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Turning Healthcare Green: A Case for Sustainable Healthcare

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The author, an experienced healthcare architect, specifier, and green building advocate, claims the healthcare industry has been slow to realize the rewards achieved through sustainability. He contends that hospitals are seen as important institutions in our society; however, for those institutions to maintain the respect they have earned, they need to be able to demonstrate that they are indeed a source of health for our communities, both symbolically and practically. By employing green building practices in the operation and construction of healthcare facilities, the industry can demonstrate its respect for its community and the environment.

Roberts recounts how healthcare has reacted to judicial regulations of its waste management practices and implemented energy conservation upgrades to improve its bottom line while ignoring the long-term benefits achieved from a holistic approach to environmental responsibility. He examines the five LEED elements of sustainability, including how they are interconnected, and presents some examples employed in healthcare facilities today.

The author concludes that sustainable design offers the potential benefits to the healthcare industry of reducing costs, energy consumption, and liabilities, while meeting the growing body of environmental regulations. Likewise, he points to how improved indoor environmental quality can diminish health risks, complement the healing process, and attract and retain staff. These sustainable features and practices can strengthen an institution's presence in the highly competitive healthcare market, and enhance its public image as a responsible environmental steward in the community.

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Toxic mold, high-energy costs, rolling blackouts, global warming, nursing shortages, poor air quality...the headlines of today are all issues that can be addressed through sustainability or green design. Sustainability, as defined in 1987 by the United Nations World Commission on Environment and Development, is "development that meets the needs of present generations without compromising the ability of future generations to meet their own needs." This is a definition that easily equates with the credo of every healthcare professional, primum non nocere: First, Do No Harm.

The holistic framework of sustainability took root in Sweden in 1989 when Dr. Karl-Henrik Robèrt, an oncologist who noticed a significant increase in childhood leukemia cases and the connection between human illness and toxins. On a cellular level, he observed that there are limits within which a living cell will properly function. He was concerned that so much of the environmental debate was focused on downstream issues and so little on systemic causes of problems. With the help of 50 Swedish scientists, Robèrt developed a consensus document that describes the basic knowledge of the biosphere's functions, how society influences natural systems, humans as a part of natural systems, how humans are threatening themselves by deteriorating natural functions, and the many possibilities to change the situation. In the early 1990s, Robèrt worked with Swedish physicist John Holmberg to define a set of system conditions for sustainability that are based on laws of thermodynamics and natural cycles. Together, the ideas behind the consensus document and the four system conditions are the foundation of The Natural Step, which has become the backbone for building an ecologically and economically sustainable society.

The value of sustainability has been recognized by governments, academic institutions, and a growing number of corporations and commercial developers. Healthcare, on the other hand, has been slow to realize its rewards. While the industry has made considerable strides on the operational side through energy-efficient operation and the improved handling and reduction of solid waste, these account for only a portion of the benefits that can be achieved from a holistic approach to the design, construction, and commissioning process.

In 2000, $19.67 billion was spent on healthcare construction. While healthcare buildings are among the least prevalent commercial building types--105,000 by the EPA's estimate--they are the fourth highest consumer of energy for all building types. At 561 trillion BTUs, they account for 11% of all commercial consumption. The healthcare industry also contributes 5 million tons of solid waste annually to the nation's landfills. Nationally, the healthcare industry employs 4.5 million workers, accounting for 6% of the total commercial workforce. National health expenditures account for 13.4% of the gross domestic product and 31.8 million people (inpatients) were discharged from the nation's hospitals in

1998.

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The numbers illustrate that in addition to providing medical service in the community, the healthcare industry is a significant employer and a major purchaser of goods and services. And of course this means that the industry is also a significant consumer of resources and producer of wastes. Communities set great store by their hospitals, which are seen as important community institutions. For healthcare to maintain the respect it has earned, it needs to be able to demonstrate that it is indeed a source of health for the community, both symbolically and practically. One way the industry can do this is to demonstrate that it is being more environmentally sustainable. Application of sustainable practices within the industry as a result of this large footprint can make a tremendous impact on improving the environmental stewardship of our resources while enhancing the healing process.

Sustainability encompasses far more than federally mandated solid waste handling or energy-efficient systems to reduce operating costs. The U.S. Green Building Council has divided the elements of sustainability into five categories in its building evaluation system known as LEED (Leadership in Energy and Environmental Design): sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.

A much more concerted effort is needed from America's healthcare institutions to address sustainability, not only in their practices, but also in their design and construction. While applying bits and pieces of green design to solve a particular issue are commendable, they miss the larger impact and long-term benefits of a holistically designed sustainable solution. To better understand sustainability and how the elements are interconnected, we will examine the five basic elements in more detail and look at some examples employed in healthcare facilities today.

Sustainable Sites

Sustainable design does not stop at the property line. It has a far more global meaning that encompasses both the ecosystem and its community resources. Sustainable design examines how local, regional, and global conditions influence and shape the site, as well as how the site's design will enhance the standards of living of those environments.

Lake Forest Hospital in the Village of Graylake, Ill., is an example of just such a sustainable site. The campus' vision statement says it all: "The campus will be physically inviting with a sense of healing and will promote a healthy lifestyle." The designers took a 44-acre parcel, intensively farmed since 1861, and returned it to a biodiverse environment, complementing the adjacent Prairie Crossing conservation development. The site design uses the diversion and detention of water runoff as an integral part of the plan, enhancing the site's restored wetlands. The design avoided a sea of asphalt by dispersing parking in smaller lots, and grading to allow bio-filtration of oil and sediment before water flows into the wetlands. By carefully balancing the development needs of the 256,000 square feet of building space and 736 parking spaces, the designers created effective storm water management and a more

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stimulating healing environment.

Water Efficiency

The amount of fresh water consumed by buildings and by irrigation of the surrounding land are key concerns of sustainable design, since industry accounts for 20 percent of the world's water consumption. Already, water shortages in the Western and Midwestern states demand conservation efforts. Sustainable design can answer these demands by reducing consumption of fresh water by specifying materials that do not waste excessive water in their manufacturer, by selecting water-efficient fixtures and appliances, and by selecting landscape vegetation that requires minimum irrigation. More advanced designs can implement gray-water and rain catchment systems for toilet flushing and irrigation.

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Two healthcare facilities are meeting the challenges of water conservation by using ozone water purification systems in their laundries. The recently opened Mercy Health Center in Laredo, Tex., reports a reduction of 90 percent in water heating costs, 50 percent reduction in chemical usage, and a 20 percent shorter wash time. It has also noted a 25 to 40 percent increase in fabric life as a result of the new technology. Ozone also purifies water in Mercy's cooling towers as an alternative to chemical treatment resulting in less down time for cleaning. Virginia's Department of Mental Health hospital in Lynchburg reports similar savings since its ozone laundry system went on line in 1998.

Energy and Atmosphere

Improving energy efficiency is the best way to meet energy demands without adding to air and water pollution. This is one sustainability element healthcare has not fallen behind the curve on. Healthcare firms are working in tandem with governmental programs such as local utility conservation guidelines and EPA's Green Lights and Energy Star Buildings to improve their facilities and reduce consumption and pollution.

Leading edge solutions undertaken recently include the lake-coupled geothermal system at Burlington, Iowa's, Great River Medical Center, which went online in April 2000. Great River set out with the vision to "build one of the most energy-efficient health facilities in the country--both to reduce operating costs and to minimize patient-care costs." It is reaching that goal through a 15-acre lake designed as a thermal source and heat sink for the lake-coupled geothermal system, one of the nation's largest. Working with the local utility, the designers were able to offset the 15% higher costs of the system by an unprecedented $2 million rebate.

Taking a different approach in saving money while being environmentally sensitive, St. Mary Medical Center in Long Beach, Calif., began using an environmentally friendly blend of soybean oil to fuel its boilers and generators. This alternative to natural gas is saving the facility $50-$400 a day while reducing emissions.

The University of Massachusetts Medical Center in Worcester installed a new cogeneration system as part of a comprehensive energy strategy. The hospital anticipates that it will be 43% more fuel-efficient than the original steam turbine system and estimates it will be able to generate electricity for about half the cost of purchased electricity. The system is expected to save $36 million in utility and operating costs over the next 10 years while improving power and reliability. Lake Forest Hospital, highlighted above, is likewise undertaking a power upgrade by installing a 3200-kW cogeneration system to power 99% of its electrical needs.

Another first for healthcare is taking place at New York's North Central Bronx Hospital, where a 200-kW fuel cell power plant has gone into operation, generating clean electricity. The installation, derived from technology pioneered in the space program, offers an environmentally benign alternative to traditional power sources while providing a clean, dependable source of electricity for the hospital's diverse needs. Operating

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since 1997, the 185-kW fuel cell at Naval Hospital Jacksonville, Fla., saves about $52,000 annually in energy costs.

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Medical waste incinerators are among the top industrial sources of both dioxin and mercury contamination, according to the Environmental Working Group/Health Care Without Harm study "Greening Hospitals." Yet, over 40% of the survey respondents continue to incinerate medical waste that should in fact be treated by safer methods. Borrowing from European technology for drying fruit, Mercy Health Center in Laredo, Tex., has implemented a disposal system that shreds "red bag" waste, disinfects it in a fluidized bed of heated air, and then ejects the treated material into sealed containers. The system has proven to be safer for employees too, "because once the waste is put in the red bag, it is never again touched by human hands."

Designing and installing efficient, high-tech equipment does not signal the end of the energy efficiency quest. Commissioning has become a fundamental procedure in sustainable designs. The traditional practice after equipment installation has been to turn it on, test, balance, and walk away. Commissioning takes that process a step further to ensure the building components are working together as designed. Commissioning is a systematic, detailed process of ensuring that all building systems perform interactively according to the documented design intent and the facilities operational needs. Florida Power & Light Company recently presented Bethesda Memorial Hospital in Boynton Beach the Outstanding Building Commissioning Award for its success in improving operating efficiency and energy cost savings through commissioning.

Materials and Resources

"Health Care Without Harm" is a campaign devoted to reducing the environmental harms--namely, pollutants and unnecessary waste--generated by the healthcare industry. It has published a landmark study titled "Greening Hospitals" that documents the efforts and shortcomings of America's top hospitals in preventing pollution.

The study reports, among other issues, that hospitals around the country have implemented procedures to eliminate the use of PVCs in such products as IV bags, vinyl gloves, plasma collection bags, and sharps containers, to name a few. PVC is thought to account for 45 percent of dioxin emissions from the healthcare industry, a proven carcinogen. But that same commitment has not been focused on the many PVC products used in healthcare construction. Construction applications account for two-thirds of all PVC use, according to Greenpeace. The list of those products can be extensive, but a few familiar ones include vinyl wall covering, vinyl guardrails and corner guards, vinyl composition floor tile, carpet backing, electrical wire covering, and plastic piping. Greenpeace has labeled PVC a top environmental concern and has listed on their Web site alternatives to PVC in construction. Almost daily, new and innovative environmental building materials are introduced that are nontoxic, made of recycled materials, manufactured with low embodied energy, and derived from renewable, salvaged, and certified sustainable sources.

A number of medical facilities across the nation, from Roanoke (Va.) Memorial Hospital to Mercy Hospital in Sacramento, Calif., have

implemented comprehensive recycling programs to reduce their waste stream, even moving away from disposable products to reusable goods. This same dedication can easily achieve environmental results by exploring adaptive reuse of aging facilities in lieu of filling the landfills with demolition waste (construction accounts for 28% of the landfill volume in this country). Another possibility is deconstructing buildings slated for demolition by reducing the "tipping fees" of landfilling waste while generating revenue from resale of the salvaged materials.

"Green leasing" is a sustainable partnership between owners and manufacturers for creating economies and conserving resources. With a green lease the owner receives the service of a product without owning it, while the manufacturer retains the responsibility for the disposition of the product at all times. So when a product wears out, breaks down, or is replaced by a new model, the manufacturer is obligated to repair, refurbish, reclaim, or disassemble it for recycling and install a new model. Since 1999, Duke University Medical Center has benefited from a "Bed Management" program with Hill-Rom. Under the green lease, Duke receives the services of over 800 state-of-the-art beds--without locking into one model for 10 or 12 years--while Hill-Rom is responsible for maintenance, repairs, and bed movement 24 hours a day, seven days a week.

Carpet mills and large equipment manufacturers are offering green leases, which they view as a long-term business relationship that provides cost efficiencies and a closed loop of recyclable resources. Roofing manufacturers and other building component manufacturers are also exploring the benefits of these innovative business approaches.

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Indoor Environmental Quality

Faced with a tight labor market, corporate America has discovered that sustainable solutions can attract and retain employees by offering a safer, cleaner, more pleasing work environment. A number of studies have found that increased worker productivity and reduced absenteeism have been the direct result of green design solutions.

Indoor air quality (IAQ) has emerged as a key issue in sustainable design due to its relationship to occupant health and productivity, as well as to energy conservation, building materials, and HVAC system design. Poor IAQ has been linked to sick building syndrome, building-related illnesses, and multiple-chemical sensitivities. Good IAQ, according to the EPA and NIOSH, includes introduction and distribution of adequate ventilation air, control of airborne contaminates, and maintenance of acceptable temperature and relative humidity.

Studies indicate that most people spend as much as 90% of their time indoors, where the level of pollutants may be 2 to 5 times (and on occasion 100 times) higher than outdoor levels. Accordingly, EPA and its Science Advisory Board rank indoor air pollution among the top five environmental risks to public health. It has further been estimated that improvements in indoor air quality could annually avoid up to $43 billion in healthcare costs and as much as $125 billion in productivity loss.

Building materials can have a significant impact on indoor air quality, in terms of odors, particles, and volatile organic compounds (VOCs). VOCs refer collectively to a large number of mostly petrochemical-derived substrates that readily volatize at room temperature and contaminate indoor air. The most significant sources of VOCs include wet-applied products such as paints, sealers, adhesives, pesticides, and joint compounds. Other materials like carpeting, vinyl flooring, wood sheet products (e.g., particleboard, plywood), insulation, and furnishings also emit VOCs. Wet-applied materials are a major concern because they evaporate after application and therefore release a large percentage of their weight. Carpets not only release VOCs, or off-gas, but also act as sinks to absorb VOCs released by other products, slowly re-releasing them over time. Other things that act as sinks are drywall, acoustic ceiling products, furnishings, and fabrics.

Most studies suggest that VOC emissions decrease over time. Some individual VOCs are known or suspected human carcinogens or irritants to the eyes, nose, and mucous membranes. The complex chemical combinations are not well understood and the increasing number of VOC combinations hamper definitive studies. Nevertheless, it has been established that VOCs contribute to indoor air pollution, building related illness and urban smog production. As a result, the EPA, under the 1970 Clean Air Act, implemented the National Volatile Organic Compound Emission Standards for Architectural Coatings.

Indoor air quality is especially vital in healthcare facilities, not only for infection control but also for enhanced occupant health and productivity.

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The Center for Health and Healing at Beth Israel Medical Center in New York treats many patients suffering from environmentally induced medical problems. The designers for that project selected materials and installation methods that would eliminate any substances that might aggravate a patient's health. Natural biodegradable flooring materials of cork and linoleum were used, as were fabrics with a high-recycled content. To maintain a healthy IAQ, materials were selected based on whether they could be cleaned with natural products.

Particles (dusts) and bioaerosols (fungus, bacteria, pollen, mites) also contribute to poor IAQ. Installation and maintenance of HVAC systems is a major component in the equation. The systems must be able to displace VOCs, respired carbon dioxide, body odors, fragrances, skin flakes, and particles shed from clothing and office machines. Additionally, the systems must provide dehumidification. Because microorganisms need water to grow, moisture intrusion into buildings plays a critical role in sick building issues.

IAQ is a serious subject brought to the forefront of public attention by reports of Legionnaires' disease, salmonella, E. coli, and other sources of sick buildings and building-related illnesses. Accordingly, one law review reports that more than $700 million in damages has been awarded to date in IAQ lawsuits, with a $1 million average settlement. Aside from the liability exposure, numerous studies have shown that buildings designed for good IAQ have other benefits as well, including improved productivity, safety, and occupant well-being, not to mention the extended life and value of the building.

A growing volume of scientific evidence and case studies indicate that environmental factors do affect the quality of healthcare. Dr. Roger Ulrich, environmental psychologist at Texas A&M University, has published studies that link a patient's proximity to natural views and daylight to shorter recovery times, fewer complications, and reduced need of pain medications than those forced to stare at neutral, unnatural settings. Therefore, daylighting can provide both energy conservation and therapeutic results. The amount of light exposure affects vitamin synthesis and biochemical and hormonal body rhythms, according to Dr. Ulrich's research.

Landscape elements, long used as climatic buffers against heat and wind, are also having profound effects on the healing process. This body of research has proven that therapeutic gardens and natural environments can not only add to the healing process for patients but also reduce stress on the healthcare staff. NASA studies have shown that indoor plantings are capable of cleaning out VOCs. According to Dr. William Wolverton, NASA's principal investigator in this research, "Low levels of chemicals such as carbon monoxide and formaldehyde can be removed from indoor environments by plant leaves alone..."

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Total Healthcare Sustainability

There is still hope for the healthcare industry to embrace sustainability in a systemic manner both in new construction and daily operations. Europe, which is far ahead of the U.S. on sustainability issues, offers us many excellent case studies. In 1985, the south wing of the Vidar Clinic was opened in Järna, a small town fifty kilometers south of Stockholm. Swedish architect Erik Asmussen designed the facility to support the healing of body, soul, and spirit as conceived by anthroposophical medicine. While the practice of sustainability was not the guiding principal behind the clinic's design, it serves as an early example of how many of those ideas fit within a healing environment.

Scheduled for completion in November 2002, and being developed under England's Private Finance Initiative (PFI), Carillion's hospital for Swindon and Wiltshire is a 600,000-square-foot replacement facility for the aging Princess Margaret Hospital. Its builders have "determined that the 'green' credentials of the project will be second to none." Guided by the "Natural Step," the design team is strongly committed to caring for the environment and the pursuit of a sustainable development.

Meletitiki - A. N. Tombazis and Associates Architects Ltd. is designing a 700-bed general teaching hospital to serve Thessaloniki, Greece. The aim of this project is to "integrate 'sensible' bioclimatic architectural design with innovative but appropriate systems through a team effort to achieve sustainable goals and enhance the comfort and well being of the users."

The West Coast has led the way to sustainability in the U.S., and applying those green lessons to healthcare is no different. McKenzie Williams Hospital in Springfield, Ore., is being planned as a model in healthcare sustainability, and Laguna Honda Hospital in San Francisco is seeking a LEED rating.

In Austin, Texas, Barley + Pfeiffer Architects designed an orthopedic clinic for the Texas Specialist Center outside Lufkin, Tex., that serves as a model of healthcare sustainability. Dr. Jackson Wagnon and Betsy Wagnon, the owners, figure they are saving $5000 per year in energy costs as a result of passive and active solar energy technologies coupled with a highly efficient HVAC system. Daylighting, a rainwater collection and storage system, and the use of low-toxicity materials throughout are just a few of the other green features in the facility.

What's It Going to Cost?

Achieving a healthy, efficient, cost-effective healthcare environment requires an early commitment. There must be collaboration among all players to integrate design strategies. The greatest benefits are achieved when the stakeholders realize that the building is a living machine, precisely engineered, and not just a collection of independent parts.

Some of the innovative green building designs examined above have demonstrated that cost efficiency is not sacrificed for environmental stewardship. On the contrary, sustainability can be as cost effective as

conventional projects. The real challenge is for owners and architects to think long term rather than first cost. When we factor in energy savings over time, or increased durability, or enhanced worker productivity, green design features and materials become much easier to justify. The impact of a building's life cycle cost has far greater significance on successful financial return than initial cost--studies show initial design and construction costs account for only 2% of a building's life-cycle cost over a 30-year period. Employees, an owner's most expensive asset, account for 92% of a buildings life cycle cost over the same period. Even a 1% improvement in worker health and productivity could justify additional up-front costs for an improved indoor environment. Life-cycle cost benefits should be particularly inviting to the healthcare owners who traditionally occupy and use their buildings over a 40- to 50-year life span. Greening the built environment has become a global issue that will play a defining roll in this century's economic and social structure. With construction accounting for over 40% of the carbon emissions in the U.S., its significance cannot be denied.

Sustainable design offers the healthcare industry the potential benefits of reducing costs, energy consumption, and liabilities while answering to the growing body of environmental regulations. Likewise, improved indoor environmental quality can diminish health risks, complement the healing process, and attract and retain staff. Together, these sustainable features and practices strengthen an institution's presence in the highly competitive healthcare market, while enhancing its public image as a responsible environmental steward in the community.

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