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Visual Accessibility and Inclusive Wayfinding Design in Hospital Environment in Nigeria

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Abstract

Visual accessibility refers to the legibility and intelligibility of space cues that most contribute to the searching and use of information from the environment for wayfinding in hospitals. Because of building complexity and expansions over time, there is a lack of visual clarity to navigate and access the most desired destinations in the hospital. However, the inaccessibility of space by many unfamiliar users of any age, gender, or disability resulted in disorientation, uncertainty, stress, frustration, getting lost, and missed medical appointments. The purpose of this study is to investigate the impact and barriers of visual accessibility on wayfinding in hospital buildings. Mixed-method approach combined quantitative and qualitative measures for the study area with focus on General Outpatients Departments (GOPD). A simple random sampling technique was used to select 98 participants. 24 respondents were selected for interview, while GOPD hospital buildings were observed for data elicitation. The main findings show that some of the circulation spaces were crowded with patients, and that most destinations within the GOPD were not visible from the main entrance. In addition, indistinctive nodes act as barriers, rendering some buildings inaccessible during navigation. It also revealed that signage, unit building entrances, and lighting were legible and properly positioned, enhancing space accessibility during wayfinding. The main limitations of this study are the absence of physically challenged people and the elderly in the research process, as well as cultural and linguistic differences. The implications are that designers should make simplified building layout more legible to the wide group of users such that core sections are visible and interlinked with high traffic flow pathways in the hospital for inclusive wayfinding. This study suggested solutions to the problems of visual accessibility in the hospital could improve all users' inclusive wayfinding, increase satisfaction, confidence, reduce confusion during direction-finding in the hospital.

Keywords:
Barriers, hospital environment, impact, inclusive wayfinding, visual accessibility

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INTRODUCTION

The difficulty of easily locating desired destinations in a hospital is exacerbated by the building's complexity and evolving spaces (Ahmed et al., 2020). Hospitals typically grow and expand in response to increased demand for services, necessitating the addition of new buildings and extensive route changes. Due to the renamed and disordered systems of linked corridors and entrances that results from the expansion of the hospital, consequently confuses new users which affects successful wayfinding (Brunyé et al., 2018). Furthermore, hospitals must accommodate a wide range of user requests and emotional states, as well as address a wide range of physical and cognitive abilities (Mollerup, 2009). Complex building layouts typically provide very limited visual access from the main entrance to some target locations, which impedes the user's orientation within the buildings (Hughes et al., 2015; Kamal et al., 2010). Impediments to orientation hamper wayfinding, resulting in uncertainty, anxiety, stress, and frustration (Martins & de Melo, 2014). As a result, the level of optical admittance to building layout is a significant variable in the hospital environment for effective legibility of buildings and circulations for efficient wayfinding (Baskaya et al., 2004).

Successful wayfinding requires knowing the origin, the best route to take to reach the intended destination, recognizing the destination, and being able to retrace the route out of the premises (Vaez et al., 2016). Getting to the destination easily is currently a problem for new users at the University of Abuja Teaching Hospital (UATH), Gwagwalada-Abuja due to the expansion of buildings, which creates complication in cognitive and visual understanding of finding a target (Ahmed et al., 2018). Consequently, imprecise visual access from start to destination and lack of pathway intelligibility may obstruct movement and decision making for effective wayfinding (Kamal et al., 2010). Despite the convenience of various guides such as signage, maps, and directories in the hospital, uninformed patients and those with language barriers have difficulty accessing the facilities (Verghote et al., 2019). As a result, all users, including those that experience disability such as the elderly with difficulty in movement, uninformed and language barrier users who cannot read signs, all require access to navigate hospital environment.

Hospital designs are expected to meet the growing needs of diverse users by being inclusive and accessible in addressing the needs of a wide range of physical, language, cognitive, and sensory, aptitudes, and desires of the users (Morag et al., 2016). Aside from language, other aspects of inclusive wayfinding design considerations include social and cultural background, which ensure effective wayfinding to many groups of potential users (Passini, 1992). These inclusive wayfinding characteristics give meaning to wayfinding systems and the cues provided in the hospital. Visual access, though intricate to accomplish in a multifaceted layout, has been shown by researchers to be a significant factor that eases one's spatial orientation and influences new users'

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wayfinding behavior more than available signage (Baskaya et al., 2004; Belir & Onder, 2013; Carpman et al., 1985; Sadek, 2015). Previous research looked into the effects of visual access and the capacity of available information on the legibility of an environment. Kuipers (1978) investigated the use of optical sanity in navigation, whereas Turner and Penn (2002) investigated the relationship between visual field and human behavior in the wayfinding procedure.

These previous studies hypothesized that an increased scale of intersection between the optical arena of a starting point and the intended landmark might aid users in developing the necessary spatial knowledge for wayfinding tasks. This implies that clear visual access and prominent landmarks are important factors in effective wayfinding (Ahmed *et al.,* 2020). According to Shokouhi (2003), a high degree of global integration, such as the configuration of landmarks and pathways, influences the legibility of the built environment. However, there have been few studies on the factors that act as roadblocks to wayfinding, particularly the lack of understanding of accessibility in the hospital setting.

This research evaluated the barriers to accessibility and their impact on the inclusive wayfinding design of hospital buildings. It focused on able-bodied individuals who were not impaired, but were hampered by the experience of difficulty due to the level of information available in the hospital setting. It is argued in this context that wayfinding cues should be inclusive and accessible to all users. The study's significance is to advance understanding of accessibility and inclusive wayfinding design in order to improve all users' access, increase satisfaction, and reduce confusion during hospital direction-finding as espoused by Morag et al. (2016). Consequently, the paucity of research on accessibility problems in hospital wayfinding necessitates the study.

PERCEPTION AND COGNITION OF WAYFINDING

Wayfinding is an exceptionally perplexing intellectual task that contains various instruments (spatial recollections and signs) and systems (route looking and course following) utilised successively or all the while(Andresen et al., 2016) . Direction-finding in hospital involves perception and cognition of cues afforded by the environment. When addressing a wayfinding task, individuals obtain environmental cues through observation (perception) and utilise spatial recollections (cognitive map) accumulated from past visits, summed up data, signs, maps, and navigational frameworks. Perception is the visual comprehension of a situation with limited information, while cognition is the intellectual understanding of a situation with additional data processing and varying levels of psychological activity (Cubukcu, 2003; Verghote et al., 2019).

The discovery of one's path in a location is a task that requires decision making by first sketching out a plan of action for where to go (Sadek, 2015). This is followed by decision execution, which

encompasses navigating to the correct position and information processing, which involves comprehending the acuity of the setting (Curl, 2018). All of these processes are accomplished through the psychological perception and cognition of the user, which results in wayfinding behavior (Kang et al., 2017). Thus, a comprehensive wayfinding system aids the wayfinder's decision-making process and provides equipment designed for spatial orientation and cognitive mapping.

Perception and cognition are both required to develop spatial knowledge of a built environment in order to maintain orientation and make the best route choice to efficiently access and reach a destination (Andresen et al., 2016; Kamal et al., 2010). The concept of accessibility refers to the ease of access to destinations by all people in a timely manner and is related to the relationship between people, mobility, and the built environment (Curl, 2018). Inaccessibility occurs when a person wishes to use a hospital's services but is unable to do so due to difficulty or an obstacle encountered in reaching the desired destinations (Creem-Regehr et al., 2021). Furthermore, the effective accessibility of the hospital environment increases opportunities for improved mobility as well as social and economic autonomy (Kang et al., 2017). Inaccessible space, on the other hand, may cause patients to experience a disability situation if the hospital environment does not provide the conditions required for appropriate accessibility (Brunyé et al., 2018; Montello, 2014). This inaccessibility in hospital wayfinding has the unintended consequences of uncertainty, stress, and becoming disoriented. Therefore, the design of wayfinding systems and spaces is expected to be organized in such a way that it effectively communicates to all groups of users by raising awareness of inclusive design and universal access.

As a result, most users should be guided from their starting point to their final destination by recognising and spotting places with distinguishing landmarks, zoning of spaces, connecting and arranging spaces using architectural and graphic means(Morag et al., 2016) . As such, the setting of the hospital is expected to emphasize on distinctiveness and structure towards aiding the reading of space and formation of image in the perceiver's memory to facilitate interpretation of 'place legibility.

Inclusive Wayfinding Design Strategies

The strategy for an inclusive wayfinding system includes recognising and marking spaces, categorising spaces, and connecting and systematizing spaces using architectural and graphic techniques (Curl, 2018). It should account for and effectively communicate with large groups of people with varying sensory abilities, cerebral capacities, literacy levels, languages, and physical statures (Verghote et al., 2019). The criteria for inclusive wayfinding design as stated by Vaez et al.

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(2016) include equitable and flexible use of facilities by all. The design should be made simple with instinctive exploits regardless of the user's experience, familiarity, and language proficiency. It should ensure competent and contented use with the least amount of effort. It can be surmised that inclusive wayfinding design guidelines ensure that objects and supports are accessible to all people without distinction, and reducing the barriers to free circulation.

Scholars have identified some factors that are significant variables for the assessment of visual access in public spaces such as the accessibility of hospital settings for wayfinding. Differentiation, visual access, and layout complexity are three major spatial attributes that influence orientation and wayfinding, according to Montello and Sas (2006). Furthermore, Colfelt (2012) investigated accessibility in public spaces, with a focus on wayfinding in Danish hospitals. The study's findings revealed that spatial knowledge is acquired when there are a few distinct and visible choice points from a long distance. However, Colfelt (2012) did not adequately facilitate users' general understanding of the wayfinding design that eases accessibility. The issue with building accessibility prevented users from taking the best routes to targeted locations in hospitals. Hughes et al. (2015) discovered hospital site size, security concerns, and signage constraints as wayfinding barriers.

Hunter (2010) also investigated accessibility and universal design in architectural wayfinding for various building types, classifying wayfinding obstacles as exterior or interior. However, the urgency required in hospitals to access facilities in emergency situations necessitates additional research into the barriers that hinder accessibility in wayfinding (Morag et al., 2016). Similarly, (Carpman & Grant, 2003) states that wayfinding impediments include lack of distinguishing space, connecting walkways at sharp angles. However, little is known about the amount of information provided in the setting that allows all users, regardless of their abilities, to easily access and navigate the hospital environment. Thus, there is a need for this research to further the understanding of accessibility and inclusive wayfinding design.

METHODOLOGY

The study is situated at the University of Abuja Teaching Hospital (UATH) as depicted in Figures 1 and 2 showing the site layout as well as the marked out study units. The General Outpatient Departments (GOPDs), a radiology unit, a theatre, a laboratory, wards, and the National Health Insurance Scheme (NHIS) Complex were all part of the delineated area. The NHIS building contains a pharmacy. The variables evaluated include circulation patterns, corridor intersections, clarity of visual access, and building floor plans in terms of configuration. Furthermore, the variables were used to assess the

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factors that obstruct successful wayfinding and the impact of such obstructions to Inclusive wayfinding in the hospital.

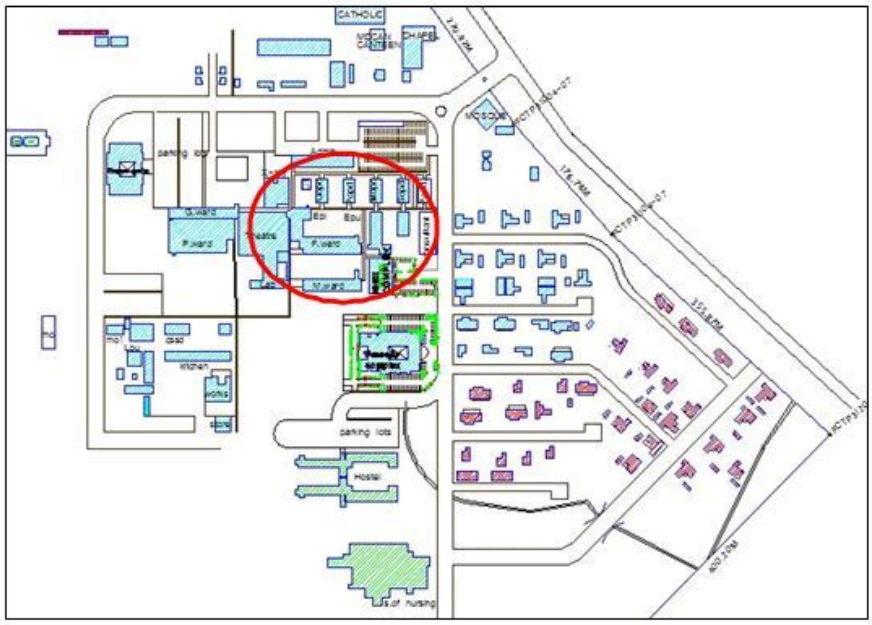

Figure 1. The layout of University of Abuja Teaching Hospital (Ahmed et al., 2018)

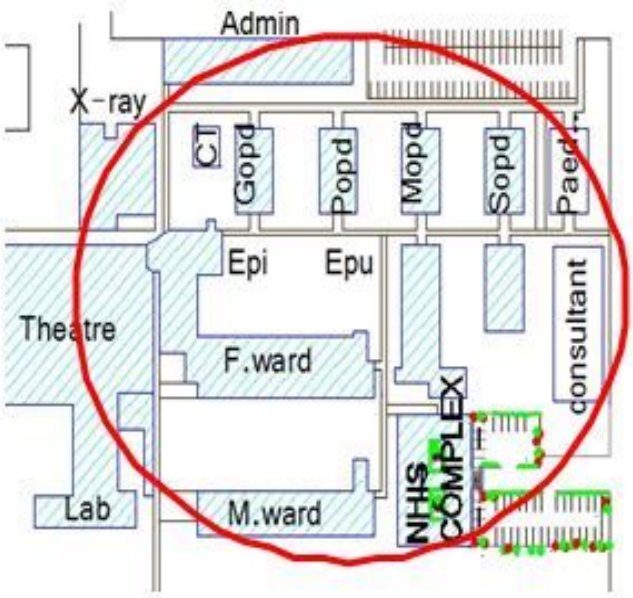

Figure 2. The study area within the University of Abuja Teaching Hospital (Ahmed et al., 2018)

Method of Data Collection

Data collection for the research entailed the use of the survey questionnaire and semi-structured interviews as research instruments, thus, a mixed method approach was used via a concurrent strategy. The average number of daily outpatients for the (GOPD) obtained from the hospital's medical information unit was 131, which serves as the population. For the survey, a simple random sampling technique was used, while for the interview, a purposive sampling technique was employed. Bartlett et al. (2001) states that that Cochran's formula in equation (i) for categorical data should assume a 95% confidence level

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and a 5% sampling error, which was used to compute the sample size as follows:

$n_{0 =(}t)\ 2^*\ (p)\ (q)\ /\ n_0\ (d)^2$..... (i)

Where t = the value of the chosen alpha in each tail = 1.96; d = the acceptable limit of error, alpha degree =.05. As a result, $n_0 = (1.96)^2*(.5)\ (.5)\ /\ (.05)^2 = 384$. As a result, Cochran's correctional formula for sample size used in equation (ii) was:

$n_1 = n_0\ /\ (1+n_0\ /$ population) ..... (ii)

Where population size = 131 and n_0 = basic return sample size according to Cochran's formula = 384. Since n_1 is the sample size we want to find, $n_1 =384\ /\ (1+384/131) = 98$.

Consequently, a sample size of 98 (49 male, 49 female) was employed for the survey questionnaire. Furthermore, the sample size for the interview was found based on theoretical data saturation, which is the position where further interview provides no fresh data (Singh & Masuku, 2014). Therefore, saturation was achieved at 24 interviews which were used as the sample size for the study. Previous research suggested that the sample size threshold of 10-15 interviews is adequate for theoretical data saturation for qualitative interview (Morse, 2000).

Procedure for data collection

The UATH's Ethical Research Committee granted permission for the research. Furthermore, prior to the start of data collection, the participants gave their verbal informed consent. While the patients were waiting for consultation in the hospital, the survey questionnaire was administered on the spot by the recruited research assistants. In addition, the interviews and building observations were conducted at different times.

Also, the variables utilised in the instruments were modified from preceding researches on hospital wayfinding (Ahmed et al., 2020; Colfelt, 2012; Morag et al., 2016; Vaez et al., 2016; Verghote et al., 2019) To obtain the frequencies and percentages of the opinion poll, the inquiries were assessed using a 4-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree). This is because Joshi et al. (2015) stated that the 4-point Likert scale could be used to make an imposed decision of measure to avoid unresponsive choices such as 'neutral' or indecision. In addition, the 24 respondents were interviewed at the GOPDs. The conversation was undertaken in English language, however, the research assistant sometimes interpreted in local languages for those not fluent in English language. The consent of each respondent was sought to record the interview and each lasted approximately 30 minutes. The protocol for the interviews also included notification of the audio recording to the participants. However, some respondents declined participation because they were not emotionally stable for the interview.

Data Analyses

The data collected in this study were both quantitative and qualitative in nature. In analysing the quantitative data statistical tools were used, while content analysis was used for the qualitative data. The survey questionnaire data was descriptively analysed to elicit perception for the questionnaire survey, using a 4-point Likert's-scale (1 = Strongly Disagree to 4 = Strongly Agree) to get frequencies, and percentages. The 4-point Likert's-scale was used to generate an enforced choice of measure to avoid unresponsive option such as 'neutral' (Neither Agree nor Disagree) as affirmed by (Joshi et al., 2015). For better interpretation, the weighted score (WS) and weighted mean value (WMV) for each item were obtained and ranked based on the mean values. Similarly, the interview transcripts were transcribed and content analysed.

The recurring themes were identified from the texts through coding and creation of categories. Thereafter, there was the emergence of respondents' wayfinding knowledge. This followed Miles et al. (2014) which affirmed that the frequency of similar categories could be counted to determine the number of recurrences to evade replication and to highlight commonalities. Transcripts of interviews were used to analyze the impact and barriers of visual accessibility on wayfinding in hospital buildings. Data from tape-recorded interviews was transcribed verbatim, and nonverbal cues were noted. The transcript was divided into sense parts, and reduced sense components were summarized and labeled with ciphers. The various ciphers were compared in terms of their differences and similarities, and then classified into sub-groups and groups that constituted the obvious content.

The transcripts revealed recurring themes that represented a wide range of respondents' wayfinding experiences. In the form of a framework matrix, these themes were used in the content analysis. Similar concepts were merged and counted in the second column based on the number of times they appeared. The data mapping and interpretation were completed by identifying the core concept. According to Gale, Heath, Cameron, (Gale et al., 2013) mapping entails establishing relationships between groups in order to discover associations. The information was described and explained in terms of the implicit and explicit meanings of the data in the interpretative steps. In the content analysis, a matrix table (framework method) was used to manage the large data set obtained, allowing for a holistic and descriptive synopsis of the entire data set. Subsequently, the interpretation focuses on the connections between disparate parts of the summarized information, with the goal of drawing descriptive or explanatory conclusions. Furthermore, peer debriefing was used by allowing seminar researchers to read through analysed data to increase credibility in the qualitative research as stated by Nguyen (2008). This was done to ensure openness, sensitivity, and insight throughout the entire data collection and analysis process.

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RESULTS AND DISCUSSION

Survey Data

There were 98 respondents in UATH of which half were male (50%) and the other half (50%) were female. Similarly, almost half of the respondents (48%) were aged between 20 to 34 years that were classified as youth, 49% were aged between 35 to 55 years categorised as middle aged, and the remaining 3% were above 55 years which was classified as elderly (senior citizens). For the educational status, 30% had secondary education, 47% were graduates, while 21% of the respondents had primary education, and 2% had no formal education. Furthermore, over half of the respondents (60%) could speak English language while the other 40% of the respondents speak other languages.

Table 1 shows the results of the survey questionnaire, including the weighted sum (WS) as response scores for each item, the weighted mean value (WMV), the ranking, and the degree of agreement in the interpretation. The architectural features used in the wayfinding process were the factors considered in the survey questionnaire. Table 1 shows that the most critical variables that enhance visual accessibility of wayfinding success in the hospital are signage, building entrance identification, and well-lit up circulation space, ranked first, second, and third, respectively.

Table 1. Users' responses on architectural factor for wayfinding in UATH, Abuja (Researcher's work, 2018)

Item	WS	WMV	Ranking	Interpretation
A11: Designed signage system makes destination easy to identify	104	3.10	1st	Agree
A1: Easy identification of building entrance	102	3.04	2nd	Agree
A8: Lighting up circulation space play a vital role in wayfinding	99	2.95	3rd	Agree
A4: Legible pathway identification	95	2.85	4th	Agree
A2: Floor plan arrangement was difficult to understand (building layout)	94	2.82	5th	Agree
A3: Easy direction finding in circulation space	94	2.82	5th	Agree
A6: Too many patients around circulation space disturb wayfinding (Crowdedness)	93	2.78	7th	Agree
A9: Visible environmental picture	92	2.77	8th	Agree
A12: See direct from entrance to important building and destination	89	2.74	9th	Agree
A5: Easy identification of stairways	89	2.74	9th	Agree
A10: Corridor intersection (nodes) makes wayfinding difficult	88	2.72	11th	Agree
A7: Map was used to find direction	86	2.70	12th	Agree

*WS (Weighted Sum); WMV (Weighted Mean Value)

This implies that the signage was clear and legible in terms of text and symbols provided where users needed the information to find their way to destinations in the hospitals. Consequently, signage influences ease of wayfinding and reduces wayfinding errors, such as incorrect turns and backtracking, supporting the findings of Michael O'Neill (1991) and Potter (2017) (2017). This implies that the hospital

provided adequate signs and landmarks at decision points, reducing the complexity of route directions.

There was clear visual access from the building entrance and was easily identified, which ranked as the second most important influential variable in the hospital's wayfinding success. This was due to the fact that the majority (76%) of respondents agreed with the statement that the building entrance was visible and easily accessible for wayfinding. This lends credence to the findings that visual access influences spatial legibility and has the potential to reduce uncertainty and stress during wayfinding (Montello, 2014; Verghote et al., 2019) The implication is that prominent landmarks such as signs, artwork, and visible main staircases from the main entrance area can help wayfinders identify and access navigation options available during wayfinding.

The third variable influencing the ease of wayfinding in the hospital was the use of lighting in the circulation space. This was because the circulation spaces were adequately lighted, with an open courtyard for natural lighting, allowing users to clearly see signs and cues while navigating (See Figure 2). This implies that lighting improves visibility for navigation. Similarly, the majority of respondents (71.3%) ranked legible pathway as the fourth influential variable influencing ease of wayfinding. This implies that there were distinguishable signs and landmarks at decision points, reducing the complexity of route directions and facilitating accessibility.

Furthermore, the hospital's building layout complexity (5th), crowdedness (7th), and mental image (8th) rankings show that the attributes impede successful wayfinding. This means that the vast majority of patients (71%) were unable to understand the functional spaces of the building layout. Consequently, the hospital environment was far too complicated for effective wayfinding.

Crowding around the circulation space was a barrier to hospital wayfinding by the majority of respondents (70%), while 69.5 percent were unable to form a cognitive map of the setting. The visual clarity of the users to see from the building entrance to the desired destination within the buildings was ranked ninth, and as such, was ineffective for hospital wayfinding (See Table 1). This implies that users' wayfinding behavior through the building entrance to the desired destination was influenced by visual access. Stairways, nodes, and maps in circulation space, on the other hand, were ranked as the 9th, 10th, and 11th influential attributes to wayfinding, respectively. This implies that respondents found stairways, nodes, and maps difficult to perceive in situations where there were no directional signs to identify and improve correct route knowledge to the preferred destination.

Interview Data

The impact of the building's entrance on wayfinding

The GOPD patients and their family members who were interviewed included 12 males and 12 females ranging in age from 25 to 55 years.

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Two (2) had graduate degrees (Masters and PhD), twelve (12) had first degrees or diplomas, five (5) had secondary school education, three (3) had primary education, and two (2) had no formal education. Fifteen (15) of the respondents had never been to the hospital, while nine (9) had been there twice. The respondents were asked about the impact of building entrances on wayfinding in terms of accessibility and visibility. Table 2 summarizes the findings and the emerging core theme.

Table 2. Influence of Building entrance on wayfinding (Researcher's work, 2018)

Identifying themes	Indexing: coding and merging similar issues	Charting: Data abstraction and summary	Mapping and Interpretation
Theme: Building entrance (A) Help to direct me to destination (**2**) (B) Makes wayfinding easy (**3**) (C) Good and centrally located for easy access (**4**) (D) Easily noticed (**4**) (E) Centrally placed for easy accessibility (**2**) (F) GOPD entrance was not distinctive (**3**) (G) Confuses emergency entrance with NHIS/OPD entrance (**3**) (H) Difficult to notice (**2**) (I) Confusing entrances (**1**)	(A – B) Help to direct me to destination / makes wayfinding easy (**5**)* (C -E) Good/ Centrally located for easy access (**10**)* (F -I) GOPD entrance was not distinctive; Difficult to notice; Confusing entrances (**9**)*	(A – E) = (**15**)* (R1, R4) (F - I) = (**9**)*	The main trend was that the building entrance was user-friendly, thus, easily accessible. **Core concept:** Easy accessibility

*The bold numbers indicate the frequency of count of concepts;

As shown in Table 2, the majority of respondents (15 out of 24) stated that the building entrance was user-friendly and thus easily accessible. This is supported, for example, by the following quotes from respondents: "*the entrance of the building is centrally located for easy accessibility, so, it really helped me to find my destination*." (R4); "*I easily noticed the building entrance location and helped to direct me to my destination in the hospital*" (R1). These assertions could be attributed to the parking lot's proximity to the entrances.

However, some pedestrians (9) were perplexed by the entrances because they mistook the emergency section for the GOPD sections. This implies that the location of the building's entrance for each section should have been more visible and marked to facilitate access to various locations within the hospitals. Furthermore, a well-designed layout should provide users embarking on wayfinding with a clear visual understanding of the building configuration, including the easy access to the main entrance.

Recognising building layout in hospital wayfinding

The respondents were asked how they understand the hospital's building layout that enabled finding direction to the desired destination. The respondents' narrations and experiences were considered,

analyzed, and interpreted (See Table 3). The alphabets in capital letters represent the coding of themes, while the numbers represent the number of themes that appeared in all of the responses.

Table 3. Opinion on building arrangement (Author's field work, 2018)

Identifying themes	Indexing: coding and merging similar issues	Charting: Data abstraction and summary	Mapping and Interpretation
Theme: Building layout (A) Simple to understand (**3**)* (B) Complex layout and stressful (**2**)* (C) Difficult to understand (**7**) (D) Confusing layout (**3**)* (E) Layout was very easy to understand (**3**)* (F) Very easy to access (**2**)* (G) Very big and complex; one can get lost (**2**)* (H) Simple layout (**2**)*	(A, E, F, & H) Simple to understand ; Simple layout; Very easy to understand / Very easy to access (**10**)* (B,C,D,&G) Complex layout and stressful; confusing layout /difficult to understand (**14**)*	Layout was simple to understand : A, E, F, (**10**)* (R2, R12) Complex to understand, confusing and stressful B, C, D, & G = (**14**)* (R3, R7)	Majority of the respondent agreed that the building layout was complex to understand, confusing and stressful. **Core concept:** Building layout was **complex** and **stressful** to navigate

* Bold numbers were count of recurring themes

The majority of respondents (14) stated that the building layout was complex and stressful to navigate, making accessibility and wayfinding in the hospital difficult to understand (See Table 3). This finding was supported by the following quotes from the respondents: ''the building arrangement was complex to understand" (R3); ''Hospital buildings were complex and stressful to navigate" (R7). This suggests that the majority of users found it difficult to reach their destinations, which impedes wayfinding in hospitals. This implies that the conceptual composition of hospital building layout should be simple to understand to ease successful wayfinding.

Key features used in hospital navigation

The important features (landmarks) that were accessible cues and used in hospital wayfinding were asked of the respondents. Table 4 shows the analysis of their responses as well as the emergence of the core concept.

Table 4 reveals that the majority (15) of the respondents agreed that signage were a prominent feature in hospital that enhances accessibility and wayfinding. The quotes from some of the respondents support the claim which states as follows: For example, ''the important features that aid my movement in the hospital were signs and symbols'' (R1); ''Pictographs and signpost on the wall and the door post'' (R14). This implies that the signage was legible and used as landmarks. However, some patients identified ATM stand (5) while trees, flowers, overhead tank and distinctive buildings account for 2 each as landmarks which assisted users to identify and access their destinations.

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Table 4. Important features in wayfinding (Researcher's Field Work, 2018)

Theoretical framework: Identifying themes	Indexing: coding and merging similar issues	Charting: Data abstraction and summary	Mapping and Interpretation
Theme: Landmarks (A) Signs and symbols (**9**) (B) Overhead tank and parking lot (**2**) (C) Use trees as landmark (**2**) (D) ATM stand (**2**) (E) signage & Signpost (**6**) (F) stairways (**1**) (G) Unique height and design of the buildings (**2**)	(A & E) Signs and symbols ; signage = (**15**)* (B &D) ATM stand, overhead tank and parking lot (**4**)* (C) Use trees as landmark (**2**)* (F) stairways (**1**)* (G) Unique height and design of the buildings (**2**)*	(A) Signage (**15**)* (R1, R14) (B) ATM stand, overhead tank and parking lots (**4**)* (C) Trees and flowers (**2**)* (R2, R7) (G) Unique height and design of the buildings (**2**)*	The major landmarks used were signage. **Core concept:** Signage

* Bold numbers were count of recurring themes

Influence of lighting on wayfinding

Table 5 shows the emerging themes and concepts from the transcript of responses from the participants when the question was raised on the influence of lighting on wayfinding. The emerging similar themes were merged in column three of the table.

The main trend of opinion in Table 5 reveals that all the respondents agreed that lighting enhance accessibility and visibility in hospital wayfinding as it illuminates pathways and improve ease to identify destinations. The quotes from some of the respondents support the findings as follows: ''the lighting in the circulation space brightens up the corridor so I was able to access the destination without stress'' (R2); ''the lighting was helpful and aids my visibility to the destination'' (R12). This implies that that hospital designs should provide both natural and artificial lighting to illuminate the pathways for accessibility and effective wayfinding.

Table 5. Influence of lighting on wayfinding (Researcher's work, 2018)

Theoretical framework: Identifying themes	Indexing: coding and merging similar issues	Charting: Data abstraction and summary	Mapping and Interpretation
Theme: Lighting (A) All pathways are well lighted (**3**)* (B) Adequate lighting aid me to see the writings on the walls and doors ; easy access to destinations (**3**)* (C) Lighting helps me to see sign post better (**8**)* (D) Lighting was very okay; Lighting brightens the corridor (**5**)* (E) Help enhance visibility (**3**)* (F) Lighting ease movement (**2**)*	(A - D) All pathways are sufficiently lighted; helps me to see sign post better (**17**)* (E - F) Help enhance visibility; ease movement; brightens the corridor (**7**)*	A -D = (**17**)* E - G = (**7**)* (R2, R12) (A –G) Sufficient lighting at pathways and enhance visibility = (**24**)*	The main trend was that pathways were sufficiently lighted and enhances visibility to destinations. **Core concept:** Lighting enhance visibility and accessibility

* Bold numbers were count of recurring themes.

Wayfinding barriers in the hospitals

The participants were asked about the wayfinding barriers encountered in the hospitals. The responses were analysed as shown in Table 6.

Table 6. Wayfinding barriers (Researcher's work, 2018)

Identifying themes	Indexing: coding and merging similar issues	Charting: Data abstraction / summary	Mapping and Interpretation
Theme: Wayfinding barriers (A) Far distance to walk (**1**); (B) complexity of buildings (**2**) (C) Some confusing Signs and symbols (**1**) (D) Distance (**1**) and too many stairs causes confusion (**1**) (E) Similarity of building colours confuses users (**1**) (F) Many junctions and turns (**2**) (G) Crowd in the hallway (**5**)	(A & D) Far distance to walk; (B) complexity of buildings (**4**)* (C) Some confusing Signs and symbols (**1**) (D) Confusing stair cases (**2**) (E) Many junctions and turns (nodes) (**2**) (F) Crowd in the hallway (**5**)*	A & D = (**4**)* B = (**1**)* C = (**2**)* E = (**2**)* F = (**5**)* (R3, R9)	Crowdedness in the hallway was the main barrier in the hospital followed by the building layout complexity. **Core concept:** Crowdedness and building layout complexity

* Bold numbers were count of recurring themes; Capital letters indicate coding

The main perception in Table 6 illustrates that crowdedness and building layout complexity accounted for 5 and 4 of the respondents respectively which agreed that the attributes constitute barriers to accessibility in hospital wayfinding. It is to be noted that 24 respondents were interviewed. The combine effect of the attributes on accessibility and wayfinding is 15 of the respondents. The quotes from some of the respondents that support the claims are as follows: ''there are many people in the hallways and at the corridors at peak periods which makes the hospital crowded and causes confusion in finding destinations'' (R3); ''the heavy human traffic in the corridor cause obstruction to movement on busy days'' (R9); the building layout was very complex and confusing (R7). These attributes are considered as hidden barriers because they are intangible objects, which made wayfinding inaccessible and inadequate for all users' navigation. Furthermore, confusing junctions and staircases constitutes 2 each as substantiated by the following quotes: "staircase and junctions (nodes) in the hospital caused confusion in accessing destinations" (R6). This suggests that designs should consider sufficient corridor widths and hallways in hospitals. Also, sufficient seats should be provided in the waiting areas to avoid people hanging around the walkways in the hospital, particularly at emergency section.

Summary of Findings

Both the quantitative and qualitative findings corroborate that signage was used as the main landmark at decision points, thus, facilitates accessibility in hospital wayfinding. This result confirms the findings of other researchers that both directional and destination signage at decision points positively improve wayfinding (Michael O'Neill, 1991; Tzeng & Huang, 2009; Verghote et al., 2019) . This implies that textual, pictographs, tactile and audible signage are major and important landmarks for wayfinding. This also indicates that signage should be translated into local languages for better understanding by major group of users to ensure accessibility and inclusive wayfinding in the hospital.

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The result of other research in wayfinding asserted that clear visual access in hospital building entrance was capable of reducing uncertainty and stress during wayfinding (Montello, 2014). This proposes that the hospital building entrance should be conspicuous, visible and accessible to all users for successful wayfinding. Similarly, the qualitative research outcome substantiates the quantitative finding that lighting enhanced accessibility and visibility of patients in hospital pathways during wayfinding. Accordingly, the study of Hidayetoglu et al. (2012) found that the rise in the illumination of space absolutely correlates with optimistic perception and accessibility of space during wayfinding. This implies that visibility is a function of building layout; as such hospital design should ensure greater visibility to most destination zones.

Furthermore, crowdedness and difficulty in forming the cognitive map of building layout create barriers to accessibility and wayfinding in hospital. Similarly, Dogu and Erkip (2000) found crowding in pathways to have impacted on individual's aptitude to recollect a building and its position. Likewise, it is argued that a crowded environment suggests complexity and could offer a lot of visual distortion, causing difficulty in giving concentration to suitable wayfinding data in the hospital (Verghote et al., 2019). This supports the findings that crowd control is significant in hospital wayfinding design (Hughes et al., 2015).

CONCLUSIONS AND RECOMMENDATIONS

The complexity of the building layout results in lack of accessibility and wayfinding difficulty which causes uncertainty, stress, frustration, and getting lost in hospital. This research set out to assess the impact of visual accessibility and barriers of wayfinding in hospital buildings. The major findings of the research indicate that well placed signage recognisable entrances, and adequate illumination of circulation spaces do enhance accessibility of spaces during wayfinding. In addition, crowdedness in the circulation spaces, invisibility of most destinations from the main entrance, and indistinctive nodes constitutes barriers that impede effective wayfinding. These imply that the main building zones and signage should be conspicuous and accessible to all users; adequate pathway width and proper segregation of waiting areas should be created for crowd control, and building layout be made simple to understand in hospital design.

This research is significant to the understanding of accessibility and inclusive wayfinding design to improve all users' access, increase satisfaction, reduce confusion and confidence during hospital wayfinding. It is to be noted that inclusive wayfinding design refers to providing sufficient wayfinding information that allows diverse people to efficiently use their capabilities in discovery routes to the desired destinations. The policy implications are that designers should make building layout more legible through simplified design such that core departments are visible and interlinked with high traffic flow pathways in the hospital. Also, the study recommends that decision points should

be made distinctive with markers (landmarks) to improve imageability and readability of the hospital environment. Finally, policy makers and designers should ensure the utmost independent wayfinding to the extensive group of users beyond physical and sensory accessibility for a successful inclusive wayfinding system.

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