

The Transition to Green Hospitals: Steps toward Achieving Sustainability

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Abstract:

This study aims to explore the significance of transitioning towards green hospitals as a means of achieving sustainability, through the implementation of green practices such as resource consumption optimization, waste management enhancement, the adoption of renewable energy, among others. These initiatives empower hospitals to mitigate their negative environmental impacts while reaping health and economic benefits. The study employs a descriptive-analytical methodology, focusing on the experience of The Bristol Royal Infirmary as a model for the application of these initiatives. Additionally, the challenges that hospitals may encounter in executing these transformations are identified, along with recommendations to encourage the further adoption of green practices within healthcare institutions.

Keywords: The green hospital; sustainable practices; The Bristol Royal Infirmary.

JEL Classification Codes : Q56 ; I18

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Introduction:

The healthcare sector has witnessed significant progress in recent years, with environmental sustainability now becoming an integral part of the strategic frameworks of many healthcare institutions worldwide. The transition towards green hospitals stands out as one of the most prominent initiatives, aimed at integrating green practices and environmentally responsible measures into all operational facets of healthcare institutions. This shift represents a pivotal step towards achieving a balance between providing exceptional healthcare services and minimizing negative environmental impacts.

As a contemporary concept, the green hospital serves as a model designed to reduce negative environmental effects by offering innovative solutions that prioritize sustainability. These include enhancing the efficiency of natural resource use, reducing water and energy consumption, and increasing reliance on renewable resources. Furthermore, it plays a significant role in raising societal awareness about the importance of sustainable environmental practices within the healthcare sector. Thus, the achievement of these goals not only contributes to environmental protection but also promotes a healthy and safe environment for both patients and staff. This underscores that the green hospital is a paradigm to be emulated in the pursuit of sustainability within both healthcare and environmental systems.

Given the above, we can pose the following central question:

How can sustainability be achieved through the transition to green hospitals?

This question breaks down into the following sub-questions:

- What is a green hospital, and what is its significance?
- What are the challenges associated with the transition to a green hospital?

Main Hypothesis:

The application of green hospital principles significantly contributes to achieving both environmental and healthcare sustainability.

Study Objectives:

This study aims to clarify the concept of a green hospital and identify the environmental practices and principles that distinguish it, while also addressing the barriers and challenges encountered in such a transformation.

Study Significance:

This study is of paramount importance given the environmental and health challenges facing contemporary societies. Hospitals directly contribute to the consumption of natural resources, such as energy and water, as well as the generation of waste. Therefore, by transitioning to green hospitals, it is possible to reduce negative environmental impacts and achieve economic benefits. This study sheds light on the significance of the shift towards green hospitals and its contribution to achieving sustainability.

Study Methodology:

The study adopts a descriptive-analytical approach to analyze the concept of the green hospital, with reference to the model of The Bristol Royal Infirmary (BRI) to illustrate the environmental practices implemented at this hospital. The results are then analyzed to identify the practices that enhance sustainability in green hospitals.

1. The Concept of the Green Hospital:

Hospitals are vital institutions that directly contribute to promoting human health and well-being. In light of the growing environmental challenges, it has become imperative for these institutions to evolve in alignment with the principles of environmental sustainability. Thus, the concept of the "green hospital" has emerged as an effective solution aimed at achieving a balance between delivering high-quality healthcare services and preserving the environment. The definition of a green hospital is as follows:

There is no universal standard that defines what constitutes a green hospital or outlines its exact requirements. However, it can be described as a healthcare facility that continuously advances public health by mitigating environmental impacts and emphasizing the symbiotic relationship between human health and the environment. A green hospital may also be defined as a building that promotes the well-being of patients and contributes to the healing process, while efficiently utilizing natural resources in an eco-friendly manner. (Azmal, et al., 2014, pp. 2633-2635)

Although no specific global model exists for the green hospital, numerous hospitals and healthcare systems worldwide have taken proactive measures to minimize their environmental footprint, enhance public health, and reduce associated costs simultaneously. (Shaabani, Okhovati, Sarkhosh, & Vali, 2022, pp. 1-2)

The shift towards green hospitals encompasses reducing waste and energy consumption, as well as safeguarding resources. This includes waste management, recycling, and the reprocessing of reusable materials, all of which contribute to bolstering environmental sustainability and achieving harmony between health and the environment. (Azar, Farzianpour, Foroushani, Badpa, & Azmal, 2015, p. 260)

2. The Implementation of Green Practices in Hospitals:

Green hospitals aim to integrate the principles of environmental sustainability across all aspects of their operations, with the goal of reducing environmental impact while enhancing the health and well-being of patients and staff. Below are some of the green practices implemented by green hospitals:

Green Building: The design of green hospitals is based on several key principles, as follows: (Vallée, 2024, pp. 2-3) (Alsawaf & Albadry, 2022, p. 1801)

✓ **Lighting Design:** By maximizing the use of natural light and minimizing artificial lighting, this can be achieved through transparent openings in green courtyards, the installation of skylights, or the use of energy-efficient LED lighting. Natural light is beneficial for patient health and is also a valuable source of vitamin D.

- ✓ **Indoor Air Quality:** Improving indoor air quality through the use of indoor plants that release oxygen and reduce pollutants, alongside minimizing volatile organic compounds (VOCs) in construction materials.

- ✓ **Pure and Green Interior Materials:** Hospital walls and surfaces are designed to resist the growth of bacteria, fungi, and disease-causing viruses.

- ✓ **Gardens and Landscaping:** These are among the most significant aesthetic tools in the concept of green hospitals. Plants are a source of positivity and help reduce negativity. Green surfaces also enhance energy efficiency by reducing heat transfer, providing natural insulation, and absorbing rainwater, thus reducing stormwater runoff.

Energy Management: Hospitals operate 24/7, 365 days a year, and with the increasing demand for high-quality healthcare, it is no surprise that hospitals require significant amounts of energy. The following are key green practices in energy management: (Kumari & Kumar, 2020, pp. 48-49) (dhillon & Kaur, 2015, pp. 3-4)

- ✓ The transition to compact fluorescent lamps (CFL) and light-emitting diode (LED) lights, purchasing energy-efficient products, and reducing "standby" energy consumption.

- ✓ Installing motion sensors in rooms that turn off lights when unoccupied, and when a patient opens a window for ventilation, the sensor notifies the air-conditioning system to switch off.

- ✓ Utilizing renewable energy sources such as solar, wind, water, organic materials, and geothermal heat. For example, solar energy can be used for sterilizing medical equipment, heating water for showers, lighting outdoor corridors at night, and providing energy for residential buildings and offices, maximizing solar heating and cooling.

Water Management: Hospitals consume large amounts of water, contributing to climate change and exacerbating the effects of droughts and glacial melting. Hospitals can conserve water through: (Kumari & Kumar, 2020, pp. 48-49) (dhillon & Kaur, 2015, pp. 3-4)

- ✓ The use of modern water-efficient equipment, with ongoing maintenance to prevent water leaks.

- ✓ Rainwater harvesting and the recycling of water for non-potable purposes.

Waste Management: Sustainable medical waste management is critical to public health and environmental protection. International organizations such as the World Health Organization and the United Nations have called for clear legislation and procedures for safely handling medical waste. However, inadequate funding and weak enforcement remain significant challenges. Sustainable waste management in hospitals depends on a range of solutions and strategies aimed at minimizing environmental impact. Below are some key practices: (Azmal, et al., 2014, pp. 2636-2638)

Medical waste is categorized according to the risk of its transmission: 75%-90% of waste is non-hazardous and similar to household waste, while 10%-25% presents significant health risks, including infectious, chemical, and radioactive waste. Waste reduction can be achieved through:

- ✓ Purchasing glass and metal items that are recyclable, sterilizable, and reusable to the greatest extent possible.

- ✓ Sterilizing reusable items, enhancing sterilization procedures, ensuring quality, and controlling cleaning and disinfection processes.

- ✓ Adopting steam sterilization as an alternative to chemical sterilization to reduce the generation of hazardous chemical waste.

- ✓ Proper disposal involves:

- ✓ First, proper sorting is essential. Many hospitals worldwide use a three-color container system to separate waste: yellow or red for infectious waste, black for regular waste, and a designated container for sharps, known as the safety box, where needles and other sharp objects are disposed of according to specific instructions. Sorting waste at the source is critical, as mixing it increases both the danger and disposal costs.

- ✓ Second, various technologies are available for waste treatment, which require a good understanding of the level and volume of waste. These technologies are often categorized into incineration and non-incineration methods. While incineration is used for treating infectious waste, it is criticized for emitting greenhouse gases and toxic pollutants. Non-incineration techniques, such as autoclaves and microwave sterilization systems, are safer and less polluting.

Food Management: Diets high in saturated fats, refined carbohydrates, and processed foods contribute to the burden of non-communicable diseases, which require long-term treatment, thus increasing healthcare costs and environmental footprints. Hospitals can manage this by promoting public health through: (Kumari & Kumar, 2020, pp. 48-49) (dhillon & Kaur, 2015, pp. 3-4)

- ✓ Encouraging patients and staff to embrace the benefits of a healthy, balanced diet.

- ✓ Offering fresh, varied, and nutritious food options for patients and staff.

- ✓ Supporting local and sustainable food production, which benefits both the environment and health.

- ✓ Converting food waste into compost.

Green Transportation: The healthcare sector consumes large quantities of fossil fuels for patient and staff transportation. Transportation has significant health impacts, but hospitals can reduce emissions from transportation through: (Kumari & Kumar, 2020, pp. 48-49) (dhillon & Kaur, 2015, pp. 3-4)

- ✓ Effective site selection (proximity to public transport infrastructure) for hospitals.

- ✓ Using alternative fuel vehicles.

- ✓ Encouraging staff and patients to use bicycles and public transport.

- ✓ Purchasing goods from local suppliers or those who utilize energy-efficient transport.

- ✓ Adopting telemedicine, which can reduce air pollution by minimizing patient travel.

Thus, it can be stated that green hospitals strive to integrate environmental sustainability into their operations in order to mitigate environmental impact and promote public health. These hospitals focus on a range of practices, from building design that utilizes natural light and improves indoor air quality, to using antibacterial materials and creating landscaped gardens. They also work to reduce energy consumption through energy-efficient devices and renewable energy sources such as solar power. In water management, they employ rainwater harvesting and water recycling techniques. Sustainable waste management practices, including non-incineration sterilization methods like autoclaving, are applied to reduce environmental risks. In terms of food, they promote sustainability by offering healthy, local food options and converting food waste into compost. Green transportation practices include the use of alternative fuel vehicles and telemedicine, reducing carbon emissions.

3. The Importance of Transitioning to Green Hospitals:

The benefits of green hospitals for both the environment and individuals are as follows:

- ✓ **Environmental Benefits:** These include: (Alkaabi & Aljaradin, 2022, pp. 34-35)
 - A reduction in carbon dioxide emissions and the mitigation of environmental damage during construction.
 - Enhanced management of rainwater through green roofing systems.
 - The promotion of biodiversity and air purification by absorbing toxins and pollutants.
 - A decrease in energy consumption through the use of natural light and renewable energy, which subsequently reduces heating and cooling expenses.
- ✓ **Economic Benefits:** These encompass:
 - A reduction in operational costs through the efficient use of resources such as water and electricity.
 - Support for recycling initiatives, leading to cost savings associated with environmental management.
- ✓ **Improvement in Public Health:** By creating optimal indoor environmental conditions, green hospitals improve the health of individuals. They foster non-toxic environments, promote green cleaning practices, and minimize waste, contributing to a safer atmosphere for both patients and staff.
- ✓ **Enhancement of Care Quality:** Green hospitals facilitate quicker recovery for patients, reduce the length of hospital stays, lessen the need for painkillers and secondary injuries, and improve the mental well-being of both patients and staff. This ultimately leads to enhanced performance and the delivery of higher-quality care.
- ✓ **Increased Patient and Community Satisfaction:** Green hospitals elevate patient satisfaction by promoting social responsibility and advancing environmental and social justice through their eco-friendly practices.

4. Challenges in Transitioning to Green Hospitals:

Green hospitals face several significant challenges that hinder their full realization of sustainability goals. The foremost of these challenges include: (Kumari & Kumar, 2020, p. 50) (dhillon & Kaur, 2015, pp. 2-3) (Vallée, 2024, p. 5)

- ✓ **High Establishment Costs:** The creation of green hospitals requires substantial investments in infrastructure and sustainable ecosystems, which raises costs significantly in comparison to conventional hospitals.

- ✓ **Technology and Innovation:** Green hospitals demand advanced technologies and specialized expertise in environmental design and resource management, which may pose a barrier to adopting sustainable practices.

- ✓ **Operational Hours:** Healthcare facilities operate year-round without interruption, making the implementation of sustainable solutions more difficult.

- ✓ **Energy and Water Consumption:** Operating around the clock, hospitals consume vast amounts of energy and water, presenting a major challenge in achieving resource efficiency.

- ✓ **Waste Disposal:** Hospitals generate large volumes of waste, including hazardous medical waste that necessitates specialized and safe disposal methods, thereby increasing operational burdens.

- ✓ **Infection Control:** The stringent protocols for infection control in hospitals often rely on potent chemicals and precise sterilization techniques, which may conflict with sustainable environmental practices.

- ✓ **System Redundancy:** Green hospitals require backup systems that function independently during emergencies, adding complexity and cost, especially when environmental systems need additional support.

- ✓ **Training and Awareness:** Implementing green principles requires specialized training for hospital staff to shift their daily practices toward sustainability, a process that can be time-consuming and demanding in terms of guidance and awareness-building efforts.

- ✓ **Ensuring Long-Term Environmental Quality:** The costs and resources required to maintain indoor environmental quality and long-term sustainability may become increasingly burdensome over time, potentially leading hospitals to scale back on certain environmental initiatives after a period of implementation.

- ✓ **Reliance on Local Suppliers:** To ensure sustainability in the supply chain, green hospitals must collaborate with local suppliers offering eco-friendly materials, but such materials may not always be readily available or competitively priced.

- ✓ **Integration of Green Design with Traditional Infrastructure:** Existing hospitals may struggle to update or adapt to green environmental principles, making the implementation of sustainability strategies in older buildings a significant, challenging, and costly endeavor.

5. The Contribution of Green Hospitals to Achieving Sustainability:

The contribution of green hospitals to the achievement of sustainability can be explored through its three fundamental dimensions: environmental, economic, and social. The following table illustrates how green hospitals contribute to enhancing these dimensions:

Table No. 01: How Green Hospitals Contribute to Enhancing the Dimensions of Sustainability

Dimension of Sustainability	How Green Hospitals Contribute to Enhancing It
Environmental Dimension	Green hospitals can achieve environmental sustainability by adopting eco-friendly practices, such as utilizing renewable energy technologies like solar panels and wind energy systems, which reduce dependence on fossil fuels and subsequently lower the hospital's carbon footprint. The creation of therapeutic gardens and green spaces around the hospital enhances biodiversity and provides a natural environment that aids in improving the mental health of patients. Furthermore, water retention systems, such as rainwater harvesting and reuse for irrigation and non-potable purposes, help reduce freshwater consumption, thus preserving the environment. Notably, the development of safe and environmentally friendly methods for managing hazardous medical waste, such as sterilization and recycling, minimizes the environmental impact of waste and prevents harmful substances from leaking into the ecosystem, thereby ensuring environmental sustainability.
Economic Dimension	Green hospitals achieve economic sustainability by reducing operational costs. By relying on energy- and water-saving technologies, a green hospital decreases long-term operational expenses, ultimately saving funds for the hospital's budget. Additionally, by purchasing local materials and utilizing local services for construction and maintenance, the green hospital contributes to strengthening the local economy and creating job opportunities.
Social Dimension	Green hospitals contribute to social sustainability by adopting practices that reduce pollution and toxic emissions, thereby improving the quality of the surrounding air and water, which enhances community health and reduces pollution-related diseases. Moreover, the adoption of these practices allows for the creation of a comprehensive therapeutic environment. Through the design of green spaces and the provision of comfortable and healthy facilities, green hospitals improve the mental health and overall well-being of patients, which enhances recovery rates. They also improve the work environment, reducing burnout and occupational diseases among staff.

Source: Prepared by the researcher.

This table illustrates how green hospitals contribute to enhancing sustainability through the three core dimensions: environmental, economic, and social.

Environmentally, green hospitals reduce their carbon footprint by employing renewable energy technologies, achieve ecological balance through the creation of green spaces, and improve the management of water and waste. Economically, these hospitals lower operational costs by utilizing energy- and water-saving technologies, while also strengthening the local economy by sourcing materials and services locally. Socially, the adoption of green practices in these hospitals enhances air and water quality, benefiting community health, and fosters a therapeutic environment that supports patient well-being and improves the work environment for staff.

6. Case Study of The Bristol Royal Infirmary (BRI):

Situated in the heart of Bristol, United Kingdom, The Bristol Royal Infirmary is a renowned teaching hospital with a close affiliation to the University of Bristol. The hospital offers a comprehensive range of specialized medical services, including acute medicine and surgery, critical care and trauma, orthopedic surgery, as well as emergency and accident services for the local community (NHS, n.d.). The core values of BRI embody the guiding principles that form the essence of the institution; they direct behavior and shape the identity and culture of the organization, all with the goal of providing the best possible environment for both patients and colleagues. These values are: (The Bristol Royal Infirmary (BRI), n.d.)

Figure No. 01: Core Values of The Bristol Royal Infirmary (BRI)



Source: (The Bristol Royal Infirmary (BRI), n.d.)

The aforementioned values signify:

- ✓ **Respectful (Listen to Learn):** This value emphasizes the importance of actively listening to others in order to understand their perspectives and learn from them.
- ✓ **Collaborative (Better Together):** This value reflects the significance of teamwork in achieving superior outcomes through cooperation among individuals and teams.
- ✓ **Supportive (Be There):** This value underscores the importance of offering assistance and emotional or practical support to others in times of need.

✓ **Innovative (We Can Do This):** This value encourages creative thinking and innovation in developing new solutions to overcome challenges.

It can also be noted that this hospital is dedicated to implementing green practices in pursuit of sustainability, with some of the key initiatives outlined in the following table:

Table No. 02: Green Practices at The Bristol Royal Infirmary (BRI)

Green Practices	Applications in the Hospital
Green Building	The creation of therapeutic gardens, alongside the cultivation of plants, flowers, and even vegetables and fruits within the premises. Encouraging staff, visitors, and patients to spend time in these green spaces that promote both physical and mental well-being.
Energy Management	Enhancing lighting and heating systems to reduce carbon emissions.
Water Management	Conducting audits of water stations to ensure the use of water from the municipal supply instead of bottled water, while also promoting the refilling of personal bottles over purchasing packaged water.
Waste Management	Partnering with collaborators to recycle plastic waste. Additionally, working with partners to reuse as much office furniture as possible, either by offering unwanted furniture to them, which reduces environmental and financial costs of disposal, or by receiving furniture from them, thereby saving the need to purchase new pieces.
Food Management	Replacing plastic utensils, such as spoons and forks, with wooden alternatives. Utilizing ceramic tableware in the hospital's cafés instead of disposable items, and offering discounts to staff who use their reusable cups at the hospital cafés.
Green Transport	The use of electric bikes by the "Early Supported Discharge" team for patient home visits, reducing reliance on traditional cars. Minimizing car journeys through a lift-share system and encouraging walking and cycling to work. The hospital also owns two electric cars used for hospital transport services.

Source: Prepared by the researcher, based on: (The Bristol Royal Infirmary (BRI), n.d.)

From the preceding table, it is evident that the green practices adopted by Bristol Hospital serve as a prime example of how sustainability can be achieved in healthcare

institutions through the implementation of innovative and effective environmental solutions. Each of these practices plays a pivotal role in fostering sustainability across the environmental, economic, and social dimensions as outlined below:

- ✓ **Green Building:** The creation of green spaces and therapeutic gardens not only enhances the aesthetic beauty of the hospital but also contributes significantly to the mental and physical well-being of both patients and staff. These practices help alleviate stress and promote relaxation, which positively impacts patient health and bolsters the sustainability of both the community and the environment.

- ✓ **Energy Management:** By optimizing lighting and heating systems, the hospital reduces its energy consumption, which in turn lowers carbon emissions. This effort aids in achieving environmental sustainability by diminishing the hospital's carbon footprint while also curtailing long-term operational costs.

- ✓ **Water Management:** Auditing water stations to ensure the use of municipal water rather than bottled water helps reduce plastic consumption and conserve water resources, thereby lowering plastic waste and improving resource efficiency. This, in turn, contributes to sustainability.

- ✓ **Waste Management:** Through the recycling of plastic waste and the reuse of office furniture, the hospital significantly reduces waste, thereby lessening the environmental impact associated with waste accumulation. These practices also reduce disposal costs, enhancing both economic and environmental sustainability.

- ✓ **Food Management:** Replacing plastic utensils with wooden or ceramic alternatives and offering discounts to staff who use reusable cups promotes a reduction in plastic waste and fosters a culture of sustainability among employees and visitors. This contributes to environmental sustainability while also decreasing the costs associated with single-use materials.

- ✓ **Green Transportation:** By utilizing electric bicycles and vehicles, the hospital reduces carbon emissions from transportation. Encouraging employees to minimize car use through carpooling systems helps reduce pollution and improves the air quality surrounding the hospital, thus furthering environmental sustainability.

Thus, each of these practices significantly contributes to the achievement of environmental, economic, and social sustainability within the hospital.

Conclusion

The study demonstrates that the shift toward green hospitals is not merely an option, but an urgent necessity in today's world. By adopting green practices such as optimizing energy and water consumption, managing waste efficiently, and utilizing environmentally friendly building materials, hospitals can make significant contributions to environmental conservation and enhance public health.

The case study of the Bristol Royal Infirmary reveals that this transformation is not a mere theory but can be successfully implemented in healthcare settings. Through the adoption of simple yet effective initiatives, hospitals can achieve a multitude of benefits, including reduced operational costs, improved air quality and surrounding environment, heightened employee satisfaction, and an enhanced institutional reputation.

However, hospitals face numerous challenges, requiring the collective efforts and collaboration of all stakeholders. It is essential to provide the necessary financial and technological support, as well as encourage the exchange of knowledge and expertise between institutions.

In conclusion, green hospitals represent the future of healthcare. They not only deliver high-quality medical services but also contribute to the creation of healthier and more sustainable communities.

Among the recommendations that can be proposed are the following:

- ✓ Providing workshops and training sessions for hospital staff to educate them on the importance of sustainability and the implementation of green practices.
- ✓ Collaborating with environmental organizations and eco-friendly technology companies to foster innovation and the application of green technologies within hospitals.
- ✓ Encouraging scientific research in the field of green hospitals and health sustainability.
- ✓ Rewarding staff members for their contributions to green initiatives.

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