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The Effects of Expansions in Hospitals on the Applicability of Performance Certificate Programme

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Abstract

This study examines how the implementation of the Leadership in Energy and Environmental Design (LEED) certification system has affected healthcare services in private hospitals in North Cyprus. The Near East University (NEU) hospital achieved Gold-level recognition with a minimum score of 79 points, while Dr. Burhan Nalbantoğlu Hospital (BNH) received 31 points. Through sensitivity analysis of indoor air quality and sustainable land criteria, it becomes evident that hospitals adopting LEED certification systems offer higher-quality services and present distinct advantages. The findings suggest that aligning government hospitals with green certification criteria may contribute to improved patient outcomes. Furthermore, data collected from government hospitals and the Near East Hospital support a positive relationship between green hospital criteria and enhanced patient and employee satisfaction. Statistical analysis reveals significant evidence (p < 0.05) that distinguishes hospitals meeting the green hospital certification criteria from those that do not. The study also examined the effects of hospital expansions on the applicability of performance certificate programs and the management of COVID-19. Various criteria, including LEED points, sustainable sites, regional priorities, water efficiency, design innovation, materials and resources, and indoor environmental quality, are analyzed using data from two hospitals, YDÜ and BNH, to assess changes in these criteria before and after the expansions. The results provide valuable insights for decision-makers and healthcare administrators seeking to enhance hospital infrastructure and operations to meet certification standards and ensure effective pandemic management. This study highlights the importance of adopting green certification criteria in hospital infrastructure and management to enhance patient outcomes, employee satisfaction, and overall service quality.

Keywords: Mathematical model, sensitivity analysis, LEED conditions, Green Hospital.

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1 Introduction

Buildings are known to pose a threat to human health and the environment due to the emission of greenhouse gases that result from the resources used during their construction and operation [1]. The concept of green hospitals has emerged as a solution to these problems, with the goal of improving healthcare and the environment, and ultimately benefiting human welfare and society [2, 3]. To certify these green hospitals, systems such as the Building Research Establishment Environmental Assessment Method (BREEAM) for Healthcare and Leadership in Energy and Environmental Design (LEED) for Healthcare were developed, which graded them and certificated them at various levels [4–6].

The COVID-19 pandemic has resulted in various measures being implemented to reduce its spread and prevent the collapse of health systems [7–9]. The aim of this study is to investigate the implications of renovation and expansion initiatives on hospital certification systems and management strategies during the pandemic. Hospitals play a vital role in providing healthcare services to communities, and as societal needs and technological advancements evolve, hospitals face the challenge of meeting these demands. This study focuses on the implementation of the LEED certification system in a private university hospital undergoing renovation and expansion.

To understand the implications of hospital renovations and expansions, it is important to examine the definitions and objectives of healthcare systems and planning, including general healthcare services, the classification of healthcare institutions, and interdepartmental relationships within hospitals. This provides valuable insights for healthcare administrators and decision-makers in shaping hospital infrastructure projects [10, 11]. One significant aspect of hospital renovation and expansion initiatives is the adoption of certification systems such as the LEED certification, which evaluates hospitals based on environmental standards, energy efficiency, and overall performance [12, 13]. This study assesses the impact of hospital renovations and expansions on the attainment of LEED certification and the benefits gained in terms of higher-quality services and improved patient outcomes. Additionally, the study evaluates the management strategies employed during hospital expansions in the context of the COVID-19 pandemic, examining criteria such as LEED points, sustainable sites, regional priorities, water efficiency, innovation in design, materials and resources, and indoor environmental quality. This analysis provides insights into how hospital expansions influence the implementation of performance certificate programs and the management of COVID-19.

1.1 Concept of Green Hospital

A century ago, hospitals were typically small, naturally ventilated structures that maximized access to sunlight and fresh water while blending in with their environment [14]. However, modern hospitals have evolved into sprawling complexes that generate nearly 5 million tonnes of waste per year and require significant amounts of water and energy [15, 16]. With the dynamic shifts in population growth and urbanization, hospitals are confronted with the challenge of adapting their infrastructure to meet the increasing demands for healthcare services. The literature emphasizes the need for hospitals to develop flexible and scalable infrastructures that can accommodate the changing needs of the expanding population [17]. This trend has become increasingly unsustainable due to limited resources, insufficient waste management and disposal infrastructure, inadequate training in hazardous substance usage and management, and limited incentives for adopting renewable energy sources. In response to these challenges, the concept of green hospitals has emerged as a key strategy for promoting sustainable healthcare institutions. The green hospitals movement began in 1998 with the establishment of LEED certification standards by the US Green Building Council, which provided a framework for designing, constructing, and operating hospitals in an environmentally sensitive manner [18–20].
Green hospitals are defined as healthcare facilities that prioritize sustainability and efficiency in their design and operation. They are constructed using sustainable and recyclable materials and are designed to minimize their environmental impact throughout their entire lifecycle [21, 22]. Green hospitals also employ waste reduction and recycling measures and contribute to cleaner air by minimizing their carbon footprint. The benefits of green hospitals extend beyond energy savings and emissions reductions. By prioritizing sustainability, these institutions can provide better healthcare services to patients and society as a whole, improving efficiency, quality, and environmental performance [23, 24]. To achieve these goals, green hospitals employ a range of strategies, including energy-efficient lighting and HVAC systems, water conservation measures, and sustainable procurement practices [25, 26]. They also prioritize waste reduction and recycling, hazardous substance management, and the use of renewable energy sources. The concept of green hospitals is an essential strategy for promoting sustainable healthcare infrastructure in the face of growing environmental challenges. By adopting sustainable design and operation practices, these institutions can provide high-quality healthcare services while minimizing their environmental impact, contributing to a healthier planet and a healthier society [27–29].

1.2 Green Hospital Certification Systems

The construction and building industries have played a critical role in sustainable development worldwide, with the need for efficient resource utilization and ecological balance being of utmost importance. However, these activities have had a detrimental impact on the environment, consuming excessive energy and resources [30–32]. To address this challenge, green building certification systems have been developed to create healthier environments where resources are used efficiently and ecological balance is maintained [33–35]. Green hospitals, being part of green buildings, require certification systems that evaluate hospitals based on sustainable design and construction criteria. The most commonly used green hospital certification systems are BREEAM for Healthcare, LEED for Healthcare, and Australian Green Star certification systems [36,37]. Other lesser-used certification systems include Green Health Practices Green Guide for Healthcare, American Society for Healthcare Engineering, and Healthcare Without Harm [38]. The certification of hospitals with green building standards has multiple benefits. It can increase patient satisfaction and inpatient revenue, which contributes positively to both the health of patients and the environment. Additionally, hazardous waste produced can be disposed of up to 100% more efficiently, qualitatively, and at a lower cost. Implementing green hospital certification systems not only benefits the environment, but also contributes to the establishment of a sustainable healthcare infrastructure, ensuring that hospitals provide the best service to patients and society as efficient, quality, and environmentally friendly institutions [39–41].

1.3 LEED for Healthcare

The Leadership in Environmental and Energy Design (LEED) certification system was developed in 1998 by the US Green Building Council (USGBC), and it is currently the most widely used building environmental assessment system [42, 43]. LEED is designed to provide a framework that enables building owners and operators to define, design, and operate buildings in a way that is practical and measurable, with a focus on green building design, construction, operation, and sustainable solutions [44, 45]. While the system is used for various types of buildings, the unique complexities of hospitals, including their high energy and water usage, use of various chemicals, need for infection control, and production of medical waste necessitated the development of a certification system specifically for hospitals.

The LEED for Healthcare certification system was introduced in 2011 to address these challenges. The evaluation process for LEED certification starts with project registration with the USGBC, after which construction and design documents are sent for preliminary evaluation [46]. If documents are missing, the
project team has 15 days to send them back to the USGBC for final evaluation and determination of the certification level. LEED certification can be awarded for various types of buildings, including new buildings and major renovations, existing buildings’ operation and maintenance, corporate interiors, building core and shell, schools, shopping malls, healthcare institutions, and houses. The evaluation criteria for LEED for Healthcare include energy and atmosphere, which carries the highest score (33 points), as well as integrative process, which carries the lowest score. The four different certificate levels in this system range from certified (40–49 points) to platinum (80 points and above) [47, 48]. In Turkey, the Ministry of Health (MOH) has required LEED certification for hospitals with more than 200 beds since 2012, marking the start of the green hospital era in the country [49]. LEED for Healthcare is an essential certification system for hospitals seeking to create a healthier environment where resources are used efficiently, the ecological balance is observed, and hazardous wastes produced can be disposed of efficiently, qualitatively, and at lower costs. By adopting LEED certification, hospitals can increase patient satisfaction and income from inpatients, benefiting both patients and the environment.

1.4 Australian Green Star

In Australia, the Green Star certification system was launched by the Green Building Council of Australia (GBCA) in 2003, with the aim of reducing carbon pollution by up to 60% in 30 years [50]. The certification system is voluntary [51] and the evaluation process begins with online registration of the project to the institution. Next, the necessary documents are checked, and the compliance of the structure with Green Star’s sustainability standards is examined. In the final stage, the documents are sent to the GBCA for Green Star evaluation, where an independent group of sustainable development experts reviews the project and assigns an overall score. Based on the score obtained, certification is carried out. Hospitals, as well as offices, schools, universities, industrial establishments, public buildings, train stations, conference and trade centers, and residences, can be evaluated and certified under the Green Star system.

Green Star evaluates buildings under four main headings, namely design, built interiors, communities, and performance. The assessment criteria for Green Star certification include management, indoor quality, energy efficiency, transport, water efficiency, material use, space use and ecology, emissions, and innovation [52]. The projects are scored out of 100 points, and projects with a score between 10 and 44 (1-3 stars) cannot be certified. In contrast, projects with a score of 45 and above (4-6 stars) are eligible for certification. The certification is awarded at three different levels, namely Best Application (45-59 points/4 stars), Excellent Application for Australia (60-74 points/5 stars), and Leading Application in the World (75 points and above/6 stars) [53].

Australia’s commitment to sustainability is reflected in its policies, such as the National Climate Change Adaptation Research Facility, which supports research on adaptation to climate change, and the National Greenhouse and Energy Reporting System, which collects information on greenhouse gas emissions and energy consumption of large companies. Additionally, the country’s commitment to sustainability is reflected in its leadership in the use of renewable energy sources such as solar and wind energy. Furthermore, the Green Building Council of Australia has also established partnerships with organizations around the world to promote the adoption of sustainable building practices.

1.5 COVID-19 Management in Hospital Expansions

The COVID-19 pandemic has posed unprecedented challenges to healthcare systems worldwide. Hospital expansions undertaken during this period need to consider the unique requirements for managing infectious diseases and ensuring patient and staff safety. Studies have emphasized the importance of incorporating
infection control measures, such as isolation units, ventilation systems, and triage protocols, into hospital expansion projects to effectively manage the spread of COVID-19 [54]. Hospital infrastructure plays a crucial role in influencing patient outcomes, including treatment effectiveness, patient satisfaction, and overall healthcare experience. Studies have shown that well-designed healthcare facilities with optimized layouts, efficient workflow patterns, and adequate space allocation contribute to improved patient outcomes, reduced medical errors, and enhanced staff performance [55]. Understanding the correlation between hospital infrastructure and patient outcomes is essential for guiding hospital expansion initiatives toward achieving positive healthcare outcomes.

The adoption of certification systems, such as LEED, ensures sustainable and environmentally friendly healthcare facilities, while performance certificate programs promote quality standards and continuous improvement. The COVID-19 pandemic further emphasizes the need to consider infection control measures and effective pandemic management strategies in hospital expansion projects. The relationship between hospital infrastructure and patient outcomes underscores the importance of optimizing healthcare facilities to enhance patient experiences and treatment outcomes. By investigating the implications of hospital expansions on the applicability of performance certificate programs and COVID-19 management, this research contributes to the existing body of knowledge in healthcare infrastructure planning and management. The findings of this study will provide valuable insights for decision-makers and healthcare administrators, enabling them to enhance hospital infrastructure, meet certification standards, and ensure effective pandemic management in the face of evolving healthcare needs.

2 Materials and Methods

2.1 Mathematical Model

A mathematical model is utilized to examine the effect of the Leadership in Energy and Environmental Design (LEED) criteria on hospital performance. The differential equations of the model are given by:

\[
\frac{dH}{dt} = \pi - \lambda_1 H + \lambda_2 G - \varepsilon_1 H \\
\frac{dG}{dt} = \lambda_1 H - +\lambda_2 G - \varepsilon_2 G
\]

where \( \lambda_1 = \alpha + \beta + \gamma + \delta + \sigma + \theta + \rho \) and \( \lambda_2 = (1 - \alpha) + (1 - \beta) + (1 - \gamma) + (1 - \delta) + (1 - \sigma) + (1 - \theta) + (1 - \rho) \). The variable \( H \) represents the hospital performance, \( G \) represents Green Hospital that satisfies the LEED conditions and the parameters \( \alpha, \beta, \gamma, \delta, \sigma, \theta, \rho \) are represent Energy and Atmosphere, Indoor Environmental Quality, Sustainable Sites, Materials and Resources, Water Efficiency, Innovation in Design, and Regional Priority respectively which are the LEED criteria and \( \pi, \varepsilon_1, \varepsilon_2 \) are constants that influence the rates of change in the equations.

This mathematical model provides a framework for evaluating the impact of the LEED criteria on hospital performance and the effect of hospital performance on the implementation of the LEED criteria. The model allows for the examination of how changes in the LEED criteria variables \( (\alpha, \beta, \gamma, \delta, \sigma, \theta, \rho) \) affect hospital performance over time.
2.2 Sensitivity Analysis

Equating each equation of system (1) to zero and solving simultaneously, the equilibrium point of the system is obtained as follows:

\[
\left( \frac{\lambda_1 \pi}{\lambda_1 \epsilon_2 + \lambda_2 + \epsilon_1 + \epsilon_1 \epsilon_2} \right), \left( \frac{\lambda_2 \pi}{\lambda_1 \epsilon_2 + \lambda_2 + \epsilon_1 + \epsilon_1 \epsilon_2} \right). \tag{2}
\]

The threshold condition of the model obtained by using the Next Generation matrix method as follows;

\[
R_0 = \frac{\lambda_1 \lambda_2}{(\lambda_1 + \epsilon_1)(\lambda_2 + \epsilon_2)}. \tag{3}
\]

This section, using the local sensitivity analysis method outlined the sensitivity of the threshold condition \(R_0\).

Our main concern is to explain the sensitivity of the significant parameters which represent the LEED conditions in the model. The set of input parameters relative to \(R_0\) is

\[
\sigma = \{\alpha, \beta, \gamma, \delta, \sigma, \theta, \rho, \} . \tag{4}
\]

Typically, if a model has different parameters, variations in parameters might not always influence the outcome due to variance in the sensitivity of the parameters, those with the positive sign are considered as highly and proportionally sensitive for increasing the value of \(R_0\) while those with the negative sign are sensitive for the decrease of \(R_0\) value and the other category is neutrally sensitive (with zero relative sensitivity). \(\Omega^{R_0}_\gamma\) is denoted as a normalized local sensitivity index of the output \(R_0\) with respect to a parameter \((\gamma)\), where \(\gamma \in \sigma\), and is defined as

\[
\dot{\psi}_\gamma = \Omega^{R_0}_\gamma = \frac{\partial R_0}{\partial \gamma} = \frac{\partial ln(R_0)}{\partial ln(\gamma)} .
\]

Using the above definition, computed the following indices for the output \(R_0\) with respect to every parameter presented for both the Public and Near East University in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Elasticity Indices</th>
<th>Values of the EI for YDU</th>
<th>Values of the EI for BNH</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha)</td>
<td>(\Omega^{R_0}_\alpha)</td>
<td>0.791752</td>
<td>0.3287761</td>
</tr>
<tr>
<td>(\beta)</td>
<td>(\Omega^{R_0}_\beta)</td>
<td>0.37142</td>
<td>0.10151</td>
</tr>
<tr>
<td>(\gamma)</td>
<td>(\Omega^{R_0}_\gamma)</td>
<td>0.361142</td>
<td>0.142113</td>
</tr>
<tr>
<td>(\delta)</td>
<td>(\Omega^{R_0}_\delta)</td>
<td>0.322731</td>
<td>0.162415</td>
</tr>
<tr>
<td>(\sigma)</td>
<td>(\Omega^{R_0}_\sigma)</td>
<td>0.182918</td>
<td>0.081208</td>
</tr>
<tr>
<td>(\theta)</td>
<td>(\Omega^{R_0}_\theta)</td>
<td>0.121722</td>
<td>0.040604</td>
</tr>
<tr>
<td>(\rho)</td>
<td>(\Omega^{R_0}_\rho)</td>
<td>0.081297</td>
<td>0.020302</td>
</tr>
</tbody>
</table>

Table 1: Gender Distribution in Hospitals

Table 1 shows that even increasing the LEED conditions respectively has different effects, increasing the parameters has a positive effect. Graphically, the effects of the parameters are shown through Figures 2-8.
Figure 1: LEED criteria YDU & BNH

Figure 2: sensitivity of Energy and Atmosphere for YDU & BNH
Figure 3: Sensitivity of indoor environmental quality for YDU and Public hospitals.

Figure 4: Sensitivity of sustainable sites for YDU and Public Hospitals.
Figure 5: Sensitivity of Materials and Resources for YDU and Public Hospitals.

Figure 6: Sensitivity of Water Efficiency for YDU and Public Hospitals.
Figure 7: Sensitivity of Innovation in Design for YDU and Public Hospitals.

Figure 8: Sensitivity of Regional Priority for YDU and Public Hospitals.
3 Results

3.1 Water-saving

The water used in special armatures, washbasin and showers were collected in a separate system and then fed to toilets with a different network. A visual pond was built in front of the hospital by collecting surplus and rainwater. A circulation pump was used to achieve the highest level of water savings.

Wastewater damages in all respects. It has harmful consequences not only economically but also in many aspects. The circulation pump is a powerful piece of equipment in terms of preventing water waste. Because, with the circulation pump, there is always hot water, there is no waste of liquid. We know that most places do not need constant hot water. When it is not needed, the water does not accumulate in the pipes. Thus, it allows you to save energy and money. Closed-circuit water control is followed by pumps and efficient use can be achieved.
3.2 Certificate Scores of Near East University Hospital and Nicosia Dr. Burhan Nalbantoğlu Hospital

According to the LEED certification system, the comparison of Near East University and Nicosia Dr. Burhan Nalbantoğlu Hospital is shown Table 2. The references for these criteria are as follows Table 2: CRC, 2008, 2011; LEED, 2009; California Energy Code, 2011. According to Table 2, the certification system evaluation scores of the Near East Hospital are higher than the scores of Nicosia Dr. Burhan Nalbantoğlu Hospital.

The environmental performance of buildings is evaluated based on the evaluation criteria under the LEED certification system, and they are evaluated over a total of 110 points. The buildings are certified at four different levels, certified, silver, gold and platinum, based on the total score they receive from the evaluation [56].

<table>
<thead>
<tr>
<th>LEED Certification Level</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum</td>
<td>80 and above</td>
</tr>
<tr>
<td>Gold</td>
<td>69-79</td>
</tr>
<tr>
<td>Silver</td>
<td>50-59</td>
</tr>
<tr>
<td>Certified</td>
<td>40-49</td>
</tr>
</tbody>
</table>

Table 2: LEED Certification Levels

3.3 Statistical Results

According to the data that collected from Near East Hospital, 52% of the inpatients are women and 48% are men, 68% are women and 32% are men of the outpatients and 92.3% and 3.8% are men of the staffs. The mean age of inpatients is 65 and the mean age of outpatients is 47. The mean work year of staffs changes between 1 and 5 years. According to the data that collected from Government (Dr. Burhan Nalbantoğlu) hospital, 28% of the inpatients are women and 72% are men, 56% are women and 44% are men of the outpatients and 32% women and 68% are men of the staffs. The mean age of inpatients is 48 and the mean age of outpatients is 48. The mean work year of staffs changes between 5 and 10 years. That are shown in Tables 3, 4 and 5, respectively.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Inpatients</th>
<th>Outpatients</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near East Hospital</td>
<td>52% women, 48% men</td>
<td>68% women, 32% men</td>
<td>92.3% men, 3.8% women</td>
</tr>
<tr>
<td>Dr. Burhan Nalbantoğlu Hospital</td>
<td>28% women, 72% men</td>
<td>56% women, 44% men</td>
<td>32% women, 68% men</td>
</tr>
</tbody>
</table>

Table 3: Gender Distribution in Hospitals

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Mean Age (inpatients)</th>
<th>Mean Age (outpatients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near East Hospital</td>
<td>65</td>
<td>47</td>
</tr>
<tr>
<td>Dr. Burhan Nalbantoğlu Hospital</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

Table 4: Mean Age of Patients

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Mean Work Year of Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near East Hospital</td>
<td>1-5 years</td>
</tr>
<tr>
<td>Dr. Burhan Nalbantoğlu Hospital</td>
<td>5-10 years</td>
</tr>
</tbody>
</table>

Table 5: Mean Work Year of Staff
4 Discussion and conclusion

The model presented in the research sheds light on the changes observed in various LEED criteria before and after hospital expansions. The results indicate a clear trend of improvements across the board. For example, the Near East Hospital (YDÜ) experienced a significant increase in its LEED Certification Points, rising from an initial score of 79 to a final range of 163.13-163.14 points after the expansion. Similarly, Dr. Burhan Nalbantoğlu Hospital (BNH) saw its points climb from 41 to a final range of 85.93-86.39 points as seen in Figures 1. These substantial enhancements in LEED points suggest that the hospital expansions positively influenced their ability to meet certification standards. The improvements were not limited to LEED points alone. The sustainable sites category, which evaluates the environmental impact of a building’s location, also exhibited notable progress. The Near East Hospital (YDÜ) recorded an increase from 79 initially to a final range of 169.19-169.30 points, while the Dr. Burhan Nalbantoğlu Hospital (BNH) saw an upward shift from 41 to a final range of 90.13-91.20 points, as shown in Figures 1. This improvement signifies that the expansions were successful in promoting environmentally conscious practices.

Similarly, the regional priority and water efficiency categories witnessed positive developments. The expansion efforts led to an increase in regional priority scores for both hospitals, with the Near East Hospital (YDÜ) scoring 169.20-169.30 points (up from 79 initially) and the Dr. Burhan Nalbantoğlu Hospital (BNH) scoring 90.13-91.20 points (up from 31 initially).

The positive effect rates of each LEED factor for NEU and State hospital to be Green Hospitals are shown in Table 1, and the effects of these parameters can be seen graphically in Figures 2-8 respectively.

Additionally, both hospitals displayed progress in the materials and resources category, emphasizing their commitment to sustainable resource management. We see from Figure 9 that the LEED criteria has some effects on hospital performances. An increase in \( (G) \) LEED criteria contributes positively to the rate of change of \( H \), indicating an improvement in hospital performance.

The implications of these findings are significant for decision-makers and healthcare administrators. The analysis suggests that hospital expansions can effectively enhance infrastructure, meet certification standards, and improve overall operations. By investing in expansion initiatives, hospitals can achieve higher LEED scores, promote sustainable practices, and create environmentally friendly facilities. Furthermore, the research also examines the effects of these expansions on the applicability of performance certificate programs and the management of COVID-19, offering valuable insights to guide future decision-making processes in the healthcare sector.

As a result of the study, Sustainable strategies can also improve energy efficiency, reduce water consumption and waste, and reduce operating costs. The study showed that the Near East University Hospital implemented sustainable strategies more effectively than the Nicosia Dr. Burhan Nalbantoğlu Hospital.

The water-saving system used in the Near East University Hospital can save significant amounts of water and reduce water costs. The hospital also saved energy by using a circulation pump that ensures hot water is always available when needed, reducing waste in the process. The implementation of the water-saving system not only saved costs but also contributed to the sustainable use of resources. The analysis of the data collected from both hospitals showed that the majority of inpatients in both hospitals are men. However, the Near East University Hospital had a higher percentage of women in both inpatient and outpatient care. This may be due to the hospital’s location and its reputation for quality healthcare services. The mean age of inpatients in the Near East University Hospital was higher than that of the Dr. Burhan Nalbantoğlu Hospital. This may be due to the fact that the Near East University Hospital provides specialized services that attract older patients. On the other hand, the mean age of outpatients was lower at the Near East University Hospital. This may be due to the fact that the hospital provides a wide range of services, including preventive care and outpatient procedures, attracting younger patients. In
terms of staff, the majority of staff in both hospitals were men. However, the Near East University Hospital had a higher percentage of female staff than the Dr. Burhan Nalbantoğlu Hospital. The mean work year of staff at the Near East University Hospital was also lower than that of the Dr. Burhan Nalbantoğlu Hospital.

In conclusion, the research highlights the positive outcomes of hospital expansions in multiple aspects of LEED certification. The significant improvements observed in LEED points, sustainable sites, regional priority, water efficiency, innovation in design, and materials and resources indicate the tangible benefits of expansion initiatives. By considering these findings, decision-makers and healthcare administrators can make informed choices to enhance hospital infrastructure, meet certification standards, and improve overall operations, ultimately leading to better healthcare delivery and sustainability.

References


