Hand Hygiene	Private Room	Gloves	Gown	Mask/Respirator	Eye Protection
Standard	Yes	PRN	PRN	PRN	PRN	PRN
Droplet	Yes	Yes*	PRN	PRN	Mask	PRN
Contact	Yes	Yes*	Yes	Yes	PRN	PRN
Airborne	Yes	AIIR/ Airborne Precaution Room*	PRN	PRN	Respirator	PRN

*When possible; cohort if not possible in resource-poor settings

PRN = as needed

Transmission of Influenza

- Transmitted person-to-person through close contact
- Droplet, contact, and transmission via tiny particles at short range may occur
- Insufficient data to determine relative contribution of each mode
- Limited data with varying interpretation
- Droplet likely most important (via coughs and sneezes)

Airborne Transmission of Influenza?

- Several studies suggest at least some component of airborne transmission
- However, more research is needed to quantify the several modes of transmission

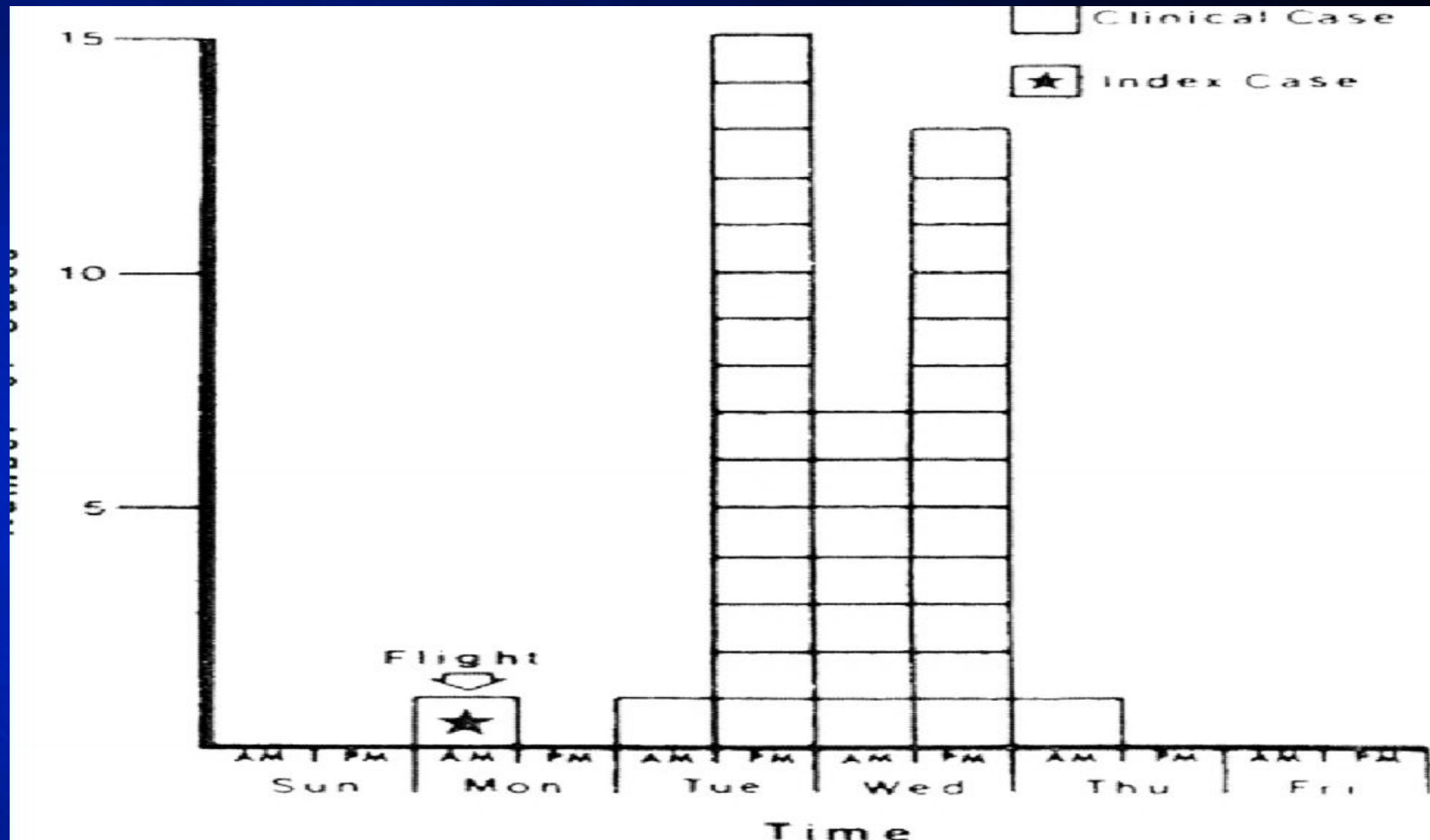
Animal Studies

- Mice got flu 24 hours after the virus was aerosolized into a room - not consistent with droplets that fall out quickly. (Proc Soc Exp Biol 1943;53:205-6)
- Infectious particles of <10 um have been recovered around infected mice using air sampling. (J Exp Med 1967;125:479-88, Am J Public Health Nations Health 1968;58:2092-6)
- Relevance of these studies to humans is unknown

Influenza Transmission on an Airplane

- A symptomatic passenger with drifted H3N2 influenza boarded a flight and sat near lavatory and buffet area at the rear of plane
- Plane delayed for 4.5 hours and ventilation off for 2-3 hours
- 72% of the 49 passengers and 5 crew developed flu-like illness within 72 hours of the flight. 91% tested positive for influenza

Cases of influenza-like-illness in passengers



Other Data on Airborne Transmission

- Observational study during 1957-58 pandemic
- 2% of patients in a building with UV lights in the room (to kill airborne microbes) got influenza
- 19% of patients in another building without UV lights got influenza

Proposed Classification Scheme for Airborne Transmission

- Effect of time, distance, environmental factors
- Airborne transmission
 - Obligate
 - Preferential
 - Opportunistic
- Prevention strategies for emerging infections causing severe disease may reflect the possibility of airborne transmission until better defined

Theoretical Contact Transmission Potential

- Influenza virus survival on surfaces at room temperature and moderate humidity:
 - Steel and plastic: 24-48 hours
 - Cloth and tissues: 8-12 hours
- Transfer to hands possible after inoculation of:
 - Steel: up to 24 hrs
 - Tissue: up to 15 minutes
 - Reproduction of infection has not been observed
- Enveloped virus - inactivated by detergents, alcohol, bleach, household disinfectants

Review Question #3

Which precaution is always practiced in all of the transmission based precautions?

- a. Patient placement
- b. Use of Mask
- c. Hand hygiene
- d. Eye protection

Answer:

c. Hand hygiene is always practiced for all transmission-based precautions (as well as standard precautions)

Review Question #4

What is the route of transmission of seasonal influenza?

- a. Droplet transmission
- b. Airborne transmission may be possible
- c. Contact transmission may be possible
- d. All of the above

Answer: d. All of the above

Infection Control for Influenza

Seasonal Influenza

Seasonal Influenza: Droplet Precautions

- Generally 5-7 days from symptom onset in adults with normal immune systems
- Droplet precautions should be maintained for 1-2 weeks in children less than 2 years old
- Gown and gloves according to Standard Precautions may be especially important in pediatric settings

Seasonal Influenza Infection Control

- House patients in single patient room when available
- Cohorting is an acceptable option (avoid placement with high-risk patients)
- Symptomatic patients should wear a surgical mask when outside room, if tolerated

Infection Control for Influenza

Human Infection with Avian Viruses

CDC Recommendations for Influenza A (H5N1)

- Standard Precautions –*hand hygiene!*
- Contact Precautions –*gloves and gown, dedicated equipment*
- Droplet Precautions –*eye protection within 6 feet of the patient*
- Airborne Precautions
 - *Place the patient in an airborne isolation room*
 - *Use a fit-tested respirator, at least as protective as a NIOSH-approved N-95 filtering facepiece respirator*

WHO Recommendations for Influenza A (H5N1)

- Standard Precautions
- Contact Precautions
- Droplet Precautions
 - Eye Protection if splashes anticipated and for aerosol-generating procedures
 - Medical mask for routine patient care
 - Single room (not routine use of AIIR)
- * For Aerosol-generating procedures:
 - Wear a particulate respirator at least as protective as NIOSH-certified N95, instead of medical mask

Comparison of CDC & WHO: Known or Suspected Infection with Avian Influenza Viruses

	Hand Hygiene	Gloves	Gown	Eye Protection	Mask/ Respirator	Patient Placement
CDC	YES	YES	YES	YES	Particulate Respirator	AIIR (negative pressure)
WHO	YES	YES	YES	YES	Surgical Mask (respirator for aerosol-generating procedures)	Airborne precaution room or adequately ventilated single room; cohort if unavailable

CDC and WHO Guidelines for Avian Influenza

Both Recognize Droplet Transmission

- WHO emphasizes what is achievable in resource-poor settings
- CDC recommends respirator use and AIIR for routine patient care
 - However, no evidence of airborne transmission of H5N1
- CDC guidelines reflect a precautionary approach
 - Current uncertainty about modes of transmission
 - Risk of serious disease and mortality
 - Potential to be transmitted more easily among people

Infection Control for Influenza

Pandemic

Infection Control Challenges for Pandemic Influenza

- We don't know which virus will cause a pandemic
- We don't know exactly how that virus will be transmitted
- We won't have a vaccine initially
- Mortality might be high
- There may be limited supplies for infection control (masks, respirators) and antivirals

Recommendations are likely to evolve

Healthcare Facility Infection Control for Pandemic Influenza

- Conduct hospital surveillance
- Educate staff, patients, family, visitors
- Develop triage procedures for clinical evaluation and admission policies
 - Segregated waiting areas
 - Enforce respiratory hygiene/cough etiquette
 - Patient placement and cohorting

Healthcare Facility Infection Control for Pandemic Influenza, *cont.*

- Limit facility access
- Establish occupational health plan for management of sick healthcare workers, cohorting of staff
- Use of vaccines and antivirals as indicated by public health officials

CDC Recommendations for Reducing Worker Exposure During Pandemic Influenza

- Use of particulate respirators (N95 or higher) for direct care of patients with confirmed or suspected pandemic influenza
- Reduce worker exposure and minimize demand for respirators
 - Establish specific wards
 - Assign dedicated staff (healthcare, housekeeping, etc)
 - Dedicate entrances and passageways
- Precautionary rather than evidence-based, not always achievable in international settings

CDC Guidance Until More is Known

“Extra precautions might be especially prudent during the initial stages of a pandemic, when viral transmission and virulence characteristics are uncertain, and medical countermeasures, such as vaccine and antivirals, may not be available.”

Interim guidance on planning for the use of surgical masks and respirators in health care settings during an influenza pandemic, Oct. 2006

Prioritization of Respirator Use During a Pandemic

- N-95 or higher respirator recommended for activities with high likelihood of generating aerosols in patients with confirmed/suspected pandemic flu:
 - Intubation, suctioning, nebulizer treatment, bronchoscopy
 - Resuscitation
 - Direct care for patients with influenza-associated pneumonia
- Contact precautions and eye protection also recommended by CDC

CDC Recommendation for Negative Pressure Rooms

- Already in very short supply
- Little data to suggest transmission of influenza over long distances
- Recommendation is more conservative than WHO guidance in an effort to protect against possible short-range inhalational exposures, *where resources allow*
- Would not be recommended for routine patient care in an established pandemic
- If possible, should be used when performing high-risk aerosol-generating procedures

Alternatives to N95

In the event of actual or anticipated shortages

- Other NIOSH certified N-, R-, or P- class respirators
- Re-usable elastomeric respirators
 - Must be decontaminated after each use
- Powered air purifying respirators (PAPRs)
 - Training is required

CDC Recommendations for Pandemic Influenza

- Standard Precautions - *hand hygiene!*
- Contact Precautions
 - Gloves and gown for all patient contact
 - Dedicated equipment
- Eye Protection - *wear when within 6 feet of the patient*
- Airborne Precautions
 - Fit-tested respirator, at least as protective as a NIOSH-approved N-95 filtering facepiece respirator
 - Airborne isolation room not used for routine patient care in an established pandemic

WHO Recommendations for Pandemic Influenza

- Standard Precautions
- Eye Protection
 - Wear if splashes anticipated and for aerosol-generating procedures
- Droplet Precautions
 - Medical mask for routine patient care
 - Single room (not routine use of AIIR)/cohorting
- * For Aerosol-generating procedures:
 - Wear a particulate respirator at least as protective as NIOSH-certified N95, instead of medical mask

Comparison of CDC & WHO: Pandemic Influenza

	Hand Hygiene	Gloves	Gown	Eye Protection	Mask/ Respirator	Patient Placement
						AllIR not routinely used
CDC	YES	YES	YES	YES	Particulate Respirator	Single room, adequately ventilated; cohort if unavailable
WHO	YES	PRN*	PRN*	PRN*	Surgical Mask (respirator for aerosol-generating procedures)	Single room, adequately ventilated; cohort if unavailable

*PRN – as needed based on standard precautions

Review Question #5

Which set of infection control recommendations are more conservative: WHO or CDC?

Answer: CDC



Prevention is Primary

Glossary

- Pathogenic
- Contact
- Droplet
- Airborne (droplet nuclei)
- Standard Precautions
- Transmission-based Precautions
- Contact Precautions

- AIIR
- Obligate airborne transmission
- Preferential airborne transmission
- Opportunistic airborne transmission

References and Resources

- CDC isolation guidelines at:
<http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Isolation2007.pdf>
- Hand hygiene Guidelines: <http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf>
- Interim Recommendations for Infection Control in Health-Care Facilities Caring for Patients with Known or Suspected Avian Influenza.
<http://www.cdc.gov/flu/avian/professional/infect-control.htm>
- Infection prevention and control of epidemic- and pandemic-prone acute respiratory diseases in health care. WHO Interim Guidelines, 2007.
http://www.who.int/csr/resources/publications/WHO_CD_EPR_2007_6/en/index.htm
- HHS Pandemic Influenza Plan, supplement 3
<http://www.hhs.gov/pandemicflu/plan/sup3.html>
- Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic
<http://www.pandemicflu.gov/plan/healthcare/maskguidancehc.html>