What ASHRAE Says About Infectious Disease

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As I write this, the Ebola outbreak in Africa and the events in Texas are the major news stories. I can't speak directly to that crisis. However, I do know that you need access to essential information from ASHRAE on HVAC, and its potential role in the spread of infectious disease. One good source is the recently released "ASHRAE Position Document on Airborne Infectious Diseases."

Airborne Spread of Disease

ASHRAE's position document contains a valuable synopsis of control measures such as dilution ventilation, pressure differentials, exhaust ventilation, air cleaning, ultraviolet germicidal irradiation (UVGI) and even temperature and humidity. These techniques have broad applicability to any disease that is airborne.

Because of the difficulties in separating out the relative importance of transmission modes, health-care facilities often focus on "infection control bundles" (i.e., use of multiple modalities simultaneously) and err on the side of caution. The need for action may go beyond health-care facilities to include passenger transportation buildings and conveyances, jails, homeless shelters and schools.

The Ebola outbreak illustrates how vulnerable we all are to new infectious agents, a future one of which might be airborne. Tuberculosis, in some cases influenza, the common cold, and other diseases spread by the airborne route. Four worldwide (pandemic) influenza outbreaks occurred in the last 100 years: 1918, 1957, 1968, and 2009. There were also three notable epidemics: 1947, 1976 and 1977. The 1918 Spanish flu was the most serious pandemic in recent history and was responsible for the deaths of an estimated 50 million or more people. The most recent H1N1 pandemic in 2009 resulted in thousands of deaths worldwide. Statistically, it seems like we have had the recent good fortune of avoiding a truly devastating pandemic such as these historical ones. Another way of saying this is that such a tragic event is long overdue.

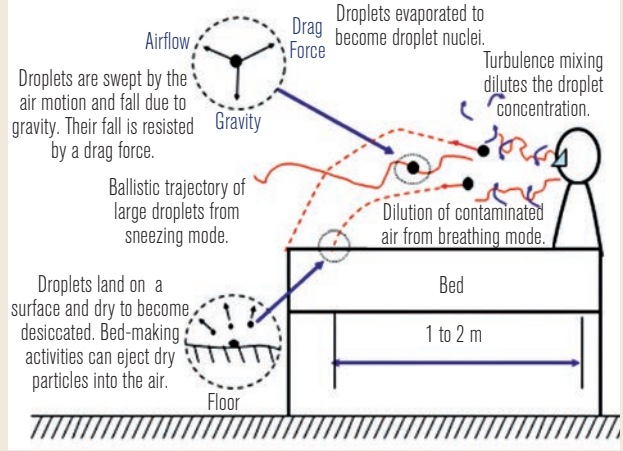
ASHRAE's Position

ASHRAE takes no position on the issue of the relative importance of precautions for airborne exposure vs. those for direct contact. The former is clearly within ASHRAE's expertise, while the latter is not. ASHRAE's position document recommends that designers and

How Diseases Spread

Direct contact is any surface contact such as touching, kissing, sexual contact, contact with oral secretions or skin lesions.
Indirect contact involves contact with an intermediate inanimate surface (**fomite**), such as a doorknob or bedrail that is contaminated.
Exposure through the air occurs through (1) **droplets,** which are released and fall to surfaces about 3 ft (1 m) from the infected and (2) small **particles,** which stay airborne for hours at a time and can be transported long distances. When droplets become small particles by evaporation, they may be called **droplet nuclei.** This is illustrated in *Figure 1.*
Tuberculosis and in **some** cases **influenza,** the **common cold,** and other diseases spread by the airborne route.
An **epidemic** affects the population in a limited geographic area, whereas a **pandemic** affects a large geographic area or the entire world.

FIGURE 1 Droplet suspension: aerobiology of droplets and small airborne particles produced by an infected patient.



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operators go beyond existing minimum practice standards to be better prepared for known risks and for an outbreak that might be caused by a new microorganism capable of spreading by the airborne route.

Do you know the difference between direct and indirect contact? What is a fomite? Can you distinguish among a droplet, droplet nucleus and aerosol? Which diseases spread by the airborne route? For this information as well as its importance, the position document is essential reading and reference for anyone involved in the design, construction or operation of facilities having occupants who may spread or be susceptible to such diseases. For a brief explanation of these terms and concepts, see the sidebar, "How Diseases Spread."

What Preparation Should Facilities Undertake?

In the event of a pandemic or major epidemic (the difference being the extent of spread), people may be quarantined, travel may be disrupted, schools may be closed[2] and people may be instructed to avoid crowds and contact.

However, some facilities, such as prisons, shelters and those related to health care, cannot close or curtail activities. Fast action regarding building operations may be needed. Since the problem and its solutions are multidisciplinary, the document recommends involving engineers, building operators, scientists, infection prevention specialists, and epidemiologists.

The document says that new facilities should incorporate the infrastructure to quickly respond to an outbreak, in areas including emergency, admission and waiting rooms in health care buildings, crowded shelters, and similar facilities. Such infrastructure might include HVAC systems that separate high-risk areas, physical space and HVAC system capacity to upgrade filtration, the ability to increase ventilation even as high as 100% outdoor air, the ability to humidify air, receptacles at the upper room for UVGI and ceiling heights of at least 8 ft (2.4 m). Once the building is in operation, filter elements and upper-room UV fixtures should be available for rapid deployment in an emergency.

What Should You Do?

Public health and disease prevention are essential elements of protecting and serving the public, and engineers have a role to play. I like to say that engineers and plumbers have saved more lives than all the doctors and health workers through the removal of sewage and the provision of clean water that would otherwise spread disease. In the event of an airborne outbreak, for which the world is statistically overdue, engineers and technicians who understand airflow in buildings will be needed to reduce the spread of disease.

Be prepared. Download a copy of this and other ASHRAE position documents at www.ashrae.org/about-ashrae/position-documents.

HVAC and Transmission

Several HVAC interventions can affect airborne disease transmission. Existing practice standards cover many, but not all of these.

- Dilution ventilation
- Temperature and humidity
- Personalized ventilation
- Local exhaust
- Central system filtration
- Local air filtration
- Upper-room UVGI
- Duct and air-handler UVGI
- In-room flow regimes
- Differential pressurization

Acknowledgments

The position document owes it existence to the knowledge, intelligence, hard work and spirit of cooperation of the committee members and ASHRAE staff: Michael J. Hodgson, Occupational Safety and Health Administration; William F. McCoy, Phigenics LLC; Shelly L. Miller, University of Colorado; Yuguo Li, The University of Hong Kong; Russell N. Olmsted, Saint Joseph Mercy Health System; Chandra Sekhar, National University of Singapore; Sidney A. Parsons, deceased; Council for Scientific and Industrial Research, South Africa; and Steve Hammerling, ASHRAE.

Notes

1. A majority of states identify school closure as a potential mitigation strategy in their pandemic influenza plans. However, schools can serve as a central point for organized child hygiene work and disease screening, as evidenced by results in the 1918 pandemic wherein New York City had minimal infection among school age children despite being perhaps the only large city that kept its schools open. Sources: Baker, S.J. 2013. *Fighting for Life*, pp. 155-156, New York Review Reprint of 1939 Edition; and The Center for Law & the Public's Health at Georgetown & Johns Hopkins Universities. 2008. "Legal Preparedness for School Closures in Response to Pandemic Influenza and Other Emergencies: A Review and Report Submitted to the Centers for Disease Control and Prevention." ■