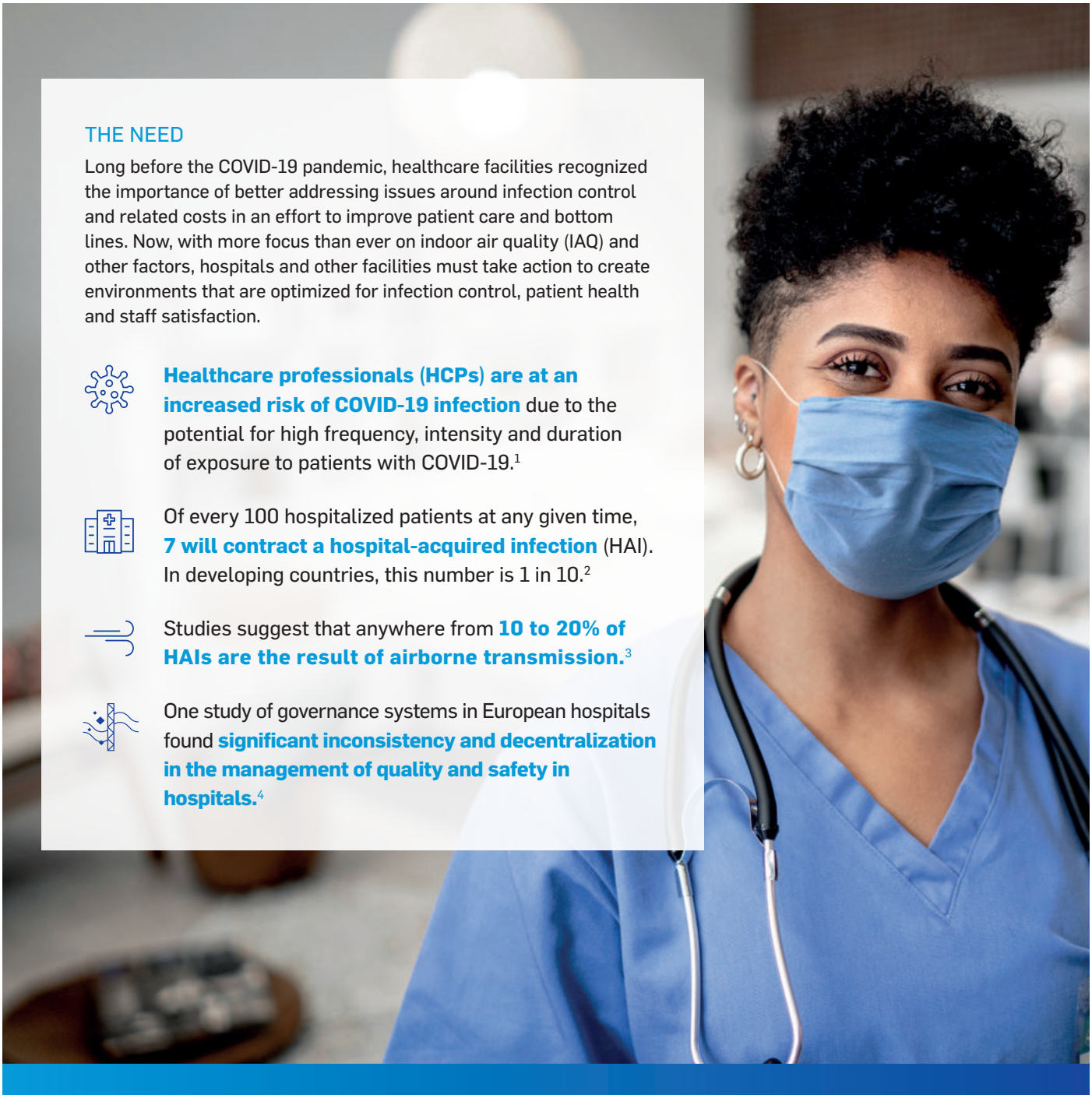
INSIGHTS INTO HEALTHIER INDOOR ENVIRONMENTS: HEALTHCARE

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.[1]

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.[2]

Studies suggest that anywhere from **10 to 20% of HAIs are the result of airborne transmission.**[3]

One study of governance systems in European hospitals found **significant inconsistency and decentralization in the management of quality and safety in hospitals.**[4]

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,[5] speed healing processes, reduce the length of hospital stays[6] 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.[7] 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:[8]

- **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.

VENTILATION

Strategies

- **Prioritize maximizing fresh air delivery rates to achieve 51 m³/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

- **Carrier i-Vu supervision** 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, i-Vu supervision enhances efficiency through greater visibility and control of all systems.

- **Our air handling units (AHU)** provide a cost-effective improvement by inhibiting bacterial and microbial growth on the interior of the unit.

FILTRATION

Strategies

- In healthcare facilities with mechanical ventilation systems, **existing filters can be upgraded to filters with efficiency ratings of at least F7 (ePM2.5 >65%), and up to the highest fine particle classification or even HEPA filters,** if the available pressure drop of the system enables.
- **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 ePM filters and HEPA filters for particulate matter. 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™ Air Scrubber** 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.
- The **new range of Carrier's 39CP air handling units** is the latest generation of AHUs developed to meet the EN 1886 and EN13053 standards, integrating the most innovative components (filters, recovery units, fans, electric motors, etc.). Designed with a green building approach, the 39CP unit can play a part in achieving green building labels.

CONTROLS AND SERVICES

Strategies

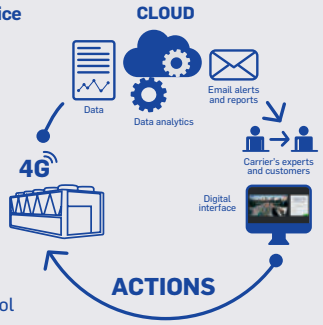
- **Facilities should not shut off or reduce their mechanical ventilation** during or before regular business hours while there still may be people inside.
- **Facilities can ensure that there is adequate ventilation and filtration through a process of commissioning and testing.** Commissioning and testing 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_2 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_2 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™ building IoT platform.

- **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, **security-based occupancy sensing** provides real-time integration to access control systems to determine occupancy based on access card swipes.

PREDICTIVE MAINTENANCE

- Remote connection through BMS manages IAQ and ventilation in line with best practices
- Make changes and fix issues remotely
- Optimize maintenance and operational costs
- 24 x 7 command center

HVAC EUROPEAN DIGITAL PORTAL (ABOUND™ HVAC PERFORMANCE)

- Provide advanced remote analytics
- Optimize energy efficiency, equipment uptime, occupant comfort and operational productivity
- Actionable insights by different communication protocols
- Optimize autonomously or through a remote application

RETROFIT SPARE PART SOLUTIONS

INNOVATIVE TECHNOLOGIES

- M5 filters
- New filtering media technologies
- High filtration efficiency of PM2.5 particles

ADD-ON RETROFIT ALTERNATIVES

- AHU-UVC add-on kits
- Carbon surface & F7 filtering technology options
- Add-ons are easy to install in the universal frames of existing AHUs
- Effective against viruses, bacteria, small particles and VOCs

RANGE OF FILTRATION SOLUTIONS

- High-efficiency filtration solutions
- A large variety of air filters
- Solutions for our full product range (AHU, RTU, TFCU)
- More than 1300 references of air filters to cover all sizes / filtration needs

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.

[1] Centers for Disease Control (2020)
[2] World Health Organization (2021)
[3] Kowalski (2016)
[4] Shaw, Kutryba, Crisp, Vallejo and Suñol (2009)
[5] Hendron, Leach, Bonnema, Shekhar and Pless (2013)
[6] Calkins (2009); Nimlyat and Kandar (2015)
[7] Lowen, Mubareka, Steel and Palese (2007)
[8] Thiel, Needy, Ries, Hupp and Bilec (2014)