

# Modeling Patient Satisfaction in Hospital Design Using Evidence-Based Design (Case Study: Kasra Hospital)

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**ABSTRACT:** Patient satisfaction is a key indicator in evaluating the quality of healthcare services and plays a crucial role in the healing process and patients' perception of the healthcare system. Evidence-Based Design (EBD) is a scientific approach that uses empirical data to optimize healthcare environments. The goals of this research are to promote the principles of designing healthcare centers using an evidence-based approach, thereby improving the quality of space, enhancing patient satisfaction, and accelerating the recovery process.

The research method is based on patient-centered principles, aligning with analytical-descriptive research that incorporates field observations, library studies, and data collection through questionnaires from 65 patients hospitalized at Kasra Hospital. These data are analyzed to provide a suitable solution for the design. Data analysis is conducted using the regression and correlation methods. The software used is ASPECT and SPSS 26.

According to the obtained results, threshold rate of 6, the average factors of views (3.646), nature and outdoors (3.472), comfort and control (3.913), Legibility of place (3.900), facilities (3.079) and staff (3.594) means that the patients in the hospital are relatively satisfied with the aforementioned factors and the average of privacy and participation (2.769) and interior design (2.896) indicating low satisfaction with the mentioned factors.

This study confirms that implementing evidence-based design principles in hospital environments significantly enhances the patient experience, increases satisfaction, and accelerates the healing process.

**Keywords:** Healing Environment, ASPECT Tool, Patient-Centered Design, EBD, Hospital Architecture, User Experience.

## INTRODUCTION

The patient is the primary focus of the hospital, and all services provided are tailored to their specific needs. Patient satisfaction is an indicator of the proper implementation of these services. Today, health systems are increasingly emphasizing the issue of patient satisfaction (Teschke, 1991). Over the last decade, there has been widespread attention to the issue of patient satisfaction in the NHS, making this concept a key pillar of the organization's policies (Garcia & Martinez, 2021). In the context of NHS programmes, quality is not limited to clinical assessments but also includes the patient experience. Reduced patient satisfaction may lead to poor cooperation in the treatment process, which can lead to waste of resources and reduced quality of treatment outcomes (Kim & Choi, J. 2023, 46). Currently, designing healthcare centers to improve clinical outcomes, reducing

psychological stress for patients and staff, reducing medical errors, increasing the level of satisfaction of patients, families, and healthcare staff, and also controlling high healthcare costs, are among the key goals in building hospitals of the future (Smith & Hamilton, 2023).

As a modern approach to medical center design, EBD emphasizes the importance of using valid data to examine its effect on the design process. In therapeutic architecture, this approach is known as "an attempt to improve the wellbeing of patients and staff, the treatment process of patients, safety, and stress reduction" (Guenther & Vittori, 2020).

In recent years, enhancing the quality of healthcare environments has become a central focus in global health systems (Rashid, 2020). The physical environment of hospitals, beyond its functional role, plays a significant part in shaping patients' subjective experiences,

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accelerating recovery, and increasing overall satisfaction (Anderson, 2024). Evidence-Based Design (EBD) is a scientific, interdisciplinary approach that integrates empirical findings to identify and apply environmental factors that promote health outcomes in the design of healthcare spaces (Smith et al., 2022, 794).

Given that patient satisfaction is a key indicator of healthcare service quality, this study aims to model the relationship between environmental design components and patient satisfaction. Focusing on a case study of Kasra Hospital, the research aims to develop a comprehensive conceptual model that identifies key environmental factors influencing patient satisfaction and analyzes the causal relationships among these factors using advanced statistical methods. This article aims to address the question: How can EBD frameworks, such as ASPECT, inform the spatial and interior improvements that enhance patient satisfaction in existing Iranian hospitals?

Despite the growing international literature on EBD, a significant gap remains in the localization of environmental satisfaction factors within the context of Iranian healthcare facilities. Accordingly, this research, through a case study of Kasra Hospital in Tehran, seeks to develop a scientifically grounded and contextually adapted model for analyzing and enhancing patient satisfaction. The study not only addresses an existing theoretical gap but also offers practical insights for improving the design quality of healthcare environments in Iran.

The novelty of this study lies in its integration of architectural design, behavioral science, and data analysis to offer a practical, evidence-based framework for improving patient experience in healthcare settings. This model can serve as a practical guide for architects, interior designers, and hospital administrators in the future design of healing environments.

## MATERIALS AND METHODS

This research is a descriptive-analytical study based on field observations, library research, and a case study, involving data collection through questionnaires from hospitalized patients at Kasra Hospital in Tehran. By examining their strengths and weaknesses and analyzing the data, an appropriate design idea and solution have been presented. Data analysis is based on regression and correlation methods, grounded in the theoretical foundations of the research in question.

### Statistical Population

The statistical population of this study consists of patients at Kasra Hospital, totaling 254 individuals.

### Sample Volume

The Cochran formula was used to determine the sample volume (Equation 1)

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N} \left( \frac{z^2 pq}{d^2} - 1 \right)}$$

Equations 1: Cochran formula

n = Sample size

N = Statistical population size

z = Acceptable confidence interval standard error percentage

q = Proportion of the population lacking a certain attribute

q (1-p) = Proportion of the population lacking a certain attribute

d = Desired degree of confidence or probable accuracy

According to the above formula, to achieve a sample size with a population gap of 0.5, the value of z is usually 1.96. The confidence interval in this formula is 95%, the population size is 891 people, the error rate is 0.05, and in the most conservative case, the number of questionnaires is 65.

### Research Tools

The tool used in this study is an ASPECT-based questionnaire, and SPSS 26 software is used to extract diagrams and descriptive data.

### Data Analysis Method

Consistent with the nature of the research and its findings, data analysis was conducted using logical reasoning and an inductive method. Descriptive statistics were used to analyze the data. In this study, 96 male and female hospitalized patients aged 15-80 years were surveyed face-to-face about "satisfaction with the hospital." The answers to the questions were entered in the ASPECT software. The results were weighted on a 6-point Likert scale, ranging from 0 to 5, with 0 indicating 'unanswered', 1 indicating 'disagree', 2 indicating 'somewhat disagree', 3 indicating 'somewhat agree', 4 indicating 'agree', and five indicating 'totally agree'. The eight parts of the ASPECT software were privacy, company, dignity, views, nature and outdoors, comfort and control, place legibility, interior appearance, facilities, and staff.

The questionnaire was again categorized based on the healing environment characteristic, and more results were elicited. The results were entered into SPSS 26 software, and the following figures were calculated.

## RESULTS AND DISCUSSIONS

The mean and standard deviation of the eight sections of the ASPECT score of patients admitted to Kasra Hospital are reported in Tables 1 and 2. It can be seen that the total average is 3.299, which is higher than the theoretical average value of 3, indicating relatively better satisfaction with the eight factors of Kasra hospital. Also, the data shows that the average factors of views (3.646), nature and outdoors (3.472), comfort and control (3.913), Legibility of place (3.900), facilities (3.079) and staff (3.594) has a relatively higher average than the average, which means the relative satisfaction of the hospitalized patients concerning the mentioned factors. The average of the components of Privacy, company, and dignity participation (2.769) and interior appearance (2.896) is lower than the average, indicating low satisfaction with these factors. The important point is that, in Kasra Hospital, the average answers of the patients for none of the eight ASPECT factors exceeded the number 4, indicating a very high level of dissatisfaction with the mentioned factors. It is necessary to explain that the standard deviation of the answers given in the eight factors of ASPECT has small fluctuations with favorable numbers and indicate that the data is more focused on the average and is a seal of approval on the results

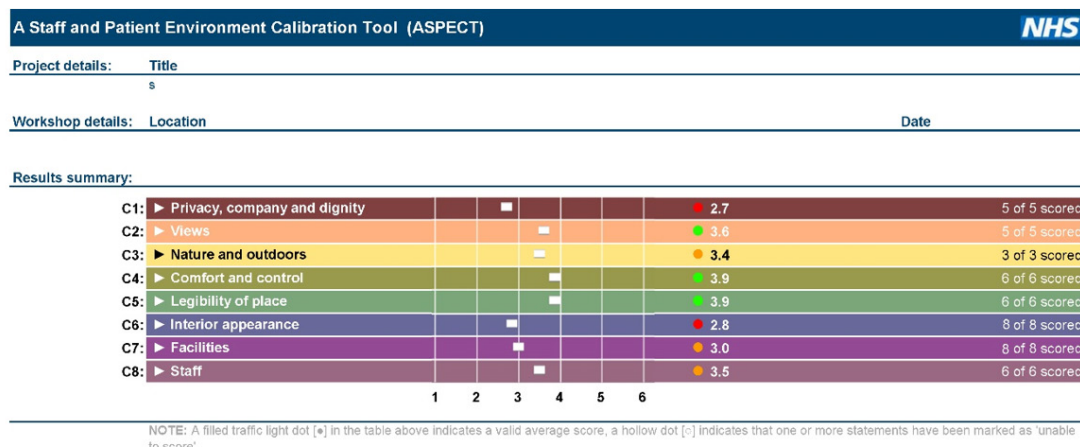


Fig. 1: Statistical indicators of satisfaction of patients in Kasra Hospital by the eight sections of ASPECT

(Figure 1) & (Figure 5).

#### Eight Sections of Assessment through ASPECT Software

- **Privacy, company, and dignity:** everybody's privacy is a feeling about their dignity, autonomy, and personal space (Heidari et al., 2011, 645).

- **Views:** The view of natural landscapes is associated with stress reduction and patients' recovery, characterized by a set of positive emotional, psychological, and physiological changes (Ulrich, 1984, 420).

- **Nature and outdoors:** The design and application of green spaces in hospitals are less expensive than manufacturing hospital equipment. These spaces provide the following advantages: reducing the stress of patients, staff, and visitors, alleviating the pain of patients, decreasing depression, enhancing the quality of life for permanent patients, improving routing ability, increasing the physical activity of patients, and strengthening their sense of autonomy (Mardomi et al., 2013, 64 & 65). The design of healing green space tends to create open space to meet the medical needs of patients. The garden is indeed a place and tool used to treat various patients; for instance, it serves as a rehabilitation space for patients, a green space for those suffering from Alzheimer's and other sensory impairments, and a green space for cancer patients (Adibhesami et al., 2021).

- **Comfort and control:** The term "subjective comfort" refers to individuals' subjective assessments of their situations. There is a high relationship between subjective comfort and sufficient knowledge about the disease, the close relationship between the patient and physician, social support, and spiritual aspects, which are all coping strategies (Siegrist, 2003).

- **Legibility of place:** Most clients of medical centers have fewer sensory, physical, and cognitive resources due to disease and stress, making it difficult for them to navigate and be present in a complex and stressful environment (Mollerup, 2009). Legibility of place refers to creating a space where visual information is organized and coherent, providing a basis for the action and movement of individuals within the

environment (Mardomi et al., 2011, 51).

#### • Interior design

**Light:** natural and artificial illuminance must satisfy the following needs: occupational efficiency, comfort, psychological needs, aesthetics, visual wellbeing, human relationships, hygiene, and safety (Ministry of Health, 2013, 270). Available studies confirm that natural light can reduce depression in patients with seasonal disorder and bipolar depression (Benedetti et al., 2001), shorten the treatment period, and improve sleep status (Joseph & Zimring, 2022). Alleviate emotion and relieve pain (Lacgrace, 2002) (Hosseini et al., 2022, 30).

**Color:** color plays an underlying role in improving the environment, acquiring knowledge, and routing (Dalke et al., 2004, 3). Accurate application of color in medical centers not only fosters morality and makes the space happy but also can be effective in treating many diseases by influencing the body and soul of patients (Hosking & Haggard, 1999, 120).

**Sound:** sound pollution or noise in medical centers may cause negative effects, such as insomnia, anxiety, hypertension, and considerable need for relieving pain, disorder in processes and activities, and disturbing comfort of patients, companions, and staff (Ministry of Health, 2013, 283). "The noise that causes discomfort would hurt the patient. Too much noise is the cruellest kind of inattention," Florence Nightingale explained it for the first time in the book "Note on Nursing." (Nightingale, 1969, 47).

**Positive Distraction:** Positive distraction is anything that can divert a person's attention, creating a positive feeling response in them. When proper positive distractions are selected in the medical setting, the stress of patients can be reduced, and a sense of security is created for them (Kaiser, 2007, 8). Music can decrease stress and distract the patient's mind from focusing on the adverse side effects of the disease. Music has an instant physiological effect due to the body's autonomous neural system (Kemper & Danhauer, 2005; Pati & Nanda, 2020). Music can also leave a numbing sense (Malkin, 1992, 19).

**Beauty:** Considering interior architecture components in medical centers based on the aesthetic approach and creating a healing space can

improve the quality of medical spaces. Beauty can reduce stress, and increase the satisfaction of staff, patients, and companions (Mardomi et al., 2013, 41). There are specific features of spatial arrangement and environmental design in hospital spaces or workplaces that affect the outcomes, which must be considered in further studies (MacAllister & Zimring 2016, 1).

**Facilities:** The replacement of multiple-bed rooms with single-bed rooms has been a debatable issue in developed countries over recent decades. There is now a considerable willingness to use single-bed hospital rooms (Hosseini et al., 2022, 30). Two features of several beds and the landscape observable through the window are correlated with the hospitalization period of patients (Nikabadi et al., 2021, 87). Single-bed hospital rooms providing many confirmed advantages, such as reducing hospital infections, decreasing medical errors, physical injuries and possible falling, improving sleep, increasing patients' satisfaction, respecting privacy, and improving the relationship between staff, patients, and companions would improve safety of patients (Nikabadi et al., 2022, 98; Ulrich & Zimring, 2021).

**Staff:** The staff of medical centers are responsible for introducing patients to doctors and nurses, providing access to physicians and members of medical groups, meeting the religious and educational needs of patients, and obtaining consent letters signed by the patient for medical, diagnostic, research, and therapeutically risky measures.

Evidence-based design frameworks such as ASPECT offer structured, research-informed tools that guide the spatial and interior enhancement of healthcare facilities. In the context of existing hospitals in Iran, where many buildings lack up-to-date design standards, ASPECT can serve as a practical roadmap to improve spatial functionality and

elevate patient satisfaction.

Applying ASPECT in Iranian hospitals empowers design and management teams to upgrade environments through incremental, evidence-based improvements rather than costly overhauls. Thus, ASPECT not only functions as an assessment tool but also represents a strategic approach for enhancing human-centered, scientifically validated healthcare design.

#### Patient Satisfaction Model with a Patient-Centered Approach

The explanation of the patient satisfaction model of hospital architecture with a patient-centered approach requires consideration of multiple criteria, including various functional, environmental, human, and technical aspects of hospital architecture. These criteria are divided into three general categories: architectural features, interior design features, and psychological and social features, as well as two general categories of internal and external factors. To achieve higher quality in the design of public hospitals, these categories can be further developed by collecting scientific evidence and practical experiences (Figure 2). These models demonstrate that achieving patient satisfaction depends on various factors, ranging from the patient's basic rights to the principles of environmental design that help reduce stress and enhance the feeling of safety and comfort. This model provides a multifaceted approach to hospital design, considering the physical and psychological needs of patients, as well as professional and environmental standards. The sources of patient satisfaction used in this model include the Patient Rights Charter, the eight ASPECT sections, and the EBD principles (Figure 3).

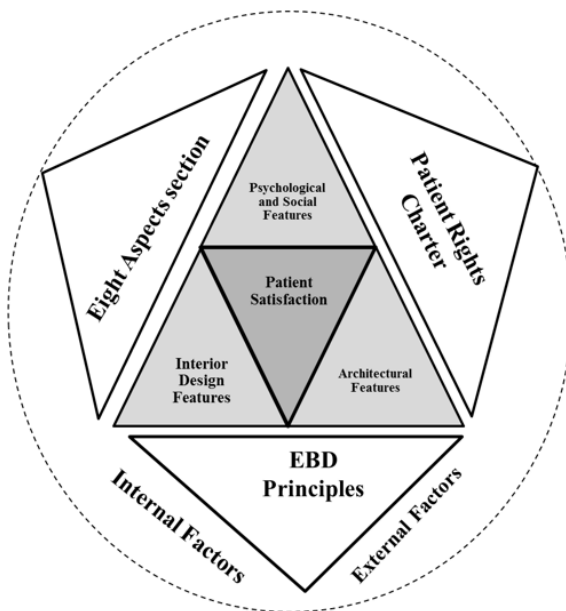


Fig. 2: patient satisfaction model 1

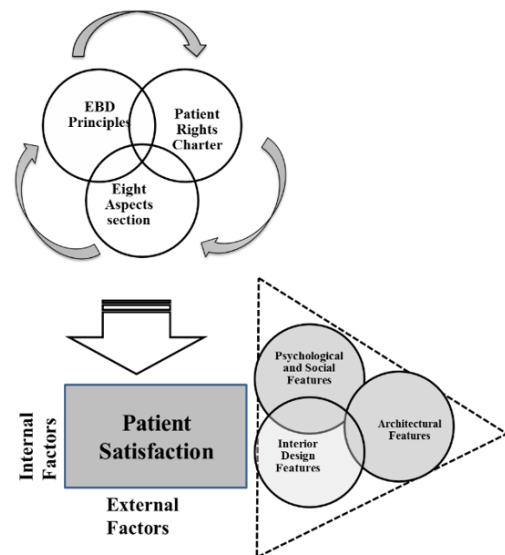


Fig. 3: patient satisfaction model 2

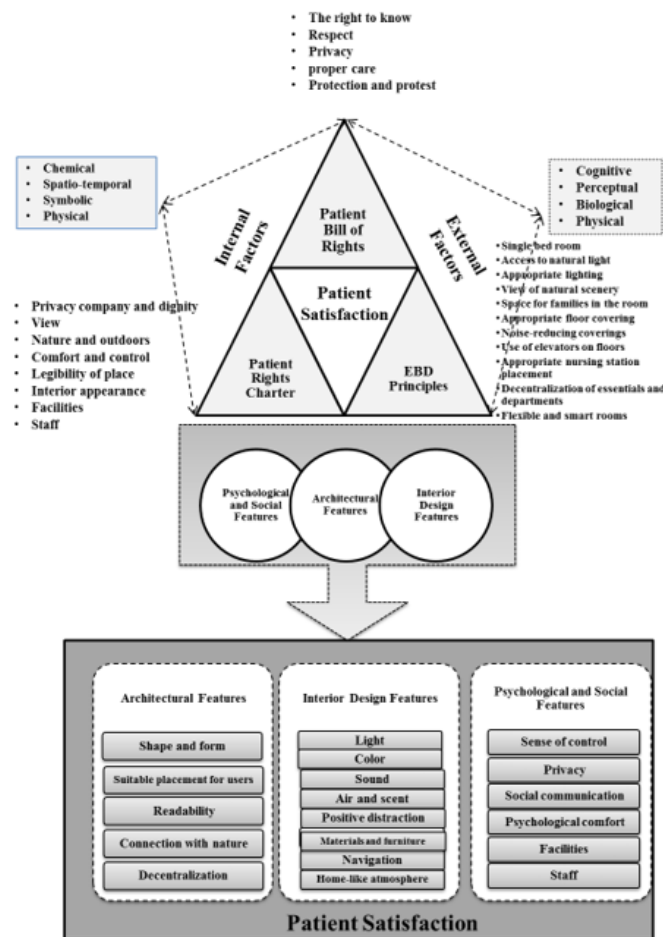


Fig. 4: patient satisfaction model 3

• **Patient Rights Charter:** This section includes the basic rights of the patient, such as the right to know, the right to be respected, confidentiality, receiving proper care, and the right to object. Paying attention to these rights in the design and management of the hospital environment makes the patient feel safe and respected, which in turn helps to create a positive experience for him. (Mosaddegh Rad & Esna Ashari, 2004).

• **Eight ASPECT sections:** This section includes elements of hospital design and planning that have a direct impact on the patient's feelings and experiences. Important sections, such as privacy and participation, appropriate visibility, access to nature, comfort and control, and interior design, are included in this category.

• **Evidence-Based Design (EBD):** This approach to hospital design is defined as "an effort to improve the lives of patients and their families, reduce stress, improve the process of disease treatment, and ensure patient safety and security" (Cama, 2009). Evidence-based design has become a necessity in modern hospitals.

The Patient Satisfaction model, based on the patient-centered approach, is a comprehensive and practical tool for analyzing and improving the patient experience within the hospital environment. Combining

architectural design principles, psychosocial considerations, and hospital internal features can lead to improved quality of healthcare services and increased patient satisfaction (Figure 4).

The average indicators and standard deviation of the healing environment components of Kasra Hospital are shown in Table 1. It can be seen that the total average, the average of architectural features, the average interior design features, and the average of mental and social features are reported as 3.166, 3.309, 3.073, and 3.817, respectively, and the total average score of the number It is almost favorable, and in general, the patients' opinion about the condition of the hospital is less than satisfactory. Additionally, the dimensions of architectural features, interior design features, and mental and social features exceed the theoretical average, indicating relative satisfaction with these factors. With a closer look at each component, we see that the average level of satisfaction of patients in the factors of shape and form (4.715) and light (4.415) is relatively high and higher than the score of 4 out of 6, which shows They have a higher than average level of satisfaction with these components. After that, the average level of satisfaction of the patients in the dimensions of Suitable deployment of uses (3.328), connection with nature (3.508), positive Distraction (3.20),



Fig. 5: Outcome of 8 elements of ASPECT and healing environment factors and patient rights in Kasra Hospital

arrangement (3.215), Textiles, materials and furniture (3/001), routing (3/862), home-like atmosphere (3/210), sense of control (3/261), social communication (3/085), facilities and safety (3/031) and staff (3/670) It was on a Likert scale of 6, which is more than the theoretical average, which means that it leads to their relative satisfaction in these areas. Although these numbers do not provide the desired satisfaction, they indicate that the design of Kasra Hospital has been relatively successful in these indicators. It can also be seen that the average level of patient satisfaction in other areas (routing, decentralization, color, sound, Temperature, air, decor, beauty, privacy, and Psychological comfort) is lower than the average, indicating a lower level of satisfaction. It is necessary to explain that the standard deviation of the answers given in the categories and their factors has favorable numbers due to small fluctuations, indicating the concentration of the data around the average and serving as a seal of approval for the results (Table 1).

The table below outlines the Problem, supporting Evidence, and corresponding Design Intervention (P-E-DI) for Kasra Hospital in Tehran. It highlights specific challenges identified within the hospital environment, presents research-based or observed evidence, and proposes design solutions aimed at improving patient and staff outcomes (Table 2).

## Hypothesis Test

In the current research, the variables of the healing components, which include architectural features, interior design features, and psychological and social aspects, are considered independent variables, while the design of the treatment center is considered the dependent variable. Before testing the hypotheses, the presuppositions of structural equations, including normality (Kolmogorov–Smirnov test), non-collinearity of independent variables (variance inflation factor test (VIF)), and independence of observations (Durbin-Watson test), were examined. It is assumed that all the mentioned assumptions have been confirmed. According to Figure 6, it can be seen that the architectural features with a rate of 0.486 have the greatest impact on the design of the treatment center, and the psychological and social features with a rate of 0.333 have the second priority, and at the end, the interior design features with a rate of 19 0/ has had the least role (Figure 6).

## Evaluation Checklist

### 1. Patient Rights

According to the National Hospital Accreditation Standards, compliance with patient rights is of particular importance. Some of the relevant measures include:

Table. 1: Statistical indicators of the level of satisfaction of patients hospitalized in Kasra Hospital with the factors of the healing environment

Average	Factors Of The Healing Environment	Category
4.715	Shape and form	Architectural features
3.328	Suitable deployment of uses	
2.908	Routing	
3.508	Connection with nature	
2.077	Decentralization	
<b>3.309</b>	<b>Total score of architectural features</b>	
4.415	light	Interior design features
2.338	Color	
2.80	Sound	
2.423	Temperature, air, and adore	
3.20	Positive Distraction	
2.261	Beauty	
3.215	Arrangement	
3.001	Textiles, materials, and furniture	
3.862	Legibility	
3.210	Home-like space	
<b>3.073</b>	<b>Total score of interior design features</b>	
3.261	sense of control	Mental and social features
2.823	Privacy	
3.085	Social communication	
2.761	Psychological comfort	
3.031	Facilities and safety	
3.670	Staff	
<b>3.817</b>	<b>Total score of Mental and social features</b>	
<b>3.166</b>	<b>The score of the components of the healing environment of Kasra Hospital</b>	

Table. 2: Problem / Evidence / Design Intervention (P-E-DI) for Kasra Hospital in Tehran

8 factors of ASPECT	Problem	Evidence	Design Intervention
<b>1. Privacy, Company, and Dignity</b>	Patient beds and examination areas are not always acoustically or visually private. Visitors often lack designated spaces.	Studies show that perceived privacy increases patient satisfaction and reduces stress (Ulrich et al., 2008).	Introduce semi-private rooms with sound-absorbing partitions, provide family zones within patient rooms, and use visual shielding without full isolation.
<b>2. View</b>	Many inpatient rooms lack meaningful visual access to nature or urban context.	Natural views promote faster recovery and reduced use of pain medication (Ulrich, 1984).	Reconfigure window openings to maximize natural views; add interior courtyards with visual access from corridors and patient areas.
<b>3. Nature and Outdoors</b>	Limited access to outdoor areas or healing gardens.	Interaction with nature is linked to improved mood and lower blood pressure (Marcus & Barnes, 1999).	Create accessible green roofs, terraces, and garden courtyards, and incorporate greenery into indoor waiting areas.
<b>4. Comfort and Control</b>	Patients have minimal control over lighting, temperature, and noise levels.	Environmental control correlates with patient empowerment and reduced anxiety (Lawson & Phiri, 2003).	Provide individual controls for lighting and temperature; use sound-insulating materials; and ensure blackout blinds are installed in patient rooms.

Continue of Table. 2: Problem / Evidence / Design Intervention (P-E-DI) for Kasra Hospital in Tehran

8 factors of ASPECT	Problem	Evidence	Design Intervention
5. Legibility of Place	Navigation is difficult due to poor signage and similar-looking corridors.	Wayfinding issues increase stress and staff burden (Carpman & Grant, 2001).	Utilize color zoning, graphic signage, and landmarks to differentiate areas, and incorporate intuitive circulation paths.
6. Interior Appearance	Some areas feel institutional or outdated, lacking warmth or identity.	Welcoming aesthetics reduce anxiety and increase perceived quality of care (Malkin, 1992).	Use calming colors, natural materials, and local artwork; design with a hospitality approach.
7. Facilities	Overcrowded waiting rooms and limited patient amenities (e.g., family rest areas, Wi-Fi).	Well-equipped environments contribute to patient and family satisfaction (Huisman et al., 2012).	Redesign waiting zones for comfort and functionality; provide access to food, internet, and family rest areas.
8. Staff	Staff rest areas are inadequate; circulation patterns create inefficiencies.	Supportive workspaces improve staff wellbeing and efficiency (Hamilton & Watkins, 2009).	Provide quiet rest lounges for staff; design efficient nurse stations with visibility and easy access to patient rooms.

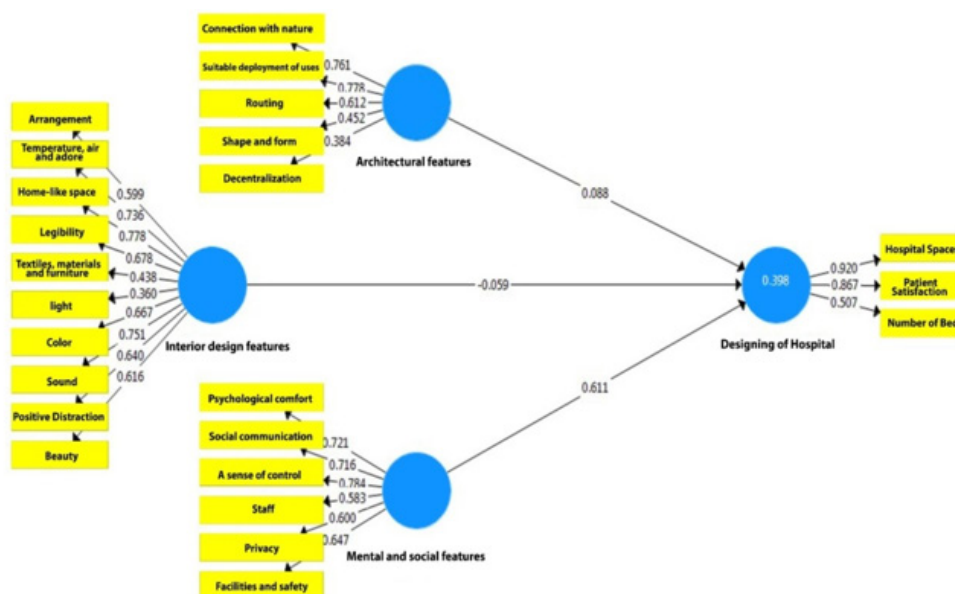


Fig. 6: Standardized path coefficients of the conceptual model in Kasra Hospital

- Providing information about the Patient Rights Charter in appropriate locations in the hospital
- Accurately recording the patient history, physical examinations, and initial diagnoses in the patient file.
- Providing necessary training to patients and their companions, and recording it in their files.
- Ensuring that services are provided following the needs of patients at all hours of the day and night.

## 2. Architectural Areas

In the field of architecture, national standards emphasize the following:

- The presence of active and accessible alarm and security call systems in wards and units.
- Providing suitable space for the hospital's Emergency Operations Center (EOC) with the necessary equipment.
- Wheelchair ramps and elevators are available at all entrances
- Detailed and level paths for patients with mobility disabilities
- Acoustic partitions in waiting areas
- Examination rooms with soundproof doors and walls
- Access to natural light in inpatient rooms
- View of green space from patient beds
- Use of soft colors in interior design

- Comfortable furniture in the waiting area for companions
- Separation of patient, staff, and equipment paths
- Signboards with legible, multilingual fonts and international symbols
- Use of antibacterial and anti-slip materials in rooms and services
- Ventilation and filtration system
- Ventilation with a HEPA filter in surgical rooms and the ICU.

### 3. Treatment Criteria

In the field of treatment criteria, the evaluation checklists refer to the following:

- Establishment of various committees, such as the Quality Monitoring and Evaluation Committee, the Crisis and Disasters Committee, and the Occupational Safety and Health Committee, to improve the quality of services.
- Assessing patients' nutritional needs and providing diets tailored to their specific conditions.
- Ensuring accurate recording of treatment, care, and paraclinical orders in the patient's file.
- Providing standard services 24/7.

### CONCLUSION

The findings of this study showed that hospital architecture, beyond a physical factor, acts as a fundamental variable in enhancing the patient's user-centered experience and improving treatment indicators. Hospitals that pay special attention to these aspects are not only leaders in providing health and medical services, but are also recognized as centers that prioritize the physical and psychological needs of their patients. This comprehensive approach, while gaining the trust of patients, also helps to improve the overall health of the community. Ultimately, patient satisfaction with the hospital is a key factor in its success.

Many studies must be conducted, and academic references should be generated to achieve efficient medical centers that align with the country's macro-level goals, describing medical centers based on international standards. The application of the EBD approach in planning, designing, and constructing medical centers can yield the best results. The presence of a multidisciplinary team and the EBD process ensures the achievement of these goals.

The model proposed in this study provides a framework that combines evidence-based design principles, human-centered design, and modern approaches to health-centered architecture, which can be used as an implementation strategy for architects, interior designers, hospital managers, and health system policymakers. This model shows that optimizing the physical environment of the hospital not only reduces the cognitive burden of patients and enhances their sense of psychological safety but also improves the productivity of medical staff, reduces job fatigue, and increases the efficiency of the medical system. From a futures perspective, this research emphasizes the need to transition from traditional design patterns to new paradigms of smart and patient-centered hospitals. It demonstrates that a successful hospital is not merely a treatment environment, but also a platform that can accelerate the patient's recovery process and enhance the overall

quality of medical care by incorporating health-based architecture principles. It is suggested that future research, by examining international examples more extensively, evaluate the impact of this model in hospitals of different scales and provide more operational solutions for its implementation.

### AUTHOR CONTRIBUTIONS

A. Sadeghi performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text, and edited the manuscript. Compiled the data and manuscript preparation. A. Shahcheraghi performed the experiments, literature review, and manuscript preparation, Kh. Daneshjoo & SB. Hosseini helped in the literature review and performed some of the remaining experiments.

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### CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the authors have acknowledged the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy.

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