

Architectural Interventions for Navigation Stress Reduction in Hospital Environments

Abdullahi Yusuf

Department of Architectural Technology, College of Environmental Studies, Hassan Usman Katsina Polytechnic P.M.B. 2052, Katsina, Nigeria

Abstract

Navigation inside hospital environments continues to be a major source of psychological stress for patients, visitors, and healthcare staff due to the spatial complexity of medical facilities and users' unfamiliarity with internal layouts. Poor navigation performance causes anxiety, delayed appointments, inefficiencies in service delivery, and lower satisfaction with healthcare visits. This study looks into architectural improvements that reduce navigation-related stress in hospital settings, with a special focus on orthopaedic healthcare facilities in Nigeria. A quantitative study strategy was taken, with standardised questionnaires distributed to healthcare workers and facility users at an orthopaedic hospital in Minna, Niger State. Out of 200 distributed surveys, 160 valid responses were collected and examined using descriptive statistics and the Relative Importance Index (RII). The findings show that spatial landmarks (RII = 0.889), visually identifiable entrances (RII = 0.811), simplified circulation intersections (RII = 0.809), and integrated signage systems all have a substantial impact on navigation comfort and orientation performance. Additional measures, such as colour-coded zoning, tactile floor markers, and digital wayfinding interfaces, help to reduce environmental stress among hospital visitors. The study indicates that architectural legibility and spatial distinction are key components of patient-centered healthcare design and advocates for the incorporation of evidence-based wayfinding strategies into hospital planning frameworks in developing nations. These interventions boost spatial cognition, reduce user anxiety, and improve overall healthcare service delivery outcomes.

Keywords: *Architectural legibility, Evidence-based design, Healthcare environments, Hospital wayfinding, Navigation stress, Nigeria*

1. Introduction

Hospitals are among the most spatially complicated building types, serving a wide range of users with different physical, cognitive, and emotional needs. Many patients and visitors experience bewilderment, anxiety, and psychological stress when traversing hospital facilities, especially when circulatory systems lack clarity or spatial clues [1] (Carpman & Grant, 2016). Navigation stress can have a poor impact on appointment punctuality, treatment compliance, staff productivity, and evaluations of healthcare quality [2] (Ulrich et al., 2008). Orthopaedic healthcare facilities face additional navigation issues since they commonly serve patients with mobility disabilities, injuries, or chronic musculoskeletal diseases that prevent autonomous movement within complex spatial layouts. As a result, the architectural design of such facilities is crucial in promoting patient orientation and decreasing stress during movement within the physical environment. Wayfinding is the cognitive and behavioural processes that people employ to orient themselves, determine routes, and reach destinations in unfamiliar surroundings [3] (Passini, 1996). When spatial surroundings are not legible, users experience

disorientation, dissatisfaction, and higher cognitive burden [4] (Arthur and Passini, 1992). These impacts are especially noticeable in hospital settings, where patients are already under emotional stress owing to illness or caring responsibilities. Despite increased global focus on patient-centered healthcare design, many hospital facilities in underdeveloped nations continue to prioritise functional accommodation over spatial legibility and navigation aids. As a result, architectural techniques for minimising navigation stress are underutilised in healthcare infrastructure delivery. As a result, this study looks into architectural improvements that reduce navigation stress in hospital settings, with an orthopaedic hospital in Minna, Nigeria serving as the case study.

2. Literature Review

Navigation stress is the psychological distress felt when people struggle to orient themselves in unfamiliar spatial surroundings. In healthcare facilities, stress is exacerbated by illness-related anxiety, time constraints, and environmental complexity [5] (Devlin, 2014). According to research, poorly designed circulation systems cause confusion, delay treatment access, and lower patient satisfaction. Effective wayfinding systems boost spatial confidence, minimise cognitive strain, and increase the perceived quality of healthcare settings [1] (Carpman & Grant, 2002). Cognitive mapping refers to the mental processes by which people create internal representations of spatial situations [6] (Tolman, 1948). These representations allow users to grasp spatial linkages and choose the most efficient paths to their destinations [7] (Downs and Stea, 2017).

Environmental cues like landmarks, signpost systems, circulation clarity, and visual access to destinations all have an impact on cognitive mapping in hospitals [3] (Passini, 1996). Environments that promote cognitive mapping reduce spatial ambiguity and boost user confidence when navigating. Architectural legibility refers to the ease with which consumers can understand and interpret architectural layouts [8] (Lynch, 2013). Legible environments help users navigate efficiently by allowing them to identify paths, nodes, landmarks, districts, and edges with spatial knowledge structure. Weisman [9] (1981) highlighted four essential factors influencing architectural legibility: signpost systems, floor plan layout, spatial difference, and visual accessibility. Hospitals with excellent spatial legibility reduce navigation errors and user emotional stress [10] (Pati et al., 2008).

Signage systems provide critical contextual information for orientation, identification, and route selection in healthcare settings [4] (Arthur & Passini, 1992). Effective signage mixes textual and symbolic information to accommodate different reading levels and user skills [11] (Rousek & Hallbeck, 2011). The three major types of hospital signage are directional signage, identification signage, and orientation signage. When signage is strategically incorporated with architectural characteristics, it increases navigation performance dramatically. Spatial differentiation improves environmental recognisability by generating visually separate zones within structures [12] (Montello 2014). Architectural landmarks such as atria, welcome rooms, stair cores, and landscape elements serve as orientation anchors, facilitating route memorisation [13] (Kaplan 1976). Distinctive environmental elements lower cognitive burden and increase navigation accuracy in large healthcare institutions.

3. Methodology

This study used a quantitative research methodology to assess architectural modifications that reduce navigation stress in hospital surroundings. Data were gathered using standardised questionnaires sent to healthcare personnel and facility users at an orthopaedic hospital in Minna, Niger State, Nigeria. A total of 200 questionnaires were distributed, and 160 valid replies were obtained, representing an 80% response rate. Cronbach's Alpha coefficients were used to examine data reliability, and they showed adequate internal consistency across measurement variables (Table 1). The Relative Importance Index (RII) study was utilised to rank architectural features that influence navigation stress reduction based on user perceptions.

Table 1: Summary of Data Preparation and Reliability

	Cases	Reliability test	Interpretation
Critical factors	4	0.572	Moderately reliable
Effectiveness of Hospital building	4	0.558	Moderately reliable
Professional	8	0.702	Highly reliable

4. Results and Discussion

4.1 Demography information about the respondents

Table 2 summarises the findings in terms of demographic information for general responders. In terms of hospital users, the statistics show that 42.5% are medical workers, 30% are visitors, and 27.5% are patients. In terms of job designations for medical workers, the statistics show that 11.9% are doctors, chemists, and orthopedicians, while 4.4% are nurses.

Table 2: Respondents demography information

Respondents Demography information	Frequency	Percentage
Category of hospital users		
Patient	44	27.5
Visitor	48	30
Medical personnel	68	42.5
Is medical Personnel, identify the specialty		
Not applicable	92	57.5
Doctor	19	11.9
Nurse	7	4.4
Pharmacist	21	13.1
Orthopaedic	21	13.1
Have you ever been an orthopaedic patient before		
Yes	72	45
No	88	55
Gender		
Male	98	61.3
Female	62	38.8

If Medical personnel or built environment professionals	Years of experience	Frequency	Percentage
Not applicable		92	57.5
0-5 years		23	14.4
6-10 years		35	21.9
11-15 years		10	6.3

In terms of whether respondents had previously been orthopaedic patients, the findings show that 55% have never been orthopaedic patients, whereas 45% have. The results show that 61.3% of respondents are male and 38.8% are female. In terms of years of experience as medical personnel or built environment professionals, the findings show that 21.9% have 6-10 years of working experience, 14.4% have 0-5 years of working experience, and 6.3% have 11-15% of working experience.

4.2 Demography information about the professionals

Table 3 summarises the findings in terms of professional demographics. In terms of professional classifications, the statistics show that 37.5% of professionals are architects, 21.3% are engineers, 15% are quantity surveyors, 11.9% are estate valuers, and 14.4% are land surveyors. In terms of educational attainment, the statistics show that 50% are HND/B.Sc holders, 46.3% are M.Sc holders, and 3.8% are Ph.D. holders. In terms of gender, the results show that 55.6% of respondents have 5-15 years of work experience, 26.9% have 15-25 years of work experience, and 11.9% have less than 5 years of work experience.

Table 3: Demography information about the Professionals

Professional demography information	Frequency	Percentage
Professional categories		
Architect	60	37.5
Engineer	34	21.3
Quantity surveyors	24	15
Estate valuer	19	11.9
Land surveyors	23	14.4
Educational attainment		
HND/B.Sc	80	50
M.Sc	74	46.3
Ph.D	6	3.8
Work experience		
<5 years	19	11.9
5-15 years	89	55.6
15-25 years	43	26.9
25years and above	9	5.6

4.3 Perception orthopaedic hospital users on the critical factors of wayfinding

Table 4 presents the data of the perceptions of orthopaedic hospital users on the essential criteria of wayfinding. When I visit the hospital, I can easily find the building's entrance.

The findings show that 38.6% of respondents agreed that it is easy for them to visually identify the building entrance when they visit the hospital, 36.3% strongly agreed, 19.4% were neutral, and 5.6% disagreed. In terms of how easy it is for me to use important buildings (landmarks) to find a desired destination in the hospital, the results show that 53.1% of respondents agreed, 45.6% strongly agreed, and 1.3 were neutral.

Table 4: Perception of the users of orthopedic hospital

Variable	Frequency (Percentage)
<hr/>	
It is easy for me to visually identify the building entrance when I come to the hospital	
Strongly disagree	0
Disagree	9(5.6)
Neutral	31(19.4)
Agree	62(38.8)
Strongly agree	58(36.3)
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It is easy for me to use important buildings (landmarks) to find a desired destination in the hospital	
Strongly disagree	0
Disagree	0
Neutral	2(1.3)
Agree	85(53.1)
Strongly agree	73(45.6)
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It is easy for me to use trees to find a desired destination in the hospital	
Strongly disagree	0
Disagree	14(8.8)
Neutral	44(27.5)
Agree	77(48.1)
Strongly agree	25(15.6)
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Do you agree that too many patients (crowd) around the circulation space disturb the ease of wayfinding	
Strongly disagree	0
Disagree	12(7.5)
Neutral	53(33.1)
Agree	62(38.8)
Strongly agree	33(20.6)
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Do you agree that intersections make wayfinding difficult in the hospital	
Strongly disagree	0
Disagree	0
Neutral	33(20.6)
Agree	87(54.4)
Strongly agree	40(25)
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Do you agree that signs that include both words and icons make it easy for you to find your desired destination in the hospital	
Strongly disagree	0
Disagree	0
Neutral	45(28.1)
Agree	77(48.1)
Strongly agree	38(23.8)
Do you agree that the use of signs and room numbers makes it easy to provide identification or directional information	
Strongly disagree	0
Disagree	3(1.9)
Neutral	28(17.5)
Agree	88(55)
Strongly agree	41(25.6)

Regarding whether it is easy for me to use trees to locate a desired destination in the hospital, the data show that 48.1% of the respondents agreed that it is easy for them to use trees to discover a desired destination in the hospital. 15.6% strongly agreed, 27.5% were neutral, and 8.8% disagreed that they can easily use trees to get to their chosen destination in the hospital. Do you agree that having too many patients (crowds) around the circulation space makes it difficult to find your way around? According to the findings, 38.8% of respondents agreed that having too many patients (crowd) around the circulation space makes it difficult to find their way around. 20.6% strongly agreed, 33.1% were neutral, and 7.5% disagreed that having too many people (crowd) around the circulation space makes it difficult to find their way around. Do you agree that crossings make navigating difficult in hospitals? According to the findings, 54.4% of respondents agreed that intersections make it difficult to find their way about the hospital, 25% strongly agreed, and 20.6% were neutral. Do you think that signage with both text and images make it easier to reach your chosen location in the hospital? The data show that 48.1% of respondents believe that signage with both words and images make it easier to find your chosen destination in the hospital; 23.8% strongly agreed, and 28.1% were neutral. Do you believe that the usage of signs and room numbers facilitates identification and navigational information? The data show that 55% of respondents felt that using signage and room numbers makes it easier to provide identification or navigational information. 25.6% of respondents strongly agreed, 17.5% were neutral, and 1.9% disagreed that the usage of signs and room numbers facilitates identification or directional information.

4.3 Professional's view and perception on architectural design element

From the results obtained from the findings, Table 5 shows that architectural intelligibility is crucial in minimising navigation stress in hospital surroundings. The establishment of visually distinct spatial zones received substantial expert agreement (56.3%), implying that environmental difference boosts orientation confidence. Similarly, 61.3% of respondents strongly agreed that clear, strategically placed signage improves navigation clarity. Digital navigation tools such as interactive kiosks and touchscreen information

systems were also identified as useful stress-reduction strategies, with 46.3% strongly endorsing their use. Tactile indications and braille signage increased accessibility for visually challenged individuals, strengthening inclusive design ideals in healthcare settings.

Table 5: Perception of Professionals on Architectural Design Element

Variable	Frequency (Percentage)
Creating distinct regions with unique visual characteristics	
Strongly disagree	0
Disagree	0
Neutral	12 (7.5)
Agree	58 (36.3)
Strongly agree	90 (56.3)
Provision of landmarks in the hospital environment that can aid orientation and make it easier to users to remember the route	
Strongly disagree	0
Disagree	18 (11.3)
Neutral	67 (41.9)
Agree	75 (46.9)
Strongly agree	
Provision of sight lines to show what is ahead	
Strongly disagree	0
Disagree	0
Neutral	15 (9.4)
Agree	67 (41.9)
Strongly agree	78 (48.8)
Provision of clear, concise, and easy to understand signage at key decision points such as at entrances, hallways, elevators, stairways and wards	
Strongly disagree	0
Disagree	0
Neutral	4 (2.5)
Agree	58 (36.3)
Strongly agree	98 (61.3)
Provision of digital wayfinding, such as interactive kiosks, mobile apps and touchscreens, can provide real-time information and personalised directions to help users navigate the hospital more easily	
Strongly disagree	0
Disagree	0
Neutral	11 (6.9)
Agree	75 (46.9)
Strongly agree	74 (46.3)

Offering training sessions to employees to familiarize them with the signage and teach them how to effectively help visitors navigate the hospital	
Strongly disagree	0
Disagree	0
Neutral	10 (6.3)
Agree	90 (56.3)
Strongly agree	60 (37.5)
Provision tactile markings on the floor or braille signs assist to the help the visually impaired to navigate the building and find the right department	
Strongly disagree	0
Disagree	0
Neutral	7 (4.4)
Agree	90 (56.3)
Strongly agree	63 (39.4)
To provide a hospital site plan or a survey map either on a brochure distributed to visitors or mounted as a wall plaque inside the hospital in the main reception area	
Strongly disagree	0
Disagree	12 (7.5)
Neutral	42 (26.3)
Agree	72 (45)
Strongly agree	34 (21.3)

The Relative Importance Index analysis (Table 6) highlighted major architectural stress-reduction variables such as landmark visibility (RII = 0.889), identifiable entrances (RII = 0.811), simplified circulation intersections (RII = 0.809), and integrated signage systems (RII = 0.791). These findings confirm that adding environmental signals to architectural design improves spatial orientation. According to prior study by Arthur & Passini [4]; Ahmed et al., [14]; Musa and Akande, [15], the combination of textual and symbolic signage improves route recognition and minimises decision-making ambiguity at circulation nodes.

Table 6: Relative Important index on critical factors influencing way finding

Critical factor influencing way finding	$\sum W$	RII	Rank
It is easy for me to visually identify the building entrance when I come to the hospital	649	0.811	2

It is easy for me to use important buildings (landmarks) to find a desired destination in the hospital	711	0.889	1
It is easy for me to use trees to find a desired destination in the hospital	593	0.741	7
Do you agree that too many patients (crowd) around the circulation space disturb the ease of wayfinding	596	0.745	6
Do you agree that intersections make wayfinding difficult in the hospital	647	0.809	3
Do you agree that signs that include both words and icons make it easy for you to find your desired destination in the hospital	633	0.791	5
Do you agree that the use of signs and room numbers makes it easy to provide identification or directional information	647	0.809	3

5. Conclusion

This study reveals that architectural modifications have a major impact on reducing navigation stress in hospital surroundings. Spatial landmarks, visible access to destinations, readable circulation systems, and integrated signage networks all improve orientation performance and reduce psychological discomfort for users. Hospitals with significant spatial hierarchy and environmental distinction make it easier for patients and visitors to navigate while also boosting the overall quality of the healthcare experience.

6. Recommendations

The study suggests the following architectural interventions to reduce navigation stress in hospital environments: (i) incorporating distinctive external landscape landmarks (ii) implementing colour-coded departmental zoning systems (iii) integrating tactile floor guidance systems (iv) improving entrance visibility and spatial hierarchy (v) providing digital wayfinding technologies (vi) strategically placing directory maps at decision nodes. These solutions promote patient-centered treatment and increase spatial accessibility inside complicated medical institutions.

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