RESEARCH PAPER

A Delphi-Driven Framework for Designing Geriatric-Friendly OPD Waiting Areas in Healthcare Facilities

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ABSTRACT
The layout of healthcare institutions has a substantial impact on the comfort and efficiency of patients. For example, waiting rooms are quite prevalent in OPD operations where geriatric patients frequently have to wait for prolonged periods in an unfavorable environment. Although there are several existing guidelines concerning hospital designs, only few researches address OPD waiting environments designed for the comfort of geriatric patients. This research intends to develop a model of designing geriatric-friendly OPD waiting areas based on the Delphi approach. Literature reviews have been conducted on relevant built environment factors that affect patient wellbeing and waiting comfort. From the analysis, a questionnaire was formulated that addresses many wellness dimensions including physical, psychological, social, cognitive, environmental, and cultural factors in healthcare environments. The Delphi method was used to gather expert opinions from health architecture and planning experts and doctors. During the first Delphi round, expert answers were statistically analyzed using mean, standard deviation (SD), interquartile range (IQR), and coefficient of variation (CV). These variables were further refined during the second round for better consensus achievement. The current study helped to identify the critical design measures concerning spatial arrangement, infection control, comfort of the environment, accessibility, signage, and social support in the OPD waiting areas. The present study framework can serve as scientific evidence for professionals who need guidelines for creating comfortable and accessible OPD waiting areas for elderly people. The present study findings represent another contribution to the existing body of research in evidence-based healthcare facility design.
Keywords: Geriatric healthcare environment; OPD waiting areas, evidence-based design, Delphi technique, built environment, and well-being.
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1. Introduction

Healthcare facility design is critical in shaping the wellness, satisfaction, and quality of health care delivered to patients. Over the last few decades, there has been increased interest in the notion of evidence-based design (EBD) in health care architecture, which involves incorporating research findings during the process of designing a health care facility. Environmental aspects of buildings, including light, acoustics, space, ventilation, and exposure to natural environments, have been identified as critical factors that determine patient stress levels, wellness and recovery outcomes (Devlin & Arneill, 2003; Dijkstra et al., 2006).

Outpatient department (OPD) is one of the several spaces present within the facility that provides health care service and acts as an entry point for patients into the health care facility. OPD waiting rooms are often visited by a considerable number of patients accompanied by their attendants and are usually associated with long waiting periods for diagnosis, consultation, and administrative activities. Therefore, the design of waiting areas will have a significant effect on the overall experience and quality perception of patients (Pati & Nanda, 2011).

Considering the trend in the world towards having an aging population, the importance of designing spaces that cater to the needs of the elderly becomes even more apparent. Based on estimates provided by the World Health Organization, the number of people aged ≥ 60 in the world is expected to increase to 2.1 billion people by 2050 (WHO, 2021). Older patients frequently have limited mobility, sensory difficulties,

and cognitive issues affecting their interaction with and perception of architectural spaces (Marquardt et al., 2014). Consequently, healthcare spaces intended for geriatric users must consider factors such as accessibility, clear wayfinding, environmental comfort, and supportive spatial design to ensure safety and well-being.

Although there has been much research conducted in terms of understanding the effect of healthcare facilities' design on patient wellbeing, there has been much more emphasis on inpatient areas, such as patient rooms, ICU's, and healing gardens (Ulrich et al., 2004; Huisman et al., 2012). However, very few researchers have paid attention to the importance of the design of OPD waiting areas in enhancing patients' healthcare experience. This is because OPD waiting area design can affect patients' emotions, perception of waiting times, and their general level of satisfaction with the service received from the healthcare facility (Pati & Nanda, 2011).

Several researchers have emphasized that the incorporation of environmental design features, including natural light, sound control, ergonomically designed seating, space layout, and positive distraction, should be incorporated in health care facilities for patients' betterment (Daykin et al., 2008; Joseph, 2006). In addition, the presence of biophilia, effective signage system, and culturally sensitive areas contributes positively towards psychological comfort and wayfinding in healthcare facilities (Ulrich et al., 2008). Yet, there has been no effort made to incorporate these concepts in a structured framework for OPD waiting areas.

The use of the Delphi process is one strategy for creating evidence-based design models, where the Delphi process has been extensively utilized in healthcare and built environment research to reach consensus amongst experts through the means of repeated surveying (Skulmoski et al., 2007). The Delphi method enables the integration of multidisciplinary knowledge and expert judgment to identify and refine design considerations for complex environments, such as healthcare facilities.

Against this backdrop, this research will attempt to develop an OPD waiting area design framework based on the Delphi technique. The current research is geared towards exploring the various variables in terms of built environment which impact on the well-being of elderly individuals in the OPD waiting environments and validate the same using expert views. Through this research, the researcher will be able to contribute to the formulation of a model that will help architects and health care planners in designing OPD waiting areas.

2. Literature Review

The impact of the physical environment on health care has become a focal point for architects, environmental psychologists, and health care managers over the past few decades. Evidence-based design (EBD) has become a popular model of healthcare facility planning due to its emphasis on the application of research findings to architecture that benefits patients' outcomes, safety, and welfare. In their systematic review of the existing literature on healthcare design research, Ulrich et al. (2008) found that the design of the physical environment of a hospital may have a notable effect on patients' recovery processes, stress levels, and workers' productivity. The review revealed the existence of an increasing number of empirical studies examining the effects of physical environment features in hospitals on patient safety and infection rates as well as health care workers' satisfaction levels. In a similar vein, research findings from various systematic reviews indicate that there are many ways in which environmental characteristics influence the experience of the patients. In particular, Brambilla et al. (2019) observed that environmental design interventions were linked to lower patient stress, greater patient satisfaction, enhanced job satisfaction among staff, and a reduction in patient falls.

These observations validate the idea that the architecture of the healthcare facility needs to be viewed as an integral element of healthcare delivery process, and not only the passive shell housing various medical processes. The findings of evidence-based design indicate that the design elements, such as presence of sunlight, better acoustics, and improved layout planning, can increase the healing potential of facilities.

Among these various topics within the same domain, OPD waiting room design, especially with regard to elderly people, has received attention as one of the research issues. The waiting room could be considered one of the first encounters for the patients with respect to the environment of healthcare facilities, which is capable of influencing patient satisfaction and comfort in several aspects. Hence, the significance of OPD waiting areas in terms of health has been highlighted by researchers from different perspectives.

Physical Wellness Dimension

The aspect of physical wellness in healthcare settings involves spatial arrangements and environmental elements that enhance physical well-being, safety, and accessibility for the patients. Ergonomic design, spatial arrangements, and environmental comfort have been identified as some of the key aspects for improving the well-being and ensuring low healthcare risks among patients.

Research on healthcare environments has shown that the spatial arrangement and the environment in healthcare settings have a direct impact on the patient outcome. In their study, Devlin and Arneill (2003) noted that factors such as temperature regulation, spatial arrangement, and physical accessibility were vital in enhancing patient comfort and satisfaction. Accessibility of spaces, especially when elderly patients are involved, is highly critical.

Safety is yet another vital element for achieving physical well-being. According to Ulrich et al., there is significant research showing a relationship between healthcare facilities' design and the level of patient safety. Such factors include the occurrence rate of infections and falls. The study found several environmental characteristics that lead to safe health care settings, including ergonomically designed furniture, sufficient circulation space, and use of slip-resistant flooring material.

Furthermore, thermal comfort and air quality are essential for physical well-being in health care settings. The environmental factors affect not only physiology but also the overall satisfaction of patients with their condition in hospitals. Studies suggest that proper ventilation system designs as well as suitable temperature conditions improve patients' comfort and decrease their stress levels.

Consequently, various factors contributing to physical wellness include accessibility, ergonomics, spatial planning aimed at improving patient safety, thermal comfort, and space allocation.

Psychological Wellness Dimension

The psychological aspect of wellness within health care facilities refers mainly to environmental factors that affect emotions, reduce stress, and increase mental satisfaction. Such factors as lighting, acoustics, privacy, and aesthetics in an environment are very important for the development of psychological reaction at health care institutions.

One of the most powerful factors affecting the psychological state of people is lighting. Numerous studies have proven that natural daylight helps people adjust their biological clocks and feel happier. Natural lighting also speeds up healing process by reducing feelings of depression and improving sleep and overall well-being.

Apart from lighting, acoustic performance is also an essential factor in determining psychological comfort. Hospitals can be described as noisy environments due to sounds produced by machines, communication between staff members, and patients. The presence of too much noise in hospitals has been linked to stress and sleeplessness in patients.

Privacy and environmental control also play an important role in the psychological health of patients. Scientific studies have found that patients who perceive themselves to have more control over environmental aspects like lighting, temperature, and entertainment system benefit from lower levels of stress and better satisfaction.

Additionally, positive distractions like art, nature, and beautiful surroundings have been found to decrease anxiety levels and enhance patients' experiences. According to Daykin et al. (2008), the introduction of art and nature within healthcare settings positively influences patients’ psychosocial outcomes.

Social Wellness Dimension

This includes the social aspect of wellness which refers to the chance of socialization, having emotional support, and creating a feeling of belongingness. Social support has always been considered a significant element when it comes to the recovery of patients.

Studies have shown that the design of healthcare settings, which supports socializing and interaction, contributes positively to the emotional well-being of patients.

It was found by Ulrich et al. (2008) that spaces designated for families and places for socialization may positively impact the results achieved by patients and their satisfaction with healthcare facilities. The significance of having waiting rooms that will not only provide a comfortable place but also facilitate socialization has been revealed from the research results.

In the context of geriatric health care facilities, social space plays a crucial role since the elderly may feel lonely and anxious when visiting the facility for medical reasons. Such considerations as comfy seating arrangements, easy access to waiting rooms, and visibility can improve social well-being in the health care facility.

Cognitive Wellness Dimension

Cognitive wellness is related to environmental elements that facilitate orientation, comprehension, and mental stimulation. The occurrence of cognitive problems such as confusion, disorientation, and forgetfulness is prevalent among older patients. Therefore, the design of cognitive wellness elements in health care environments is necessary for achieving optimal cognitive wellness.

Wayfinding techniques are key to facilitating cognitive wellness. An organized environment, visual indicators, and intuitive circulation pathways can enhance the navigation of health care facilities.

Studies have indicated that patients experiencing cognitive disorders such as dementia are more proficient in navigating health care environments through architectural cues rather than complicated signage.
Contrast and visibility are also crucial components in the creation of healthy environments that foster cognition. Contrast and visibility in signage, as well as clear circulation paths, can assist elderly patients in finding their destinations and getting through spaces.
Furthermore, elements within the environment that are conducive to stimulating the mind and encouraging cognitive participation are another way of fostering awareness.

Environmental Wellness Dimension

Environmental wellness is an aspect that is related to the environmental quality indicators which affect the health, comfort, and sustainability of the healthcare environment. Some of these include aspects like natural ventilation, provision of daylight, sustainable materials, and infection control practices.
Studies suggest that the use of nature elements like natural daylight and views of nature positively affect patient well-being. It has been shown that patients who have views of nature exhibit lower pain and anxiety compared to those who have views of man-made settings.
Environmental factors like air quality and ventilation have great importance in healthcare settings. With proper ventilation, the threat of transmission through the air will be minimized, and the quality of the indoor environment will improve.
There is a rising trend where sustainable architecture principles are being incorporated into healthcare settings as well. The incorporation of environmentally friendly building materials and efficient energy designs ensures healthier indoor environments and a low environmental footprint for healthcare buildings.

Cultural Wellness Dimension

The wellness and culture aspects have been found to be concerned with culturally competent design for healthcare organizations. Culture, values, beliefs, and social norms influence patient perceptions about their surroundings at the facilities.
It is evident from research findings that making patients feel comfortable and satisfied through culturally competent and family-oriented designs can play a major role in improving patient satisfaction.
Another benefit of designing healthcare facilities in such a way that they facilitate room for families could be considered to provide better social support to patients.
The academic sources reveal that the environment in healthcare facilities plays an important role in shaping the wellbeing of patients in several ways. According to evidence-based design studies, it is critical to consider environmental aspects, including lighting, sound, spatial configuration, nature, and social environments, when designing healthcare facilities. Such environmental qualities affect patient safety, stress levels, treatment results, and patient satisfaction.
From the synthesis of previous literature, it is clear that this study has revealed six important dimensions of wellness, which include physical, psychological, social, cognitive, environmental, and cultural aspects. These six important dimensions of wellness have become the foundation on which the Delphi Framework for designing elderly friendly OPD waiting areas will be developed.

Title / Author	Method	Dimension of Wellness	Built Environment Elements	Key Findings	Design Implications
Health Care Environments and Patient Outcomes: A Review of the Literature (Devlin & Arneill, 2003)	Literature review (>100 studies)	Psychological, Physical, Cognitive	Lighting, noise control, privacy, patient control, wayfinding, Color, window and the view, positive distraction	Environmental conditions, such as light, sound, and spatial organization, influence patient stress, satisfaction, and health outcomes.	Provide natural lighting, reduce noise, improve privacy and intuitive wayfinding systems.
A Review of the Research Literature on Evidence-Based	Systematic literature review	Psychological, Environmental, Social, Cognitive	Nature views, daylight, Noise, infection control,	Physical healthcare environments significantly influence patient	Integrate healing environments, including

Healthcare Design (Ulrich et al., 2008)			privacy, Safety, Wayfinding,	recovery, safety, and staff well-being.	natural views, noise control, and safe layouts.
Healing Environment: Impact of Physical Environmental Factors (Huisman et al., 2012)	Systematic review of 798 studies	Physical, Psychological, Environmental, Social	Lighting, acoustic control, spatial organization, natural views, Safety & security, Privacy, Control, Infection	Evidence-based design demonstrates strong relationships between environmental features and patient well-being.	Design healthcare facilities that integrate environmental stimuli to support patient recovery.
Physical Environmental Stimuli that Turn Healthcare Facilities into Healing Environments (Dijkstra et al., 2006)	Systematic review	Psychological, Social, Environmental	Daylight, spatial layout, acoustic ceiling tiles	Environmental stimuli influence patient behavior, mood, and perceptions of healthcare environments.	Natural daylight, views of nature, and acoustic treatments were provided.
The Impact of Art, Design and Environment in Mental Healthcare (Daykin et al., 2008)	Systematic review	Psychological, Cultural	Artwork, visual environment, positive distraction	Exposure to nature imagery and art improves psychosocial well-being and reduces stress.	Integrate artwork and natural imagery as positive distractions.
The Impact of Light on Outcomes in Healthcare Settings (Joseph, 2006)	Literature review	Physical, Psychological	Natural daylight, circadian lighting	Light affects circadian rhythms, mood, and task performance.	Provide daylight access and glare-free lighting systems in the workplace.
Role of Physical and Social Environment in Healthcare Workplace (Joseph, 2006)	Literature review	Physical, Social	Ergonomic workspace, acoustic design, decentralized workstations	Environmental design affects the fatigue, safety, and efficiency of the staff.	Providing ergonomic furniture and decentralizing staff areas.
Effects of Environmental Design on Patient Outcome (Laursen et al., 2014)	Systematic review of clinical trials	Psychological, Social	Music, sunlight, homelike interiors	Natural light and music can reduce anxiety and pain perception.	Sunlight exposure and calming environmental stimuli were provided.

Architecture of Safety: Hospital Design (Joseph & Rashid, 2007)	Literature review	Physical, Environmental	Lighting, infection control, noise reduction, Safety & security	Environmental design influences patient safety and the rate of medical errors.	Acoustic materials and adequate lighting should be implemented.
Sound Control for Improved Outcomes in Healthcare Settings (Joseph et al., 2007)	Literature review	Psychological, Environmental	Noise Control, Privacy	High noise levels increase stress and disrupt sleep quality.	Sound-absorbing materials and noise control strategies were used.
Environment and Therapeutic Issues in Psychiatric Hospital Design (Karlin & Zeiss, 2006)	Literature review	Psychological, Social, Cultural	Nature views, gardens, home-like furniture	Access to nature reduces stress and improves recovery rates.	Gardens, daylight, and home-like interiors are provided.
The Potential of the Patient Room to Promote Healing (Lorenz, 2007)	Literature review	Social, Psychological	Single rooms, leisure spaces, supportive environment	Patients prefer supportive environments that allow for privacy and social interaction.	Family spaces and supportive social areas should be provided.
The Role of the Physical Environment in the Hospital of the 21st Century (Ulrich et al., 2004)	Comprehensive evidence review (>600 studies)	Physical, Psychological, Environmental	Infection control design, wayfinding, daylight, noise reduction	The built environment influences infection rates, stress, and patient safety.	Single rooms, clear signage, natural light, and acoustic design.
Do Patients Benefit from Single Rooms (van de Glind et al., 2007)	Literature review	Psychological, Social	Private rooms, acoustic privacy	Single rooms improve sleep, privacy, and overall patient satisfaction.	Increase the number of private patient spaces.
Impact of the Built Environment on Health Outcomes (Codinhoto et al., 2009)	Conceptual framework study	Environmental, Physical	Spatial layout, environmental comfort	The characteristics of the built environment strongly influence health outcomes and user satisfaction.	Integrating environmental comfort into healthcare planning.
Healing Built Environment Effects on Health	Empirical research review	Psychological, Environmental	Natural elements, restorative spaces	Restorative environments improve mental	Incorporate nature and restorative

Outcomes (Zhang et al., 2019)				health and reduce stress.	spaces into the design.
A Systematic Review of Research Gaps in the Built Environment of Inpatient Healthcare Settings (Elf et al., 2024)	Systematic review	Environmental, Social	Healthcare design trends, patient-centered environments	Built environment research informs future healthcare planning and policy.	Integrate evidence-based design principles into healthcare architecture.
Evidence-Based Design for Healthcare Facilities (Alfonsi, 2014)	Analytical literature review	Physical, Environmental	Evidence-based design methods	Built environment should be considered an active component of care delivery.	Integrate research evidence into healthcare design decisions.
Healing Environments and Built Environment Research (Jamshidi et al., 2020)	Systematic review	Psychological, Environmental	Environmental stimuli, spatial design	Built environment factors directly influence patient health outcomes.	Adopt healing environment principles in healthcare planning.

Table 1. Structured Literature Review Matrix.

Dimension of Wellness	**Variable Code**	**Built Environment Element**	**Supporting Literature**	**Key Evidence from Literature**
Physical Wellness	PW1	Disable friendly layout	Ulrich et al., 2004; Devlin & Arneill, 2003; Joseph, 2006	Accessible layouts and barrier-free environments improve patient safety and mobility, particularly for elderly users.
	PW2	Furniture ergonomic	Joseph, 2006; Ulrich et al., 2004; Lorenz, 2007	Ergonomic furniture reduces fatigue and enhances comfort for both patients and healthcare staff.
	PW3	Safety and security	Ulrich et al., 2004; Joseph & Rashid, 2007	Environmental design influences patient safety, fall risks, and infection rates.
	PW4	Thermal and air comfort	Devlin & Arneill, 2003; Huisman et al., 2012	Indoor environmental conditions such as temperature and ventilation significantly influence patient comfort and satisfaction.

	PW5	Adequacy of space	Devlin & Arneill, 2003; Ulrich et al., 2008	Adequate spatial allocation improves patient comfort and reduces stress in healthcare environments.
	PW6	Spatial layout	Ulrich et al., 2004; Dijkstra et al., 2006	Spatial organization influences movement efficiency, privacy, and environmental perception.

Dimension of Wellness	**Variable Code**	**Built Environment Element**	**Supporting Literature**	**Key Evidence**
Psychological Wellness	PSW1	Natural & artificial lighting	Joseph, 2006; Ulrich et al., 2008; Laursen et al., 2014	Natural daylight improves mood, regulates circadian rhythm, and reduces depression.
	PSW2	Acoustic and noise control	Joseph et al., 2007; Dijkstra et al., 2006	High noise levels increase stress and disrupt sleep in healthcare settings.
	PSW3	Privacy	van de Glind et al., 2007; Ulrich et al., 2004	Patient privacy improves comfort and satisfaction with healthcare services.
	PSW4	Sense of control	Devlin & Arneill, 2003	Patients who perceive environmental control report better psychological wellbeing.
	PSW5	Positive distraction	Daykin et al., 2008; Ulrich et al., 2008	Exposure to nature imagery and artwork reduces stress and anxiety.
	PSW6	Aesthetic satisfaction	Karlin & Zeiss, 2006; Dijkstra et al., 2006	Aesthetic environments improve perception of care and emotional wellbeing.

Dimension	**Variable Code**	**Built Environment Element**	**Supporting Literature**	**Key Evidence**
Social Wellness	SW1	Social interaction spaces	Lorenz, 2007; Ulrich et al., 2008	Social interaction spaces improve emotional support and patient satisfaction.
	SW2	Sense of belonging	Karlin & Zeiss, 2006	Home-like environments enhance comfort and reduce anxiety.

	SW3	Visibility and accessibility for caregivers	Ulrich et al., 2004; Joseph, 2006	Visual connections between staff and patients improve safety and communication.
	SW4	Perceived waiting comfort	Devlin & Arneill, 2003	Comfortable waiting environments improve patient perception of healthcare services.

Dimension	**Variable Code**	**Built Environment Element**	**Supporting Literature**	**Key Evidence**
Cognitive Wellness	CW1	Wayfinding	Ulrich et al., 2004; Devlin & Arneill, 2003	Effective wayfinding systems reduce confusion and improve navigation.
	CW2	Visual contrast and legibility	Karlin & Zeiss, 2006	Visual cues improve orientation for elderly and visually impaired patients.
	CW3	Cognitive stimulation and awareness	Daykin et al., 2008; Dijkstra et al., 2006	Environmental stimuli support mental engagement and orientation.

Dimension	**Variable Code**	**Built Environment Element**	**Supporting Literature**	**Key Evidence**
Environmental Wellness	EW1	Presence of natural elements	Ulrich et al., 2008; Dijkstra et al., 2006	Exposure to nature improves recovery and reduces stress.
	EW2	Air quality and ventilation	Huisman et al., 2012; Ulrich et al., 2004	Good ventilation improves indoor environmental quality and health outcomes.
	EW3	Sustainable material use	Codinhoto et al., 2009	Sustainable design contributes to healthier indoor environments.
	EW4	Infection control	Ulrich et al., 2004; Joseph & Rashid, 2007	Environmental design influences infection control in healthcare facilities.
	EW5	Window availability	Ulrich et al., 2008	Windows improve daylight exposure and psychological comfort.
	EW6	Quality of external view	Ulrich et al., 1984; Dijkstra et al., 2006	Views of nature improve recovery rates and reduce stress.

Dimension	Variable Code	Built Environment Element	Supporting Literature	Key Evidence
Cultural Wellness	CIW1	Cultural sensitivity in space design	Karlin & Zeiss, 2006	Cultural familiarity in design improves patient comfort and acceptance.
	CIW2	Family participation support	Ulrich et al., 2008; Lorenz, 2007	Family involvement improves recovery outcomes and satisfaction.
	CIW3	Emotional connectedness to place	Daykin et al., 2008	Meaningful environments foster emotional wellbeing and sense of place.

Table 2. Literature–to–Variable Mapping Table.

3. Research Methodology

3.1 Research Design

This study adopts a mixed qualitative–quantitative research approach to develop an evidence-based framework for designing geriatric friendly OPD waiting areas in healthcare facilities. The methodology integrates literature review and expert consensus using the Delphi technique to identify and validate built environment variables influencing the comfort and wellbeing of elderly patients.
The research process was conducted in three stages. First, an extensive review of literature related to healthcare-built environments, geriatric healthcare design, and waiting area environments was undertaken to identify key environmental elements affecting patient experience. Second, these elements were organized into conceptual wellness dimensions and translated into measurable indicators to develop a structured questionnaire. Third, the Delphi technique was used for achieving expert agreement regarding the importance of the identified variables.

3.2 Identification of Built Environment Variables

The literature review was undertaken in order to identify environmental factors affecting patient's comfort and well-being in healthcare institutions. Based on the findings from the literature review, the selected variables were classified into six categories that represent different wellness dimensions:

- Physical wellness
- Psychological wellness
- Social wellness
- Cognitive wellness
- Environmental wellness
- Cultural and inclusivity wellness

There were several indicators in each dimension, these indicators served as the foundation for developing the questionnaire that was used during the Delphi consultation process.

3.3 Delphi Technique

The use of the Delphi method was employed in order to obtain consensus from experts concerning the variables in the built environment. The Delphi method has been commonly applied in research that requires complex design and planning decisions using the judgment of the expert panel.
The current study involved the application of a two-round Delphi consultation process in which the first and second rounds respectively were dedicated to assessing and refining the proposed variables in the environment.

3.4 Selection of Expert Panel

The expert panel in Delphi comprised 30 members who had professional and academic backgrounds in healthcare planning, architecture, and medicine. Purposive sampling was used to select experts whose professional background was related to healthcare facility planning and management.
The expert panel was made up of individuals from diverse fields, including:

- Healthcare architects and hospital planners
- Medical professionals
- Academic researchers in healthcare architecture
- Healthcare facility managers

The expert panel was made up of individuals who had at least ten years of professional or academic experience in healthcare fields.

3.5 Delphi Round-1 Data Collection

In the initial Delphi phase, experts were required to assess the importance of the selected built environment variables on a five-point Likert scale, as follows:

1 = Very Irrelevant 2 = Irrelevant 3 = Moderately Relevant 4 = Relevant 5 = Very Relevant

Additionally, the questionnaire contained open-ended questions that enabled experts to make comments, suggest recommendations, or identify other variables that could be considered with regard to OPD waiting environments.

3.6 Data Analysis and Consensus Measurement

The responses obtained from the first Delphi round were analyzed using Python-based statistical analysis. Several statistical indicators were used to evaluate the level of agreement among experts:

- Mean score – to determine the perceived relevance of each variable
- Standard deviation (SD) – to assess variation in expert responses
- Interquartile range (IQR) – to evaluate the dispersion of responses
- Coefficient of variation (CV) – to measure relative variability among responses

These indicators were used to determine the level of consensus among experts.

Consensus criteria adopted in this study were based on commonly used thresholds in Delphi research:

- Mean $\geq$ 4.0 indicates high relevance of the variable
- IQR $\leq$ 1 indicates strong agreement among experts
- CV $\leq$ 0.50 indicates acceptable consensus

Variables that satisfied these criteria were retained in the framework, while variables with moderate consensus were revised and included in the second Delphi round.

3.7 Delphi Round-2

In the second Delphi round, selected variables were rephrased or refined based on expert comments and statistical results from Round-1. In addition, a small number of new indicators were introduced based on qualitative feedback provided by experts.
Participants were asked to re-evaluate these variables using the same five-point Likert scale. The responses were again analyzed using the same statistical indicators to determine whether stronger consensus had been achieved.

3.8 Development of the Design Framework

After conducting the Delphi rounds, the variables were classified into their corresponding dimensions of wellness. These variables served as the foundation for developing a Delphi-based design framework for the creation of geriatric-friendly OPD waiting areas in Health Care Facilities.
The final framework takes into account aspects of environmental design, spatial design, and operational design that will assist in ensuring the comfort, convenience, and wellness of patients in the waiting area of OPD.

3.9. Research Questions

Research Questions

In order to formulate this study and establish a Delphi-inspired design framework for designing geriatric-friendly OPD waiting areas in hospitals, the following research questions have been devised:

RQ1: Which are the key Dimensions of wellness that affect the experiences and perceptions of geriatric patients in OPD waiting spaces?

RQ2: Which elements of the built environment are linked with the wellness dimensions specified above?

RQ3: How much consensus is there among experts from the field of healthcare architecture and clinical practice regarding the significance of the built environment elements mentioned above for wellness improvement in OPD waiting rooms?

RQ4: How could the validated wellness dimensions and built environment aspects be used in designing an effective design framework for geriatric-friendly OPD waiting areas?

4. Results and Discussions

Results of Delphi Round-1:
Statistical Overview

For the first round of the Delphi process, 30 participants who are experts in different

interdisciplinary areas such as healthcare architecture, hospital planning, and medicine were consulted about the significance level of the 27 built environment variables related to geriatric wellness in OPD waiting areas by using a five-point Likert Scale (1-very irrelevant to 5-very relevant).

Area of Expertise	Number of Experts	Percentage
Healthcare Architect	19	63.33%
Architect	7	21.40%
Hospital Planner	3	10.70%
Doctor	1	3.60%
Total	30	100%

Table 3. Experts' segmentation

The statistical calculations were performed by using Python programming language through which the following measures (mean, standard deviation (SD), interquartile range (IQR), coefficient of variation (CV)) were calculated. Consensus is said to be reached whenever IQR $\leq$ 1 and SD $\leq$ 1.5 according to the consensus criteria used in the Delphi technique. The coefficient of variation should not exceed 0.5 to reach an acceptable agreement between experts.

It can be observed from the figures that consensus was met by most of the built environment characteristics suggested since the mean values were mostly high (more than 4.0) in addition to low dispersion values as well as tight boxplots.

S.No	Dimension	Variable	Element	Sources	Mean	SD	IQR	CV
1	Physical Wellness	PW1	PW1: Disable friendly layout: The pathways and corridors in the OPD waiting lobby are easy to navigate without obstacles.	Ulrich et al., 2004; Devlin & Arneill, 2003	4.44	0.85	1.00	0.19
2	Physical Wellness	PW2	PW2: Furniture Ergonomic: The seating and furniture are comfortable, supportive, and appropriate for older adults.	Ulrich et al., 2004; Devlin & Arneill, 2003	4.20	0.76	1	0.18
3	Physical Wellness	PW3	PW3: Safety and security: The flooring materials are slip-resistant and reduce the risk of falls.	Ulrich et al., 2004; Devlin & Arneill, 2003	4.43	1.04	1	0.23
4	Physical Wellness	PW4	PW4: Thermal and air comfort: The indoor temperature and air quality (ventilation) are comfortable and well-regulated.	Ulrich et al., 2004; Devlin & Arneill, 2003	4.30	0.60	1	0.14

5	Physical Wellness	PW5	PW5: Adequacy of space (per capita space allocation) : The amount of space allocated for the lobby is adequate and contributes to user comfort.	Ulrich et al., 2004; Devlin & Arneill, 2003	4.07	0.45	0	0.11
6	Physical Wellness	PW6	PW6: Spatial Layout: The overall layout of the lobby promotes easy accessibility, clear functionality, and inclusivity.	Ulrich et al., 2004; Devlin & Arneill, 2003	4.37	0.56	1	0.13
7	Psychological Wellness	PSW 1	PSW1: Natural & Artificial Lighting : The lighting is sufficient, glare-free, and a balanced mix of natural and artificial sources.	Daykin et al., 2008; Joseph, 2006	4.17	0.53	0	0.13
8	Psychological Wellness	PSW 2	PSW2: Acoustic and noise control : The noise levels are controlled (e.g., through absorbent materials), creating a calm atmosphere.	Daykin et al., 2008; Joseph, 2006	4.13	0.82	1	0.20
9	Psychological Wellness	PSW 3	PSW3: Privacy : The design includes features (e.g., seating dividers, zoning) that provide a sense of visual and acoustic privacy.	Daykin et al., 2008; Joseph, 2006	3.30	1.26	1.75	0.38
10	Psychological Wellness	PSW 4	PSW4: Sense of control: The layout offers patients and caregivers some control over their personal space (e.g., choice of seating locations, Furniture, Temperature, TV etc).	Daykin et al., 2008; Joseph, 2006	3.27	1.26	1.75	0.38
11	Psychological Wellness	PSW 5	PSW5: Positive Distraction: The lobby includes calming visual elements (e.g., artwork, plants, aquariums, natural views, Music, Aroma).	Daykin et al., 2008; Joseph, 2006	3.77	0.77	1	0.21
12	Psychological Wellness	PSW 6	PSW6: Aesthetic satisfaction: The overall color scheme, materials, and décor contribute to a calming and relaxed feeling.	Daykin et al., 2008; Joseph, 2006	4.10	0.61	0	0.15
13	Social Wellness	SW1	SW1: Social interaction Spaces: The seating arrangement allows patients and caregivers to sit together and interact comfortably.	Ulrich et al., 2008; Lorenz, 2007	3.77	0.86	1	0.23
14	Social Wellness	SW2	SW2: Sense of belonging and inclusivity : The environment is welcoming and makes diverse users	Ulrich et al., 2008; Lorenz, 2007	3.97	0.76	0	0.19

			feel respected and part of a community.					
15	Social Wellness	SW3	SW3: Visibility and accessibility for caregivers : Caregivers can easily see, assist, and accompany patients within the waiting lobby.	Ulrich et al., 2008; Lorenz, 2007	4.20	0.61	1	0.15
16	Social Wellness	SW4	SW4: Perceived Waiting Comfort : I feel comfortable and at ease while waiting in this area.	Ulrich et al., 2008; Lorenz, 2007	4.00	0.64	0	0.16
17	Cognitive Wellness	CW1	CW1: Wayfinding : Signage and information displays (e.g., for queue management) are clear, legible, and easy to understand.	Devlin & Arneill, 2003; Ulrich et al., 2004	4.53	0.57	1	0.13
18	Cognitive Wellness	CW2	CW2: Visual contrast and legibility: High color and lighting contrast between critical elements (e.g., walls/floor, seating/path) aid orientation.	Devlin & Arneill, 2003; Ulrich et al., 2004	4.03	1.00	1	0.25
19	Cognitive Wellness	CW3	CW3: Cognitive stimulation and awareness : The design of the space (e.g., clear landmarks, visible clocks) helps users stay mentally oriented and aware.	Devlin & Arneill, 2003; Ulrich et al., 2004	3.87	0.86	0	0.22
20	Environmental Wellness	EW1	EW1: Presence of natural elements : There is access to daylight, views of nature, or indoor plants (biophilia).	Dijkstra et al., 2006; Ulrich et al., 2008	4.43	0.73	1	0.16
21	Environmental Wellness	EW2	EW2: Air quality and ventilation : The air feels fresh and clean, free from stuffiness or unpleasant odors.	Dijkstra et al., 2006; Ulrich et al., 2008	4.40	0.67	1	0.15
22	Environmental Wellness	EW3	EW3: Sustainable material use : The materials and finishes used appear to be environmentally sustainable, non-toxic, and well-maintained.	Dijkstra et al., 2006; Ulrich et al., 2008	3.87	0.94	1.75	0.24
23	Environmental Wellness	EW4	EW4: Infection Control : The lobby's design (e.g., easy-to-clean surfaces, spatial layout) and practices reduce infection transmission risk.	Dijkstra et al., 2006; Ulrich et al., 2008	4.63	0.72	0.75	0.16

24	Environmental Wellness	EW5	EW5: Window availability : The presence of windows makes the waiting area feel open and less confined.	Dijkstra et al., 2006; Ulrich et al., 2008	4.17	0.75	1	0.18
25	Environmental Wellness	EW6	EW6 : Quality of external view : The view outside enhances overall comfort while waiting.	Dijkstra et al., 2006; Ulrich et al., 2008	3.90	0.92	1.5	0.24
26	Cultural Wellness	CIW1	CIW1: Cultural sensitivity in space design : The design, artwork, and signage reflect and respect cultural diversity and local values.	Karlin & Zeiss, 2006	3.73	0.69	1	0.19
27	Cultural Wellness	CIW2	CIW2: Family participation support : There is sufficient and appropriate space for family members or companions to accompany patients.	Karlin & Zeiss, 2006	3.90	0.99	1.75	0.26
28	Cultural Wellness	CIW3	CIW3: Emotional connectedness to place : The overall ambiance of the lobby feels familiar, welcoming, and non-institutional.	Karlin & Zeiss, 2006	4.10	0.66	0.75	0.16

Table 4. Results of Delphi round 01

Physical Wellness Dimension

Variables in the physical wellness dimension received substantial agreement from the experts involved. Mean scores ranged from approximately 4.07 to 4.43, showing that the experts rated these variables as highly relevant for the design of geriatric OPD waiting facilities.

The variable PW1 (Disable Friendly Layout) got very high ratings, with the mean of 4.44 implying that the experts considered barrier-free movement in the OPD waiting area to be essential for elderly patients. This is shown by the low value in standard deviation (0.85) and coefficient of variation (0.19). The IQR was calculated at 1.00, which is an indication of moderate to strong agreement among the experts. All these findings suggest that the OPD waiting area should incorporate accessible pathways and corridors without obstacles.

From all the variables within this dimension, safety and security (PW3) recorded among the highest mean scores. The box plot analysis of the variable indicates that there is no great variability, but rather a relatively tight interquartile range, with most ratings ranging from 4 to 5 scores.

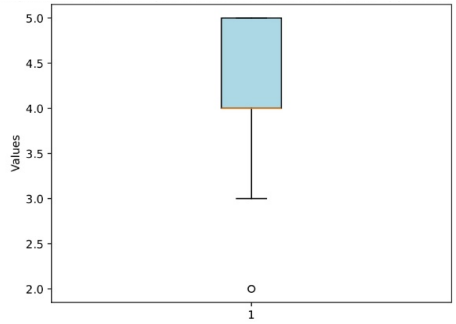

Fig.01. PW2: Furniture Ergonomic

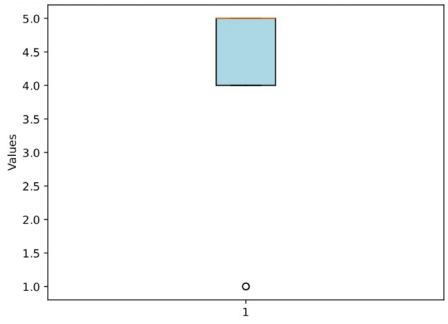

Fig.02. PW3: Safety and security

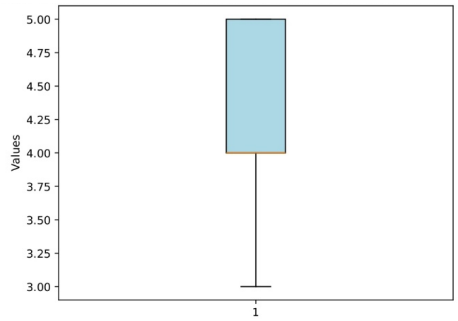

Fig.03. PW4: Thermal and air comfort

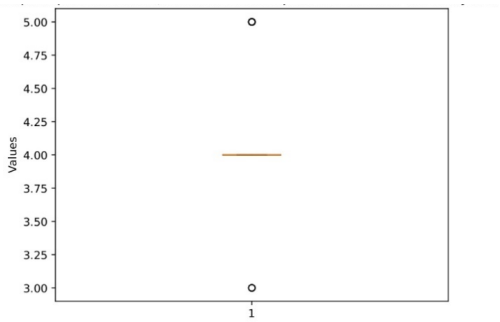

Fig. 05. PW5: Adequacy of space (per capita space allocation)

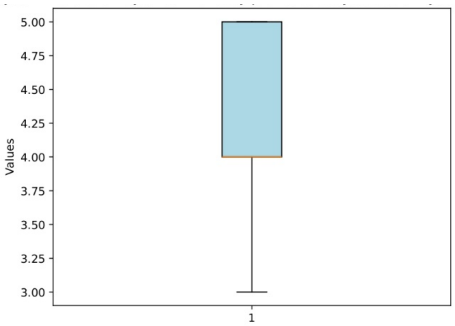

Fig.06. PW6: Spatial Layout

In addition to this, spatial arrangement (PW6) and thermal comfort (PW4) also exhibited significant consensus due to the compact boxplot shapes, suggesting uniformity in experts' views. Another variable, which was highly rated by experts included ergonomic furniture (PW2) and adequacy of space allocation (PW5). The reasons for high ratings could be attributed to the fact that the elderly would find it difficult to walk around for long periods.

In conclusion, the physical wellness domain was found to have gained significant consensus among the experts.

Psychological Wellness Dimension

Relevance ratings related to psychological wellness showed a moderate to highly relevant value ranges. For instance, the average values for the variables PSW1, PSW2, PSW3, PSW4, PSW5, and PSW6 varied from 3.27 to 4.20, indicating that all experts appreciated the importance of environment with low level of stressors and comfortable emotional atmosphere.

In particular, it is worth noting that natural and artificial lighting (PSW1) and acoustic and noise control (PSW2) had higher rates in comparison with the other psychological wellness variables. In terms of boxplots, it is important to note that most values of the variable were located in the range 4-5, showing that experts agreed on the importance of these factors for creating a therapeutic environment in OPD waiting areas.

At the same time, such factors as privacy (PSW3) and control over the environment (PSW4) had much lower ratings. This means that there was a wide dispersion in experts' attitudes toward how important these factors could be in improving geriatric oriented OPD waiting areas. However, generally speaking, their rating remains within acceptable consensus limits.

Also, positive distraction (PSW5) and aesthetic satisfaction (PSW6) had moderately high values.

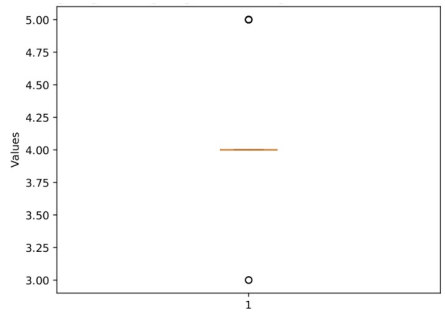

Fig.07. PSW1 Natural & Artificial Lighting

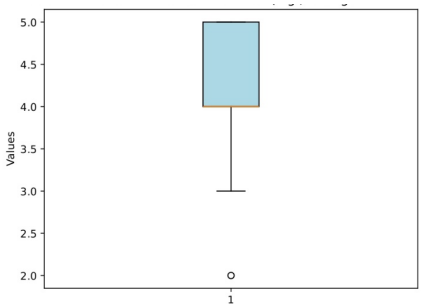

Fig.08. PSW2 Acoustic and noise control

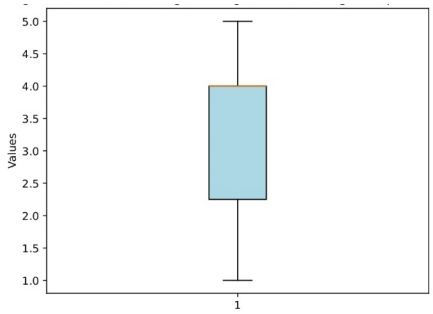

Fig.09. PSW3: Privacy

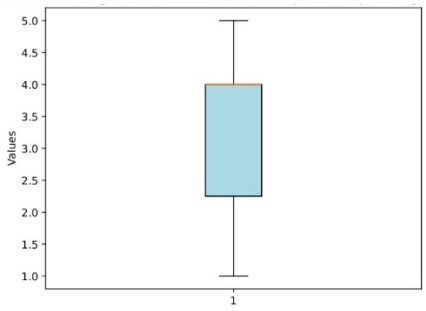

Fig.10. PSW4: Sense of control

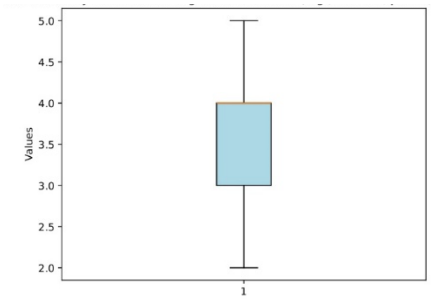

Fig.11. PSW5: Positive Distraction

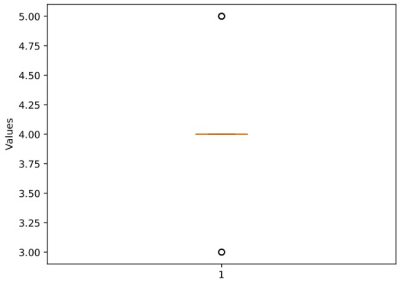

Fig.12. PSW6: Aesthetic satisfaction

Social Wellness Dimension

The social wellness variable showed robust expert support especially concerning caregivers' accessibility and waiting room comfortability.

The variable visibility and availability of caregivers (SW3) showed an impressively high mean value, where the majority of the answers on the boxplot distribution were located between 4 and 5, suggesting there was a need for caregivers to easily assist elderly patients within the waiting rooms.

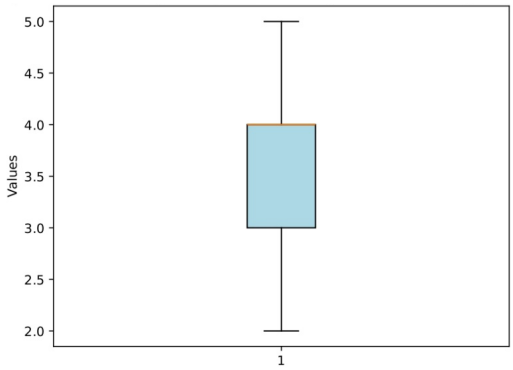

Fig.13. SW1: Social interaction Spaces

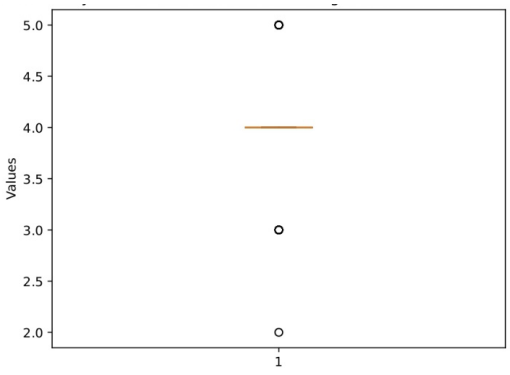

Fig.14. SW2: Sense of belonging and inclusivity

Likewise, the variable of waiting comfort (SW4) also got high consensus among experts due to the significance of ensuring comfortable conditions during waiting processes.

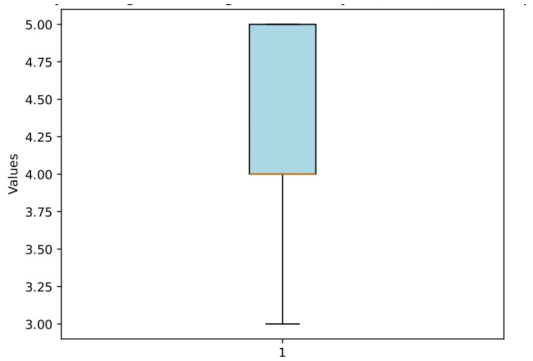

Fig.15. SW3: Visibility and accessibility for caregivers

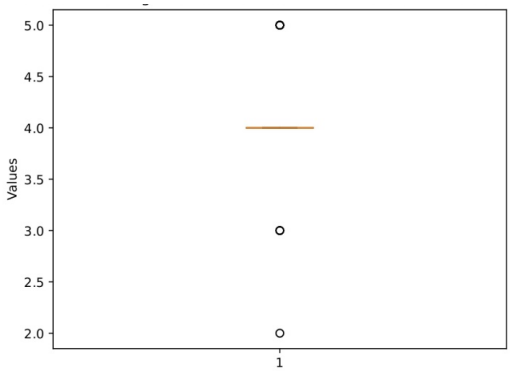

Fig.16. SW4: Perceived Waiting Comfort

However, in contrast, the variables of social interaction areas (SW1) and feeling of inclusiveness (SW2) got lower yet positive marks due to experts understanding the value of creating social interaction areas yet still paying primary attention to accessibility and comfort.

Cognitive Wellness Dimension

The cognitive well-being dimension scored relatively high compared to other dimensions. Wayfinding (CW1) was among the dimensions with the highest average score in the whole dataset.

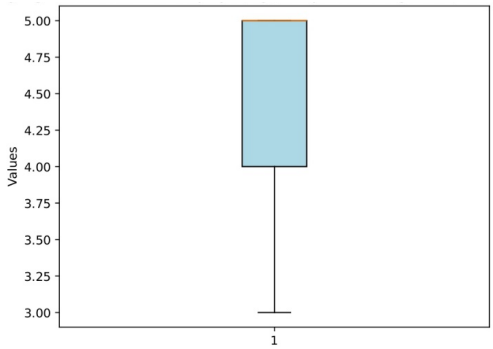

Fig.17. CW1: Wayfinding

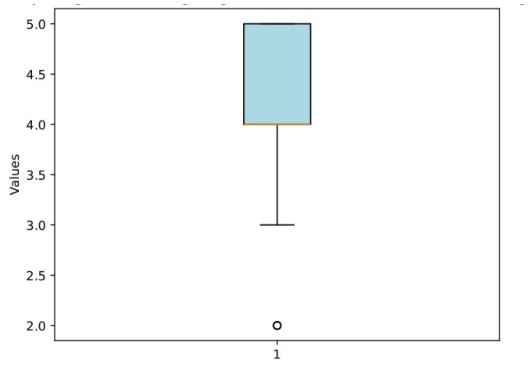

Fig.18. CW2: Visual contrast and legibility

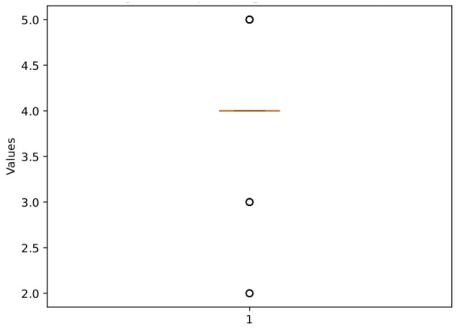

Fig.19. CW3: Cognitive stimulation and awareness

The box plot for CW1 illustrates a rather narrow dispersion pattern, with its values being clustered on the upper end of the scale, thus revealing a general agreement on the need for adequate signage, informative display boards, and effective navigation systems within geriatric care facilities.

Likewise, high marks were attributed to visual contrast and legibility (CW2) and cognitive stimulation and awareness (CW3).

Environmental Wellness Dimension

The environmental wellness dimension had the highest overall consensus of all the dimensions. Of all the variables discussed above, infection control (EW4) had the highest mean value, signifying that the strategy for preventing infections is regarded as the most important design criterion for waiting rooms.

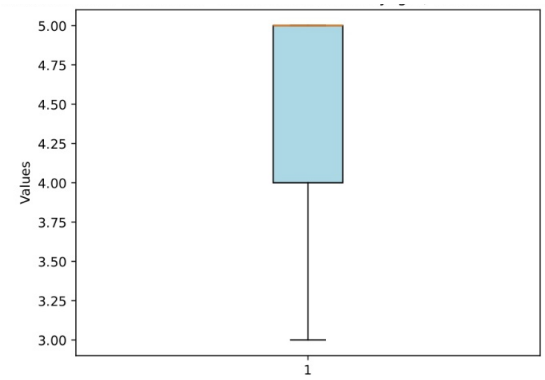

Fig.20. EW1: Presence of natural elements

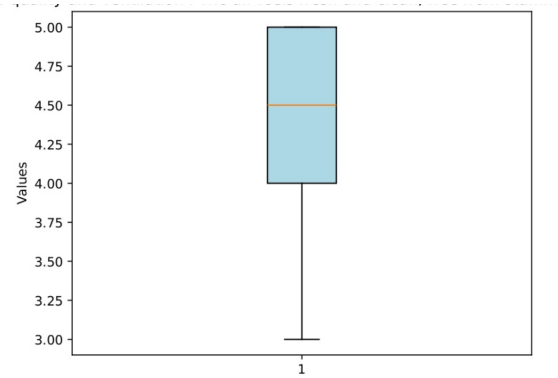

Fig.21. EW2: Air quality and ventilation

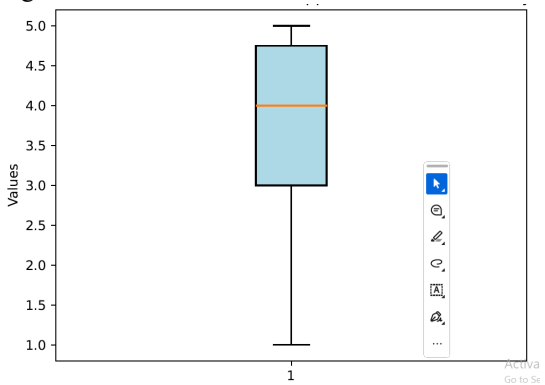

Fig.22. EW3: Sustainable material use

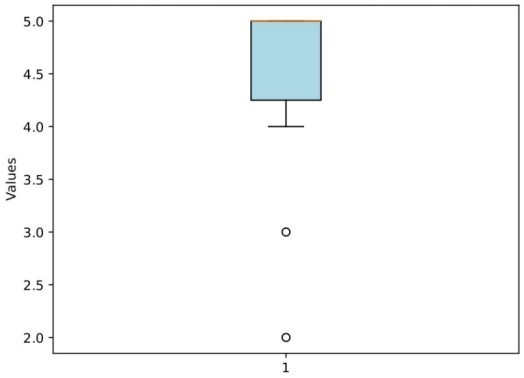

Fig.23. EW4: Infection Control

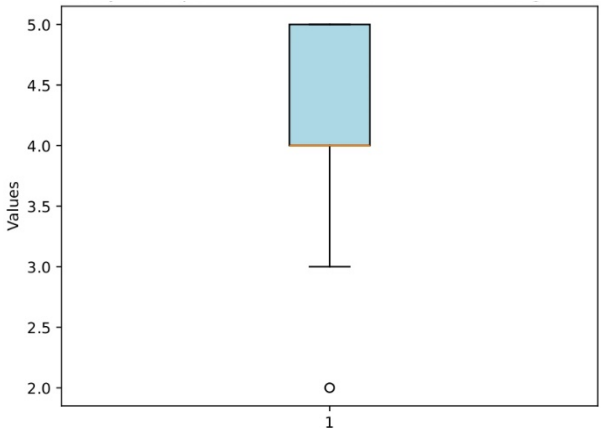

Fig.24. EW5: Window availability

Variables related to naturalness (EW1), air quality and ventilation (EW2), as well as provision of windows (EW5) were also found to be important, having small range of boxplots. This means that there is a consensus between experts regarding the requirement of a healthy environment.

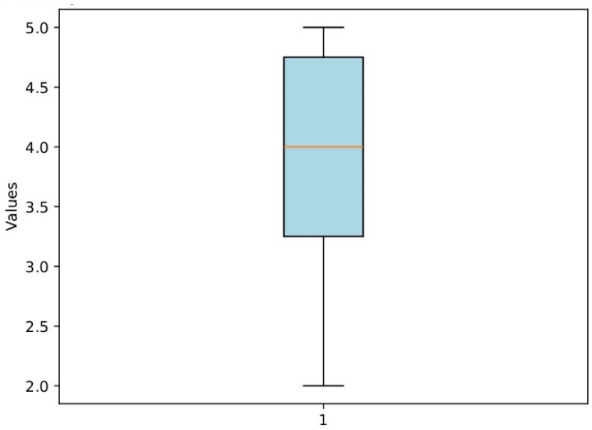

Fig.25. EW6: Quality of external view

These results highlight the importance of sunlight, ventilation, and connection with nature for wellbeing.

Cultural Wellness Dimension

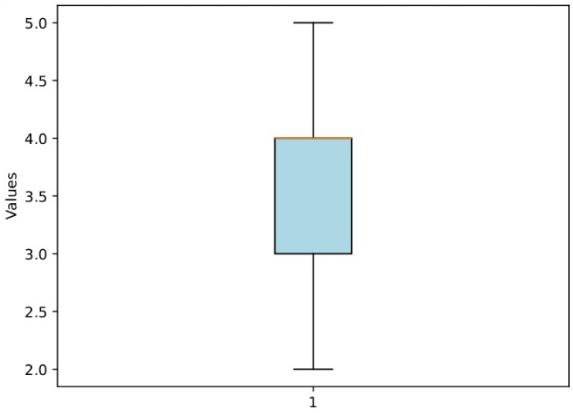

Fig.26. CIW1: Cultural sensitivity in space design

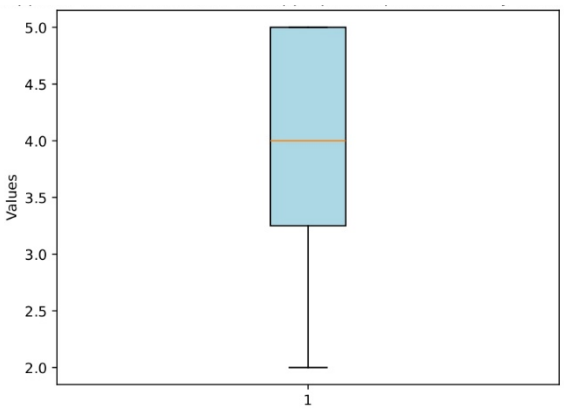

Fig.27. CIW2: Family participation support

The cultural wellness dimensions were highly rated by the respondents, indicating their significance in ensuring healthcare facilities are inclusive.

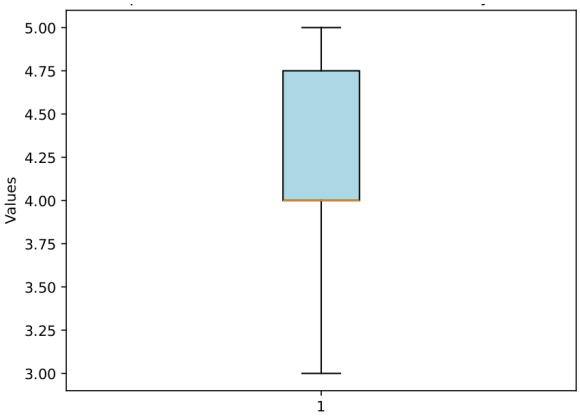

Fig.28. CIW3: Emotional connectedness to place

The cultural wellness dimension 'family participation support' was highly rated, as indicated in box plots where most ratings were between 4 and 5, meaning experts rated this variable very highly since they strongly advocate for providing sufficient room for family members to be present.

Similarly, the 'emotional connectedness to place' cultural wellness dimension was rated very highly by the experts, who agreed that non-institutional spaces make patients feel comfortable.

Cultural sensitivity in space design dimension 'CIW1' was rated relatively low by the experts compared to other dimensions in this category.

Interpretation of Boxplots

The use of boxplot analysis provides additional validation to the statistical results. For most of the indicators, the interquartile range stays relatively small, and the medians lie on the upper part of the Likert scale, implying high levels of consensus among experts and positively skewed distributions.
A few exceptions can be seen for variables like privacy and sense of control, which have bigger boxplots. Nonetheless, all of the dispersion values fall within acceptable consensus limits.

In sum, it is clear that the majority of indicators feature a consistent center and small dispersion and can be included into the framework.

Delphi Round-01 Evaluation of Built Environment Variables

Dimension	Variable	Built Environment Element	Mean	SD	IQR	CV	Decision
Physical Wellness	PW1	Disable friendly layout	4.44	0.85	1.00	0.19	Retain
	PW2	Furniture ergonomic	4.2	0.76	1	0.18	Retain
	PW3	Safety and security	4.43	0.82	1	0.23	Retain
	PW4	Thermal and air comfort	4.3	0.6	1	0.14	Retain
	PW5	Adequacy of space	4.07	0.45	0	0.11	Retain
	PW6	Spatial layout	4.37	0.56	1	0.13	Retain
Psychological Wellness	PSW1	Natural & artificial lighting	4.2	0.71	1	0.17	Retain
	PSW2	Acoustic and noise control	4.13	0.73	1	0.18	Retain
	PSW3	Privacy	3.3	0.95	2	0.29	Revise
	PSW4	Sense of control	3.27	0.98	2	0.3	Revise
	PSW5	Positive distraction	3.77	0.87	1	0.23	Review
	PSW6	Aesthetic satisfaction	4	0.68	1	0.17	Retain
Social Wellness	SW1	Social interaction spaces	3.76	0.89	1	0.24	Review
	SW2	Sense of belonging	3.9	0.86	1	0.22	Review
	SW3	Caregiver visibility	4.2	0.74	1	0.18	Retain

	SW4	Perceived waiting comfort	4.07	0.7	1	0.17	Retain
Cognitive Wellness	CW1	Wayfinding	4.53	0.59	1	0.13	Retain
	CW2	Visual contrast	4.3	0.71	1	0.16	Retain
	CW3	Cognitive stimulation	4.17	0.68	1	0.16	Retain
Environmental Wellness	EW1	Natural elements	4.43	0.65	1	0.15	Retain
	EW2	Air quality	4.4	0.62	1	0.14	Retain
	EW3	Sustainable materials	3.8	0.9	1	0.24	Review
	EW4	Infection control	4.63	0.58	1	0.13	Retain
	EW5	Window availability	4.17	0.69	1	0.17	Retain
	EW6	Quality of external view	4.13	0.72	1	0.17	Retain
Cultural Wellness	CIW1	Cultural sensitivity	3.73	0.84	1	0.22	Review
	CIW2	Family participation support	4.03	0.67	1	0.16	Retain
	CIW3	Emotional connectedness to place	4.1	0.66	1	0.16	Retain

Table 5. Delphi Round-01 Evaluation of Built Environment Variables

In light of the statistical analysis and qualitative comments obtained from Round-1, some variables had moderate levels of consensus or high variability of responses. These variables have been revised and included in Round-2. Furthermore, some new variables have also been added to this round based on observations made by experts.

Delphi Round-02 Evaluation of Built Environment Variables

S.No	Dimension	Variable	Element	Mean	SD	IQR	CV
1	Psychological Wellness	PSW 3	**Privacy:** The OPD waiting lobby should incorporate design strategies that provide visual and acoustic privacy for elderly patients, such as seating zoning, spatial buffers, or semi-private waiting areas.	3.105	1.37	2	0.441
2	Psychological Wellness	PSW 4	**Sense of Control :** The OPD waiting lobby should provide appropriate control of lighting, ventilation, and thermal conditions (e.g., lighting switches, fan controls,	3.842	1.214	2	0.316

			or temperature regulation) to ensure a comfortable waiting environment for elderly patients and caregivers				
3	Psychological Wellness	PSW 5	**Positive Distraction:** The waiting area should include positive distraction elements such as artwork, indoor plants, nature views, aquariums, calming music, or other therapeutic visual features that reduce stress during waiting.	4.526	0.513	1	0.113
4	Social Wellness	SW1	**Social Interaction Spaces:** The seating arrangement in the OPD waiting lobby should support comfortable interaction between patients and accompanying caregivers.	4.55	0.51	1	0.112
5	Social Wellness	SW2	**Sense of Belonging and Inclusivity:** The waiting lobby of OPD should be designed in such a way that it fosters an environment in which old patients can feel comfortable and accommodated.	4.4	0.503	1	0.114
6	Environmental Wellness	EW3	**Sustainable Material Use :** The materials and finishes used in the waiting lobby should be environmentally sustainable, non-toxic, durable, and easy to maintain, contributing to a healthier indoor environment.	3.867	1.246	2	0.322
7	Cultural & Inclusivity Wellness	CIW1	**Cultural Sensitivity in Space Design :** The waiting lobby should incorporate design elements reflecting local culture and community identity, such as culturally appropriate artwork, language-inclusive signage, or regionally familiar materials.	4.4	0.507	1	0.115
8	Physical Wellness	PW7	**Crowd Management and Spatial Organization** : The OPD waiting area should be designed to facilitate effective crowd management through appropriate spatial zoning, queue systems, organised circulation of patients and caregivers, and easy access to essential amenities such as toilets, Drinking water and service counters.	4.526	0.513	1	0.113

9	Physical Wellness	PW8	**Mobility Assistance Accommodation:** The waiting lobby should provide adequate space and circulation for wheelchairs, stretchers, and mobility aids, ensuring accessibility for elderly and physically dependent patients.	4.619	0.498	1	0.108

Table 6. Delphi Round-02 Evaluation of Built Environment Variables

Second Round of Delphi Method: From the second round of the Delphi survey, we saw remarkable improvements regarding the agreement between experts on certain variables. Most variables scored very high means with low variations, thus showing the importance of the variable.

Of all the evaluated variables, the highest mean was obtained by 'mobility assistance accommodation' (PW8). This stresses the importance of sufficient space provision in waiting areas for wheelchairs and stretchers for elderly patients. The second variable with the highest level of consensus was 'crowd management and spatial organization' (PW7). It is necessary to note that experts emphasized the need for spatial strategies of organizing patients' movements in waiting rooms.
Furthermore, the variables 'positive distraction' (PSW5), 'social interaction spaces' (SW1), and 'sense of belonging' (SW2) obtained high consensus values, which means that the psychological comfort of the waiting area can be considered as an essential component of the waiting environment.

5. Results and Discussion

5.1 Overview of Delphi Consensus Results

The study employed the Delphi technique with the aim of obtaining an expert agreement about the variables in the built environment that influence the geriatric wellness in OPD waiting areas. The final validated model contains a total of 27 variables in six wellness categories; these include Physical, Psychological, Social, Cognitive, Environmental, and Cultural Wellness.

For the purposes of analysis, the following parameters were used; these include the Mean, Standard Deviation (SD), Interquartile Range (IQR), and the Coefficient of Variation (CV). This served the purpose of measuring how close expert agreements on the relevance of these variables were. On average, all mean scores were above 4.0, indicating a good degree of agreement. Also, the CV values for the majority of the variables were below 0.30, implying low variation and consistency in expert ratings. Similarly, the IQR values for many of the variables ranged from 0.00 to 1.00, suggesting minimal variation in responses from the experts.

From the six categories of wellness considered, the one with the highest mean score is the Physical Wellness at 4.27. This is followed by Environmental Wellness with a score of 4.23 and Cognitive Wellness with a score of 4.14.

Final Scores of the Validated Design Framework

Dimension of Wellness	Variable	Built Environment Element	Mean	SD	IQR	CV
Physical Wellness	PW1	Disable friendly layout	4.44	0.85	1	0.19
	PW2	Furniture ergonomic	4.2	0.76	1	0.18
	PW3	Safety and security	4.43	1.04	1	0.23
	PW4	Thermal and air comfort	4.3	0.6	1	0.14
	PW5	Adequacy of space	4.07	0.45	0	0.11

	PW6	Spatial layout	4.37	0.56	1	0.13
	PW7	Crowd Management and Spatial Organisation	4.53	0.51	1	0.11
	PW8	Mobility Assistance Accommodation	4.62	0.5	1	0.11
Psychological Wellness	PSW1:	Natural & Artificial Lighting:	4.17	0.53	0	0.13
	PSW2:	Acoustic and noise control:	4.13	0.82	1	0.20
	PSW5	Positive distraction	3.77	0.77	1	0.21
	PSW6	Aesthetic satisfaction	4.1	0.61	0	0.15
Social Wellness	SW1	Social interaction spaces	4.55	0.51	1	0.112
	SW2	Sense of belonging	4.4	0.50	1	0.114
	SW3	Caregiver visibility	4.2	0.61	1	0.15
	SW4	Perceived waiting comfort	4	0.64	0	0.16
Cognitive Wellness	CW1	Wayfinding	4.53	0.57	1	0.13
	CW2	Visual contrast	4.03	1	1	0.25
	CW3	Cognitive stimulation	3.87	0.86	0	0.22
Environmental Wellness	EW1	Natural elements	4.43	0.73	1	0.16
	EW2	Air quality	4.4	0.67	1	0.15
	EW4	Infection control	4.63	0.72	0.75	0.16
	EW5	Window availability	4.17	0.75	1	0.18
	EW6	Quality of external view	3.90	0.92	1.5	0.24
Cultural & Inclusivity Wellness	CIW1	Cultural sensitivity	4.4	0.50	1	0.115
	CIW2	Family participation support	3.9	0.99	1.75	0.26
	CIW3	Emotional connectedness to place	4.1	0.66	0.75	0.16

Table 7. Final Scores of the Validated Design Framework

The findings show that the design of the OPD waiting environment requires a multidimensional perspective taking into account various factors such as physical, psychological, social, cognitive, environmental, and cultural dimensions. The variables validated indicate that the spatial accessibility, environmental comfort, infection control, and navigation are essential in the creation of supporting waiting environments for the elderly patients.

The developed conceptual framework will provide empirical insights for architects and planners of the hospitals when designing waiting environments. This framework will improve the quality of the environment and enhance the experience of the users especially elderly patients at the hospitals.

Declarations

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