A Cruel Irony: Sick Building Syndrome in Healthcare Facilities

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Written by GBRI

What happens when a building designed for healing ends up making people sick? Healthcare facilities, particularly hospitals, have traditionally been war zones where the fight against infection takes place, employing the weapons of thorough sterilization and high-tech treatment. The design of the building itself also plays a part in keeping the facility medically sound. Unfortunately, many healers and patients are at a disadvantage without realizing it—due to Sick Building Syndrome (SBS). Indeed, studies have shown that no building, not even a hospital, is immune to this very real but often misunderstood malady. Compounding the irony, healthcare facilities have been slow to adopt the only cure for SBS: green building. Of the thousands of medical centers in the US, less than 200 are currently listed in the US Green Building Council's directory of LEED-certified healthcare projects.

Sick Building Syndrome can affect the occupants of practically any building, whether it's an office, a school, a museum, an apartment complex, or a hospital. According to the National Safety Council, the primary symptoms of SBS are headaches; irritation of the eyes, nose, and throat; a dry cough; dry or itchy skin; fatigue; difficulty in concentrating; dizziness and nausea; and sensitivity to odors. These symptoms do not originate from a clinically defined disease or a specific contaminant. In other words, when looking for the cause, you can't simply pinpoint something as in a typical medical diagnosis. Instead, you have to look at the entire area—sometimes the entire building—where SBS symptoms have emerged.

A combination of factors usually creates an SBS situation. Outdoor pollutants (e.g. exhaust from vehicles, plumbing, bathrooms, and kitchens; or combustion byproducts from a garage) can infiltrate the building through various openings. Indoor pollutants (e.g. volatile organic compounds, or VOCs, such as formaldehyde) emanate from adhesives, carpeting, cleaning agents, upholstery, copy machines, pesticides, and manufactured wood products. Also, fireplaces, stoves, and unvented space heaters can release combustion products. Tobacco smoke is another key pollutant. On the biological side, pollen can easily permeate the air, and bacteria, viruses, and molds can breed in the water in ducts, drain pans, and humidifiers, or in carpet, insulation, or ceiling tiles. Some SBS victims have contracted Pontiac Fever and Legionnaire's Disease from the *Legionella* bacterium. Biological contaminants add fever, chills, cough, muscle aches, chest tightness, and allergic reactions to the list of SBS symptoms.

While most buildings contain at least a few of these pollutants (I mean, the world is a dirty place), the ones where SBS develops were poorly designed, are being used out of keeping with the original design, are being polluted by occupant activities, or have a combination of these problems. For instance, buildings constructed back in the 1970s had to be airtight in order to conserve energy during the oil embargo. However, this greatly reduces ventilation, allowing contaminants to remain in the air.

Because of the nature of their operation, healthcare facilities present extraordinary challenges in SBS prevention. One of the most obvious problems is the age of the buildings. Most hospitals in the US are around 30 years old, and while longevity should always be a priority in hospital design, it should not be such as to render operational methods obsolete in the future. And that's precisely where our medical centers stand now. To begin with, the largest are built according to a "deep plan." That is, the horizontal distance from the external wall is many times greater than the height between floors. This type of construction costs less per unit floor area and uses the site more efficiently. On the other hand, the core areas (e.g. diagnostic and treatment blocks) lack natural illumination from windows and so must be illuminated with electricity. The deep plan also necessitates mechanical conditioning, and hospitals generally have multiple back-up systems (some are redundant) so that the facility can continue to provide care if an outage or malfunction occurs. To add to the energy output, the diagnostic equipment, no matter how technologically advanced, has a large heat load.

In this environment of mechanical conditioning and ventilation and artificial lighting, healthcare workers and patients find themselves unable to escape the physiological effects of non-green building materials (e.g. vinyl, high-VOC paint, etc.), cleaning agents, anesthetic gases, laboratory chemicals, pharmaceutical products, mold-causing moisture, combustion pollutants, and construction dust from renovations. Working in a hospital becomes an occupational hazard, interfering with performance, and staying in a hospital proves counterproductive and unduly expensive.

Though slow to respond to SBS, hospitals have taken measures to improve indoor air quality through sustainable designs. American builders study the successful practices of other nations. In Europe, the best hospitals don't follow the deep plan, but instead use an interior courtyard to supply daylight to areas otherwise artificially lighted. For the nursing units, natural or passive conditioning is used, and for the other units, mechanical conditioning comes in the form of displacement ventilation, where cool air is introduced at floor level, displacing the warm, contaminated air, which rises and leaves through the exhaust vents in the ceiling. This type of ventilation leaves a zone of fresh, cool air at the occupied level, and works well in single-bed rooms. In the developing world, where infrastructure is basically nonexistent, healthcare facilities must become self-reliant, establishing on-site sources of potable water and renewable energy. Green builders hope that US hospitals too can reach a level of sustainability in spite of the infrastructure already present in the country.

Dell Children's Medical Center of Central Texas in Austin, the first acute-care facility to be certified LEED Platinum, represents one of the greatest green building achievements in US healthcare. Six courtyards, containing local vegetation and water features, serve as the "lungs" of the building and take in clean, oxygen-rich air to fill the interior spaces. There is no lawn maintenance, vehicle exhaust, or smoking. Air handlers are matched with specific zones of the building, thus reducing the distance air must travel through the ducts. As in developing countries, Dell utilizes on-site energy: a combined cooling heating power (CCHP) plant with natural-gas-fired turbines. Inside, builders used low-VOC paints and adhesives. Hospital floors are commonly made of sheet vinyl and vinyl composition tile, requiring continuous waxing and stripping, but the (natural) linoleum floor at Dell can be cleaned with only soap and water. To the

delighted surprise of the occupants, the medical center did not have a “new building” smell, which is a telltale sign of dangerous off-gassing.

New York Foundling in the South Bronx needed to combat high asthma rates, so it was designed as a combustion-free building, relying on a ground-source heat pump instead of a furnace. Like Dell, Foundling has several biofilters: a large vegetative wall and two intensive roof gardens, as well as gardens both inside and out. Low-VOC materials were used in construction, and at the construction site the workers adhered to strict dust-reducing methods such as keeping overhangs, ledges, and exposed piping to a minimum; using air locks and walk-off mats; and capping and sealing ducts as they worked. Breaking with medical tradition, the designers of Foundling decided to incorporate operable windows to increase ventilation. Normally you can’t open the windows in a hospital.

The chief objection to green building is the perceived cost, when in reality it’s not much more expensive than conventional building and provides priceless benefits in terms of clean energy, self-reliance, and high employee morale (due to healthier conditions). But monitoring the indoor air quality of an existing medical center poses a greater problem, because it requires that occupational health (OH) personnel work with staff and bring SBS-related symptoms to the attention of management. If it’s difficult to convince hospital directors to “go green,” it’s even harder to gather data from multiple employees, discover the various causes of the symptoms, and prove without a doubt the connection between the symptoms and the work environment. Then action must be taken to improve the indoor air quality, but symptoms may persist after the renovation. Sometimes further renovation is necessary. The delay in relief, coupled with the expense of repair and the closing of workplaces, can create a tense atmosphere among the staff, OH, and management.

It’s possible to stay abreast of SBS at a hospital through systematic monitoring, the use of questionnaires and efficient information systems, and cooperation between all parties. In some cases, the situation warrants a complete redesign of the building according to green principles. Yet the skepticism regarding SBS and green building remains a formidable obstacle, which can only be surmounted with increased investigation and education.