Shedding new light on health care

Rethinking lighting design

BY RENALDO PESSON, NCIDQ, IIDA, AAIA

The evolution of medicine has been based on evidence and research, and this is true when it comes to health care facility design as well. In the past decade, the use of evidence-based design (EBD) by those who design health care facilities has grown. The Center for Health Design defines EBD as, "the process of basing decisions about the built environment on credible research to achieve the best possible outcomes." The physical environment impacts the lives of patients, staff, and visitors and as such, one of the leading concepts for EBD is to "do no harm." Originally, EBD principles focused purely on the patient. Today architects know that it's critical to design for both patients and providers. By considering the health and well-being of providers, it enables them to give better patient care. A new study by patient safety researchers shows that medical error may be the third leading cause of death in the U.S. after heart disease and cancer (Washington Post article by Ariana Eunjung Cha, May 3, 2016). As a result, the design industry has course-corrected with the objective to "do more good." Each time the design team approaches new construction or a renovation project they must consider how design can help keep providers healthy and positioned to provide the best possible care for the one most in need, the patient. Today, architects and designers work closely with medical staff, facility managers, and other key stakeholders to provide optimum health care and better performing facilities through design.

Basic lighting design

One design element that plays an important role in supporting both patients and providers is lighting. In the past, lighting was typically dictated by the engineer and considered a wayfinding tool, not a design element. The engineer would simply install a light fixture based on desired or calculated light levels. The design of lighting fixtures was sometimes left to the architect, or an artist, but the role of "lighting designer" was yet to be defined. When lighting options expanded from incandescent bulbs to fluorescent, new fixture types helped give rise to the field of lighting design. Researchers longed for even more efficient light sources than the fluorescent bulb. LEDs (light emitting diodes) resulted from a quest for lighting with more versatility, durability, and with a smaller energy signature. With LED, the evolution of the field of lighting design really took off. LEDs do not burn out or fail; they fade over a period of years. This depreciation of lumen output, of the remaining percentage of the LED life, is not discernable to most observers and the unit may continue its light output with color shifts until replacement. Because of its technology, LED is continually being adapted to countless scenarios and configurations allowing opportunities to do more with illumination.

Use of lighting in health care facilities

Architects who focus exclusively on designing health care facilities understand that it is important to create a holistic environment that considers all the senses. Through smart facility design (a philosophy and practice that reduces operating costs, supports new care models, energizes staff, provides flexibility, and promotes wellness) it is possible to create a restorative environment that promotes health for providers and patients alike. Another key element in today's planning best practices, is to design to accommodate technological advances as they come online. Some in the industry challenge whether color, sound, and even scent can make for a better patient experience, but there is consensus through research that lighting influences most elements of our lives (article by Anjali Joseph for The Center for Health Design, August 2006.) The circadian system is responsible for

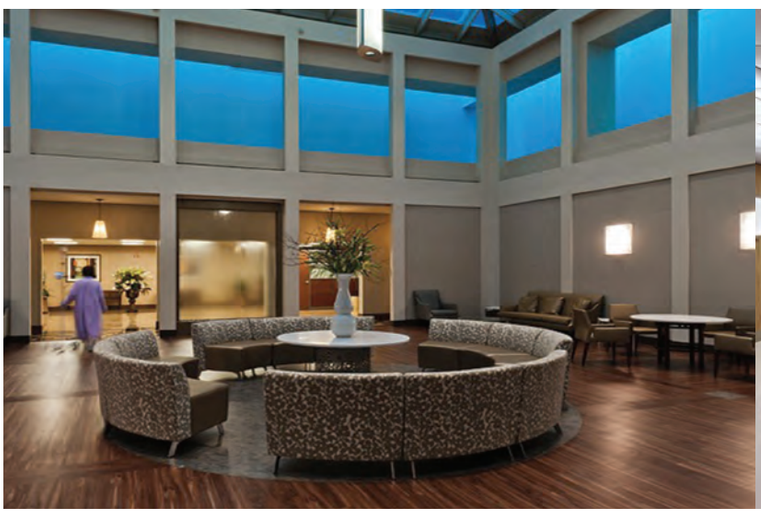

Figure 1. In the atrium, preset LED illumination replicates afternoon sunlight and the evening Aurora Borealis. Lowered evening light levels synchronize circadian rhythms inducing a sense of calm.

Figure 2. The oculus within the nurses' station can be controlled to match sun passage, heighten alertness, or simulate movement for visual stimulation.

controlling daily rhythms such as sleep and wakefulness, body temperature, hormonal secretion, and other physiological parameters including cognitive function. Light is the primary stimulus for regulating the circadian system, although other external stimuli such as sound, temperature, and social cues may also influence the body's timing functions (Aschoff, 1981a; Binkley, 1990), and as such is a controlling factor for achieving a more restful and relaxing environment (see Figure 1).

There are some hospitals that still take a simplistic view of lighting and think of it as fixtures only or just another component of the HVAC system contributing to people's basic comfort levels. Sometimes facility managers ask how LEDs might work in downlights, 2x2, or 2x4 fixtures, or in a sconce but rarely ask how lighting can be thoughtfully planned and designed. In the past, this limited way of thinking prevented the advancement of lighting design. Fortunately, in the new age of LED products, there's an opportunity to create significant lighting impact and enhance the health care workplace and this is starting to happen.

Lighting influences most elements of our lives.

Supporting providers

Doctors and nurses spend a significant portion of their time inside a facility, often working 12-hour shifts or longer without any access to daylight or the outside environment. LED offers the opportunity to counteract the negative health impact of too little daylight by controlling the cycling of indoor illumination. Programmed LED lighting systems can replicate the sun's natural progression throughout the day. For example, the lighting in a nursing zone can be scheduled to mimic daylight starting with a bright warm morning glow, then to bright 5,000 Kelvin (a unit to measure the color of a light source, referred to as temperature, where the higher the number the closer to sunlight) like the afternoon sun, and back down to the warm glow of the setting sun. Using lower light temperatures of 2,000 Kelvin (not necessarily light brightness levels) in provider respite rooms reduces anxiety and fatigue, while inducing a sense of calm for those on break. As Campbell and Dawson (1992) have reported, the two most common and destructive problems associated with shiftwork are reduced quality of sleep following night work and reduced capacity to maintain alertness while at work. Thus, shift work has drawbacks in increased accidents, decreased production, and performance deficits among those who are working at night when the body has a natural tendency to be asleep. Furthermore, evidence indicates that shift workers have increased health problems such as cognitive and emotional issues (Moore-Ede et al., 1982; U.S. Congress, 1991). Lighting design today also incorporates the concept that lighting systems can vary depending on what part of the facility they are in to best suit the purpose of that specific area. Technology facilitates more user-centric design in spaces where architects can consider lighting zones, and design to serve a specific function or a series of activities (see Figure 2). There are increased lighting scenarios and potential illumination events to create and consider now with endless possibilities in the near future as LED research and development continues to grow.

For example, LED lighting can be programmed for certain effects in provider work areas to achieve maximum awareness and reduce the potential for medical errors. Research and evidence support the theory of lighting levels and quality impacting the performance of individuals where attention is paramount. One European study by ARUP Global Research found that error rates in prescription dispensing significantly decreased when daylighting was optimized. LED may help providers maintain focus through color temperature programming, to simulate daylighting. Several studies cover the attention span and alertness of workers under various lighting levels (brightness) and lighting temperatures (Kelvin). LED can be programmed to fluctuate from the more amber color to a whiter light (see Figure 3). According to a 2013 study published in The Journal of Neuroscience, blue lights can depress night workers, while

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Figure 3. The illusion of gentle rolling clouds across an artificial sky is a pleasant distraction in a high-stress setting like an imaging room.

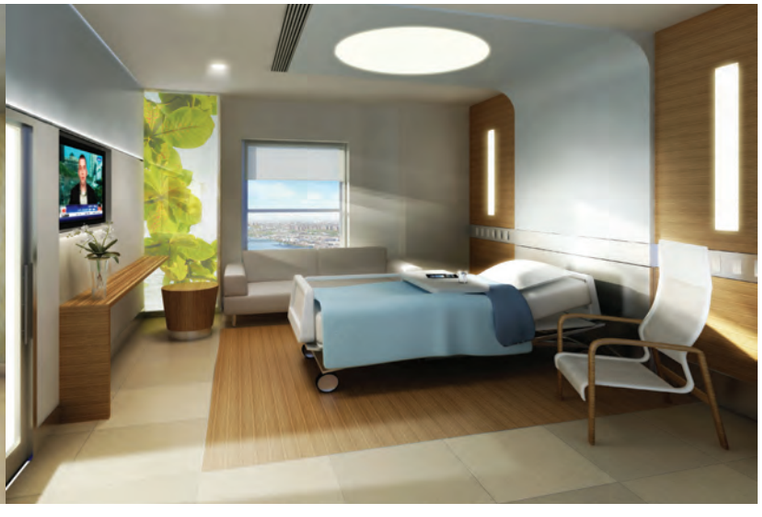

Figure 4. Programmed LED settings replicate the circadian rhythms of rise, awake, and decompress for sleep. In Pediatrics, accent wall color can be illuminated in the patient's preference without a paint change.

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red lights caused few negative effects on the mood of those same workers. Architects must challenge themselves to rethink how they approach lighting to maximize the potential benefits.

For patients

Programming LED to mimic the circadian cycle, is also beneficial to patients whose natural cycle is disrupted by stress and pain. For patients, during the daytime, lighting typically follows the sun's pattern of brightness and hue (just short of full sunny noon) then slowly dims to evening sunset depending on the geographical position of the facility. Light levels should remain at a safe sunset or twilight setting for the remainder of the evening. Patient safety is also enhanced through a lighting scheme that is designed to optimize wayfinding. Slips and falls are a major source of injury in and about patient rooms (see Figure 4). A diversified lighting scheme can provide emphasis or provide camouflage in wayfinding. A good wayfinding system can help reduce patient and visitor anxiety. LED technologies have allowed for the development and patenting of many products for health care. For instance, the light fixture manufacturer Cooper produces a touch-sensing fixture for patient headwalls called the Balance Beam. This multifunction product allows illuminated support for patients exiting their beds, but more significantly at night, it's calibrated to be non-disruptive to the sleep system. The Balance Beam can also be programmed to alert the nurses' station that a patient is mobile. This patient safety device became possible only through the advancement of LED. There are many environmental factors that are hard to control in hospitals, however lighting is an aspect that if planned well, can make a measurable difference.

Enhanced aesthetics

LED can also be used to add artistic improvements to health care facilities. Designers can consider LED lighting and how it can help bring greater identity to the exterior of the building making it a beacon to the community, a destination landmark in the evening sky. The cost of illuminating the building exterior has reduced substantially as a result of LED and its programmability.

When designing new projects, architects must help stakeholders move their thinking beyond what is familiar and educate them about how new lighting designs can benefit patients and providers. Architects must accept the challenge of designing new and innovative lighting by taking full advantage of new technology, including LED and pushing boundaries beyond the traditional. A well-thought-out lighting design will have considerable impact on the health and well-being of patients and their care providers. It will help make facilities welcoming, safer, and more productive to all of those who enter.

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