

# INSIGHTS INTO HEALTHIER INDOOR ENVIRONMENTS: HEALTHCARE

Hospitals and healthcare facilities have served as the front lines of the COVID-19 pandemic, bearing the responsibility of caring for rapid spikes in patient numbers while maintaining a safe and healthy environment. In rising to these challenges, healthcare settings have renewed focus on the long-standing importance of infection control and flexibility. With new lessons learned and the right strategies in place, healthcare facilities of all types and sizes can harness new opportunities to create healthier indoor environments that inspire confidence for healthcare workers and patients and enhance healthcare experiences moving forward.

### THE NEED

Long before the COVID-19 pandemic, healthcare facilities recognized the importance of better addressing issues around infection control and related costs in an effort to improve patient care and bottom lines. Now, with more focus than ever on indoor air quality (IAQ) and other factors, hospitals and other facilities must take action to create environments that are optimized for infection control, patient health and staff satisfaction.



Healthcare professionals (HCPs) are at an

**increased risk of COVID-19 infection** due to the potential for high frequency, intensity and duration of exposure to patients with COVID-19.<sup>1</sup>

Of every 100 hospitalized patients at any given time, **7 will contract a hospital-acquired infection** (HAI). In developing countries, this number is 1 in 10.<sup>2</sup>



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Annual direct medical costs of HAIs for inpatient services in U.S. hospitals can total up to \$45 billion, where annual benefits of prevention are estimated in the range of \$25 billion to \$31.5 billion.<sup>3</sup>

Studies suggest that anywhere from **10 to 20% of** HAIs are the result of airborne transmission.<sup>4</sup>

Specifications for ventilation in U.S. healthcare settings are provided in guidance documents such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

One study of governance systems in European hospitals found significant inconsistency and decentralization in the management of quality and safety in hospitals.<sup>5</sup>



### THE QUANTIFIABLE BENEFITS OF HEALTHIER FACILITIES

In healthcare facilities, research has shown the ability of building systems and healthier indoor environments to facilitate infection control, promote patient health outcomes and improve satisfaction and productivity of caregivers, nurses and other staff.

When effectively designed and managed, the indoor conditions of healthcare facilities can reduce patient infection rates,<sup>6</sup> speed healing processes, reduce the length of hospital stays<sup>7</sup> and enhance patient recovery time.

Humidity can affect virus residence time in the air. Residence time is extended in low relative humidity conditions, which may pose infectious disease concerns.<sup>8</sup> In addition, low humidity may cause health effects such as itchy skin, cough and thirst, which could impact both patients and healthcare staff.



A comparative longitudinal assessment of indoor environmental quality (IEQ) and occupant perceptions in a LEED®-certified vs. conventional children's hospital between 1999 and 2012 found statistically significant improvements in productivity, staff satisfaction and quality of care:<sup>9</sup>

- 30% reduction in the number of position vacancies and average age of open staff positions in the green hospital compared with its traditional counterpart
- 5% increase in employee tenure
- 25% reduction in general employee turnover
- 10% increase in direct patient time

- 70% reduction in bloodstream infections
- 49% reduction in the number of corrections to the Medication Administration Record
- Specific to registered nurses, the average vacancy rates and turnover rates decreased in the LEED-certified hospital by 60% and 43%, respectively



# ACTIONABLE STRATEGIES AND SOLUTIONS

There is no single strategy for creating healthier indoor environments in today's healthcare facilities. **Carrier can help inspire confidence in returning to normal with a layered defense approach, implementing all levels of control strategies, which can help reduce risk and maximize benefits.** For engineering controls, the healthy building experts at Carrier can help support healthcare customers with solutions and services for the entire lifecycle.



### ASSESSMENTS

There are a variety of IAQ and ventilation solutions to choose from — but not every solution fits every facility's needs. To determine which solutions best meet your needs, Carrier provides **IAQ assessments.** Assessments can be customized to each facility or follow a prescriptive assessment approach and include monitoring and testing.



## 

#### **Strategies**

- Prioritize maximizing fresh air delivery rates to achieve 30 cfm/person. Occupancy loads can also be decreased to achieve recommended air delivery rates per person.
- Eliminate or reduce air recirculation (thus maximizing fresh outdoor air) to the extent possible.

#### Solutions

 Automated Logic WebCTRL<sup>®</sup> building automation system is the hub for intelligent integrations of

technologies throughout a facility. From heating, ventilating and air-conditioning systems to security and access control to fire, lighting and more, WebCTRL enhances efficiency through greater visibility and control of all systems.

 Carrier Agion®-coated 39M air-handling unit provides clean, longlasting anti-microbial protection by resisting the growth of microbes on the equipment's interior panels.





#### **Strategies**

- In healthcare facilities with mechanical ventilation systems, existing filters can be upgraded to filters with efficiency ratings of at least MERV (Minimum Efficiency Reporting Value) 13 or the highest MERV rating the system can handle.
- Portable air cleaners with high-efficiency particulate air (HEPA) filters may be useful to reduce exposures to airborne droplets and aerosols emitted from infectious individuals.

#### **Solutions**

 Carrier filtration technologies include various MERV filters, HEPA filters for particulate matter and Infinity™ electrostatic filters for airborne pathogens. Carrier also offers devices using UVC light, which are intended to target viruses, and UV photocatalytic oxidation to help remove volatile organic compounds and improve indoor air quality.



- Carrier's OptiClean<sup>™</sup> Dual-Mode Air Scrubber & Negative Air Machine cleans and removes potentially contaminated air. The machine creates negative pressure so that when the hospital room door is opened, air is pulled into the room from outside instead of letting potentially contaminated air out from the room.
- Electrostatic filters use static electricity to catch particles as they pass through the filter and help protect facilities from harmful microscopic particles.
- Isolation room solutions such as Carrier's AiroVision™ 39HQM provide negative air pressure delivered with superior IAQ and air purification, and require few machines and minimal ductwork – saving on capital costs, maintenance and testing.







## CONTROLS AND SERVICES

#### **Strategies**

- Facilities should not shut off or reduce their mechanical ventilation during or before regular business hours while there still may be people inside.
- Facilities can ensure that there is adequate ventilation and filtration through a process of commissioning and testing. Commissioning and testing should be performed by trained individuals and should be performed at regular intervals.
- Testing can be done through the use of low-cost IAQ monitors. If CO<sub>2</sub> concentrations are measured at levels below 1,000 ppm while facilities are occupied, then the outdoor air ventilation is likely performing according to acceptable minimum standards. Higher CO<sub>2</sub> concentrations may indicate that other strategies for increasing outdoor air ventilation are necessary.
- To promote healthy indoor environments, real-time monitoring for a variety of pollutants and IAQ parameters, including (but not limited to) carbon monoxide, ozone, volatile organic compounds, formaldehyde and other aldehydes, temperature, humidity, noise and light, is recommended.

#### Solutions

- **Remote Airside Management** provides continuous validation of IAQ parameters, periodic checks of equipment health and continuous airside commissioning, enabled by a command center.
- Remote Energy Management connects HVAC and other systems to provide advanced cloud-based analytics that help optimize energy efficiency, equipment uptime, occupant comfort and operational productivity. Carrier's digital services are based on actionable insights by the EcoEnergy Insights CORTIX<sup>™</sup> building IoT platform.

 Abound, a cloud-native platform, unlocks and unites siloed building data to create smarter and more resilient spaces that improve occupant wellness.

# NBOUND

 FireWorks<sup>\*</sup> Incident Management Platform functions as a remote monitoring and control system, and is ready to provide coordinated, timely communications during threats in environments.



- Carrier's best-in-class BluEdge" service platform offers IAQ assessments, wellness services, retro-commissioning and more. As a result, facilities can operate at their peak performance, providing lower energy and maintenance costs and a more productive, healthier environment.
- Facilities should implement **multi-parameter IAQ monitoring** to baseline performance, identify deficiencies and enable demand control ventilation for specific contaminants of concern. IAQ monitoring can also confirm the effectiveness of filtration and air purification.
- By integrating with the Automated Logic WebCTRL building automation system, zone occupancy sensors can detect occupant presence to help increase ventilation, report alarms and track real-time occupancy. Additionally, securitybased occupancy sensing provides real-time integration to access control systems to determine occupancy based on access card swipes.
- FireCell<sup>®</sup> wireless door controllers are able to hold heavy fire doors open, improving ventilation while providing full health monitoring via system integration.
- SmartCell" wireless fire detection has a wide range of sophisticated fire devices to meet the demands of any facility, and all are wireless, so deployment is fast and easy, and there is no damage to the fabric of the property.
- Automated Logic's TempCTRL" provides patients with individual room temperature controls, is easy to use and can be accessible from a patient's bedside.

## TOUCHLESS PRODUCTS

#### **Strategies**

 No-contact infrastructure is an engineering control method used to reduce the indirect spread of pathogens from fomites. This includes technologies such as automatic dispensers of hand soap/hand sanitizer/paper towels, automatic toilet flushers, hands-free garbage cans and automatic doors.

#### Solutions

 BlueDiamond<sup>™</sup> touchless access enables occupants to eliminate a significant number of access touch points through implementation of industry-leading mobile credentialing technology, supporting a healthier and safer facility.



• **The Carrier MyWay**<sup>\*</sup> **facility services platform** enables occupants to use a mobile phone to interact with a healthy facility – such as opening doors, controlling room temperature, adjusting lighting, locating available conference rooms and finding someone in a facility.

### THE BOTTOM LINE

Patients around the world rely on hospitals and other healthcare facilities to provide the best possible care in a safe and healthy environment. Through healthy building strategies, these critical facilities can help patients and entire communities move past the COVID-19 pandemic while reducing infection rates and hospital stays, enhancing the experience for patients and staff and improving financial outcomes well into the future.

To learn more about healthy building solutions and strategies for healthcare, connect with a Carrier expert today.

<sup>1</sup> Centers for Disease Control (2020)

- <sup>2</sup> World Health Organization (2021)
- <sup>3</sup> Scott (2009)
- <sup>4</sup> Kowalski (2016)

<sup>5</sup> Shaw, Kutryba, Crisp, Vallejo and Suñol (2009)

- <sup>6</sup> Hendron, Leach, Bonnema, Shekhar and Pless (2013)
- <sup>7</sup> Calkins (2009); Nimlyat and Kandar (2015)
- <sup>8</sup> Lowen, Mubareka, Steel and Palese (2007)
- <sup>9</sup> Thiel, Needy, Ries, Hupp and Bilec (2014)

