Hospitals Adaption to Principles of Sustainable Architecture

(Case study in 10 hospitals)

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Abstract

Architectural designs in hospitals have evolved over time and this is in relation to innovation in medicine. The study sought to understand the issues surrounding sustainability and the architecture chosen. Hospitals have been associated with tremendous consumption of the natural resources. Production of waste is also as high though management of the waste may not be up to par from an environmentalist's perspective. The architecture's concern for the environment's sustainability is also probed in the study. This raises the worries regarding what hospitals can do while choosing the designs so as to reduce the consumption to reasonable levels and at the same time conserve the environment. The study also set out to establish the attitudes of hospitals towards sustainability and the efforts being made to achieve this. It was conducted in 10 hospitals in Hawaii and California states. The study used interviews and qualitative design to analyse the results specifically constant comparison. It has come to a conclusion that the architecture affects the sustainability of the environment as the findings suggest. It also found out that hospitals are embracing some of the new architectural aspects that consume fewer resources and maximize the utilization of the other unlimited resources such as air and light in carrying out the daily activities. This is clear as more hospitals are ready to go green especially under the guidance of LEED. The hospitals' attitudes towards sustainability are positive as it benefits them. Most have taken this up to save on costs of running the hospitals.

Keywords: sustainable architecture, Hospitals, Hawaii state, California state, environment

1. Introduction

A hospital is an institution where both in and out patients receive medical care at all levels and are even admitted when the need to do so arises. They are a very important part of the health care provision in any country. The evolution of hospitals, medicine and the services they provide has led to the need of better planned structures. This has also been aggravated by the increased demand for health care services. More people have realized that the hospitals should not only be attended at the terminal stages of diseases but right from the diagnosis [1].

The hospital's architectural designs have been developing over time as more innovations are being made in the medical section. As the medics discovered more about diagnosis of diseases, anaesthesia and controlling the spread of information, surgery procedures and equipments as well as facilities were also going through an enormous transformation. Issues regarding the environment began to be of more importance as hospitals chose their architectural designs by the end of the 19th century. Environmental issues such as use of natural instead of artificial lighting in the surgery rooms became more important thus considerable. The hospital's floors that admitted inpatients were also designed in a way that would prevent cross contamination. Response to the various medical needs of patients was also put into great consideration. This meant choosing a design that would readily provide access at all times to the various departments [2].

By the 20th century, the healthcare section had experienced more medical innovations. This meant they had to do away with some of those used in the past. Natural ventilation is one of those aspects that had to be dismissed. Hospitals needed to expand their facilities

more so as to accommodate out patients. The introduction of elevators also caused a major change in the architectural designs of hospitals especially in the cities. This was back in the year 1889. Hospitals could now take up a vertical dimension since space was limited in the cities to expand facilities from the ground. Technology was the most influential factor in hospital architectural designs. The rate at which more innovations were being made was challenging to match up in terms of infrastructural development [2]. Flexibility should be considered when designing hospital buildings. Adopting loose fit designs that can easily adapt to activity change is a good idea [3]. The shift from tight fit architectural designs to the loose fit designs is meant to increase the hospital's buildings to change while ensuring main hospital services are not being interrupted.

1.1 Background statement. Hospitals are great energy consumers since some of the facilities have to be kept running for 24 hours. These include air conditioning, lighting, life support machines among others. The amount of toxins and waste released into the environment daily are enormous in quantity. The amount of natural resources injected into the construction of these hospitals is also very great [4]. When choosing a hospital design, the environmental effect is one of the many factors put to consideration. Other factors include the economical value, flexibility to adapt to change, effect on the community and its ability to function as expected [1].

According to Rassia & Pardalos [3], for a hospital's architectural design to be sustainable or rather meet the sustainability standards; it has to be able to meet the present needs without jeopardizing its ability to meet the future needs. There are various ways in which architectural buildings can be sustainable. These include efficient use of the water resource, proper waste management, ensuring the health of occupants is taken care of, employing energy saving strategies, avoiding environmentally degrading activities and reducing incidences of pollution of the environment. It is important to note that environs of the sustainability kind improve the healing process in the context of hospitals.

De [5] has defined the environment as all the conditions that have an affect the development of any living organisms. The major components of the environment are the biological and non-biological aspects. The biological aspect includes flora and fauna. Non biological aspect of the environment includes the atmosphere, lithosphere and hydrosphere. The environment can also be categorized into two types; natural and built environment. The natural environment is made up of the biological and non biological elements of the environment. The built environment is manmade.

It includes buildings and other man made facilities and infrastructure. Often, man relies heavily upon the natural environment and the same environment relies on man to preserve and maintain it. The environment is at times negatively affected by external elements known as pollutants. The negative effect is referred to as pollution [5].

Most architects have not been able to design such buildings especially hospital buildings despite their great knowledge. This poses a great risk to the environment as a whole as adverse effects can be felt. To be able to do so, understanding the main principles of sustainability is first and foremost step. This understanding should be followed by analyzing the present designs and identify one that exhibits more of the principles. From there, improving such a design would be the next step to meet a larger percentage of the principles effectively and practically [3].

1.2 Problem statement & importance of research.

Architectural designs adopted by most hospitals tend to have adverse effects on the environment due to natural resource consumption and waste production as well as its management. This is because sustainability has not been addressed by most architects despite the fact that it has got its principles well laid out. The waste in form of water and solid produced by the hospitals all over the world daily is of great concern with regards to the environment. The energy consumed in the hospitals as they carry out even the most basic functions is also a lot. The natural resources that are used when constructing hospitals are a lot too. This consumption of these natural resources may not be as much compared to the amount of waste released and the harm this could have on the environment if not well managed.

The importance of this study is to explore the effects that architectural designs have on the environment. This will lead to development of knowledge regarding sustainability in architectural designs chosen by hospitals. The knowledge developed shall add onto what is already present. The knowledge shall then be used by academicians and other researchers. It shall also be used by the hospitals especially those that shall be featured in the research to improve their sustainability efforts. The knowledge shall also enlighten all readers and most especially the architects on sustainability issues with regards to architectural designs.

1.3 Task statement. This is a study of the hospitals adaptability to sustainable architecture. In other words, the study will focus on the efforts made by hospitals to sustain the environment through the architectural designs they choose. The study shall be presented in written form totalling to ten pages. The study will majorly depend on books for sources as well as credible

ISI papers within 2005-2012. It shall include a description of the topic, a statement of the questions to be answered and a detailed discussion of the findings in regards to the topic of study.

1.4 Forecasting statement. The findings of this study are expected to bring about a better understanding of sustainability in relation to architecture. This includes the importance as well as the process of achieving sustainability. The knowledge shall be used to improve the already established hospitals in sustaining their environment and also the upcoming hospitals in adopting the new propositions of sustainable architecture.

2. Research objectives.

1. Establish the hospitals' attitudes towards sustainability of the environment.
2. Investigate the efforts made to achieve environmental sustainability.
3. Examine the challenges faced in achieving sustainability in architectural aspects.

2.1 Focus issues. The focus issues of the study shall be

architecture in relation to sustainability in hospitals. The study shall also highlight the various challenges faced by the hospitals trying to incorporate sustainability in their designs. The attitudes towards this topic shall also be discussed.

3. Research Questions.

1. Which of these architectural aspects are sensitive to the environment in terms of sustaining it?
2. What are hospitals doing to better preserve their environment?
3. What are some of the challenges in trying to use environmentally sustainable architecture?

Most researchers have not done a lot of research with regards to this study. From the studies reviewed the impact of the architectural designs on the sustainability efforts has not been discussed in detail. This means that the building designs have not been focused on in the studies. Other architectural aspects such as landscaping, building materials, spacing, and ventilation have been considered. The efforts being made by hospitals to achieve sustainability have been delved into.

4. Literature Review (Table 1)

Time	Writer	Title of the research work	Resource	Research model	Results
2012	Janet B.	Leading Communities To a Healthier Future	Health care Design	General	Going green is one of the strategies hospitals are using to cut costs.
2011	Andersson J. E.	'Touching up' Communal Space of a Residential Home Setting: A Comparative Study of Tools for Assessing Changes in the Interior Architectural Space.	Journal of Housing for the Elderly	General	A well planned interior décor and environmentally friendly floorings and paints too can reduce the maintenance needs such as waxing of floors and so on.
2010	Hill B.	International Architectural Showcase	Healthcare Design	General	The financial challenges and lack of enough reimbursements may cause them to reduce their green activities.
2010	Damon Barda	Breaking Ground	Environmental Design and Construction	General	It is clear that sustainability efforts may begin in the planning stage. The main objective was to create a naturally friendly environment to promote healing among the children.

To be continued

Time	Writer	Title of the research work	Resource	Research model	Results
2010	Damon Barda	Breaking Ground	Environmental Design and Construction	General	During construction, the hospital recycled most of the materials whenever possible. It opted for white roofing to reduce the heat emanating from the building, the internal temperatures thus reducing the need for round the clock air conditioning. The hospital has numerous windows which make good use of the daylight thus using electricity minimally and efficiently. The plants within the compound do not need a lot of watering so as to conserve water.
2010	Damon Barda	Breaking Ground	Environmental Design and Construction	General	The sustainability objective safeguards the environment and also enhances healing process of patients and places the community who are stakeholders at an advantage too.
2010	Ferenc J.	Going Greener	Health Facilities Management	General	Hospitals produce a great amount of waste. Waste reduction has become of great importance as recycling of the waste produced. The motivation towards this is the economical benefit associated with waste reduction
2006	Bruce G.	New Ore. hospital powered by wind	Waste News	Report	In a bid to conserve energy, more hospitals are beginning to construct their buildings guided by the Leadership in Energy and Environmental Design Standards (LEED) principles. The Providence Newberg Medical Centre, in the United States shall be the first in the country to operate under wind generated power. The wind power plant is expected to shoot up the construction cost hugely. The value of environmental conservation and sustainability by the Providence hospital cannot be valued in monetary terms as it is great.

5. Theoretical framework

This study will seek to explore some of the challenges that the hospitals face while trying to incorporate sustainability in their facilities. It shall consider the

architectural aspects for research. It will also highlight some of the efforts towards sustainability in the hospitals under study.

Conceptual and operational definition for variables.

The two main variables in this study are architecture and the environment. The conceptual definitions of these variables are as follows. Architecture is the style chosen for a building and expressed into a tangible and visual form [6]. The environment is defined as the surroundings by [5]. The operational definitions of these variables are types of architecture and environment.

6. Methodology

This study will use the qualitative research design. This is a design that will concentrate more on descriptions and explanations of various phenomena in the study. It shall enable creation of comprehensive results of the study. The study will explain to the audience the occurrences and their reasons. In order to accomplish this, the feelings, comments, experiences and responses as well as opinions of the respondents regarding the topic under scrutiny must be well comprehended. Qualitative design shall compel the researcher to collect data from various correspondents who have varying opinions. This design will not end up in aggregating all the findings but shall retain individuality of the findings. It shall therefore enable the understanding of all responses that will occur under different circumstances. The sampling method that will be used in this study is simple random sampling. While using this method, the researcher randomly picks the respondents in the targeted population. The subjects in the study are hospitals in California and Hawaii states in United States. From each of these states, five hospitals shall be selected totalling to ten.

6.1 Research tools. In this study, the research instruments which will be used are interviews. These interviews shall contain questions that will lead to answers of the research questions of the study. This will allow the respondents to provide more information to the questions asked. These interviews shall be conducted face to face so as to enable collection of all expected data. This will also allow the researcher to capture the emotions of the subjects.

6.2 Limits and Limitations. The limitations of this study are time factor and finances. The study would require a lot of time to conduct effectively and comprehensively. However, much time is not available. Financial resources required to conduct the study are limited. This requires the researcher to choose the most economical methods of study that will provide the most appropriate results.

7. Results and Findings

After data has been collected, constant comparison shall be used to analyze the data collected. This method of

analysis will involve going through the data carefully and identifying all the solid issues that are there. After this the issues or themes will be coded and categorized. From this, conclusions shall be made based on constant observations.

The study shall be conducted among hospitals as they are the main topic of study. In general, 10 hospitals will be involved. Interviews shall be conducted with staff members from each of these hospitals. The study shall be conducted within the United States' hospitals. The study shall consider hospitals within California and Hawaii. These are states of the United States. From each state, 5 hospitals shall be picked randomly. The data collected shall be presented in diagrams and then later on discussed.

1. What are some of the considerations while constructing the hospital?

Diagram 1. Considerations and Evaluation Process.

Considerations	Hospitals
Purpose of the hospital	4
Budget of construction	3
Location of the hospital	1
Future prospects	2
	10

Diagram 1 shows the results from all the ten hospitals regarding their construction considerations. Four of them believe that the purpose of the hospital is paramount in construction. 3 of them believe that the budget they have allocated the project should guide the construction. 2 of them believe that the future plans of the hospital should be considered right from the beginning. 1 of the hospitals stated that the location of the hospital is very important.

2. Did you have any environmental considerations in your construction plans?

The **diagram 2** is a pie chart that represents the proportions of the hospitals regarding the presence of environmental concerns during construction. 40% responded negatively implying that they did not have the environment in mind while constructing the hospitals. 60% of them responded positively having considered the environment.

Diagram 2. Environmental consideration.

3. What were some of these considerations?

Diagram 3 is a graph showing the responses of the subjects regarding the environmental concerns that the 60% who responded positively in diagram 2 had. 1 hospital considered the minimal consumption of natural resources while building. 2 of the 6 hospitals considered having zero pollution of the environment while the other 3 considered maximising the utilisation of natural resources.

4. What were some of the challenges that you faced while trying to implement these considerations?

Diagram 4 as shown below represents the responses of the challenges faced when trying to implement these environmental considerations as in **diagram 3**. 3 of the hospitals cited financial strains as a major challenge while 2 of them cited time factor a major limitation. 1 hospital claimed to lack good sources of expertise advice regarding environmental issues.

Diagram 3. Environmental concerns. **Diagram 4. Challenges for environmental considerations.**

Table 2. Hospital Factors Analysis.**Factor 1**

Construction determinants	Purpose of the hospital	Budget allocated	Location of the hospital	Future prospects
Number of hospitals (10)	4	3	1	2

Factor 2

Environmental concerns	Minimal consumption of natural resources	Maximised utilisation of natural resources	Zero environmental pollution
Number of hospitals (6)	1	3	2

Factor 3

Challenges in implementation	Financial strain	Time limits	Expertise advice
Number of hospitals (6)	3	2	1

8. Discussion

According to the results of the study, most of the hospital's purpose greatly determines its construction. This may affect the style, the time of the project and many other factors. The financial resources are also a great deal in construction. Most hospitals conduct projects with fixed budgets. Construction that strains the budget tends to be dismissed and that within budget considered. The future plans that the hospital has laid out are a worthy consideration as well. This enables the hospital to work towards the goals much more strategically [7].

The study reveals that most hospitals have a caring attitude towards the environment. This is because most of them take it into consideration when planning construction projects. The main reason that was noted during the study among those who consider it is that it has great effect on the patient's healing process [8]. Of the most common environmental concerns is the maximization of natural resources utilization. These resources include light, fresh air among many others. The hospitals adapt to these by ensuring that their buildings are open in terms of windows so as to let in the air. This reduces the need of air conditioning that uses energy. Use of natural light eliminates the need for

electricity during the day conserving energy.

The hospital practicing minimal consumption of natural resources cited the recycling of materials when constructing. This will reduce felling of more trees for timber and reduce waste materials as featured in [9]'s study.

The study suggests that finances tend to be the greyest hurdle in incorporating the environmental concerns in construction. Landscaping is one architectural aspect that consumes a lot of water which is a natural resource. Most hospitals have started going green by planting drought resistant plants to decorate their compounds and create a serene environment [10]& [11].some of the actions that hospitals are taking up have been identified. Proper waste management dominates the results. Hospitals produce a lot of waste in their daily activities. This waste may be hazardous and infectious [12] & [13]. Managing to dispose the waste without putting anyone or the environment at risk has become of great importance. Some of the hospitals give up waste for recycling and others have incineration plants within their facilities [14].

9. Conclusion

According to this study it is clear that hospitals are embracing environmental sustainability. However, some are still facing financial challenges and lack of proper sources for expertise advice which is much needed in the transformation. They are taking into consideration some of the minor but effective ways to begin the process of going green. These include use of natural lighting and ventilation as well. They have realized that the health of their patients is important and can be enhanced by going green. It is therefore clear that the architecture chosen has a positive or negative effect on the environment as well as patients' well being depending on its nature.

10. Further Research

Studies in the future should concentrate more on the architecture field and the environment. This will need them to delve more into architecture as a field of study in its own right and highlight its major interrelation with the environment. This will enhance better understanding of the connection between architecture and sustainability of the environment.

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APPENDICES

Appendix 1

Interview

What are some of the considerations while constructing the hospital?

Did you have any environmental considerations in your construction plans?

What were some of these considerations?

What were some of the challenges that you faced while trying to implement these considerations?

What kind of materials did you use for construction of the hospital?

Which architectural aspect is your biggest natural resource consumer in the hospital?

What are some of your efforts towards conserving the environment?

Appendix 2

List of interviewed hospitals

Hawaii

Wilcox Health

Shriner's Hospital

Kaukini Medical Centre

Hawaii Pacific Health

Wahiawa General Hospital

California

San Francisco General Hospital

Sharp Memorial Hospital

Naval Medical Centre

Kern Valley Hospital

Fresno Surgery Centre