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The Lunch Version Imagine learning about these research results over a quick bite

Understanding how research fits together takes time and can be challenging, including for researchers. PNNL lighting research results from the field are spread over multiple reports and journal articles, each focused on the outcomes from a specific study. This article aims to distill recent results from PNNL projects in healthcare environments into actionable insights that can help improve healthcare environments.

These healthcare projects range from a survey of nurses working in medical-surgical units in traditional hospitals with fluorescent lighting, to two experiments in a mock-up patient room with a future-focused tunable LED system, to studies in a newly constructed behavioral health unit (BHU) and a neonatal intensive care unit (NICU). Since our opportunities to attend lunch meetings have been limited, we ask that as you read this article, you imagine yourself sitting at a table with us, eating some overcooked broccoli or chicken, asking us what we have learned from our recent work.

Occupants favor multiple lighting zones and individual control. Nurses surveyed at four Pacific Northwest hospitals appreciated having multiple zones of luminaires in the patient rooms where they worked, along with separate control for the different zones. Studies of tunable lighting in a mock-up patient room in Georgia also showed a preference for multiple zones of light, especially compared to traditional patient room lighting with the primary lighting over the bed. Interestingly, preference was not affected when the luminaires in the different lighting zones had different correlated color temperatures (CCTs), indicating that patients and visitors can be empowered to tailor their own lighting without necessarily affecting overall room perceptions. The inclination to control multiple lighting zones was also supported by occupant use data from patient rooms in a BHU in Colorado and a NICU in Kentucky. Based on the analysis of control-station button-press data from the lighting systems in the BHU and NICU, occupants regularly adjusted the lighting intensity and use of individual zones. In short, when occupants are given the power to manually control the lighting, they use it, and when they do not have it, they wish they did.

> “Nighttime lighting requires a Goldilocks scenario

Occupants find tunable CCT lighting acceptable—but use of saturated color can produce negative reactions. Beyond healthcare environments, recent PNNL projects have also taken place in schools, offices and senior care facilities, all with tunable LED systems. Overall, the tunable lighting has been acceptable to occupants, and in some instances preferred, relative to traditional static-white lighting systems. While most projects utilize tunable technology with cool white and warm white phosphor-converted (PC) LEDs, an RGB color-tunable linear luminaire was used in the mock-up patient room to graze the wall at the foot of the patient bed with light, and several lighting conditions experienced by the participants used saturated red or blue. Those conditions were not well received by the adult participants, perhaps in part because the lighting was introduced without context or an understanding of purpose. We are aware of successful examples of colored lighting in patient rooms, especially in pediatric care applications; our results seem to indicate that initial reactions may be negative. This research serves as a reminder to clearly establish the purposes and goals of full-color tunable lighting when incorporating it into a project.

High CCT can result in negative reactions. Research in the mock-up patient room showed that lighting conditions with CCT settings of 5000K and higher can produce negative perceptions, and we have seen similar findings in our classroom projects. The cool-white PC LEDs most commonly available and used in these applications

have spectral power distributions (SPDs) that can be deficient in the longer wavelengths, and research has shown this is important for occupant preference, specifically for the rendering of red. Lighting systems that include shorter wavelengths for circadian considerations and longer wavelengths for color preference may be the key to successful installations; nuances not captured by CCT alone.

Nighttime lighting needs attention. Nighttime lighting requires a Goldilocks scenario: too much can disturb patients and sleep, too little can make it difficult for nurses to complete their necessary procedures, and just right depends on who Goldilocks is. In the NICU study, the button-press data clearly showed that for the nighttime mode the downlights automatically defaulted to a light level that was too low for clinical staff, resulting in the staff always increasing the light output of the downlights during night checks, or perhaps using the exam lighting mode instead. Nurse survey respondents highlighted the challenges faced in traditional patient rooms, where a nurse needing to perform a visual task or a patient needing to use the bathroom at night must either operate in the dark or switch on a relatively high-intensity luminaire. Some even used the bathroom as a night light, turning the bathroom lighting on and shutting the door. In the mock-up patient room, nurses were unable to complete their tasks in a room with just an in-wall night light; a system providing low-level over-bed or wall lighting better supported nursing tasks without requiring the nurse to turn on potentially sleep-disrupting high-intensity lighting. Our industry has recently placed a lot of emphasis on providing bright light in the morning for these applications; however, practical solutions for the nighttime conditions remain a challenge. Lighting in a patient room at night requires thoughtful consideration of the different occupant needs and an adaptable lighting system that can make Goldilocks say, “Neither too bright nor too dim, this is just right!”

Okay, time to stop sipping the lukewarm coffee and move on from the lunch table. We hope that this conversation stimulates new ideas about how we can improve lighting in healthcare, and that we see you soon for a real conversation.

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