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HEPA Filtration

By Megan O'Sullivan, mechanical designer, Mazzetti Nash Lipsey Burch

Recently, some hospitals have used HEPA (MERV 17) filters in general patient rooms in an attempt to reduce health care-associated infections (HAIs). There is, however, a knowledge gap between the perceived sources of HAIs and the efficacy of mechanical systems in controlling those sources. This article discusses the sources of HAIs, modes of airborne pathogen transmission, the costs and benefits of HEPA filters, and the risk assessment process for considering HEPA filter use.

HAIs and Modes of Transmission

According to the Centers for Disease Control, approximately 1.7 million HAIs are reported annually in the U.S. HAIs are classified as infections that a person initially comes into contact with inside a hospital. These infections can be transmitted through direct contact, indirect contact, and airborne routes. The following discussion focuses on airborne transmission, which is the only route affected by mechanical filtration. Airborne transmission is generally acknowledged to account for only 10 to 20 percent of all HAIs.

Airborne pathogens can be transferred from the infection source to the recipient in two ways. The first mode of airborne transmission is intra-space, when the source is in the same room as the recipient. For example, when a person coughs or sneezes, particles can be transmitted through the air and infect a recipient in the same room. The second mode of airborne transmission is inter-space, when pathogens are carried by outdoor or recirculated air that enters the space through mechanical methods. This means that the infection source and the recipient are not located in the same space, and the mechanical system transfers the infectious airborne particles from one space to another.

Infection control research primarily focuses on mitigating airborne intra-space HAIs, as the occurrence of mechanical inter-space transmission is considered a small portion of airborne HAIs.

Mechanical Systems and Filters

Despite its minor role in the transmission of HAIs, a mechanical system is easily designed and controlled to limit the potential spread of infection. Filtration is the most effective method of control. The appropriate level of filtration should be governed by industry standards and a risk assessment of the facility.

ANSI/ASHRAE/ASHE Standard 170: *Ventilation of Health Care Facilities* recommends MERV 14 filters for air systems serving general patient rooms and other general areas of a health care facility. High-risk patient areas, such as protective environment (PE) rooms, use HEPA filters. These rooms are occupied by patients who are extremely susceptible to HAIs, such as bone marrow transplant patients.

Although HEPA filtration has been proven more effective at removing particles than MERV 14 filters, there is no evidence that the addition of HEPA

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Both design engineers and facility managers must understand, though, that accompanying this positive [lower limit humidity change] development is zero tolerance—in any conditions—for falling below the new minimum.

filtration to general patient rooms and hospital areas reduces the number of HAIs associated with a facility. As reported in 2011 by Farhad Memarzadeh in the ASHE monograph, *The Environment of Care and Health Care-Associated Infections*, HEPA filtration has only been proven to reduce HAIs when combined with tightly sealed rooms, higher air change rates, and positive pressurization, control measures that are crucial to reducing HAIs in PE rooms and other high-risk areas. General patient rooms are not designed with these additional safety measures.

It is important to note that when compared to MERV 14 filtration, HEPA filters have a higher up-front cost and require more fan energy due to higher pressure drops, giving them a higher operating cost over the lifetime of a building.

Risk Assessment and Special Cases

When deciding if a filtration level in excess of that required by ASHRAE Standard 170 is appropriate for an HVAC system, an infection control risk assessment (ICRA) should be considered. This assessment analyzes the susceptibility of the people in the area, the type of contaminants present, and their level of concentration. (See F. Memarzadeh and W. Xu, *Role of Air Changes Per Hour (ACH) in Possible Transmission of Airborne Infections*, Tsinghua Univerisy Press and Springer-Verlag Berlin Heidelberg, 2011).

As an example, a children's hospital in California conducted an ICRA, weighed the pros and cons, and ultimately chose to use HEPA filtration throughout its air system. Being an oncology facility, where many of the young patients are immune-compromised from receiving aggressive treatments such as chemotherapy, the facility concluded that the higher level of filtration provided by HEPA filters was worth the extra cost.

A Choice

No evidence currently shows that HEPA filtration in general patient rooms reduces the occurrence of HAIs. The use of filters only addresses inter-space HAI transmission and has no effect on intra-space transmission, which is considered the more prevalent mode of airborne transmission. Nonetheless, some facilities may perform an ICRA and conclude that HEPA filtration is preferred despite its higher cost and the lack of evidence that it reduces HAIs in general patient rooms.

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