

# ENVIRONMENT & PATIENT OUTCOMES

HOW DESIGNERS,  
ARCHITECTS,  
ENGINEERS,  
BUILDERS AND  
FACILITIES STAFF  
CAN AFFECT PATIENT  
OUTCOMES By  
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**W**hen your business is healthcare, results are measured first in patients' health outcomes. So the stakes are high.

Hospitals are pursuing every avenue to deliver the best possible results. That means part of the equation for achieving an effective healing atmosphere requires understanding that a hospital's physical environment is linked to the health of patients and caregivers, and it has a direct impact on the satisfaction of both.

A healthy hospital environment translates into better quality care and better health outcomes for patients. Fully optimized hospital building systems are critical to a healthy hospital, whereas substandard building systems can have a negative effect on the health of patients and staff, not to mention a significant negative effect on the bottom line.

In these challenging times, and as the swell of baby boomers heads into their advanced years, healthcare needs promise to increase over time. Consequently, the importance of creating high-performing buildings that facilitate staff effectiveness and enable patient healing is even greater. Hospitals that provide healthy, comfortable and cost-effective healing environments where caregivers can excel and patients can heal will have a

significant advantage over healthcare facilities that struggle to maintain such an environment.

## The unseen link to patients

A visit to the hospital these days can be risky for patients, families and staff. Hospital-acquired infections are among the leading causes of death in the United States, killing more Americans than AIDS, breast cancer or automobile accidents, according to the Institute of Medicine.

A scan of the medical literature, funded by the Robert Wood Johnson Foundation and led by the Center for Health Design, found hundreds of articles in peer-reviewed scientific journals demonstrating the effects of the hospital environment on patients and staff. More than 120 of those studies link infection to the physical structure of the hospital, and several of those specifically link air quality and infection rates.

In one of the cases cited in the Center for Health Design's study, six patients and a nurse were infected with epidemic methicillin-resistant staphylococcus aureus, which was traced to a ventilation system. In another case, the source of the infection was the exhaust ducting of the adjacent isolation room ventilation system.

Health isn't the only issue. Finances play a part too.

## Build infection fighting tools into the hospital

Just as medical practice follows an evidence-based approach when making clinical decisions, statistical data on patient outcomes and staff turnover now influences the physical environment of healthcare facilities. Armed with the knowledge that hospitals can harbor infectious agents, hospital designers and builders are increasingly turning to this research data to make design decisions.

Whether renovating or rebuilding, builders use evidence-based design to create hospitals that help patients recover more safely, support caregivers in performing their jobs better, and enable healthcare organizations to run more cost-effective and efficient healing environments.

The Robert Wood Johnson/Center for Health Design report resulting from the study opened the door for design improvements, many of which are now being deployed in the Pebble Project, a research program run by the Center for Health Design to help hospitals compare design innovations with pre-existing conditions. The goal was for the nearly three dozen hospitals participating to be pebbles that create ripples of positive design practices through the healthcare industry.

Bronson Methodist Hospital is one of those pebbles. The Kalamazoo, Mich.-based hospital reports an 11 percent decrease in hospital-acquired infection rates and attributes the improvement to the use of private rooms, a new ventilation system design, and more sinks to encourage frequent hand washing.

Other Pebble Project hospitals report dramatic reductions in staff turnover and improvements in patient satisfaction due to noise-reducing acoustical ceiling tiles and walls, updated and/or natural lighting, and improved indoor air quality through increased ventilation and airflow. These

## What is the first step toward a healthier hospital?

A comprehensive building systems audit by a professional high-performance building or energy engineer will tell you how well your hospital building and systems are performing, how to best achieve optimal performance, and identify and quantify the energy efficiency and cost savings that your building can deliver.

Whoever does your building audit, make sure that they:

- > Are experienced in designing, installing and servicing building systems comparable to your building's size and activities
- > Have a successful track record in design, service and installation of building systems
- > Can understand and apply total building solutions to address your business mission and operating budget targets.

Outcome-focused energy management that serves the needs of your business is the only type of energy management you should have. A sound understanding of your building's systems and structure will help provide that.

include Parrish Medical Center, Titusville, Fla.; Saint Alphonsus Regional Medical Center, Boise, Idaho; and the Barbara Ann Karmanos Cancer Institute, Detroit, Mich.

Considering that the estimated annual cost of hospital-acquired infections in the United States is \$5 billion, according to the Centers for Disease Control and Prevention, the opportunity to realize significant savings by investing in healthier building designs from a financial perspective also is compelling.

Even older, existing hospital structures can improve indoor air quality, deliver a more comfortable environment, and drive cost savings by retrofitting with new energy-saving technologies and evidence-based design changes. In addition, new healthcare buildings in the design and early building stages can deliver healthier environments and cost savings through proven design qualities, proper equipment installation, and correct control and maintenance.

## Indoor air quality not just hot air

Indoor air quality for infection control and comfort has a significant effect on patient care and health outcomes. Maintaining healthy air quality is critical to achieving healthcare setting accreditation, including Joint Commission on Accreditation of Healthcare Organizations standards.

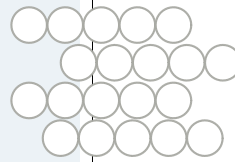
High-quality HVAC systems are critical to infection control. They also ensure comfort levels to facilitate patient healing and staff productivity.

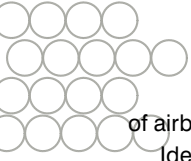
Indoor air quality is important to successful patient outcomes and should be considered part of healthcare delivery. There are numerous published rules and guidelines for ventilation rates, filtration efficiencies, and pressure control set out in building codes and state health departments. This is why it's important for HVAC engineers and healthcare professionals to work together when establishing the indoor air quality requirements or guidelines for a healthcare setting.

The survival of microorganisms, which can lead to infection, depends largely on three factors: ventilation, temperature and humidity.

## Ventilation

Up to one-third of all hospital-spread infections are airborne. Airborne contaminants include inorganic particles, airborne mold and bacteria. In poorly ventilated hospitals there is a higher risk





of airborne infectious particles.

Ideally, at the design stage the ventilation system is developed to meet the specific and strict indoor air quality needs of different hospital spaces, including operating rooms, intensive care units, airborne infection isolation areas, as well as general patient rooms, waiting areas and cafeterias.

Existing systems also can be upgraded to improve ventilation, filtration frequency of air exchanges, positive and negative air pressure, and exhaust systems. To meet optimal indoor air quality levels, air changes must occur at high frequencies with low airflow velocity. Highly effective air handlers with low leakage rates meet high filtration and static pressure standards essential to infection control. The ventilation system also should be flexible to change the room environment as necessary to isolate or contain the potential spread of airborne infection.

### Moisture control matters

Moisture control also is important to prevent the spread of pathogens. Excessive humidity can promote the spread of microbes and also requires re-sterilizing equipment.

Moisture technology, such as desiccant dehumidifiers, is helping to meet the stringent humidity requirements in healthcare settings. For example, Cool, Dry, Quiet Dehumidification with Climate Changer Air Handlers is a patented innovation developed by Dr. Charles Cromer at the University of Central Florida with partial funding from the Department of Energy. It is an energy-efficient humidity control solution for healthcare facilities, using a type II desiccant rotor. A return area regenerates the desiccant, which operates at 75 degrees Fahrenheit, and performs with 20 to 25 percent greater efficiency.



## Georgia facilities improve care while reducing costs

Improving the quality of patient care while saving energy and being operationally efficient is a three-legged stool that many U.S. hospitals continually work to balance.

The board of Evans Memorial Hospital in Claxton, Ga., and Glennue Nursing Home in Glennville, Ga., found a solution for all three by engaging in a performance-based contract with a national building systems supplier that will fund much-needed renovations through energy savings.

By reducing energy and operating costs, it is anticipated that the \$1.84 million in renovations will pay for themselves over 13 years.

“Healthcare facilities are constantly trying to find ways to cut costs while continuing to provide quality, compassionate

healthcare,” said Martha Tatum, CEO of Evans Memorial Hospital. “This usually means maintenance and upgrades to facilities end up at the bottom of the list. We recently found ourselves in this

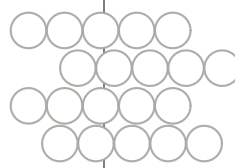
this, save on energy and improve building systems through this energy project.”

Energy and operating cost savings will be achieved through redesign of the mechanical and electrical systems, lighting and plumbing upgrades, and installation of high-efficiency heating, ventilation and air conditioning units at Glennue Nursing Home; and a new chiller and cooling tower with supporting systems, lighting upgrades, and heating, ventilation and air conditioning upgrades at Evans Memorial Hospital.

The improvements at the facilities result in a kWh reduction of 17 percent at Evans Memorial Hospital and a 36 percent kWh reduction at Glennue Nursing Home. This is equivalent to saving 725 tons of carbon dioxide annually, the equivalent of taking 143 cars off the road or eliminating 85 households’ electricity use for one year.



exact situation with aging facilities lacking modern, energy-efficient technology and a very real possibility that some of our systems would fail and not work again. We saw an opportunity to solve



Strict pressure control also is necessary to prevent mitigation of airborne contaminants. Operating rooms must be kept at positive pressure relative to other areas to diminish movement of infectious contaminants. Airborne infection isolation rooms must be kept at negative pressure to limit movement of infectious agents, such as tuberculosis, from the patient to other areas of the building. Protective environment rooms must be kept at positive pressure to protect immuno-compromised patients from infectious agents elsewhere in the building. HVAC systems should be designed and maintained to meet the various pressure needs of these healthcare spaces.

### **Keeping hot and cool**

Temperature control not only is a question of patient and staff health but of health outcomes.

For example, hypothermia, a lowering of the body temperature of less than 36 degrees Celsius, can lead to surgical site infections. Low body temperature may increase patients' susceptibility to such infections by causing vasoconstriction and impaired immunity.

Temperature also is critical to the patient experience. When evaluating hospital stay visits, patients typically remember whether they experienced comfortable temperatures during their stay. Heating and cooling solutions for hospitals should be designed to ensure the healthiest and most comfortable temperatures for each space setting, from surgical suites to patient rooms and visitor waiting spaces.

Routine monitoring of air quality, including bacteria, viruses, particulate, pressure and moisture enables the hospital to uphold or surpass regulatory

standards and correct any problems leading to high contamination risks. A particle counter measures the efficiency of filtration. The size of the filter, the seal on the housing and spacers installed for fit all may contribute to assuring that airflow passes through the filter media.

Better healthcare buildings mean better health outcomes for patients. Healthcare institutions and providers have the data and analysis to support the case for better buildings. The healthcare building design and construction industry has the know-how. Better healthcare buildings make good sense for patients, caregivers, communities and businesses.

**Laura Rygielski Preston, FACHE, joined Trane in January 2006 to lead its efforts in serving the healthcare market in the Americas. She is a fellow in the American College of Healthcare Executives and is board certified in healthcare management.**