IMPROVING WAYFINDING IN HOSPITALS FOR THE DESIGN OF TRAUMA SPECIALIST HOSPITAL, BAUCHI

BY

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THE DEPARTMENT OF ARCHITECTURE

AHMADU BELLO UNIVERSITY ZARIA

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DECLARATION

I declare that the work in this dissertation entitled 'IMPROVING WAYFINDING IN HOSPITALS FOR THE DESIGN OF TRAUMA SPECIALIST HOSPITAL, BAUCHI' has been performed by me in the Department of Architecture A.B.U Zaria. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

Dauda Abdulhamid		
Name of Student	Signature	Date

CERTIFICATION

This dissertation entitled 'IMPROVING WAYFINDING IN HOSPITALS FOR THE DESIGN OF TRAUMA SPECIALIST HOSPITAL, BAUCHI' by Abdulhamid DAUDA meets the regulations governing the award of the degree of Master of Science in Architecture of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

The purpose of this study was to establish ways of improving wayfinding in hospitals in Nigeria in response to the rise in trauma cases from insecurity in the country. The approach was explored in North East Nigeria to generate appropriate responses to wayfinding needs during emergencies. North East Nigeria is a geo political zone that has been vulnerable to various scales of terrorist attacks in the country. Two surveys were conducted in four hospitals to explore both existing wayfinding features and relationship between physical features, coded information and social practices in hospitals in North East Nigeria. Results from the first survey, visual survey and interviews, reveal extensive incorporation of wayfinding features with little or no guidelines, resulting to poor design, confusing signs and high dependency on social practices. The second, a questionnaire survey provided data analyzed for means (M) and Relative Agreement Index (RAI) under the three-wayfinding concept of physical features, coded information and social practices. Results reveal that hospital users in the study area employ physical features (M 3.22) and social practices (M 2.58) followed by coded information (M 2.55) for wayfinding in the study area, this implies that users will find it tasking to find their way through complex hospitals in the event of trauma and/or other emergency related cases by relying on poorly designed wayfinding guides. The implication is that architects and other construction professionals need to differentiate finishes, structures and landscape elements, project clear building entrances and sidewalk as well as design colour guides on walls not floor to improve wayfinding in the study area.

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ABBREVIATIONS

A&E:	Accident and Emergency
DMP:	Decision Making Point
EM:	Ethnomethodology
ICT:	Information and Communication Technology
M:	Mean
NHS:	National Health Service
PE:	Passini Era
PFI:	Private Finance Initiative
PoPE:	Post Passini Era
PrePE:	Pre Passini Era
RAI:	Relative Agreement Index
SERVICOM:	Service Compact
UA:	Unique Adequacy
WCF:	Wayfinding Conceptual Framework

1.0 INTRODUCTION

1.1 Background of study

Wayfinding systems have been the commonly used strategies to guide people's orientation and navigation within large and complex institutional and multi-level buildings. It is a problem solving process that operates in space and involves spatial organization and/or information (Passini 2002; Timf, 2005; Bianconi and Andreani, 2011). However, many researchers given the task of improving wayfinding limit the solution to developing attractive signs (Health Facilities Scotland, 2007; Wayfinding, 2005). This results to a large number of such buildings developing over time in a disordered manner, producing complex environments consisting of long and confusing corridor systems with bends, turns and confusing signs (Rooke, 2012), These settings challenge and frustrate users especially in chaotic situations such as stampedes induced by panic during fire, security and other types of emergencies (Hajibabai, Delavar, Malek, and Frank, 2006). Such scenarios have unfortunately become common place in the many parts of the troubled North East region of Nigeria.

Nigeria is also grappling with multi-dimensional security challenges, the worst of which has been terrorism. The emergence of terrorism in Nigeria marks a threshold in the dramatic reign of public insecurity, which has generated widespread anxiety in the country with the North East geo-political zone being the worst hit by the terrorist insurgency (Okoli and Iortyer, 2014). According to the United Nations High Commission for refugees, the crises has displaced over 1.4 million and traumatized 5.4 million people in the north-east Nigeria (Channels Television, 2015). Such large number of traumatized victims may or already have called for Federal Government intervention, considering the

fact that the geo-political zone has been the most prone and most vulnerable to various scales of terrorist attacks in the country (Okoli and Iortyer, 2014).

In this regard, hospitals are usually the first destination for victims of trauma and their relatives who throng medical facilities in a panicked state to inquire about the conditions of their loved ones. Anxiety and frustration from such insecurity coupled with long and confusing corridor system with bends, turns and confusing signs worsen their situation. Security and medical personnel add to this frantic scenario when carrying out their duties in aid of traumatized patients.

1.2 Statement of the problem

Challenges associated with wayfinding needs are given low priority by designers, seeing it as a hindrance to good design or a problem to be solved with signage (Carpman and Grant, 2002). While security issues set anxiety and frustration, long and confusing corridor system with bends, turns and confusing signs adds to the problem. These can course stress which may result in feeling helplessness, raised blood pressure, headache, increased physical exertion and fatigue (Heulat, 2007), thus, the need to ease the anxiety and frustration, and reduce the fear of crime and enhance the perception of security in North East Nigeria.

While wayfinding researches on hospitals have been conducted out of Nigeria, very little has been done to address wayfinding issues within hospitals in the country especially in light of insurgent attacks on the populace which often occur around hospitals. Additionally, it is not clear what users require, how they respond or their attitudes towards wayfinding needs in relation to hospital design in Nigeria.

1.3 Aim and objectives

This research therefore aims at establishing ways of improving wayfinding for users in hospitals in Nigeria.

Objectives;

The aim of this research will be achieved through the following objectives:

i. To explore the concept of wayfinding in hospital design from literature.
ii. To establish how wayfinding features have been incorporated in the design of similar hospitals from case studies.
iii. To empirically determine user requirements for wayfinding in hospital design from interviews and questionnaires in the study area.
iv. To develop a framework from literature and case studies on user wayfinding requirements in hospital design.
v. To demonstrate findings from the research in the design of the Trauma Specialist Hospital, Bauchi.

1.4 Scope of the study

This research is limited to those wayfinding strategies concerned with hospital complexes during emergencies with specific interest in the North-East region of Nigeria. This is considering the fact that the geo-political zone has been the most prone and most vulnerable to various scales of terrorist attacks in the country (Abdulrasheed, Onuselogu, & Obioma, 2015; Winsor, 2015; Segun, 2016; Okoli and Iortyer, 2014).

1.5 Research questions

i. Which wayfinding features have commonly been incorporated in the design of hospitals in the study area?

ii. Which architectural features address user requirements for wayfinding in hospital design in the study area?

1.6 Justification of study

With the rise in trauma cases from the insecurity problems in the country, it is important that new proposals for hospitals address the problem of wayfinding.

2.0 LITERATURE REVIEW

2.1 Wayfinding

Wayfinding was used for voyaging for thousands of years before the invention of European navigational instruments (Woodward and Lewis, 1992). It also has more modern connotations. The actual term "wayfinding" was first used in 1960 by architect Kevin Lynch in his book (The Image of the City), where he referred to maps, street numbers, directional signs and other elements as "way-finding" devices. This narrow description may explain the current misunderstanding that wayfinding is essentially the same as "signage." Wayfinding is simply the process of determining and following a path or route between a specified origin and a specified destination (Gollege 1999). It is the adaptive function that allows us move through an environment efficiently to locate valuable items within the environment (Downs and Stea, 1977; Evans, 1980; Bell et al., 2005: 69).

Furthermore, the concept of wayfinding had and continues to capture the interest of many professionals such as architects, designers, planners, academic researchers, estate and project managers, patient representatives in the case of healthcare etc. (Rooke, 2012). Although only cognitive and environmental psychologists have long been concerned with wayfinding, it is becoming more prominent in the field of design. The interests in wayfinding seems to be unified as a result of the dire need to find more effective solutions that go beyond the normal practice of using signs and the need to gain understanding into how wayfinders carry out the task of finding their ways in, about and out of buildings (Maina and Umar, 2015).

2.2 Historical Development in Wayfinding

According to Rooke (2012), the developments in wayfinding appear to fall into three overlapping eras: The Pre-Passini Era (PrePE) from 1960 to the 1970s, the Passini Era (PE) from the late 1970s to 1990s and the Post-Passini Era (PoPE) from the mid-1990s to date. The first era witnessed the inception and conceptualisation of wayfinding which is understood and explained in terms of spatial orientation and cognitive maps (e.g. Lynch 1960; Downs and Stea 1973, 1977; Kaplan 1976; Siegel and White 1975) and was dominated by thinkers keen to study cognitive structures responsible for information processing. The second era (PE) witnessed further conceptualization of wayfinding through extending the concept of spatial orientation and was dominated by thinkers keen to study the dynamism of humans in space (e.g. Passini 1977, 1984, 1996, Wiseman 1981, Arthur and Passini 1992). Wayfinding is understood and explained in terms of spatial problem solving. The third era sees an extensive application of existing concepts where nothing new is offered in terms of conceptualization. The era is divided into two camps, which are *pro-Passinis* (e.g. Carpman and Grant 2001, Huelat 2004, Brandon 2008, Rooke et al. 2010) and *pro-cognitivists (e.g.* Golledge 1999, Raubal 2001, Haq and Zimring 2003, Holscher et al 2005). A detailed discussion of the developments in each era is given below;

2.2.1 Pre Passini Era (PrePE)

In 1960s, Lynch asked residents of four cities in the United States to draw sketch maps of different cities from memory. By comparing the sketch maps to the actual layout of each city, he found that respondents organized their city images using a set of common images and features such as paths, landmarks, regions, edges and nodes. His work, which is seen by many as being pivotal in how we understand environments, was based on the

concept of spatial orientation and its prerequisite the cognitive map (Arthur and Passini, 1992). Lynch reasoned that the five key features (see figure 2.I); paths, landmarks, regions, edges and nodes are the main components of cognitive maps (Appleyard, 1969; Francescato and Mebane, 1973).

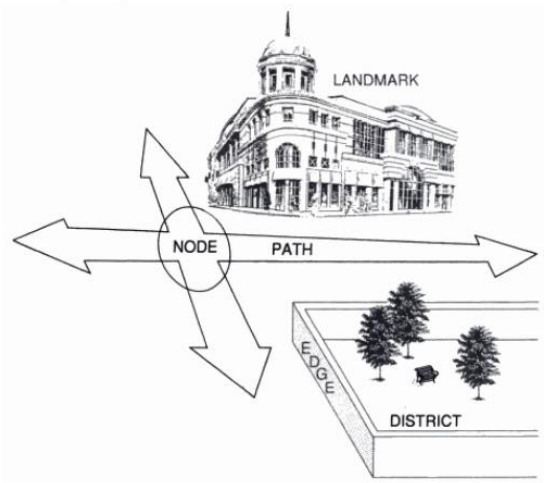


Figure 2.1: key wayfinding features. Source; Arthur and Passini, (1992).

2.2.2 Passini era (PE)

Twenty years later (in the mid-1970s) Romedi Passini extended Lynch's theory to architectural spaces, signage and other graphic communications. He made the first empirical study of wayfinding process in his book (Wayfinding in architecture) and tackled the subject in greater depth (Rooke, 2012). Romedi Passini (1977) argued that the concept of spatial orientation did not consider the dynamic aspects of human movements. He disputed that wayfinding involves more than just generation of static mental map of a spatial situation as suggested by Lynch (1960). The author then introduced the idea of wayfinding as a spatial problem-solving exercise in which people must solve a wide variety of problems as they navigate through architectural and urban spaces. He found that humans‘ depend on information and cues within environmental

spaces to aids decision making, decision execution and information processing (Passini 1977, 1984).

Passini and Paul Arthur collaborated in 1992 on a seminal work (Wayfinding: People, Signs, and Architecture) which organised architectural and cognitive research on wayfinding (Hunter, 2010). The extension of Passini's (1984) earlier work, introduction of the term environmental communication, and the argument that the built environment and its parts should communicate with its users are the clear characteristics of their work (Rooke, 2012). The work of Arthur and passini was the first to differentiate architectural and information components of wayfinding, compile relevant evidence, and translate it into design guides as opined by Hunter (2010).

2.2.3 Post Passini Era (PoPE)

According to Rooke (2012), close analysis of current research shows continuous production of solutions (principles and guidelines) that are often based on the theoretical concepts of spatial orientation as originally defined by Lynch (1960); spatial problem solving as presented by Passini (1977, 1984) and Arthur and Passini (1992); cognitive mapping as given by Gollege (1999) and to a lesser degree that of space syntax as argued by Peponis et al (1990). These solutions put into consideration the emphasis of wayfinding at all levels of scale in planning such as regional, city, neighbourhood, street systems, public transportation, parking, building complexes, infrastructure and amenities, and individual building layout (Hunter 2010).

Brandon (2008) articulates the works of Passini (1977, 1984) and Arthur and Passini (1992) in a very complimentary way. Brandon asserts that it has given a structure for describing and explaining a lot of problems which graphic designers have been facing for many years. This has ratified the perception of designers about good wayfinding

design, corrected notions and seen the development of a common language with which designers and clients can discuss wayfinding needs and solutions.

The impact of the work on cognitive mapping and wayfinding by Golledge (1999) and that of space syntax and wayfinding (e.g. Peponis et al 1990, Haq and Girotto 2003) was highlighted by Hunter (2010). The author recognises the challenges faced with characterising any specific cognitive psychological process to wayfinding generally as wayfinding is a purpose-dependent exercise. Cognitive mapping continues to be extensively used in research on wayfinding in virtual environments (e.g Darken and Banker 1998, Chen and Stanney 1999). The research heavily references the work of Lynch (1960) and it appears to be driven by the desire to find out if simulated environments can provide solutions that can be applied in real life.

The concept of space syntax and wayfinding is based on the systematic techniques developed by Bill Hillier in the late 1970s to identify and collect topological information and compare settings (Peponis et al. 1990, Haq and Girotto 2003). However, Peponis et al (1990: 556) argued that there was a scarcity of theories and analytic techniques to deal with the architectural environment as a knowable morphology' and that the concept of space syntax was the solution. They noted that knowledge acquisition rather than actual variations in the environment have been the focus of previous research on the relationship between humans and their built environment.

These developments in wayfinding have shown that wayfinding continues to be largely underpinned by the concepts of spatial orientation, cognitive mapping and spatial problem solving.

2.3 The Importance of Good Wayfinding

Arthur and Passini (1992) noted that people often blame themselves for lack of judgment and ability to make quick decisions to navigate complex environments. However, this blame was transferred away from wayfinders to designers by several scholars (eg. Haq and Zimring, 2003; Baskaya et al, 2004). They emphasise that getting lost is an indication of poor design of buildings or wayfinding systems meant to serve as guides to people not an inadequacy on the part of the wayfinder. Van der Klipp (2006), highlight limitations such as language difficulties, reduced visual ability, memory loss, reduced endurance, strength and balance, gender differences and cultural differences as major challenges associated with wayfinding. As Coleman et al (2003) rightly note people with hearing losses and communications impairments may find it difficult to make sense of verbal instructions whilst those with visual impairments cannot rely on visual information.

Bever (1992) reveal that men use globalized configuration strategies to find their way or give directions. However, female on the other hand, have a tendency to have less spatial confidence than men and rely on localized landmarks for wayfinding as revealed by Lawton and Kallai (2002) and Frank (2002). While other studies have also shown that gender differences in spatial orientation have been totally absent, and that strategies are selected depended on a combination of environmental features, past experience and individuals' fluency, or competency with particular strategies (Livingstone-Lee, Zeman, and Gillingham, 2014; Coluccia and Louse, 2004). Lynch (1960) made a point emphasizing that design ought to be used to underpin existing social meaning, not to contradict it. Carpman and Grant (2001) and Huelat (2007) reiterated that their observation that, visual dominance of entrances, definition of public space from private

space, the ability to visually separate one functional zone from another, are critical to successful navigation.

According to Huelat (2007), entrances that are easily identified, clear pathways, legible elevators and landmarks contribute to good wayfinding and the formation of cognitive maps of a space. The author also observed that a good building feature design can facilitate easy understanding and utilization of built environments therefore assisting wayfinders navigate and retain their sense of orientation. Hunter (2010) states that this should in turn contribute significantly to user satisfaction and frequency of use of a built environment.

The use of distinctive views of plantings, water views, and views of shocking or unexpected sites such as large changes in scale or colour variation, can assist users to construct wider mental maps and strong contrasts of spatial configuration (Hunter 2010). Werner and Schindler (2004) and Ruddle and Peruch (2004) highlight properties of building layout that simplify or obstruct movement. Environments with perpendicular intersections give better wayfinding performance than those with angled intersections (Werner and Schindler, 2004). Ruddle and Peruch (2004) assert that well designed signs are likely to be quite ineffective in a building that is highly complicated and does not provide simple cues that enable natural movement. They observe that signs can be confusing or unsuccessful when layered on poorly designed site or architectural features. The merits of providing users with clear sightlines on entering a building are emphasised by Hunter (2010). The author notes that this can afford the user an overview of their surroundings so they can see a large number of elements and their relationships at the same time thus giving them a sense of orientation. Holscher and Brosamle (2007) also assert that if large parts of the environment are immediately visible, people rely less on

stored spatial knowledge and more on information directly available in their field of vision.

Haq and Zimring (2003) focus to the overall structure of the system of rooms and corridors stating that the naming, numbering and general organization of the parts of a building is a critical organizational aspect of a wayfinding design. Their findings show that floor numbering, dedicatory names vs. common names, departmental names, stall numbering, and room numbering must be given carefully consideration at an early stage. The use of distinguishing views of plantings, water views, and views of shocking or unexpected sites such as large changes in scale or colour variation, can also assist users to construct wider mental maps, as can strong contrasts of spatial configuration, materials (Lynch 1960, Hunter 2010).

Evidence examined above also highlight the need to decrease dependence on signage as a means of aiding wayfinding. Miller and Lewis (1998) observe that many people associate wayfinding with signage. Huelat (2007) asserts that signage should support the good bones‘ of the physical environment, calling for a clear organized set of sign elements which should provide four types of information: informational, directional, identifying and regulatory. The author adds that these should be integrated into design in a logical, consistent and user friendly way. Heulat (2007) reiterates Carpman et al.‘s (1984) observation that directional signs are more effective when placed at or before every major intersection, at major destinations, and where a single environmental cue or a series of such cues (e.g., changes in flooring material) convey the message that the individual is moving from one area into another. Carpman and Grant (1993) point out that any good wayfinding system should go beyond mere signage and the use of colour codes to differentiate various areas. They call for an integration of coordinated elements,

such as visible and easy-to-understand signs and numbers; graphic symbols; clear and consistent verbal directions; consistent and clear paper and electronic information.

Extent literature shows that wayfinding is a macro issue involving the physical and operational environments in which it occurs (Carpman and Grant 2002). It is more than just individual perception, cognition, and behaviour. It is also clear that there is a wealth of advice regarding the design of ideal wayfinding systems and strategies that should aid effective communication with wayfinders. Furthermore, the solution is basically developing wayfinding design principles that will provide a structure to organise the environment into a spatial hierarchy capable of supporting wayfinding tasks as noted by Arthur and Passini (1992).

2.4 Factors Affecting Wayfinding

According to Demirbaş (2001), there are two distinct dimensions of wayfinding; the first is of a functional nature that corresponds to the reaching of destinations within acceptable limits of time and energy. The aim of wayfinding design in this respect is to provide the environmental information necessary for decision making and decision execution while respecting user ability to deal with basic perceptual and cognitive tasks. The second is of an evaluative nature that corresponds to the experience gained during wayfinding. A wayfinding experience is somewhat different. It establishes a very strong relation with the environment and the spatial characteristics distinguishing it. However, it is difficult to predict a person's ease at wayfinding because many factors, both individual (internal) and spatial (external), contribute to wayfinding ability (Kitchin, 1994).

Spatial factors include characteristics of a situation or environment such as the density of buildings in the area, the availability of meaningful landmarks, and the pattern of streets and intersections. Individual factors include characteristics of people, such as age,

gender, familiarity with the environment, and the types of strategies one typically uses to navigate through an environment. Unfortunately, there is little agreement in the literature about which factors may be most important for predicting wayfinding ability (Prestopnik and Roskos-Ewoldsen, 2000).

The problems with finding relevant information in public settings like hospitals, shopping, complexes etc. at the urban scale are common impediments to efficient wayfinding. The information can be ambiguous or incomplete, or it may not be appropriate for individuals coming from different backgrounds, requiring a particular effort of interpretation (Demirbaş, 2001).

2.4.1 Environmental Information

Environmental Information is the term that describes all relevant information available to a person when completing a wayfinding task. It includes a descriptive, a locational, and a time component. It plays a central role in the conceptualisation of wayfinding. It is used in all phases of spatial problem solving and contributes to the identification of a wayfinding problem and to the elaboration of the solution.

Also, the provision of adequate environmental information is a crucial design issue. Signs, maps, verbal descriptions, as well as architectural and urban space can be seen as information support systems to wayfinding (Passini, 1996). The existence or inexistence of these aids contributes significantly to efficient wayfinding in the environment as well as safety and satisfaction.

Furthermore, Demirbaş (2001) noted that wayfinding task is affected by two major physical factors; the layout of the setting and the quality of the environmental communication. Form, spatial content, organisation, and circulation are the elements that

define the layout of an environment. Environmental communication includes all of the architectural, audible, and graphic expressions that provide the essential information for wayfinding (Arthur and Passini, 1992). Weisman (1981) also identified the spatial factors that affect wayfinding, these include: 1) the ability to see through or out of a setting, 2) type of signage provided, 3) the extension one location looks different from others, and 4) the overall plan or layout of a setting.

Wayfinding difficulties are usually explained by inadequate signage. Quite often, though, the deficiency is architectural. Wayfinding difficulties might be due to a confusing layout that cannot be understood and no signage can fully remedy that shortcoming. Wayfinding difficulties may also be due to poor articulation of architectural features such as the indication of entrances, exits, horizontal paths, stairs, lifts and elevators, landmarks serving as anchor points and the circulation system which cannot always be compensated by signage systems (Passini, 1996). Nonetheless, to pick up existing wayfinding information in highly active and complex settings may cause considerable difficulty (Passini, 1996). The factors responsible as summarise by Demirbaş (2001) are:

(i) A general overload of stimuli and information
(ii) Insufficient distinctiveness among signs that have different functions or that address different populations
(iii) Inconsistent placement of wayfinding signs; and
(iv) Inconsistent use of recognisable design characteristics.

A most important part of understanding people's information-processing behaviour is to conceptualise perception as an interactive relation between a person and his environment. The viewer not only receives but also looks for information. If a person knows where to look for the desired information, she/he will simply reduce his field of search in space.

Instead of having to sample the whole setting, the person will be able to focus on a particular area, such as the ceilings of corridors, on particular architectural elements, such as columns, panels on kiosks. Visual accessibility is one of the factors that contribute to accessing the desired information.

2.4.1.1 Visual Accessibility

Visual accessibility is an important dimension of wayfinding in the built environment as it provides the users with information about the circulation system, the horizontal (i.e. corridors) and vertical paths (i.e. stairs, elevators, escalators), spaces adjacent to these paths, etc. The legibility of key architectural elements is a prerequisite to understanding the spatial organisation (Arthur and Passini, 1992). In addition, Lawton et al. (1996) state that factors found to affect acquisition of configuration knowledge in buildings include design features such as the degree of visual access and floor plan complexity. Orientation in a building is likely to be much easier if every part of a building can be seen from every other part. Obviously, visual accessibility communicates important information within a building.

Also, Visual accessibility has a major role in emergency conditions, being able to see signs, landmarks and certain parts of the built environment is an important factor that affects the behaviours of wayfinders. Stress and panic are feelings often accompanying people trying to exit a setting in a hurry. Small scale buildings with direct visual access to relevant places can support visual orientation in such condition (Marquardt & Schmieg, 2009).

2.4.1.2 Building Configuration

Configuration refers to the way in which spaces are related to one another as well as with respect to the overall pattern that they constitute. Overall configuration is influential in

wayfinding and understanding of configuration is often the final developmental stage of learning of settings (Peponis et al., 1990). A number of studies also suggest that the complexity of a floor plan configuration is the primary influence on wayfinding performance (O'Neill, 1991a; Peponis et al., 1990).

Buildings organised around an open core have the advantage of providing the users with access to the form of the circulation system (Arthur and Passini, 1992). However, According to Gestalt way of thinking, regular, symmetric and continuous rectilinear floor plans are good forms that are easier to remember, and which are believed to facilitate forming cognitive maps and to aid people's orientation (Abu-Obeid, 1998). In addition, Marquardt and Schmieg (2009) also note that analysis concerning architectural features of floor plans shows that the layout of circulation system significantly affects residents' orientation and was identified as the most influential environmental factor on a resident's wayfinding abilities. In straight circulation systems, residents were able to find their way better than in any layout that featured a shift in direction, such as L-shapes. Numerous shifts in direction, such as continuous paths around an inside courtyard, interfered further with residents' wayfinding abilities they added.

2.4.1.3 Architectural Differentiation

Architectural differentiation is a means of conveying environmental information to users, to prevent the mishap of getting confused between spaces with different functions, not to create misconceptions about the accessibility or privacy of spaces. Therefore, distinctiveness can be achieved by the form and volume of the space that define architectural and decorative elements, by the use of finishes, providing visual impact by structural and decorative elements of walls, columns, ceilings and floors, creating special illumination, colours, and graphics (Arthur and Passini, 1992).

Although, Darken (1996) states that organisational principles are intended to provide the necessary structure by which an observer can mentally organise the environment into a spatial hierarchy capable of supporting wayfinding tasks, different parts of the environment become increasingly difficult to recall and differentiate especially when they follow the same organisational principle without any differentiation among them. In such environments, architectural differentiation becomes a major factor that influences wayfinding positively or negatively. Arthur and Passini (1992) state that using colour, material and texture differences in spatial features such as structures above or below paths articulate the building organisation.

Monotony in architectural composition leading to repetitive environments, even if they are simple, is another factor that renders wayfinding more difficult. Labyrinths are difficult because of their repeated sameness (Passini et al., 2000). Thus, a certain degree of environmental complexity is required. Uniform corridors and lack of landmarks to enhance the legibility of decision points have a negative impact on wayfinding. Passini et al. (1998) emphasise the importance of distinguishing a zone; they suggest that a zone with a strong character might favour a certain spatial identification, if only in the sense of being somewhere distinct. Uniformity, after all, is the secret of labyrinths and getting people lost.

2.4.2 Signage System

Signs are another graphic information system end-users utilize when finding their way (Gibson, 2009). They complement circulation systems and function as cues to a particular destination (Ford & Torok, 2008). According to Gibson (2009), signs are classified into directional signs (signs that direct end-users to their destination e.g. text, arrows and symbols), identification signs (identify end-users' destinations and sometimes

communicating the value of a place), orientation signs (include a combination of directional and identification signs, and might also include a schematic overview of a location) and regulatory signs (usually restrictive, highlight what is permitted and prohibited).

Signs can be useful in situations such as selecting which route to take when in an unfamiliar environment or during emergencies (Chang, 2013). Their efficiency can be measured in part by their sizes in relation to the environment and their approximate distance to the end-user (Arthur & Passini, 1992). As is the case for maps, information overload is a risk for signs, and can inhibit the ability of end-users to process information (Oyelola, 2014).

The graphic conception of signs, the choice of lettering, the contrast created by black, white, and coloured elements, the size of signs, their position and illumination, all these factors contribute to legibility and to the relative ease of finding information (Passini, 1984). Time spent on reading a sign is an important aspect. Passini (1996) notes that people are annoyed and frequently become impatient when they have to read through lists of names or study unstructured information on signs and maps. Demirbas (2001) summarised a number of factors that results to difficulties in interpreting sign messages, which are;

(i) Imprecise information on signs with respect to what they mean and whom they concern;
(ii) Inconsistent application of sign type and symbol;
(iii) Application of sign elements, generally understood in a familiar context to new situations in which part of the original meaning is no longer relevant;

(iv) Introduction of new symbols, codes, and sign systems without accounting for the learning process necessary to efficiently use an innovation.

O'Neill, (1991) contends that people generally make fewer wrong turns in settings with signage than in those without. Findings suggest that graphic and textual signage may be applied to optimise different aspects of wayfinding. As buildings get larger and more complex, it becomes increasingly difficult to provide adequate wayfinding simply with signs and other cues, if the suggested pattern of movement ignores the ways people use and understand the configuration of the space Demirbas (2001).

2.4.3 Individual Characteristics

Apart from the spatial characteristics of the built environment, individual factors such as gender, age, cultural background, and disability affect wayfinding and its styles. Many researchers are interested in the differences in wayfinding and behaviour between males and females (Lawton, 1996; Malinowski and Gillespie, 2001). Many studies hold that men are superior to women in navigational ability. While some studies indicate that gender differences favour men in two types of spatial ability, mental rotation and spatial perception (Lawton, 1996; 1994), some studies report slight gender differences only in confidence ratings (Cornell et al., 1999). Studies such as that of Golledge (1991) and Lawton (1994) have found a relationship between gender and directional knowledge, report that males show higher accuracy than females.

It has also been found that men rely on cardinal directions and other type of reference point when navigating in an environment. Women have shown to refer more on landmarks when giving directions, and have also shown to have better accuracy in recalling and estimating distances to landmarks (Saucier, et al., 2002). Other studies have also shown that gender differences in spatial orientation have been totally absent, and

that strategies are selected depended on a combination of environmental features, past experienced and individuals' fluency, or competency with strategy (Livingstone-Lee, Zeman, & Gillingham, 2014; Coluccia & Louse, 2004).

The effects of age on difference in wayfinding behaviour and mental processes taking place during wayfinding has been subject to numerous studies (Lawton, 1994; Cornell et al., 1999; Passini et.al, 1998; 2000) over the years. Studies indicate wayfinding behaviour and accuracy are affected by the outcomes of aging such as lack of concentration and memory disorders as in dementia of alzheimer type (DAT) (Passini et al., 1998; 2000).

Background is also influential in wayfinding. People are socialised differently, growing up as they do in different geographical and social environments, the way they perceive and use the environment differ according to their cultural backgrounds. Differences in wayfinding behaviour may also be due to factors such as education, occupation, and previous experiences in different types of settings, or different modes of travelling. A taxi driver, for instance, is a person who is professionally engaged with travelling. Because his route changes daily, he has a broad knowledge about streets and districts compared to people with different occupations (i.e. housewife, teacher, etc.).

Research indicates that wayfinding difficulties in the built environment are magnified for the handicapped population (Arthur and Passini, 1992, Kitchin, 1994). Wheelchair users, visually impaired or blind people, and DAT patients partially represent the population which require special aids within the built environment. Generally, the built environment is designed with little consideration for people with different capabilities and this becomes a major problem.

The case of mental disabilities is an important issue in the study of wayfinding. Many people around the world suffer dementia that restricts the cognitive abilities of patients.

Disorientation and loss of memory are the two key factors to interfere with social adaptation of DAT. They are also considered among the first and clearest signs of dementia (Passini et. al, 1995).

2.5 Wayfinding in Emergency Conditions

According to Xie, Filippidis, Galea, Blackshields and Lawrence (2012), apart from navigation of complex environments, wayfinding design is also crucial in planning for emergency conditions. Stress levels in emergency situations can affect wayfinding performance, as anxiety affects perceptive and cognitive abilities. Uncertainty and the perception of danger can also have an impact on wayfinding. As a result, designers consider consistency when designing wayfinding communication, as this achieves the dual function of reducing information overload and allowing for easy recognition and understanding (Arthur and Passini, 1992). Xie et al. (2012) further assert that if end-users understand an environment well, it will be easy to navigate during emergency situations.

2.6 Wayfinding Design Principles/guidelines

Hunter (2010) observes that despite the impressive research evidence, wayfinding continues to receive less than its due in planning, research and building evaluation. Peponis and Weiseman (2002) also warn that designers should not assume that wayfinding principles are the same at all scales. They assert that these should reflect the: differences in interior and exterior wayfinding, wayfinding differences between first time and regular users, and differences in strategies used by significant population groups. Furthermore, Carpman and Grant (2002) argued that evidence-based principles of wayfinding must be translated into built and graphic form through spatial planning and environmental communication. This shows that large volumes of design

principles/guidelines on improving wayfinding have been produced over the years with relatively little conceptualization.

However, Heulat's (2007) principles integrate most of these features towards improving wayfinding, she presents her principles in graphical form showing building blocks (Facility Amenities, Graphics, Signage, Architecture, Interior Architecture, Interior Design, Landscape and Master Plan) which she asserts rely on each other to form a solid wayfinding system as seen in figure 2.2 below.

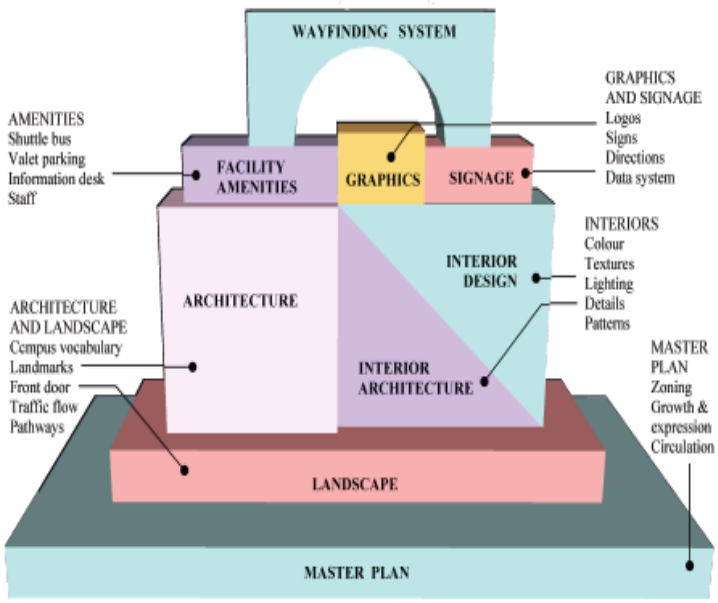


Figure 2.2: Building block model for successful wayfinding. Source: Heulat (2007)

According to Heulat's model, a facility's master and site plan can be a solid foundation upon which to build a good wayfinding system. She argues that a good maters plan addresses zoning, growth and expansion, and circulation of a facility which tends to become denser, results to corridors becoming circuitous, interrupting original pathways and resulting to the existence of few land marks. The landscape block includes trees, plantings, flagpoles, water features, and outdoor furnishings which are elements that can be strategically placed to lead to building entrances and other desired destinations.

Elements of the landscape can also provide memorable landmarks to mark the pathway. Windows in corridors that aids in visitor orientation, entrances that are easy to identify, clear pathways, easy-to-see visitor elevators, and landmarks that create visual cues at decision points constitute the architecture block. The Interior Architecture and Interior Design blocks include colour, texture, lighting, details and palettes which can delineate visitor pathways from staff pathways and enhance the visibility of signs. The Facility Amenities block includes; shuttle bus; valet parking, information desk and staff which can alleviate the visitors' fear and anxiety and make the hospital experience less stressful. Finally, the Graphics and Signage include; directories, logos, signs, you-are-hear maps and data systems which can build on good interior design to perfect a wayfinding system and helps communicate with those who do not read.

The graphical model is further accompanied by a checklist (see table 2.1) which also acknowledges the underpinning concepts.

Table 2.1: Checklist for developing good wayfinding system.

Apply the progressive-disclosure model of wayfinding	Have a highly visible visitor-information centre.
Identify all parking, buildings and entrances	Develop a sensible room-numbering system.
Use consistent graphics, colour, and logos.	Identify all destinations in the same vocabulary.
Create a user-friendly handheld map, and repeat that map in lobby directories.	Use symbols and icons to bridge language barriers.
Develop an appropriate wayfinding system that is specific to your facility.	Provide clear, concise, and consistent signs that have strong contrast and visibility.
Incorporate environmental cues such as landscapes.	Clearly light all signs and use lighting to feature landmarks.
Include windows in corridors for outdoor orientation.	Provide easy access to patient education. Offer learning centres with extended hours, high visibility, and a friendly staff.
Design main entrance drop-off areas. Offer valet parking.	Differentiate public elevators from staff and clinical elevators.

Provide easy and well-identified parking. Clearly delineate handicap parking and access routes.	Display clocks in primary waiting areas.
Establish clear routes to primary destinations.	Provide telephones in emergency areas, waiting areas, entrances, and dining areas
Train all staff in giving directions—the same way to the same place.	

Source: Heulat (2007)

The model by Heulat is stupendous in that it provides a useful visual framework for categorizing and understanding what influences the good wayfinding design. It is a graphical representation of the specific areas to focus on (e.g. master plan, architecture and landscape, graphics and signage, interiors and amenities) supported by a fairly comprehensive checklist for developing a good wayfinding system. The other attraction of this model is that it has been developed with hospital wayfinding problems in mind. In that sense, it is an improvement on the work Miller and Lewis (1998) whose document (Wayfinding: Effective wayfinding and signing systems (DOH 1999, 2005) is aimed at those wishing to design, implement or improve wayfinding systems for National Health Service (NHS) healthcare sites.

Rooke (2012) in her work (Improving wayfinding in old and complex hospital environment) responded to this conceptual gap using a theoretical framework for addressing wayfinding problems based on the tri-partite concepts of physical features, coded information and social practices from knowledge management research evaluated using Unique Adequacy approach from Ethnomethodology. She examined four different set of principles/guidelines chosen at random that reflect the general thinking within the field of wayfinding. These principles include those developed by foltz (1998) and two different sets developed by the centre for universal design (1997) as summarised below (see tables 2.2, 2.3 and 2.4). This is in addition to the Heulat (2007) graphical model

which she also commended as being outstanding amongst the principles for it provides useful visual framework for categorizing and understanding what influences good wayfinding design.

Table 2.2: Design principles for wayfinding by Foltz (1998).

Create an identity at each location, different from all others	Arthur and Passini 1992
Use landmarks to provide orientation cues and memorable locations	Lynch 1960
Create well-structured paths	Lynch 1960, Carpman and Grant 2002
Create regions of differing visual character	Lynch 1960
Don't give the user too many choices in navigation	Carpman and Grant 2002
Use survey views (give navigators a vista or map)	Huelat 2007
Provide signs at decision points to help wayfinding decisions	Passini 1984, Arthur and Passini 1992, Carpman and Grant 2002
Use sight lines to show what ahead	McLean 1993, Hunter 2010

Source: Rooke 2012

Foltz acknowledged relying on his findings from "both the study of museum exhibits and the research of environmental psychologists, cognitive scientists, and others who study how humans represent and navigate in the physical environment" to develop these principles.

Table 2.3: Wayfinding design principles developed by the Centre for Universal Design (1997).

Analyse the building or site for access points, taking into account the physical and aesthetic characteristics of the building or site. How will the site be accessed?
Divide the large-scale site into distinctive smaller parts, or zones of functional use, while preserving a sense of place and connectivity between spaces.
Organize the smaller parts under a simple organizational principle, such as use. Devise a zonation plan with a logical and rational structure.

Provide frequent directional cues throughout the space, particularly at decision points along journeys in both directions.

The design of decision points must be logical, rational and obvious to a sighted user, ensuring the directional cues relate directly to a building or landscape space. Ensure sequencing and that the priority and grouping of message signs is unambiguous.

Design and implement a naming protocol by choosing a theme for segregating places and spaces. Use names and symbols that can be easily remembered by users from diverse cultural backgrounds.
-Any naming protocol must be flexible enough to be adapted to changing functions in a building or throughout a landscape or public space.

Use a sequential, logical, rational and consistent naming protocol for places such as hospitals or educational institutions where buildings have been master planned and organized into a logical arrangement.

When considering a naming protocol of an alpha-numeric coding system provide consistency within the coding system. For example: Room B3.7 reads Building B, Level 3 Room7. Room C4.6 reads Building C, Level 4 Room 6. Block BS1 reads Building B, South, Entry 1. Block MN2 reads Building M, North, Entry 2.

Consider incorporating information in multiple languages or incorporating pictograms when devising a naming protocol.

Ensure the physical placement, installation and illumination of signs is suitable for all users.

Source: Rooke 2012

This set of principles chosen by Rooke (2012) was developed by The Centre for Universal Design (1997). They acknowledge the influence of cognitive scientists and environmental psychologists in developing these principles.

Finally, the next set of principles was developed by The Centre for Universal Design (1997) in collaboration with a consortium of universal design researchers and practitioners from across the US. It is to some extent different from the others illustrated above and contains more generic principles.

Table 2.4: Principles of Universal Design by the Centre for Universal Design (1997).

Principle 1: Equitable use	The design is useful and marketable to people with diverse abilities.
Principle 2: Flexibility in use	The design accommodates a wide range of individual preferences and abilities.
Principle 3: Simple and intuitive use	Use of the design is easy to understand, regardless of the users experience, knowledge, language skills or current concentration level.
Principle 4: Perceptible information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the users sensory abilities.
Principle 5: Tolerance for error	The design minimises hazards and the adverse consequences of accidental or unintended actions.
Principle 6: Low physical effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
Principle 7: Size and space for approach and use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of users' body size, posture or mobility.

Source: Rooke 2012

Rooke (2012) further argued that there is sufficient evidence from literature to support the assertion that the tri-partite conception is relevant to the problems of managing wayfinding information. She adopted the design science research methodology complemented by an ethno-methodologically informed approach of unique adequacy to propose the wayfinding conceptual framework (see figure 2.3). '' This represents a new way of researching wayfinding problems... in response to the current call for a better and deeper understanding of the situated behaviour of wayfinders'' (p. 166).

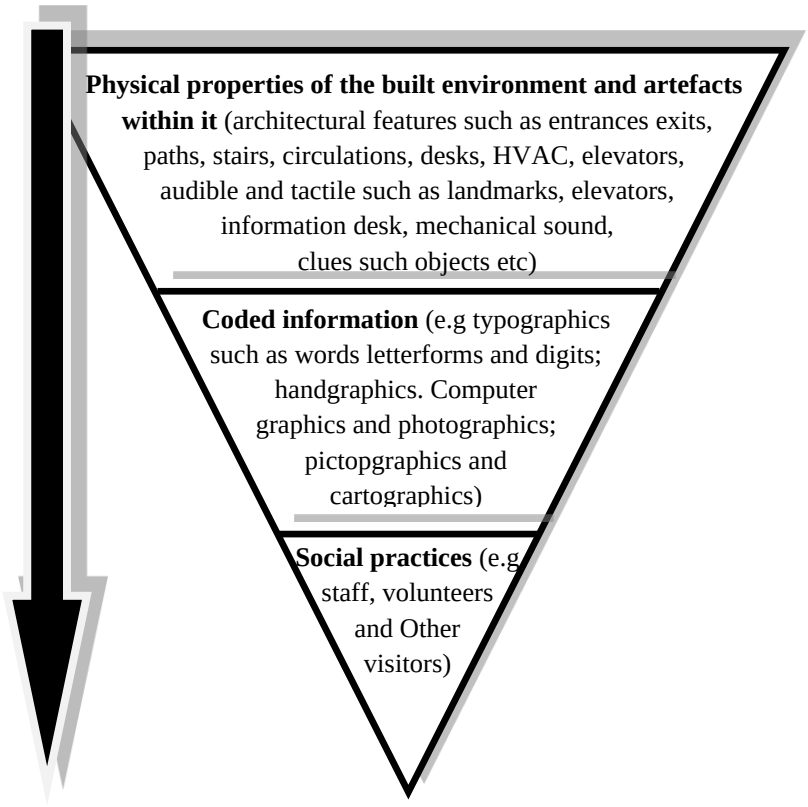


Figure 2.3: Prescriptive framework for addressing wayfinding problems. Source: (Rooke 2012)

The framework prioritises communicating through the physical properties of the built environment over coded information and social practice. It communicates that signs are not the most important means of communicating wayfinding information and that there should be less reliance on the practice of giving verbal instruction by staff, volunteers and/or other visitors (Rooke, 2012). The arrow to the left of the pyramid indicates the order of priority. The size of each segment communicates the importance of each knowledge flow in comparison. In this context, the function of the tri-partite conception can be seen with each element of the concept representing a mode of communication she added.

However, the proposed Wayfinding Conceptual Framework (WCF) was evaluated within hospital settings in United Kingdom (UK), United State (USA) and other parts of Europe where there is high level of literacy, organised security settings and stable power supply

amongst other feature of developed county that may ease wayfinding problem solving. On the other hand, Nigeria being a developing country posses many differences compared to those areas where the WCF was tested. Thus, there is the need to further validate the framework within other settings (Rooke, 2012).

2.7 Hospitals

A hospital is an institution that provides medical, surgical, or psychiatric care and treatment for the sick or the injured. According to the World Health Organization (WHO), hospital can also be defined as an institution that is built, staffed and equipped for the identification, diagnosis of diseases and the treatment, both medical and surgical, of the sick and injured or an in-patient establishment that delivers healthcare. It may be public or private; it is characterized by its large capacity and its variety of specialties and workforce. The basic services that hospitals offer include: short-term hospitalization, emergency room services, general and specialty surgical services, x ray/radiology services, laboratory services and blood services.

Hospitals are among the most complex of any environments accessed by the public. As they strive to enhance user experience and increase efficiency, successfully guiding people to their destinations is a key consideration. A prodigious amount of research has been conducted on how people navigate hospital environments. Studies on the impact of user disorientation within hospital complexes confirm that the ability to find one's way contributes significantly to user satisfaction rankings.

2.7.1 Types of Hospital

According to McKee and Healey (2002), types of hospitals can be grouped under a hierarchical classification: a) tertiary care (often national or a regional resource and

commonly linked with universities), (b) secondary care (such as district hospitals) and (c) community or rural hospitals.

2.7.1.1 Tertiary care hospitals

Tertiary care hospitals are defined as those receiving patients referred from secondary care hospitals, they offer the most technologically complex and sophisticated services and are usually linked to a medical school and are regional level resource. Tertiary care institution may either be teaching hospital, general hospital, or specialist hospital (McKee and Healey, 2002).

i. Teaching Hospital

This is the most complex of the tertiary care hospitals and it provides for the training of undergraduate and postgraduate medical students. Teaching hospitals contain significant research facilities. Teaching hospitals also train others interested in a health care career, including nurses and laboratory specialists. In this type of hospital, number of beds does not indicate level of sophistication (Glasgow, 2013).

ii. General Hospital

General Hospital is also a tertiary care institution that has the following operational areas: care provision, examination, and treatment, supply and disposal, administration and technology. In addition to these, there are possibly areas for teaching and research as well as support areas for service operation. The general hospital caters for patient with various degrees of illnesses. They are called General hospital because they are large enough to provide medical services for a number of specialist services and their sizes are usually measured in terms of bedding capacity, ranging from about 200 beds to over 1000 beds

(Glasgow, 2013). They sometimes refer patients for completion of their treatment to specialist hospitals.

iii. Specialist Hospital

Specialist hospital is one that is devoted to one or group of related diseases, the treatment of which usually requires protracted periods. It specializes in the diagnosis and treatment of one branch of medicine, e.g. trauma centres, and offers highly specialized services and training in that particular branch. They serve as a referral hospital, they are sometimes affiliated to a university (Glasgow, 2013).

2.7.1.2 Secondary care (District General) hospitals:

These types of hospitals treat people for conditions that require more complex treatment than can be provided in primary care setting. These hospitals typically have between 200 to 600 beds and usually provide inpatient and outpatient care, day surgery and an emergency service. They usually include at least departments of medicine, surgery, paediatrics, gynaecology, supported by imaging and pathology services (McKee and Healey, 2002).

2.7.1.3 Community care rural hospitals:

These types of hospitals typically have 50 beds or less and provide basic diagnostic services, minor surgery and care for patients who need nursing care but not the facilities of a district general hospital (McKee and Healey, 2002).

2.7.2 Trauma Specialist Hospital

Trauma specialist hospitals provide specialized medical services and resources to patients suffering from traumatic injuries (Pennsylvania Trauma Systems Foundation,

2015). The major component that differentiates a regular hospital from one that is a trauma centre is the requirement for 24-hour availability of a team of specially trained health care providers who have expertise in the care of severely injured patients. These providers may include trauma surgeons, neurosurgeons, orthopedic surgeons, cardiac surgeons, radiologists and nurses. Specialty resources may also include 24-hour availability of a trauma resuscitation area, an operating room, laboratory testing, diagnostic testing, blood bank and pharmacy (ibid).

According to the American College of Surgeon Committee on Trauma, trauma centres can be classified into level I, level II, level III, level IV or level V trauma centre. Facilities are designated/verified as Adult and/or Pediatric Trauma Centres. It is not uncommon for facilities to have different designations for each group (i.e. a Trauma Centre may be a Level I Adult facility and also a Level II Pediatric Facility). Below are brief description of the various categories of the trauma centres;

2.7.2.1 Level I Trauma Centre

Level I Trauma Centre is a comprehensive regional resource that is a tertiary care facility central to the trauma system. A Level I Trauma Centre is capable of providing total care for every aspect of injury from prevention through rehabilitation. Elements of Level I Trauma Centres Include:

- 24-hour in-house coverage by general surgeons, and prompt availability of care in specialties such as orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, internal medicine, plastic surgery, oral and maxillofacial, pediatric and critical care.
- Referral resource for communities in nearby regions.
- Provides leadership in prevention, public education to surrounding communities.

- Provides continuing education of the trauma team members.
- Incorporates a comprehensive quality assessment program.
- Operates an organized teaching and research effort to help direct new innovations in trauma care.
- Program for substance abuse screening and patient intervention.
- Meets minimum requirement for annual volume of severely injured patients.

2.7.2.2 Level II Trauma Centre

A Level II Trauma Centre is able to initiate definitive care for all injured patients with elements that include:

- 24-hour immediate coverage by general surgeons, as well as coverage by the specialties of orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology and critical care.
- Tertiary care needs such as cardiac surgery, hemodialysis and microvascular surgery may be referred to a Level I Trauma Centre.
- Provides trauma prevention and continuing education programs for staff.
- Incorporates a comprehensive quality assessment program.

2.7.2.3 Level III Trauma Centre

A Level III Trauma Centre has demonstrated an ability to provide prompt assessment, resuscitation, surgery, intensive care and stabilization of injured patients and emergency operations. Elements of Level III Trauma Centres Include:

- 24-hour immediate coverage by emergency medicine physicians and the prompt availability of general surgeons and anaesthesiologists.
- Incorporates a comprehensive quality assessment program

- Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II Trauma Centre.
- Provides back-up care for rural and community hospitals.
- Offers continued education of the nursing and allied health personnel or the trauma team.
- Involved with prevention efforts and must have an active outreach program for its referring communities.

2.7.2.4 Level IV Trauma Centre

A Level IV Trauma Centre has demonstrated an ability to provide advanced trauma life support (ATLS) prior to transfer of patients to a higher level trauma centre. It provides evaluation, stabilization, and diagnostic capabilities for injured patients. Elements of Level IV Trauma Centres Include:

- Basic emergency department facilities to implement ATLS protocols and 24-hour laboratory coverage. Available trauma nurse(s) and physicians available upon patient arrival.
- May provide surgery and critical-care services if available.
- Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II Trauma Centre.
- Incorporates a comprehensive quality assessment program
- Involved with prevention efforts and must have an active outreach program for its referring communities.

2.7.2.5 Level V Trauma Centre

A Level V Trauma Centre provides initial evaluation, stabilization and diagnostic capabilities and prepares patients for transfer to higher levels of care. Elements of Level V Trauma Centres Include:

- Basic emergency department facilities to implement ATLS protocols
- Available trauma nurse(s) and physicians available upon patient arrival.
- After-hours activation protocols if facility is not open 24-hours a day.
- May provide surgery and critical-care services if available.
- Has developed transfer agreements for patients requiring more comprehensive care at a Level I though III Trauma Centres.

2.8 Summary of Literature Review

Literature on way finding in the last few decades has been extensive in environmental psychology, spatial cognition and more recently in Human Computer Interaction (HCI). However, there has been little conceptualization of variables to improve daily real world wayfinding and navigation tasks. To improve conceptualization, Rooke (2012) proposed a framework which assigns primacy of physical features for wayfinding tasks, followed by coded information, then social practices.

Hospitals incorporate color and symbolism, flooring and ceiling cues, and easily identifiable landmarks. When implemented thoughtfully, this kind of comprehensive approach is very effective not only for way finding, but also in creating a solid branding statement that can be adapted and expanded as necessary in the future. Airports and hospitals have one very important thing in common: Lots of anxious visitors trying to

find their way, many of whom have never (or rarely) been there. So, this kind of thinking makes sense.

Anticipation of anxiety should be the starting point for considering how to create effective way finding, and that means straightforward, simple, and clear directions. Unless there's a staffer standing by every entrance who volunteers to guide a patient exactly to his or her destination and some facilities are doing this to a degree, as well signage is the first thing anxious visitors look for. The wording, the font, the colors, the size and shape of the sign itself, location on the wall or ceiling, all of these elements need considerable study and attention up front. With each decision made, the most important question is: Is the end result simple and clear? Those signage factors should never be compromised to serve a broader aesthetic or branding goal.

A comprehensive way finding approach is invaluable; it's especially helpful for staff and repeat visitors/patients, and it can reinforce the first-time visitor's ability to get around, especially if she does take a wrong turn somewhere. But for truly patient-centered design, the first step is simple: Just follow the signs. According to literature Way finding for Health Care shows graphically the importance and functionality of signage and way finding in hospitals and on health care campuses. It offers a systematic approach to implementing a consistent way finding program that can improve both efficiencies and facility image.

The next chapter will discuss the methods and methodology in identifying user perception towards the effectiveness of wayfinding systems in strategically selected trauma centers in north-west Nigeria.

3.0 RESEARCH METHODOLOGY

3.1 Research Design

According to Issa (2004:28), there are several Research methods used by researchers in the conduct of research, and there is on hard and just rule regarding the kind of research method to be adopted in any given research situation. Instead, the choice of a particular research method is strictly a function of the nature of the problem being investigated. In other words, the appropriateness of a given research method is determined mainly by the kind of investigation being conducted. This, in turn, determines the kind of data that will be generated in the course of the research.

Therefore, a case study approach was adopted for this research complemented by the ethno-methodologically informed criteria of unique adequacy. This is because the case study approach suggests that cases are identified for study due to their inherent qualities which were in consonance with the phenomenon under investigation (Oluigbo, 2010). This will allow for the purposive selection of the appropriate entities under specified criteria as the Unique Adequacy approach provides for better understanding of wayfinding behavior.

According to Rooke (2012), the Unique Adequacy approach is part of the new way of researching wayfinding problems and it is particularly a response to the current call for a better and deeper understanding of the situated behaviour of wayfinders. The approach draws attention to the fact that members of a setting or organisation have their own ideas about what they are doing regardless of what theorists may say about them (Rooke, 2007).

3.1.1 Case Study Approach

According to Oluigbo (2010), a case study may refer to both research method and unit of analysis, which involves the study of examples as case of being researched. Case study in architecture begins with a documentation of the physical characteristics of the case. According to Yin (2003) a case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries are not clearly stated. Meyer (2001) suggest that the approach enables the researcher to study many different aspects, examine them in relation to each other and view the process within its total environment.

3.1.2 Unique Adequacy Approach

The Unique Adequacy (UA) approach is derived from sociological discipline of ethno-methodology to evaluate and improve research in construction management and addresses problems stemming from the significance of conscious action in constituting human organization (Rooke and Kagioglou, 2007). It consists of two forms which are 1) weak form and 2) strong form;

1. Weak Form

The weak form of UA demands that the researcher is competent in the research setting (ibid), it consists in being able to perform relevant activities within that setting without censure from other members. The question of whether such an understanding has been achieved is a matter for the judgement of any other competent participant (Rooke et al, 2010). According to Wieder (1974), the requirement is proposed as a criterion for adequate ethnography, the most certain method for acquiring such knowledge being

participant observation. However, it is possible to usefully apply it to other forms of enquiry, such as interviews and questionnaires.

2. Strong Form

The strong form requires that research reports only concepts originating within the research setting (Rooke and Kagioglou, 2007), that methods which members to a situation use to make their meanings clear to other members to that situation are sufficient to the purpose of describing that situation (Rooke 1997). According to Rooke and Seymour (2005), UA insists that the methods used to produce a description of a situation, should be those which originate from the situation they describe. Hence, 'the UA criteria demands that research reports findings, concepts, and theories originating from a particular setting whose modus operandi is general knowledge across its members' Maina (2014). The summary of the UA criteria is as illustrated in figure 3.1 below by Maina.

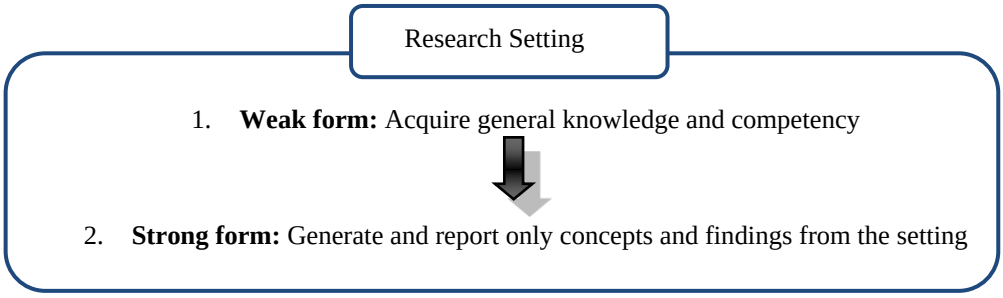


Figure 3.1: UA Criteria Source: Maina, 2014.

Furthermore, unique adequacy is a skilful practice which researchers must learn as highlighted by Lynch (1960), in order to achieve an acceptable degree of the strong requirement of unique adequacy, Francis and Hester (2004: 25) suggested three methodological steps which can be followed, this are;

(i) Notice something that is observably-the-case about some talk, activity or setting.

(ii) Pose the question 'How it is that this observable feature has been produced such that it is recognizable for what it is?'

(iii) Consider, analyse and describe the methods used in the production and recognition of the observable feature.

Employing the UA criteria above, two surveys were considered (as illustrated in figure 3.2 below) to answer the research questions posed by this study.

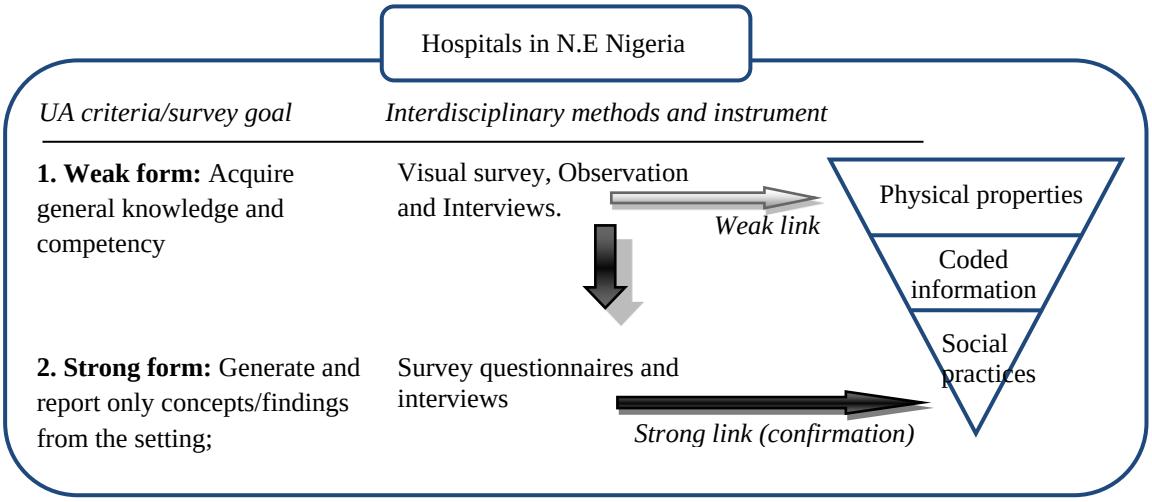


Figure 3.2: Research framework modified from Maina (2014).

The first is a survey to acquire general knowledge and determine how wayfinding features have been commonly incorporated in hospitals in North East Nigeria under the three concepts of physical properties, coded information and social practices. This can be achieved through visual survey, observation, and interviews. The second survey involves the use of questionnaires and interviews to determine which of the three concepts suggested by Rooke, (2012) is most employed for wayfinding by users in the selected case studies.

3.2 Population of Study

Population of study comprises the totality of all the subjects that have a set of specifications and characteristics that are of interest to the researcher and to whom the

research results can be generalized (Polit and Hungler, 1999). In line with the scope of this study, the population of study for this research comprises of large hospitals capable of creating more wayfinding challenges for users within the North East region. Sample size for questionnaire survey is obtained from total average users of the respective hospitals.

3.3 Sampling

Sampling involves a subset of the research population selected to represent the research population (LoBiondo-Wood and Haber, 2006). According to Burgess et al (2003:91), there are two types of sampling non-probability and probability sampling. Non probability sampling uses subjective method of selecting unit from a population. It provides a fast, easy, inexpensive way of selecting a sample and it does not require a sample frame. Non-probability sampling can be applied to studies that are used as an idea generating tool; it can be used for exploratory or diagnostic studies to gain insights into people's attitudes, beliefs, motivations and behaviors. On the other hand "Probability sampling is a method of sampling that allows inferences to be made about the population based on observations from a sample". In order to be able to make inferences, the sample should not be subject to selection bias. With a probability design, a relatively small sample can often be used to draw inferences about a large population, it is more accurate than non-probability but it is more expensive, difficult and takes longer time (Burgess et al, 2003:91).

Therefore, for the purpose of this research a non-probability method of sampling was adopted with a purposive selection of the case studies, the case studies were selected based on the criterion that they are amongst the four largest hospitals within the North East region not under the constraints of insecurity and feasibility (see figure 3.3). This

criterion ensures the much needed access to various hospitals within the limited time for this research.

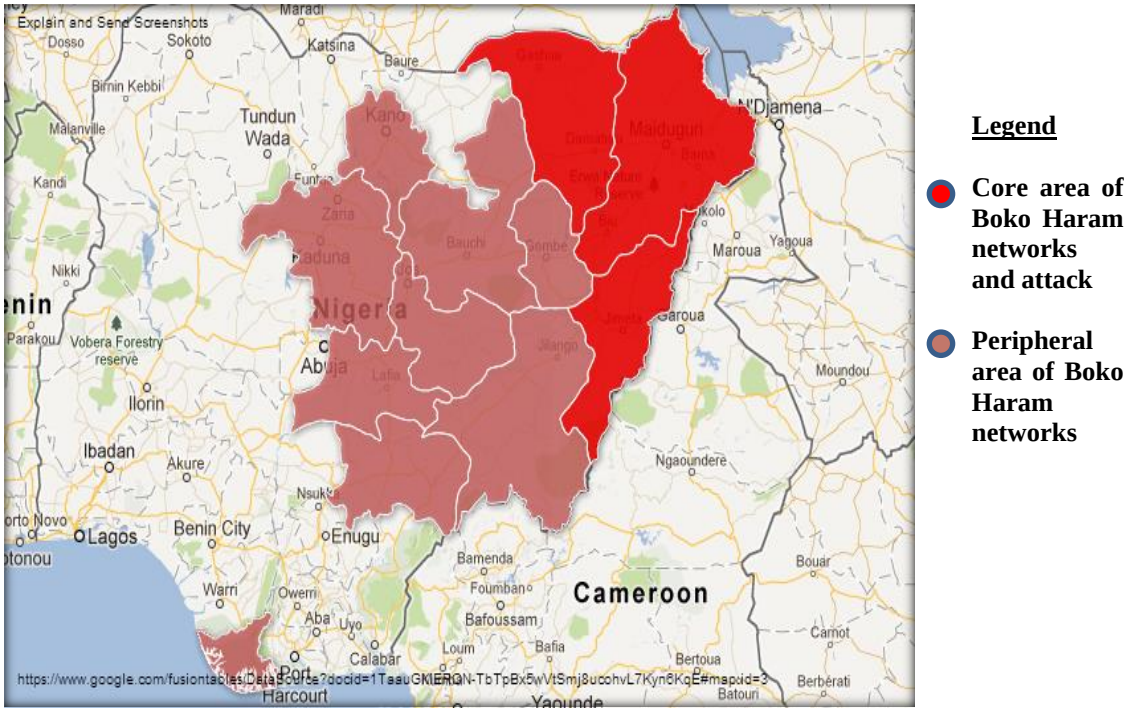


Figure 3.3: North East region of Nigeria affected by insurgency Source: http://www.premiumtimesng.com

Figure VI above shows the North East region of Nigeria affected by high level of insecurity; these include Yobe, Borno, and Adamawa. Thus, only large hospitals from Bauchi and Gombe States were considered for this study. These, resulted in having the following hospitals;

1) Abubakar Tafawa Balewa University Teaching Hospital, Bauchi State (2,000 average users).
2) Federal Medical Centre, Azare, Bauchi State (1,500 average users).
3) State Specialist Hospital, Gombe, Gombe State (1,500 average users).
4) Federal Teaching Hospital Gombe, Gombe State (1,500 average users).

Furthermore, sample size for the second survey (questionnaire survey) is obtained using probability sampling from the table for required sample size (see Appendix I) considering

95% level of confidence and 5% merging of error from the total average users (6500 users) gotten from respective hospitals. These results in a total of 363 questionnaires (see Appendix II)

3.4 Instruments for Data Collection

In research, several instruments are employed for data collection depending on the context of the research; these instruments may include interviews, focus groups, surveys, telephone interviews, field notes, taped social interaction or questionnaires (Heaton, 2004). Therefore, four instruments were considered for data collection in the two surveys design for this research, these are visual survey, observation, questionnaires and interviews.

Considering the weak requirement of the UA criteria that involves general acquisition of knowledge and competency by the researcher, visual survey, observation, and interviews were conducted. These instruments are considered in order to determine how the existing wayfinding features within the various hospitals are incorporated and their basis.

The use of questionnaires was employed in the second survey and subsequently interviews were carried out for users who could not read and understand the questionnaires. This is because questionnaires can be used to collect information on facts, attitudes, knowledge, beliefs, opinions, perceptions, expectations, experiences and the behaviour of individuals as highlighted by Parahoo (1997).

3.5 Procedure for Administration of Instruments

Visual survey of existing wayfinding features was carried out by going through the entire hospital, walking in and out of the various sections observing the wayfinding features, while observation of other users' wayfinding activities started from the main entrance of

each hospital under study. This is in order to easily recognise visitors with limited knowledge of the settings. Furthermore, brief interviews were conducted with the appropriate staff usually from works and maintenance department in the respective hospitals to understand the bases of the existing wayfinding features.

During the second survey, questionnaire forms were distributed randomly via fieldwork to staff, patients and visitors at various clinics, wards and departments in each of the hospitals. A total of four hundred (400) questionnaires were distributed randomly (considering one hundred questionnaire forms for each of the selected hospital) and only three hundred and seventy-four (374) were returned (93, 96, 92 and 93). The required 364 questionnaires were used for the analysis taking ninety-one (91) forms from each hospital.

3.6 Data Presentations and Analysis

Data obtained from the first survey were given account of descriptively, and clear explanations of procedures and information obtained were made. Also, analysis was carried out on numerical data gotten from questionnaires considering frequencies and means of values obtained from responses of wayfinders. These analyses were carried out using Microsoft Excel software and results are presented in tables for each aspect of knowledge in wayfinding (i.e. physical properties, coded information and social practice).

4.0 CASE STUDY

4.1 Introduction

The first survey, based on the weak form of the UA criteria explores the existing wayfinding features commonly incorporated within the hospital settings under the three concepts of physical features, coded information and social practices through visual survey, observations, and interviews. The second survey involves the use of questionnaire forms to reports on the most employed amongst the three concepts by hospital users in the study area.

Therefore, this chapter consists of two sections, the first section (weak form) presents reports on case studies conducted for this research basically to establish how wayfinding features have been commonly incorporated in hospitals in the study area. Thus, each part starts by offering a description of the organisation studied followed by an overview of work carried out and a discussion of the key findings is offered last. While the second section (strong form) presents reports on questionnaire analysis and findings.

4.2 Weak form

Visual survey in each hospital is conducted by a walk through the entire complex, going in and out observing wayfinding features incorporated in the hospital settings under the three aspect of knowledge using the checklist (see Appendix 3). While observation conducted involves observing wayfinding activities by users in the respective hospitals. Interviews were conducted to the appropriate staff in works and maintenance department to further understand how the wayfinding features were incorporated.

4.2.1 Federal Teaching Hospital Gombe (FTHG)

The Federal Teaching Hospital Gombe formerly Federal Medical Centre, Gombe (FMCG) is located within the city of Gombe, the capital of Gombe State. The hospital has a 300-bed capacity and was established in 1996 by the Federal Government. There are eleven (11) main wards in the hospital including the amenity ward. The various clinical departments run specialist and sub-specialist clinics during the week days while emergencies are attended to daily on a 24hour basis through the Accident and Emergency Unit (A&E). It has an overall outpatient attendance of about 1750 patients per week.

With regards to wayfinding, approximately four hours was spent going in and around the hospital. The hospital consists of several sections linked with covered walkways which give rise to multiple similar courtyards (see figure 4.1).



Figure 4.1: Ariel view of Federal Teaching Hospital Gombe, Gombe State
Source: Google earth, 2016

Notably are the large numbers of signs hanging below the roof in walkways, and paintings on floor (floor line guide) to assist in guiding wayfinders to various destinations within the hospital. Also, the use of trained staff (SERVICOM) to ensure the efficiency of services in the hospital was observed. After the walkthrough and observations, it was

possible to establish that users in the hospital largely depend on the practice of giving verbal instructions with respect to corridors, entrances, and the floor line guide. However, the abundant signs seem to be less effective as many users were observed to pay less attention to information on signs.

Brief interview conducted with the head of department of works and maintenance in the hospital further reveals that signage system within the hospital were fixed by experienced staff from the hospital with no guidelines or professional advice. He also confirms that staff regardless of their duties are already used to giving verbal description at any point in time.

4.2.2 State Specialist Hospital (SSH) Gombe

The State Specialist Hospital, Gombe is located at Jeka dafari within the Gombe state capital. It is regarded by many as the second largest hospital in the state after the Federal Teaching Hospital. According to the Head of Admin, Abdullahi Isa, the hospital was esterblished in 1954 and currently consists of about 60 doctors, 300 nurses, 18 pharmacists, 28 lab scientists, 8 radiographers and accommodates to upto 218 patients in daily basis. It has an average of 1500 out patients per week.

With regards to wayfinding, the hospital consists of numerous blocks with different functions, some of which are linked with covered walkways usually deep into the complex while those at the forefront are free standing. The hour spent walking around this hospital was enough to establish that the sparse physical layout of the building means large reliance on the practice of giving verbal directions and less signage as every point in the open space seems to be a decision point for visitors. This is as a result of poor landscape of the complex with no clear differentiation of pedestrian and vehicular paths. Visitors to the setting appeared to conduct their wayfinding tasks with little need for help

from signs as most of the buildings are free standing and verbal instructions are easily conducted by pointing to the buildings. Also, interview conducted confirms that signs within the hospital were in place with no specific guidelines and were provided by a staff in the hospital as they feel that most of the hospital users are already used to the hospital.

4.2.3 Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH) Bauchi

The Abubakar Tafawa Balewa University Teaching Hospital Bauchi was established as a Leprosarium in 1918. It became a General Hospital in 1966, a Specialist Hospital in 1978, and finally became the 18th Teaching Hospital of the Federal Government in 2010. The current bed capacity of the Hospital is 700 and based on the background of its metamorphosis there are varying generations of infrastructure within the facility available to render health services to the populace. Being the major Health facility in the State with a population of 4.6million people it also serves patients from the neighbouring states of Plateau, Jigawa, Gombe, Taraba, Yobe and Kano. The hospital is the second largest teaching hospital in the North-east geopolitical zone, with a high turnover of patients as averages of 3,400 Patients are seen per week with a percentage bed occupancy rate of 72.8%.

In this hospital, the researcher came across a layout map at the main entrance gate, after a thorough search trying to locate A&E department which was not found on the map, the admin block was the next option to seek for permission to conduct the research. However, on the way to the Admin block, the A&E was seen with Umar Musa Yar'adua written boldly at the entrance, this is about 100 metres away from the entrance gate adjacent to the long road. After a brief interview with a staff from the works and maintenance department, it was understood that a new A&E department usually called trauma centre is located few metres away from the main hospital. A visit to the new branch was possible after studying the main hospital. After the entire walkthrough and observations that lasted

for about three hours in the main hospital, it was possible to establish huge reliance on the practice of giving verbal instructions with respect to buildings within the large complex as seen in previous hospitals studied. Signs within the complex are mostly above entrances of respective buildings, insufficient information at key decision points left wayfinders with the only choice of asking other users with experience.

4.2.3.1 Trauma centre ATBUTH branch

The trauma centre was located with the help of experienced 'bike man' who already knows the hospital, it is easy to describe but no any sign to show any first time visitor that it is a hospital. The research carried out here amounted to a brief walkthrough of not more than 30 minutes, problems encountered here are similar to those found in ATBUTH and other hospitals considered above. The hospital's wayfinding system heavily relies on the practice of giving directions by word of mouth. However, it is less complex layout in comparison with other settings above means that less signs are used. It is the ATBUTH accident and emergency department that is relocated and called 'trauma centre', it is less equipped and with no major functions (such as triage, resuscitation etc.) of a trauma centre.

4.2.4 Federal Medical Centre (FMC), Azare, Bauchi State

The Federal Medical Centre, Azare is located at no. 5 Sule Katagum road, Azare Local Government area of Bauchi State. It is arguably the second to Abubakar Tafawa Balewa University Teaching Hospital in terms of both size and facilities in Bauchi state. The current bed capacity is upto 300 with an average turnover of about 1500 out patients per week. Its services includes surgical, diagnostics and general medical practice amongst others.

The hospital's wayfinding system involves large number of signs, paintings on floor, with numerous long rectangular building units linked with covered walkways. However, most of these signs underneath the roof of the walkways are hidden or blocked with roof members and cannot be easily noticed. Paintings on floor have worn out at some places and cannot be functional at such places. Also misleading signs as a result of change in function of spaces are found in numerous places, all these further stress the only need for relying on the practice of giving verbal instruction with respect to buildings, entrances and activities around the complex.

4.2.5 Key Findings

As the aim of this survey is to equip the researcher with the basic knowledge of existing wayfinding features within the studied environment and to establish how they have been incorporated, below are detailed accounts of the prevalence of physical features, coded information and the practice of giving verbal instructions from the case studies. Examples of breakdowns caused by: too much information (information overload) or lack of it; inconsistent use of colour and ill positioning of directional signs are also considered.

4.2.5.1 Physical Features

Physical features include knowledge embedded in physical objects and environments such as legible architectural features (e.g. entrances; exists, paths, stairs and circulation systems) visual, audible and tactile objects as landmarks, elevators, information desks and mechanical sounds. Below are some examples taken from the respective case studies conducted on the prevalence of this aspect of knowledge;



Plate I: Entrance to radiology complex in ATBUTH Bauchi State
Source: Author's Fieldwork (Nov. 2015)



Plate II: Entrance to NPI unit in State Specialist Hospital Gombe State
Source: Author's Fieldwork, (Nov. 2015)



Plate III: Entrance to G.O.P.D in Federal Teaching Hospital, Gombe State
Source: Author's Fieldwork (Nov. 2015)



Plate IV: Entrance to A&E department in Federal Medical Centre Azare, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)

The plates above (I-IV) are various entrances/exits in the hospitals studied, majority of entrances/exits are clear projections from the main building. This may not be the best approach as it will require coded information to say what it is which they lack in many cases. However, the projection is a better approach compared to the oblique and indirect approach to entrances as highlighted by Arthur and Passini (1992). Oblique approach is one whose facade is flushed with sidewalks and will have to rely on marquees to signify its entrance while indirect approach occurs when the entrance is obscured from view by a corner (ibid).



Plate V: Walkway in FMC, Azare, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)



Plate VI: Walkway in ABTUTH, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)



Plate VII: Walkway in SSH, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)



Plate VIII: Walkway in ATBUTH, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)

Plate five to eight (V-VIII) above are examples of corridors found within the respective hospitals. Such corridors were found to be very long and confusing in many cases, creating complex environment with oblique and indirect entrances. According to Arthur and Passini (2002), the visual access of such entrances diminishes as the approach becomes more oblique and finally disappears when the approach is indirect. Although exits are the same as entrances from an architectural point of view, for the user it is not the same, people's perception of exits is limited to actual doors which are most of the time seen at short range they further noted.



Plate IX: Electronic Board as Landmark in FTH Gombe State.
Source: Author's Fieldwork, (Nov. 2015)



Plate X: Ramp as landmark in Trauma centre Bauchi State
Source: Author's Fieldwork, (Nov. 2015)



Plate XI: Traffic circle in ATBUTH Bauchi, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)



Plate XII: Staircase as landmark in ABTUTH, Bauchi, Bauchi state.
Source: Author's Fieldwork, (Nov. 2015)

Photographs above are some of the objects used as landmarks in hospitals in North East Nigeria. Plate IX is an electronic board found in a lobby in FTH Gombe, this is observed to be very effective as a similar lobby exist adjacent to this lobby. It serves as the major difference between the two lobbies. Plates X and XII are landmarks incorporated in the trauma centre in Bauchi, the staircase is in the best position as directly opposite the main entrance and can clearly be seen, it does not need a sign to communicate what it is. However, this practice is not in conformity with other stairs and ramps (plate X) found within the hospital and other setting, such features are observed to be hidden in most cases, and they have to be supported by signs and/or verbal description to be easily located by users. The traffic circle in plate XI above is also observed to be in a very good location, it is located at the centre of the hospital layout. The road from the main entrance

gate leads straight to it and other roads spread to major sections of the hospital. These and many other objects in the various hospitals are effectively incorporated into the practice of giving verbal directions as landmarks.



Plate XIII: Courtyard system ATBUTH Bauchi
Bauchi State
Source: Author's Fieldwork, (Nov. 2015)



Plate XIV: Courtyard system in FTH Gombe
Gombe State
Source: Author's Fieldwork, (Nov. 2015)



Plate XV: Courtyard system in SSH Gombe
Gombe State
Source: Author's Fieldwork, (Nov. 2015)



Plate XVI: Courtyard system in FMC Azare
Bauchi State
Source: Author's Fieldwork, (Nov. 2015)

According to Allison 2007, clear hierarchy of circulation is essential for complex hospitals, well designed courtyards can operate as important nodes as well as landmarks to serve as reference points along a path. Plates above (XIII-XVI) are examples of many similar courtyards found in the studied hospitals, they form integral part of the circulation system and are mostly incorporated into the practice of giving verbal instructions as landmarks or reference points. However, frequent occurrence and similarities of these courtyards within their respective settings can as well make it difficult for users to

understand their location. Such courtyards have to be clearly differentiated or supported with distinctive landmarks to effectively guide wayfinders.

Additionally, public address systems were also found within the hospitals (see figure VI and plate XVII), nonetheless, they were found within limited sections as many buildings developed over time and most of them were not functioning due to lack of frequent maintenance.



Figure VI: Public address system on ceiling
Source: Author's Fieldwork, (Nov. 2015)


Plate XVII: Public address system on wall
Source: Author's Fieldwork, (Nov. 2015)

Figure VI and plate XVII above are typical examples of public address systems usually from the ceiling or fixed on walls. These were used to pass general information to users regarding the hospitals and their services. However, there is the need to further distribute the public address system to other sections as the hospital develops.

In this subsection, examples showing how basic information about entrances, exits, paths and circulatory system can provide the wayfinder with a variety of wayfinding cues have been considered. Thus, establishing how the physical properties of the built environment and objects within it have been incorporated as they play a vital role in communicating with the wayfinder.

4.2.5.2 Coded Information

Coded information is represented by all forms graphical information for both external and internal wayfinding purposes. According to Arthur and Passini (1992) symbols and typographics such as words, letterforms and digits; handgraphics, computer graphics and photographics; pictographics and cartographics fall under this category, and can be classified into directional information (information that direct end-users to their destination e.g. text, arrows and symbols), identification information (identify end-users' destinations and sometimes communicating the value of a place), and orientation information (include a combination of directional and identification information, and might also include a schematic overview of a location). Below are examples of each information (orientation, directional and identification) found in the various wayfinding settings studied;



Plate XVIII: Layout out map in ATBUTH Bauchi, Bauchi State
Source: Author's Fieldwork, (Nov. 2015)

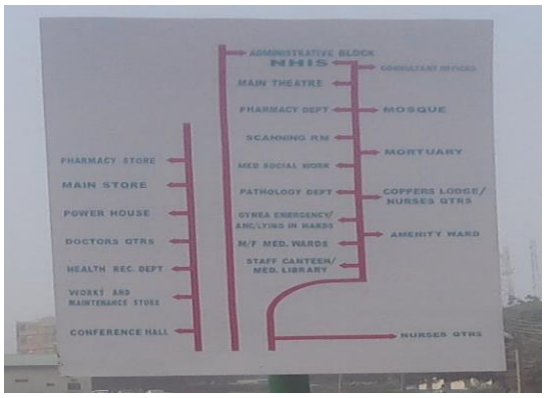


Plate XIX: Building directory in FMC Azare Bauchi State
Source: Author's Fieldwork, (Nov. 2015)

Plates XVIII and XIX above are examples of orientation information, this information according to Arthur and Passini (1992) is used in the decision making stage. It can provide the wayfinder with an overview of what shape the building is, where they are and where the destination lies. Plate XVIII is a layout map found at the main entrance gate in ATBUTH Bauchi, while plate XIX is a building directory found at the entrance

in FMC Azare. However, as good as their locations may be, information overload is a risk for signs, and can inhibit the ability of end-users to process information. Time spent on reading a sign is an important aspect, as Passini (1996) rightly notes, people are annoyed and frequently become impatient when they have to read through lists of names or study unstructured information on signs and maps, these are likely to be the case in plates XVIII and XIX above.



Plate XX: Directional sign in hanging from roof
Source: Author's Fieldwork, (Nov. 2015)


Plate XXI: Direction information on wall
Source: Author's Fieldwork,

Plates XX and XXI above are examples of directional information; this information according to Arthur and Passini (1992) is used in the decision execution stage. Many of this directional information are found in different locations, some hanging from the roof, some on the wall while some are on the floor. Nevertheless, these signs were observed to be insufficient especially at key decision points, most of the signs are on walkways guiding users to certain points.



Plate XXII: Identification sign for pediatric Complex
Source: Author's Fieldwork, (Nov. 2015)



Plate XXIII: Identification sign for A&E centre
Source: Author's Fieldwork, (Nov. 2015)

The plates above (XXII and XXIII) are examples of identification information, this type of information aids decision execution (Arthur and Passini, 1992). The first plate is for paediatric complex in ATBUTH Bauchi while the second is for A&E centre presently health insurance services in the same hospital

In almost all the hospital settings studied, the large number of signs intended to explicate the complex layouts creates more confusion to wayfinders. The layouts are far too complex to be explained with signs. Such layouts have clearly evolved over time with extensions and buildings being added in a piecemeal way thus resulting in the creation of illogical circulation routes. Additionally, the little attention given to signs results in many signs being totally misleading, a good example is that found in FMC Azare (see plate XXIV) possibly being in place for a very long time that even after various changes in functions of buildings the directory sign is still maintained at the main entrance.



Plate XXIV: A misleading building directory sign in FMC Azare, Bauchi state
Source: Author's Fieldwork, (Nov. 2015)

The directory sign (plate XXIV) is totally confusing as observed the A&E department is located where the admin block is located on the board. The two bottom directories by the left are missing and the entire signs are not getting the actual location of buildings on ground.

Also, paintings on floor intended to guide wayfinders are almost totally worn out due to lack of maintenance and poor design (see plate XXV), visitors to the hospital (FMC Azare, Bauchi state) hardly notice such information. However, those found in FTHG Gombe state are in better condition and only few places are worn out (see plate XXVI).



Plate XXV: Floor line guide in FMC Azare, Bauchi state
Source: Author's Fieldwork, (Nov. 2015)



Plate XXVI: Floor line guide in FTH Gombe Gombe state
Source: Author's Fieldwork, (Nov. 2015)

Furthermore, a common problem with floor line guide in all the hospitals used is the poor location of the guide, floor line information are mostly not in the most required locations such as close to main entrance (see plates XXVII and XXVIII), as a result, wayfinders in most cases have to rely on verbal instructions from staff or other users already familiar with the settings in order to use the floor line guide.



Plate XXVII: Floor line guide in FMC Azare, Bauchi state
Source: Author's Fieldwork, (Nov. 2015)



Plate XXVIII: Floor line guide in FTH Gombe Gombe state
Source: Author's Fieldwork, (Nov. 2015)

Plate XXVII is the location of floor line guide in FMC Azare, it is located along the walkway not at the starting point where users can access immediately as they notice the paintings on floor. Plate XXVIII is the location of floor line guide in FTH Gombe where it is also not located at the entrance but deep into the waiting hall, hardly noticed by users whom already most have asked for their location from a close reception desk.

Lastly, poor design of signs, positioning and inconsistency in their design makes it difficult for effective use (see plates XXIX to XXXII below). These are common problems associated with most of the coded information found within the various hospitals. Interviews conducted further affirm that signs were designed or put in place by the hospitals staff with no specific guidelines.



Plate XXIX: Sign painted high on the wall
Source: Author's Fieldwork, (Nov. 2015)



Plate XXX: Sign maintained after change in use of space (reception to waiting area)
Source: Author's Fieldwork, (Nov. 2015)



Plate XXXI: A&E sign covered by flowers in planter
Source: Author's Fieldwork, (Nov. 2015)



Plate XXXII: Use of different font and type of signage
Source: Author's Fieldwork, (Nov. 2015)

According to Passini (1996), the graphic conception of signs, the choice of lettering, the contrast created by black, white, and coloured elements, the size of signs, their position and illumination, are all factors that contribute to legibility and to the relative ease of finding information. However, plates (XXIX to XXXII) above are against some of these factors and painting of signs directly on walls also contribute to poor design and ease to which signs can be changed. Plate XXX shows a painting of 'reception' directly above the chairs in waiting area, initially the space used to be a reception area and presently a waiting area for the users. This is very common in all the hospitals studied.

4.2.5.3 Social practices

This aspect of knowledge is characterized by audible forms of communication which are either verbal or aural. These are provided via information desks by trained staff, an army of volunteers or fellow wayfinders and audible systems such as telephones, audible maps and public address systems. The social practice of giving directions verbally is highly prevalent in all the hospitals studied. Here, reception desks found in most of the hospitals are usually manned by one or two security personnel performing both security checks and the task of guiding visitors to the hospital (see plate XXXIII). Thus, receptions are sometimes found empty as they do offer to help way finders to their destination.

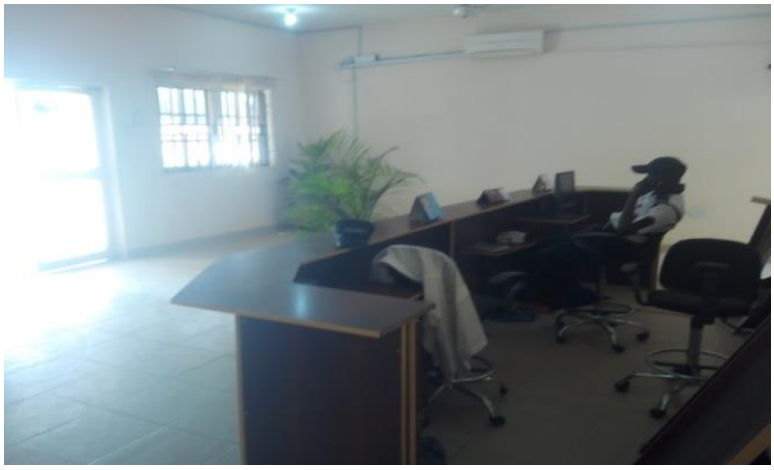


Plate XXXIII: Reception desk with one personnel left in ATBUTH Bauchi. Source: Author's Fieldwork, (Nov. 2015)

Also, the hospitals provide security personnel at specific region within the hospital complexes (see plates XXXIV and XXXV), this is possibly as a result of high security threats in the North East region of Nigeria. However, the security personnel do not always stop at their usual duty but also study and offer assistance to users in need.



Plate XXXIV: Security personnel at the exterior of hospital building
Source: Author's Fieldwork, (Nov. 2015)

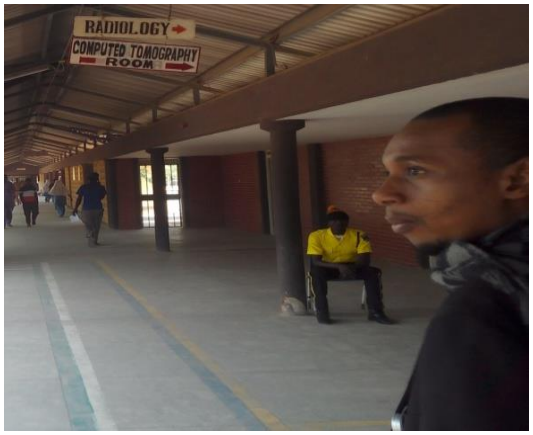


Plate XXXV: Security personnel inside the hospital building
Source: Author's Fieldwork, (Nov. 2015)

Similar security personnel were observed reading and explaining a user's hospital prescription for the user, this is also confirmed by the head of works and maintenance in the hospital that the security personnel are in two categories, the first is the usual security in charge of checking users as part of safety measures from the insecurity while the second are called the 'SERVICOM'. The SERVICOM is an acronym for Service Compact with all Nigerians and is the manifestation of the Federal Government of Nigeria's commitment towards ensuring that Nigerian citizens enjoy good quality service to which they are entitled. It was established in 2004 with the mandate to monitor, evaluate and ensure good services to clients of the hospital. They monitor activities at specific service points and submit reports to the general office. Users can seek help at the SERVICOM complaint office opened 24 hours daily.

Other forms of social practice largely observed in the hospitals have to do with visitors assisting one another, these are users already familiar with the settings offering assistance to wayfinders (see plate XXXVI).



Plate XXXVI: Nature of wayfinding activities in studied hospitals.
Source: Author's Fieldwork, (Nov. 2015).

The plate (XXXVI) above shows a user giving description to another user in a non-landscaped area of the hospital complex, typical of many similar wayfinding activities in most of the hospitals. Such open environment is as a result of several buildings developing over time in a disordered manner creating complex environment, as most of the hospitals do not have master plan. In this type of poor landscaped environment, everywhere seems to be a key decision point where users will have no choice than to rely on the practice of giving verbal instruction.

This section (weak form) has presented the data collected for the study including a brief description of the various research settings considered for the study. Particular attention is paid to how the exercise aided a more in-depth identification and definition of the problems of wayfinding, highlighting the common wayfinding features incorporated in hospitals in the study area. The section emphasises the prevalence of the three aspects of the tri-partite conception as it does the fact that an understanding of how wayfinders make sense of wayfinding information embedded in the physical properties of complex environments is possible through uniquely adequate observations.

The next section (strong form) will present data analysis of empirical findings from questionnaire survey conducted in the respective hospitals.

4.3 Strong Form

As highlighted earlier, the questionnaire survey was carried out as the strong form of the UA criteria to report on wayfinding user requirements in the study area in the event of fire/security emergency. This is to establish which of the three components of the framework illustrated in Figure III (...p23) is most employed for wayfinding in hospitals in North East Nigeria. The questionnaire forms distributed consist of seven (7) alternatives from each of the three aspects of knowledge during the wayfinding procedure; coded information; social practice; and physical features as options for wayfinders during fire emergencies. Hence, results of group means are presented based on these three aspects of knowledge, this will ease the understanding of which of the aspects of knowledge wayfinders tend to agree more with as fire/emergency escape/evacuation options.

Furthermore, individual items on the questionnaires were ranked based on a relative agreement index (RAI) obtained as a ratio of the sum of actual agreement scores (AS_{ac}) and maximum possible agreement score (PAS_{max}) on the 5 point Likert scale for each question (Ibem, Opoko, Adeboye and Amole, 2013). Mathematically, this is expressed as:

$$RAI = \sum \frac{AS_{ac}}{PAS_{max}}$$

Below are analyses of the various sections of the questionnaire including tables of respective frequencies and means of group responses based on the three aspects of knowledge obtained from the questionnaire survey, physical features, coded information and social practices. Responses 1-7 from the questionnaire are elements of the physical features, 8-14 are elements of coded information and 15-21 are elements of social

practices (see Appendix IV). These are followed by a table of ranking of individual items from these three aspects of knowledge considering their relative agreement index in order to show which items specifically addresses user wayfinding requirements in hospitals in the study area.

4.3.1 Section A of the Questionnaire (Demographics)

This section presents analyses of the first part of the questionnaire designed to determine the effect of individual factors such as gender, age, culture, and literacy level amongst hospital users in the study area. Figure 4.2 to Figure 4.5 illustrate the analysis of the respective factors in this section

Figure 4.2 below illustrates gender of users surveyed in the respective hospitals. It can be observed that majority of the users (58%) were male compared to their female counterpart (48%), the result is almost similar when looking at the individual hospitals except that of Abubakar Tafawa Balewa University Teaching Hospital where the male users (51.1) are slightly more than the female users (48.4). Federal Medical Centre Azare have the highest percentage of male users (65.9%) with the lowest number of female users (32.3).

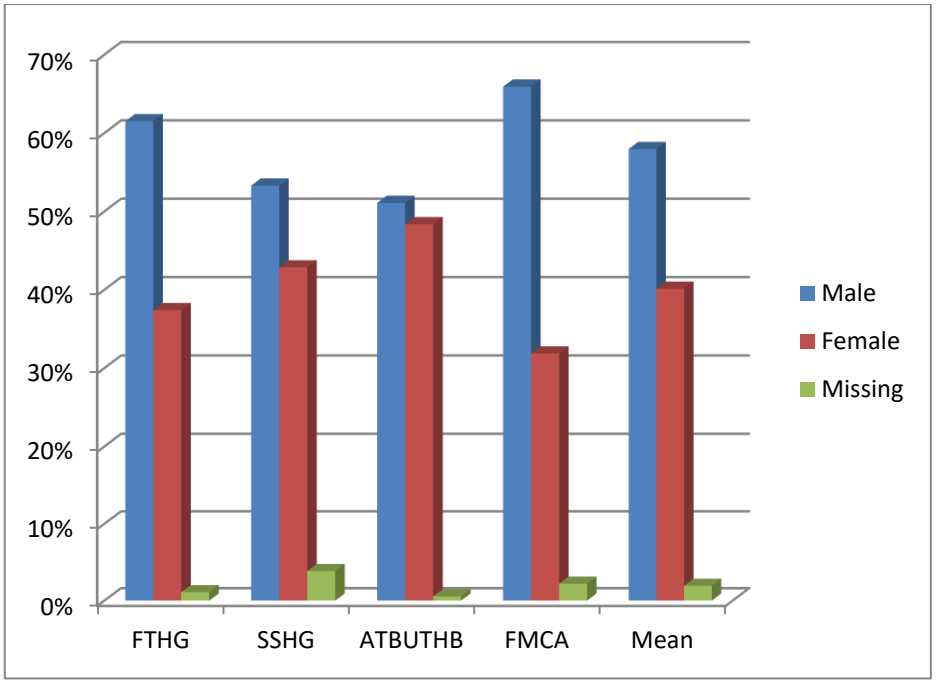


Figure 4.2: Gender of Hospital Users in NE Nigeria. Source: Author's Fieldwork (Nov. 2015).

In terms of users' age bracket, there is a clear difference in average percentages of users that fall within the various age bracket (see figure 4.3). Most hospital users in North East Nigeria fall within the age bracket of 26-35 with an average of 41%, followed by users within the age bracket of 36-45 constituting up to 32% of the entire users. The results are almost similar when looking at individual hospitals except for FMCA where almost equal number of users fall within the age bracket of 26-35 and 36-45 with 37.36% and 37.1% users respectively. However, only an average of 4% of users was found to fall above 46years.

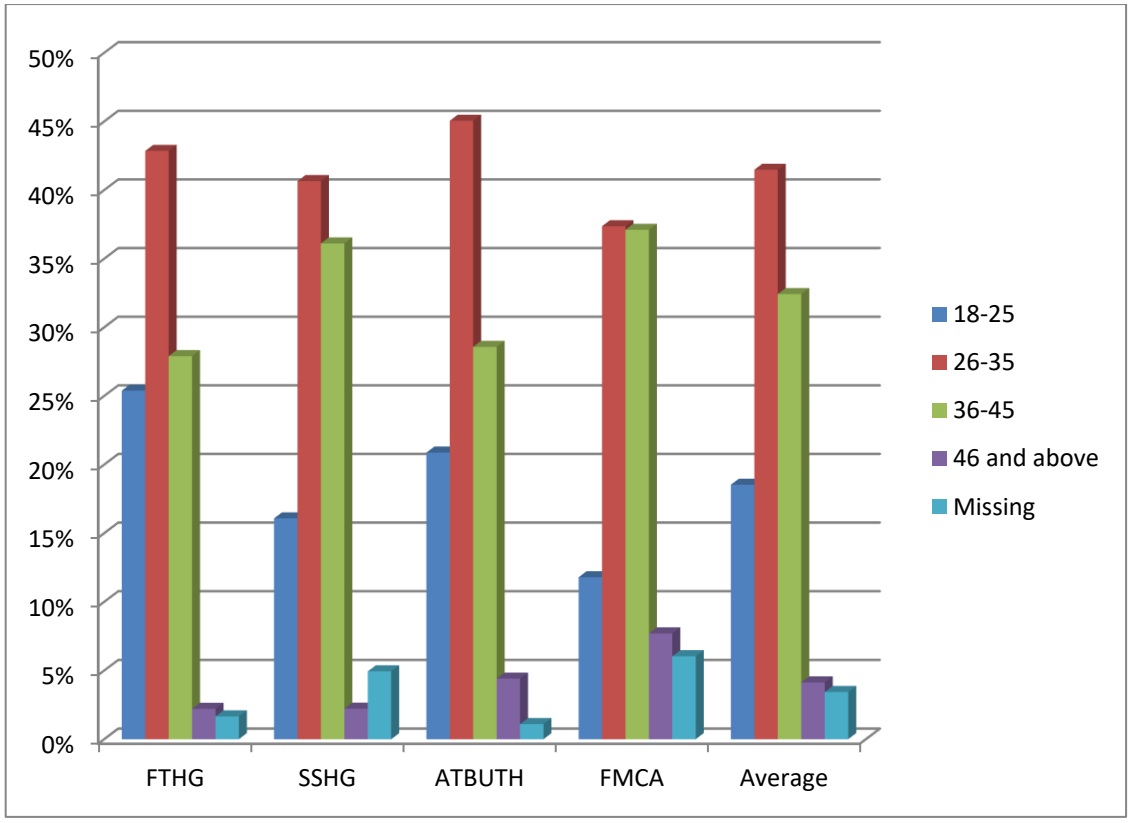


Figure 4.3: Age bracket of Hospital Users in NE Nigeria. Source: Author's Fieldwork (Nov. 2015)

Furthermore, majority of the users were found to be of the same or similar cultural background (see figure 4.4 below), it was not surprising when the result indicated that upto 73% of the users are either Hausas, Hausa Fulani or other Hausa related culture as a result of inter-ethnic relation, this is not surprising considering the location of study. 18% of the hospital users are other cultures such as Fulani, Karekare, Jarawa, sayawa, Tangale and waja, and only 4% and 2% of the average users are Yoruba and Igbo respectively.

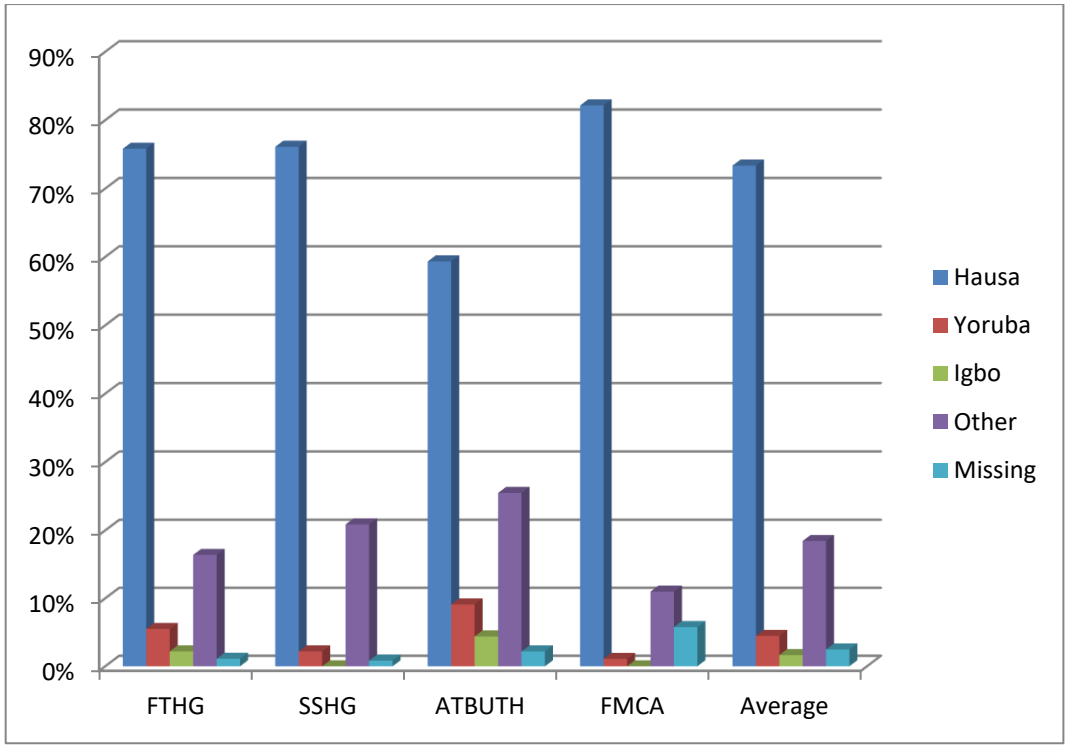


Figure 4.4: Cultural Background of Hospital Users in NE Nigeria. Source: Author's Fieldwork (Nov. 2015).

Finally, figure 4.5 below illustrate users' level of education in hospitals in North East Nigeria. Majority of the hospitals users (40%) are either school dropout, famers, traders, or hawkers and only 10% of the average hospital users have primary school certificate as their highest level of qualification. The result is almost similar when looking at the individual hospitals as the primary school qualification scores the lowest and 'others' score the highest. Upto 28% of the average users have tertiary certificates and an average of 19% of the hospital users are either enrolling or have secondary school certificates as their highest level of qualification.

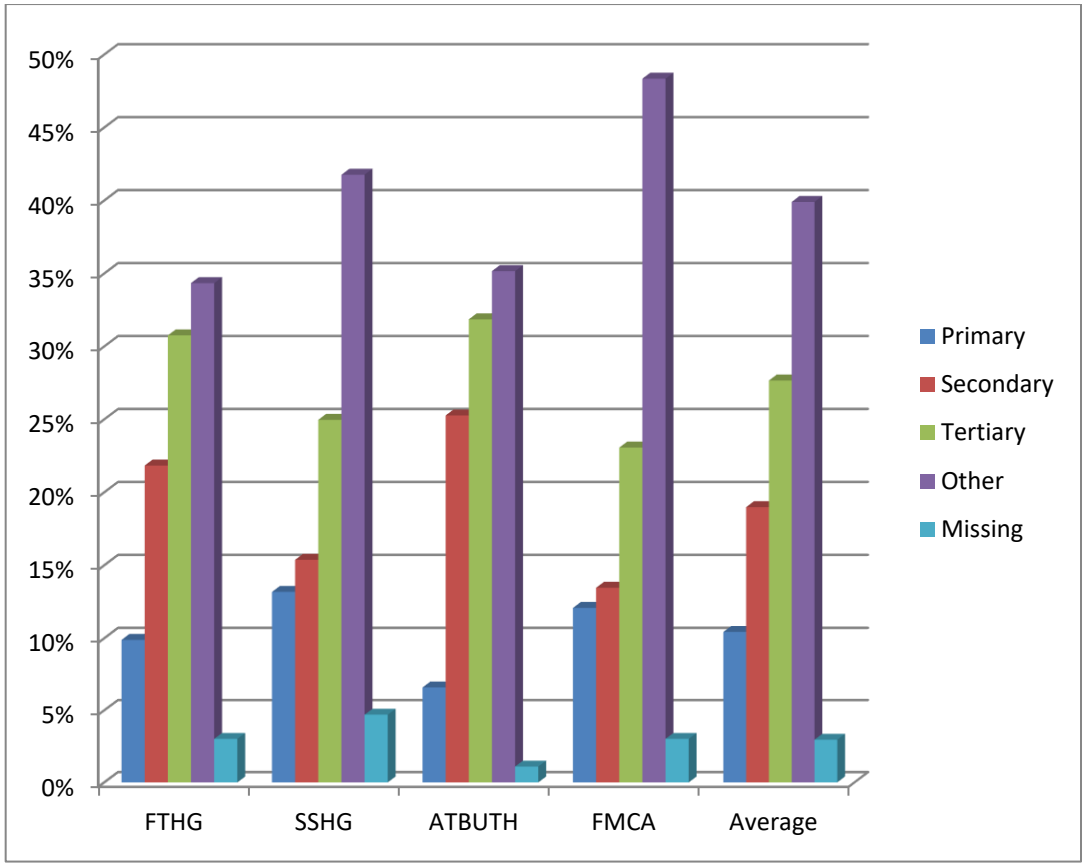


Figure 4.5: Level of education of Hospital Users in NE Nigeria. Source: Author's Fieldwork (Nov. 2015).

4.3.2 Section B of the Questionnaire

This section of the questionnaire is designed to determine which of the three concepts physical features, coded information and social practices is most employed for wayfinding by users in the selected case studies. Tables below (table 4.1, 4.2 and 4.3) illustrate frequencies and means of group responses base on the three aspects of knowledge obtained from the questionnaire survey.

Table 4.1 Group mean of responses one to seven (1-7)

x	***f***	***fx***	
1	453	453	
2	395	790	
3	347	1041	
4	836	3344	
5	517	2585	
∑	2548	8213	Mean (x) =8213 / 2548 x **=3.22**

The results illustrated in table 4.1 above shows that respondents neutrally agree that physical features of the built environment (e.g. entrances/exits, stairs, corridors, windows etc.) will influence their wayfinding behaviours in choosing appropriate fire/emergency escape alternatives.

Table 4.2 Group mean of responses eight to fourteen (8-14)

x	***F***	***Fx***	
1	668	668	
2	769	1538	
3	431	1293	
4	438	1752	
5	242	1210	
∑	**2548**	**6461**	Mean (x) = 6461 / 2548 x **=2.53**

The results illustrated in Table 4.2 above also shows that respondents neutrally agree that coded information (e.g. signs, graphics, posters, notices) will influence their wayfinding behaviours in choosing appropriate fire/emergency escape alternatives.

Table 4.3 Group mean of responses fifteen to twenty-one (15-21)

x	***F***	***Fx***	
1	500	500	
2	669	1338	
3	547	1641	
4	528	1584	
5	304	1520	
∑	**2548**	**6538**	Mean (*x*) = 6538 / 2548 *x* = **2.58**

The results illustrated above in Tables 4.3 above also shows that respondents neutrally agree that social practices (e.g. following firemen, security, volunteers etc) will influence their wayfinding behaviours in choosing appropriate fire/emergency escape alternatives.

Ranking of individual items from the three aspects of knowledge as presented in the questionnaires form is illustrated in table 4.7 below. Each item is ranked with respect to its actual agreement score as obtained from surveyed questionnaire forms and maximum possible agreement score as highlighted earlier ($RAI = \sum \frac{AS_{ac}}{PAS_{max}}$).

Table 4.4: Ranking of individual tri-partite items within hospitals in NE Nigeria

No	Category	Likert Item	$\sum AS_{ac}$	RAI
Q1	P	Entrances/exits	1445	0.793
Q2	P	Stairs	1370	0.752
Q7	P	Corridors/balconies	1345	0.739
Q15	S	Security Personnel	1303	0.715
Q18	S	SERVICOM staff	1277	0.701
Q10	C	Paintings on floor (floor line guide)	1252	0.687
Q14	C	Route from memory	1228	0.674
Q3	P	Courtyards	1034	0.568
Q20	S	Follow fire fighters	1032	0.567
Q6	P	Openings such as windows	1027	0.564
Q17	S	Follow volunteers	1026	0.563
Q4	P	Ramps	1023	0.562
Q5	P	Mechanical Sound e.g. loud speaker, P.A etc	969	0.532
Q8	C	Signs/visuals	955	0.524
Q16	S	Follow others	949	0.521
Q11	C	Graphics/picture	868	0.476
Q13	C	Posters	819	0.45
Q19	S	Look for information desk	788	0.432
Q21	S	Follow visitors	736	0.404
Q9	C	Bold words/letters/caption	704	0.386
Q12	C	Notice Board	637	0.35

The maximum score for any item per respondent is 5 from the 5 point Likert scale, with 1 for strongly disagree to 5 for strongly agree. For 364 questionnaires, the possible maximum score per item will be 1820 (364 x 5).

4.3.3 Summary

From the results obtained from the three aspects of knowledge in wayfinding, it can be seen that respondents agree neutrally with all alternatives, to varying degrees. However, their agreement with physical features which has a mean value of 3.22 is stronger than their agreement with the social practices and coded information which have mean values of 2.58 and 2.53 respectively. These findings go in contrast with the prescriptive framework of addressing wayfinding developed by Rooke (2010) (see Figure III ...p23). The findings show that respondents give priority to physical features over social practices and coded information as wayfinding alternatives. Figure 4.6 below illustrates the findings from respondents' degree of agreement with the three categories of wayfinding systems in hospitals in North East Nigeria.

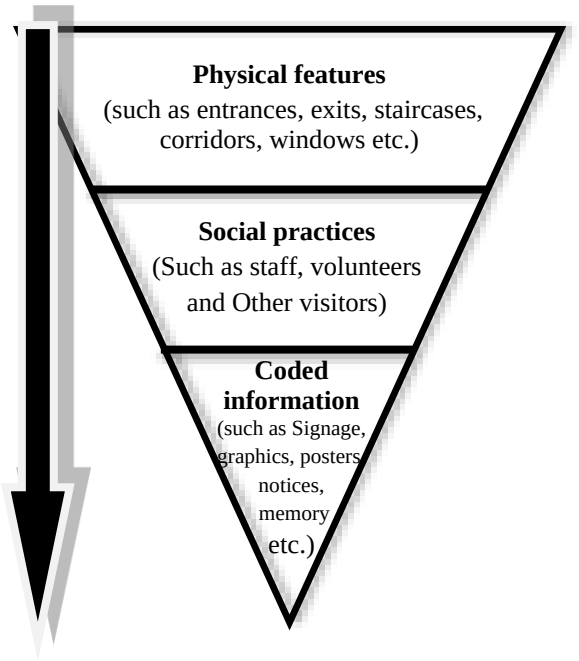


Figure 4.6: Modified framework for addressing wayfinding problems in hospitals in the study area

The arrow to the left of the pyramid indicates the order of priority and the size of each segment communicates the importance of each knowledge flow in comparison. However, the findings support earlier hypothesis by Maina and Umar (2015) that social practice

will score higher than coded information in other settings due to the social culture and literacy level in many parts on Nigeria. The authors further noted that the reason this was not so in their study of the Senate building was because the study was conducted in an institution of higher learning where English proficiency is high.

Finally, it can be said that the tri-partite conception of knowledge flows is highly relevant for the purposes of managing the flow of wayfinding information. This validates similar findings from Rooke (2012) and Maina and Umar 2015. Its usefulness as a prescriptive framework arises from the fact that it prioritises communicating wayfinding information through the physical properties of the built environment over the practice of verbal directions and coded information. In the form that it is presented in, the conception should provide a robust tool for focussing the attention of architects and other relevant designers on the precise parts of the environment where right wayfinding information should be place in order for it to be accessed at the right time.

5.0 RESULTS AND DISCUSSION OF FINDINGS

5.1 Introduction

This chapter presents results and discussion of findings for this research under the two forms of UA criteria (weak form and strong form). Thus, the first part presents findings from the first survey conducted in order to establish how wayfinding features have been incorporated in the design of hospitals in the study area. While the second presents result and discussion of findings from questionnaire survey carried-out as the strong form of the UA requirements in order to find effective ways of managing information for improving wayfinding performance in emergency situations in hospitals in North East Nigeria.

5.2 Findings from first survey (weak form)

Findings from first survey based on the weak form of UA criteria explores the existing wayfinding features commonly incorporated in hospitals in North East Nigeria. Most complex hospitals in North East region comprises of isolated building units connected with covered walkways as corridors and/or balconies. Communication through the physical properties of the built environment is largely through legible architectural features, visual, audible and tactile objects such as entrances/exits, stairs, path, circulation system, landmarks and mechanical sound.

Entrances/exists used in hospitals in the region are mostly in form of simple projections supported with columns and covered with simple pitch roof or concrete deck. They are typical of common entrances found within residential buildings in the region. Circulation system involves the use of courtyards with long covered walkways and sidewalks as a result of extensions and buildings being added in a piecemeal way as most of the hospitals

have no master plan. These creates oblique and indirect entrances/exist to various sections and may have to rely on marquees to be easily seen by users. Landmarks are used in various forms ease circulation system and most public address systems found within the settings are connected to few or limited buildings and are not functioning due to lack of frequent maintenance.

Also, coded information informs of directional information, identification information and orientation information were intensively used within the hospitals. Directional information direct end-users to their destination e.g. text, arrows and symbols, Identification information identify end-users' destinations and orientation information include a combination of both directional and identification information, and might also include a schematic overview of a location. These are mostly incorporated along walkways hanging from roof, painted on walls and floor, and placed close to entrances. However, these information are characterized by confusing arrows, ill positioning, poor design and mostly contain incomplete information as they are not design by professionals and placed under specific guideline or policy.

Furthermore, the practice of giving verbal instructions is highly prevalent within the hospitals, characterized by audible forms of communication which are either verbal or aural and are provided via information desks by trained staff, an army of volunteers or fellow way finders and audible systems such as telephones, audible maps and public address systems. These systems are incorporated into the various settings and are highly complemented by the large number of security personnel and SERVICOM staff found within the settings.

5.3 Results and Discussion of findings from second survey (Strong form)

Results from questionnaire analysis shows that wayfinders within hospitals in North East Nigeria agree more with employing physical features as wayfinding elements with a mean value of 3.22. This is followed by social practices and coded information with mean values of 2.58 and 2.53 respectively (see table 5.1). However, these findings do not fully support the prescriptive framework for addressing wayfinding developed by Rooke (2012).

Table 5.1: Survey responses on wayfinding in North East Nigeria

Survey questions	**Corresponding Likert Scale item**	**Mean**
Q 1-7	Physical features (Entrances, exits, staircases, windows etc.)	3.22
Q 8-14	Coded information (Signage, graphics, posters, notices, memory etc.)	2.53
Q 15-21	Social practices (Following firemen, security personnel, other visitors)	2.58

The first aspect of knowledge (physical properties of the built environment) is line with that of the prescriptive framework with the highest mean value. Specifically, users choose entrances/exits, stairs, and corridors/balconies as the first three items for wayfinding in hospitals in North East Nigeria in the possibility of a fire or security alert (see table 4.7). Ramps and mechanical sound on the other hand ranked lowest amongst all the physical features as they occupy the twelfth and thirteenth positions respectively. This finding may not be unrelated to the nature of hospital layouts in North East Nigeria, most buildings are in isolated units connected to one another with roofed walkways as corridors/balconies; and stairs and ramps as their only means of vertical movement as they usually not exceed two floors. Ramps are usually in hidden locations and used

mostly for moving patients to upper floors while public address systems are not connected to all buildings and are mostly faulty due to lack of frequent maintenance.

However, social practices and coded information with group mean of 2.58 and 2.53 respectively are in contrast with the prescriptive frame as their position is interchanged. Users agree more with items of social practices compared to coded information during wayfinding activities in hospitals in North East Nigeria.

Users highly appreciated the role played by security personnel and SERVICOM staff as these items rank fourth and fifth respectively. This is not surprising as security personnel are at the first point of entrance to all buildings within the hospitals due to the high level of insecurity in the North East region, while SERVICOM staff are at strategic areas are showing high level of competence in discharging their duties of ensuring effective service delivery within the settings. Additionally, the social culture within many parts of Nigeria encourages seeking directions from people around a building as highlighted by Maina and Umar (2015). This may have contributed to the relatively high ranking of these items.

On the other hand, low ranking of coded information may not be unrelated to the high level of illiteracy as observed from the results, majority of hospital users in North East Nigeria are traders, farmers, school dropout or hawkers that can hardly read signs within the settings. Users could hardly read prescription given to them and this constitutes most of the works of SERVICOM staff within the settings. They rely more on verbal instructions and or descriptions usually given with respect to position or location of entrances or buildings despite the use of identification and directional signs within the complex. Additionally, poor design and ill positioning of signs as observed in most of the hospital settings may have contributed to the low ranking, as the signs are sometimes misleading, incomplete and difficult to access. However, floor paintings as floor line

guide rank highest amongst items of coded information as it occupies the seventh position, this may not be unrelated to the visible floor paintings (floor line guide) found at most entrances/exits to buildings in the hospitals and the easy nature at which they can be understood by all users. Also, the ease at which the floor line guides are incorporated into the practice of giving verbal instructions may have contributed to the relatively high ranking of the item.

Finally, it can be concluded that findings from both surveys (weak and strong form) clearly define users' wayfinding requirement in the study area. Hospital users in North East Nigeria give priority to navigating using physical properties of the built environment over social practices and coded information in emergency situation. Specifically, legible architectural features such as clear entrances/exits to buildings, highly visible circulation system and roofed corridors/balconies usually siding courtyards address users' wayfinding requirement in North East Nigeria. However, high level of social practices especially amongst visitors and hospital staff is also commended by the users at the same time highly appreciating the role of floor line guide as aid when navigating through the complex hospital setting.

5.4 Summary of key findings

The study reveals that hospital users in North East Nigeria gives high priority to navigating using physical properties of the built environment such as entrances, exists, courtyards, corridors etc. They also appreciate social practices largely offered by security personnel and SERVICOM staff while floor paintings as guides are the only highly ranked features under coded information However, these features are associated with the following challenges from the case studies;

(I) Poorly visible entrances and exits whose facades are flushed with sidewalks and obscured from view by corners (oblique and indirect entrances and exits) especially in courtyards.

(II) Hidden stair cases explained by confusing signs

(III) Multiple similar courtyards and poor landscape

(IV) Long and confusing corridors and;

(V) Poor design of floor paintings as most parts are worn out due to frequent movement of users from one place to another.

Also, the study reveals the modulating influence of education especially at primary school/basic level on wayfinding. The implication on wayfinding is an overload when deciphering coded information. Averagely, people understand the basics in terms of colors and physical features and fall back on the socio-cultural practice of verbal instructions to supplement wayfinding information. This suggests that basic education in the study area may not be providing the requisite literacy knowledge to cater to world standards as most hospitals are modeled after the western style of healthcare delivery. These results furnish further proof for urgent improvement in primary and adult education systems as this maybe the only formal education received by the average person within the region.

Furthermore, the study reveals the predominance of physical features employed for wayfinding in the study area. Specifically, entrances, stairs, corridors and balconies are the most preferred features of the built environment employed for wayfinding (Table 5.2). The social practices of relying on hospital security and SERVICOM staff are ranked fourth and fifth. These are closely followed by the first set of coded information, which are painting on floors and route from memory. Features which demand extensive reading,

and by implication literacy, in the form of letters, bold words, captions and notices on boards are ranked lowest on the table. These findings support wayfinding activities observed within the hospitals.

Table 5.2: Ranking of individual wayfinding features in hospitals in NE Nigeria.

Items	**Rank**	**Category**	**SUM**	**RAI**
Entrances/exits	**1**	P	1445	0.793
Stairs	**2**	P	1370	0.752
Corridors/balconies	**3**	P	1345	0.739
Security Personnel	**4**	S	1303	0.715
SERVICOM staff	**5**	S	1277	0.701
Paintings on floor (floor line guide)	**6**	C	1252	0.687
Route from memory	**7**	C	1228	0.674
Courtyards	**8**	P	1034	0.568
Follow fire fighters	**9**	S	1032	0.567
Openings such as windows	**10**	P	1027	0.564

6.0 DESIGN PRELIMINARIES

6.1 Site Location (Bauchi State)

The north-eastern part of Nigeria comprises of six states, with the region mostly known for production of crops and livestock which contribute greatly to the economy of the country. The region is densely populated as compared to the southern region of the country. The major tribes are Hausa and Fulani and they are largely Muslims.

The capital city of Bauchi state is also known as Bauchi, and until 1976 the state was a province in the then North-Eastern State. Bauchi State occupies 49,119km^2 of Nigeria's total land mass and is located between latitudes 9° 3' and 12° 3' north and longitudes 8° 50' and 11° east. It is bordered to the north by Kano and Jigawa State, to the south by Taraba and Plateau State, Kaduna to the west and Gombe and Yobe to the east.

Bauchi state is one of the states in the northern part of Nigeria that span two distinctive vegetation zones, namely, the Sudan savannah and the Sahel savannah. The Sudan savannah type of vegetation covers the southern part of the state. Here, the vegetation gets richer and richer towards the south, especially along water sources or rivers, but generally the vegetation is less uniform and grasses are shorter than what grows even farther south, that is, in the forest zone of the middle belt.

There are 55 major tribes that form the tribal groups in the state, including Badawa, Bolewa, Butawa, Fa'awa, Fulani, Gerawa, Hausa, Jarawa, Kanuri, Karekare, Sayawa, Wariawa and Zulawa.



Figure 6.1: Map of Nigeria showing Bauchi State. Source: http://www.forumspotz.ng/

6.2 Selected Sites

Hospitals are one of the most important infrastructures in a community Increase in population especially in developing countries, increases the demand for new hospitals. Hospitals are usually funded by the public sectors, profit or nonprofit health organizations, charities, insurance companies or even religious orders. No matter who funds the project, where to locate a new hospital is an important question to ask (Lina Zhou , 2012).

For the purpose of this research, the trauma hospital is meant to serve the entire North East region especially in the event of any insecurity threats resulting to large number of casualties. Therefore, the two sites considered for the rsearch were located at the heart of Bauchi State where the mojor roads linking all the North Eastern states meets (see figure 6.2). This is to further ensure ease of access or close poximity of the trauma hospital to the neighbouring states.

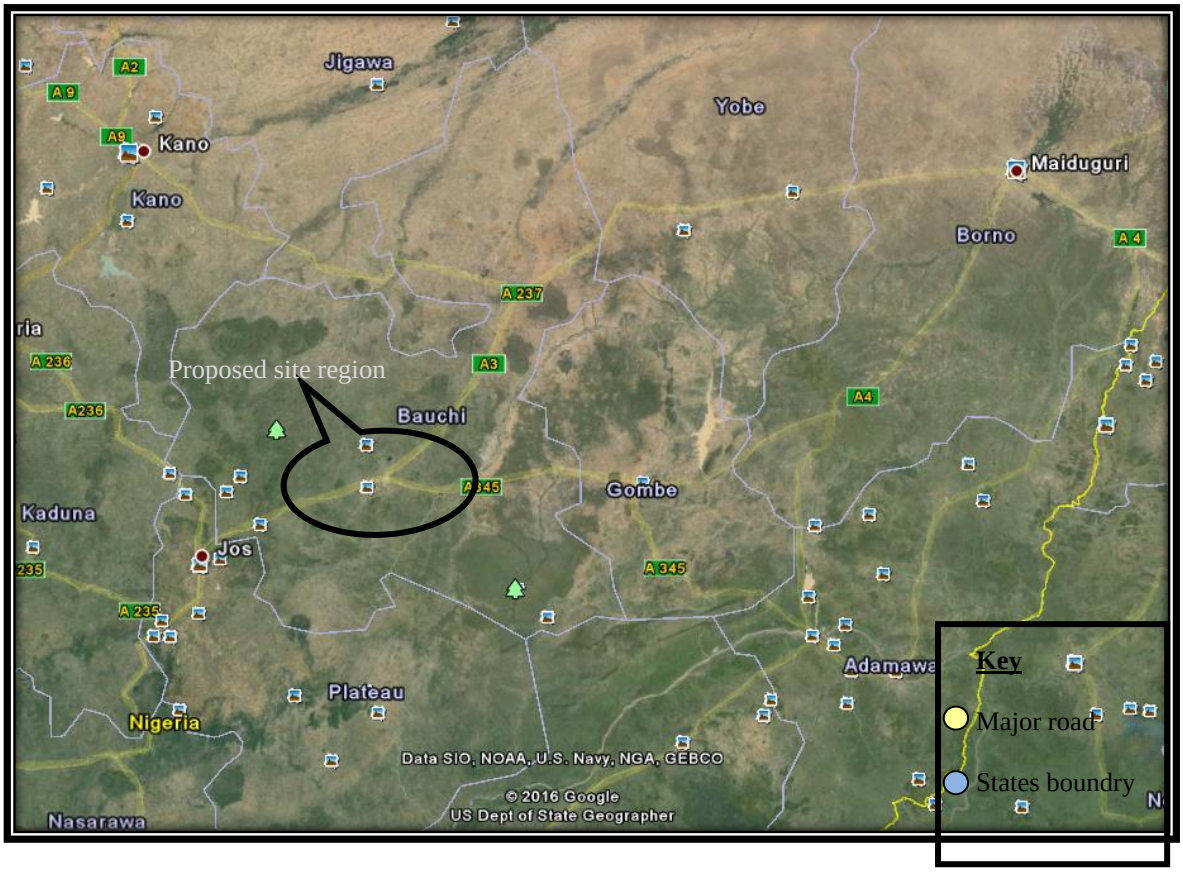


Figure 6.2: Proposed site selection region. Source: Google Earth, 2016.

The first site is located along Ahmadu Bello way close to Destination Bauchi Hotel behind Central Bank of Nigeria's (CBN) quarters sharing boundary with Sokoto Road while the second site is located along Yakubu Road opposite First Bank of Nigeria sharing boundary with Rimi Road. The two sites share approximately similar distance to Avon Healthcare Ni'ima Consultants hospital located in between (see figure 6.3).

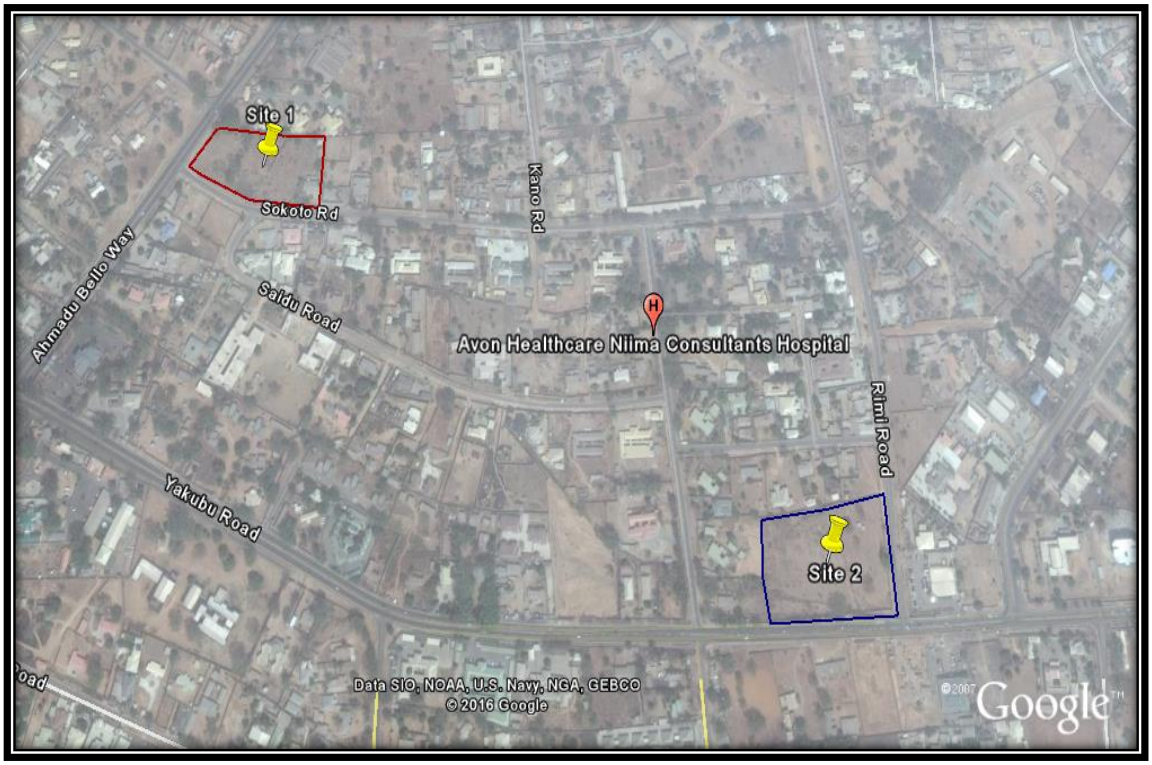


Figure 6.3: Proposed sites for trauma specialist hospital. Source: Google earth, 2016.



Figure 6.4: Proposed first sites for trauma hospital. Source: Google earth, 2016.

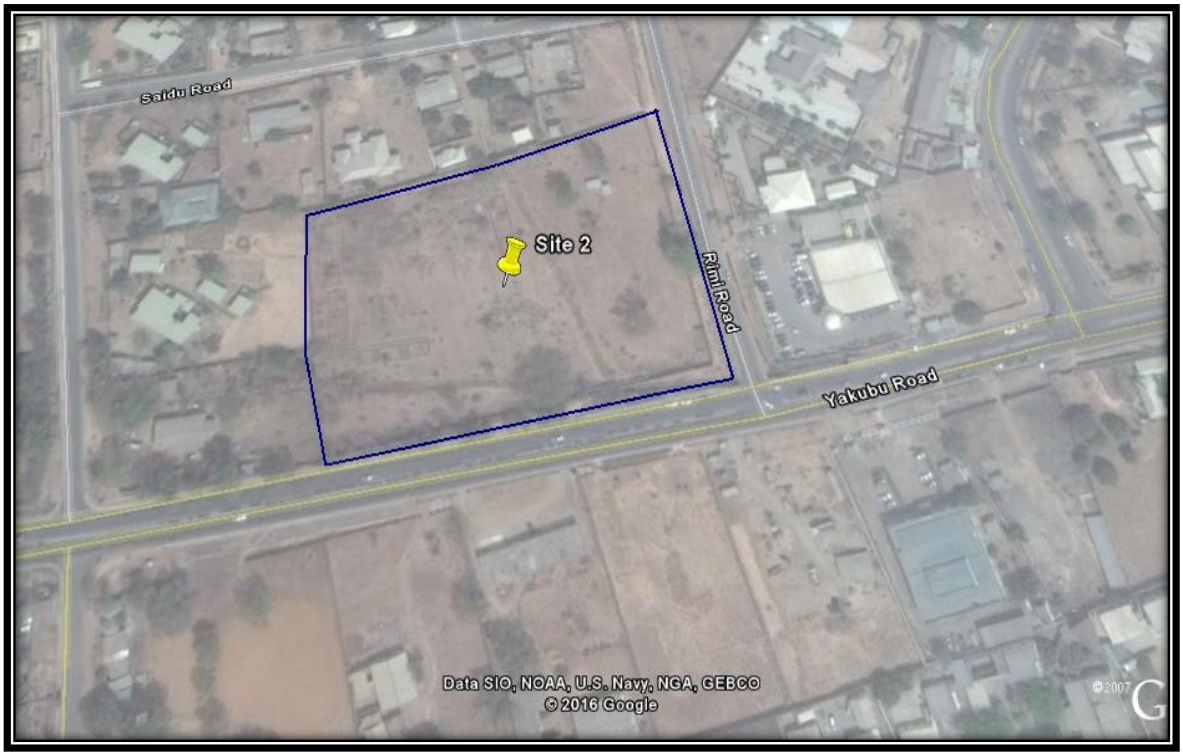


Figure 6.5: Proposed second sites for trauma hospital. Source: Google earth, 2016.

6.3 Site Selection criteria and features

According to Soltani and Marandi (2011), a broad range of site selection criteria have been recommended by medical authorities or researchers depending on the size and scale of the hospital. These criteria have been established to compare the relative viability of each site to house the proposed facility.

Below is an itemized list of the criteria outlined by (Lina Zhou , 2012), along with specific questions considered when evaluating each variation and option. A relative score is assigned to each criterion and recorded on the scoring sheet summary below. Scores were awarded using a range of 1 – 5, as follows: 5 = excellent, 4 = above average, 3 = average, 2 = below average, 1 = poor

This will result in a relative comparison where the higher the score, the more desirable the site.

Criterion 1 – Existing hospitals: How far is the site from existing hospitals? What are the anticipated impacts on existing hospitals? (The further away from the existing hospital the better). However, considering the impact of a trauma hospital on other hospitals, the closer it is to existing hospital the better.

Criterion 2–Residential area: How far is the site from the residential areas? (The nearer, the better)

Criterion 3- Accessibility: How far is the site from the access road? (The nearer, the better)

Criterion 4 - Lot Size: Is the site capable of reasonably providing for the Building's Future Expansion, and Outdoor Access? Is there space to accommodate safe Vehicular and Pedestrian Circulation, Roads, Parking, and Loading Facilities? Is there adequate frontage/Access for sight distances?

Criterion 5 – Site Physical Characteristics: Is the site flat, rolling, or does it have steep grades? Are the soils well drained? Is there any rock or ledge outcroppings? Does the site configuration lend itself to the proposed development?

Criterion 6 – Utilities: Is municipal water and sewer available? Is there adequate electrical service? Is Natural gas available? Is telephone and television cable available? Is there a storm water utility or provisions for municipal storm water disposal?

Criterion 7 – Neighbourhood: Is the site located in an Institutional area? Is the site located in a Residential area? Is the site located in a mixed-Use area? Is this a rural, suburban or urban setting? Are there views opportunities?

Criterion 8 – Construction Issues: Are there existing buildings on site that need demolition? Are there construction impacts on existing facilities? Are there existing facilities that need to be replaced?

Criterion 9 – Quality of Program/Service: Can the site accommodate a fully integrated facility? Is integration possible for clinical and medical services?

Table 6.1: Site Selection Criteria Scoring Summary

S/N	Criteria	Site 1	Site 2	Remarks
1	Distance from existing hospitals	4	4	The two sites are relatively close to Avon Healthcare Ni'ima consultants' hospital.
2	Distance from residential areas	5	5	Site 1 is very close to residential area while site 2 is farther.
3	Accessibility	5	4	Both sites can easily be accessed from the access road
4	Lot size	5	5	Both sites are large with good potentials for future expansion.
5	Site physical characteristics	4	2	Site 2 is sloppy with undulating surface while site 1 has gentle slope with relatively flat surface
6	Utilities	4	4	Both sites have available electrical services and water supply
7	Neighborhood	3	2	Both sites have good view opportunities for the surrounding buildings and road network
8	Construction issues	4	2	Both sites have few obstructions of buildings that need to be demolished
9	Quality of programme /service	4	4	Both sites have good potential to accommodate a fully integrated facility
Total		**38**	**32**	**Results shows that site 1 is more suitable for the intended facility**

6.4 Site Location

The proposed site is located at Ahmadu Bello Way behind CBN quarters Sokoto Road, Bauchi, the Bauchi State capital in close proximity with other public buildings. It is

located at longitude 10°18'38.35"N and latitude 9°48'50.58"E with an approximate altitude range of 580m see figure 6.6 below.

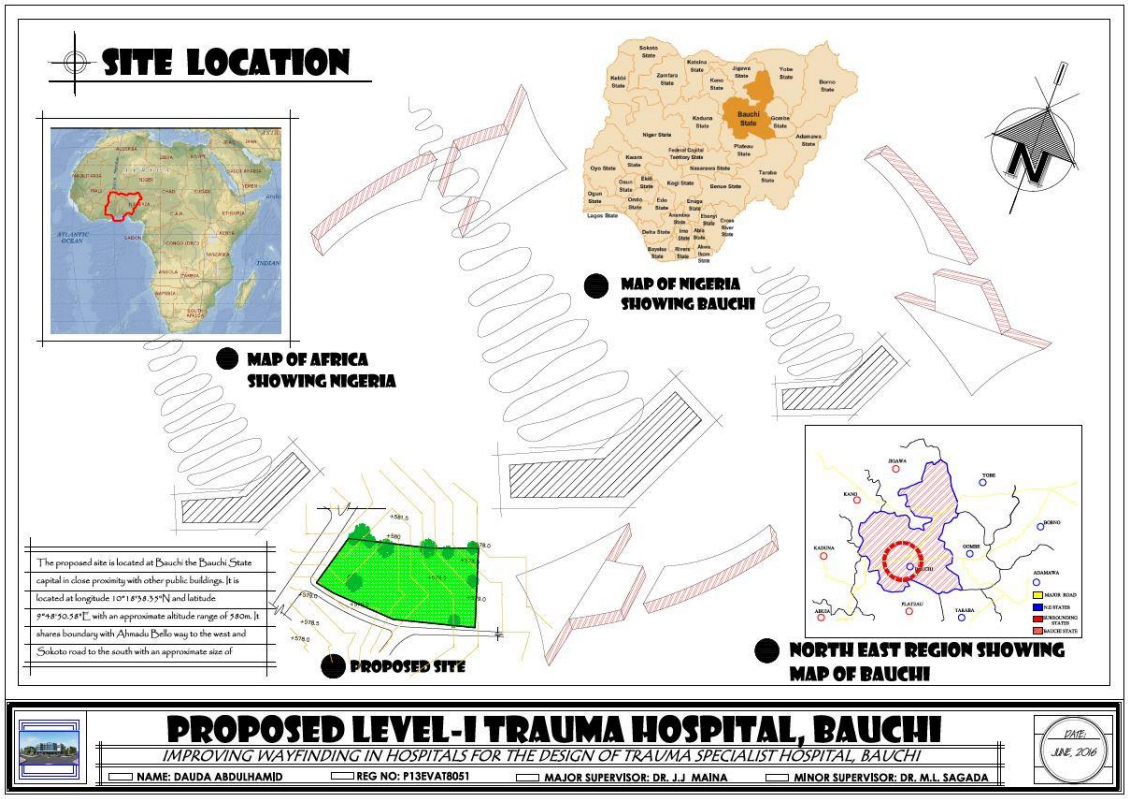


Figure 6.6: Proposed site location

6.5 Site Analysis

The physical, climatic, and general features of the site were analyzed in order to identify the possible opportunities that will be utilized for a better design, also taking note of the possible threats and measures to reduce their effect on the proposed building and surrounding environment the following are features that were noted during analysis of the site (see Figure 6.7).

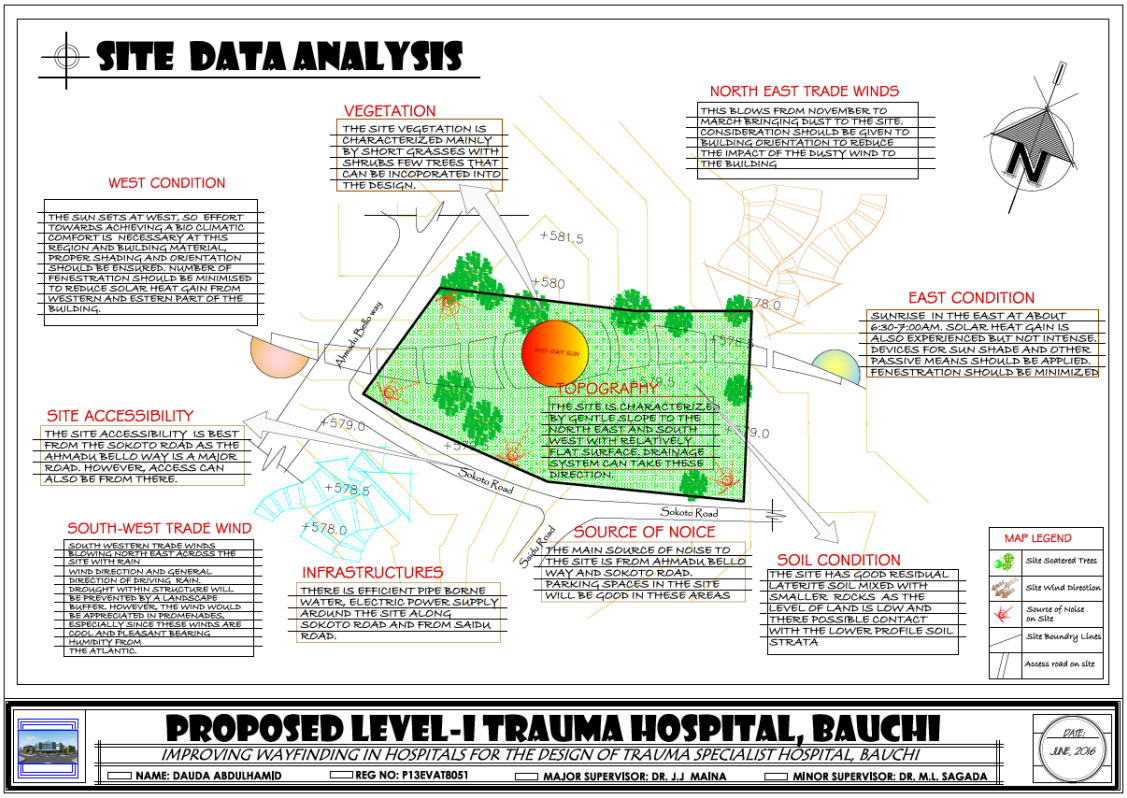


Figure 6.7: Proposed site analysis

6.6 Site Climate

The site is characterized by the two distinct climates of Bauchi State that is, rainy season and dry season which are carefully analyzed for the development of the site (see figure 6.8). Rainfall starts from the month of March to October with its peak in August. During this time temperature range between 38°c – 40°c being the hottest period in the year. The dry season begins in the month of November and ends in February, the temperature is coldest in this period with an average of 22.4°c. The humidity is low during the dry season and high during the rainy season. Hence openings should be provided to ventilate the building especially during the day and proper building orientation should be considered with adequate and proper shading system.

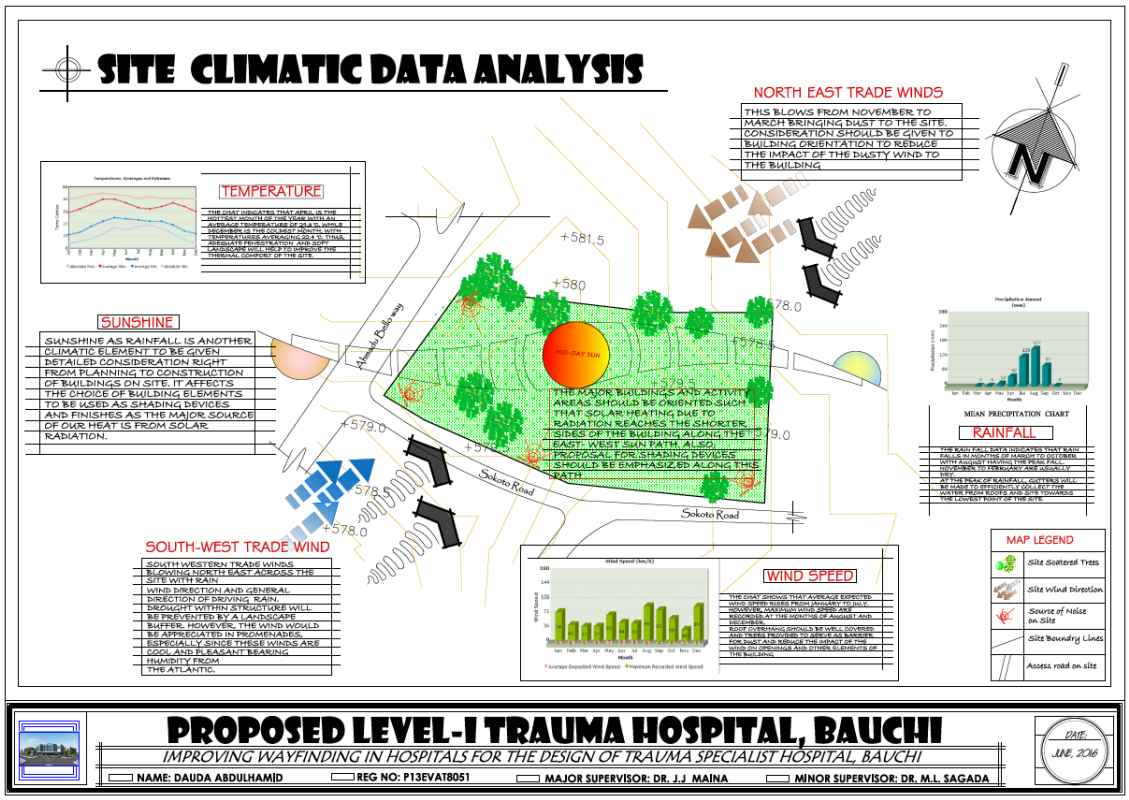


Figure 6.8: Proposed climatic data analysis.

6.7 Site Zoning

In the planning and zoning of site, the various units and facilities provided are to be properly located. Factors to be considered includes: positioning of parking spaces, positioning of building in a relatively even surface to limit cut and fill, hierarchy in the arrangement of spaces, positioning of wards to take advantage of natural landscape views; streams, river, mountain etcetera. These are carefully considered in the development of the proposed site.

6.6.1 Circulation and Safety

Circulation space should be as wide as possible that provides the flexibility needed while eliminating shape edges and sudden turns. Lobbies and corridors leading to emergency unit should be designed separately from general circulation lobbies to avoid traffic in emergency situations.

Safety is a paramount consideration in the design of multi-storey building structures. In the incident of fire outbreak, occupants should be able to evacuate the building at all level within a limited time. Escape stair case should be provided on all floors and be positioned away from traffic and a position where it can be easily located and preferably different sides of the building to reduce traffic in the case of emergency evacuation.

7.0 DESIGN REPORT

7.1 Design Brief

Terrorism as a global challenge to the security of life and properties has its inception dated back to 1835 by the advent of Nihilism in Russia. The undertakings of this so-called group is no different from other terrorist groups worldwide whose activities see no value to life and properties of others whose thoughts contradict their credence.

The terror activities of some Islamic extremist group in Nigeria particularly in the North-East region of the country has gain familiarity across the globe due to its recent recurrent attacks on public places such as schools, markets, bus stations, religion centres, hospitals and other similar areas.

Victims of the insurgent attack are admitted to hospitals, either public or private with proximity being an important factor of consideration for prompt medical attention. Such aids are usually provided in a traumatized condition for both patients and caregivers considering the high level of insecurity. While this security issues set anxiety and frustration to the fatalities, poor wayfinding scheme in the hospitals add to the problem.

Hence, the design proposal seeks to address challenges associated with wayfinding needs and to establish ways of improvement in hospitals in north-east region of Nigeria in response to the rise in trauma cases from security challenges in the region.

7.2 Concept Development

Design concept is widely seen as a three-dimensional object achieved by the arrangement of forms to depict the picture of how the final design outcome tends to look. This design concept is however psychological in nature which is a virtual means of problem solving in the design process.

The philosophy behind the concept is to first ensure an environment that eases wayfinding problems through formulating cognitive maps with respect to reference points such as atrium, courtyards and means of vertical movement. This is in other to eliminate the need for high literacy level required to ease wayfinding problems in most hospitals complex. Also, to ease the incorporation of wayfinding solutions and enhance easy understanding of wayfinding guide for users in the building complex by arranging them in other of importance identified from the study for effective wayfinding.

7.3 Design

The building is a three storey structure designed as a trauma specialist hospital Bauchi, Bauchi state. The design scheme is a product of an objective research outcome aimed at addressing wayfinding challenges in hospitals and to serve as a chef-d'oeuvre for future development in similar building typology in north-east region of Nigeria.

7.3.1 Wayfinding consideration

The study reveals that hospital users in North East Nigeria gives high priority to navigating using physical properties of the built environment such as entrances, exists, courtyards, corridors etc. They also appreciate social practices largely offered by security personnel and SERVICOM staff while floor paintings as guides are the only highly ranked features under coded information.

7.3.1.1 Physical features

To circumvent the problem of wayfinding in trauma specialist hospital Bauchi, the site plan is designed in a way that all major facilities are grouped and closely linked together in the case of preliminary facilities in other to simplify wayfinding processes. The

research findings were incorporated in the design given upmost priority to the need of subjects under investigation.

Physical feature is the highly ranked wayfinding technique among others. Unobstructed view of entrances from major routes to the facility and points of visitor's arrival becomes the first step for wayfinding solution in the design.

Site plan

The main entrance to the hospital complex is directly opposite the site entrance for vehicular and pedestrian access to give a clear view of the initial point of one's destination, see figure 7.1 below.

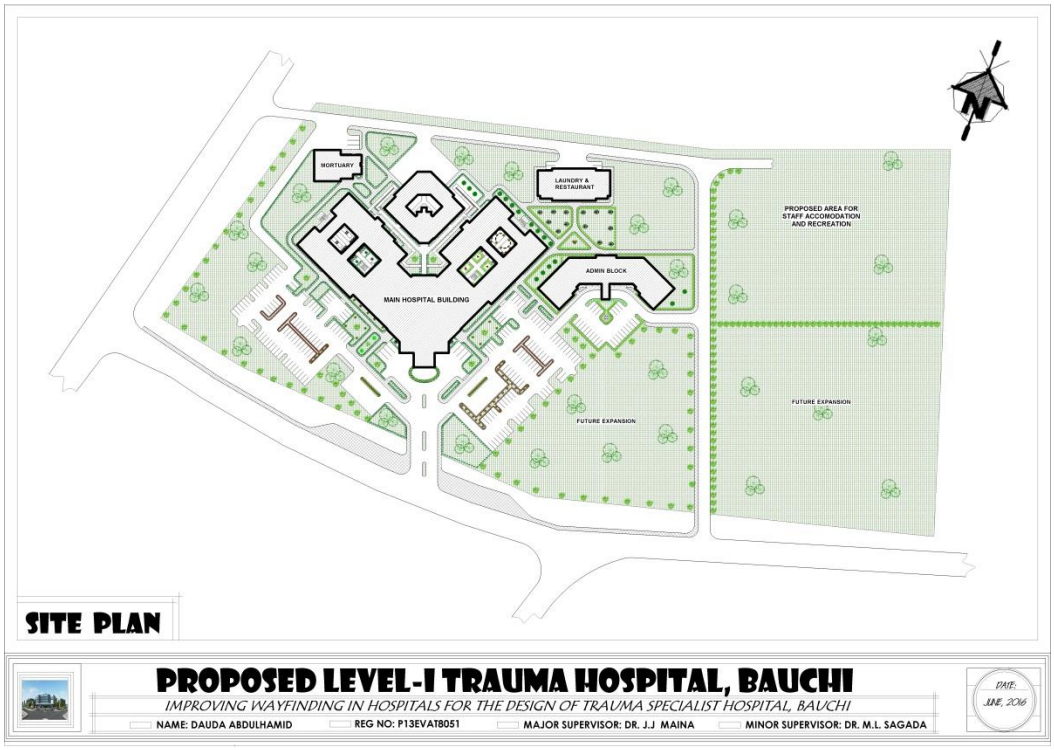


Figure 7.1: site plan of proposed trauma specialist hospital Bauchi.

Car parking spaces were situated relatively close to the building with good design walkways to redirect pedestrian circulation in an orderly manner for ease of wayfinding.

The walk ways pattern was made flexible by ensuring uninterrupted view and a streamlined movement in and within the vicinity of the facility. Thus, utilizing the building orientation by avoiding obstruction to views and oblique and indirect entrances which is a wayfinding prerequisite in this study. This also helps in avoiding panicking and stampede in traumatized or emergency situations.

Floor plan

The building floor plan is a V-shaped configuration of spaces with all walls slanted at angle 45^0 and inverted 45^0 with an attempt to create a central point of reference see figure 7.2.

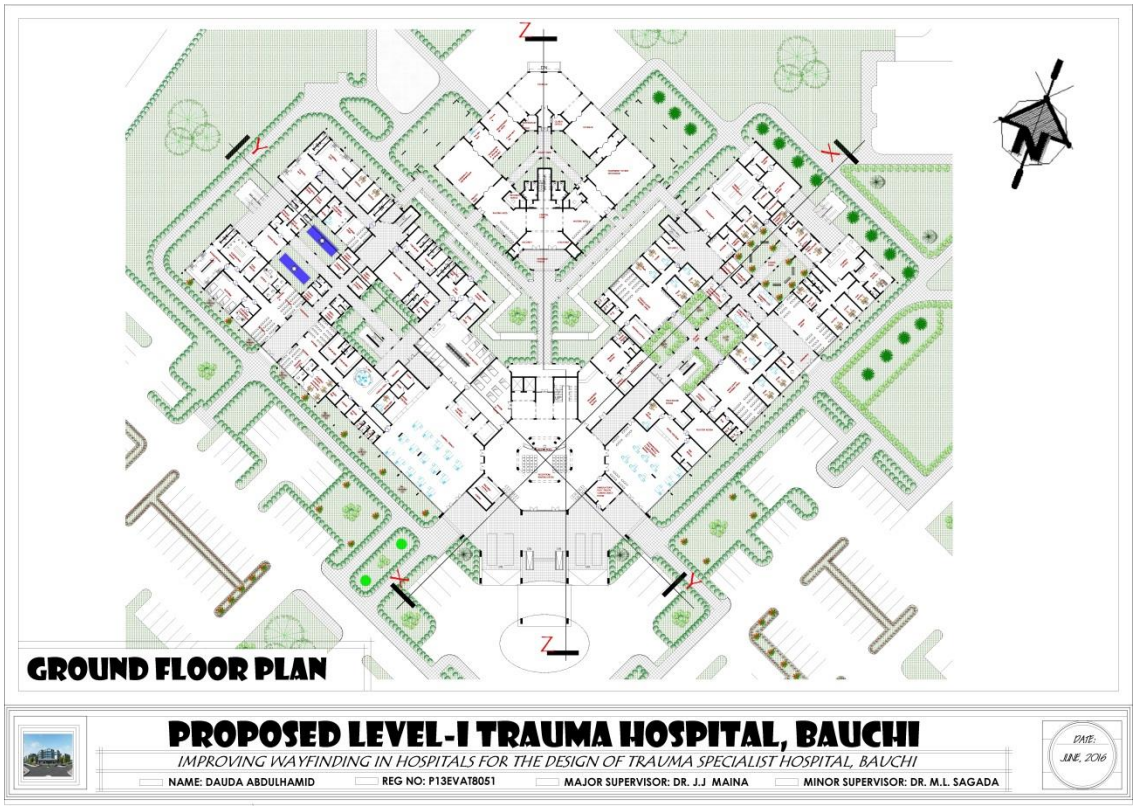


Figure 7.2: Ground floor plan of proposed trauma specialist hospital Bauchi.

The logic behind the design is to provide a central circulation system from which other spaces radiate from. This helps to bring all facilities close to each other for effective wayfinding and circulation. The physical features explore in the design are as follows;

1. All major entrances and exit are made with glazed or curtain wall system to enhance wayfinding through legible quality, allowing great visual access to the facility.
2. All stair cases are easily accessible from waiting areas, receptions, or atrium, situated in a position free from traffic
3. Use of central circulation system or atrium to enhance legibility of physical features such as elevators and staircase.
4. Achieving clear architectural differentiation in similar courtyards through change in volume, landscape, finishes etc. to ease wayfinding activities through cognitive mapping.
5. Courtyards are designed to serve as important nodes and reference point with respect to other spaces during wayfinding activities thus, enhancing spatial orientation.
6. Ensuring direct access within courtyards to eliminate oblique and indirect entrances thus, providing users with highly visible and legible entrances (see figure 7.3).

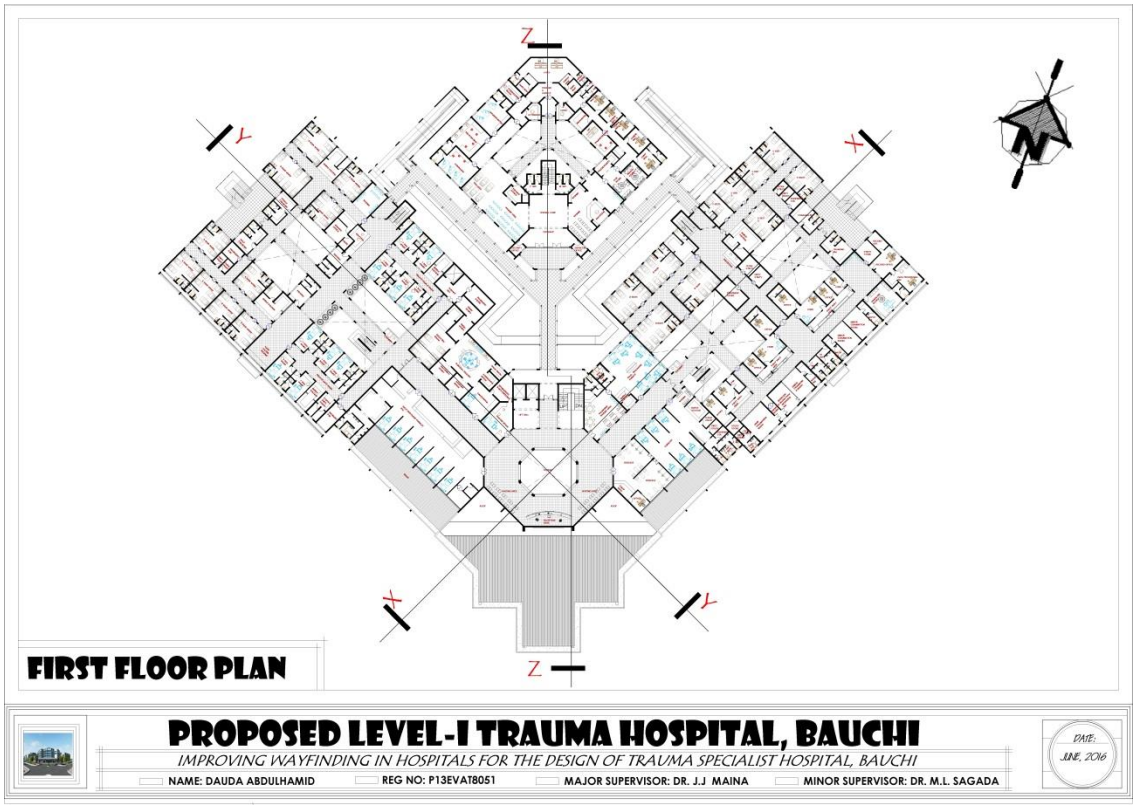


Figure 7.3: First floor plan of proposed trauma specialist hospital Bauchi.

7.3.1.2 Social practice

Social practice is the second highly ranked wayfinding system from findings in this research. Incorporating security and SERVICOM post as part of the design in the building and on the landscape environment will to a great extend enhance efficiency of the system, additional security and maintaining the purposes for which the facility is design to serve.

Unlike other hospitals where SERVICOM staffs are seen dispersed around the environment and within the building, this design allocates units at strategic points mostly close to entrances to every section of the hospital (see figure 7.2), for assisting wayfinders to their various destinations without creating obstruction to movement as observed from case studies where staffs giving assistance are seated on walkways meanwhile creating unnecessary obstruction in the process.

Also, the provision of staff base corridor system within the complex helps in eliminating long and confusing corridor system with confusing signs, at the same time greatly promoting social practices in times of wayfinding need (see figure 7.4).



Figure 7.4: Perspective view of staff base corridor system.

This ensures that hospital staff can easily provide assistance with ease to users with wayfinding difficulties without having to leave working area or station.

Furthermore, positioning of waiting areas at strategic points within the building complex is a deliberated attempt to engage the services of volunteers in form of visitors already knowledgeable with the setting as study reveals is an important role usually played by this category.

7.3.1.3 Coded information

Floor line guide ranked highest among items of coded information. However, this design seeks to address the problems associated with poor design (wearing away) of coded lines on floors by incorporating them on walls (see figure 7.5). this will eliminate the wearing

away of the line guide due to constant contact by users moving within the hospital complex being it on the floor.



Figure 7.5: Perspective view of covered walkway with line guide.

However, different finishes especially in texture are also provided on floor to guide visually impaired users in navigating within the building as a universal principle associated with hospitals design (see figure 7.6 below).



Figure 7.6: Perspective view of covered walkway with line guide.

Additionally, the building concept as stated earlier enhances cognitive mapping through the provision of areas with distinct views such as the atrium, clear architectural differentiation in courtyards and the use of landmarks. These largely reduce the need for complex and large number of signs within the hospital.

8.0 SUMMARY, CONCLUSION AND RECOMMENDATION

8.1 Summary of Findings

Wayfinding systems have been the commonly used strategies to guide people's orientation and navigation within large and complex institutional and multi-level buildings. The purpose of this study was to establish ways of improving wayfinding in hospitals in Nigeria in +response to the rise in trauma cases from insecurity in the country. The approach was explored in North East Nigeria to generate appropriate responses to wayfinding needs during emergencies. The research is qualitative and quantitative in nature with visual survey, interview and observation as method used in the qualitative aspect while questionnaire was used for the quantitative part of the research in the collection and analysis of data. Two surveys were conducted in four hospitals to explore both existing wayfinding features and relationship between physical features, coded information and social practices in the hospitals. Results from the first survey, visual survey and interviews, reveals extensive incorporation of wayfinding features with little or no guidelines, resulting to poor design, confusing signs and high dependency on social practices. The second, a questionnaire survey provided data analyzed considering simple frequencies and means under the three wayfinding concepts. Results show that physical features gained significantly higher mean than social practices, followed by coded information, this implies that users will find it tasking to navigate complex hospital in a traumatized state by relying on poorly designed wayfinding guides.

However, in other to attain efficiency of wayfinding in hospitals located in north-east Nigeria, two questions are posed in which this research seeks to answer.

i. Which wayfinding features have commonly been incorporated in hospital design in the study area?

ii. Which architectural features address user requirements for wayfinding in hospital design in the study area?

The answer to research question one "which wayfinding features have commonly been incorporated in hospital design in the study area" was identified from visual survey, interviews and observation during case studies. These are elements under physical features, coded information and social practices used for the questionnaire survey.

Low level of literacy among the hospital users, who are mostly, with little or no formal education will account for the lack of utilization of some of the wayfinding features like items of coded information and physical features; therefore, rely solely on the practice of giving verbal information to navigate complex hospitals.

Answer to the second research question "which architectural features address user requirements for wayfinding in hospital design in the study area" can be seen from the framework derived from research findings (see figure 4.6).

8.2 Conclusion

This study set out to establish wayfinding strategies and features for hospital users within northeast Nigeria. Results reveal the predominant use of physical features notably entrances/exits, staircases as well as corridors and balconies. A modification of Rooke's (2012) framework is proposed where social practices precede coded information for low literate communities such as found in the study area. The study also established a statistically significant difference at primary school level compared to other levels of education with regards wayfinding.

8.3 Recommendation

The outcome of this study could have several applications. A few of these applications are discussed in the following paragraphs. As wayfinding is an important concept and a problem solving scheme in mitigating the hitches associated with panic and anxiety in trauma or other emergency cases, it is also a means of saving lives in hospitals.

Wayfinding in trauma hospitals in north-east Nigeria could be highly utilized by proper incorporation of physical features from the design stage, enhancing the efficiency of social practice and coded information, and simplifying circulation pattern both within the building and in the external environment.

The design framework developed from the study could be used to guide future trauma hospitals development or redevelopment in north-east region of Nigeria. This is demonstrated in the proposed design of Trauma Specialist Hospital, Bauchi. It could also serve as a framework for architects involved in hospital design to help inform design decisions during the design process. The findings however recommend the following;

a) Physical features

1. All entrances from major visitors' convergence point should be made visible and free from obstruction.
2. All major entrances and exits should be made legible with transparent glass doors to give a clear view of activities going on.
3. All stair cases should be easily accessible from reception, atrium and waiting areas.
4. Use of central circulation system or atrium to enhance legibility of physical features such as elevators and staircase.
5. Sidewalks as corridors/balconies should be designed with offset from the building to make adjacent entrances/exits visible for users.

6. Clear architectural differentiation should be achieved in similar areas especially in courtyards through change in volume, landscape, finishes etc. to ease wayfinding activities through cognitive mapping.
7. Courtyards should be incorporated in to the design to serve as important nodes and reference points with respect to other spaces to ease wayfinding orientation.

b) Social practice

1. Strategic incorporation of SERVICOM and security posts at entrances to major facilities.
2. Provision of staff base corridor system within the hospital to eliminating long and confusing corridor system with confusing signs, at the same time promoting social practices in times of wayfinding need.

c) Coded information

1. Provision of line guide on walls and not floor to avoid constant wearing away of major areas.
2. Provision of an elements or configuration that will ease the formulation of mental image (cognitive map)

8.4 Contribution to knowledge

I. The study provided a modified framework for addressing wayfinding problems in hospitals in North East Nigeria, prioritising physical features (M 3.22), over social practices (M 2.58) and coded information (M 2.55) as wayfinding features to be considered in hospital design in the study area.

II. The study established specific wayfinding features for hospital design in North-east Nigeria, highlighting entrances (RAI 0.793), stairs (RAI 0.752), corridors and balconies (RAI 0.739) as the most preferred features of the built environment employed for wayfinding in the study area.

III. The study also demonstrated the impact of low literacy level in northeast Nigeria as it influences wayfinding design solutions in the study area.

8.5 Areas for further research

The focus of this research has been to establish ways of improving wayfinding in hospitals in Nigeria. However, scope and limitation due to time frame for the study limits generalization of findings across the country. Thus, further studies on the effect of other demographic factors such as gender, age and ethnicity on wayfinding in other regions of the country is necessary to provide a holistic framework for wayfinding in socio-economically disadvantaged areas in Nigeria. This is important as results from the present study limits generalization of findings across the entire country.

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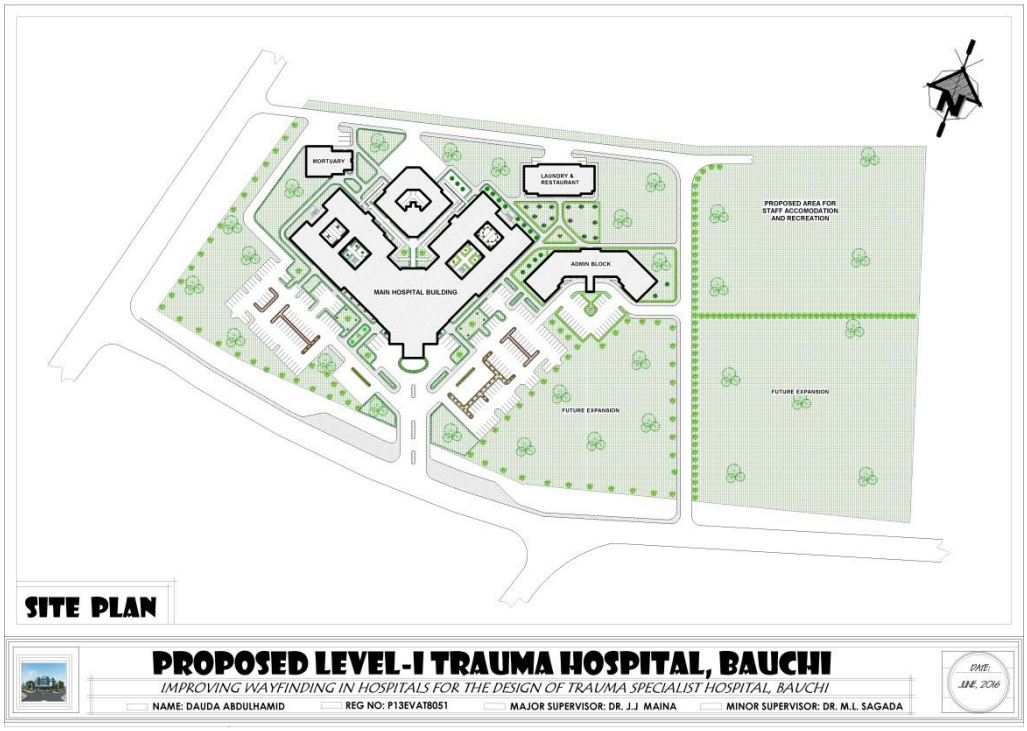
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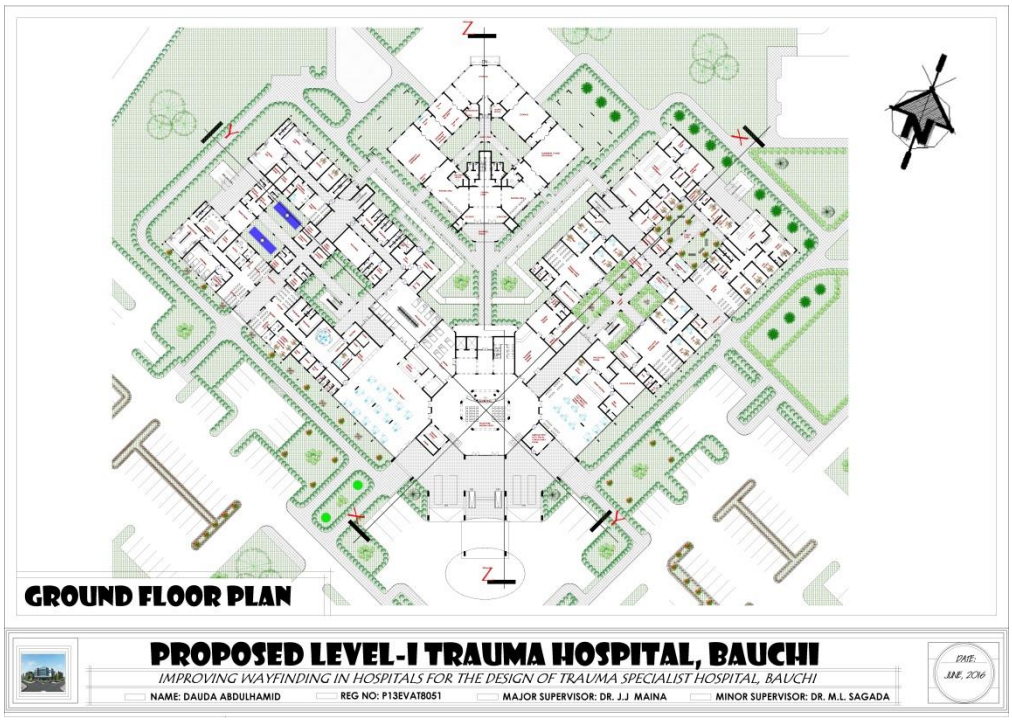
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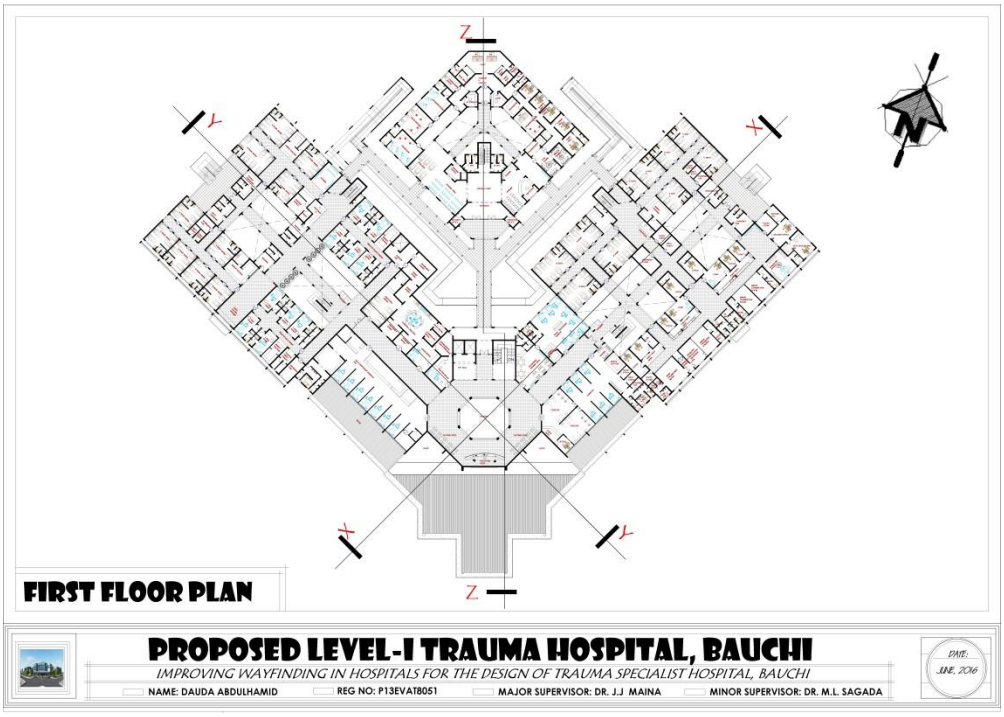
APPENDICES



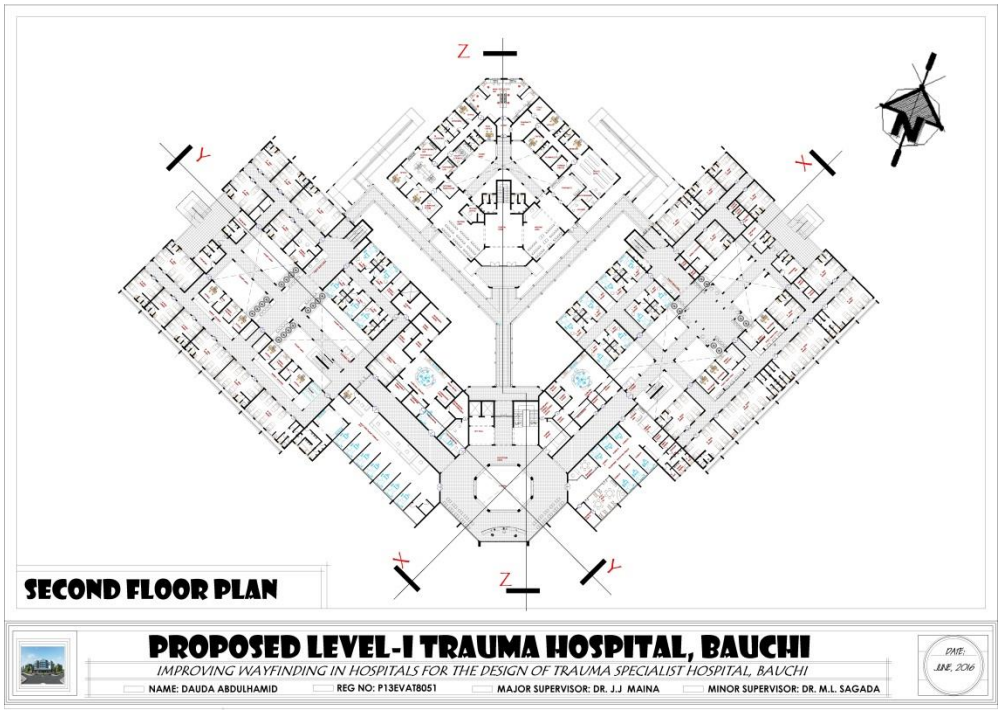
Appendix I: Site plan



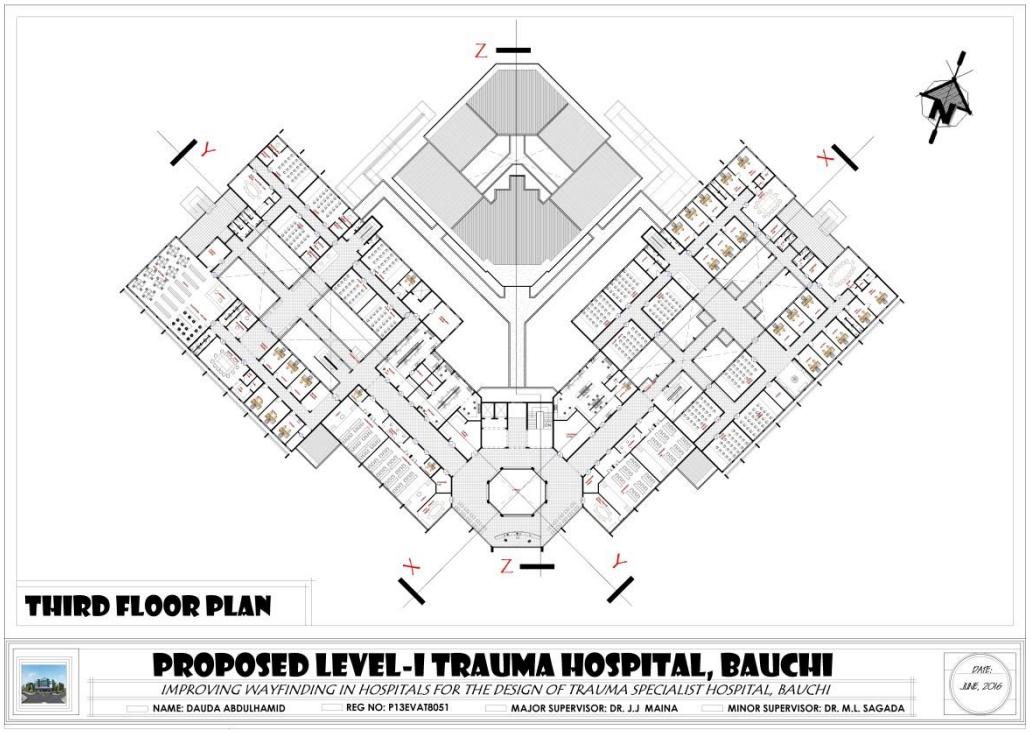
Appendix II: Ground floor plan



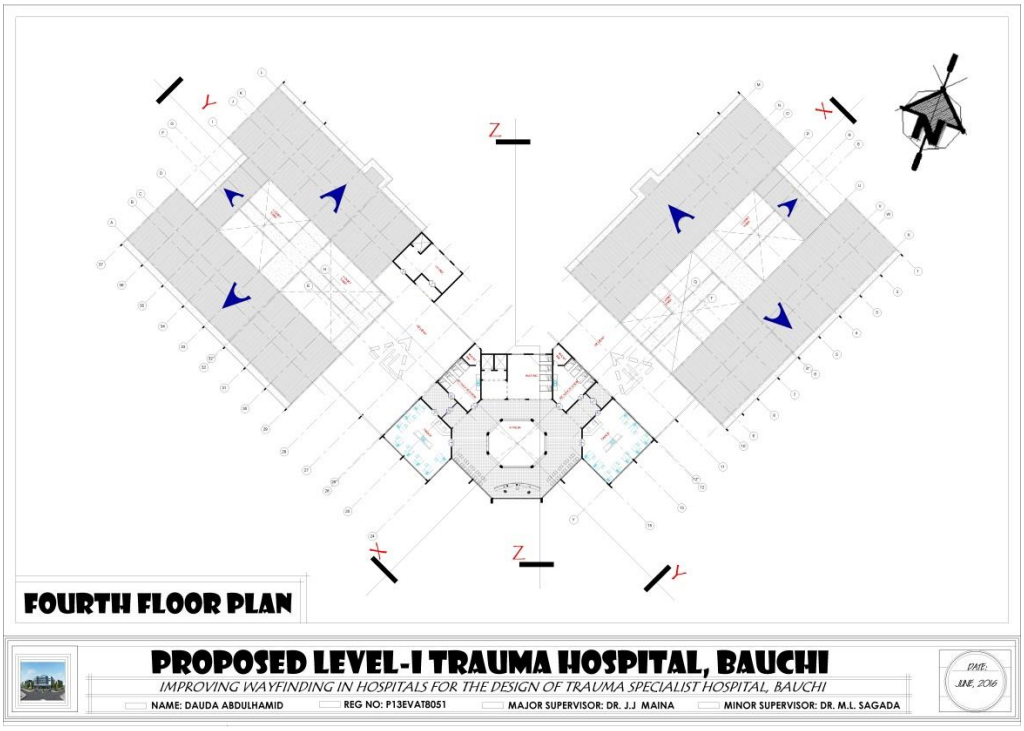
Appendix III: First floor plan



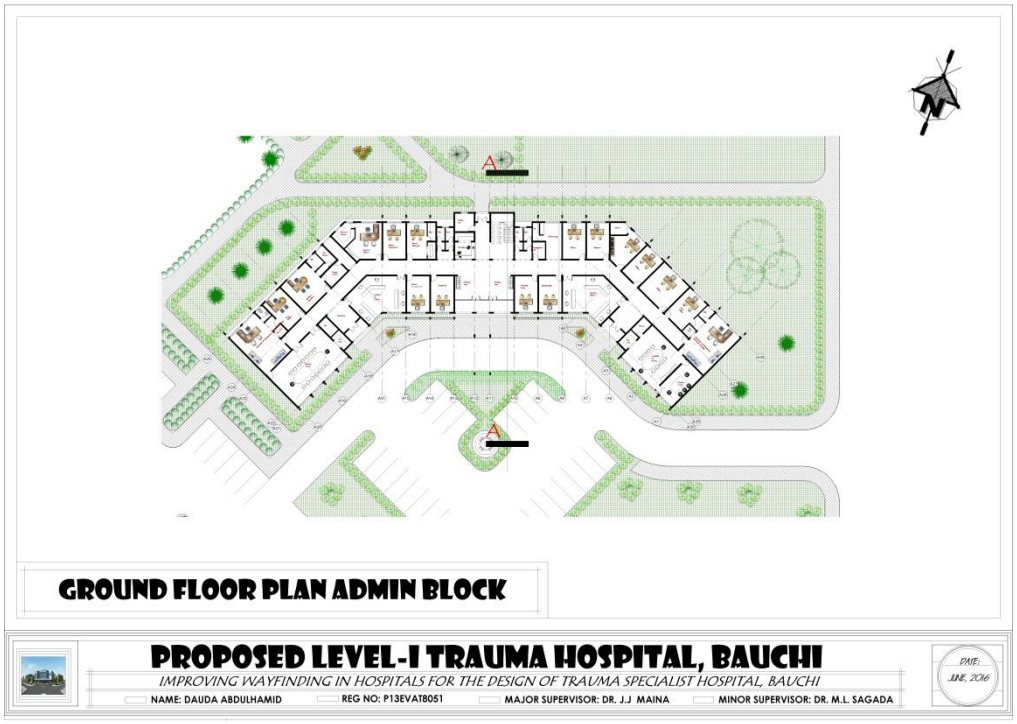
Appendix IV: Second floor plan



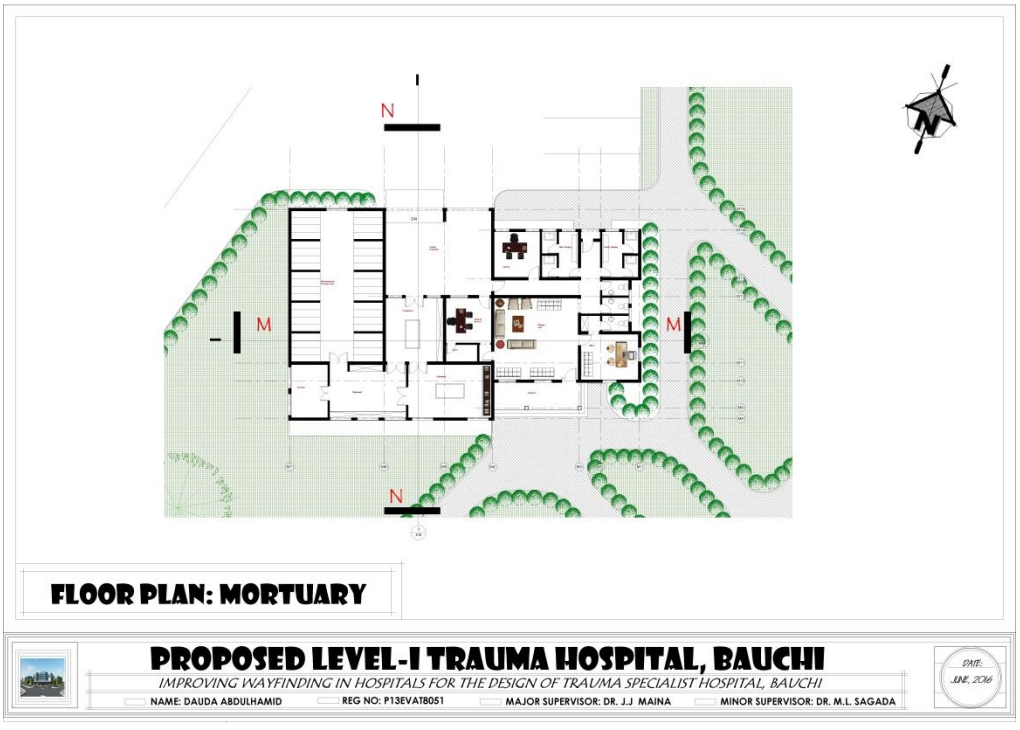
Appendix V: Third floor plan



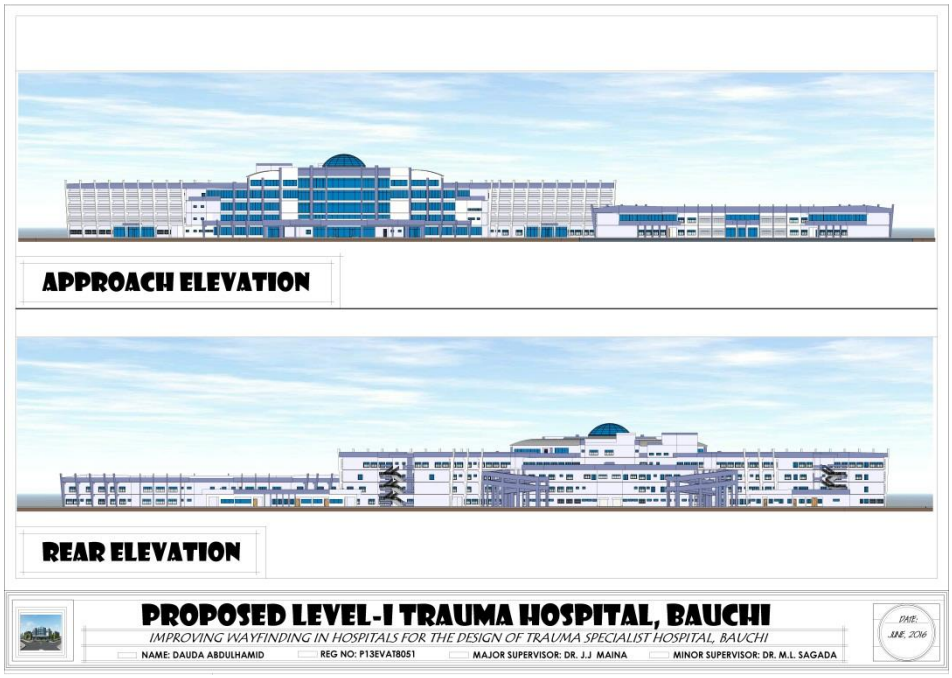
Appendix VI: Fourth floor



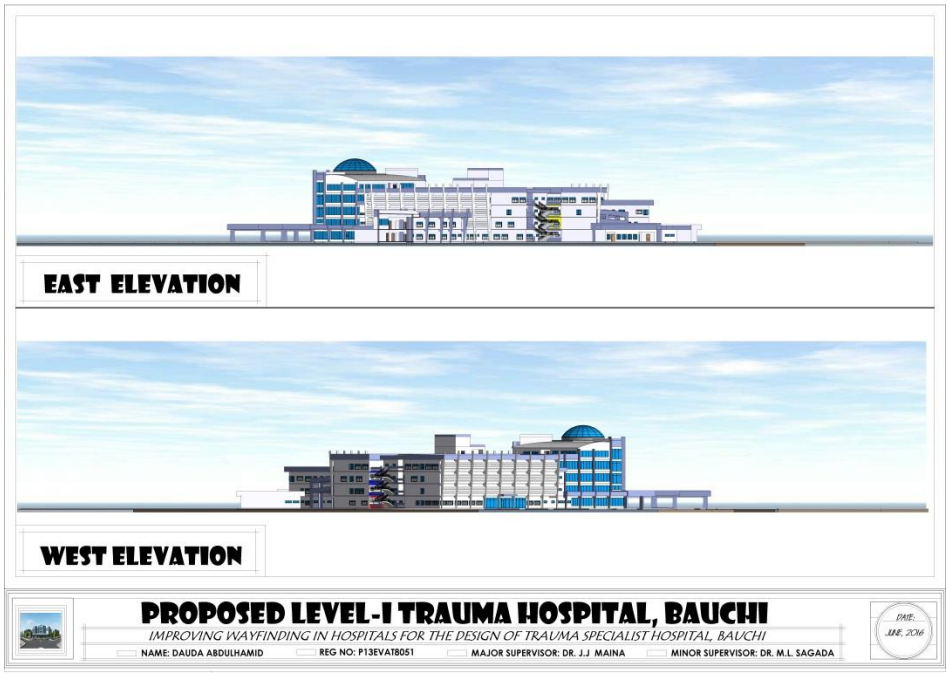
Appendix VII: Ground floor admin



Appendix VIII: Floor plan Mortuary



Appendix IX: North and South Elevation



Appendix X: East and West Elevation



Appendix XI: Section Y-Y



Appendix XII: Section Z-Z



Appendix XIII: Areal view of the hospital complex



Appendix XIV: Approach view



Appendix XV: Perspective view of Admin block

Questionnaire for Patients, Staff and Visitors on improving wayfinding in hospitals during fire/security emergencies.

Hello, I am Dauda Abdulhamid, a Master of Science Postgraduate Architecture student from ABU, Zaria. I am conducting a research to establish ways of improving wayfinding in hospitals during fire/security emergencies. The information you provide will be used strictly for research. It will also be treated with utmost confidentiality. Thank you for your time and generosity.

Signature.....

Gender: ☐ Male ☐ Female **User Category:** Patient ☐ Staff ☐ Visitor ☐

Education level: Primary [ ] Secondary [ ] Tertiary [ ] Other.....

Culture: Hausa [ ] Yoruba [ ] Igbo [ ] Other.....

Age bracket: 18 – 25 [ ] 26 – 35 [ ] 36 – 45 [ ] 46 & above [ ]

Kindly rate your level of agreement for each alternative provided by ticking the box provided (e.g.☑).

In case of fire/security emergency, I will find my way out of the hospital using;

	Strongly disagree	disagree	neutral	Agree	strongly agree
Entrances/exits	☐	☐	☐	☐	☐
Stairs	☐	☐	☐	☐	☐
Courtyards	☐	☐	☐	☐	☐
Ramps	☐	☐	☐	☐	☐
Mechanical Sound (e.g. loudspeakers, P.A systems etc)	☐	☐	☐	☐	☐
Openings i.e. windows	☐	☐	☐	☐	☐
Corridors/balconies	☐	☐	☐	☐	☐
Signs/visuals	☐	☐	☐	☐	☐
Bold words/letters/ captions	☐	☐	☐	☐	☐
Paintings on floor	☐	☐	☐	☐	☐
Graphics/pictures	☐	☐	☐	☐	☐
Notices on boards	☐	☐	☐	☐	☐
Posters	☐	☐	☐	☐	☐
Route from my memory	☐	☐	☐	☐	☐
Follow Hospital security personnel	☐	☐	☐	☐	☐
Follow others	☐	☐	☐	☐	☐
Follow volunteers	☐	☐	☐	☐	☐
Follow SERVICOM staff	☐	☐	☐	☐	☐
Look for information desk	☐	☐	☐	☐	☐
Follow fire-fighters	☐	☐	☐	☐	☐
Follow visitors	☐	☐	☐	☐	☐

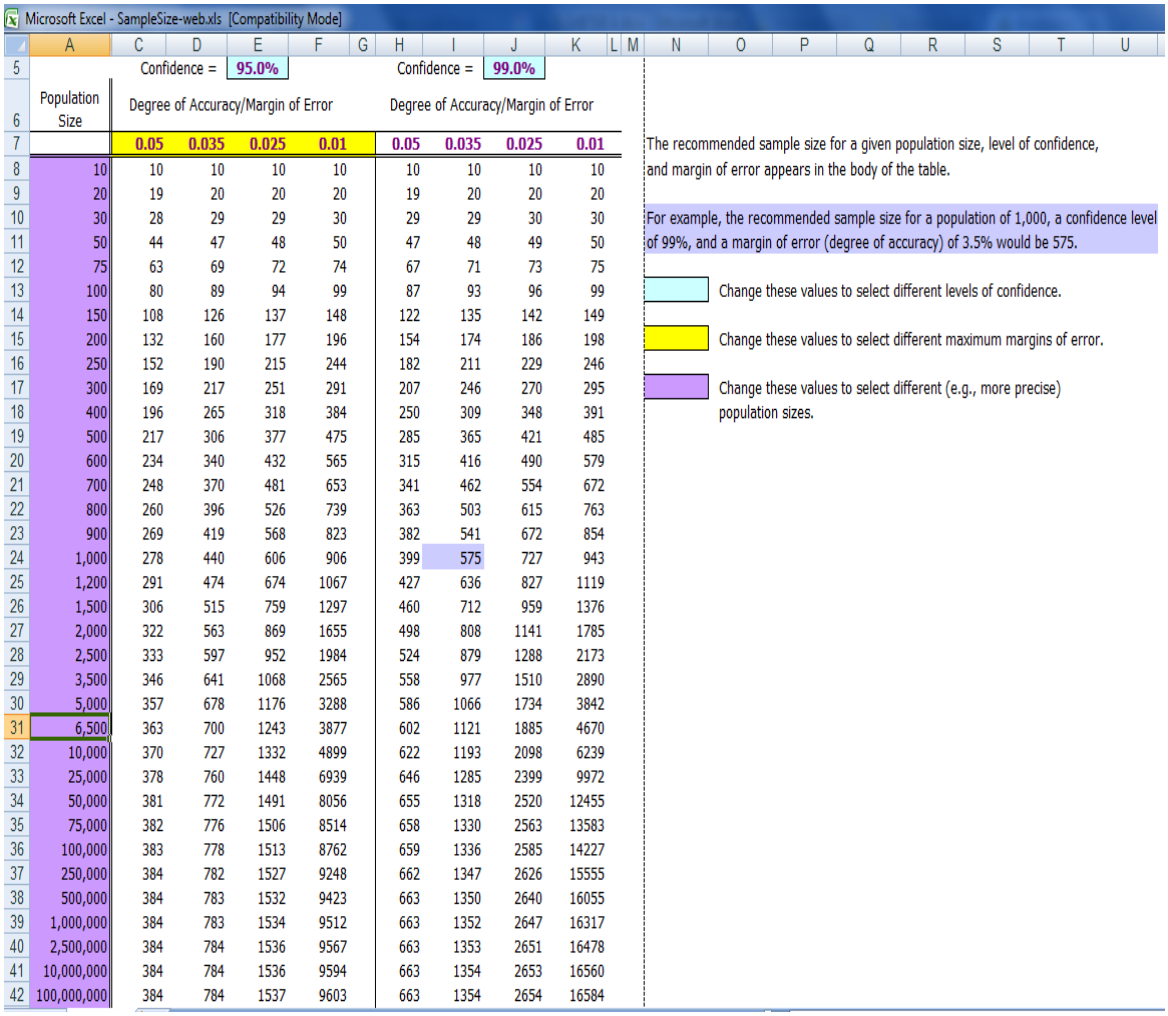
Appendix XVI: Questionnaire for hospital users in NE Nigeria

Required Sample Size†

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

† Copyright, The Research Advisors (2006). All rights reserved.

Appendix XV II: Sample size



Microsoft Excel - SampleSize-web.xls [Compatibility Mode]

	Population Size	Confidence = 95.0% Degree of Accuracy/Margin of Error				Confidence = 99.0% Degree of Accuracy/Margin of Error			
		0.05	0.035	0.025	0.01	0.05	0.035	0.025	0.01
	10	10	10	10	10	10	10	10	10
	20	19	20	20	20	19	20	20	20
	30	28	29	29	30	29	29	30	30
	50	44	47	48	50	47	48	49	50
	75	63	69	72	74	67	71	73	75
	100	80	89	94	99	87	93	96	99
	150	108	126	137	148	122	135	142	149
	200	132	160	177	196	154	174	186	198
	250	152	190	215	244	182	211	229	246
	300	169	217	251	291	207	246	270	295
	400	196	265	318	384	250	309	348	391
	500	217	306	377	475	285	365	421	485
	600	234	340	432	565	315	416	490	579
	700	248	370	481	653	341	462	554	672
	800	260	396	526	739	363	503	615	763
	900	269	419	568	823	382	541	672	854
	1,000	278	440	606	906	399	575	727	943
	1,200	291	474	674	1067	427	636	827	1119
	1,500	306	515	759	1297	460	712	959	1376
	2,000	322	563	869	1655	498	808	1141	1785
	2,500	333	597	952	1984	524	879	1288	2173
	3,500	346	641	1068	2565	558	977	1510	2890
	5,000	357	678	1176	3288	586	1066	1734	3842
	6,500	363	700	1243	3877	602	1121	1885	4670
	10,000	370	727	1332	4899	622	1193	2098	6239
	25,000	378	760	1448	6939	646	1285	2399	9972
	50,000	381	772	1491	8056	655	1318	2520	12455
	75,000	382	776	1506	8514	658	1330	2563	13583
	100,000	383	778	1513	8762	659	1336	2585	14227
	250,000	384	782	1527	9248	662	1347	2626	15555
	500,000	384	783	1532	9423	663	1350	2640	16055
	1,000,000	384	783	1534	9512	663	1352	2647	16317
	2,500,000	384	784	1536	9567	663	1353	2651	16478
	10,000,000	384	784	1536	9594	663	1354	2653	16560
	100,000,000	384	784	1537	9603	663	1354	2654	16584

The recommended sample size for a given population size, level of confidence, and margin of error appears in the body of the table.

For example, the recommended sample size for a population of 1,000, a confidence level of 99%, and a margin of error (degree of accuracy) of 3.5% would be 575.

Change these values to select different levels of confidence.

Change these values to select different maximum margins of error.

Change these values to select different (e.g., more precise) population sizes.

Appendix XVIII: Sample size compatibility mode

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