How to Cite:
Akinluyi Muyiwa, L., Fadamiro Joseph, A., Awe Foluso, C., & Akinyemi Akinniyi, T. (2022). Effects of design features: The determinant for hospital performance in southwest, Nigeria. *International Journal of Health Sciences*, *6*(S2), 9813–9832.
https://doi.org/10.53730/ijhs.v6nS2.7567

Effects of design features: The determinant for hospital performance in southwest, Nigeria

Akinluyi Muyiwa L.
Department of Architecture, Bamidele Olumilua University of Education, Science and Technology, Ikere Ekiti, Nigeria
Corresponding author email: akinluyimuyiwa@gmail.com

Fadamiro Joseph A.
Department of Architecture, Federal University of Technology (FUTA), Akure, Ondo- State, Nigeria

Awe Foluso. C.
Department of Architecture, Federal University, Oye-Ekiti (FUOYE), Nigeria

Akinyemi Akinniyi T.
Afe Babalola University, Ado-Ekiti (ABUAD), Nigeria

***Abstract*---**This study examined the effects of design features on the user as a determinants for hospital performance in Southwest, Nigeria. The design features to proactively improve the hospital environment should be put in place to increase the hospital performance and users 'satisfaction. This study was carried out at the first generation Federal University Teaching Hospitals (FUTH) in southwest, Nigeria. Methodologically, it employed mixed methods of data collection. The primary source involves the use of multiple-choice structured questionnaire to collect data from the sample population. Also, semi-structured interview (SSI) was used to support the information gathered through the questionnaire in the study area. Sample size which amounted to 575 respondents and were randomly taken from the staff, inpatients and outpatients across the FUTH. However, Respondents were asked to rate the design features such as cleanness of the healthcare environment, natural lighting and ventilation, design for regular hygiene and handwashing policy, noise level within the environment and ward spaces, adequate air quality within wards, offices, and treatment spaces, location of the nursing station to oversee patients without obstructions and design for spatial flexibility and adaptability in order of preferences as a major determinants for hospital building performance. The general result of the study showed that Locations of the nursing station to oversee

patients without obstruction were perceived to be very okay and satisfactory according to the information obtained from at the three FUTH. However, findings from the SSI at the three FUTH revealed that the impacts of the cleanness of the healthcare environment promote the healthcare environment, improves overall efficiency and performance of staff, and improve the health of the patients. In addition, the result also affirmed that the high rate of patronizing the selected hospitals is the major factor that influences the performance of the physical facilities in the Federal University Teaching Hospital in Southwest, Nigeria. The result of this study will help the transformation of design and construction strategies that are truly needed to reach our goal of providing compassionate and safe care for the staff and patients of the Teaching Hospitals in Nigeria.

***Keywords*---**design features, hospital, performance, southwest, Nigeria**.**

Introduction

The functional architectural design features of a building can be defined as the extent to which it provides a proper level of support to the desired activities, creates a pleasing environment for the users and also the extent to which the building is suitable for the activities the space/building is meant to perform. (Pellitteri & Belvedere, 2010) posit the functional aspects of a hospital building often overshadow the others that characterize hospital architecture.

The current hospital design features are, on average, over 35 years old (Sternberg, 2009). These outdated physical facilities were not intended for the current clinical processes and technologies and the related challenges create inefficiency in the system. The physical facilities design features may be modified through change or redesign, for example, existing physical structures or spaces within the hospital environment may be restructured or improved upon such as additional space provided in waiting areas and patient-care rooms among others (Quan, Joseph, Keller, &Taylor, 2011). Thus, experts and researchers are needed to develop strategies for renovation and reconstruction of new building and environment facilities to address the current growth in Nigeria.

This is important because the design features of the physical facilities in terms of the buildings, equipment, furnishings, signage, colors, art, landscape, and other sensory stimuli offer an outpouring of clues about the organization and impact the users' evaluation of service (Berry et al., 2004). Hospital physical facilities design features can create and enhance the moods of clients and employees (Sadler et al., 2011). Another importance of the hospital design features may contribute to the creation of a "healing environment" (Joseph, 2006; Sternberg, 2009). In addition, the quality of design of the physical facilities can positively influence well-being, satisfaction, and intention to recommend to others (Sadler et al., 2011; Steinke, 2015). This study will the examine the effects of the hospital design features on hospital users which is perceived to be the determinants for hospital performance in Southwest, Nigeria and similar contexts.

Literature Review

The Hospital Design Spaces and their Characteristics

Forgas, (2000) conceptualized design spaces as an important component of human interaction with others, as organized, dynamic and talented (Forgas, 2000). Gan (1968) defined a potential design space as a space that provides a wide range of opportunities to satisfy personal needs. Space design can be perceived objectively and feel directly and it can identify by its defining elements (Ampt, Harris & Maxwell, 2008). Design of a space is more than just the geometric organization; it influences users' sensory perceptions. Spatial designs affect staff recruitment and retention, as well as efficiency and productivity (Guenther & Vittori, 2008). Design space is a man-made object modifies the natural environment, producing new ambiances. The experience design space is possible through geometry, forms, function, structure, dimension, volume, surface, materials, shape, texture, light, colour, temperature, odour and sound (Rodriquez Manzo, 2008). However, the design and use of spaces need to be classified. The classification of spaces according to design and use is explained below.

Peponis and Zimring (1996) concluded that, in the past the design of hospitals was more focused on functional requirements of the hospital organization and that this focus shifted over the years to the needs and experiences of the users. Ampt, Harris & Maxwell, (2008) for example only carried a review of the literature on health impacts of the design of hospital facilities on patient and staff wellbeing and identified functional aspects of architecture futures such as windows, provision of staff area, physical plan of the ward & overall hospital plan and single room other factors include patient interior features such reception space, floor covering/finishes as a physical design factors that have impacts on the patient and staff wellbeing in the hospital environment. Also, Kathleen; Mads; Damien; Clemence ; Amanda & Lauren , (2013) carried out a study that present a comprehensive review of the research literature on the effects of the architectural designs of mental health facilities on the users. The functional factors identified include, interior detail patients' rooms, privacy and therapeutic milieu. These factors emerged from the literature as a significant design feature affecting mental health outcomes.

In a different approach, Parke, (2007) identified the physical design facilities of an elder friendly hospital using an evidence-based practice for the Vancouver Island health authority. The functional aspects of the physical design facilities identified include architectural features such as the physical configuration of the space, equipment, furnishings other factors include elements of physical design facilities such as the location of treatment setting; the amount of privacy offered to patients and families and how easily patients understand signage and find their way around the building. The report of Parke, (2007) introduced key elements of design critical to maximizing independent function in older patients and visitors. The author posits that functional ability is assumed to include physical, cognitive and social dimensions in a person's life.

Effects of Hospital Design Features on User' Level of Satisfaction

Hospital design decisions features can drastically improve the quality of stay of patients and enable them to continue their certain daily activities. Schreuder, Goedhart, Van Heel, and Dusseldorp (2015) investigated the effects of the newly built designed hospital buildings on Staff Perceptions and posited that the main objectives of Hospital Design Features environment are safe, pleasant and sustainable environments. The primary objective of the hospital design features was to create a safe working environment that supports staff performance, perceived safety and improve the working environment of the users. The study, however found significant improvements and overall satisfaction in perceived safety, working environment, well-being, physical facilities, indoor climate and sustainability. The study, however, concluded hospital design features for safe, pleasant and sustainable building resulted in actual performance of the staff.

Another aspects of the hospital design features refers to the interior design features which play an important role in the satisfaction of patients regarding the required healthcare facilities environment (Suess and Mody, 2017). Arrangement of fixtures and furniture is an example of interior design features which is also an important component of a hospital room and influence both the quality of stay for patients and their visitors, as well as, are directly linked to social support, and efficiency of workflow of hospital staff (Malone & Dellinger, 2011). Furniture is also an important element of interior design and directly affects the overall atmosphere of the room and create an acoustic comfort to the patients.

According to Black (2015) and Schweitzer et al., (2004) the design of the hospital physical environment has a direct effect on patient stress and promote their healing process. In addition, it is suggested that appropriate aesthetic decisions could help patients to cope with the frightening reality of their illnesses (Bromley, 2012), because "people experience space and space influences them in its turn. Specialized medical care buildings are no exception to this statement" (Foque & Lammineur, 1995). Similarly, Devlin et al. (2015) posited that an adjustable hospital environmental design features, enable patients to rearrange their environment and meet their different levels of social needs. On the other hand, Berwick (2009) argues that a better health system design should support individualization and customization as a design target, and recommends flexible solutions in an effort to meet individual needs.

Another impact of physical facilities design on patient is caused by exposure to bright light (especially morning sunlight) which assists in mood elevation, is associated with reduced length of stay for certain patients and reduction in mortality as well as reduced need for analgesia (Lorenz, 2007; Joseph ,2006a; Ulrich and Quan, 2004a). Lighting is another important component of the overall atmosphere, which should support the changing needs of different types of users in a hospital environment. Studies have also demonstrated that female patients who were in sunny rooms had reduced length of stay (Joseph, 2006a). Exposure to daylight and night darkness cycles is necessary for maintenance of Circadian Rhythm which helped patients gain more weight and exhibited improved sleep when exposed to cycle lighting which consisted of reduced night light intensity

(Joseph, 2006a).When patient have some control over the ambient environment, they experienced a feeling of normality and psychological well-being.

When nurses were exposed to daylight for at least three hours each day, they experienced less stress and were more satisfied at work (Joseph, 2006a). The provision of natural light is especially important as current diagnostic and treatment areas tend to offer the least access to daylight of any regularly inhabited building type (Guenther and Hall, 2007). Evidence is mounting that staff value provision of daylight. Studies showed that increased natural lighting have a positive influence on staff work life and it was rated the most significant design feature that affect staff efficiency (Mosadeghrad, 2014). There is also evidence that bright light can improve performance, leading to a decrease in errors.

Various studies have attempted to quantify the time nurses spend walking and in transit, with estimates ranging from 8% of time in transit (Ampt, 2007) to 29% of time spent in walking (Joseph, 2006b). Long distances between different working areas have a negative impact on nursing performance (PwC, 2004) and quality of care. Long corridors contribute to noise volume, and make wayfinding more difficult especially for the elderly (Karlin and Zeiss 2006). Design features providing additional areas for the staff was attributed to increased difficulty when observing patients. More space also made staff feel isolated at times as they moved further away from each other (Lambert, Coad, Hicks and Glacken, 2013).

Also, the basic layout of the hospital ward has influence on patients. Rashid (2014) in his study, showed preference for the “racetrack” configuration with patient beds on the perimetre of the unit, service rooms and areas in the centre, and corridors in between one benefit of this design is that the use of the perimetre wall is maximized, thus allowing for more patient rooms to have natural light and outdoor views. The basic layout of the hospital ward attributed to increased difficulty observing patients and design features providing additional areas for patients can be associated with unintended negative consequences with increase in patient’s privacy and choices of personal space.

The provision of natural ventilation in hospital buildings allow patients, and staff contact with nature (Yau, Chandrasegaran & Badarudin, 2011). Hospital layout allows nurses and other medical staff to easily supervise patients, it tends to cause a lack of the patient’s privacy and increases the risk of cross-infection among patients (Hughes, 2000). It is important that the layout of the ward allows the nurses to be in visual proximity with patients. Also, movement flow or pattern allows easy movement between the patients’ rooms, from nurse station to supply closet. It also helps in spending more time on patient care activities and improve greater documentation, coordination of care, medication administration and movement around the unit” (Hendrich et al., 2008). Nurse stations are generally located in the centralized point of the floors in healthcare interiors and the other facilities surround it. Therefore, nurses spend most of their time walking up and down the corridor.

Excessive noise affects staff by increasing their stress levels, burnout and emotional exhaustion (Ulrich and Quan, 2004). Another study revealed that

noise-induced staff stress could account for 6% of the independent variance in headaches at work, as self-reported by nurses in critical care areas. When noise levels were reduced, staff report less stress and overall better working environments (Devlin and Arneill, 2003). Excessive noise is also implicated in error generation in healthcare environment.

Other hospital design features identified from the literature include: cleanness of the healthcare environment, natural ventilation within the spaces, design for regular hygiene and handwashing policy, adequate air quality within wards, offices, and treatment spaces, Location of the Nursing station to oversee patients without obstructions and design for spatial flexibility and adaptability (Ulrich and Quan, 2004; Ampt, Harris and Maxwell, 2008 and Rashid, 2014).

The Study Areas

The study areas are the old generation University Teaching Hospitals in Southwest, Nigeria built between 1950s and 1970s. These hospitals are the University College Hospital (UCH), Ibadan, Oyo-State established in the year 1957, Lagos University Teaching Hospitals (LUTH), Lagos-State established in the year 1962 and Obafemi Awolowo University Teaching Hospital, Ile-Ife, Osun-State which was established in the 1975. Figure 1.1 show the location of the study areas in the Southwest, Nigeria. The hospital physical facilities design include aging facilities that no longer support efficient and safe care delivery; advances in treating complicated diseases (Levin and Joseph, 2009) (Figure 1.1).

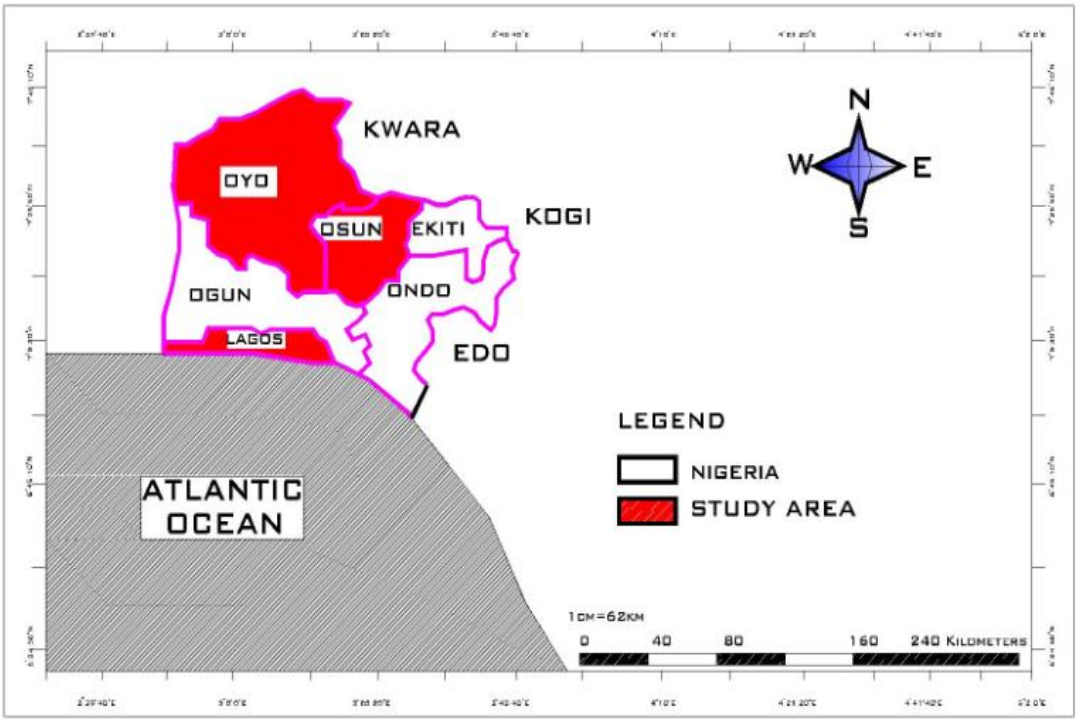

Figure 3.1 ; Map of the Southwest parts of Nigeria Showing the study Area
Sources: http//www.nigerinmuse.com (Digitalized by the Author, 2019)

Research Methodology

The survey design method adopted involves the use of close-ended questionnaires designed to cover parameters which met the stated aim and objectives. Copies of these questionnaires were administered on the users of the study areas within the four main departments (Medicine, Paediatrics, Surgery, Obstetrics and Gynaecology) selected randomly across the three Hospitals which constituted the sampling frame for the study. The total sampling frame for the users (staff and patients) were 468, 538 and 241 at UCH, Ibadan; LUTH, Lagos and OAUTHC, Ile-Ife respectively, giving a total of 1,247 across the selected departments as presented in Table 4.0. Also, the departmental buildings used for pure medical treatment across the study areas which constituted the sampling frame were 18, 11 and 16 at UCH, LUTH and OAUTHC respectively.

Krejcie and Morgan (1970) efficient method of determining the sample size from a given population was used to determine the sample size of 210, 217 and 148 at UCH, LUTH and OAUTHC respectively as represented in Table 4.0. In all, a total number of 575 copies of questionnaire were administered to the users in the study areas. The sample size for the buildings were restricted to twelve buildings (four from each hospital) accommodating the departments (Paediatrics, Surgery, Medicine, Obstetrics and Gynaecology) that were carrying out pure clinical services for medical treatment in the study areas. Stratified sampling technique was used to classify respondents into patients and staff while the respondents from each category of users were selected randomly for questionnaire administrations. However purposive sampling method was used to select the respondents for the semi-structured interview.

In the analysis of the qualitative variables, tables and charts used in the presentation of the results included frequency distribution, percentage distribution, weighted mean score, standard deviation, and ranking is explained and analyzed in (Table 5.1). While Kruskal-Wallis Test was used at multivariate level to find out the difference in the user's assessment of the hospital physical facilities design features among the Federal University Teaching Hospitals. In addition, Content Analysis was used to report the quantitative data obtained through the semi-structured interviews from the respondents.

Table 4.0: Sampling Frame, Sample Size and Percentages of sample selected

S/N	Selected Teaching Hospitals	Sampling Frame					Sample Size		
		Staff	Patients	Total	% Staff	% Patients		% Staff	%Patients
1	University College Hospital, Ibadan, Oyo-State (UCH)	177	291	468	37.8	62.7	210	79	131
2	Lagos University	181	357	538	33.6	66.3	217	73	144

	Teaching Hospital, Lagos-State (LUTH)								
3	Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife (OAUTHC)	84	157	241	34.8	65	148	52	96
Total		442	805	1247			575	204	371

Source: Study areas record office, 2019 (Between the periods of December 2019-December 2020) : Krejcie and Morgan, 1970

Data Presentations and Analysis

This section explains the design feature for the wellbeing and performance of the staff, out-patients, and the in-patients using different categories of variables rated from 1 to 7. At Univariate level, frequency distribution, percentage distribution, weighted mean score, standard deviation, and ranking were used for the data analysis and presented in (Table 5.1). Kruskal-Wallis Test were used at multivariate level to find out the difference in the user's assessment of the hospital physical facilities design features among the Federal University Teaching Hospitals as represented in the (Table 5.4)

Design Features for Staff performance and Patients' wellbeing

The result of the assessment from the staff on design for spatial flexibility and adaptability has the highest weighted mean score of 5.283 and the standard deviation of 1.951 being rated "7th" by the frequency and percentage distribution of 53 respondents (26.1 percent); followed by the location of nursing station with the value of (5.268 wms; 1.981 std) by the frequency and percentage distribution of 50 respondents (25.5 percent); noise level within the environment and wards (5.210 wms; ±2.047 std) by 49 respondents (25.0 percent); adequate air quality within wards, offices and treatment spaces (5.080 wms; ±2.047 std) by 47 respondents (24.0 percent); cleanness of the healthcare environment (5.019 wms; ±2.251 std) by 43 respondents (21.9 percent); design for regular hygiene and handwashing policy (4.983 wms; ±2.125 std) by 44 respondents (22.4), and natural lighting and ventilation within the spaces (4.971 wms; ±2.138 std) by 44 respondents (22.4 percent).

From the results obtained, the staff of the selected FUTH proves that design for spatial flexibility and adaptability is rated the best of all the design features for wellbeing and performance, while natural lighting and ventilation within the spaces are rated the less of all the variables used to measure the design features for patients' wellbeing and performance. This implies that design for spatial flexibility and adaptability is one of the design features and factor that determine the wellbeing and performance in the selected study areas. This result is also

following the study of Price& Lu (2013) who concluded that the impact of standardization of spatial flexibility and adaptability of spaces on healthcare clinical areas may promote safety and efficiency which has a great influence on the patients' wellbeing and staff performance.

The result of the analysis from the out-patients proved that the location of the nursing station to oversee patients without obstruction is rated the highest of all the variables with the weighted mean score of 5.132 and the standard deviation of 1.897 is rated "7th" by the highest frequency and percentage distribution of 51 respondents (21.1 percent); followed by noise level within the environment and wards (5.097 wms; ±1.918 std) by 51 respondents (21.1 percent); natural lighting and ventilation within the spaces (5.062 wms; ±1.959 std) by 51 respondents (21.1 percent); adequate air quality within the wards, offices, and treatment spaces (5.047 wms; ±1.927 std) by 51 respondents (21.1 percent); design for regular hygiene and handwashing policy (5.039 wms; ±1.935 std) by 50 respondents (20.7 percent); cleanness of the health environment (4.991 wms; ±2.126 std) by 50 respondents (20.7 percent) and design for spatial flexibility and adaptability (4.970 wms; ±1.971 std) by 49 respondents (20.2 percent). This result implies that the location of nursing station to oversee patients without obstruction, noise level within the environment and clinical spaces and natural lighting and ventilation within the spaces are very important design features for the wellbeing and performance of the outpatients while the design for spatial flexibility and adaptability is not important to the out-patient on the design features for wellbeing and performance.

The study of Yau, Chandrasegaran and Badarudin (2011) agrees with the above results, it could be concluded that the provision of natural ventilation and lighting in hospital buildings allows patients and staff contact with nature (Yau, Chandrasegaran & Badarudin, 2011). Also following the Fawole, Okunlola and Adekunle (2008), they examined the hospital facilities design issues relating to adequate ventilation and design for total noise level reductions within ward spaces which is a factor that determine the quality of antenatal care within the hospital environment. Evidence is also mounting from the study conducted by Mosadeghrad (2014) which opined that staff value the provision of daylight. Studies showed that increased natural lighting has a positive influence on staff work life and it was rated the most significant design feature that affects staff efficiency.

For the in-patients, the findings in Table 5.1 show that design for regular hygiene and hand washing policy is rated the highest weighted mean score with the value of (5.091) and the standard deviation of 2.012 is rated “1st” by the frequency and percentage distributions of 29 (24.4 percent); natural lighting and ventilation within the spaces (5.014 wms; ±2.013 std) by 26 respondents (21.8 percent); location of nursing station to oversee patients without obstructions (5.005 wms; ±1.935 std) by 27 respondents (22.7 percent); design for spatial flexibility and adaptability (4.986 wms; ±2.017 std) by 26 respondents (21.8 percent); cleanness of the healthcare environment (4.986 wms; ±2.056 std) by 32 respondents (26.9 percent); noise level within the environment and wards (4.958 wms; ±1.909 std) are rated “2nd” by the frequency and percentage distribution of 25 (21.0 percent),

and adequate air quality within wards, offices and treatment spaces (4.933 wms; ±1.909 std) are rated “2nd" by 26 (21.8 percent).

From the result of the in-patients displayed, it is shown that design for regular hygiene and handwashing policy is the most important features for the in-patients' wellbeing and performance even though it is rated very low. Other variables having the rate of "1st” include cleanness of the healthcare environment; noise level within the environment and wards; location of nursing station to oversee patients without obstructions and design for spatial flexibility and adaptability. Meanwhile, natural lighting and ventilation within the spaces and adequate air quality within wards, offices and treatment spaces are rated "2nd" among the variables considered for inpatients' design features for wellbeing and performance.

Generally, the variables are rated between 1st to 7th. Among the variables, the location of nursing station to oversee patients without obstruction has the highest weighted mean score of 5.15 and the standard deviation of 1.94 is rated "7th” by the frequency and percentage distribution of 122 respondents (21.9 percent); noise level within the environment and wards (5.11 wms; ±1.98 std) by 120 respondents (21.5 percent); design for spatial flexibility and adaptability (5.09 wms; ±1.98 std) by 126 respondents (22.6 percent); Adequate air quality within wards, offices and treatment spaces (5.03 wms; ±1.97 std) by 118 respondents (21.2 percent); design for regular hygiene and handwashing policy (5.03 wms; ±2.02 std) by 118 respondents (21.2 percent); natural lighting and ventilation within the spaces (5.02 wms; ±2.03 std) by 120 respondents (21.5 percent) and cleanliness of the health environment (5.00 wms; ±2.15 std) is rated “1st" by the frequency and percentage distributions of 175 respondents (31.4 percent). This shows that the respondents from the three Federal University Teaching Hospitals in Southwest, Nigeria affirmed that the location of the nursing station to oversee patients without obstruction is the most important design feature for wellbeing and performance. Meanwhile, all variables are rated 7th but the cleanliness of the healthcare environment is rated 1st.

Findings from the SSI at the three FUTH revealed that the impacts of the cleanliness of the healthcare environment promote the healthcare environment, improves overall efficiency and performance of staff and improve the health of the patients. It reduces the rate of transmission of diseases and germs, improves patient health, reduces infection rate and enhances the quick recovery of patients. In addition, the respondents at UCH are well satisfied with the cleanliness of the environment. The cleanliness of the environment is usually carried out regularly by the cleaners employed by the authority of the hospital. Also, the respondents at OAUTHC expressed a satisfactory opinion about the cleanliness of the hospital environment which makes the patients feel secured.

The SSI carried out in the selected study areas revealed that natural lighting and ventilation within the interior spaces are very good. Moreover, at LUTH, some interior spaces within the departments/buildings are very dark when there is no electricity. However, the experiences of ventilation in most interior spaces are poor. Generally, the natural lightening and ventilation within the clinical ward spaces and other spaces are very good because the windows are adequate in

terms of height, width and its location. Contrary to the point above, the SSI at UCH affirmed that the ventilation or aeration within the hospital interior spaces is fairly satisfactory.

The impacts of the Regular Hygiene and Handwashing policy reduces the transmission of diseases and micro-organisms, improves patient health and reduces the rate of disease transmission. It has a great impact on both staff and patients by reducing the infection rate and spreading rate of germs. Interviews carried out at LUTH revealed that the regular hygiene and handwashing policy in the physical facilities is being supervised by everybody including the supervisors and head of the department to enforce compliance to control the spread of infectious diseases. Information from SSI at UCH and OAUTHC expressed good and satisfactory results about the hand washing policy. In addition, adequate provision for regular hand washing policy is put in place and standard operation procedure is provided to guide the workers.

Locations of the nursing station to oversee patients without obstruction were perceived to be very okay and satisfactory according to the information obtained at the three FUTH. Some respondents interviewed at LUTH claimed they experienced a bad location of nurse station in some departments such as Ophthalmology and Dentistry while other respondents claimed the nursing location is very good and satisfactory. Also, at UCH and OAUTHC respondents were very satisfied with the nurse station, except during the COVID 19 pandemic, when some of the nurses attending to the out-patients at UCH moved out of their location to attend to patients.

Findings from the SSI report at LUTH by some respondents confirmed that every space in the department was used for the purpose-designed. Therefore, no impact of flexibility is experienced in the department since the spaces are used for its allocation. Other respondents claimed that they experienced satisfactory flexibility use of spaces in some departments such as Obstetrics and Gynecology because some of their spaces can also be used for another purpose. This enhanced the conducive of giving and receiving care in the hospital environment. However, the respondents interviewed at UCH and OAUTHC affirmed that the flexible use of spaces in the hospital have very good effect because it helps to manage space very well and gives adequate protection against injury.

Table 5.1: Design features for wellbeing and performance

Variable	1st	2nd	3rd	4th	5th	6th	7th	WMS	Std. dev	Rank
Staff										
Cleanness of the healthcare environment	83 (42.3)	16 (8.2)	23 (11.7)	15 (7.7)	10 (5.1)	6 (3.1)	43 (21.9)	5.019	2.251	5
Natural Lighting and Ventilation within the spaces	45 (23.0)	45 (23.0)	23 (11.7)	21 (10.7)	12 (6.1)	6 (3.1)	44 (22.4)	4.971	2.138	7
Design for Regular Hygiene and Handwashing policy	51 (26.0)	31 (15.8)	32 (16.3)	22 (11.2)	9 (4.6)	7 (3.6)	44 (22.4)	4.983	2.125	6
Noise level within the environment and Wards	31 (15.8)	46 (23.5)	27 (13.8)	15 (7.7)	12 (6.1)	16 (8.2)	49 (25.0)	5.210	2.031	3
Adequate air quality within wards, offices, and treatment spaces	43 (21.9)	34 (17.3)	24 (12.2)	29 (14.8)	13 (6.6)	6 (3.1)	47 (24.0)	5.080	2.047	4
Location of the Nursing station to oversee patients without obstructions	36 (18.4)	34 (17.3)	27 (13.8)	21 (10.7)	11 (5.6)	17 (8.7)	50 (25.5)	5.268	1.981	2
Design for spatial flexibility and adaptability	29 (14.8)	33 (16.8)	31 (15.8)	25 (12.8)	11 (6.6)	14 (7.1)	53 (26.1)	5.283	1.951	1
Out-Patients										
Cleanness of the healthcare environment	60 (24.8)	58 (24.0)	21 (8.7)	21 (8.7)	17 (7.0)	15 (6.2)	50 (20.7)	4.991	2.126	6
Natural Lighting and Ventilation within the spaces	39 (16.1)	51 (21.1)	26 (10.7)	41 (16.9)	13 (5.4)	21 (8.7)	51 (21.1)	5.062	1.959	3
Design for Regular Hygiene and Handwashing policy	36 (14.9)	49 (20.2)	36 (14.9)	28 (11.6)	26 (10.7)	17 (7.0)	50 (20.7)	5.039	1.935	5
Noise level within the environment and Wards	36 (14.9)	47 (19.4)	32 (13.2)	34 (14.0)	20 (8.3)	22 (9.1)	51 (21.1)	5.097	1.918	2
Adequate air quality within wards, offices, and treatment spaces	34 (14.0)	46 (19.0)	39 (16.1)	33 (13.6)	21 (8.7)	18 (7.4)	51 (21.1)	5.047	1.927	4
Location of the Nursing station to oversee patients without obstructions	39 (16.1)	42 (17.4)	34 (14.0)	27 (11.2)	27 (11.2)	22 (9.1)	51 (21.1)	5.132	1.897	1
Design for spatial flexibility and adaptability	30 (12.4)	63 (26.0)	29 (12.0)	36 (14.9)	18 (7.4)	17 (7.0)	49 (20.2)	4.970	1.971	7
In-patients										
Cleanness of the healthcare environment	32 (26.9)	21 (17.6)	13 (10.9)	12 (10.1)	8 (6.7)	11 (9.2)	22 (18.5)	4.986	2.056	5
Natural Lighting and Ventilation within the spaces	21 (17.6)	26 (21.8)	16 (13.4)	14 (11.8)	9 (7.6)	8 (6.7)	25 (21.0)	5.014	2.013	2
Design for Regular Hygiene and Handwashing policy	29 (24.4)	22 (18.5)	12 (10.1)	9 (7.6)	13 (10.9)	10 (8.4)	24 (20.2)	5.091	2.012	1
Noise level within the environment and Wards	25 (21.0)	25 (21.0)	20 (16.8)	6 (5.0)	7 (5.9)	16 (13.4)	20 (16.8)	4.958	2.031	6
Adequate air quality within wards, offices, and treatment spaces	21 (17.6)	26 (21.8)	11 (9.2)	16 (13.4)	15 (12.6)	10 (8.4)	20 (16.8)	4.933	1.909	7

Location of the Nursing station to oversee patients without obstructions	27 (22.7)	21 (17.6)	10 (8.4)	16 (13.4)	13 (10.9)	11 (9.2)	21 (17.6)	5.005	1.935	3
Design for spatial flexibility and adaptability	26 (21.8)	22 (18.5)	12 (10.1)	22 (18.5)	4 (3.4)	9 (7.6)	24 (20.2)	4.986	2.017	4
Overall										
Cleanness of the healthcare environment	175 (31.4)	95 (17.1)	57 (10.2)	48 (6.3)	35 (6.3)	32 (5.7)	115 (20.6)	5.00	2.15	7
Natural Lighting and Ventilation within the spaces	105 (18.9)	122 (21.9)	65 (11.7)	76 (13.6)	34 (6.1)	35 (6.3)	120 (21.5)	5.02	2.03	6
Design for Regular Hygiene and Handwashing policy	116 (20.8)	102 (18.3)	80 (14.4)	59 (10.6)	48 (8.6)	34 (6.1)	118 (21.2)	5.03	2.02	5
Noise level within the environment and Wards	92 (16.5)	118 (21.2)	79 (14.2)	55 (9.9)	39 (7.0)	54 (9.7)	120 (21.5)	5.11	1.98	2
Adequate air quality within wards, offices, and treatment spaces	98 (17.6)	106 (19.0)	74 (13.3)	78 (14.0)	49 (8.8)	34 (6.1)	118 (21.2)	5.03	1.97	4
Location of the Nursing station to oversee patients without obstructions	102 (18.3)	97 (17.4)	71 (12.7)	64 (11.5)	51 (9.2)	50 (9.0)	122 (21.9)	5.15	1.94	1
Design for spatial flexibility and adaptability	85 (15.3)	118 (21.2)	72 (12.9)	83 (14.9)	33 (5.9)	40 (7.2)	126 (22.6)	5.09	1.98	3

Source: Researcher' Field Survey, 2021

Reason for FUTH Performance by the In and Outpatients

The performance of the Federal Teaching Hospital is determined using different variables as indicated in Table 5.2 . The result shows that in the three study areas, the mortality rate factor with the mean value of 1.901 and the standard deviation of 0.300 is rated with "no" by the frequency and percentage distribution of 218 respondents (90.1 percent); followed by infection rate (1.847 mean; 0.361 std) which is rated "No" by 205 respondents (84.7 percent); morbidity rate is high (1.822 mean; 0.380 std) is rated "No" by 199 respondents (82.2 percent); pain alleviation rate is high (1.822 mean; 0.383 std) is rated "No" by 199 respondents (82.2 percent); patient discharge rate is high (1.756 mean; 0.430 std) respondents rated "No" by 183 respondents (75.6 percent) and the patronizing rate is high (1.624 mean; 0.485 std) is rated "No" by 151 respondents (62.4 percent).

Among the in-patients of the selected study areas, the performance of the hospital in the way patients are being attended to and the rate of infection is determined in the analysis using frequency and percentage distribution as well as mean and the standard deviation of each of the variables. It is indicated that the infection rate has the highest mean value of 1.891 and the standard deviation of 0.313 and rated "No" by the frequency and percentage distribution of 106 respondents (89.1 percent); followed by mortality rate (1.857 mean; 0.351 std) is rated "No" by 102 respondents (85.7 percent); morbidity rate (1.857 mean; 0.351 std) is rated by "No" by 102 respondents (85.7 percent); patient discharge rate (1.765 mean; 0.426 std) is rated "No" by 91 respondents (76.5 percent); pain alleviation rate (1.756 mean; 0.431 std) is rated "No" by 90 respondents (75.6 percent) and

patronizing rate (1.656 mean; 0.477 std) is rated "No" by 78 respondents (65.5 percent).

According to the out-patients of the selected study areas, the above results indicate that the mortality rate in the three FUTH is not the major factor that determines the performance of the hospitals but the rate at which people are patronizing the Federal University Teaching Hospital is high compared to other hospitals. Similarly, the results obtained from the in-patients' respondents indicate that a low infection rate in the three study areas is not the major determinant of hospitals' performance. They affirmed that the high rate of patronizing the selected hospitals is the major factor that influences the performance of the physical facilities in the Federal University Teaching Hospital in Southwest, Nigeria.

SSI findings at the FUTH showed that the hospitals are trying their best as well as performing because they are serving the purpose to which they are built. In addition, the hospital is performing in a way but the physical facilities need refurbishment, renovation of spaces and replacement of most components. According to the respondents' report during the SSI, LUTH is the most attended health facility in Lagos State even with the two other teaching hospitals in the Southwest. On the contrary opinion, some respondents at LUTH claimed that the hospital is not performing at all, almost all the physical facilities need restructuring, re-organization, renovation and replacement of many old physical facilities. Moreover, SSI conducted at UCH also buttress the above reports and affirmed that the hospital is performing with the existing physical facilities, but presently, there is an ongoing refurbishment, renovation and reconstruction of facilities in most of the departments/buildings which could improve the performance of the hospital. The OAUTHC SSI respondents also confirmed that the hospital is performing with the available facilities because of the difference in health conditions and claimed that hospital management is building new structures and are trying to renovate the old ones.

Table 5.2 : Performance of the Federal University Teaching Hospital

		Descriptive Statistics			
Out-patient	Yes	No	Mean	Std. dev	Rank
Patient discharge rate is high	59 (24.4)	183 (75.6)	1.756	0.430	5
Pain alleviation rate is high	43 (17.8)	199 (82.2)	1.822	0.383	4
Mortality rate is very low	24 (9.9)	218 (90.1)	1.901	0.300	1
Morbidity rate is high	43 (17.8)	199 (82.2)	1.822	0.380	3
Patronizing rate is high	91 (37.6)	151 (62.4)	1.624	0.485	6
Infection rate is low	37 (15.3)	205 (84.7)	1.847	0.361	2
In-patient					
Patient discharge rate is high	28 (23.5)	91	1.765	0.426	4

		(76.5)			
Pain alleviation rate is high	29 (24.4)	90 (75.6)	1.756	0.431	5
Mortality rate is very low	17 (14.3)	102 (85.7)	1.857	0.351	2
Morbidity rate is high	17 (14.3)	102 (85.7)	1.857	0.351	3
Patronizing rate is high	41 (34.5)	78 (65.5)	1.656	0.477	6
Infection rate is low	13 (10.9)	106 (89.1)	1.891	0.313	1

Source: Researcher's Field Survey, 2021

Extent of Agreement to Design Features General Performance and Working Conditions

The extent to which the respondents agree to the working condition and general performance of the design feature is displayed in Table 5.3. The results obtained indicated that the staff has the weighted mean score of 1.469 and the standard deviation of 0.500 being rated "some extent" by the frequency and percentage distribution of 103 respondents (52.6 percent). In addition, the outpatients (2.617 wms; ±0.889 std) is being rated "some extent" by 156 respondents (64.5 percent) and the inpatients (2.627 wms; ±0.820 std) is being rated "some extent" by 75 respondents (63.1 percent) while the generally (overall) weighted mean score is 2.434 with the standard deviation of 0.632 is being rated "some extent" by the frequency and percentage distribution of 334 respondents (60.0 percent). This means that the respondents to some extent agrees to the design features of the general performance and working condition of the three selected study areas.

Table 5.3 : Extent of Agreement to Design Feature General Performance and working condition

Variables	1	2	3	4	WMS	Std. dev
Staff	16 (8.2)	103 (52.6)	22 (11.2)	55 (28.0)	1.469	0.500
Outpatients	20 (8.3)	156 (64.5)	32 (13.2)	34 (14.0)	2.617	0.889
Inpatients	6 (5.0)	75 (63.1)	24 (20.2)	14 (11.7)	2.627	0.820
Overall	42 (7.5)	334 (60.0)	78 (14.0)	103 (18.5)	2.434	0.632

Where 1 indicates low extent, 2 – some extent, 3 – I don't know, and 4 high extent, wms- weighted mean score, and std. dev – standard deviation
Source: Researcher's Field Survey, 2021.

Hypothesis HO1: *There is no significant difference in the assessment of the design features for wellbeing and performance among the Federal University Teaching Hospitals in the Southwest Nigeria.*

The variables are measured at an ordinal level which is not numeric and shows that a non-parametric method was used for the analysis. Since the main aim is to test the significant difference, therefore, Kruskal-Wallis test was used for the test as displayed in Table 5.4. The perception of the respondents on each of the

variables used to measure the design features wellbeing and performance shows that there is a significant difference between the opinions of the respondents in the Federal University Teaching Hospital in the southwest of, Nigeria as displayed in the table below. The result includes cleanliness of the healthcare environment ($x_{2(cal)}$ = 65.307, p = 0.000); natural lighting and ventilation within the spaces ($x_{2(cal)}$ = 64.214, p = 0.000); design for regular hygiene and handwashing policy ($x_{2(cal)}$ = 61.488, p = 0.000); noise level within the environment and wards ($x_{2(cal)}$ = 55.300, p = 0.000); adequate air quality within wards, offices, and treatment spaces ($x_{2(cal)}$ = 63.342, p = 0.000); location of nursing station to oversee patients without obstructions ($x_{2(cal)}$ = 71.531, p = 0.000), and design for spatial flexibility and adaptability ($x_{2(cal)}$ = 54.454, p = 0.000). The findings show a significant difference in the opinion of the respondents in the Federal University Teaching Hospitals in Southwest, Nigeria.

Table: 5.4 Kruskal-Wallis Test

Variables	Chi-square	P-value	Remarks
Cleanness of the healthcare environment	65.307	0.000	Significant
Natural Lighting and Ventilation within the spaces	64.214	0.000	Significant
Design for Regular Hygiene and Handwashing policy	61.488	0.000	Significant
Noise level within the environment and Wards	55.300	0.000	Significant
Adequate air quality within wards, offices, and treatment spaces	63.342	0.000	Significant
Location of the Nursing station to oversee patients without obstructions	71.531	0.000	Significant
Design for spatial flexibility and adaptability	54.454	0.000	Significant

*Where *** indicates P-value < 0.01 (1% significance level), ** indicates P-value < 0.05 (5% significance level), and * indicates P-value < 0.1 (1% significance level).*
Source: Researcher's Field Survey, 2021.

Research Implication, Conclusion and Recommendations

This article have examined the effects of design features on the user as a determinants for hospital performance in Southwest, Nigeria. This study was carried out at the first generation Federal University Teaching Hospitals (FUTH) in southwest, Nigeria.

The staff of the FUTH claimed that the design for spatial flexibility and adaptability is the best of all the design features for staff performance. This implies that design for spatial flexibility and adaptability is an important hospital design features and factor that determine the wellbeing and performance in the selected study areas. On a contrary opinion, the out patients rated the location of nursing station to oversee patients without obstruction as the best of all the design features for wellbeing and performance. This result implies that the location of nursing station to oversee patients without obstruction is also an important design features to be considered for optimum patients' well-being.

However, the in-patients displayed that design for regular hygiene and handwashing policy is the most important features for the in-patients' wellbeing. On a general note, the respondents from the three FUTH, southwest, Nigeria affirmed that the location of the nursing station to oversee patients without obstruction is the most important design feature for wellbeing and performance and hence should be taking as a vital design features in the overall planning and development of a hospital buildings in Nigeria.

The out-patients indicates that the rate at which people are patronizing the hospital is high compared to other hospitals. As a result, the rate of patronizing the hospital is the major factor that influences the performance of the physical facilities in the FUTH in Southwest, Nigeria. In addition, the SSI report reveals the hospital is performing in a way but the physical facilities need refurbishment, renovation of spaces, and replacement of most components. The SSI conducted at LUTH reported that LUTH is the most patronized health facility in Lagos State. On the contrary opinion, some respondents at LUTH claimed that the hospital is not performing at all and claimed that almost all the physical facilities need restructuring, re-organization, renovation, and replacement of many old physical facilities. The OAUTHC also confirmed that the hospital is performing with the available facilities because of the difference in health conditions and confirmed that hospital management is building new structures and are trying to renovate the old ones.

Results from the structured questionnaires showed that respondents can recommend the hospital for friends or other intending users while some respondents interviewed through SSI at FUTH claimed they are not well satisfied with recommending the hospital for use and they can only recommend the hospital physical facilities for friends if there is an improvement on the overall efficiency of staff performance, in the health condition of the patients and reduction in the rate of transmission of disease and germs. However, for optimum patient’s well-being and staff performance at the Federal University Teaching Hospitals in Nigeria; the following general recommendations are hereby suggested;

1. Federal University Teaching Hospitals in Nigeria should embark on the refurbishment of the physical facilities by carrying out appropriate renovation, reconstruction and re-organization of existing structures and construction of additional buildings to complement the old buildings. This should be done alongside the building professionals such as Architects, Urban Planners, interior designers, landscape Architects, Engineers and other professionals in the built environment.
2. These designers should be monitored to give appropriate attention to the various design features such as size and proportion (volume) of interior spaces, aesthetics, design for privacy , proximity, wayfinding, layout, organization, movement flow/pattern, spatial flexibility and adaptability, location of nursing station to oversee patients without obstruction, noise level within the environment and clinical spaces, natural lighting and ventilation and design for regular hygiene and handwashing policy and other design features identified in this study.

These recommendations above will help the transformation of design and construction strategies that are truly needed to reach our goal of providing compassionate and safe care for our patients and the facilities could eventually be recommended to all intending users both home and abroad.

References

Ampt A, Harris P and Maxwell M. (2008). The Health Impacts of the Design of Hospital Facilities on Patient Recovery and Wellbeing, and Staff Wellbeing: A Review of the Literature. *Centre for Primary Health Care and Equity*, University of New South Wales: Sydney.

Berry, L., & Bendapudi, N. (2003). Clueing in on customers. Harvard Business Review, 81, 100–106.

Berwick D. M. (2009). What 'patient-centered' should mean: Confession of an Extrimist. Health Affairs, 28 (3/4), 555-565.

Beukeboom C. J., Langeveld D. & Dijkstra T. K. (2012). Stress-reducing effects of real and artificial nature in a hospital waiting room. The journal of alternative and complementary medicine. V: 18 (4), 329-333.

Black A. (2015). Designing a very different hospital. Future Hospital Journal. V: 2 (1). 19-21.

Bromley E. (2012). Building patient-centeredness: Hospital design as an interpretive act. Social Sciences & Medicine, 75, 1057-1066.

Devlin, A. S. and Arneill, A., B. (2003). Health care environments and patient outcomes. E*nvironment and behavior, 35(5),* 665-694.

Forgas, J. P. (2000). Psychology and social interaction: interpersonal behaviour, translated by Firouzbakhsh.M.. and Khashayar Beigi, Mahd Publications, Tehran.

Gans, H. (1968). Planning and Social Life, Friendship and Neighbor Relations in Suburban Communities, New York.

Guenther, R. and Hall A. G. (2007). "Healthy buildings: impact on nurses and nursing practice."Online Journal of Issues in Nursing 12(2): 10p.

Guenther, R. and Vittori,G. (2008). Sustainable Healthcare Architecture New Jersey Wiley & Sonsilne Beheshti Publications, Tehran.

Hendrich, A., Chow, M. P., Bafna, S., Choudhary, R., Heo, Y., & Skierczynski, B. A. (2009). Unit related factors that affect nursing time with patients: Spatial analysis of time and motion study. Health Environments Research and Design Journal, 2, 5–20.

Hughes, M.D. (2000). Analysis and design issues for studies using censored biomarker measurements with an example of viral load measurements in HIV clinical trials. National Liberary of Medicine. *National Centre for Biotechnical Information.* Stat Med. 2000 Dec 15;19(23):3171-91. doi: 10.1002/1097-0258(20001215)19:23<3171::aid- sim619>3.0.co;2-t. PMID: 11113952.

Joseph, A. (2006b) "The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace." The Center for Health Design http://www.healthdesign.org/research/reports/workplace.

Joseph, A.. (2006a). The impact of light on outcomes in healthcare settings. Concord, CA: Center for Health Design; Accessed at www.healthdesign.org/ research/reports/longtermcare.php.

Joseph, C. and Quan, X. (2021). .Impact of the Physical Environment of Residential Health. https://www.healthdesign.org/knowledge-repository. CHD-KPS.pdf | 278.17 KB pd.

Karlin, B. E., and Zeiss, R. A. (2006). Environmental and therapeutic issues in psychiatric hospital design: Toward best practices. *Psychiatric Services,* 57, 1376–1378.

Kathleen C., Mads G., Damien R, Clemence D, Amanda R & Mustillo, (2013). Stressed Spaces: Mental Health and Architecture. *Health Environments Research & Design Journal.* Vol. 6 No. 4, Pp. 127–168.

Lambert, V., Coad, J, Hicks, P. and Glacken, M. (2013). Young children's perspectives of ideal physical design features for hospital-built environments. *Journal of Child Health Care;* Vol. 18(1) 57–71.

Levin, D. J and Joseph A. (2009). Planning, Design, and Construction of Health Care Facilities, Second Edition. *Joint Commission on Accreditation of Healthcare Organizations*. Printed in the U.S.A. 5 4 3 2 1. PP.1-9

Lorenz, S. G. (2007). "The potential of the patient room to promote healing and well-being in patients and nurses: an integrative review of the research." Holistic Nursing Practice 21(5): 263-277.

Malone, E.B., & Dellinger, B.A. (2011 In Press) Using an evidence-based design furniture checklist. Healthcare Design Magazine, May

Mosadeghrad AM. (2014). Factors influencing healthcare service quality. *International Journal of Health Policy Management,* 3: 77–89. doi: 10.15171/ijhpm.2014.65.

National Policy and Strategy, (1988). The National Health Policy and Strategy to Achieve Health for all Nigerians Report-October. *Record of the Africa Regional Vice Presidency*. Ref. code: WB IBRD/IDA AFR.

National Population Commission, (2006). Population distribution by sex, state, LGA & senatorial district. 2010. Retrieved from http://www.population. gov.ng/images/Vol03-Table-DSx-LGAPop-by-SDistrict-PDF.pdf..

Ogaji, D.S., Giles, S., White G.D and Bower, P. (2015). Systematic review of patients' views

Parke, B. (2007). Physical Design Dimension of an Elder Friendly Hospital: An evidence-based practice review undertaken for the Vancouver Island Health Authority. *University of Victoria Centre on Aging.* Pp 2-26.

Pellitteri, G., Belvedere, F., (2010). "Characteristics Of The Hospital Buildings: Changes, Processes and Quality", Proceedings from 2010 ARCC_EAAE International Conference On Architectural Research, 23-26 June 2010, Howard University, Washington, DC.

Peponis, J., Zimring, C., Choi, Y. K., 1990, "Finding the Building in Wayfinding", *Environmentm & Behavior,* 22(5), 555-590.

PwC, (2004). *The role of hospital design in the recruitment, retention and performance of NHS nurses.*

Quan, X., Joseph, A., Keller, A., & Taylor, E. (2011). Designing safety-net clinics for innovative care delivery models. Concord, CA: The Center for Health Design.

Rashid, M. (2014). Two decades (1993-2012) of adult intensive care unit design: A comparative study of the physical design features of the best practice examples. Critical Care Nursing Quarterly, 37, 3–32.

Rodriquez-Manzo, F.E., (2008). Toward A Classification of the Sonic Character of the Architectural Space. *Euronoise, Acoustic of Paris*.Pp. 2689-2694.

Sadler, B. L., Berry, L. L., Guenther, R. D., Hamilton, D. K., Hessler, F. A., Merritt, C., and Parker, D. (2011). Fable hospital 2.0: The business case for building better health care facilities. *The Hastings Center Report, 41*(1) 13–23.

Schreuder E., van Heel L., Goedhart R., Dusseldorp E., Schraagen J. M., Burdorf A. Effects of newly designed hospital buildings on staff perceptions: a pre-post study to validate design decisions. Health Environments Research and Design Journal. 2015;8(4):77–97. doi: 10.1177/1937586715573736.

Schweitzer, M.; Gilpin, L. (2004). Frampton, S. Healing Spaces: Elements of Environmental Design That Make an Impact on Health. J. Altern. Complement. Med. 10, 71–83. [Google Scholar] [CrossRef].

Steinke, C. (2015). Assessing the physical service setting: A look at emergency departments. *Health Environment Research and Design Journal*, 8, 31–42.

Sternberg, R. J. (2009). The theory of successful intelligence. In J. C. Kaufman, E. L. Grigorenko (Eds.) & R. J. Sternberg, *The essential Sternberg: Essays on intelligence, psychology, and education* (pp. 71–100). Springer Publishing Co.

Ulrich, R. and Quan, X. (2004)a. The Role of the Physical Environment in the Hospital of the 21st century: A Once-in-a-Lifetime Opportunity. Designing the 21st Century Hospital Project. *The Center for Health Design.* http://www.healthdesign.org/research/reports/physical_environ.php Accessed on 5 June 2008.

World Health Organization, (2011). *World Health Statistics*. Geneva: WHO.

Yau, Y.H, Chandrasegaran, D. and Badarudin, A. (2011). The ventilation of multiple-bed hospital wards in the tropics: A review. *Building and Environment* 46(5):1125-1132. DOI:10.1016/j.buildenv.2010.11.013