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Seven Steps to Reduce the Risk of Infectious Disease in Hospitals

by Christopher Roberts

Executive summary

Healthcare organizations face growing challenges related to infectious disease control. Although adherence to best practices such as frequent hand washing and the use of personal protective equipment are regarded as the leading weapons against infectious disease spread and hospital-acquired infections, the built environment, including the HVAC systems, also play an important role. Strides in the development of smart building operation management platforms that easily and cost-effectively integrate with a facility's existing systems can give healthcare providers a powerful tool with which to enhance the effectiveness of their overall infection control programs.

Introduction

Preventing the spread of infectious diseases and protecting patients and healthcare workers from hospital-acquired infections (HAIs), including airborne infections, remain essential priorities for health systems around the world. The global pandemic caused by the spread of the novel coronavirus in 2020 provides one of the more vivid recent examples of why health systems must continue doing everything they can to guard against infectious disease spread within their built environments.

HAIs persist as a major global public health challenge. Current estimates indicate HAIs cost the U.S. health system approximately $35.7 to $45 billion annually.[1, 2]

With new biological threats emerging at an increasing rate, hospitals and health systems will be grappling with growing challenges around infectious disease control for the foreseeable future.

A growing range of biological threats

According to the Infectious Diseases Society of America,[3] these challenges will come in a variety of forms:

- The appearance of new, potentially dangerous bacteria, viruses, fungi and parasites such as severe acute respiratory syndrome (SARS).
- Previously recognized pathogens that evolve to become resistant to available antibiotics and other treatments.
- Increased vulnerability of populations to the spread of infectious agents due to crowding and global travel.
- Re-focused attention on eradicated or rare infectious diseases such as small-pox and anthrax stemming from bioterrorism threats.

Unfortunately, the places where people go to receive care for their conditions and illnesses also put them at risk of infection. Hospitals, skilled nursing facilities and other healthcare settings are inherently conducive to the spread of disease-causing microorganisms. Large numbers of people, many with suppressed immune systems or community-acquired infections, are placed together in close quarters, creating an environment that leaves patients, visitors and employees susceptible.

Leading public health organizations, including the World Health Organization, the European Centre for Disease Prevention and Control, and the U.S. Centers for Disease Control and Prevention (CDC), uniformly stress the critical importance of adherence to infection control best practices by healthcare workers as the most effective weapon against infectious disease spread in healthcare settings. These best practices include frequent hand washing, disinfection of surfaces, and the proper use of masks, gloves and other personal protective equipment (PPE).

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[1] Klevens, RM, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002, Public Health Reports, 2007 Mar-Apr; 122(2): 160–166

[2] Scott, RD. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention, U.S. Centers for Disease Control and Prevention, 2009

[3] Infectious Diseases Society of America. Facts About ID,

The role of the built environment

The physical hospital environment can support effective infection control measures as well. This includes the hospital building's heating, ventilation and air conditioning (HVAC) systems and the increasingly smart and versatile electronic platforms that can be used to manage those systems.

In its *Guidelines for Natural Ventilation for Infection Control in Healthcare Settings*, the WHO notes that "the design of proper, general ventilation systems can play an important role in preventing the spread of infections." According to the WHO, for this reason, ventilation should be part of an overall infection control strategy, along with environmental and other engineering controls, ongoing assessments of threats and resources, appropriate administrative controls, and provision of PPE.[4]

Healthcare leaders, infectious disease specialists and facility managers should work together to incorporate factors related to the design, operation, safety and efficiency of air quality and HVAC systems in their overarching infection control plans.

The focus is to help break the chain of infection and how infections are spread through a building, see **Figure 1**.

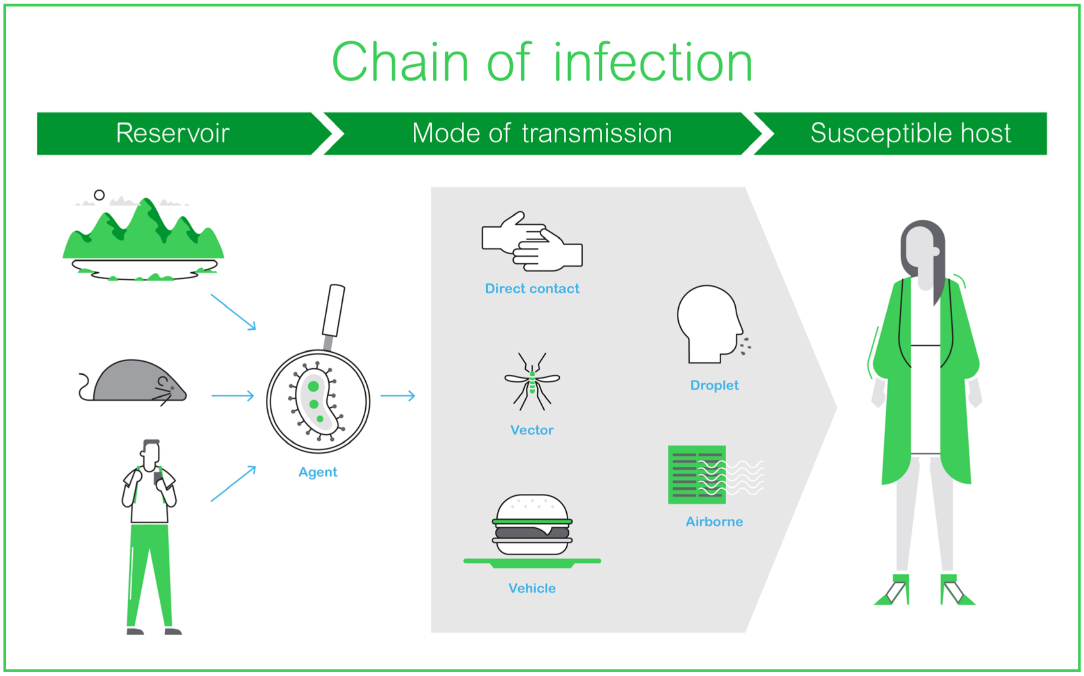

Figure 1

Chain of infection
Source: CDC

[4] Atkinson, J., et al. *Natural Ventilation for Infection Control in Health-Care Settings*, WHO guidelines 2009, World Health Organization.

Major considerations for facilities

The **reservoir** can be people, equipment, water or surfaces.

Modes of **transmission** include:

- Direct or indirect contact between infected and non-infected individuals. Someone infected may transmit an infectious disease by coming into direct bodily contact with others or indirectly, such as by touching a frequently touched surface, such as a light switch. This is the most frequent mode of transmission.
- Droplet transmission. When droplets containing microorganisms are propelled through the air by coughing, sneezing and talking. The microorganisms enter the new person's system through contact with their eyes, nose and/or mouth. The infected droplets may linger on surfaces for long periods of time. Droplet and contact infection control strategies are often implemented simultaneously.
- Airborne. The transmission of infectious agents can occur either by airborne droplet nuclei (particles of 5 mm or less in size) or dust particles containing infectious agents. Microorganisms can remain suspended in the air for long periods of time and be dispersed widely by air currents. This mode presents the greatest risk and the biggest challenges for healthcare systems. Microorganisms can potentially travel throughout the building via the ventilation system.
- Common vehicle. Transmission caused by contaminated items such as food, water, medications, medical devices and equipment.

Recent developments in electronic air quality monitoring and troubleshooting systems are helping healthcare providers reduce the spread of pathogenic microorganisms in their facilities and ensure a safer environment for patients, employees and visitors.

These developments include everything from monitoring systems that provide facility managers with real-time information for the timely correction of problems to systems for managing the access and movement of people and equipment through the facility.

This paper outlines seven steps that healthcare organizations can take to reduce the risk of infectious disease spread in their built environments. They are:

1. Maintain the correct air change rate.
2. Maintain the correct air pressures throughout the building.
3. Manage the flow of people, equipment and supplies.
4. Adjust and monitor relative temperature and humidity in keeping with current findings.
5. Create and monitor suitable filtration and clean status.
6. Ensure the safety of resilient power supplies.
7. Maintain and monitor water supplies.

Included in this paper are reviews of relevant research and thinking, and glimpses of developments and monitoring capabilities that can help healthcare administrators, safety and compliance teams, and facility managers and engineers develop and manage a more effective and thorough infection control program for their organizations.

Maintain the correct air change rate

Human exposure to pathogens is influenced by the ways in which buildings exchange air with their surrounding environment. These exchanges can occur through a variety of means, including natural ventilation (such as the opening of windows) and mechanical ventilation (HVAC systems).

According to the American Society for Healthcare Engineering (ASHE), the complex interplay of variables that influence the relationship between air changes per hour (ACH) in a ventilation system and infection transmission make it difficult to determine ventilation's direct effect on disease spread. But evidence from studies of natural ventilation and controlled indoor ventilation suggest that ACH does play a role in controlling the spread of infectious disease. "The most prudent course of action is to carefully consider a risk assessment and look at evidence-based factors to determine the best ACH for a space," ASHE states in a literature review.[5]

The role of ventilation in reducing airborne infections drew heightened attention following the 2003 SARS outbreak. Despite the many variables involved, a more frequent rate of air change in a hospital room is accepted as a useful strategy for reducing the risk of infectious disease because it can help remove or dilute virus- or bacteria-laden droplets from the air.

Adequate ventilation is key

Following the SARS outbreak, the recommended minimum ventilation rate for airborne infection isolation rooms (AIIRs) rose from 6 ACH to 12 ACH. In comparison, 1 ACH is recommended for commercial buildings.[6]

Microbes that are dispersed in saliva and mucous when a patient sneezes or coughs (such as COVID-19) drop to surfaces in the room. As these droplets evaporate, the pathogens can remain suspended in the air. A more frequent air change rate reduces the likelihood that these airborne particles will be spread to others.

A 2007 systematic literature review published in Indoor Air reported "strong and sufficient evidence to demonstrate the association between ventilation, air movements in buildings and the transmission/spread of infectious diseases such as measles, tuberculosis, chickenpox, influenza, smallpox and SARS."[7]

A 2000 study of tuberculosis infection (as shown by a positive result on a tuberculosis skin test) among healthcare workers and the ventilation rate in patient care areas found that the infection was strongly associated with inadequate ventilation in general patient rooms and the amount of time spent in the room.[8]

A 2003 Chinese study following the SARS outbreak found that isolating SARS patients in wards with good ventilation reduced the viral load in the ward and helped prevent outbreaks of the disease among healthcare workers in isolation units.[9]

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[5] Memarzadeh, F. Literature Review: Room Ventilation and Airborne Disease Transmission, American Society for Health Care Engineering, 2013.

[6] Qian, H, et.al. Ventilation control for airborne transmission of human exhaled bio-aerosols in buildings, Journal of Thoracic Disease, 2018 Jul: (10)

[7] Li, Y, et al. Role of ventilation in airborne transmission of infectious agents in the built environment – a multidisciplinary systematic review, Indoor Air, 2007 Feb;17(1):2-18.

[8] Menzies, D. et al. Hospital ventilation and risk for tuberculosis infection in Canadian health care workers. Canadian Collaborative Group in Nosocomial Transmission of TB, Annals of Internal Medicine, 2000 Nov 21;133(10):779-89.

[9] Jiang, S. et al. Ventilation of wards and nosocomial outbreak of severe acute respiratory syndrome among healthcare workers, Chinese Medical Journal, 2003 Sep;116(9):1293-7.

Systems that address ventilation <u>and</u> energy goals

Integrated platforms that facilitate the automated monitoring and control of building operations, including ventilation in clinical care spaces, are enabling hospital facility managers to ensure that their systems are working correctly and achieving the specified ventilation rates. These platforms also allow systems to be adjusted as needed to enhance safety.

Healthcare organizations commonly focus on reducing energy usage by reducing airflow. However, efforts to reduce energy consumption should always include careful consideration for the impact of changes in air flow on the ventilation system's role in reducing the spread of pathogenic microorganisms. In other words, energy-saving and infection control are not separate silos. This means that healthcare organizations should employ a systems approach to ensuring that these two functions of the built environment work hand in hand to optimize benefits in both aspects of hospital operations.

Comprehensive building operation management platforms that easily integrate with a facility's existing electronic building management applications, including HVAC applications, are allowing facility management staff to access, control and monitor all building systems from a single interface.

These intelligent systems allow facilities to consider air flow rates *and* energy optimization. Their interoperability supports the more effective monitoring and maintenance of safe and comfortable ventilation that balances the health system's infection control needs with its needs to maintain a comfortable environment while conserving energy and reducing energy costs. These platforms run intelligent algorithms against the system's performance and provide reports and guidance that allow healthcare systems to address ventilation system-related performance issues.

Maintain the correct air pressures throughout the building

ASHE standards and guidelines designate areas of healthcare facilities that should be positively or negatively pressurized in relation to their surrounding areas. Maintaining these air pressures throughout the building is a major component of effective infection control.

According to The Joint Commission, maintaining correct air pressures is a common quality and safety issue in healthcare. In 2018, problems related to airborne isolation room (AIIR) airflow (EC.02.05.01 EP15) were the 11th most frequently cited element related to hospital clinical and environmental performance.[10]

Why positive and negative pressures are vital

A positively pressurized area is designed to prevent the entry of pathogenic microorganisms and other contaminants into the space. These areas include operating rooms, delivery rooms, trauma rooms, the newborn intensive care unit and protective environment rooms, among others.[11]

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[10] 10 Most Frequently Cited Environmental Elements of Performance, Hospital Accreditation Program, Q1 through Q3: Joint Commission Findings, The Greeley Company

[11] J.R. Barrick, R.G. Holdaway. Room Pressurization, excerpt from Mechanical Systems Handbook for Health Care Facilities, 2014.

A negatively pressurized room is an environment of lower air pressure in relation to surrounding areas that allows air from surrounding areas to flow into, but not out of, the space. These areas include emergency room (ER) waiting rooms, radiology waiting rooms, toilet rooms, sterilizing laboratories and soiled workrooms or holding rooms, and infectious isolation rooms.

The infectious isolation rooms are created for the purpose of isolating patients with infectious diseases or isolating areas where infectious agents may be present in order to protect others from infection. The negative pressure room stops the flow of potentially harmful particles to other areas of the facility by preventing the air inside from leaving the space. "Hospitals have proven to be sites of epidemic magnification during smallpox outbreaks, probably because of a lack of negative pressure isolation facilities," notes ASHE.[12]

The intricacies of AIIRs

An AIIR is a single-occupancy negative pressure room for patient care designed to prevent the circulation of airborne pathogens into public areas. The creation of these rooms in hospitals involves a specialized design of the facility's HVAC system that maintains the flow of air into the room with the flow of air out of the room to produce negative pressure in relation to the adjacent space.

The ventilation of an AIIR is designed to ensure a clean-to-less clean air pathway and prevent pathogenic particles from escaping into surrounding nursing workspaces and public areas. The air from the corridors flows into the patient room, but the air from the AIIR is prevented from leaving. The exhaust from the AIIR should not be recirculated by the HVAC system, but should be exhausted through dedicated ductwork and diluted through HEPA filters before it is released into the atmosphere.

The CDC requires the use of AIIRs for patients with infectious illnesses such as tuberculosis, SARS and H5N1.[13] ASHRAE outlines specifications for the design of airflow in these spaces, including air change rates and pressure requirements.[14]

Maintaining negative pressure in the AIIR is important to help ensure that airflow moves in the correct vector. Several cases of infection have been reported in instances of pressure reversal caused by door openings.

A case report of nosocomial transmission of varicella zoster virus from a patient to a nurse published in *The Journal of Hospital Infection* recommends that "susceptible personnel should not stand at the entrances of isolation rooms containing patients with respiratory infections since, despite negative pressure, nosocomial transmission via an airborne route may still be possible." The authors suggest the use of sliding doors with an airlock-like arrangement rather than hinged doors to reduce the likelihood of pressure reversal.[15]

[12] Memarzadeh, F. The Environment of Care and Health Care-Associated Infections: An Engineering Perspective. American Society for Health Care Engineering, p. 22.

[13] Infection Control Impact of HVAC System Maintenance and Repair, Guidelines for Environmental Infection Control in Health-Care Facilities, U.S. Centers for Disease Control and Prevention, 2003

[14] Position Document on Airborne Infectious Diseases, American Society of Heating, Refrigerating and Air-Conditioning Engineers, February 5, 2020.

[15] Tang, JW, et al. Door-opening motion can potentially lead to a transient breakdown in negative-pressure isolation conditions: the importance of vorticity and buoyancy airflows, The Journal of Hospital Infection, Volume 61, Issue 4, P283-286, December 1, 2005

To ensure safety, the AIIR must be continuously monitored to prevent infection. The differential pressure from the contaminated area to the clean space is a key indicator that air flow is moving in the correct direction. This indicator must be monitored and recorded. For patient and staff safety, staff must be alerted immediately to any issues in these areas through local displays and/or notifications.

How real-time alerts can bolster safety

Current integrated building operation systems can provide critical real-time alerts to facility managers and clinical staff when the integrity of an AIIR has been compromised and individuals outside the isolation room have been put at risk. By enabling staff to take precautionary measures in a timely fashion, these alerts can add another layer of protection against infectious disease transmission that enhances the overall safety and reliability of an organization's comprehensive infection control measures. These conditions should also be monitored and logged within the building's operation system to provide records that the systems comply with current safety standards.

Manage the flow of people, equipment and supplies

Preventing the spread of infection is critical in healthcare, and controlling and monitoring the flow of people, tools and supplies is a vital aspect of infection prevention and control. Controlling and monitoring the spaces they have entered and where they have traveled are essential for the tracking of contact risk.

Managing the flow of people and equipment at this level of specificity requires spaces that are designed with consideration for traffic flows that separate individuals based on the activities they perform. An access control system plays a key role in managing these carefully designed spaces and workflows by restricting movement into and maintaining the security of sterile locations and recording details of traffic into and out of the various spaces.

The added security of location aware systems

Integrated building operation platforms with location awareness systems as components of their security functionality are also making it possible for hospitals to monitor the movement of people and equipment. These include radiofrequency identification (RFID) and real-time location systems (RTLS).

RFID identifies objects, locations and people through the remote use of radio waves. RTLS extends the benefits of RFID by facilitating the identification and tracking of objects and people in real time, with greater precision and granularity than RFID and other identification systems can provide.

RTLS provides an additional source of protection that allows facility management staff and safety and compliance teams to determine the exact trail of a healthcare worker or other individuals who have entered the room and where they traveled after leaving. For example, with Portering systems a detailed analysis of patient movement and porter interaction can be done to show the interactions with individuals within the building to improve a facility's understanding of infection transmission and prevention.

Insights regarding specific incidents and patterns of unauthorized access that are acquired through these enhanced capabilities can be used for the ongoing improvement of infection control processes and procedures.

RTLS also can also be used as a safety-enhancing measure by notifying staff of the location of patients with known infections and allowing them to take the necessary precautions before entering these areas.

In addition to enhanced access control and monitoring and environmental conditions monitoring, both RFID and RTLS have a wide range of additional applications across healthcare settings, including asset and equipment tracking, operating room management, emergency response, hand sanitization monitoring, infant protection, inventory management and loss prevention and many others.

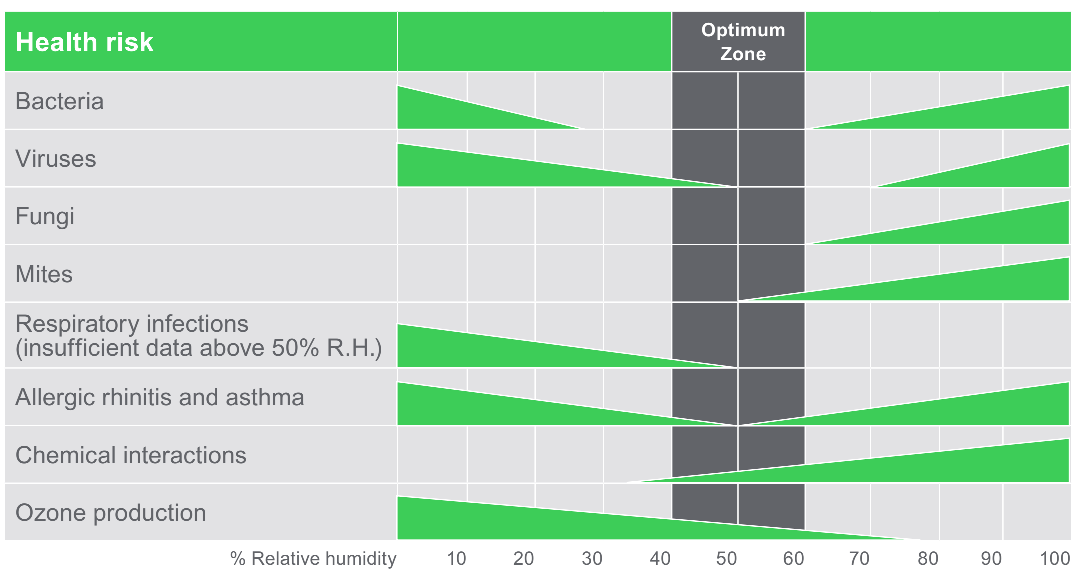
Adjust and monitor relative temperature and humidity in keeping with current finding

Careful monitoring of temperature and humidity as part of a comprehensive infection control plan can help hospitals reduce the growth of viruses and bacteria and lower the risk of infectious disease transmission.

According to ASHE, despite a large number of scientific studies of the effect of temperature and humidity on the survival of disease-causing viruses and bacteria, the ideal temperature and humidity range for the optimal reduction of pathogenic organisms is not yet known.[16]

However, new recommendations in the wake of the COVID-19 pandemic based on recent findings call for maintaining indoor humidity levels at 40% to 60% to decrease exposure to infectious particles and reduce viral illness transmission. This can be reflected in **Figure 2**, which shows the impact the indoor humidity can have on health.

Optimum relative humidity for health – the effect indoor humidity has on health risks



Decrease in bar width indicates a decrease in effect

Figure 2

The impact temperature and humidity on bacteria and viruses.

Graph courtesy Criteria for Human Exposure to Humidity in Occupied Buildings, ASHRAE

[16] Memarzadeh, F. p. 30.

One previous study showed that increasing the mean relative humidity from 35% to 50% may accelerate the removal of infectious influenza A virus and help prevent or reduce infection.[17] A 2011 study published in PLOS One found humidity to be an important factor in the aerosol transmission of influenza A viruses. Relative humidity impacted droplet size and affected the rate of virus inactivation. The authors concluded that maintaining a high indoor relatively humidity and ventilation rate may help reduce the chances of influenza A virus infection.[18]

A 2011 study of temperature and humidity on transmission of the SARS virus showed that lower temperatures and low humidity prolonged survival of the virus on contaminated surfaces. According to the authors, these findings may also explain why most of the SARS outbreaks in Singapore, which is in a tropical area, occurred in the air-conditioned environments of hospitals.[19]

IoT sensors provide room-level monitoring

Advances in HVAC design technology and building monitoring systems, including the development of IoT sensors, have enhanced monitoring of conditions at the room level. The systems allow for better control of temperature and relative humidity in specific spaces, separately from other areas of the building.

IoT sensors are also enabling room-level temperature and humidity monitoring of critical areas throughout the hospital. Smart building operations management systems can yield detailed analytics for use by facility managers and infection control teams in pinpointing areas of the building in which environmental conditions could potentially impact the growth of bacteria (high humidity) and viruses (low humidity).

Create and monitor suitable filtration and clean status

Because the particle size of airborne viruses and bacteria is exceedingly small, ventilation, while essential, is insufficient by itself to guard against the movement of pathogens from one area of the hospital to another.

According to ASHE, acceptable indoor air quality can be achieved with proper ventilation in combination with filtration of recirculated and fresh air, mechanical arrestance media, such as high-efficiency particle air (HEPA) filtration, and ultraviolet germicidal irradiation in targeted applications.

HEPA filters are at least 99.97% efficient in removing particles of 0.30 μm, becoming even more efficient in removing both larger and smaller particles, according to a recent article.[20]

Therefore, even when exhaust from an AIIR and other negative pressure spaces is moved directly to the outdoor environment, where pathogens are diluted in the atmosphere, air filtration must be used in conjunction with ventilation to help control the spread of viruses, bacteria and other potentially harmful microbes.

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[17] Dr. Stephanie Taylor, "Indoor humidity regulations will reduce burden of COVID-19," Planning, BIM & Construction Today, April 2020

[18] Yang, W, Marr, LC. Dynamics of airborne influenza A viruses indoors and dependence on humidity, PLOS One, June 24, 2011.

[19] Chan, KH, et al. The effects of temperature and relative humidity on the viability of the SARS coronavirus, Advances in Virology, Volume 2011, Article ID 734690.

[20] Schurk, DN. The HVAC system's role in environmental infection control for hospitals, Carrier West, March 2020.

"Choosing a filter that matches the health care space use and contaminant control requirements is an essential step in proper filtration application," ASHE states.

In addition, according to ASHE, although HEPA filtration is an effective strategy, it must be used in combination with tightly sealed rooms, higher air change rates, positive pressure (airflow out of the room) and other control measures.[21]

Monitoring systems enhance safety and productivity

When HEPA filters are used, the facilities team should ensure that these filters are changed as needed based on dirty status. Sensors integrated with a smart building operation management system that monitor pressure drop across the filters can deliver notifications to facility personnel when filters need replacing. Incorporating this aspect of safety and maintenance into smart operations can help maximize staff productivity while reducing unnecessary exposure among employees to potentially harmful microbes. ASHRAE provides safety guidance for facility personnel who perform these tasks.[22]

Ensure the safety of resilient power supplies

Ventilation, air filtration and the other environmental controls that work together as key components of a comprehensive infection control strategy are only as effective as the reliability of the power source that makes it possible for them to run.

Power outages are not rare incidents. A 2018 survey by S&C Electric Company found that one in four companies experience a power outage at least once a month.[23]

The need for hospitals to ensure that their HVAC and other critical systems can continue working in the event of a power failure is vital for patient and staff safety. The UK's Healthcare Building Note (HBN) 04-01 – supplement one, which focuses on facilities for infectious patients, mandates that "Appropriate standby provision should be identified (for example connection to the essential power supply or uninterruptible power supplies) to enable continuity of supply should a main power failure occur."

Similarly, according to the CDC Guidelines for Environmental Infection Control in Health Care Facilities, healthcare providers should:

- Develop a contingency plan for backup capacity in the event of a general power failure
- Deploy infection-control procedures to protect occupants until power and systems functions are restored
- Provide backup emergency power and air-handling and pressurization systems to maintain filtration, constant ACH, and pressure differentials in PE rooms, AII rooms, operating rooms and other critical care areas

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[21] Memarzadeh, F. p. 40

[22] ASHRAE Standard 170-2017. Ventilation of Healthcare Facilities (ANSI/ASHRAE/ASHE Approved).

[23] S&C's State of Commercial & Industrial Power Reliability Report, S&C Electric Company, April 23, 2018.

Digitized systems deliver powerful assurance

The digitization of electrical distribution represents a major step forward in the management of complex power systems. Healthcare providers now have access to IoT-enabled platforms that can completely digitize their medium- and low-voltage electrical distribution systems. These platforms, which can be cost-effectively integrated with a facility's existing systems, offer analytics capabilities that can deliver actionable insights to facility management teams either at the desktop or on their mobile devices to ensure that critical systems, including HVAC and related components, continue running in the event of a power failure.

The analytics and insights available through these digitized systems can also be employed by facility managers to provide:

- Early warnings of risks
- Faster recovery when problems occur
- Data regarding opportunities for time- and cost-savings
- Streamlined maintenance opportunities
- Enhanced equipment performance and lifespan

It is also critical for health systems to build redundancy into their infrastructure by design. Having the correct backup systems for power, fans and other components will ensure operation in the event of a power failure.

Maintain and monitor water supplies

Water safety in healthcare facilities is often under-appreciated until an infection occurs.

However, a large number of pathogens can be spread through a healthcare facility's central pipes, cooling systems or points of use (e.g., drinking fountains, sinks), including *Legionella* and other Gram-negative waterborne bacteria, nontuberculous mycobacteria (e.g., *Mycobacterium avium, M. mucogenicum, M. smegmatis*), and molds (e.g., *Aspergillus, Fusarium*).

Remember to address risk and mitigation

For this reason, the safety of the healthcare facility's water supplies should be part of a comprehensive infection control strategy.

ASHE and ASHRAE have both published guidelines recommending that healthcare facilities prospectively develop and follow a comprehensive water management program that includes a risk assessment of all water treatment systems and all water-use points that present a potential hazard, as well as control strategies to mitigate any problems.[24]

[24] Krageschmidt, DA, et al. A comprehensive water management program for multicampus healthcare facilities, Infection Control and Hospital Epidemiology, 2014 May; 35(5):556-63.

Monitoring of temperature and water throughput or flow are particularly important in the prevention of legionella. Stagnant water in pipes, cooling towers or air handling units can become a reservoir for legionella, which can be aerosolized. The building operation system should monitor temperature and water flow of piping systems and facilitate the automatic flushing of pipes. These preventive efforts should be recorded to demonstrate compliance with infection control regulations. Considerations related to the efficient and effective operation of a facility's HVAC systems should be a part of every healthcare organization's larger infection control strategy.

Hospital leaders, facility managers and infectious disease specialists should work together to ensure that these environmental factors are given the emphasis they deserve as part of the organization's overall efforts to reduce infectious disease risk and HAIs among patients, staff and visitors.

As discussed in this paper, key considerations that warrant close attention include the maintenance of air change rates throughout the facility; the maintenance of the correct pressures for safety in different departments; protocols to manage the flow of people, equipment and supplies; adjusting and monitoring temperature and relative humidity in keeping with current findings; air filtration and removal; ensuring the safety of resilient power supplies; and maintaining and monitoring water supplies. The monitoring, recording and logging of these conditions is also a critical part of the system to ensure safety and adherence to compliance standards.

Healthcare organizations that tap the insights, efficiencies and safety monitoring enhancements available to them through today's smart building operation management platforms will be best prepared to meet the growing challenges they face with infectious disease prevention and management.

About the author

Chris Roberts. As the Global Solution Architect for the Schneider Electric's Healthcare segment, Chris Roberts is responsible for design, development, and support of intelligent healthcare infrastructure solutions. He leads a team of technical experts, and works with external partners to develop integrated architectures that have improved the environment of care and the operating efficiency for healthcare facilities around the world. In addition, he designed and built the Healthcare Innovation Lab where all Healthcare solutions are tested, validated, and documented. Chris serves as Vice President of the Association Medical Facility Professionals, and holds a Bachelor of Science in Engineering Management from University of Lincoln, United Kingdom.

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