PATIENT EXPERIENCE WITH HOSPITAL CARE - COMPARISON OF A SAMPLE OF GREEN HOSPITALS AND NON-GREEN HOSPITALS

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ABSTRACT
Although the sustainability movement in the healthcare sector was initiated in response to ecological concerns, green hospitals are expected to outperform traditional hospitals on a variety of levels. The impacts of environmental quality on patients and caregivers are demonstrated in numerous studies. However, there is still a lack of evidence on the benefits of green hospitals with respect to different dimensions of patients’ experiences. In this study, data from the public Hospital Consumer Assessment of Health Plans Survey is used to compare the performance of green hospitals with the average performance of traditional hospitals. This study included 19 green hospitals and found that patients hospitalized in green facilities reported overall higher ratings than those in traditional hospitals when compared to the average performance of traditional hospitals of similar sizes and locations. Additionally, patients in green hospitals were more likely to recommend the hospital to their friends and family. However, relationships between specific green building features and patient experiences were not identified in this study.

KEYWORDS
green hospitals, patient experiences with hospital care, HOSPITAL Compare, patient survey

INTRODUCTION
According to the American Hospital Association (AHA 2011), healthcare spending in the United States accounted for 17.6% of the gross domestic product (GDP) in 2009. It is expected that the government will face greater healthcare needs in the coming years due to an aging U.S. population and increased life expectancy (Bierman et al. 2001). In 2009, hospital care accounted for 32.6% of the healthcare market (AHA 2011). Statistics reported by the Center for Medicare and Medicaid Services (CMS 2012c) show that hospital care expenses are...
the largest proportion of national health expenditures and are expected to remain the largest until at least 2020.

As the healthcare sector grows, people are becoming more aware of the environmental impacts associated with constructing and operating hospitals (Guenther 2009). The sustainability movement in the healthcare sector was initiated in response to these ecological concerns. However, green hospitals are expected to provide advantages beyond the environmental benefits. The operation of hospitals is accompanied by several risks to building occupants, including the usage of hazardous and toxic materials, and protecting occupants is of particular importance in healthcare facilities because patients are often vulnerable to infections and respiratory distress. Accordingly, the health and wellbeing of caregivers, patients, and other building users is becoming an important consideration in hospital design (Bartley et al. 2010; Rashid and Zimring 2008).

Improving indoor environmental quality is essential with respect to its influence on patients’ care experiences and overall evaluation of the hospital. Literature on healthcare delivery systems in the United States suggests that with the emergence of consumerism and patient-centered care, patients who once were regarded as recipients of care are now recognized as consumers of health services (Frampton 2012; Wagner and Bear 2009). Accordingly, similar to other consumer-driven industries, healthcare providers are carefully considering customer evaluations (Bierman et al. 2001; Dale et al. 2008; Messina et al. 2009; Stanton 2002). Shaw’s (2010) survey of healthcare executives found that patient experience is among the top five priorities of more than 90% of top-level healthcare executives in the United States.

Several studies in green building literature have established the positive influence of green buildings on the health, wellbeing, and comfort of occupants. Studies in healthcare settings regularly focus on patient satisfaction, clinical outcomes (e.g., length of stay, medical errors), and job attitudes or behaviors of caregivers (e.g., job satisfaction, work-related stress, and absenteeism; Ulrich et al. 2010; Ulrich et al. 2008). Although patient satisfaction has been recognized in several healthcare environmental studies, there is still insufficient evidence to demonstrate the impact of green building features on different aspects of hospital care experiences.

The primary purpose of this study was to compare patients’ experiences with hospital care in green facilities to patients’ experiences in non-green facilities using data collected from a standardized survey of hospital patients. This study used the Leadership in Energy and Environmental Design (LEED) system, which is one of the most commonly used certification systems in the United States, as the standard of comparison for the green facilities.

**BACKGROUND**

In addition to protecting the environment, promoting occupants’ health and wellbeing is a major objective of green building (Kibert 2008; National Institute of Building Sciences 2003; United States Green Building Council 2011). Through the efforts of organizations such as the Green Guide for Healthcare (GGHC) and United States Green Building Council (USGBC), many institutions have realized their related missions of providing a healing environment inside the facility and safeguarding the environment outside the facility (Vittori 2008). Among the issues addressed by LEED, indoor environmental quality (IEQ) covers design features required for providing a physically and psychologically healthy environment for building occupants.
In LEED Healthcare, IEQ accounts for 16% (18 out of 110) of credits (USGBC 2011). The IEQ credits consider factors such as air quality monitoring, ventilation, indoor air quality management, acoustics, indoor chemical and pollutant source control, thermal and lighting system controllability, thermal comfort, and day lighting. As Meir et al. (2009) noted, it is expected that by incorporating these features, green buildings will provide occupants with a better indoor environment. As stated previously, this study compared patients' experiences in green and non-green hospitals across several different dimensions of hospital care experience.

LITERATURE REVIEW
Healthcare literature has one of the most extensive bodies of knowledge on the relationship between the physical design of buildings and key organizational outcomes. This field of study is commonly known as evidence-based design (EBD). In healthcare settings, EBD has focused on the relationship between the physical environment of healthcare facilities and key performance indicators, such as patient safety (e.g., hospital-acquired infections, medical errors, and falls), patient outcomes (e.g., pain, stress, length of stay, and perceived quality of care), and staff outcomes (e.g., injury, stress, work effectiveness, and satisfaction; Ulrich et al. 2010; Ulrich et al. 2008).

According to Hamilton (2003), healthcare design is becoming more evidence based as design decisions are increasingly guided by rigorous research. Several empirical studies have established the positive impact of environmental improvements on patients' experiences and satisfaction with hospital care. For example, Swan et al. (2003) conducted a comparative study on two groups of patients using typical hospital patient rooms and hotel-like rooms. The study found that patients in hotel-like rooms were more satisfied with the hospital and reported that they were more willing to reuse or recommend the facility. These patients also had a more positive rating of physicians, housekeeping, and food service employees. In another comparative study of room types, Nguyen Thi et al. (2002) surveyed 533 patients and found that patients placed in private rooms reported higher satisfaction levels with overall quality of care.

Empirical studies in other types of units also support the positive influence of indoor environmental quality on patients' experiences. Becker and Douglass’s (2008) correlational study of six outpatient facilities found that higher ratings of environmental attractiveness were associated with more favorable perceptions of the quality of care and interaction with staff. Krueckeberg and Hubbert (1995) studied 474 patients visiting the outpatient department of an acute care community hospital and found that physical attributes such as cleanliness, attractiveness, and comfort were significant predictors of the variation in outpatient satisfaction. In another correlational study involving 261 patients undergoing endoscopic procedures, Ko et al. (2009) listed the environment of the endoscopy unit among contributing factors to patient satisfaction.

According to Shepley et al. (2009), although sustainability and EBD are two important factors influencing design in healthcare architecture, EBD has been prominent for a longer period. They noted that creating patient-centered facilities that influence positive health outcomes has been driving the EBD movement for the last 25 years, while the first major document to move healthcare design toward sustainability (i.e., Green Guide for Healthcare) was released in 2002. Nevertheless, Shepley et al. (2009) acknowledged that because these two design philosophies both include an objective associated with human health, they overlap substantially on a practical level, and their relationship is typically synergistic.
Sadler et al. (2009) conducted a systematic review of EBD literature for the Institute for Healthcare Improvement (IHI) to show how design interventions can improve patients’ experiences. One of the findings of this review was that access to nature and sunlight improved the perception of pain, accelerated patient recovery, and increased overall patient satisfaction with quality of care. In an empirical study of the effect of sunlight on the psychosocial health of post-surgery patients, Walch et al. (2005) found that patients exposed to an increased intensity of sunlight reported less perceived stress and pain. Additionally, Hagerman et al. (2005) investigated the influence of noise in an intensive coronary care unit and found that patients in units with sound-absorbing ceiling tiles were more satisfied with the overall quality of care and had a more positive evaluation of staff attitudes.

In summary, literature review suggests that implementing the green building solutions included in LEED rating systems, such as improving indoor air quality, reducing noise, and increasing the amount of daylight, may improve patient experience. As stated previously, by collecting data from a national database, this study compared patients’ experiences in a sample of green hospitals with national and state averages across different dimensions of hospital care experiences. The use of a large database helped determine improvement levels relative to industry norms and provided an additional opportunity to investigate how LEED facilities achieved, or failed to achieve, their respective performance levels.

METHODOLOGY
This study compared a sample of LEED hospitals with the average performance of a large group of non-LEED hospitals. The comparison was based on two global items: (1) a patients’ overall rating of the hospital, based on a scale of 1 to 10; and (2) a patient’s willingness to provide a recommendation of the hospital to family and friends. In addition to these global indicators of patient satisfaction the authors included two dimensions of hospital care experience that covers the physical environment, namely quietness (how often the area around the patient’s room was quiet at night) and cleanliness (how often the bathroom in the patient’s room was cleaned). To compare facilities, the authors calculated percentile rank using the following equation:

\[
\text{Percentile Rank} = \frac{\text{number of cases with the same or lower composite score}}{\text{total number of records}} \times 100
\]  

Equation 1

A high percentile rank indicated good performance, and a low percentile rank indicated poor performance. For example, the composite score of Site 5 on recommendation was 80%, and only 109 sites out of the 3,050 short-term acute care facilities across the United States had a higher score than Site 5. Using Equation 1, we calculated the national percentile rank for Site 5 on recommendation to be 96.43.

Data
Patient experience data: The authors used two publicly available data sources of patient satisfaction with hospital care. Data on patients’ perspectives of hospital care were obtained from the online Hospital Compare database, which was created through the efforts of CMS and is maintained by the U.S. Department of Health and Human Services (CMS 2012b). The database reports the results of the Hospital Consumer Assessment of Healthcare Providers
and Systems, commonly referred to as HCAHPS. HCAHPS is a national standardized survey of hospital patients measuring different dimensions of hospital care. According to CMS, the HCAHPS survey is designed to produce comparable data on patients’ perspectives of care that allow objective and meaningful comparisons between hospitals (CMS 2012a). Participants in the HCAHPS survey are patients who are 18 years or older and are randomly selected after an inpatient stay of one night or longer for medical, surgical, or maternity care (CMS 2012d). The survey measures eight dimensions of hospital care: communication with nurses, communication with doctors, responsiveness of caregivers to patient needs, patient receiving help in pain control, quietness and cleanliness of patient rooms, communication about medicine, and patient receiving information at discharge. The survey also reports two global items: patients’ overall rating and willingness to recommend the hospital to family and friends. As explained previously, in addition to the global rates on overall rating and recommendation, this study included quietness and cleanliness as they specifically address building features. The authors decided not to included other dimensions of hospital care experience reported by the HCAHPS survey (nurse communication, staff responsiveness, and pain management, etc.) as several non-LEED factors, such as patient call systems, nurse station design (centralized and decentralized nurse station design), and layout of the pods (radial units versus rectangular units) influences patients’ evaluations with respect to those dimensions. Appendix I, however provides analysis results for nurse communication, staff responsiveness, and pain management as well.

3,578 usable records were obtained (3,062 short-term acute care hospitals and 493 critical access hospitals) from the HCAHPS dataset in January 2012. To increase the reliability of analysis, the authors removed outliers and hospitals with fewer than 100 participants. The Hospital Compare webpage notes that for hospitals where fewer than 100 patients completed the survey, the number of surveys may be too low to reliably assess the hospital’s performance. To identify the outliers, outlier labeling rule (Hoaglin and Iglewicz 1987; Hoaglin et al. 1986), was used as all variables were approximately normally distributed. The authors investigated the normality of each variable in terms of its skewedness and kurtosis.

Green building data: The USGBC LEED project directory was used to extract the list of LEED hospitals (USGBC 2012). As of August 8, 2012, 202 healthcare facilities had achieved LEED certification and 336 projects had applied for certification. The second group of projects were referred to as registered projects in this study. The authors used the names and addresses of projects provided in the LEED directory as the criteria for finding common records between the HCAHPS database and LEED project directory. 203 projects out of the total 508 LEED-certified/registered projects were labeled as confidential; thus, the authors removed these projects since the project titles and addresses were not available. The authors found 25 LEED projects in the HCAHPS database, all of which were acute care hospitals. Verification of project title showed that of these 25 facilities, six had LEED certification/registration for only some parts of the facility.

The authors decided to limit the analysis to 19 hospitals with LEED certification/registration for the whole facility. Nine projects were under review by USGBC, and 10 facilities had already received certification, specifically LEED for New Construction (LEED-NC) certification. The author then decided to include LEED registered projects, as registration indicates that the facility possesses the basic characteristics to be eligible for LEED certification, known as minimum program requirement, and shows project team commitment to implementing LEED design, construction, and operation principles.
Analysis

For the hospital care dimensions listed previously, the Hospital Compare database reports the percentage of patients who select one of three response levels: (a) always, (b) usually, and (c) sometimes or never. The response levels for overall rating, which are based on a scale of 1 to 10, are reported as follows: (a) 10-9, (b) 8-7, and (c) 6 and below. Finally, the response levels for the recommendation rate are reported as (a) definitely yes, (b) probably yes, and (c) no.

The composite scores by subtracting the percentage of responses to the least desirable choice (i.e., response level “c”) from the percentage of responses to the most desirable option (i.e., response level “a”). The authors decided to use the equation to allow choice “a” to have a positive impact on the composite score and to penalize level “c” responses. Choice “b” is not included in the equation because it was a neutral response and should have no impact on the overall score.

RESULTS

Figure 1 shows the performance of the 19 LEED facilities compared with the national and state average performance. As Figure 1 reveals, at the time of this study, the average composite score was higher than the national average across all HCAHPS items included in this study. The largest absolute difference was 6.39% on recommendation, followed by 4.73% on overall rating; the smallest absolute difference was 0.57% on quietness.

Figure 1: Comparison of LEED hospitals with the national average
When individual facilities were considered, Site 7 had the highest average score (86.29%) and was ranked above the other 18 LEED hospitals across all dimensions captured from the HCAHPS survey. Sites 5, 7, 9, 10, 13, and 17 were also ranked above the national average on all four items, while Sites 2 and 15 fell below the national average across all items. The highest positive difference between LEED and non-LEED facilities was 41.15% for quietness for Site 7. Quietness was also the criterion on which the highest negative difference was observed for Site 15 (-31.85%).

Appendix I shows the ranking of LEED hospitals at the time of this study based on average score across different dimensions of hospital care experience measured by the HCAHPS survey. Overall rating and recommendation are not included in the calculations of the average scores, as they do not represent experience dimensions. Appendix I shows that on average, Site 7 had the highest percentile rank and Site 2 had the lowest percentile rank at the national level among LEED hospitals in this study.

In order to verify the results of the analysis, the authors used response levels “a,” “b,” and “c” and developed two alternative equations for calculating composite scores. The first alternate equation (composite score = 3a + 2b + c) led to similar results, and the second alternate equation (composite score = 3a + 2b − c) led to stronger results in support of the LEED

Figure 2: Mean of national and state percentile rank of LEED hospitals

![Figure 2: Mean of state and national percentile rank in LEED acute care facilities](image-url)
facilities. Moreover, when the authors only included LEED-certified facilities and removed LEED-registered project from the study sample, the analysis led to stronger result in support of LEED facilities. Accordingly, the authors decided to adopt a more conservative approach by using the original sample of facilities and the original equation explained previously.

**Comparison of Scores on Overall Rating, Recommendation, and Dimensions of Experience**

Figure 2 shows the mean state and national percentile rank for each HCAHPS item in the sample of LEED facilities.

As Figure 2 indicates, on average, LEED hospitals in this study scored above 64% and 59% non-LEED facilities on recommendation and overall rating, respectively. Quietness had the lowest average national percentile rank (50.43). However, as Appendix I shows, three sites (Sites 6, 12, and 13) had their best national percentile rank on quietness. Figure 2 also shows that on average, LEED facilities scored above at least 50% of 3,062 non-LEED acute care facilities across the United States on quietness and cleanliness.

**Comparison of LEED Hospitals with State and National Averages**

In addition to calculating the mean state and national percentile rank for each HCAHPS item, the authors compared each LEED facility with the average score of non-LEED hospitals at the state and national levels.

Overall rating. Figure 3 shows the comparison of LEED hospitals with the national average and the average of corresponding states on overall rating.

**Figure 3:** Comparison of LEED hospitals with state and national averages on overall rating
As Figure 3 illustrates, 13 LEED projects stood above the corresponding state averages. The largest positive difference was 18.42% (Site 7), and the largest negative difference was -18.81% (Site 15). With respect to the state percentile rank, Site 7 had the best performance (98.3), and Site 15 had the poorest performance (4.2). Figure 3 also suggests that 12 LEED projects ranked above the national average. The largest positive difference was 28.15% (Site 7), and the largest negative difference was -20.85% (Site 15). The national percentile rank of Site 7 was 98.69, and the national percentile rank of Site 15 was 5.7.

Recommendation. Figure 4 shows the comparison of LEED hospitals with the national average and the average of corresponding states on recommendation.

**Figure 4:** Comparison of LEED hospitals with state and national averages on recommendation

As Figure 4 reveals, 15 LEED projects ranked above the corresponding state average. The largest positive difference was 19.60% (Site 13), and the largest negative difference was -17.56% (Site 15). With respect to the state percentile rank, Site 7 scored above all non-LEED facilities in Louisiana, and Site 15 had the poorest performance among LEED facilities (6.17). Additionally, Figure 4 shows that 14 LEED projects had higher scores than the national average. The largest positive difference was 25.44% (Site 7), and the largest negative difference was -19.56% (Site 15). The national percentile rank of Site 7 was 98.79, and the national percentile rank of Site 15 was 6.25.

Cleanliness. Figure 5 displays the comparison of LEED hospitals with the national average and the average of corresponding states on cleanliness.

As Figure 5 shows, 15 LEED projects scored above the corresponding state average. The largest positive difference was 18.60% (Site 7), and the largest negative difference was -20.40% (Site 15). For the state percentile rank, Site 5 had the best performance (97.4), and
**Figure 5:** Comparison of LEED hospitals with state and national averages on *cleanliness*

![Comparison of Hospitals on Cleanliness](image)

**Figure 6:** Comparison of LEED hospitals with state and national averages on *quietness*

![Comparison of Hospitals on Quietness](image)
Site 15 had the poorest performance (2.8). Figure 5 also indicates that 13 LEED projects ranked above the national average on cleanliness. The largest positive difference was 28.24% (Site 7), and the largest negative difference was -19.76% (Site 15). The national percentile rank of Site 7 was 99.9, and the national percentile rank of Site 15 was 3.8.

Quietness. Figure 6 shows the comparison of LEED hospitals with the national average and the average of corresponding states on quietness.

Figure 6 reveals that 11 LEED projects ranked above their corresponding state average. The largest positive difference was 32.27% (Site 7), and the largest negative difference was -22.78% (Site 15). For the state percentile rank, Sites 5, 12, and 14 ranked above all non-LEED facilities in their corresponding states, while Site 15 fell below all non-LEED facilities in Pennsylvania. Additionally, Figure 6 indicates that 11 LEED projects stood above the national average. The largest positive difference was 41.15% (Site 7), and the largest negative difference was -31.85% (Site 15). The national percentile rank of Site 7 was 99.64, and the national percentile rank of Site 15 was 1.0.

In summary, similar to what Figure 1 showed, the comparison of LEED hospitals with their corresponding state averages also favored the LEED facilities identified in this study.

**DISCUSSION**

Figure 1 showed that on average, patients in LEED hospitals reported considerably higher overall rating and recommendation rates. Moreover, patients in LEED hospitals reported a slightly higher satisfaction with quietness and cleanliness of patient rooms. Despite small differences in quietness and cleanliness, the average percentile rank of LEED hospitals, shown in Figure 2, revealed that LEED facilities in this study scored higher than at least 50% of non-LEED facilities in their corresponding states. Accordingly, the authors concluded that on average, patients who used the LEED hospitals in this study had a better-than-average hospital care experience and reported a higher overall evaluation of the hospital. The difference in some dimensions of the experience between LEED and non-LEED hospitals, such as quietness was small, while it was higher in other aspects, such as cleanliness and pain management.

**Overall Rating and Recommendation**

Figure 1 indicates that the average score achieved by LEED hospitals in this study on overall rating and recommendation was 5.7% and 6.4% higher than non-LEED facilities, respectively. Figure 3 shows that 13 out of 19 LEED facilities had a higher overall rating than their corresponding state average. Additionally, Figure 4 indicates that only four LEED hospitals received a recommendation rate lower than the non-LEED facilities in their state.

Although data show that patients in LEED hospitals have reported better overall experiences, the relationship between IEQ credits and scores on overall rating and recommendation is not clear. As stated before, of the 19 LEED projects examined in this study, 10 had achieved certification. Table 1 shows LEED-certified hospitals and the IEQ credits they had achieved. LEED hospitals are ordered in an ascending order based on the number of IEQ credits they had achieved. The national percentile ranks shown in column 11 to 14 do not follow the same ascending order. Additionally, Table 1 shows that Site 15, with 10 credits, had achieved the overall rating score of 6.17%, and Site 9, with eight IEQ credits, had an overall rating score of 92.99%. As stated before, while Site 9 with lower IEQ credits ranked above the national average on all seven HCAHPS items, Site 15 with higher IEQ credits fell below the national average on all seven items.
Table 1 shows that the highest score on *overall rating* and *recommendation* among LEED-certified facilities was achieved by Site 5, which had the highest number of IEQ credits in the study sample. Note that Site 5 was the only facility that had achieved IEQ Credit 8.1 for providing views to the outdoors. The authors believe that achieving this credit might have led to a higher overall rating and recommendation rate for Site 5. To achieve IEQ Credit 8.1, a direct line of sight to the outdoor environment must be achieved for building occupants in 90% of all regularly occupied areas (USGBC 2010). Several empirical studies in EBD literature have demonstrated the positive psychological and emotional impacts of providing an outdoor view (Diette et al. 2003; Harris et al. 2006). For example, Ulrich (1984) found that window views of nature were associated with expedited recovery and reduced negative comments from patients.

It is also important to point out the branding advantage of LEED facilities. Case studies of LEED facilities suggest that green hospitals are environmentally responsive, resource efficient, and community sensitive (Swift 2011). The authors believe that the higher scores of green hospitals on *overall rating* and *recommendation rate* might be, in part, due to the branding advantage of LEED-certified healthcare facilities.

Also noteworthy is the fact that previous studies found that hospitals with a higher overall rating are those with high profitability and high clinical scores. In a report by Press Ganey Associates (2011), all U.S. hospitals were grouped into four equally sized categories based on patients’ ratings. The report revealed that the 25% of hospitals with the highest overall rating by patients were also the most profitable. Accordingly, higher overall ratings might be due in part to the quality of clinical services.

**Cleanliness and Quietness**

_Cleanliness* and *quietness* are the only environmental factors captured by the HCAHPS survey. Green building solutions covered by the IEQ credit category of LEED do not include the facility cleaning programs or frequency. Additionally, the HCAHPS survey only addresses the cleanliness of bathrooms, so it does not measure satisfaction with the cleanliness of other parts of the facility or patient rooms. Thus, we believe that cleanliness scores are not greatly influenced by whether a facility has an LEED certification.

Many of the LEED hospitals in this study had not achieved the IEQ credit addressing acoustic environment. As Joseph and Ulrich (2007) noted, hospitals are extremely noisy, and peak hospital noise levels often exceed 85 to 90 decibels (dB). Pope’s (2010) study of four medical/surgical nursing units found that the minimum noise level in patient rooms and their corresponding units were 48 dB, 59 dB, 61 dB, and 62 dB. According to the World Health Organization (WHO), continuous background noise in hospital patient rooms should be 35 dB during the day and 30 dB at night (Berglund et al. 1999). Figure 1 reveals that among the five different dimensions of hospital experience examined in this study, *quietness* had the lowest national score. To address the problems associated with noise in patient rooms, LEED-Healthcare, published in 2009, allows 2 points for acoustics. The purpose of this credit is to provide building occupants with an indoor healing environment free of intrusive or disruptive levels of sound (USGBC 2011). Because acoustic points were absent in earlier LEED certifications achieved by the hospitals in this study, verifying whether these facilities have implemented noise control strategies would be very difficult. In summary, compared with non-LEED hospitals, the sample LEED hospitals included in this study were not found to provide a quieter environment.
IEQ Features Not Incorporated in LEED Hospitals

As stated before, none of the LEED-certified hospitals examined in this study had achieved credit for acoustic environment, as the rating system used in these facilities did not offer a credit for acoustics. More specifically, Table 1 shows that none of the LEED-certified facilities had achieved the IEQ Credit 8.2 for daylight, despite the fact that daylight has a positive impact on reducing depression among patients and decreasing their length of stay (Joseph 2006; Shepley et al. 2012). Credit 8.2 requires providing daylight in at least 75% of regularly occupied spaces (USGBC 2010). As Pradinuk (2009) noted, meeting this requirement is difficult for large healthcare projects during the design process, and only two daylight credits are not enough of an incentive to change design practices. According to Pradinuk (2009), many hospitals use ducted mechanical ventilation, cooling, and artificial illumination, which leads to massive diagnostic and treatment blocks, leaving as little as 20% of usable space within 15 feet of a daylight perimeter.

CONCLUSION

This study used publicly available data collected from the Hospital Consumer Assessment of Healthcare Providers and Systems survey. A comparison of 19 LEED-certified/registered projects with state and national averages found that patients hospitalized in LEED facilities reported a higher overall rating of the facility and were more likely to recommend the hospital to their friends and family. Patients in LEED hospitals also reported a slightly higher satisfaction with quietness and cleanliness of patient areas. However, the relationship between indoor environmental quality credits and HCAHPS scores is not clear. Because of the small sample size and lack of data on the influence of non-LEED factors on patients’ experiences, generalization should be done with care.

This study is one of the first to use a national dataset to compare the performance of a sample of LEED hospitals with national and state averages with respect to patient experiences. Although this comparison provided significant insight, the analysis did not include environmental benefits and clinical performance outcomes. In a similar study by the same authors, cost report data reported by the Center for Medicare and Medicaid Services (CMS) were used to compare a sample of 14 LEED hospitals with national and state averages with respect to financial performance. CMS data did not suggest that the sample of LEED hospitals had a financial advantage over non-LEED hospitals. However, HCAHPS data showed that patients reported a better experience with hospital care in the sample of LEED facilities of this study.

There are several other factors that influence financial performance and patient experience, some of which were discussed in this study. Future efforts should investigate the role of the clinical performance of organizations as a confounding variable or a mediating variable in the relationship between facility design and organizational performance outcomes. It is expected that clinical excellence has a positive impact on both the patient experience and financial performance of a hospital. In line with the previous recommendation, it would be interesting to see whether achieving clinical excellence precedes efforts of healthcare organizations for meeting their social and environmental responsibilities by attempting to achieve LEED certification. It is expected that only hospitals with higher levels of clinical excellence will participate in the LEED certification program.
ACKNOWLEDGMENT

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REFERENCES


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## Appendix I: Comparison of LEED facilities with state and national averages of non-LEED facilities

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### I. Nurse Communication (National Average = 69.93%)

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### II. Responsiveness (National Average = 51.39%)

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<td>CA</td>
<td>279</td>
</tr>
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</table>

### III. Pain Management (National Average = 61.38%)

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<tbody>
<tr>
<td>62%</td>
<td>CA</td>
<td>279</td>
<td>67%</td>
<td>CA</td>
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<td>67%</td>
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### IV. Cleanliness (National Average = 60.76%)

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<tbody>
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<td>60%</td>
<td>CA</td>
<td>279</td>
<td>67%</td>
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<td>279</td>
<td>67%</td>
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### V. Quietness (National Average = 44.85%)

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<tbody>
<tr>
<td>18%</td>
<td>CA</td>
<td>279</td>
<td>24%</td>
<td>CA</td>
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</tbody>
</table>

### VI. Overall Rating (National Average = 57.85%)

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<tbody>
<tr>
<td>18%</td>
<td>CA</td>
<td>279</td>
<td>24%</td>
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<td>24%</td>
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<td>279</td>
</tr>
</tbody>
</table>
### VII. Recommendation (National Average = 63.56%)

<table>
<thead>
<tr>
<th>LEED Facility</th>
<th>77%</th>
<th>53%</th>
<th>69%</th>
<th>71%</th>
<th>83%</th>
<th>55%</th>
<th>89%</th>
<th>77%</th>
<th>79%</th>
<th>80%</th>
<th>64%</th>
<th>71%</th>
<th>83%</th>
<th>77%</th>
<th>44%</th>
<th>65%</th>
<th>79%</th>
<th>61%</th>
<th>52%</th>
</tr>
</thead>
<tbody>
<tr>
<td>State average</td>
<td>61%</td>
<td>61%</td>
<td>61%</td>
<td>61%</td>
<td>69%</td>
<td>63%</td>
<td>71%</td>
<td>58%</td>
<td>64%</td>
<td>71%</td>
<td>57%</td>
<td>55%</td>
<td>63%</td>
<td>68%</td>
<td>62%</td>
<td>62%</td>
<td>63%</td>
<td>62%</td>
<td>62%</td>
</tr>
<tr>
<td>State percentile</td>
<td>87.81%</td>
<td>24.37%</td>
<td>69.53%</td>
<td>74.19%</td>
<td>97.44%</td>
<td>20.19%</td>
<td>100.0%</td>
<td>97.67%</td>
<td>90.70%</td>
<td>83.33%</td>
<td>66.67%</td>
<td>86.93%</td>
<td>93.59%</td>
<td>87.50%</td>
<td>6.25%</td>
<td>55.56%</td>
<td>94.38%</td>
<td>41.67%</td>
<td>13.89%</td>
</tr>
<tr>
<td>National percentile</td>
<td>86.36%</td>
<td>17.05%</td>
<td>64.09%</td>
<td>70.38%</td>
<td>95.54%</td>
<td>21.32%</td>
<td>98.79%</td>
<td>86.36%</td>
<td>90.06%</td>
<td>91.77%</td>
<td>46.11%</td>
<td>70.38%</td>
<td>95.54%</td>
<td>86.36%</td>
<td>6.17%</td>
<td>49.82%</td>
<td>90.06%</td>
<td>36.54%</td>
<td>15.09%</td>
</tr>
</tbody>
</table>

### Average Scores and Average Percentile Rank**

<table>
<thead>
<tr>
<th>LEED Facility***</th>
<th>51%</th>
<th>40%</th>
<th>50%</th>
<th>57%</th>
<th>70%</th>
<th>59%</th>
<th>86%</th>
<th>59%</th>
<th>65%</th>
<th>66%</th>
<th>56%</th>
<th>58%</th>
<th>70%</th>
<th>63%</th>
<th>40%</th>
<th>48%</th>
<th>71%</th>
<th>55%</th>
<th>61%</th>
</tr>
</thead>
<tbody>
<tr>
<td>State percentile</td>
<td>33%</td>
<td>6%</td>
<td>28%</td>
<td>49%</td>
<td>86%</td>
<td>48%</td>
<td>100%</td>
<td>51%</td>
<td>75%</td>
<td>79%</td>
<td>45%</td>
<td>43%</td>
<td>83%</td>
<td>68%</td>
<td>7%</td>
<td>19%</td>
<td>89%</td>
<td>37%</td>
<td>59%</td>
</tr>
<tr>
<td>National percentile</td>
<td>55%</td>
<td>15%</td>
<td>50%</td>
<td>76%</td>
<td>90%</td>
<td>46%</td>
<td>98%</td>
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<td>66%</td>
<td>71%</td>
<td>77%</td>
<td>4%</td>
<td>17%</td>
<td>86%</td>
<td>38%</td>
<td>64%</td>
</tr>
<tr>
<td>Rank within sample of LEED hospitals</td>
<td>7</td>
<td>17</td>
<td>5</td>
<td>13</td>
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<td>9</td>
<td>14</td>
<td>19</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>11</td>
<td>12</td>
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<td>1</td>
<td>3</td>
<td>16</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

* Hospitals have received LEED certification.

** Average state and national percentile ranks are calculated using percentile ranks for five dimensions of hospital care experience (I through V).

*** Average score is based on the five dimensions of hospital care experience measured (I through V). Overall rating and recommendation are not included in the calculations of the average scores, as they do not represent experience dimensions.