



ID Snapshot

How are respiratory viruses transmitted?

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Three major routes for transmission of respiratory viruses are recognized. This understanding forms the basis for infection control recommendations. Match the route of transmission in column 1 with the characteristics of that route in column 2.

Routes of transmission

1. Small particle aerosol (airborne transmission)
2. Large particle droplet aerosol infectious secretions (droplet transmission)
3. Self-inoculation with contaminated secretions (fomites)

Characteristics

- a. close contact required
- b. direct contact with secretions
- c. capable of distant spread

Answers: 1. c., 2. a., 3. b.

Particle size, settling velocity

Factors determining the efficiency of viral transmission include the size of the respiratory aerosol and the settling velocity of the particle.

Large particles settle more rapidly than small particles and present a risk mostly to those close to the infected person. Large particle droplets are generated during a sneeze or a procedure such as bronchoscopy or suctioning. Large particles travel less than 3-5 feet from an infected person and transmit infection when the particle lands on the conjunctiva or nasal mucosa of a susceptible person. Infection caused by viruses spread by large particle aerosol may be intermittent and occur without clustering of cases. Pathogens spread by large particle droplet aerosol include adenovirus, influenza, rhinovirus and *Bordetella pertussis*.

Small particles (less than 10 microns in diameter) remain airborne for longer periods of time than large particle aerosols. These small particles can be inhaled by susceptible persons in the same room or are capable of more distant spread as they are carried in air currents. Because viruses spread by small particle aerosol do not require close contact, the source of infection may not be evident and a more rapid outbreak may occur. Agents transmitted by small particle transmission include measles virus, varicella-zoster virus and *Mycobacterium tuberculosis*.

Special ventilation is required to prevent airborne transmission (negative air pressure ventilation and an N95 respirator). Ultraviolet irradiation is highly effective at inactivating viruses in a small particle aerosol but is not effective for eliminating virus in surface contamination or large droplets.

Small respiratory particles contain fewer infectious viral particles (virions) but are more likely than large particles to be inhaled and reach the lower respiratory tract. Large particles are more likely to settle in the upper respiratory tract and tend to produce milder disease.

Survivability of viruses

Viruses generally survive longer on a hard surface than on a porous surface. Secretions containing influenza virus or respiratory syncytial virus (RSV) are infectious on a countertop for less than six hours. Infectivity is lost after 30 minutes or less from RSV or influenza-containing secretions on a gown. Rhinoviruses or adenoviruses are capable of surviving on contaminated surfaces for more than 24 hours.

The difference in survivability partly is related to the presence or absence of a viral lipid envelope. Paramyxoviruses such as RSV, parainfluenza and human metapneumovirus as well as influenza viruses (orthomyxoviruses) have a lipid envelope that is vulnerable to dehydration and rapid loss of infectivity. Viruses that do not contain a lipid envelope

(such as adenovirus, enterovirus and parechovirus) survive for longer periods in an extracellular environment than viruses containing a lipid envelope.

One role of the viral envelope is to anchor surface glycoproteins, enabling the virus to attach to specific epithelial cells in the respiratory tract which will support viral replication (tropism).

Routes of transmission

Self-inoculation with contaminated secretions is the most common route of respiratory virus transmission in a health care setting. This can involve direct contact between an infected person and a susceptible host or indirect contact with contaminated objects such as dressings, toys or instruments.

Direct contact with infectious secretions is most likely to occur with prolonged contact or in settings with poor hygiene such as homes or child care centers.

Role of meteorological conditions

A clear seasonal pattern of outbreaks is well-recognized with many respiratory viruses. Meteorological conditions such as relative humidity, minimum temperature, cloud cover, exposure to sunlight (ultraviolet A and B), barometric pressure and rainfall affect viral survival and infectivity. For example, at locations with persistently warm temperatures and high humidity, RSV activity is present throughout the year. In temperate climates, RSV circulation correlates with lower temperature, and

transmission is inversely related to temperature. In colder climates, RSV activity persists throughout the year.

Conflicting results from studies regarding the role of these factors and different viral agents indicate a complex and poorly understood relationship between viral survival and meteorological conditions.

Individual differences

Infected individuals differ in their ability to spread respiratory viruses. Sneezing and coughing are more effective means of generating infectious secretions than shouting. “Super-shedders” are people who expel extraordinarily large amounts of infectious aerosols, which may account for a disproportionate amount of disease transmission. Why this happens is not well-understood.

Much of what is known about viral transmission and what is described here has come from the pioneering research of Caroline B. Hall, M.D., FAAP, who died on Dec. 10, 2012.



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