BŞEÜ Fen Bilimleri Dergisi
9(2), 1056-1076, 2022

BSEU Journal of Science
https://doi.org/10.35193/bseufbd.1115411

e-ISSN: 2458-7575 (https://dergipark.org.tr/tr/pub/bseufbd)

Araştırma Makalesi - Research Article

Evidence Based Design in Healthcare Facilities*

Sağlık Yapılarında Kanıta Dayalı Tasarım

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Geliş / Received: 11/05/2022 ***Revize / Revised: 10/08/2022*** ***Kabul / Accepted: 01/09/2022***

ABSTRACT

The design of healthcare structures is a complex and constantly evolving issue due to the need for addressing various interrelated functions. Today, user involvement in the design phase is considered to be one of the main pillars of successful design. However, in healthcare structures, efforts toward this end are often hampered by the need for identifying the various requirements of multiple user groups and for setting priorities between different requirements of these groups. Recently, the effects of physical environmental conditions on user satisfaction have become more important in health building designs. Along with the rise of user satisfaction in design, the concept called 'evidence-based design' is increasingly attracting the attention of researchers and has become the theoretical concept of the healing physical environment in design.

The aim of this study is to determine the gaps and areas needed to improve the effects of the physical environment on the user in terms of evidence-based design strategies. In this context, scientific studies on the design of health buildings between 2012 and 2021 were systematically reviewed and analyzed according to the evidence-based pyramid method with kohen kappa analysis within the scope of evidence-based design criteria. A total of 1641 articles were identified for the scope of the study. Among these a total of 48 scientific studies were analyzed fitted to the criteria of the study. The impacts of physical environment on users are evaluated on two main types of user groups: (1) patients and relatives and (2) healthcare workers. The results reveal that evidence design principles are mostly evaluate in terms of patients and there are gaps in evidence-based design literature for healthcare personnel and more studies should be undertaken by multidisciplinary teams for the development of design strategies.

Keywords- Evidence Based Design, Healthcare Facilities, Users

ÖZ

Birbiriyle ilişkili birçok işleve sahip mekanlardan oluşan sağlık yapılarının tasarımı karmaşık ve sürekli gelişmekte olan bir konudur. Günümüzde, kullanıcı gruplarının fiziksel çevre gereksinimlerinin tasarım sürecine yansıtılması başarılı bir tasarımın temelleridir. Fakat sağlık yapılarında bu hedef, farklı ihtiyaçlara sahip olan birçok kullanıcı grubunun gereksinimlerinin belirlenmesini ve daha sonra da önceliklerin tespit edilerek tasarım sürecine dahil edilmesini gerektirerek karmaşıklığı arttırmaktadır. Son zamanlarda sağlık yapıları tasarımlarında fiziksel çevre koşullarının kullanıcı memnuniyeti üzerindeki etkileri daha da önemli hale gelmiştir. Tasarımda kullanıcı memnuniyetinin ön plana çıkması ile birlikte, kanıta dayalı tasarım kavramı gittikçe daha çok ilgi çekmeye başlamış ve tasarımda iyileştirici fiziksel çevrenin teorik konsepti haline gelmiştir.

**Bu çalışma Mimar Sinan Güzel Sanatlar Üni., Fen Bilimleri Enst., Yapı Mühendisliği Ana Bilim Dalı'nda, Yrd. Doç. Dr. Selin Gündeş danışmanlığında tamamlanan "Sağlık Yapılarında Tasarım Yönetimine Yönelik Bir Model Önerisi" başlıklı tezden türetilmiştir.*

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Bu çalışmanın amacı fiziksel çevrenin kullanıcı üzerindeki etkilerinin kanıta dayalı tasarım stratejileri bakımından geliştirilmesi için gereken eksiklikler ve faktörlerin belirlenmesidir. Bu kapsamda 2012 ve 2021 yılları arasında sağlık yapıları tasarımına yönelik yapılan bilimsel çalışmalar, sistematik olarak incelenmiş ve kanıta dayalı tasarım kriterleri kapsamında kohen kappa analizi ile kanıta dayalı piramit yöntemine göre değerlendirilmiştir. Çalışma kapsamında toplam 1641 bilimsel makale tespit edilmiştir. Bunlar arasından çalışmanın kriterlerine uygun olan toplam 48 makale analiz edilmiştir. Nihai kullanıcıların bakış açılarına göre ele alınan bu çalışmada fiziksel çevrenin kullanıcılar üzerindeki etkileri, (1) hasta ve hasta yakınları, (2) sağlık personeli olmak üzere iki ana nihai kullanıcı grubu üzerinde ele alınmıştır. Sonuçlar, kanıta dayalı tasarım ilkelerinin çoğunluklukla hastalar açısından değerlendirildiği; sağlık çalışanları için eksiklikler olduğu ve geliştirilmesi için kullanıcı memnuniyetini değerlendiren multidisipliner çalışmalara gereksinim duyulduğunu göstermektedir.

Anahtar Kelimeler- Kanıta Dayalı Tasarım, Hastaneler, Kullanıcılar

I. INTRODUCTION

Recently, there has been a significant increase in studies conducted to examine the effects of health structures on patient recovery processes. Studies show that "evidence-based design" approaches have gained importance in terms of service quality in health services, which are quite effective at the welfare level of society. Evidence based design (EBD) is the formulation of design strategies based on studies that identify the impacts of the physical environment on users [1]. Today, many hospitals and healthcare systems, especially in developed countries, adopt these design principles in order to increase the quality of healthcare services, and benefit from these design principles in renovation/maintenance works and new projects [1, 2].

Previous studies prove that the satisfaction of both "patients" and "staff" groups are higher in hospitals that are planned based on the views and feedback from these two groups. According to Andrade et al (2012), satisfaction level increases in hospitals planned by feedback from patients, and patients prefer these hospitals again to solve their next health problems [3]. In a study investigating the effects of environmental factors on healthcare workers' stress and satisfaction, Applebaum et al. (2010) state that considering employees' opinions increased satisfaction and reduced stress [4]. Waroonkun (2018) has studied ambient features (lighting, temperature, noise, air quality, odors), architectural features (building design or architectural design), interior design (greenery, color, furniture, signage) and outdoor environment features (view & surrounding, rest areas, parking) that influence patients' perception of satisfaction in the Thai Community Hospital. The researcher highlighted that ambient features were the most important influence on patients' comfort [5].

Today, it is accepted that a properly planned hospital in the context of person-place creates positive effects on the physical and psychological states of individuals [6, 7]. Therefore, in the design of health buildings, it is important to create healing spaces where individuals can feel good physiologically and psychologically [8, 9, 10]. However, healthcare structures often cannot adequately meet the needs of the society, which leads to user dissatisfaction. Previous studies reveal that the problems encountered are generally associated with the designs of health structures [11]. This situation causes problems such as prolongation in the recovery process, increase in mortality rates and decreases in work efficiency of employees. Therefore, in the health sector, where significant investments are made, it is important for a good service delivery to design these structures to meet the needs of the society. However, in order to meet social needs in a good way, user needs, and satisfaction should also be taken into account in hospital designs. Otherwise, design changes and rework will be inevitable. Perhaps the most important issue arising from neglecting user requirements is that the discontent and errors arising from the design will continue to negatively affect project performances and building users.

Healthcare facilities, which have an important place among public buildings, should be designed in a way that will provide comfortable conditions, and increase the quality of life for patients /healthcare staff. The feedback obtained from patients and healthcare staff will provide a very important design input to the designs of hospitals. Therefore, the aim of this research is to analyze environmental design factors that need to be considered in order to create therapeutic environments in hospitals through a systematic review of previous literature and to identify the obstacles and deficiencies in the development of EBD strategies in healthcare buildings. The impacts of physical environment on users are evaluated on two main types of user groups: (1) patients and relatives and (2) healthcare workers. In this context, the study aims to answer the following research questions:

- Which evidence-based design principles and findings were reached in previous literature regarding the impact of healthcare design on the physiological and psychological conditions of patients, patient relatives and the staff?
- Is there sufficient scientific evidence on the healing properties of hospital architecture?

In order to find answers to the above questions, scientific studies on the design of health buildings between 2012 and 2021 were systematically reviewed and analyzed according to the evidence-based pyramid method with kohen kappa analysis within the scope of EBD criteria. The online search databases used were "Web of Science", "Pubmed" and "Scopus". As a result of the literature review, 48 articles suitable for the aims of the study were obtained. Afterward, these 48 studies were evaluated under two main headings: (1) patients and their relatives, (2) healthcare staff. Evaluations were made according to the levels of evidence in the research, and Kappa analysis was applied to measure the consistency between the findings obtained from the publications.

It is also expected that the EBD criteria to be obtained from this study will contribute to the field by determining the effects of the physical environment on the patients and health personnel in the design of healthcare facilities and other design factors needed in the field of health.

II. METHODS

Within the scope of the study, “Web of Science”, “Pubmed” and “Scopus” databases were used for systematic literature review. The research was conducted between March and July 2021. In the first stage, “physical environment AND (hospital OR health services)”, “physical environment AND patient satisfaction”, “physical environment AND employee satisfaction in hospitals”, “physical environment AND hospital design” were used as keywords for the literature review and these keywords were searched in the titles both in Turkish and English. Among the 1641 studies obtained in the literature review, the studies directly related to the physical environment were examined. The language of the publications was limited to Turkish and English, and non-related publications such as customer-oriented marketing, clinical-oriented applications, medical equipment technology, biological effects of the physical environment on animals, book reviews, full-text notifications, and letters to the editor were excluded from the study.

In the second stage, 474 studies in which user satisfaction was measured among the publications obtained were examined. At this stage, evaluations were considered methods used by the authors’ sampling and findings. At the final stage, total results of 48 studies were evaluated (Figure 1).

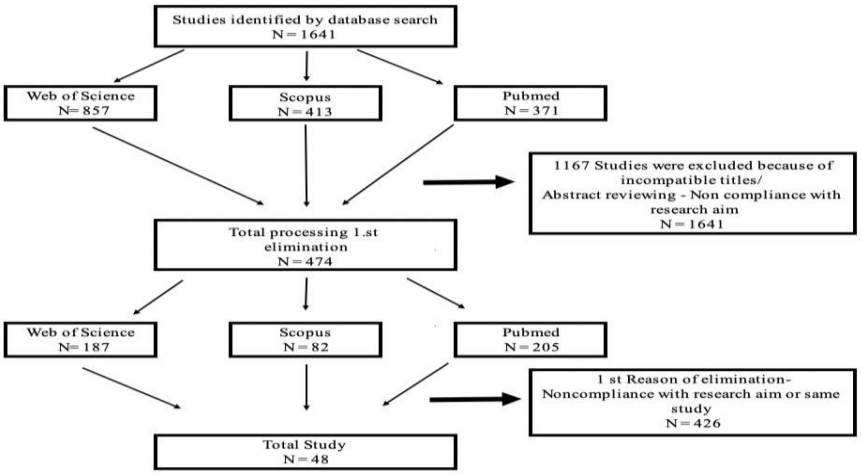

Figure 1. Determination Process of the Literature Included in the Scope of the Systematic Review

A. Evidence-Based Design Approaches in Healthcare Structures

It was shown in the studies that a well-planned hospital will have an impact on the psychological, physical, physiological of patients/workers and work efficiency of employees [12]. Therefore, EBD principles started to be developed in order to increase the quality of healthcare services [13]. EBDs are architectural solutions designed to both improve patient health and increase the work efficiency of staff by determining the effects of the physical

hospital environment on users [14]. Such physical environment factors include natural light, colors, windows, scene, healing gardens, noise level, sooting music, ergonomic items and art [15].

Integrated building design criteria (Figure 2) was used in the study in order to determine the evidence on the users of the physical environment in healthcare facilities [16].

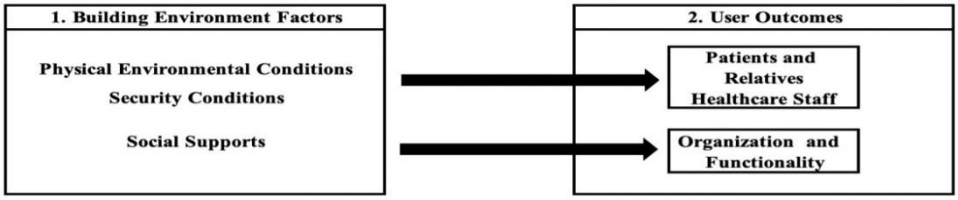

Figure 2. Design Model for EBD in Healthcare Facilities (Adapted from [16])

B. Research Criteria

The selection of the articles included in the study was made according to the following criteria:

- Including EBD studies on the effects of the physical environment on users in healthcare structures involved,
- The languages of the publications are either English or Turkish,
- Publications that are not related to the subject, such as customer-oriented marketing, clinical-oriented applications, medical equipment technology, biological effects of the physical environment on animals, are excluded from the scope of the study,
- Studies published between 2012 and 2021 and articles for which the full texts are available are included.

In the present study, which was shaped according to the perspectives of the end users, the physical effects of EBD were examined within the scope of the evidence pyramid on two main groups as (1) patients and relatives, (2) employees (Figure 3).

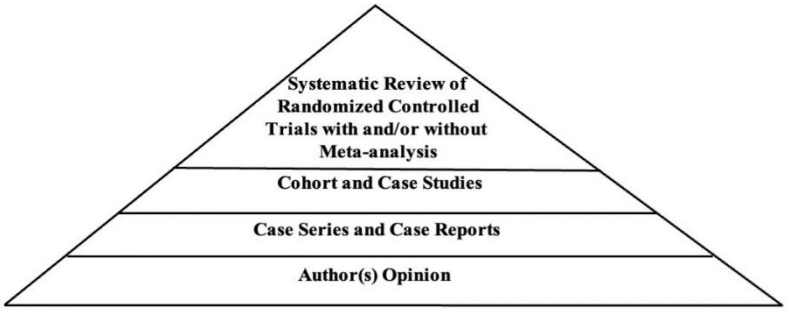

Figure 3. The Evidence Pyramid (Source: Adapted from [17])

The evidence pyramid is a research tool that produces evidence or evaluates the available evidence in research conducted in the field of health [18]. Studies in the field are classified from strong to weak in the order of importance in terms of evidence value and formed the pyramid according to their validity and reliability levels [19, 20]. The order of the best and reliable studies as evidence according to pyramid considering their definition and importance are shown in Table 1.

Table 1. The Order of Studies in the Evidence Pyramid by Definition and Importance (Source: Adapted from [21, 22, 23])

Level	Description of Study
I	Evidence from systematic literature searched by randomized controlled trials
II	Evidence obtained by examining individuals selected to represent the relevant universe over time

III	Evidence from interesting results observed in a small group without a planned study setup
IV	Evidence from the opinions and reports of experts in the field

C. Data Analysis

The final 48 studies examined in the study were divided into two main titles as 1) patients and relatives, 2) healthcare personnel, and subtitles representing these topics according to their subjects (Figure 4). In this study following the research by Huisman et al (2012), the evidence-based pyramid tool is used for data analysis [24]. The study by Huisman et al., (2012) analyzed the period between 1960 and 2011; the present research focuses on the period between 2012 and 2021. Evaluations were made according to the levels of evidence in the research, and Kappa analysis was applied to measure the consistency between the findings obtained from the publications. Kappa statistic was developed to determine the degree of agreement between two raters scoring at the classification level [25].

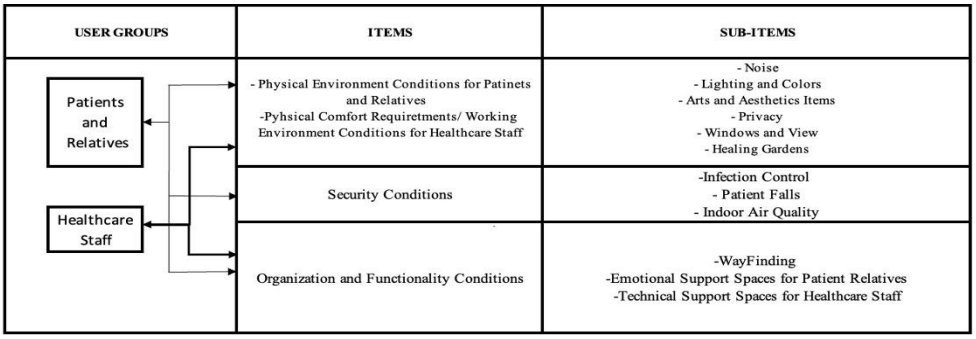

Figure 4. Themes and Sub- Themes (Source: Adapted from [16-24])

In the calculation of the Kappa coefficient in the analysis, there were two different possibilities, namely Pr (a), which is the total proportion of the observed fit, and Pr (e), which is the probability of this fit occurring by chance. The formula used for the Kappa coefficient over these two possibilities was "K= (Pr(a) – Pr(e) / (1-Pr(e))" [26].

The analysis was carried out by two different coders. As a result of the analysis, the consistency between the coders was found to be 0.70. According to Dawson-Saunders and Trapp Robert (1994), the Kappa coefficient takes values in the range of 0-1, and according to this value range, the consistency levels are as follow: 0.93-1 is excellent, 0.81-0.92 is very good, 0.61-0.80 is good, 0.41-0.60 is fair, 0.21-0.40 is below middle and 0.01-0.20 is weak consistency [27]. Accordingly, the number of Kappa coefficient obtained in the study as 0.70 indicated that the consistency between coders was at a good level. (Table 2).

Table 2. Values for Kohen Kappa Coefficient of Consistency

Kohen Kappa Coefficient of Consistency	Values
Pr (a)	%81
Pr (e)	%35
K= Kappa	**%70**

III. FINDINGS

A. Evidence-Based Design in Healthcare Structures: Patients and Relatives:

In this category EBD factors were evaluated in terms of the patient and their relatives according to items and subitems (Figure 4). This topic includes examination;

- Physical Environmental Conditions,
- Security Conditions,
- Organizational and Functionality Conditions

will be explained comprehensively as below.

• *Physical Environmental Conditions*

In this section, physical environmental conditions factors of EBD were examined in terms of the patients and their relatives according to themes and sub-themes given in Table 3.

Table 3. Distribution of Publications Determined for EBD Approach by Evidence Levels

User Group	Themes	Sub-Themes	References	Evidence Level	Total Number of study	Lowest Level of Evidence	Highest Level of Evidence
Patient and Patient Relatives	Physical Environment Conditions	Noise	[12] Bosia et al (2016)	III	4	III	I
			[15] Iyendo et al (2016)	I (rev)			
			[31] Luetz et al. (2016)	III			
			[45] Laursen et al (2014)	I (rev)			
		Lighting and Color	[12]Bosia et al (2016)	III	7	III	I (rev)
			[15] Iyendo et al (2016)	I (rev)			
			[44] Choi et al (2012)	II			
			[45] Laursen et al (2014)	I (rev)			
			[46] Wang & Pukszta (2018)	III			
			[47] Ghamari and Amor (2016)	I (rev)			
			[48] Iyendo (2014)	II			
		Arts and Aesthetics Items	[15] Iyendo et al (2016)	I (rev)	8	III	I
			[45] Laursen et al (2014)	I (rev)			
			[48] Iyendo (2014)	II			
			[50] Tinner et al (2018)	II			
			[51] Peeters et al (2018)	II			
			[52] Vetter et al (2015)	I			
			[53] Water et al (2017)	III			
			[54] Salderay (2018)	III			
		Privacy	[12] Bosia et al (2016)	III	7	III	II
			[51] Peeters et al (2018)	II			
			[55] Trochelman et al (2012)	III			
			[56] Stevens et al. (2012)	II			
			[57] Bosch et al (2012)	II			
			[59] Larsen et al (2014)	III			
			[60] Ferri et al (2015)	III			
		Windos and View	[12] Bosia et al (2016)	III	5	IV	I (rev)
			[15] Iyendo et al (2016)	I (rev)			
			[24] Huisman et al (2012)	I (rev)			
			[64] Connellan et al (2013)	II			
			[65] Campagnol & Shepley (2014)	IV			
		Healing Gardens	[51] Peeters et. al (2018)	II	5	III	I
			[66] Reeve et. al (2017)	II			
			[67] Jiang et al (2018)	III			
			[69] Van der Riet et. al (2014)	II			
			[70] Weerasuriya et.al (2019)	I			

1)Noise: For users to benefit from the hospitals in a healthy way, the noise levels in the building should be at appropriate levels. The World Health Organization (WHO) recommends that the noise level in hospitals should not exceed 40-45 dB during the day and 35 dB at night [28]. However, it was emphasized in the literature that the noise levels in hospitals do not correspond to the values determined by WHO and that these structures are mostly composed of noisy environments. Studies show that noise causes many serious problems for users such as the acceleration of heartbeat, increase in headaches, temporary/permanent hearing disorders, stress and tension [28-30]. These studies highlight that surface coating materials, various devices and human-originated sounds are the main causes of noise in healthcare structures.

Noise studies were also undertaken specifically for individual functional spaces in hospitals. For example, Luetz et al. (2016) proved that noise levels can be reduced with minor architectural interventions in adult intensive care units [31]. Architectural interventions that were made by the researchers, in adult intensive care units, include a technical corridor with a soundproof wooden wall behind the head of the patient bed to hide the medical equipment that causes noise, and the use of furniture with soundproof wood material in the room. Moreover, since all the rooms in the adult intensive care units were twin rooms, a noise-canceling console was placed between both patients to prevent noise. In order to reduce alarms at staff and bedsides, they have planned a closed staff workspace that allows patient observations between rooms [31]. Bosia et al (2016) indicated that acoustic comfort, visual privacy and space flexibility seem to be more important for ambulatories in the internal medicine and oncology departments [12]. Sound-absorbing ceiling and floor coverings should be used to prevent unwanted noise in healthcare buildings. Flooring materials selected in accordance with the functional features of the hospitals have positive contributions to reducing noise, preventing glare, supporting infection control and increasing patient care efficiency [32]. Within the scope of this research, 4 evidence-based studies (Table 3) were identified.

2)Lighting and Colors: In many studies, it was stated that lighting has very important effects on the physiological and psychological conditions of individuals. According to previous research, natural and artificial lighting, especially morning light [33] have beneficial effects on depression, stress, mortality, hospital stay and sleep [34]. Studies indicated that individuals generally prefer natural lighting [33, 35-37] and artificial lighting causes visual fatigue and headaches [38, 39]. Researchers on lighting in hospitals have shown that ultraviolet light has positive effects on healing by promoting emotional well-being [15].

In the literature, it was seen that the main lighting problems that occur in health buildings are related to the orientation of these structures [11]. Creating design strategies according to the orientation of buildings to the sun in terms of natural lighting is an important architectural element in improving the lighting performance. Studies showed that the location of rooms in hospitals is a very important factor especially in psychological disorders [40, 41]. Van (2006) conducted a study proving that lighting has an effect on the hormones and nervous system in the body [42]. Walch (43) stated that daylight in hospital rooms positively affects patients' mental health and reduces the use of painkillers. [43]. Within the scope of this study, 7 publications were identified as an evidence of the positive benefits of light (Table 3). Based on patient recovery times in a hospital in Korea, Choi et al. (2012) proved that the recovery times in rooms facing the southeast direction and therefore receiving morning light are significantly shorter than the recovery times of patients in rooms facing the northwest and receiving intense sunlight in the afternoon [44]. Laursen et al. (2014) determined that plants and sunlight were effective in reducing anxiety and pain levels in post-operative patients [45]. Wang and Pukszta, (2018) concluded that a well-designed natural lighting had positive effects on the patients, patients relatives and healthcare workers during chemotherapy treatment [46]. On the other hand, the study conducted by Ghamari and Amor (2016), showed that different light sources and colors have positive physiological and psychological effects on patients [47]. The authors have found that light and color reduced the rate of medical errors and stress, shortened patient stay and increased healing, and patient satisfaction. According to Bosia et al. (2016), for patients in the oncology department, the color of fittings and furniture and the presence of restorative spaces is less important for them. In addition, authors found that outside views seem to be less important for ambulatories in the internal medicine department [12]. Furthermore, Iyendo (2014) also argued that the artistic elements and daylight of the hospital interiors had positive effects on both healthcare personnel and patients [48].

3) Arts and Aesthetics Items: Evidence based literature also suggests that the presence of art elements in hospitals creates positive thoughts on users and increases well-being. The presence of paintings such as nature views and happy smiling figures in the corridor and entrance halls provides positive benefits for individuals [15, 45, 48-50]. Within the scope of this study, 8 publications were identified as an evidence of the positive benefits of

arts and aesthetics items scientifically (Table 3). Peters et al. (2018) concluded that adolescent cancer patients give importance to vibrant colors and decoration items that will arouse the feeling of home, rather than those colors that made them- feel- cold and bored in the hospital environment. However, it was observed that there were great differences in the colors and decoration items preferred among the patients [51]. Likewise, Iyendo (2016) stated that colors have a systematic effect on people's moods, emotions and behaviors [15]. However, in the literature, it has been observed that no information was given about which colors these colors were. On the other hand, a study conducted by Laursen et al. (2014) found that patients had significantly lower pain intensity when they were exposed to visual designs or listening to music [45]. Similary Vetter et al. (2015) pointed out that music had significant effects on postoperative pain, anxiety, blood pressure and heart rate. In addition, the authors emphasized that nature views, more spacious rooms and architectural features that provide more sunlight had positive effects on patients' anxiety and postoperative pain [52].

Water et al. (2017) surveyed 175 children between the ages of 5 and 16 regarding their perceptions of children's outpatients' environments at national children's hospital in New Zealand/Aotearoa. Using Art-based methods and semi-structured interview tools, the authors evaluated children's perceptions in four categories including aesthetics of the environment, wayfinding (navigation), noise and uniforms. The findings indicated that they were aware of their environment and noise was the most important among all factors. Indeed, they wanted a friendly environment and the use of colours associated with well-being, which all together created a less scary clinical environment [53]. The paper by Salderay (2018) evaluated the factors contributing to the improvement process in Main-Science Department of Brain and Nerve Surgery in Gazi Uniersity Hospital examined the assessment of the opinions of patients and healthcare staff. As a result of the study, it has been seen that the use of comforting and reassuring items that will increase patient compliance, reduce fear and anxiety, allow playing and activities have positive effects on patients' health [54].

4)Privacy : A common view in evidence-based studies on privacy (Table 3) is that single patient rooms provide benefits for the user. In a study, it was seen that providing privacy in single rooms is an important factor in terms of patient satisfaction, both visually and acoustically [55]. Stevens et al. (2012) conducted an extensive comparision of open-bay and single-family room neonatal intensive care unit design and found that single-family rooms provided an improved quality of work environment and enhanced patient safety [56]. On the downside, the researchers indicated that increased walking distance and, steps per nursing staff shift were the main complaints in hospitals incorporating single-bed rooms [56]. A similar study conducted by Bosch et al. (2012) found that single-family rooms provided benefits for nursing staff in terms of reduced job stress, increased quality of work environment and enhanced safety and increased quality of environment provided to patients and their relatives [57]. Peeters et al. (2018) explored hospital stay experiences of adolescents with cancer and how physical environment affects these experiences. It has been proven that adolescents attach importance to privacy, green space, artistic and aesthetic items. The reasons for adolescents to prefer single patient rooms include being alone with their families or friends, coping with their own situation without anyone seeing them, not wanting others to see and hear everything they say and do [51]. Bazuin and Cardon (2011) pointed out that private intensive care unit patient rooms for children reduce patient and family stress and reduce the rates of hospital-acquired infection transmission [58]. However, it has been determined that the communication between the patients who have the same disease types such as colon/breast cancer has to be maintained and these patients need to be in close proximity to each other in rooms with more than one bed. Looking from this point of view, it appears that although multi-bed rooms have a positive effect in terms of patient psychology, they have negative effects in terms of privacy [59]. Ferri et al (2015) concluded that single-bed rooms not only provide user privacy, but also reduce the risk of infection [60].

5)Windows and Views: The effects of natural scenery on individuals with different cultures were examined by various studies for buildings such as schools, hospitals, residences, and offices [61, 62] and it was found that natural scenery has benefits on human health [63]. It was pointed out that there is a high probability of developing depression, anxiety, and cognitive impairment in patients hospitalized in windowless units [35, 39, 49]. Within the scope of the present study, it was found that 5 studies provided evidence that windows and nature views provide positive benefits to users (Table 3). The proven effects of the landscape on patient health were first determined by Ulrich in 1984. He showed that patients who had gallbladder surgery and who stayed in rooms with a view took less pain medication and received positive feedback from nurses about patient psychology [24]. Iyendo et al. (2016) noted that monitoring the natural vegetation, green leaves, flowers, water and other natural elements used in hospital buildings had positive effects on patient health [15]. Connellan et al. (2013) observed that the lack of windows and the connection with the outside atmosphere are factors that can increase stress and depression in

terms of mental health [64]. In the study carried out by Campagnol and Shepley (2014) in rehabilitation hospitals in Brazil, it has been observed that nature and art are used as a tool to create healing environments in the physical environment and patients benefit from these environments [65].

6)Healing Garden: Research interest in how gardens can benefit patients in terms of health and well-being is increasing day by day [66]. Healing gardens are nature-oriented open spaces that increase the physical activity and motivation of individuals, reduce their stress, improve their well-being, and enable activities that are beneficial to renew their memories [67]. Healing gardens aim to support patient treatment and create a harmonious environment [68]. Studies proving the effects of gardens on users were shown in Table 3. In Van Der Riet's (2014) study on the hospital experiences of sick children in the garden called "Fairy Garden", it was observed that the garden reduced the duration of hospital stays and provided psycho-social and physical benefits [69]. As a result of user experiences, Reeve (2017) found that the garden saves the users from negative thoughts about traumas and diseases and that the fresh air makes them feel normal [66]. Jiang et al. (2018) demonstrated that natural landscape can improve the ability of people to cope with stress, as well as nature has positive health effects thus improve health outcomes. The same study stated that patients experienced comfort and peace when they sat in their rooms and enjoy the outside [67]. Weerasuriya et al. (2019) proved that the green field provides benefits to patients in meeting their psycho-physiological, social, spiritual needs and socialization [70]. Similarly, in the study conducted by Peeters et al. (2018), it has been proven that adolescents with cancer want nice outdoor spaces in hospitals where they can have a good time, socialize and meet their mobility needs [51].

- ***Security Conditions***

In this section, the security conditions factors of EBD were examined in terms of the patients and their relatives according to themes and sub-themes given in Table 4.

Table 4. Distribution of Publications Determined for EBD Approach by Evidence Levels

User Group	Themes	Sub-Themes	References	Evidence Level	Total Number of study	Lowest Level of Evidence	Highest Level of Evidence
Patient and Patient Relatives	Physical Environment Conditions	Infection Control	[71] Ebrahimi et al. (2013)	III	1	III	III
		Patient Falls	[24] Huisman et al. (2012)	I (rev)	4	III	I (rev)
			[75] Bayramzadeh et al. (2018)	III			
			[77] Copeland & Chambers (2017)	III			
			[78] Pati et al. (2021)	I (rev)			
		Indoor Air Environment	[79] Shajahan et al. (2019)	I (rev)	6	III	I (rev)
			[30] Tang et al. (2019)	III			
			[82] Dougall et al. (2019)	II			
			[83] Azimi et al. (2013)	II			
			[84] Eijkelenboom &Bluysen (2019)	I (rev)			
			[85] Abbasi & Samaei (2019)	II			

1)Infection Control: The most important issue regarding infection control in previous literature is that single-bed patient rooms contribute to the reduction of infection spread [24, 58]. However, in the present study, no evidence-based research could be determined in terms of patients and their companions. It was observed that the research on this issue were mostly conducted in recent years and infection control was mainly discussed in terms of healthcare professionals. Within the scope of this study, only one study on infection control was obtained (Table 4). Ebrahimi et al. (2013) concluded that the main reasons for the increase in infections are the inappropriate physical structure of the wards regarding location and the user circulation control that is not reserved for patients, relatives and healthcare workers [71]. In previous studies and in the study determined within the scope of this study, the common belief was that infection spreads are predominantly seen in intensive care units and patients hospitalized in these units have a higher risk of infection than other patients [24].

2)Patient Falls: Patient falls reduce the life quality of individuals by causing serious psychological and physiological problems in patients [72]. However, patient falls are associated with the physical environmental characteristics or the individual health problems of the patient. For example, private or semi-private rooms can be a factor in designing to reduce falls because patients can help each other when necessary and received help from each other when necessary [73]. However, there are few studies in the literature that deal with the type of room in which the falls occur as private or semi-private. In this study, a total of 4 scientific studies were obtained based on

evidence (Table 4). Huisman et al. (2012) stated that while a patient diagnosed with mental disorder had a higher risk of falling, this risk was lower in individuals with a disease related to the central nervous system, musculoskeletal system or sensory organs [24]. In the literature, it was stated that patient falls in healthcare buildings mostly occur in patient rooms and bathrooms when patients go to the bathroom or get up from their beds [34, 74]. Bayramzadeh et al. (2018) concluded that falls are generally in patient rooms, and day care rooms, and the factors that cause falls are due to poorly arranged lighting systems, flooring material properties and causes limiting to access [75]. In addition, for patients with vision problems, it is necessary to make sure that the flooring materials do not appear wet or slippery [76]. Copeland and Chambers (2017) found that the presence of handrails and non-slippery floor covering contributed to a 55% reduction in patient falls [77]. Pati et al. (2021) found that the toilet seat on the side wall instead of directly opposite the bathroom entrance is a factor reducing falls [78]. Bosia et al. (2016) suggested that oncology and internal medicine departments care about patients and their relatives, their mobility, the ability to move around the room, and easy access to the bathroom. According to researchers, patients' privacy in the oncology department is significantly important. However, the provision of a pleasant environment, hand disinfection facilities and comfortable conditions for visiting relatives are important for both departments [12].

3) Indoor Air Quality: Indoor air quality includes issues such as ventilation, relative humidity, odor, and dust particles, which have an impact on the breathing air quality in indoor environments. In the literature, emphasis was placed on the healing environment and ventilation. Inadequate indoor air quality in hospital environments leads to worsening of patient treatments, prolonging the hospital stay of patients, and negative consequences such as decrease in work efficiency and absenteeism on healthcare staff [79]. The research by Tang et al. (2019) on indoor air quality in a healthcare center in China showed that the EBD had positive results on the physical health and recovery status of the patient. Furthermore, the authors identified that air freshness is the most important disturbing factor [30]. Ventilation should be sufficient so that patient care can be provided easily. A poor ventilation system in hospitals increases the risk of hospital infections such as lung and respiratory diseases for healthcare workers [80, 81]. Looking at other studies determined within the scope of the research [30, 82-85] it was seen that indoor air quality, which positively affects the health and comfort of building users, is associated with ventilation and the amount of CO2 in the environment (Table 4). In the study conducted by Shajahan et al. (2019) on temperature, relative humidity and ventilation system, it was concluded that a higher ventilation rate reduces the infection rate. However, there is insufficient scientific evidence to recommend a minimum ventilation rate for infection control and there is a need for interdisciplinary collaborative research in the future [79].

- ***Organizational and Functionality Conditions***

In this section, the organizational and functionality factors of EBD were examined in terms of the patients and their companions according to themes and sub-themes given in Table 5.

Table 5. Distribution of Publications Determined for EBD Approach by Evidence Levels

User Group	Themes	Sub-Themes	References	Evidence Level	Total Number of study	Lowest Level of Evidence	Highest Level of Evidence
Patient and Patient Relatives	**Organization and Functionality**	**Way Finding**	[15] Iyendo et al. (2016)	I (rev)	4	III	I (rev)
			[76] Waller (2012)	II			
			[87] Kalantari & Snell (2017)	II			
			[88] Morag et al. (2016)	III			
		Emotional Support Spaces	[91] Andritsch et al. (2013)	II	1	II	II

1)Wayfinding: Hospitals, which consists of various interrelated functions, are very complex structures. Users may have problems in going to the units they want to go that they have never experienced before. Problems faced by users in navigating can lead to negative situations such as disorientation, anxiety and loss of control, stress, headache, and increase in blood pressure [33, 86]. In this study, 4 studies proved that several types of wayfinding problems were experienced by users which could be resolved with simple design solutions (Table 5). In this context, researchers suggested that when designers used colors, images, and signposts, orientation was facilitated in hospitals [15, 87]. Kalantari and Snell (2017) observed that the integration of appropriate graphical indicators, color markings, and linear markings provide benefits to the staff as well as the users in finding direction in hospitals [87]. It has been observed that the use of accent colors, pictorial text and signs to find direction in hospitals help confused people find their way [76].

The comprehensiveness of wayfinding tools was evaluated in 9 hospitals for people with different needs and abilities by Morag et al. (2016). The authors concluded that the lighting in the corridors is insufficient for visually impaired people to lip-read and follow direction signs. Moreover, the lack of handrails along the corridors for the physically disabled or the absence of voice announcements when reaching the desired floor in the elevator were other related issues to wayfinding. In the same study, when the colors used in direction signs are similar (such as gray and beige) and there is no verbal indication of what the color of the arrow is, finding direction becomes problematic. It was observed that since the signs were not clear, many users had to ask the personnel to confirm that they had arrived at their desired destination [88].

2) Emotional Support Spaces: According to the holistic health approach, a person is always in interaction with the environment [89]. Social support includes the spiritual support that patients receive from their immediate surroundings, and it has a very important contribution to the recovery process of patients [15, 58, 90]. Studies showed that family involvement in patient care provides patient satisfaction. Family areas in patients' rooms reduce patient falls, stress and depression and provide patient privacy [91]. Families, especially in intensive care, may want to be with their relatives during patient treatment processes, so designs should allow this closeness [49]. Recently, it is accepted that social support as well as medical treatments have a significant curative effect on patient healthcare [92, 93]. Studies show that social support received from individuals such as family, friends, and healthcare personnel during patient treatment has stress-reducing and patient health-enhancing effects [34, 58, 94, 95]. Areas for relaxation, food service and internet service are among the important factors that make patient attendants feel comfortable [58]. In hospitals, it is possible to increase social support by providing waiting rooms and lounges with comfortable furniture, designing patient rooms suitable for visitors, and considering facilities that make it easier for family members to stay overnight [15]. Although it is emphasized in the literature that social support is very important for both patients and their relatives, it has been seen that the studies identified in the present study are based on empirical studies rather than proven studies and there is only one proven study (Table 5).

B. Evidence-Based Design in Healthcare Structures: Healthcare Staff

In this category EBD factors were evaluated in terms of healthcare staff according to items and subitems (Figure 4). *This topic includes examination;*

- Physical Environmental Conditions

- Spatial Organization and Functionality Conditions

will be explained comprehensively as below.

- ***Physical Environmental Conditions***

In this section, physical working environmental conditions factors of EBD were examined in terms of the healthcare staff according to themes and sub-themes given in Table 6.

Table 6. Distribution of Publications Determined for EBD Approach by Evidence Levels

User Group	Themes	Sub-Themes	References	Evidence Level	Total Number of study	Lowest Level of Evidence	Highest Level of Evidence
Healthcare Staff	**Physical Comfort Requirements**	**Working Environments**	[15] Iyendo et al. (2016)	I (rev)	6	III	I (rev)
			[100] Lavender et al (2020)	III			
			[102] Han et al. (2018)	II			
			[97] Sadatsafavi et al. (2015)	III			
			[103] Ergun et al. (2019)	II			
			[99] Sunderberg et al. (2017)	II			

Physical environmental factors such as lighting, noise level, sufficient green space, temperature and ventilation have direct effects on employees. Lighting and noise are very important in terms of work satisfaction, medical errors working efficiency, and stress. Especially nurses working in intensive care units are sensitive to stress [58]. Poorly planned acoustic arrangements create communication problems between patients and employees in hospitals [76]. Lightings that are not well regulated make the staff less sensitive to stress and reduce job satisfaction [33]. There is some evidence that bright light can improve the performance of staff and that this has positive effects on reducing medical errors that may occur in patient care [38]. Buchanan et al. (1991) stated that the level of illumination is of great importance in preventing mistakes made by healthcare personnel working

in pharmaceutical units. In their study, which they conducted for 21 days at three different lighting levels, they found that those working at high levels of illumination made fewer mistakes [96]. Buchanan et al. (1991) examined the rate of medical errors by the personnel preparing drugs at 450 lux, 1100 lux, and 1500 lux lighting levels. Researchers found that the medical error rate was 2,6% at the light level of 1,500 lux and 3,8% at the light level of 450 lux. As a result, it was observed that the usage of a correct artificial lighting system in the spaces is important in terms of work performance, considering the risks of medical errors of the personnel [96]. In this study, it was determined that the research about the lighting related to EBD were mostly done in the past. Therefore, in the literature review made for the specified years, no publications with the quality to make evidence-based inferences about this section were obtained.

In this research, a total of 6 scientific studies were obtained based on physical working environmental conditions factors evidence for healthcare staff. (Table 4). The study conducted by Iyendo (2016), concluded that a well-designed physical environment has the potential to reduce stress and fatigue on health personnel, increase the efficiency of health service delivery, and prevent other possible negative consequences [15]. Considering suitable lighting, windows, quiet areas, suitable areas for breaks, the ability to adjust workstations and outdoor spaces and courtyards for nurses working in intensive care units are important to make working environment more comfortable [58]. Sadatsafavi et al. (2015) evaluated the perceptions of healthcare professionals regarding 27 different architectural and physical features in patient areas, work areas and personnel areas. The authors pointed out that the healthcare staff in the study paid more attention to the improvement of aesthetic properties of floor coverings, indoor air quality and furniture design for a safe and comfortable working environment [97]. Olausson et al. (2014) pointed out that although the architectural designs of the intensive care unit had a great impact on the health of nurses, job satisfaction and the provision of patient care, more research was needed on the subject [98]. The working experiences of 8 intensive care nurses and 5 assistant staff in an evidence-based intensive care unit patient room were investigated by Sunderberg et al. (2017). The researchers stated that nurses were more efficient, when the room provided well-being for the patients. In addition, it was stated that the personnel should be involved in the design process of intensive care units, about improving the sound environment with sound absorbers during hospital renovations or construction and installing cyclic lighting elements [99]. They concluded that providing adjustable mobile solutions for patients and providing space around the patient bed had very positive effects on the staff. Lavender et al. (2020) carried out a study to investigate how the design of medical-surgical patient rooms can be developed to improve the efficiency, effectiveness and ergonomics of hospital staff and how these design features affect patients and attendants. In their study, the researchers presented 66 EBD guidelines (including entryway 16 guidelines, the patient clinical area 22 guidelines, the bathroom 17 guidelines, the family area 8 guidelines, storage areas for patients and their visitors 3 guidelines) that open up many opportunities to improve the design of patient rooms and can assist designers in their design decisions [100]. On the other hand, Kotzer et al. (2011) conducted a study to measure family and staff user satisfaction before and after alterations made on physical environmental conditions such as light, noise, temperature, aesthetics, comfort, security and privacy in a children's hospital in Denver. Researchers found that design and operational changes of light south-facing floor-to-ceiling windows are designed within the new built hospital, accommodate more natural light, as well as adequate foot candles to provide the necessary artificial lighting for staff to do the job as efficiently and as accurately as possible. In order to decrease the noise level, the usage of rubber floors are suggested in places where the carpet is not medically appropriate, such as operating rooms in the newly built hospital. This issue is also important in the usage of acoustic ceiling plates, especially in the neonatal intensive care unit, and also decentralized patient care stations in order to prevent noise. The authors have shown that the use of basic EBD principles in hospital designs can increase staff and family satisfaction in the built environment [101]. Han et al. (2018), proved that environmental conditions such as temperature, lighting, noise, music and scent are very important for the efficient and comfortable working of healthcare personnel [102]. In another study from Turkey, Ergun et al. (2017) focused on the current status of psychiatric clinics from the point of view of a therapeutic environment. They indicated that there were inadequacies in physical configuration and restricted therapeutic activities in Turkey [103].

- ***Spatial Organization and Functionality***

In this section, spatial organization and functionality factors of EBD were examined in terms of the healthcare staff according to themes and sub-themes given in Table 7.

Table 7. Distribution of Publications Determined for EBD Approach by Evidence Levels

User Group	Themes	Sub-Themes	References	Evidence Level	Total Number of study	Lowest Level of Evidence	Highest Level of Evidence
Healthcare Staff	**Spatial Organization and Functionality**	**Way Finding**	[12]Bosia et al (2016)	III	6	III	I (rev)
			[15] Iyendo et al. (2016)	I (rev)			
			[71] Ebrahimi et al. (2013)	III			
			[77] Copeland & Chambers (2017)	III			
			[106] Wu et al. (2013)	III			
			[108] Chou et al. (2018)	II			
		Technical Support Spaces	[109] Haddad et al. (2012)	II	2	II	II
			[110] Rozenbaum et al. (2013)	II			

The spatial organization and functionality of hospitals should be able to meet the needs of users. Undoubtedly, the biggest users of these structures are their staff. However, it was observed that the studies conducted on this factor in the literature were generally discussed in terms of patients and their relatives. In the literature review conducted in terms of employees, there are few studies (Table 7) but the subject of finding direction involving both groups in studies are seen more in way finding. In the literature, it is emphasized that patients and their companions may face dangerous consequences such as loss of anxiety and control [33], stress, fatigue, headache, increase in blood pressure and death in some cases as a result of having difficulties in finding directions [86, 104, 105]. The help request of patients from the personnel to find their ways, cause loss of time [105]. According to Ulrich (2010), wayfinding problems can be solved by considering the healing effects of the physical environment together with some changes in organizational and functional scales [105]. For instance, it was determined that some hospitals use symbols such as ponds and artworks [106], well-organized lighting systems, plan schemes and signboards [15] in order to facilitate the movement of patients and prevent the loss of time. On the other hand, a study investigating the effects on walking distance energy of the nurses in terms of expenditure, and job satisfaction by Copealand and Chambers (2017) found that excessive walking distances in a hospital not only decrease nurses' job satisfaction but also contribute to inefficient care delivery [77]. Mohsin-Shaikh et al.'s (2019) study, which was a comprehensive analysis of healthcare facilities, aims to improve the healing environment in two acute care hospital buildings, related to design determinants, areal distribution and adequate spatial organization. Findings indicate that, wasted spaces could be removed up with suitable design in healthcare buildings [107]. A study conducted in Taiwan focused on gender differences in physical and psychological services and, attention was drawn to the equal health services of male and female patients [108]. Evidence obtained in the study conducted by the authors shows that there are five factors, including physical design, functional design, marking design, gender perception, and gender-friendly services in the measurement scale of hospital environments. The authors also found that gender-friendly hospitals had positive effects on customers' loyalty and willingness to pay [108].

In the studies determined in terms of technical support, it is seen that ergonomic designs were important in working conditions. Elements such as adjustable patient beds, raised toilets, and shower chairs were identified as evidence-based auxiliary design criteria for reducing health workers' musculoskeletal risk factors [24]. In addition, hospitals should get help from ergonomics experts to increase hospital staff productivity; to provide a more comfortable working environment for the personnel. Haddad et al. (2012) proved that ergonomic design of operating room equipment had positive effects on the quality of work efficiency [109]. Rozembaum et al. (2013) proved that ergonomically designed medicine rooms have an effect on reducing medical errors [110].

IV. DISCUSSION

In this research, scientific studies on healthcare facilities were analyzed and evaluated on two main users, (patients/ relatives and healthcare personnel) within the scope of EBD criteria. In the study following questions aimed to be answered: "Which evidence-based design principles and findings were reached in previous literature regarding the impact of healthcare design on the physiological and psychological conditions of patients, patient relatives and the staff?" and "Is there sufficient scientific evidence on the healing properties of hospital architecture? At this point, the data obtained within the scope of the study consists of mixed methods and qualitative studies, and some quantitative studies have been identified. It has been observed that the identified studies are mostly handled in terms of patients and there is a lack of studies for healthcare staff. The considerable and most of the highest level of findings for patients are lighting/color, arts and aesthetics items, privacy, and

indoor air environment. In terms of personnel, it has been seen that working environment conditions are important for their psychological health and work efficiency.

Physical environmental factors such as lighting, noise level, sufficient green space, temperature and ventilation have direct effects on users. It has been proven in many studies on health sciences that physical environmental conditions have positive effects especially on psychological disorders, heart diseases, drug use, pain, and the desire for medical intervention. When the noise criteria for patients and their relatives in hospitals are examined; it has been observed that noise has very important effects on the user's health and there are some design criteria to prevent noise in the design of health buildings. For instance, the selection of sound-absorbing materials such as ceiling tiles, carpets, wooden furniture, the design of single-bed patient rooms, and the use of cork partitions around noisy equipment have been found to have noise-blocking properties [12, 31]. On the other hand, it has been determined that music has psychologically relaxing effects on the user; It has been observed that presenting music to patients in hospital settings, especially in the post-operative phase, is among the interventions that can reduce pain [45]. When the studies about lighting and color were examined, it was seen that different light sources and colors had positive physiological and psychological effects on patients. For this reason, it is noted in the studies that natural light and art works will be very important to the users in the hospital design process. On the other hand, it has been observed that appropriate lighting levels are needed in the delivery of patient health care services. In this context, appropriate lighting should be provided for individuals performing different activities. The most important factor in the illumination of patient rooms designed for patients, especially patients undergoing heart surgery and chemotherapy, is daylight saving [12, 46]. For this purpose, patient rooms should be planned in a position where they can benefit from daylight directly and adequately [15]. Studies have shown that the length of stay in rooms facing southeast is significantly reduced [44]. Considering the studies on art and aesthetic elements, it is revealed that these elements create positive effects on users in hospital designs and designs that encourage patients' exposure to these environmental elements should be made. Especially in units where child health care services are provided, the use of familiar and loved characters and objects by children is recommended [53, 54]. In these design parameters, which are thought to be made for adults, it is emphasized that the preferences of the individuals should be considered, and the culture, religion and geographical regions of the users may differ [16]. In this context, these design elements should be planned by considering the user profiles in hospital designs. In studies on patient privacy, the common belief is that single-bed patient rooms provide user privacy and infection control. For this reason, it has been understood from the studies that designers should take into account the opinions of users regarding privacy, and single-bed patient rooms have significant benefits not only in privacy but also in infection and ensuring efficiency in healthcare delivery [12, 51, 55, 57]. On the other hand, the provision of privacy reduces patients' medical needs and improves doctor-patient communication [12]. The common belief in studies on windows, views and healing gardens is that the natural environment has calming and pleasant effects on users and patients. Iyendo et al., (2016), emphasized that the presentation of natural elements used in places where there is no human-nature interaction has important effects on patient health [15]. In this context, it is possible to create physical environments that will contribute to the health of patients by using visual art elements in places where human nature interaction is not possible in hospital designs.

When the safety conditions are evaluated for the patients and their relatives, it is seen that the risk of infection is very important and the single-bed patient rooms contribute to the prevention of the spread of infection, but there is not enough scientific data for evidence-based inferences in this area. Considering the studies on patient falls and indoor air quality, a designer should consider using of handrails and non-slippery floor covering in the patients' rooms to prevent falls. A poor ventilation system in hospitals increases the risk of hospital infections such as lung and respiratory diseases for healthcare users' but there is insufficient scientific evidence to recommend a minimum ventilation rate for infection control and there is a need for interdisciplinary collaborative research in the future [79].

According to organization and functionality, wayfinding has anxiety and loss of control, stress, headache, and increase in blood pressure significant effects of user health. The integration of appropriate graphical indicators, color markings, and linear markings provide benefits to the staff as well as the users in finding direction in hospitals. It has been observed that the usage of efficient colors, pictorial text and signs to find direction in hospitals help confused people find their way [77, 88]. In this context, attention should be paid to the use of accent colors, pictorial texts and signs by hospital designers and hospital managers to help users find direction. In addition, a hospital designer should get help from a graphic designer for suitable wayfinding design elements. As for social support, it includes that family involvement in patient care provides patient satisfaction. Family areas in patients' rooms reduce patient falls, stress and depression and provide patient privacy. In hospitals, it is possible to increase

BSEU Journal of Science
https://doi.org/10.35193/bseufbd.1115411

e-ISSN: 2458-7575 (https://dergipark.org.tr/tr/pub/bseufbd)

social support by providing waiting rooms and lounges with comfortable furniture, designing patient rooms suitable for visitors, and considering facilities that make it easier for family members to stay overnight [15]. However, within the scope of this study, only 1 study related to social support was obtained.

Physical environmental factors such as lighting, noise level, sufficient green space, and properties of medical spaces architectural design have direct effects on healthcare employees' efficiency. However, in the research, it has been observed that the identified studies were mostly handled in terms of patients and there was a lack of studies for healthcare staff. Similar results were obtained in the study by Huisman et al (2012) and considering that the main users of healthcare structures are employees, there is also a lack of evidence-based research on the working environments and expectations of this group [24]. Therefore, it is possible to say that more research is needed for healthcare professionals.

In the evidence obtained except the physical environmental conditions within the scope of the study, it was seen that there are ergonomic conditions as evidence-based design criteria that were important for healthcare professionals. Ergonomic design of operating room equipment had positive effects on the quality of work efficiency and ergonomically designed medicine rooms have an effect on reducing medical errors [109, 110]. In this context hospitals should get help from ergonomics experts to increase hospital staff productivity, and to provide a more comfortable working environment.

V. CONCLUSION

Health facilities, which have an important place among public buildings, should be designed to provide comfortable conditions and increase the quality of life for patients/health personnel. Feedback received from patients and healthcare personnel will provide significant design input to the designs of hospitals. Therefore, this study, it is aimed to analyze and examine the environmental design factors that should be considered to create therapeutic environments in hospitals. This issue is particularly important for hospitals' design because making designs that can provide good and quality healthcare in the future will increase the service performance in hospital architecture.

EBD approach gained importance in the design of health buildings recently. When the data obtained within the scope of the study were evaluated, it is possible to say that the studies are generally randomly controlled studies, case studies, and expert experiences and opinions. Most of the evidence was obtained primarily from physical environment factors including lighting/color, arts and aesthetics items and privacy for patients' relatives. It was understood from the previous studies on health sciences that physical environmental conditions had positive effects on psychological disorders, heart diseases, medication usage, length of stay in the hospital, pain and medical intervention. The first issue that requires further attention is that there are sufficient number of studies in which inferences about designing each functional area independently of each other and in accordance with the service among the obtained data. The findings show that there is a link between a number of aspects of the physical environment of hospitals and the well-being of patients, family comfort of their relatives and the care process as a whole. In this research, it has been seen that it is important to consider design and physical environmental factors for user health and well-being in healthcare buildings. The effect of a well-planned physical hospital environment has significant benefits on patients' anxiety and pain. It has been concluded that the development of design strategies to provide lighting and privacy, especially art and aesthetic elements, among physical environmental factors, is very effective on the health of the user physically and psychologically. As a result of the research, it has been revealed that the designs of single-bed patient rooms, which have a great effect on ensuring privacy, have health-improving effects such as noise control, infection control, and privacy control. Thus, they should be considered as a design strategy in hospital planning. But a poor ventilation system in hospitals increases the risk of nosocomial infections for healthcare users, but there is insufficient scientific evidence to recommend a minimum ventilation rate for infection control and future interdisciplinary research is needed.

Suggestions developed according to the data obtained in terms of EBD strategies within the scope of the study are explained below:

- In the general hospital configuration, it may not be possible to place all patient rooms facing southeast or green space. For this reason, designers and other actors who will take part in the design need to create their design strategies by taking into account the level of natural sunlight.
- In cases where it is not possible to provide human-nature interaction, physical environments that will contribute to the health of patients by using visual art elements should be created with wall panels and

digital visuals. Thus, it is possible to increase the quality of health care services by reducing patient care costs with simple and easy-to-apply design interventions.

- Considering that the main users of healthcare structures are employees, there is also a lack of evidence-based research on the working environments and expectations of this group. Therefore, it is possible to say that more research is needed for healthcare professionals.
- In the findings obtained within the scope of this study, it was seen that physical environmental factors such as lighting, noise level, sufficient green space, temperature and ventilation have direct effects on employees. In this context, hospital designers should be encouraged to consider design decisions according to the requirements needed in different spaces by user groups, such as lighting levels, and ventilation.
- In addition, it was seen that the most important design strategies for increasing the working efficiency of healthcare workers are ergonomic designs. Therefore, hospital designers should get help from ergonomics experts to increase hospital staff productivity; and to provide a more comfortable working environment.
- Considering the different health service delivery and especially healthcare personnel staff diversity of hospitals, it can be said that more research is needed that could improve these findings and address specific contexts and hospital units that will increase the evidence-based design factors in healthcare structures.

Finally, the data obtained show that the physical characteristics of the healthcare facilities are more effective on the physical and psychological health of the users. In this respect, healthcare facilities, which have an important place in the health quality of society, should be able to respond to excellently to user needs. Therefore, in the design of healthcare buildings, design criteria that will increase the working performance of patient health and working health personnel should be determined and these criteria should be considered during the design phase. For this reason, that there should be done adequate research on user needs while designing health buildings. Since different users such as doctors, health personnel and patients in hospitals will have different needs, designs suitable for the user profile are needed. Evidence-based design recommendations are a valuable design concept tool to consider in the design process. There is an increase in the construction of healthcare buildings to meet the healthcare service needs of the increasing population in the world. However, in most buildings, user needs are generally ignored and a customer-oriented management approach is developed. Therefore, it is concluded that the points identified in the studies are important for understanding the needs and relations between the built environment and the user. In addition, it is thought that the findings of the study can guide for similar studies in determining the effects of the physical environment on patients and health staff in the design of healthcare facilitiries and other design factors needed in the field.

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