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ENGINEERING GREEN HOSPITALS: AN IMPERATIVE FOR A SUSTAINABLE FUTURE

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ABSTRACT

Climate change is an issue of grave international importance. It has an obvious direct impact on human health. The healthcare sector, which consumes a significantly substantial amount of resources through the construction and operation of complex hospitals and healthcare establishments, the use of modern technologies that are

energy-intensive and the generation of a large amount of waste, has itself become a public health concern of some significance[1]. 10.6% of all energy utilized by commercial establishments in Brazil is by hospitals[2]. The National Health Service (NHS) in England, which is the country's largest healthcare provider, accounts for almost one fourth of all emissions from the public sector in England: amounting to 18 million tons of Carbon dioxide per year

Key words: Green hospitals, Green buildings, environment friendly hospitals

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1. INTRODUCTION

Climate change is an issue of grave international importance. It has an obvious direct impact on human health. The healthcare sector, which consumes a significantly substantial amount of resources through the construction and operation of complex hospitals and healthcare establishments, the use of modern technologies that are energy-intensive and the generation of a large amount of waste, has itself become a public health concern of some significance[1]. 10.6% of all energy utilized by commercial establishments in Brazil is by hospitals[2]. The National Health Service (NHS) in England, which is the country's largest healthcare provider, accounts for almost one fourth of all emissions from the public sector in England : amounting to 18 million tons of Carbon dioxide per year.[3] The healthcare industry in the United States of America is the largest user of carcinogenic chemicals[1]. India generates more than 15 lakh tons of healthcare waste every year.[5]

The healthcare industry is in many ways a very respected and trusted part of society. It is a big employer and a big consumer of energy. There is a duty and an opportunity to bring in efficiency, cost reduction and environment friendly measures in a synergistic manner.[6] The United States Environmental Protection Agency defines green building as, "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building".[8]

2. BARRIERS TO THE CREATION OF GREEN HOSPITALS:

The following barriers to the engineering of green hospitals have been cited:[9]

- Compliance to regulatory requirements: Building codes and safety and health regulations can prevent or make it very difficult for hospitals to adopt sustainable practices.
- Operational hours: The need for most healthcare facilities to function without interruption round the clock and throughout the year.
- Redundancy of systems: The requirement of secondary and tertiary backup systems to make sure that the hospital or healthcare operations do not stop during emergencies.

- Meeting the requirements of licensing and accreditation agencies: The need to comply with central, state and accreditation requirements can make it difficult or even prevent healthcare facilities from making environmentally sound choices.
- Rates of ventilation: In comparison to other commercial office spaces, the frequency of air changes required in a hospital is higher.
- Hospital Infection control: The rigid infection control protocols in place in hospitals very often run counter to sustainability practices.
- Life cycle of hospital buildings: The hospital building exteriors have a reasonably long life, in contrast to the interiors which can require upgradation or renovations every few years.
- Chemical use: The chemicals used to clean, disinfect, sterilize equipment, for laboratory research, testing and to treat certain diseases can be toxic and hazardous.
- High-volume waste stream: Hospitals generate around 0.5 Kg of biomedical waste per bed per day.
- Intense water and energy use: Hospitals consume 210% more electricity per square foot than other commercial buildings. On an average, hospitals consume 80-150 gallons of water per bed per day.
- The myth of higher cost[21]: A significant barrier to the adoption of green building techniques and processes seems to be the unwillingness of conventional builders to professionalise the processes of energy management, architecture and water management. Costs have fallen. The Platinum Green buildings of the Indian Green Building Council (IGBC) that used to cost 15 percent more ten years ago now cost just 9 to 12 percent more than non-green buildings.[22]
- Lack of green hospital practices being mandatory[21]: Since there is no legislation that makes it mandatory for hospitals to be built with green practices, the concept will obviously take its time to grow. Governments need to take ownership of the need for green buildings and push through relevant, well thought out legislation.
- Lack of pull from customers[21]: The green hospital movement will receive a fillip when consumers and buyers begin to demand green buildings. This will happen over time with better awareness.

3. DEFINING FEATURES OF GREEN HOSPITALS

3.1. Conservation of Energy

A large western style hospital will consume copious quantities of energy for regular day to day functioning. It is possible to increase energy efficiency without compromising on the quality of care[1]. Many assessment studies of hospital energy use have shown the potential for cutting a fifth to a third of energy cost, which is a very significant proportion[4]. To achieve energy efficiency, the low hanging fruit that can be plucked with relatively easily would be : regulating the thermostat appropriately in tune with the surrounding temperature, a comprehensive integration of compact fluorescent and light-emitting diode (LED) light bulbs, large scale incorporation of energy efficient products and energy friendly retrofitting of buildings[10].

3.2. Energy Procurement from Alternative Sources

Hospital managements must actively look to harness renewable energy (water, wind, sun, geothermal heat, organic matter) sources in the provision of health services. Governments must

facilitate this and the utilization of low energy and no energy medical devices through subsidies and other policies that encourage the use of renewable energy.

3.3. Design

The environmental sustainability index of healthcare facilities can be enhanced by locating healthcare facilities as close to public transportation facilities as possible, utilizing locally sourced building materials, incorporating design components like water harvesting, natural ventilation, day lighting and planting trees on the site.[3,11].Research has demonstrated that the difference in average costs of green and regular buildings is insignificant[12]. The Carnegie Mellon University Center for Building Performance and Diagnostics identified 17 international studies that look at the relationship between improved indoor air quality and positive health impacts on illness, including asthma, flu, sick building syndrome, respiratory problems and headaches. The range of improvements was from 13.5 to 87%.[13]

3.4. Management of Biomedical Waste

Biomedical waste (BMW) management in India is very often mismanaged. Many healthcare facilities in the country have no BMW system, as a result of which BMW can be found in regular garbage bins and in water bodies.[14] Both BMW handlers and the general public are at increased risk from hazardous BMW, which constitutes approximately 15 percent of total BMW.[15, 16] Diseases that could be transmitted through BMW are HIV, Hepatitis B and C, Tuberculosis, Typhoid and Cholera.[15]

4. CONSERVATION OF WATER

Very large amounts of water are used up by healthcare facilities. Rainwater harvesting and water recycling for non-drinking purposes are two ways in which water conservation can be practiced by healthcare facilities.

5. REDUCTION IN COST OF TRANSPORTATION.

The health care sector accounts for the consumption of significant amounts of fossil fuel in the health care related transportation of doctors, paramedical personnel, patients and patient families.[17] the transport sector is a major greenhouse gas emission source. It has an important place in climate change mitigation efforts.[18] Strategies for healthcare facilities to reduce their transportation emissions include smart siting of the facilities close to public transportation facilities; the use of alternative fuel vehicles like CNG and electric vehicles; encouraging and facilitating the use of bicycles; carpooling and public transportation; and sourcing hospital supplies from local suppliers.[1,7,18] Telemedicine has the potential of reducing air pollution, by reducing travel and transportation[18].

6. THE PROVISION OF HEALTHY, NUTRITIOUS FOOD.

Modern diets rich in refined sugars, saturated fats and processed foods increase the burden of non-communicable diseases, thereby contributing to morbidity, mortality, healthcare cost and the healthcare sector environmental footprint. Hospitals and healthcare facilities must make it their prerogative to provide fresh, nutritious and good tasting food to patients and staff. They must also undertake initiatives to support food production that is local and protective of the environment and citizen health.

Examples of Green hospitals:[19]

1. The Children's hospital of Pittsburgh, Pennysylvania, USA, incentivizes car pooling, does landscape maintenance with the efficient use of recycled water and is completely paperless, with e storage of all test results, patient notes and other data.
2. The Dell Children's medical centre of central texas, USA, incorporated environment friendly adhesives and interior paints, a white roof to reflect light from the sun to keep the facility cool naturally. Plant steam is captured and reused as chilled water.
3. Providence Newberg Medical center, Oregon, USA meets all of its energy requirements with energy from renewable sources like geothermal, hydroelectric and wind power. Its ventilation system continually brings in fresh air from outside, offering significant air quality benefits.
4. Vivian and Seymour Milstein Family Heart Center, New York, USA has computer controlled heating and ventilation, a state of the art motorized system to reduce glare from the sun and an occupant sensing lighting system.
5. West Kendall Baptist Hospital, Florida, USA uses Eco-friendly construction materials, including Forest stewardship council certified wood and low emitting paint. These materials are sourced locally wherever possible. Debris is recycled. Dual flush toilets and other water conservation measures have reduced water usage by 20 percent. High efficiency chillers and air handling units conserve energy.
6. Care Institute of Medical Sciences (CIMS), Ahmedabad, India has all its sewage treated on site with the water being reused for irrigation and flushing. Rain water harvesting and water efficient landscaping are practiced. 30% of space is dedicated to gardens, hallways and free skylights. All load bearing walls are made of fly ash bricks. Natural stone flooring has been used as far as possible. Low emitting adhesives, seals, paints, composite wood and agrifiber products have been used.[20]
7. The Rush University medical center, Chicago, USA is designed to maximize the amount of sunlight it receives. Several green roofs are incorporated, which capture storm water and reduce the load on the city drainage system.
8. Great Ormond street hospital, U.K. has an under floor heating system that can heat or cool the hospital. Its waste heat recovery systems help offset an estimated 20,000 tons of carbon dioxide emissions a year.

7. CONCLUSION

All modern industries using sophisticated technology are very resource intensive. This holds good for healthcare as well. Hospitals function 24 by 7, 365 days a year. Climate change is a stark reality that stares us all in the face. The health sector needs to do a lot more to reduce the impact of global climate change, primarily by putting in place protocols to reduce its own substantial climate footprint. In the United States of America, healthcare buildings are ranked second in the list of commercial sector buildings consuming energy. Traditional hospitals consume approximately double the energy per square foot as does traditional office space. The spending by the health sector every year to meet patient needs is US$ eight and a half billion.[21,22] Evidence has been generated to show that the energy use by the health sector, with its attendant toxic emissions, is, in a tragic paradox, adversely affecting the health of the very people that the sector intends to serve. It is estimated by the Environmental Protection Agency of the United States that the use of seventy three billion kWh of conventional electricity in the U.S. adds more than six hundred million US dollars in increased health costs every year, with

that massive spending being on hospital emergency department visits, asthma and other respiratory illnesses. The very same processes and practices that bring about climate change and harm public health can almost always also have a significant effect on a hospital's or ministry's budget. This holds good for countries across the economic spectrum. As an example, a large modern hospital in a small South American country was built without following traditional practices of lighting and ventilation, with the result that the hospital became a heat sink: it needed huge amounts of electricity for cooling, with the result that resources that could otherwise have gone to health care had to be used to pay the power bill.

For those in the noble healthcare profession, there is a responsibility to do the right thing for the environment. With doctors and hospital administrators being part of the most educated, sophisticated and elite sections of society in terms of their education and social responsibility, it is but a natural corollary that this section of society take greater ownership of the concept of green buildings and green hospitals, thereby making a very significant and lasting contribution to the sustainability of the planet for future generations.

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