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PRIORITIZATION OF PASSIVE MEASURES FOR ENERGY OPTIMIZATION IN PRIMARY HEALTH CARE CENTERS IN NIGERIA

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Abstract

Electricity plays a very important role in the socio-economic and technological development of every nation. The electricity demand in Nigeria far outstrips the supply and the supply is epileptic in nature. This inconsistency in electricity provisions hampers economic growth, affects daily life, and necessitates reliance on costly alternatives such as generators. This paper determines the level of prioritization of passive measures in primary healthcare centers with a view to improving the thermal comfort, cooling, lighting and ventilation requirement for a primary healthcare building in Nigeria. Systematic field surveys followed by in-depth statistical analysis were adopted. Descriptive statistics based on mean ranking was carried out and a total of 350 set of questionnaires were administered to the case study areas and 87% responses were received while 83% are valid. The result revealed that respondents prioritized passive design elements with a mean value of 4.09 ranked first, natural ventilation strategies come second with a value of 4.04, and the active employment of passive cooling strategies ranked third with a mean value of 3.99. The paper concluded that there is a decreasing level of prioritization on thermal comfort through passive measures and incorporating passive solar design principles. Its recommends that hospitals should endeavor to make use of courtyards in its design as it has been established that courtyards can greatly improve passive cooling which will reduce dependence on HVAC systems for cooling.

Keywords: Passive measures, Primary healthcare center PHC, Energy optimization

Introduction

Electricity plays a very important role in the socio-economic and technological development of every nation. The electricity demand in Nigeria far outstrips the supply and the supply is epileptic in nature. The country is faced with acute electricity problems, which is hindering its development notwithstanding the availability of vast natural resources in the country. The epileptic power supply in Nigeria has been a longstanding issue, causing significant challenges for both individual and businesses. This inconsistency in electricity provisions hampers economic growth, affects daily life, and necessitates reliance on costly alternatives such as generators. The energy system of a hospital organization is usually exceptionally complex and must respect strict regulations, since any changes to the performance have impact on other aspects. Energy efficiency and energy use are major components of sustainability.

Primary health care centers are institutions for the care of the sick and injured and usually function 24 hours per day, all year round. They usually consist of large buildings, and careful control of their internal climate

is considered necessary. Substantial amount of heat is
normally generated internally by the occupants and
operating equipment. An effective cooling (and heating depending upon the external weather conditions.) and ventilation systems combined with good insulation of hospital building, usually reduce hospital's sensitivity to the outside weather. Health care center also require standby electricity generators to ensure a continuous supply of power in emergencies and critical operations. When considering energy-efficiency in health care center, it is important to keep in mind that it is not the end-use of energy alone, but also the need to control the indoor climate, that is one of the principal requirements (Kapoor, 2011).

PHC depends largely on electricity power supply, but lack of steady power supply has affected services and discouraged attendance by patients. workers said lack of regular electricity at the PHC is the main problem stopping them from providing round the clock healthcare services to the community. a laboratory technician at one of the PHC in the study area, lamented that the laboratory was unable to carry out most tests required by patients because electricity supply is irregular and limited and for a laboratory to function efficiently, it needs regular power supply to operate some equipment such as the microscope. It is very important for every healthcare center to implement a comprehensive energy management program so that the utility costs can be reduced and some of the savings are used for more essential things such as the replacement of medical assets and the day-to-day operation of the healthcare facility.

Literature review

Role of Prioritization in Energy Optimization

In the recent times, the conventional mode of energy supply and demand management has come under criticism due to the various economic and environmental concerns associated with it (Gurel et al., 2019). Climate change has been identified as a global threat and energy use has been identified as a main contributor to this phenomenon and other negative environmental impacts (Environment Canada, 2015). On the other hand, resource depletion and high energy prices are posing challenges for economic development of countries especially with the high dependency on fossil fuel that is approximating to 85% of the total global energy use (Agbulut et al., 2019).

Key Parameters for Prioritizing Passive Measures

The present condition and the need for effective sustainable solutions to the global issues on climate change have brought a lot of challenges to the architectural profession, with a call for transformation and adaptation (Magarida and Miguel 2019). The architect needs to understand the principles of sustainability in a more detailed manner while creating and transforming space into a more energy-efficient building (Brophy and Lewis, 2011). In order to implement sustainability as a fundamental in the building lifecycle, sustainable principles should be integrated into the architectural design (Amado et al, 2015).

The design stage which is the first decision-making phase of every building design has a lot of influence on the building's performance down to its lifecycle, the architectural design principle or concept used by the architect should be based on sustainability principles (Magarida and Migue, 2019). This is possible through the introduction and implementation of deconstruction, passive, adaptive strategies, and Design for Human Comfort as an architectural design principle, with the aim of using the architectural concepts above as a sustainable tool for energy reduction in buildings, looking at it from the design stage (Guy and farmer, 2011, Kanters et al 2014).

Energy Efficiency in Health Infrastructures

Inserted in the tertiary sector, the health services are one of the most energy demanding activities, due to the also demanding operating conditions. Health infrastructures are full functioning 24 hours a day, 7 days a week and in certain building areas the Indoor Air Quality (IAQ) must obey strict conditions, so that the procedures and the patient's health are not jeopardized(Jo, 2021). The health services represent 10% of the total tertiary sector's electricity demand. In 2014, the healthcare sector's global carbon emissions were 2 GtCO2e, equivalent to 4.4% of the global emissions. The improvement and/or better control of HVAC equipment can also provide a great contribution for energy efficiency in commercial buildings like the hospital. The installation of heat pumps is one

re- current measure for natural gas reduction (Deline,2011) and the use of variable-frequency drivers can present payback periods smaller than 1 year (Saidur,2010).

Successful Implementation of Passive Measures in Primary Health Care Facilities

Driven by the rising population, increasing the economy and a look for improved quality of life, energy consumption has raised and the growth rates are expected to continue, fueling the energy demand further. Raised energy consumption can lead to a lot of greenhouse emission (GHG) emission with serious impacts on the atmosphere (Harish & Kumar, 2016). Many researchers have studied this issue and analyzed occupancy diversity at the building level from the superior management perspective (Oldewurtel, Sturzenegger, & Morari, 2013) with a focus on global controller optimization, from the occupant classification and segmentation perspective (Gulbinas, Khosrowpour, & Taylor, 2015). The reduction of hospital energy consumptions may be obtained at different building levels, such as ward/room and a complete hospital building. This will be done by controlling heating and cooling in mere one area or thermal zone (e.g. by adopting sensors that regulate the radiator valves), and by reducing the complete building energy consumption (e.g. by adopting a chiller water temperature management counting on the ambient temperature).

Energy Optimization

Energy efficiency as another means to decrease energy and electricity usage that indirectly contributes to the mitigation of GHGs emission (Teke & Timur, 2017). Efforts on rising the energy efficiency of the existing buildings were mainly targeted on the technology and instrumentation efficiency levels from both powers provide and demand sides.

At technology efficiency level, efforts are made to introduce renewable power generating technologies to buildings, as well as solar systems (Wu, Tazvinga, & Xia, 2015), wind systems. From the energy provide side. At the same time, several energy efficiency technologies are developed and reported from the demand side. These technologies embrace the development of insulation materials (Hurtado, Rouilly, Vandenbossche, & Raynaud, 2016), energy-efficient equipment. At the instrumentation level, the maintenance of envelope system, ventilation and air-con (HVAC) systems and lighting systems was additionally studied (B. Wang, Wu, & Xia, 2017).

Challenges and Barriers in Prioritizing Passive Measures in Nigeria

The health sector of the Nigeria Economy is statutorily established to provide essentially health care services to Nigerians irrespective of their locations within the territorial jurisdiction of Nigeria. In short, the health sector belongs to the concurrent legislative list which empowers the Federal, the State and the Local Governments to legislate on health matters. So, the health care delivery services in Nigeria, as well as the National Health Policy, aim at addressing the provision of intensive, effective and efficient health care services to the people of Nigeria in order to allow them achieve laudable goals of health standard such that everyone will enjoy life at all levels of human endeavor. This statutory provision lends credence to the popular adage of "Health is Wealth" and of course, this is an irrefutable statement of fact as for example, if the rich have health challenges, his wealth is of no use to him. This assertion buttresses the significance of the health sector in any nation. In Nigeria, the first major point of contact of the populace with the health care is the Primary Health Care facilities nationwide. In essence, the pivot of health care delivery services is the Primary Health Care under the Administration of Local Government Councils in the country. Its mission or central focus is basically on preventive care. The secondary and tertiary health institutions provide curative care and render supervisory and complementary services. They also receive referral cases from the Primary and Secondary levels as the case may be. The Federal Ministry of Health formulates health policies and ensures that there is compliance in form of implementation by the Hospitals Management Boards, hospitals and health institutions/agencies.

METHODOLOGY

The methodology adopted for the study included both primary and secondary data collection. primary data were collected from the administered question. Descriptive statistics based on mean ranking was carried out to explore the levels of prioritization of passive measures in primary healthcare centers. A total of 350 set of questionnaires (5point Likert scale closed-ended) were administered to the case study areas and 304 responses were received this resulted in an overall response rate of 83%. Systematic field surveys followed by in-depth statistical analysis of the ensuing survey results were adopted.

RESULTS AND DISCUSSION

Analysis of Questionnaire Administered

A total of 350 set of questionnaires were administered to the case study areas and 304 responses were received as shown in table 3. Of these, twelve (12) were not fully completed and therefore discarded. Specifically, those who

left out or ticked noting or few items in the questionnaire were discarded. This resulted in an overall response rate of 83%. This is reasonable considering the fact that majority of the respondents were proportionally captured.

Questionnaire Administration

Questionnaire	Number	Response rate
Administered	350	-
Received	304	87%
Valid	292	83%

Source: Field Survey, 2024

Demographic Information of the Respondents

The demographic information of the respondents was analyzed in table 1. The frequency and percentage analysis were carried out and the results were presented to explore the respondents' profile. Table below shows the profile of respondents for the study. There were some reasonable responses across the major staff of the primary healthcare center. The result also indicates diverse set of academic backgrounds among usable responses received as almost 57% had bachelor's degree while 5.8% had master's degree. All other cadres are also well represented in a reasonable proportion. This means that larger proportion of the respondents have spent reasonable years in the system to be able to give a reliable information about prioritization of passive measures for energy optimization in designing sustainable primary healthcare centers.

Table 1: Demographic Information of the respondents

Variables	Option	Frequency	Percentage
Age	Less than 30years	62	21.2
	Between 31 to 40	167	57.2
	Between 41 years and above	63	21.6
Gender	Male	95	32.5
	Female	197	67.5
Qualification	O' level	40	13.7
	NCE/Diploma	29	9.9
	HND	37	12.7
	Degree	167	57.2
	Master's Degree	17	5.8
	PhD	2	7
Working Experience	Less than 5 years	44	15.1
	6 to 10 years	102	34.9
	11 to 20 years	101	34.6
	21 years and above	45	15.4
Which category do you belong?	Staff	167	57.2
	Visitors	84	28.7
	Patients	41	14.0

Source: Field Survey, 2024

Table 2: Level of Prioritization of Passive Measures

Variables	Mean	Std. Deviation	Rank
High priority to passive design elements such as natural ventilation, shading, and insulation	4.09	.752	First
Healthcare facility should prioritizes natural ventilation strategies, such as well-designed windows and airflow patterns, to enhance indoor air quality	4.04	.738	Second
Healthcare center are to actively employ passive cooling strategies	3.99	.764	Third

Focus on using insulation and other passive measures to enhance thermal comfort	3.99	.865	Fourth
Incorporating passive solar design principles	3.93	.805	Fifth

Source: field survey, 2024

Descriptive statistics based on mean ranking was carried out to explore the levels of prioritization of passive measures in primary healthcare centers. The results showed the ranking, mean and standard deviation for each Item. high priority to passive design elements indicating that respondents prioritize the incorporation of passive design elements such as natural ventilation, shading, and insulation. The low standard deviation implies a relatively consistent agreement among respondents, leading to the first rank. The focus on prioritizing natural ventilation strategies, including well-designed windows and airflow patterns, also has a high mean, placing it in the second rank. Healthcare facilities actively employing passive cooling strategies are considered with a slightly lower mean, ranking third. The focus on using insulation and other passive measures to enhance thermal comfort has a mean similar to the active employment of passive cooling strategies. However, the higher standard deviation implies a greater range of opinions among respondents, placing it in the fourth rank. Incorporating passive solar design principles has a slightly lower mean compared to the other measures, placing it in the fifth rank. In summary, the respondents prioritize passive design elements, natural ventilation strategies, and the active employment of passive cooling strategies in primary healthcare. There is a decreasing level of prioritization for focus on thermal comfort through passive measures and incorporating passive solar design principles.

Conclusion and Recommendations

In view of the research conducted, the respondents seem to prioritize passive design elements, natural ventilation strategies, and the active employment of passive cooling strategies in primary healthcare. And the study further recommends that hospitals should endeavor to make use of courtyards in its design as it has been established that courtyards can greatly improve passive cooling which will reduce dependence on HVAC systems for cooling.

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