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Accessibility in intensive care units: A qualitative study on exploring architects' perspective

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Abstract
This study addresses healthcare designers' perspectives concerning the architectural features within the Intensive Care Unit (ICU) environments that can impact visual and physical access to patients. In line with patient-centered approaches, providing accessible environments in ICUs is becoming increasingly critical for healthcare providers. The existing literature suggests various architectural features to influence levels of access to patients. How architects prioritize these features and translate them into the configuration of ICU environments has not been explored extensively. A series of semi-structured interviews were conducted to understand the perspectives of healthcare architects in the context of Turkey. The interviews were conducted with twelve participants with recent experiences in ICU design. The research followed a thematic analysis to link the qualitative data with the participants' drawings that emerged during interviews. Five essential themes emerged, including: "Unit Model," "Unit Layout," "Unit Size," "Bed Position," and "Transparent Material." The participants implied configurational models, including "open ward" and "single-patient room," to facilitate high levels of accessibility. Beyond the key decisions concerning layouts, the participants also emphasized the strategic use of transparent materials, which was considered critical in establishing visual access within units. The findings suggest that healthcare architects mostly favor open wards as a suitable model to provide high levels of physical access by decreasing nurses' walking distances during shifts and visual accessibility by enhancing nurses' capacity to supervise the patients within ICU environments. The findings can advance our understanding of how the issue of access is formulated and implemented in ICU settings.

Keywords
Expert interviews, Intensive care unit, Thematic analysis.

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1. Introduction

The Intensive Care Unit (ICU), throughout the decades, has evolved as a unit for providing care by offering immediate and quick access to patients without unnecessary impediments to the care protocols. The ultimate aim was, obviously, to improve patient safety and staff efficiency in the ICU. A well-designed ICU environment can have numerous benefits, including reducing staff walking, enhancing time utilization, facilitating easier visibility, as well as improving worker satisfaction and patient safety (Hamilton & Shepley, 2010; Rashid et al., 2016). In this way, the architectural features need to be carefully considered to facilitate conditions of physical and visual access (Hamilton et al., 2018; Leaf et al., 2010; Pachilova & Sailer, 2020; Rashid et al., 2016). ICUs provide critical care for critically ill and injured patients, which requires more special demands than other nursing units. Therefore, the ICU employs properly trained medical specialists and uses highly advanced equipment when necessary. Patients are observed directly by these specialists 24 hours a day and can receive quick access to them (Berthelsen & Cronqvist, 2003).

There are two main zones in ICUs, namely the patient zone and staff zone, and the physical relationship between these zones could impact staff accessibility to patients. The patient zone in an ICU is an important area to include the patient's bed and medical equipment in close proximity (Rashid, 2014). Marshall et al. (2017) state that ICU beds must be accessible from all sides to facilitate effective care. Staff zone in ICU is identified as an area for staff teamwork to primarily serve as a nurse station (Hamilton & Shepley, 2010; Rashid, 2006; Rashid, 2014). This zone involves patient monitoring, charting, and providing support (Hamilton & Shepley, 2010; Rashid, 2006; Rashid, 2014). Staff zone should be structured to elevate patient care by suggesting appropriate workspaces for staff (Hamilton & Shepley, 2010). Consequently, the nurse station must have a direct view of the patient's bed in the ICU as it is located at the center of the staff zone (AusHFG, 2016; Facility Guidelines Institute, 2014; Sağlık Bakanlığı, T. C., 2010). Accessibility in ICUs means designing an accessible environment by eliminating barriers that inhibit physical and visual accessibility between staff and patient zones.

Visual accessibility in the ICU refers to having a sightline to patients and intervening rapidly with patients in critical situations (Apple, 2014; Hamilton et al., 2018; Harvey & Pati, 2012; Pachilova & Sailer, 2020; Rashid, 2014). High visibility helps nurses intervene rapidly with patients in critical situations, improving patient safety and staff efficiency in the ICU (Apple, 2014; Harvey & Pati, 2012; Pati et al., 2015). If patients are not immediately visible, patient safety may not occur or be seriously impacted (Rashid et al., 2016). For example, Leaf et al. (2010) studied the association between patient mortality and ICU architecture. The study suggested that the mortality rates increased for patients assigned to ICU rooms with low visibility levels from the nurses' station. Physical accessibility includes the capacity to get close to the patients' beds and interfere with them in critical situations. The distance between patients' beds and staff can directly affect patients' physical accessibility in the ICU. A better physical environment in the ICU can reduce staff walking, allow for better time use, and provide quick access to patients (Rashid et al., 2016). Specific barriers within ICU environments that prevent patients from being approachable would be removed to provide visual and physical accessibility in the ICU.

Due to the developments of the patient-centered approach (Frampton & Guastello, 2010; Stichler, 2011), patient demands are getting significant in the design of a safe and efficient environment in the ICU. Thus, the patient-centered approach has provided a new design movement toward decentralized units or single-patient rooms that offer direct and clear visual and physical access for patients. In contrast, the centralized unit or open ward model was a popular design idea for many decades (Ritchey & Pati, 2008). It was through this approach that healthcare architects were encouraged to devel-

op decentralized ICUs to create safer and more efficient ICU environments by reducing nurses' walking distances and increasing the amount of time that nurses could spend with patients in the ICU (Hamilton & Shepley, 2010; Rashid, 2014; Verderber & Fine, 2000; Zborowsky et al., 2010). In contrast to the centralized unit model, a decentralized unit model refers to several nurse stations that are decentralized inside ICUs to assist in the observation of one or two patients' beds separately from one another (Hamilton & Shepley, 2010; Ritchey & Pati, 2008; Schweitzer et al., 2004).

The body of research conducted during the Coronavirus Pandemic (COVID-19) also emphasized the importance of accessibility to patients in the ICU. The results suggested that low visual and physical accessibility to patients' beds was related to a more significant proportion of COVID-19 deaths in the ICU (Arabi et al., 2021; Bauer et al., 2020; Shang et al., 2020). During COVID-19, there were a number of patients who needed critical care due to the high number of patients requiring critical care in the ICU environment (Shang et al., 2020). Arabi et al. (2021) also stated that there was limited access to patients within ICUs during COVID-19 due to the overwhelming amount of people found in the ICUs. In light of technological medical advancements and the growing patient-centered approach, an increasing number of studies have examined the relationship between ICU architectural features and accessibility issues. Concerning this literature, some architectural features have been identified as having significant impacts on the interrelationships between staff and patient zones as follows:

1.1. Unit model

The existing literature characterizes three types of ICU design models, including an open ward, a single patient room, and a hybrid unit, which are all known to have significant effects on accessibility in the ICU. Florence Nightingale was one of the first to suggest a nursing unit with an open ward plan, namely the Nightingale Ward. She implied the relation between the unit design model and the accessibility to patients where patients were observed and approached by nurses in one open space (Hamilton & Shepley, 2010; Verderber, 2010). It also makes sense that the open ward model positively impacts the levels of co-awareness from the clinician's vantage point (Rashid et al., 2016). There has also been discussion of the single-patient room or decentralized model with charting alcoves to enhance the visibility of two rooms and ease of access to the patient (Hamilton et al., 2018). Patients can be monitored from a close distance from the monitoring station due to a window between them and the monitoring station (Rashid, 2014). Similarly, the hybrid ICU can enhance the efficiency and safety of nurses by providing a flexible work environment. It is the mix of centralized and decentralized nurse stations that allowed nurses to select a space that worked best for their needs or tasks in the ICU (Apple, 2014).

1.2. Unit layout

According to studies, the unit layout is related to the arrangement of spaces and connections between different spaces inside the unit and has significant impacts on staff access to patients in ICU (Durham & Kenyon, 2019; Fay et al., 2017; Keys & Stichler, 2018; Shpuza & Peponis, 2008). There are seven kinds of unit layouts (Cai, 2013; James & Tatton-Brown, 1986) specified in hospitals that can employ to shape ICUs in hospital settings. However, the layout of the ICU should support staff by minimizing travel distances between patient and staff spaces. In units with a longer distance between the patient rooms, there might be a lower level of visual and physical accessibility for patients (Hadi & Zimring, 2016). According to Hamilton and Shepley (2010), a recognizable and simple layout can facilitate physical accessibility for patients by placing equipment and medications close to them. Moreover, he discussed the circular layout of the ICU, which includes a central nurse station surrounded by rooms that provide access to supplies and medications. In another study, Keys

and Stichler (2018) suggested that U-shaped units can enhance the visual accessibility of staff. A double corridor layout is another kind of layout that could reduce the walking distance of nurses by locating patient beds around the central nurse station (Rashid, 2006). Almost, some studies have suggested the relationship between corridor width resulting from unit layout and accessibility issues in ICUs (Hamilton et al., 2018; White et al., 2013). For example, Hadi and Zimring (2016) stated that wider corridors give nurses a better view of patients.

1.3. Unit size

Several studies mentioned relations between accessibility issues and overall unit size. The number of beds in the unit determined the unit size in ICUs. According to Seo et al. (2011), large nursing units may improve nurses' walking distance to the patient room. Otherwise, smaller nursing units reduce walking distance and provide better patient sightlines (Ferri et al., 2015; Ritchey & Pati, 2008). Generally, large units with more than nine beds could not provide sufficient visual accessibility and should be divided into clusters of seven or eight beds to provide better visual access to patients (Hamilton & Shepley, 2010). Dutta (2008) also suggested a multi-hub approach in which each central station serves a cluster of not more than 6-8 rooms, reducing walking distances to achieve better visual access to patient rooms.

1.4. Life support system

There is literature that discusses the life support system as a patient space feature that affects the interior design of the room in different ways in order to gain access to the patients' beds and amenities (Hamilton & Shepley, 2010; Rashid, 2014). These systems assist the ICUs' patients in critical situations and are presented in five different types, including headwall, power column, pendant-mounted overhead, and bridge system (Hamilton & Shepley, 2010; Rashid, 2014). In the ICU, life support systems are selected based on their characteristics that affect access to beds. The headwall system is a kind of system that fixes the medical gases, vacuum, and electrical outlets behind the patient's head (Hamilton & Shepley, 2010). There is limited flexibility in bed positioning with this system and limited ability to reach the patient's head from behind (Hamilton & Shepley, 2010). A power column is another kind of life support system that allows the installation of all equipment on the column fixed to the ceiling and floor of the room (Hamilton & Shepley, 2010). It allows access to the patient's head from behind the bed, and beds can be arranged around a column in various positions (Hamilton & Shepley, 2010). A pendant-mounted system also connects utilities to the mounting system's suspended cable from the ceiling or wall. The pendant-mounted system is the most flexible life support system in ICUs and allows for wide variations in bed position (Hamilton & Shepley, 2010). A bridge system extends on the head of the patient's bed by attaching to the floor or hanging from the room's ceiling allowing physical accessibility to patients' beds from all sides (Hamilton & Shepley, 2010). However, this system has difficulties related to the height of the crossbar (Hamilton & Shepley, 2010).

1.5. Material

Some studies have shown that elements of the patient room, such as the door, should be made of transparent materials to provide patients with visual accessibility and physical accessibility. Opaque material may hinder visibility between patients and staff in the ICU. It is preferred that breakaway glass doors be used in ICUs so that patients and monitors can be viewed as clearly as possible (Hadi & Zimring, 2016; Hamilton & Shepley, 2010; Keys & Stichler, 2018; Rashid, 2006, 2014). According to Hamilton and Shepley (2010) and Rashid (2006), designers emphasized providing visual and physical accessibility to patients in single-patient rooms by using transparent walls between the observation station and patient rooms (Hamilton & Shepley, 2010; Rashid, 2006). Furthermore, healthcare design guidelines emphasize the importance of using transparent materials as part

of ICU design in order to provide adequate access to patients (AusHFG, 2016; Sağlık Bakanlığı, T. C., 2010).

The mentioned review introduced above suggests that various architectural features impact accessibility issues in the ICU. Through improving the patient-centered approach and considering patients' demands in hospital design, providing access is becoming essential in the design of healthcare environments. Given the importance of accessibility issues in ICU, healthcare architects have a vital role in finding suitable solutions to design an accessible environment by consolidating or redefining their concepts through the design process. However, there is not enough research to provide a picture of architects' knowledge concerning various dimensions of accessibility in ICUs. For instance, how the published empirical studies inform healthcare architects' knowledge base is not profoundly investigated. Consequently, it is imperative to maintain awareness of the relationships between the architectural features of an ICU and issues associated with accessibility in order to ensure a safe and efficient environment for patients and staff. In order to evaluate architects' concerns regarding accessibility issues, the three essential aims of this research can be summarized as follows:

- Examining the ICU design process from the perspective of architects.
- Investigating how architects provide accessibility in ICU.
- Understanding how architects articulate the issues concerning accessibility verbally and through drawings.

Thus, the primary research question is formulated as follows: "How do healthcare architects conceptualize and articulate the issues of accessibility in ICU design?" Understanding the nature of architects' knowledge has the potential to improve the issues of how related research is communicated and translated into practice. In this research, we have conducted semi-structured interviews to inquire about accessibility through designers' own expressions and their specific reference to precedents.

2. Methodology

The techniques of semi-structured interviews (Edwards & Holland, 2013; Merriam & Tisdell, 2015) were employed to learn about architects' perspectives on accessibility issues. We interviewed twelve healthcare architects in the context of the healthcare design community in Turkey. Snowball sampling (Parker et al., 2019) was used to identify participants who have specified criteria as follows:

- To be an expert in their profession and familiar with the hospital design process and hospital design guidelines in Turkey.
- To Contribute to the design of major "City Hospitals" in Turkey, especially the "Intensive Care Unit" design.
- To Have contributed to the mentioned design fields over the past five years.
- To agree to share their experiences related to ICU design voluntarily and to record their voices.
- To accept signing the consent form before starting the interview.

The qualitative data set was transcribed and analyzed using thematic analysis (Braun & Clarke, 2006; Vaismoradi et al., 2013) to explore participants' insights. Data saturation was attained after finishing the twelfth interview when new information was not yielded about the study's aim. The participants were between 25 to 54 years old and held bachelor's or master's degrees in architecture. The participants' level of work experience in healthcare design varied from 3 to 20 years.

2.1. Data collection instruments

In order to explore the participants' conceptualizations and insights, we have focused on a set of data, including verbal and visual components (Comi et al., 2014; Denzin & Lincoln, 2011; Pain, 2012). The combination of the visual and verbal data helped to better understand participants' formulations on the subject. Table 1 presents the twelve open-ended questions on four distinct topics, which rely on the existing literature on ICU design. The first section of the interview started

with a few basic and straightforward questions. This part enables participants to introduce themselves to the interviewer and establish a connection with the interviewer. In this way, three questions were designed to capture information about the participant's age, work experience, and educational level. In section 2, two primary questions were designed to determine architects' general knowledge and opinions about an ICU. These two questions have been developed based on the literature review described on pages 1-3. Question (a) was intended to determine architects' views on the role of intensive care units in hospitals. In question (b), architects were asked to provide their opinions about the physical relationship between an intensive care unit and other nursing units in a hospital. The following section of questions aimed to find out what architects know about the architectural features of the ICU in terms of architectural features.

Three essential questions were developed based on the literature mentioned on pages 4-7 as a data source to gather architects' knowledge of the ICU's design features. Questions started with asking about ICU spaces and moved towards asking about the ICU's general architectural features and equipment. Lastly, the participants were asked what type of architectural layout they preferred for the design of the ICUs. Finally, to elicit further information on participants' formulations of accessibility in the ICU, four questions were developed in the last section of the interview questions. In order to design the questions in this section, the literature review mentioned on pages 4-7 was employed as a data source. Questions (a) and (b) of this section were designed to determine architects' opinions about the nurse station and patient room properties. In the following, questions (c) and (d) were considered to discover architectural features which provide physical relations between patient and nurse's space in ICU.

Also, participants were asked to explain their opinions or experiences through simple sketches in sections 2, 3, and 4. Using these sketches could enhance the validity and quality of the collected data. Additionally, some examples were included in the questions of sections 2, 3, and 4 to assist participants in understanding the questions quickly. The order of twelve open-ended questions was followed throughout the interviews, with the freedom to change the order, time, and wording allotted to questions in each interview. Before conducting the interviews, we conducted a pilot study (Edwards & Holland, 2013; Kvale, 2007; Merriam & Tisdell, 2015) with two participants to test the formulation and legibility of questions and the flow of the interview sessions. The pilot interviews informed the field strategies on how to ask questions to participants, what questions could be suitable to ask participants, and how much time was necessary to complete the interview. The analysis of pilot study interviews suggested changes in questions to eliminate ambiguity and to keep participants focused on the subjects investigated. This study was also approved by the Institutional Ethics Committee of Middle East Technical University before conducting the interviews.

All interviews were conducted in the participants' offices and natural work settings. Each participant was given a consent form before the interview began. The interviews were recorded on an audio device. After conducting the interview, each participant was given a debriefing form describing the interview's goals and hypotheses. In order to enrich the verbal data acquired during the interview sessions, the participants were given blank papers, if needed, to better explain their thoughts by drawing sketches for the six open-ended questions, including 2(b), 3(c), 4(a), 4 (b), 4(c), and 4 (d) questions (See Table 1). Eventually, recorded interviews were transcribed into Microsoft Word and saved in specific folders, each with its code. Participant sketches were also attached in JPG format to each transcript. The obtained data's validity was confirmed by member checking (Birt et al., 2016; Candela, 2019) to endorse the content of transcribed data.

2.2. Data analysis

The set of interviews was analyzed using Braun and Clark's (2006)

Table 1. *Interview questions.*

Section	Topics	Questions
1	To achieve architects' personal information and their working experiences.	(a) How old are you? (b) How many years of experience do you have in the healthcare design field? (c) What is your level of education in architecture? (For example, Bachelor, Master, or, Ph.D.)
2	To find out the general approach and architects' opinions about ICU in hospitals.	(a) Could you tell me about the specific issues and roles of the ICU in the hospital? (b) In your opinion, what kind of physical relations must there be in ICU in the hospital? (For example, relations with other nursing units, location of ICU in hospital, etc.) Please indicate them in simple diagrams or sketches.
3	To find out architects' approach to ICU's architectural features.	(a) What types of architectural spaces do you specify in ICU? (For example, patient's space, nurse's space, etc.) (b) Could you tell me about the general architectural features and equipment of ICU spaces? (For example, technical and medical equipment, furnishing, etc.) (c) What types of architectural layout do you prefer in ICU's design? (For example, rectangular, circular, etc.) And, why? Please indicate them in simple diagrams or sketches.
4	To find out architects' approach to providing accessibility in ICU.	(a) In your opinion, what is a nurse station/ nurse workplace in ICU? And what are the properties of the nurse station? (For example, size, shape, location in ICU, type. doors, etc.)? Please indicate them in simple diagrams or sketches. (b) In your opinion, what is a patient room in ICU? And what are the properties of the patient room? (For example, size, shape, location in ICU, type, equipment, etc.) Please indicate them in simple diagrams or sketches. (c) To provide physical relations between patient and nurse's space in ICU, what architectural features do you consider in the design process? (For example, entrances of areas, the distance of spaces, size of spaces, relations between spaces, etc.) Please indicate them in simple diagrams or sketches. (d) To provide physical relations between patient and nurse's space in ICU, what furnishing/equipment do you consider in the design process? (For example, door, window, bed, medical equipment, technical equipment, etc.) Please indicate them in simple diagrams or sketches.

thematic analysis technique in five essential steps, including familiarizing with data, generating initial codes, searching, reviewing, and defining themes. In the first step, we read and reread acquired data to give better contact and greater awareness about the gathered data and determine an explicit understanding of participants' responses. At the end of this stage, a thorough understanding of the pattern within the collected data was obtained. In the second step, the preliminary coding was conducted using a deductive approach to summarize the raw data into meaningful units in an iterative process. The codebook was used for initial coding and provided formalized coding to repeat the coding process and test the reliability of the coding process. Codes were described by code label, definition, descriptions, and an example quote from participants to avoid ambiguity in specified codes. Initial codes were generated in two cycles, including reviewing the initial codes, revising the codes, and evaluating the inter-rater reliability of codes (McAlister et al., 2017). In the third step, all initial codes were organized in groups to extract the theme or sub-themes. After that, they

were reviewed to achieve the viability of each theme. All the refined codes were grouped into groups to extract the theme or sub-themes. In the fourth step, we reviewed extracted themes regarding the purpose of the interview to remove repeated or unrelated codes for the ultimate refinements of themes. Extracted themes were associated meaningfully, while clear and identifiable distinctions were among them. The consistency of findings also enhanced the reliability of the analyzing process. Finally, we have inductively extracted five critical categories, including unit model, unit layout, unit size, bed position, and transparent material. A summary of the key findings from each category was included in Table 2 to explain

Table 2. *Categorization of the findings.*

Category	Sub-Category	Key Findings
Unit Model	Open Ward	• Improving observation of all the patients at the same time without any obstructions by locating the nurse station in the central part of the unit. • Providing a high level of staff efficiency by accessing the bedside of patients in a short time. • Linking the support area to the nursing station and reducing the total distance covered by a single nurse in a given shift by locating the nurse station beside the open ward.
	Single-Patient Room	• Providing close observation to patients through a nurse observation desk outside the patients' room. • Enhancing patient safety considerably through the proximity of nurses' workplace to patients. • Allowing staff members to perform critical interventions efficiently by providing enough space for each patient. • Allowing the utilization of necessary equipment to improve patient care processes through the clearances in the unit organizations.
Unit Layout	Simple Layout	• Saving multiple trips between patients and nurse stations and avoiding wasting time by decreasing the number of corners or unrecognizable spaces inside the unit.
	Rectangular Layout	• Decreasing the nurses' walking length and improving the visibility of patients by: 1) Organizing beds around the perimeter. 2) Locating various spaces close together, 3) Using the floor plan sufficiently and providing proper relations between the patient and nurse spaces. 4) Decreasing the number of corners and unrecognized spaces within the unit.
Unit Size		• Providing high surveillance of patients within open ward and single-patient room units with eight patient beds. • Decreasing trips between patients and nurse stations within open ward and single-patient room units with eight patient beds.
Bed Position		• Providing three sides of access to the patient with the exception of the patient's head by putting the patient's bed against the same wall of two single-patient rooms. • Controlling two patients from the nurse observation desk located outside the room by putting the patient's bed against the same wall of two single-patient rooms.
Transparent Material	Glass Door	• Allowing nurses to see the patients while sitting at the nurse observation desk outside the room. • Allowing nurses to see the patients while crossing the corridor. • Facilitating the interaction between patients and nurses.
	Transparent Wall or Window	• Improving patient observation by decreasing obstacles such as walls that prevent visual accessibility. • Facilitating patients' control without entering the patient room.

the significant results obtained from thematic analysis. It allows us to depict how participants conceptualize the issue of accessibility in the ICU. evaluating the inter-rater reliability of codes (McAlister et al., 2017).

3. Findings

This section introduces the various dimensions of the themes identified through thematic analysis. The descriptions below elaborate on the meaning of the extracted themes and sub-themes by describing the theme and sub-themes and their importance. Almost the descriptions are linked to the authentic expressions and drawings that emerged during interviews with participants.

3.1. Unit model

As participants suggested, the unit model to configure patient beds, nursing stations, and support areas emerged as one of the significant architectural features to facilitate access in ICU settings. The participants mainly addressed two kinds of ICU unit models, which were also recognized in the literature, namely open wards and single-patient rooms.

a. Open ward: The open ward is one unit model, including a centrally located nursing station to control multiple patient beds organized following the room perimeter. According to Hamilton and Shepley (2010), "critical care began in the tradition of the surgical post-anesthesia recovery room, an open bay containing multiple beds. Critical care units most often were based on this open bay model in which multiple patients could be observed simultaneously, allowing caregivers to rapidly support each other as they cared for a group of patients" (p.72).

Regarding their design experience, most participants mentioned employing an open ward as the suitable unit model for providing high accessibility to ICU patients. For example, P6, an architect with eight years of professional experience in healthcare, emphasized a model with the nursing station at the very core of the unit as a valid configuration to help nurses observe all the patients simultaneously and access the bedside in a short time. Similarly, as shown in Figure 1 below, P5, a junior-level healthcare designer, identified the open ward with a nurse station in the center and eight patient beds located around the perimeter on a drawing produced during the interview. He emphasized that "two nurses are assigned in the nurse station, and each nurse must monitor and control four patients." According to P5, an open ward with a centralized station has a high level of staff efficiency because nurses can observe patients' beds easily without any obstacles and can access patients in a short time.

In another interview, P2 explained the importance of relationships between the patient and nurse areas within the ICU and emphasized another configuration in which the nursing station was located at the edge of the unit close to the support area. This organization (Figure 2) that links the support area to the nursing station hypothetically reduces the total distance covered by a single nurse in a given shift.

Similarly, P4 mentioned the significance and value of direct observation

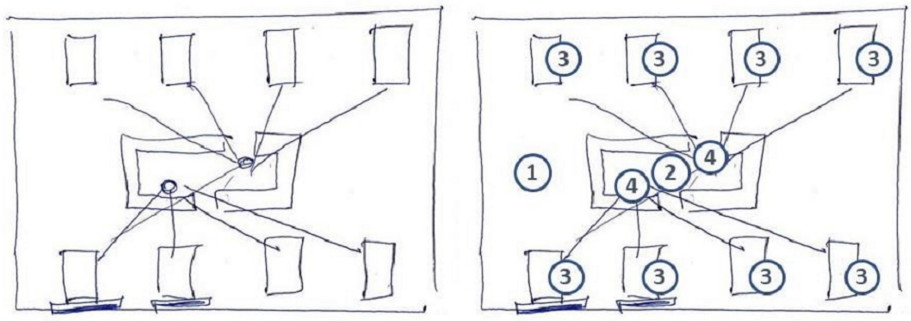

Figure 1. *This sketch (left: unchanged; right: coded for explanation) drawn by P5 shows an open ward (1) with a central nurse station (2) and eight patient beds (3) arranged around the perimeter of the unit. He shows that two nurses (4) are assigned to the central nursing station (2), and they are responsible for monitoring and controlling four patients each.*

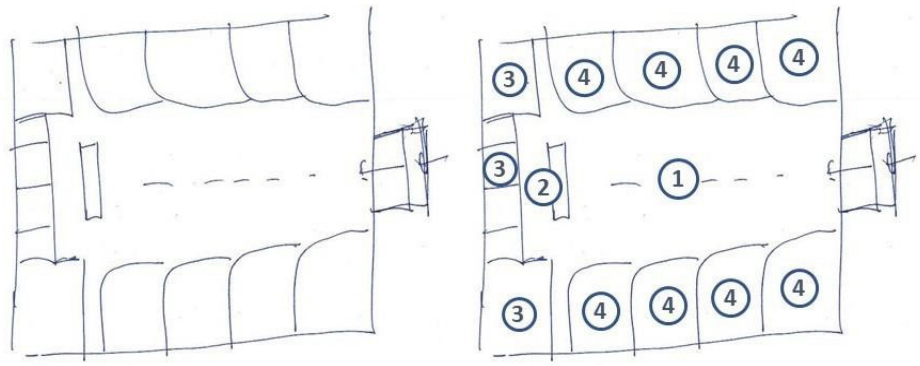

Figure 2. *In this sketch (left: unchanged; right: coded for explanation), P2 depicts an open ward (1) with patient beds (4) placed on two sides of the unit and a nurse station (2) located beside the unit close to the support areas (3). She noted that in this layout, support areas (3) are linked to the nursing station (2), reducing the total distance that a single nurse must cover in a shift.*

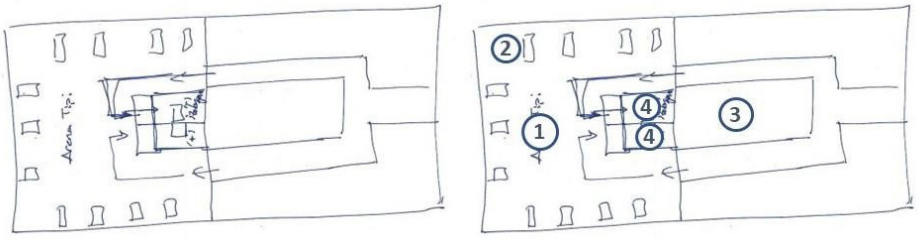

Figure 3. *This sketch (left: unchanged; right: coded for explanation) presented by P4 depicts the open ward (1) with patient beds (2) located around the unit, a central nurse station (3) at the edge of the unit, and two isolation rooms (4) in this sketch. He emphasized that placing a nurse station on one side of the unit takes less space than putting it in the middle of the open ward and facilitates nurses' movement inside the ICU.*

and physical access to patients in the ICU and explained the open ward (Figure 3) with a nurse station to the edge of the open ward. He stated, "placing a nurse station on one side of the unit takes less space than putting it in the middle of the open ward and facilitates the nurses' movement inside the ICU."

b. Single-patient room: The single-patient room comprises private rooms with a decentralized nurse observation desk between two rooms and the central nurse station to independently monitor one or two patients' beds (Hamilton & Shepley, 2010). According to Hamilton and Shepley (2010), "decentralized workstations allow the caregiving staff to remain near the patient. Windows along the corridor from these decentralized stations maximize the staff's ability to see into the room" (p.93).

During interviews, ten out of twelve participants expressed their thoughts about the single-patient room and how this unit model affects patient access in ICU. The participants stressed the importance of an observation station between two rooms in the single-patient room and providing quick access to patients in the single-patient room. For example, P1 (Figure 4) shared her opinions by stating that "the single-patient room provides close observation to patients through a nurse observation desk outside the patients' room." She implied the proximity of nurses' workplace to patients as one of the essential characteristics of this model that can enhance patient safety considerably. She also said nurses could constantly observe patients from small stations and easily approach patients inside the room.

Several participants also remarked on the significance of having enough space for each patient in the single-patient room, allowing staff members to easily perform critical interventions. The participants also expressed concern that the clearances in single-bed organizations allow the utilization of necessary equipment to improve ICU patient care processes. For instance, P10 stated, "the single rooms are suitable for convenient access to patients, pro-

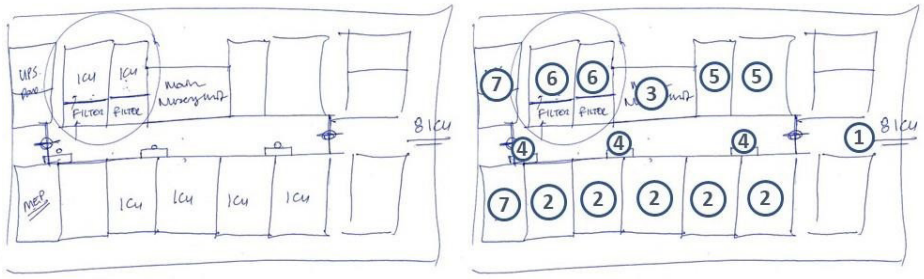

Figure 4. *This sketch (left: unchanged; right: coded for explanation) presented by P1 shows a single-patient room model (1) with the main nursing unit (3), support areas (5), patient rooms (2), the decentralized nurse stations (4), two isolation rooms (6), and mechanical/ electrical/ plumbing systems (MEP) and UPS zones (7). She suggested that this unit model would increase patient safety by continuously observing patients from small stations and quickly accessing patients within the room.*

viding enough space for each patient, and nurses can enter the room easily and interfere with patients quickly." In general, participants recommend an open ward and a single-patient room organization as prominent ICU unit models to cover issues of access based. The Turkish healthcare design guideline (Sağlık Bakanlığı, T. C., 2010) also describes open ward and single-patient room models for ICU, recommending a single-patient room as a suitable ICU unit model. Despite this recommendation, participants primarily recommend an open ward to improve nurses' visual and physical accessibility by allowing them to observe all patients at the same time and access patients quickly. Accordingly, nurses may observe patients' beds properly without any obstructions. They can access patients in a short period in an open ward with a centralized station, which has a high level of staff efficiency. The participants underlined the nurse station's proximity to the open ward, which increases accessibility by reducing the distance that nurses need to walk.

3.2. Unit layout

The unit layout is an important architectural feature of ICUs that determines space organization and connectivity between different places inside the unit (Rashid, 2014). Concerning this theme, several participants in this study addressed the connections between kinds of ICU layout and accessibility issues. They shared their experience related to mainly two types of layouts, including a simple and rectangular layout, which have positive effects on the accessibility between patient and nurse space in ICU as follows:

a. Simple layout: A simple layout is a unit with simple geometry and few corners in the floor plan. Five out of twelve participants mentioned the necessity for employing simple layouts structured in easily recognized and simple geometries. According to participants' statements, nurses could save multiple trips between patients and nurse stations and avoid wasting time within simple layouts. In contrast, complicated configurations make more corners in the floor plan and consequently cause more problems in the movement and communication of nurses when they want to approach patients inside the unit. For example, P2 shared that "designing an ICU based on a simple floor plan provides good interaction and communication between patients and nurses by decreasing the number of corners or unrecognizable spaces inside the unit."

b. Rectangular layout: The participants mentioned the benefits of rectangular layouts that follow an orthogonal perimeter to include ICU services. Four participants introduced rectangular layouts with a low depth which hypothetically decreased the nurses' walking length and improved the visibility of patients by organizing beds around the perimeter. For instance, P2 explained that "a rectangular floor plan could be used to locate various spaces close together, significantly decreasing nurses' walking distance. In other words, we can use floor plan sufficiently and provide proper relations between the patient and nurse spaces." Participants suggested simple

and rectangular geometries to promote visual and physical access, as well as uncomplicated geometry and fewer corners in the floor plan to reduce multiple walks between patients and nursing stations and waste time within the unit. They stressed the potential benefits of these designs on accessibility difficulties, citing improved engagement and communication between patients and nurses and a reduction in the number of corners and unrecognized spaces within the unit.

3.3. Unit size

The patient spaces commonly include patients' beds, which eventually determine ICU unit size. Three of the twelve participants emphasized the critical decision of determining the unit size based on the number of patient beds. Suggested as a norm, the architects introduced open ward type units with eight patient beds, where two assigned nurses provided the care. In Figure 5, for instance, P4 introduced an exemplary ICU layout with eight patients and two nurses assigned. According to his statements, an ICU with more than eight patient beds requires an elongated layout, eventually increasing nurses' distance from patients. He stated that "a unit with eight patients can easily be controlled by nurses and other staff. The large units with more than eight patient beds need large space and more nurses to control patients."

P7, as shown in Figure 6, drew an ICU with eight patient rooms during the interview and emphasized staff efficiency by ensuring appropriate physical accessibility without additional walking. She noted that "efficiency of the ICU is directly related to the unit size determined by the number of the patient's bed. ICUs with more than eight patients may increase the unit size and disrupt accessibility issues by increasing walking distance."

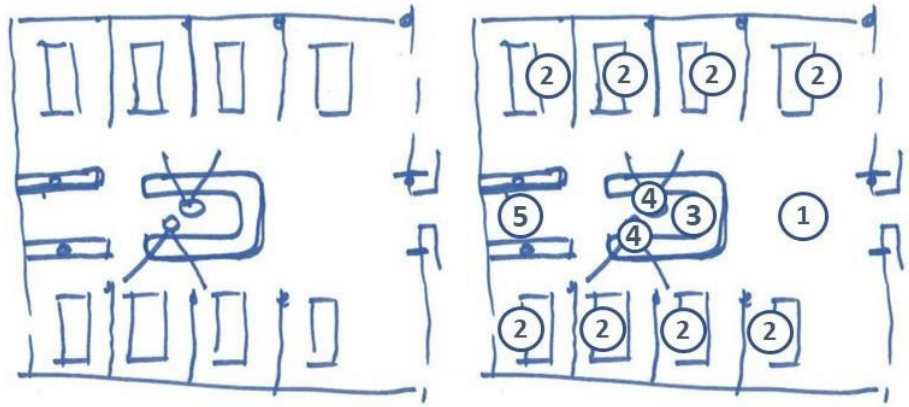

Figure 5. *This sketch (left: unchanged; right: coded for explanation) drawn by P4 shows an open ward ICU (1) with patient beds (2) located on two sides of the unit, a central nurse station (3) with two assigned nurses (4), and a support area (5). He stated that a unit with eight patients could easily be controlled by staff. Large units with more than eight patient beds need larger spaces and more nurses to control patients.*

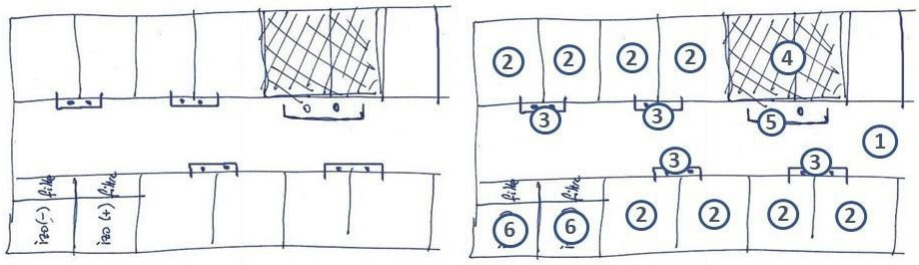

Figure 6. *In this sketch (left: unchanged; right: coded for explanation), P7 presented a single-patient room (1) with the main nurse station (4;5), eight patient rooms (2), a decentralized nursing station (3) located between two patient rooms, and two isolation patient rooms (6). She stated that the ICU with eight patients could improve staff efficiency significantly, while ICU with more than eight patients might increase the unit size and disrupt accessibility issues by increasing walking distance.*

In both open ward and single-patient unit models, participants suggested an ICU with eight patient beds as an appropriate unit size to allow physical and visual accessibility without additional walking and impediments inside the unit.

3.4. Bed position

Bed position can define the nature of accessibility to patients in ICUs. In the current study, five of the twelve participants implied that putting a bed against the same wall of two rooms provides high visibility and accessibility to the patients in the single-patient room. This bed position provides three sides of access to the patient except for the headwall. For instance, P3 (Figure 7) stated that putting a patient's bed against the wall is more suitable than in the middle of a single-patient room because nurses could efficiently observe and control two patients from the nurse observation desk outside the room.

According to Figure 8 below, P12 also emphasized the efficiency of this location of the patient bed and discussed that "putting a bed against the same wall of two rooms does not restrict the visual and physical accessibility to the patient's head and does not take much space inside the room."

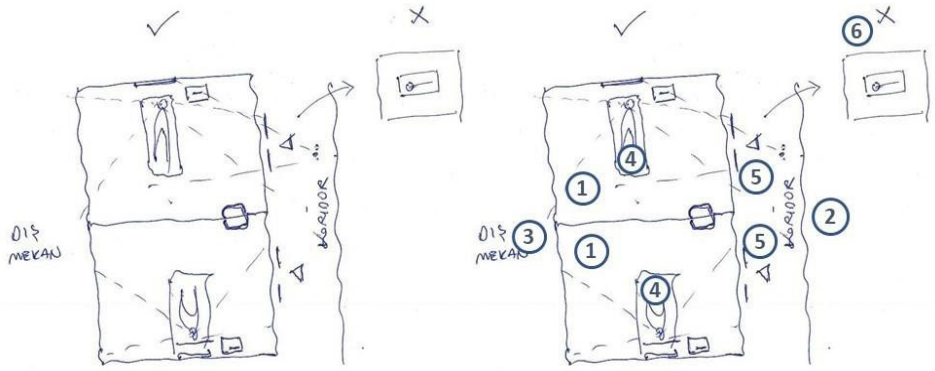

Figure 7. *In this sketch (left: unchanged; right: coded for explanation), P3 represents the patient bed (4) against the wall in a single-patient room (1) and outdoors (3). He emphasized the efficient observation of patients from the nurse observation desk (5) located outside the room and the corridor (2). He also emphasized the unsuitability of the patient bed (6) located in the middle of the patient room in the ICU.*

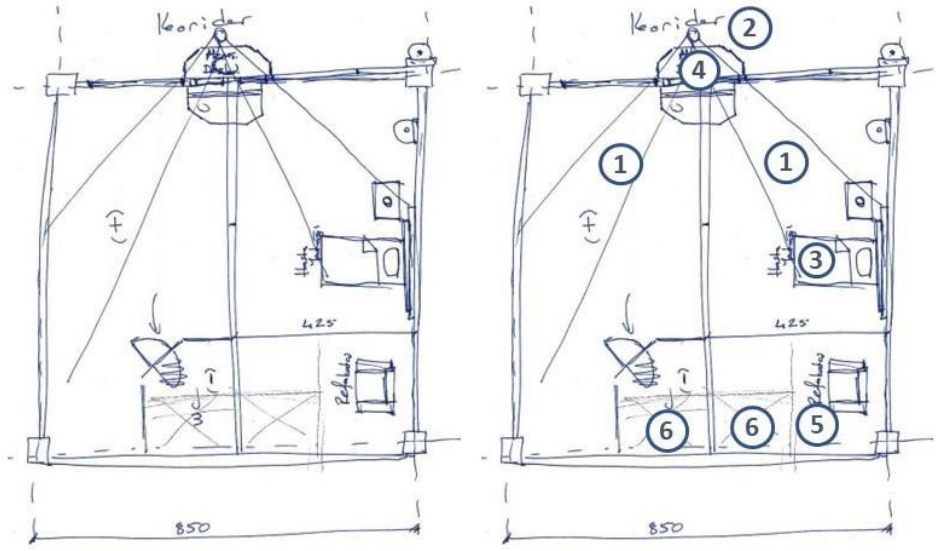

Figure 8. *This sketch (left: unchanged; right: coded for explanation) drawn by P12 shows a single-patient room (1) with a decentralized nurse station (4) located between two rooms, a family zone (5), and WC (6) beside the family zone. She noted that putting a patient bed (3) against the wall help nurses to see patients from the decentralized nurse station (4) and the corridor (2) efficiently and does not take much space inside the room.*

According to participants, patients' beds against the same wall of two rooms improve accessibility in a single-patient room unit model. The participants stated that placing a patient bed in this area would allow access to the patient from three sides, except for the patient's head. They provided this type of bed for efficient surveillance and control of two patients from the nurse observation desk outside the room.

3.5. Transparent material

Employing transparent materials can increase the possibility of direct observation between patients and nursing spaces in the ICU. Seven out of twelve participants implied an application of a glass door and a transparent wall or window to provide continuous observation of patients in the ICU.

a. Glass door: P4 shared his experience in the single-patient room and said glass doors should be used to easily observe the patients from the nurse observation desk outside the room or while crossing the corridor. He said that "using glass doors in single-patient rooms allows nurses to see the patients while sitting at the nurse observation desk outside the room or crossing the corridor. This can enhance patient safety within ICU." Similarly, P6 mentioned that employing sliding glass doors in ICU can increase nurses' efficiency by improving visual accessibility to patients. She mentioned that "we use sliding glass doors to enhance the visibility in a single- patient room. Glass doors add transparency to patient space and increase the nurse efficiency by facilitating the interaction between a patient and nurse in ICU."

b. Transparent wall or window: A transparent wall or window is mainly used between a patient room and a corridor or nurse observation desk in a single-patient room. Some participants described that the transparent wall or window between a patient room and a nurse observation desk can provide visual accessibility between patients and nurses in ICU. For instance, P8 stated that employing transparent material, such as windows between the patient and nurse spaces, can decrease obstacles such as walls that prevent visual accessibility and facilitate patients' control without entering the patient room in the ICU. Participants recommended that transparent materials be used in the ICU, particularly glass doors and windows between the patient and nursing areas, to improve accessibility issues. They prioritized improving patient observation by removing impediments like walls and employing transparent materials in the ICU.

4. Discussion

This study aimed to understand architects' perspectives on accessibility issues in ICU environments. The insights provided by the participants have the potential to advance our understanding of how the issue of access is formulated and implemented in ICU settings. As a result of these insights, five main features, such as unit model, unit layout, unit size, bed position, and transparent material, have been identified that impact accessibility in ICUs. According to the findings, although single-patient rooms have been demonstrated to significantly improve access to ICUs (McCullough, 2010; Rashid, 2007; Rashid, 2014) and the Turkish healthcare design guideline (Sağlık Bakanlığı, T. C., 2010) recommended using the single-patient room model, a majority of architects offered open ward configurations as better solutions for visual and physical accessibility in ICUs due to two main concerns.

The first issue mentioned by architects is the ability to immediately access patients in an open ward since the beds are organized in one space with limited or no separators to prevent rapid movement inside the unit. Also, the participants mentioned that a support area near the central nurse station decreases nurses' walking distance in an open ward.

The architects also implied the disadvantage of a single-patient room by suggesting that nurses need to travel long distances to enter a single-patient room to interfere with patients in critical situations. Another issue mentioned by architects is the limited number of nurses assigned to intensive care services in Turkey. The architects stat-

ed that an open ward generally needs fewer nurses than the single-patient room model. The single-patient room model needs one nurse in a nurse observation desk placed between two patient rooms (Rashid, 2007; Rashid, 2014). The architects we interviewed stated that providing patient safety in the single-patient room model primarily depends on providing sufficient nurses to control patients, which is one of the main problems in Turkey.

Among various kinds of unit layouts suggested in healthcare design literature (Cai, 2013; James & Tatton-Brown, 1986), the architects implied a simple and rectangular layout in the ICU with minimum obstacles and corners to facilitate better accessibility in the ICU. Rectangular units provide various spaces in a compact form, locate patient beds in observable places, and decrease the nurses' walking distance in ICU environments (Hamilton & Shepley, 2010). The participants also mentioned eight-bed formations in ICU as the optimum configuration to provide high visual and physical accessibility. According to the participants, organizing large units with more than eight patient beds could not offer suitable visibility to patients. The unit should be arranged with clusters to accommodate seven or eight beds (Rashid, 2014).

The findings show that architects considered the patient's bed position concerning circulation to provide maximum accessibility to the patients' heads in the ICU. The Architects we interviewed emphasized placing the patient bed in a mirrored- organization to allow better visibility. The participants explained that nurses could efficiently observe patients' heads from the nurse observation desk and corridor in a mirrored organization. On this particular topic, the literature does not suggest definitive evidence to employ mirrored or same-handed models in organizing ICU environments. Finally, the participants discussed utilizing transparent materials in the ICU to decrease visual obstacles and improve accessibility to patients. For instance, a glass door or glass wall and windows between the nurse observation desk and the single-patient room can significantly enhance visual accessibility to patients in ICU (Hamilton & Shepley, 2010; Keys & Stichler, 2018; Rashid, 2006; Rashid, 2014).

5. Conclusion

According to the importance of accessibility to patients in the ICU, this study is cutting-edge research that aims to examine the ICU design process from the perspective of architects, investigate how architects provide accessibility in ICU, and understand how architects articulate the issues concerning accessibility verbally and through drawings. In Turkey, the architects' voice is even weaker in a context where a large-scale healthcare facility development program has been progressing in the last decade. Consequently, the study presents authentic drawings and statements from architects with recent experience in designing and building intensive care environments in order to contribute to the growing literature.

In this way, a qualitative interview method was employed, and twelve architects were interviewed in semi-structured interviews utilizing twelve open-ended questions. A snowball sampling method was used to select twelve healthcare architects who are experts and contributed to the design of major "City Hospitals" in Turkey, especially the "Intensive Care Unit" design over the past five years. The qualitative data was analyzed by thematic analysis. Five essential themes were revealed, including unit model, unit layout, unit size, bed position, and transparent material. According to the findings, the open ward of the ICU is frequently referred to by architects as the appropriate ICU model to facilitate visual and physical accessibility. Arranging the patient beds around the open ward and providing visual accessibility without obstacles is an advantage of the open ward in providing patient safety in the ICU from the architects' perspective. Also, placing the support areas close to the central nursing unit can decrease nurses' walking distance and improve staff efficiency in ICU. These findings provide significant evidence regarding the architects' perspectives on the accessibility issues in ICU.

Generally, architects' opinions on accessibility issues were parallel with the Ministry's design guidelines (Sağlık Bakanlığı, T. C., 2010) which are required to be followed in the design process. We found some essential conflicting ideas about the single-patient room unit model stated in the discussion section. Although approachability and observability to patients in the single-patient room are recently suggested as an appropriate unit model in ICU, the architects offer the open ward as a suitable unit model. However, the topic requires further investigations to explore the emerging dimensions.

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