

## **Attachment N: Infection Control Recommendations**

## **Minnesota Department of Health Infection Control Recommendations for Avian and Pandemic Influenza – April 2006**

Current U.S. Infection Control Recommendations for Avian and Pandemic Influenza

Centers for Disease Control and Prevention

For avian influenza, the current CDC guidance recommends airborne and contact precautions, plus eye protection, in addition to standard precautions.\* It is noted on the CDC website that this guidance is under revision and will be reposted when final. This guidance can be accessed at: <http://www.cdc.gov/flu/avian/professional/infect-control.htm>

### **Occupational Safety and Health Administration**

For avian influenza, OSHA recommends airborne and contact precautions, plus eye protection, in addition to standard precautions. This guidance can be accessed at: <http://www.osha.gov/dsg/guidance/avian-flu.html>

### **Health and Human Services**

For pandemic influenza, the HHS Pandemic Influenza Plan recommends droplet precautions (use of surgical or procedure mask when within 3 feet of patient), in addition to standard precautions. This guidance can be accessed at: <http://www.hhs.gov/pandemicflu/plan/sup4.html#modes>

However, airborne and contact precautions, plus eye protection are recommended for:

- aerosol-generating procedures;
- pandemic influenza exhibiting increased transmissibility;
- the initial stages of an outbreak of an emerging or novel strain of influenza; and
- as determined by other factors such as vaccination/immune status of personnel and availability of antivirals.

Minnesota Department of Health recommendations

The Minnesota Department of Health recommends airborne† and contact precautions, plus eye protection, in addition to standard precautions (“full barrier precautions”) for all known and suspect avian and pandemic influenza patients. Personal protective equipment (PPE) for full barrier precautions,‡ includes:

- respirator at least as protective as a NIOSH-certified N95 respirator;§
- gown;
- gloves; and
- eye protection (faceshield/goggles)

In making this recommendation, MDH acknowledges that supplies of PPE necessary to implement full barrier precautions, particularly respirators, may be limited during a pandemic. The Institute of Medicine is currently formulating recommendations for the reuse of disposable particulate respirators. MDH will provide guidance on prioritization and possible reuse of PPE when supplies are limited.

\*Detailed information about standard, droplet, contact, and airborne precautions can be accessed at: [http://www.cdc.gov/ncidod/dhqp/gl\\_isolation.html](http://www.cdc.gov/ncidod/dhqp/gl_isolation.html)

†Airborne precautions include patient placement in a airborne infection isolation room, if available. To access more information about this topic, see:

[http://www.cdc.gov/ncidod/dhqp/gl\\_enviroinfection.html](http://www.cdc.gov/ncidod/dhqp/gl_enviroinfection.html)

‡Full barrier PPE posters are available on the MDH website at:

<http://www.health.state.mn.us/divs/idepc/dtopics/infectioncontrol/ppe/>

§Respirators should be used in the context of a complete respiratory protection program as required by OSHA. This includes training, fit-testing, and fit-checking to ensure appropriate respirator selection and use. To be effective, respirators must seal properly to the wearer's face. Detailed information on respiratory protection programs is available at:

<http://www.osha.gov/SLTC/etools/respiratory/> and

<http://www.health.state.mn.us/divs/idepc/dtopics/infectioncontrol/rpp/index.html>

#### Rationale for MDH recommendations

##### Infectious respiratory aerosols

- Coughing, sneezing, and talking can generate respiratory aerosols of varying sizes.<sup>1</sup>
- A cough can contain up to 100,000 particles and a sneeze can generate 20 times more particles than a cough.<sup>2</sup>
- The greater the force and pressure involved in aerosol generation, the smaller the expelled particles will be.
- The smallest particles evaporate quickly and the dried residues that remain (droplet nuclei), are so small that they can be carried on air currents a considerable distance from the source and remain suspended in the air for substantial lengths of time and infect people at some distance from the source.<sup>1</sup>
- Particle size determines where particles are deposited in the respiratory tract of the host. Where the particles are deposited can determine whether or not infection will occur, e.g., smaller particles may be deposited lower in the respiratory tract than larger particles.<sup>3</sup>

##### Current CDC infection control recommendations for infectious respiratory diseases

- Infectious particles are typically measured in microns; there are 25,400 microns in one inch.
- Infection control guidelines cite a particle size of 5 microns ( $\mu\text{m}$ ) as a break point that distinguishes between diseases spread by “droplet transmission” (particles  $\geq 5 \mu\text{m}$ ) and diseases spread by “airborne transmission” (particles  $< 5 \mu\text{m}$ ).<sup>4</sup>
- Larger droplets are thought to typically travel no more than 3 feet and small particle aerosols have the ability to travel longer distances.
- Larger droplets are thought to be deposited mainly in the mucous membranes of the nose, eyes, and mouth; small particle aerosols are more likely to be deposited in the lower respiratory tract.
- Communicable diseases are classified by their presumed route of transmission and infection control recommendations are based on this classification.
- Current guidelines recommend that health care workers wear a surgical mask when working within 3 feet of patients with an infection spread via the droplet route and that they wear a respirator when in the same room with a patient with an infection spread by the airborne route.

##### Transmission of respiratory aerosols

- Existing infection control recommendations do not reflect current knowledge of respiratory aerosols.

- There is no clear delineation between droplet and airborne transmission and the distances that particles travel can vary (e.g., particles  $\geq 5 \mu\text{m}$  can travel more than three feet).<sup>5</sup>
- The length of time particles remain airborne varies and is determined by particle size, settling velocity, and airflow in the area.
- There is no predictable size for droplet nuclei; final size depends on the nature of the fluid that contained the organism, the initial size of the aerosol, environmental conditions (e.g., temperature, relative humidity, airflow), the time spent airborne, and the size of the organism within a droplet.
- Using current infection control terminology, there is evidence that influenza is transmitted between humans via small particle aerosols (airborne transmission), larger droplets (droplet transmission), as well as by direct and indirect contact (contact transmission).<sup>3, 4, 6, 7</sup>
- The relative importance of each route of transmission is unclear.

### **Evidence for airborne transmission of influenza**

The explosive spread of influenza after introduction into a community has long suggested the possibility of airborne transmission.

- Observational evidence of airborne transmission of influenza in humans:
  - Tuberculosis patients housed in a building with ceiling ultraviolet radiation (which is known inactivate influenza virus and to reduce airborne disease transmission)<sup>8</sup> during the 1957-58 pandemic were less likely to become infected with influenza than tuberculosis patients housed in a building without ultraviolet radiation.<sup>9</sup>
  - In 1979, aircraft passengers, including a passenger who became acutely ill with influenza within 15 minutes of boarding the plane, were detained on a runway for 4.5 hours during which time the ventilation system was turned off for 2-3 hours. The ill passenger stayed on the plane the entire time and the other passengers and crew were free to come and go. Within 72 hours, 72% of the passengers and crew subsequently developed influenza-like-illness (91% with confirmed influenza). The risk of illness was dependent on the amount of time spent on board.<sup>10</sup>
- Experimental evidence of airborne transmission of influenza in humans:
  - The infectious dose of influenza is 10-100 fold lower when small particle aerosols are delivered to the lower respiratory tract (mimicking airborne transmission), rather than when delivered as intranasal drops (mimicking droplet transmission).<sup>11</sup>
  - Influenza virus administered intranasally typically does not cause cough or lower respiratory tract symptoms, whereas early onset of cough and protracted cough are associated with natural influenza infection.<sup>12</sup>
- Experimental evidence of airborne transmission of influenza in animals:
  - Infected and uninfected mice were placed in a closed chamber in which the airflow could be manipulated. As the rate of airflow increased, the rate of influenza transmission decreased proportionately.
  - In a setting of constant airflow, some uninfected mice were separated from infected mice by a screen while other uninfected mice were on the same side of the screen as the infected mice. The infection rates in both groups of initially uninfected mice were similar.<sup>13</sup>
  - Uninfected mice placed in an unventilated room with constantly agitated air and low relative humidity became infected with influenza as late as 24 hours after virus was aerosolized into the room. As relative humidity levels were increased, the virus was infective for shorter periods of time. The possibility of reaerosolisation of influenza virus is supported by increased infectivity of the air after the floor of the room was vigorously swept.<sup>14</sup>

- A highly transmissible influenza strain could be recovered easily from the air surrounding infected mice during the period when they were most infectious, but there was no recoverable virus in the air surrounding mice infected with a less transmissible influenza strain during the same period.<sup>15</sup>
- Efficient transmission of influenza from infected to uninfected ferrets was demonstrated whether or not the ferrets were separated by a long straight air duct or by air ducts in the shape of an “s” or a “u.”<sup>16</sup>

### **Influenza transmission in health care facilities**

The data on influenza transmission in health care facilities is observational and limited.

- During the 1957-1958 influenza pandemic, an acutely ill patient was admitted to a four-person hospital room with no precautions. Subsequently, roommates, health care workers, and other ward patients became ill. The epidemic curve suggested a point source outbreak with additional droplet or contact spread, rather than a single source outbreak, which would be more likely to be associated with airborne transmission.<sup>17</sup>
- More recent influenza experiences at two U.S. hospitals have been described:
  - In one hospital transmission of influenza was rarely noted; most rooms were private, but had positive pressure.<sup>3</sup>
  - In the other hospital, transmission of influenza in paediatric patients was most often observed among patients in the same room, particularly those in adjacent cribs. Patients in other rooms in the same ward were less likely to become infected, even though room doors were open and influenza patients were not housed in negative pressure rooms.<sup>6</sup>
  - These two studies suggest that the predominant mode of transmission in these facilities was either through large droplets or by direct or indirect contact, although it should be noted that pediatric patients do not typically have a forceful cough and are known to be less likely to transmit airborne diseases such as tuberculosis.<sup>18</sup>

### **Respiratory protection**

- Respirators are designed to protect the wearer from respiratory aerosols expelled by others.
- Surgical masks are designed to protect the sterile field from respiratory aerosols expelled by the wearer and are not designed to offer respiratory protection to the wearer.
- Although there are no data on the efficacy of respirators vs. surgical or procedure masks in preventing transmission of influenza to health care workers, there are data demonstrating the poor filtration and fit capacity of single or even multiple surgical masks worn at one time.<sup>19-21</sup>
  - Surgical and procedure masks are not evaluated for fit and cannot be properly fitted to the face or tested for fit and do not prevent leakage around the edge of the mask when the user inhales.
  - There are no minimum standards for surgical or procedure mask filter efficiency, there are a wide variety of filter efficiencies among available masks, and most masks do not effectively filter small particles from the air.

### **Conclusions**

- Influenza may be transmitted by small particle aerosols and surgical masks do not offer adequate protection against the inhalation of these particles.
- To minimize exposure of health care workers to avian and pandemic influenza virus, MDH recommends that health care workers use full barrier precautions, including respirators (if available), when working with known or suspect avian or pandemic influenza patients.

- Providing appropriate protection to health care workers during a pandemic is critical because:
  - vaccine for the pandemic influenza strain is unlikely to be available in the initial stages of a pandemic;
  - antiviral supplies are likely to be limited; and
  - pandemic influenza may cause disproportionate morbidity and mortality in younger, healthier people, such as health care workers, as it did in the 1918 pandemic.

## References

1. Lidwell OM. Aerial dispersal of micro-organisms from the human respiratory tract. *Soc Appl Bacteriol Symp Ser.* 1974;3(135-154).
2. Evans D. Epidemiology and etiology of occupational infectious disease. In: Couturier A, ed. *Occupational and environmental infectious diseases: epidemiology, prevention and clinical management.* Beverly Farms, MA: OEM Press; 2000:37-132.
3. Salgado C, Farr B, Hall K, Hayden F. Influenza in the acute hospital setting. *Lancet Infect Dis.* 2002;2(3):145-155.
4. Garner J. Guideline for Isolation Precautions in Hospitals. *Infect Control Hosp Epidemiol.* 1996;17(1):53-80.
5. Vars McCullough N, Brosseau L. Selecting Respirators for Control of Worker Exposure to Infectious Aerosols. *Infect Control Hosp Epidemiol.* 1999;20:136-144.
6. Buxton Bridges CB, Kuehnert MJ, Hall CB. Transmission of influenza: implications for control in health care settings. *Clin Infect Dis.* 2003;37(8):1094-1101.
7. Stott DJ, Kerr G, Carman WF. Nosocomial transmission of influenza. *Occup Med (Lond).* 2002;52(5):249-253.
8. Riley R, Wells W, Mills C, Nyka W, McLean R. Air hygiene in tuberculosis: quantitative studies of infectivity and control in a pilot ward. *Am Rev Tuberc.* 1957;75:420-431.
9. McLean R. Comment on: The mechanism of spread of Asian influenza. *Am Rev Respir Dis.* 1961;83(2):36-38.
10. Moser MR, Bender TR, Margolis HS, Noble GR, Kendal AP, Ritter DG. An outbreak of influenza aboard a commercial airliner. *Am J Epidemiol.* 1979;110(1):1-6.
11. Alford R, Kasel J, Gerone P, Knight V. Human influenza resulting from aerosol inhalation. *Proc Soc Exp Biol Med.* 1966;122(3):800-804.
12. Treanor J, Hayden F. Volunteer challenge studies. In: Nicholson K, Webster R, Hay A, eds. *Textbook of Influenza.* 1 ed. Malden, MA: Blackwell Science Ltd; 1998:517-537.
13. Schulman J. The use of an animal model to study transmission of influenza virus infection. *Am J Public Health Nations Health.* 1968;58(11):2092-2096.
14. Loosli D, Lemon H, Robertson O, Appel E. Experimental airborne influenza infection. I. Influence of humidity on survival of virus in air. *Proc Soc Exp Biol Med.* 1943;53:205-206.
15. Schulman J. Experimental transmission of influenza virus infection in mice. IV. Relationship of transmissibility of different strains of virus and recovery of airborne virus in the environment of infector mice. *J Exp Med.* 1967;125(3):479-488.
16. Andrewes C, Glover R. Spread of infection from the respiratory tract of the ferret: I. Transmission of influenza A virus. *Br J Exp Pathol.* 1941;22:91-97.
17. Blumenfeld HL, Kilbourne ED, Louria DB, Rogers DE. Studies on influenza in the pandemic of 1957-1958. I. An epidemiologic, clinical and serologic investigation of an intrahospital epidemic, with a note on vaccination efficacy. *J Clin Invest.* 1959;38(1 Pt 1-2):199-212.
18. Munoz F. Tuberculosis among adult visitors of children with suspected tuberculosis and employees at a children's hospital. *Infect Control Hosp Epidemiol.* 2002;23(568-572).

19. Kaye K, Weber D, Rutala W. Nosocomial Infections Associated with Respiratory Therapy. In: Mayhall C, ed. *Hospital Epidemiology and Infection Control*. 3 ed. Philadelphia: Lippincott Williams & Wilkins; 2004:1207-1222.
20. Derrick JL, Gomersall CD. Protecting healthcare staff from severe acute respiratory syndrome: filtration capacity of multiple surgical masks. *J Hosp Infect*. 2005;59(4):365-368.
21. Pippin D, Verderame R, Weber K. Efficacy of face masks in preventing inhalation of airborne contaminants. *J Oral Maxillofac Surg*. 1987;45(319-323).

This page intentionally left blank.