ASSESSMENT OF ARCHITECTURAL DESIGN ELEMENTS INFLUENCING WAYFINDING FOR ORTHOPAEDIC HOSPITALS IN MINNA, NIGERIA

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Abstract

Wayfinding in healthcare facilities has been found to be quite difficult for a new patient or visitor. This is as a result that the physical environment of a health care setting may be the most challenging area in architecture in terms of wayfinding and humanistic planning and design. The Niger State Government has set out to improve healthcare delivery, reduce accident mortality, develop a good wayfinding system that uses less staff and volunteer time. Also assist in alleviating people's stress, frustration, and anxiety that have been associated with healthcare facilities that are difficult to navigate. Hence, the aim of this study is to assess architectural design elements influencing wayfinding in an orthopaedic hospital in Minna, Nigeria. The study adopted a quantitative esearch approach; a total of 200 questionnaires were distributed throughout the study population, with 160 questionnaires (80%) successfully recovered. The results show that 56.3% of the professionals indicated that making distinct areas with unique visual characteristics would improve wayfinding. Further findings show that offering training sessions to employees to familiarise them with signage and teach them how to effectively help visitors navigate the hospital will enhance wayfinding in the hospital. The study recommended that there's need for architects to use distinctive landscape components in order to function as external indicators for users of hospital facilities. It concluded that the ability to find a desired destination in a hospital effectively reduces stress and fatigue, improves care delivery, reduces patient and family stress, and enhances overall healthcare quality.

Key words: Architectural, Design Elements, Influencing, Orthopaedic Hospital, Way Finding

INTRODUCTION

Orthopaedics is a branch of medicine that deals with prevention, correction of bones, muscles and joints disorder (Oliver, 2010). Accidents are part of everyday life; it can only be reduced to a minimal level but may not be completely eradicated. The result of accidents ranges from burns to dislocation, fractures or even death in extreme cases. These injuries or disorders of the skeletal system requires aftermath correction. However not all cases of skeletal disorder result from accidents. Some are caused by congenital anomaly, absence of a limb, or the malformation

of one or more limbs. Other causes of orthopaedic impairments may be as a result of degenerative diseases which includes childhood obesity, arthritis and muscular dystrophy.

Many health care organizations have been criticized for poor facility design. Often, the first challenge for users is the successful navigation of the often-overwhelming medical environment. Unfortunately, most hospitals and medical centers are complex mazes of long and confusing corridor systems with bends, turns, and foreign-sounding signs hence frustrating those who visit them (Ndhlovu, 2012). Nothing looks familiar, and visitors, often stressed with demands of an illness, can find coping with confusing corridors frustrating and stressful.

Wayfinding is the process of understanding where you are in the environment, determining where you need to go, identifying the most optimal route to get there, and recognizing when you have arrived (Carpman, 1993). The need for people to navigate their way around an environment and successfully get to their destination in large or complex buildings either through the use of a vehicle or pedestrianly is a very crucial matter.

Wayfinding in healthcare facilities has been found to be quite difficult for a new patient and visitor as the physical environment of a health care setting may be the most challenging area in architecture in terms of wayfinding and humanistic planning and design (Mario, 2013). However, the challenges associated with designing for the wayfinding needs of the different groups of users (e.g. the blind, elderly, children, newcomers, foreign visitors, wheelchair users etc.) who visit complex environments such as hospitals are immense (Rooke, 2012). This happens not only because the complexity of the environment itself, but also because of the unfamiliarity of the patient and visitor with this new environment (Triandriani *et.al,* 2013). This problem in finding places is not only an uncomfortable experience for a patient and visitor, but being lost or disoriented in a new environment can be time consuming and at worst, create a stressful situation that may give a severe impact, especially on the patient health condition. For this reason, wayfinding is an important aspect in healthcare facilities design and become one of the key parameters of space quality that affect the quality care of the facilities (Samah *et.al,* 2013).

Despite awareness of the beneficial role of wayfinding and humanistic design on the physical environment, a majority of studies in healthcare design literature focus on aesthetic physical environments. Therefore, there is a dire need to improve wayfinding performance in the physical hospital environment.

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LITERATURE REVIEW
Dimensions of Wayfinding

The dimensions of wayfinding analyses involve cognitive mapping and legibility as the signal of person and physical factors of wayfinding respectively, and the connection between wayfinding and architecture. Accordingly, cognitive mapping, legibility of spatial environment, and the relationships of architecture and wayfinding are discussed.

Cognitive Mapping

Cognitive maps are mental representations of the physical environment that people use to find their way and to recall important features of the environment. The presence and development of cognitive maps, and the term 'cognitive-like map', were derived by Tolman (1948) as an explanation for route behaviour. Tolman suggested that these mental representations indicate routes, paths and environmental relationships and that it is information from the maps, rather than directly from the environment, which determined the path choice responses in the subjects which were being studied. In any environment, the cognitive map allows one to locate oneself in a familiar environment and to move from one place to another even through parts of the environment never visited before. In wayfinding situation, people develop a cognitive map or mental image their surrounding environment based on senses and memory (Lynch, 1960). Cognitive mapping is a process or series of psychological transformation for solving any wayfinding task for people influenced by spatial memories collected from previous visits, generalized information, signs, maps, navigational system and information from other people (Passini; 1970; Downs and Stea,1973,).

Legibility of the Environment

According to Lynch (1960), legibility denotes to "the ease with which (an environment's) parts can be recognized and can be organized into a coherent pattern". Weisman (1981) provides a definition of this construct that links the physical environment and human behavior. He defines it, as "Legibility is the degree to which a building facilitates the ability of users to find their way". Legibility influences the degree at which an environment can be learned and perceived (Lynch, 1960; Weisman, 1981). In addressing the issue of legibility of environment, Lynch (1960) stated that if the spatial organization of environments is more readily imaged, it helps to make the environment to become more legible. Architectural legibility is the extent to which the designed features of the environment help people in creating an effective mental image of the spatial relationships within a building, and the subsequent ease of wayfinding within the environment (Dehghan *et al.,* 2012).

Others researchers have adapted the concept as it applies to the process of way-finding, at the architectural scale. For example, Passini (1984) uses the term legibility to refer to the quality of an environment, which lends itself to easily extracting and comprehending the information, which is relevant to wayfinding. According to Warner and Kaminoff (1983), legibility significantly reduced user confusion, anger, perceived crowding, and overall emotional discomfort. Similarly, Weisman (1981) has stated that the legibility of an environment refers to the extent to which it facilitates the process of wayfinding. According to him at the building scale, there are four general features of an environment which contribute to determining the legibility:

a) Signage; The use of signs and room numbers to provide identification or directional information
b) Floor Plan Configuration
c) The extent of architectural differentiation
d) Visual access

Other spatial factors are edges, nodes, pathways, districts, use of finishes, colour, luminosity (lighting), utilisation, structure, flow pattern and junctions (Lynch, 1960; Weisman, 1981; Pati *et al.,* 2015).

a) Signage

The signage is one of the elements that can help guide the users within the facilities, since its purpose is to direct, inform, identify, and likewise in specific signs, define appropriate behaviors that users should follow (Carpman & Grant, 1993). When entering the institutions, the main concern of the users is to know where to go to find the destination they are looking for. For this purpose, a well-designed signage system together with other environmental features, appropriately designed for the target audience, can help orientate them and prevent confusion, frustration, stress, and even time losses (Carpman & Grant, 1993). As signs are not the solution for most of the wayfinding problems of the users, they must be connected to all the other environmental aids of the facilities (Ministry of Health, 2014). Although the signage system is not the only element that may provide environmental guidance, primarily the first-time visitors will be looking for these types of information supports when they arrive to an unfamiliar environment, and they expect them to provide the information they need (Ministry of Health, 2014). There are three types of signs that make part of a wayfinding system and that should be considered according to the needs of information required, which are (Ministry of Health, 2014):

- Directional signs – gives information regarding which direction to follow. While the design of directional signs should harmonize with the environment they are in, they also need to stand out enough to be easily recognizable.

- Identity or Locational signs - identify the locations and tell people where they are. They are the visual markers that display the name and function of a space or place.

- Directory or Orientation signs - give general information regarding the location of places and how to get there. It allow visitors to have a sense of where they are in relation to the entire space or place, such as directories and site maps. These signs are large, free-standing or wall-mounted units, and are often strategically located to stand out from their surroundings.

Therefore, authors, such as Rousek and Hallbeck (2011a), suggest that signage design must consider four factors in order to be effectively designed:

- Signage recognition: the users should be able to recognize the meaning and purpose of a specific sign.

- Signage color: the use of colors that can establish a meaning for the users and help their guidance inside the setting.

- Signage font type: carefull choice of the font type and style since it can influence signage legibility and interpretation. Both color and font format should be tested among the users.

- Americans with Disabilities Act (ADA) guidelines: which provide guidelines for designing the signage system, i.e., as to the use of symbols and specific parameters, in consideration to those with disabilities, such as visual impaired, hearing impaired, blind people and mobility impaired.

b) Floor Plan Configuration

The design of the floor plan layout has the greatest influence on wayfinding and perceived legibility (Weisman, 1981). Floor configuration makes it easy for the user to build a mental map for use in wayfinding within it. As mentioned in Abu-Obeid's work (1998), having a good floor plan is not enough to help people form clear environmental images unless it is accompanied by pictorial differentiation. According to Lynch (1960): "most significant for the discussion of environmental information is the finding that the spatial organization of some environments can be more readily imaged that those of others and, further, that path finding performance is better in these more 'imageable' or 'legible' settings". Weisman (1981) used several subjective measures during his research on university buildings as "goodness of form" of floor plan configuration which includes; simplicity, memorability and describability. After that, O'Neill (1991) considered in detail the influence of floor plans on way-finding and found that subjects who travelled the simplest floor plan travelled 25% more quickly, then the floor plan judged to be the most complex.

c) Architectural differentiation:

Weisman defined architectural differentiation as for which character of the region and the landmarks within a building to generate distinctiveness thus the regions can be recognized easily. This is the extent to which dissimilar parts of a setting are distinguished. The environment could be made distinct from one another in terms of size, form, colour, and architectural technique (Mandel & LeMeur, 2018). Besides, the more distinct an environment, the more memorable in supporting wayfinding (Montello, 2014). Kaplan's (1976) study explained about landmark and region that it differentiates an environment into smaller and uniquely identifiable places or areas. Within a building, spaces can differ architecturally which can be served as landmark as

well. Weisman found in his study that elevators, doors, desks, plants also did serve as a landmark function. Architectural differentiation can occur at several scales within a building; these include differentiation between specific rooms or spaces, between regions or wings of a building, or between floors.

d) **Visual access;**

A collective measure of visibility of a setting which includes the visibility of origins, destinations and intermediate landmarks has influence on architectural legibility in indoor environment. According to Weisman (1983) visual access is a variable which involves the ability to "see ahead," that is, to see one's goal before actually arriving there by visually locating and using landmarks in the environment and it is based on the idea that it is easier to find one's way if the goal is within sight. In wayfinding literature, it is a common agreement that when the desired destination become out of sight it causes wayfinding difficulties for the users. The visual accessibility is likely to be weakened if the desired destination cannot be identified because of obstruction by some object or architectural projection or even if the destination itself blends in with the surrounding background. Garling et al. (1983) studies showed that reduced visual access significantly interfered with orientation ability. Therefore, the gradual reduction of visual accessibility may increase the difficulty of way-finding task which will negatively affect the legibility of that environment. On the other hand, success of way-finding task depends on the direct visibility of the desired destination (Garling *et al,* 1983; Braakma & Cook, 1980).

The colour of buildings could aid to distinguish amid constituents in a location and between settings in an environment (Ekstrom *et al.,* 2018). Equally, colour strips are also used in directing patients to some destinations in hospitals. Furthermore, colours that contrast with their background could make perception of objects easier. Besides, strong contrasting colours attract the eye, but should not be too many in order not to create confusion (Harris & Wolbers, 2014). From the foregoing, it can be argued that the use of colour in buildings performs a vital function in wayfinding.

METHODOLOGY

The primary goal of the project is to create a prototype hospital design that integrates architectural aspects aimed at improving navigation in an orthopaedic hospital setting. Since it is imperative that the type and mode of data collected affect and to a large extent determine the outcome of research, in carrying out this work, quantitative tools was adopted in data collection and presentation. In the course of conducting this research work, a number of data collection tools were employed, such as personal observation and questionnaires, with preference given to sources such as patients and medical staff from whom direct information were acquired. Their responses were subsequently noted down for further analysis, which were used in accomplishing the aim of this study.

Generally, the reliability in terms of Cronbach Alpha for the critical factors data (0.572) is moderately reliable, the effectiveness of hospital building data (0.558) is moderately reliable, and professional data (0.702) is highly reliable.

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

RESULTS AND DISCUSSION

Perception of professionals on architectural design element that enhances wayfinding in Niger State.

Table 2 shows the findings as regards the perceptions of professionals on architectural design elements that enhance wayfinding in Niger State. The results show that 56.3% of the professionals strongly agreed that making distinct areas with unique visual characteristics will improve wayfinding, 36.3% agreed, and 7.5% were not sure. The findings reveal the provision of landmarks in the hospital environment that can aid orientation and make it easier for users to remember the route. The results show that 46.9% of the professionals strongly agreed that landmarks in hospitals can help people find their way and make it easier for them to remember the route. Another 41.9% agreed, and 11.3% were not sure how they felt about it. Also, regarding the provision of sight lines to show what is ahead, the findings reveal that 48.8% of the professionals strongly agreed that the provision of sight lines to show what is ahead will enhance wayfinding, 41.9% agreed to it, and 9.4% were neutral about it. The findings also revealed the provision of clear, concise, and easy-to-understand signage at key decision points such as entrances, hallways, elevators, stairways, and wards. The findings reveal that 61.3% of the professionals strongly agreed that the provision of clear, concise, and easy-to-understand signage at key decision points can enhance wayfinding in the hospital; 36.3% agreed to it; and 2.5% were neutral about it.

As regards the provision of digital wayfinding, such as interactive kiosks, mobile apps, and touchscreens, that can provide real-time information and personalised directions to help users navigate the hospital more easily, the findings reveal that 46.3% of the professionals strongly agreed that the 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. 46.9% agreed, and 6.9% were neutral about it. With respect

to offering training sessions to employees to familiarise them with the signage and teach them how to effectively help visitors navigate the hospital,

The findings reveal that 56.3% of the professionals agreed that offering training sessions to employees to familiarise them with signage and teach them how to effectively help visitors navigate the hospital will enhance wayfinding in the hospital; 37.5% strongly agreed, while 6.3% were neutral about it. As regards provision, tactile markings on the floor or braille signs assist the visually impaired to navigate the building and find the right department. The findings reveal that 56.3% of the professionals agreed that the provision of tactile marking on the floor or braille signs helps the visually impaired navigate the building and find the right department; 39.4% strongly agreed, while 4.4% were neutral about it.

With respect to providing 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, The results show that 45% of the professionals agreed that putting a hospital site plan or survey map on a brochure for visitors or on a wall plaque in the main reception area of the hospital will help people find their way around. Another 21.3% strongly agreed, 26.3% were neutral, and 7.5% didn't agree.

Table 2: Perception of Professionals on Architectural Design Element

S/NO	Statements	S.D(1)	D.A(2)	N (3)	A (4)	S.A (5)
C1	Creating distinct regions with unique visual characteristics	0	0	12(7.5)	58(36.3)	90(56.3)
C2	Provision of landmarks in the hospital environment that can aid orientation and make it easier to users to remember the route	0	0	18(11.3)	67(41.9)	75(46.9)
C3	Provision of sight lines to show what is ahead	0	0	15(9.4)	67(41.9)	78(48.8)
C4	Provision of clear, concise, and easy to understand signage at key decision points such as at entrances, hallways, elevators,	0	0	4(2.5)	58(36.3)	98(61.3)

	stairways and wards consumption?					
C5	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	0	0	11(6.9)	75(46.9)	74(46.3)
C6	Offering training sessions to employees to familiarize them with the signage and teach them how to effectively help visitors navigate the hospital	0	0	10(6.3)	90(56.3)	60(37.5)
C7	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	0	0	7(4.4)	90(56.3)	63(39.4)
C8	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	0	12(7.5)	42(26.3)	72(45.0)	34(21.3)

Identifying the critical factor influencing wayfinding in Orthopaedic Hospital buildings.

Relative Importance Index was used to identify the critical factors influencing way finding in the orthopaedic Hospital and to rank each variable according to their important

The Relative Important index formular is given as:

$$RII = \frac{\sum W}{A * N}$$

Where W= Weight given to each statement by the respondent

A=Highest response integer which is 5

N= Total number of respondents for users=160

Table 3: 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

It is easy for me to use important buildings (landmarks) to find a desired destination in the hospital was ranked first as the critical factor influencing way finding as identified using the Relative important index, the variable "It is easy for me to visually identify the building entrance when I come to the hospital" was ranked second while the variables "Do you agree that signs that include both words and icons make it easy for you to find your desired destination in the hospital", "Do you agree that too many patients (crowd) around the circulation space disturb the ease of wayfinding" and "It is easy for me to use trees to find a desired destination in the hospital" were ranked 5th, 6th and 7th respectively. The present research examines the

perspectives of experts about architectural design components that contribute to the improvement of wayfinding. These results are consistent with previous research indicating that the signals were effectively seen and comprehended by a significant proportion of users due to their reading skills (Arthur & Passini, 1992; Lewis, 2010; Ahmed *et al.,* 2019). As a result, this suggests that the signage was strategically positioned and the information was comprehended either at, or somewhat before to, a critical juncture. The results of this research pertaining to the essential aspects that impact wayfinding This proposal indicates the use of signage that combines textual information and visual symbols, so facilitating the process of locating certain destinations inside the hospital premises. This discovery aligns with the results reported by Anacta *et al.* (2017) and Ahmed *et al.* (2018). These characteristics possess the potential to serve as prominent points of reference for individuals seeking to establish their bearings, verify their chosen path, and gain a sense of confidence when navigating their surroundings. Furthermore, it is crucial to acknowledge the importance of providing relevant information at decision-making places, such as circulation junctions sometimes referred to as nodes, in order to facilitate the process of wayfinding. Therefore, it is essential that landmarks used as conspicuous elements be intentionally built to possess high visibility from a considerable distance, particularly at critical junctures inside the hospital when decisions about wayfinding must be made.

Conclusion and Recommendation

This research is aimed at designing an orthopaedic hospital that integrates wayfinding strategies within the hospital environment in order to aid in movement. The Relative Importance Index was used to identify the critical factors influencing wayfinding in the orthopaedic hospital and to rank each variable according to its importance. It is easy for me to use important buildings (landmarks) to find a desired destination in the hospital, which was ranked first as the critical factor influencing way-finding. Based on the findings of this study, it was concluded that the ability to find a desired destination is effective in reducing stress and fatigue. that the ability to find a desired destination in the hospital is highly effective in the delivery of care. Given the significant advancements in hospital design, it is strongly advised that architects incorporate the findings of this study into the practical implementation of hospital design. This research recommends:

i.   Distinctive landscape components have to be used in order to function as external indicators for users of Hospital facilities.

ii.   Utilising interior design cues, such as the use of distinct colour coding for certain zones or departments.

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