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Sustainable Healthcare: An Over View

Matthew N. O. Sadiku, Philip O. Adebo, And Janet O. Sadiku
Roy G. Perry College of Engineering
Prairie View A&M University
Prairie View, TX 77446
2Juliana King University
Houston, TX, USA

ABSTRACT

Healthcare systems are supposed to protect and improve public health, but they are also socially and environmentally impactful structures which can cause negative side effects on the people's health. Although healthcare accounts for approximately 10% of global economic output, healthcare systems have a considerable environmental impact. As our climate changes, healthcare systems and healthcare facilities come under mounting pressure. The health outcomes for patients and populations from healthcare systems are weighed against its environmental, social, and financial impacts to determine its overall sustainable value. Sustainability has become an important issue in a rapidly changing healthcare sector. The environment contributes to people's wellbeing, contributing to chronic diseases, such as asthma and cancer, or to acute illnesses like heat exhaustion. As the climate continues to change, risks to health systems and facilities (such hospitals, clinics and community care centers) are increasing, reducing the ability of health professionals to protect people from a range of climate hazards. This paper summarizes the healthcare sector's environmental footprint and the potential for reducing that footprint by applying the principles and tools of sustainability science.

***KEY WORDS*: sustainability, sustainable healthcare, healthcare, environment, laboratory medicine**

INTRODUCTION

Climate change is one of the largest threats to human health and well-being globally. Due to the impacts of climate change, our health and our very existence are under threat. The healthcare industry is a major consumer of natural resources, thereby contributing to the threat to planetary health. Air pollution is associated with 31 adverse health outcomes, including cancer and stroke. The healthcare industry itself is a major contributor to pollution as well as the greenhouse gas (GHG) emissions responsible for global warming and to the impoverishment of the environment. The industry possesses a substantial and growing environmental footprint due to several factors, including global population growth, ageing populations, and the rise of increasingly energy and resource-intensive medical technologies. Each year 39 million people are pushed into poverty because of indebtedness to cover healthcare costs. Healthcare has been estimated to account for 4.4% of global GHG emissions, with large variability between nations. Figure 1 shows the impacts of climate change on human health [1]. The healthcare industry's contribution to global warming is counter to the mission of improving health [2].

HEALTHCARE SYSTEMS

Healthcare systems serve to protect and improve public health. Figure 2 illustrates the various stakeholders and their functions in the healthcare system [3]. As the western world is approaching a pandemic in obesity and stress related illnesses, such as high blood pressure, heart disease, cancer and diabetes, good health is something we take for granted. Healthcare services enrich and prolong people's lives through health promotion and disease prevention and treatment. A successful health system has three attributes: healthy people, superior care, and fairness. It is a system that is fair to the health professionals, institutions, and businesses supporting and delivering care. A sustainable health system also has three key attributes: affordability, acceptability to key constituents, and adaptability. America's health system is neither as successful as it should be nor as sustainable as it must be. Some of the sources of inefficiency in US healthcare include the following [4]:

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- Financial incentives that reward inefficiency (complications or readmissions)
- Dysfunctional competition rather than performance-based competition
- Insufficient involvement of patients in decision making (as in end-of-life care)
- Insufficient attention to prevention, disparities, primary care, health literacy, population health, and long-term results
- Administrative complexity of coping with multiple forms, regimens, and requirements of different insurers
- Regulatory regime that can only retard and not accelerate innovation
- Distortions resulting from fraud, conflict of interest, and a dysfunctional malpractice system

The Commonwealth Fund periodically conducts a systematic comparison of health system performance in Australia, Canada, Germany, the Netherlands, New Zealand, Britain, and the United States. When assessed on the basis of various aspects of performance, including quality, access, efficiency, and equity, the United States came in last overall in 2010. The combination of high cost and relatively poor performance reflects inefficiency in the health system. To achieve a successful and sustainable health system, we must be able and willing to try many different things. We must be willing to adopt many strategies and use them to reach one big goal [4]. Everyone, including hospitals, needs to be a part of the solution and make changes that will help improve the environment.

Healthcare facilities are the frontline in protecting lives – but too often they are vulnerable to extreme weather events and long-term climate change. Health systems include an ensemble of all public and private organizations, institutions and resources mandated to improve, maintain or restore health as well as incorporate disease prevention. Sustainability has become an important issue for the public at large, for governments, and for the healthcare systems. It is related to the well-being of patients, healthcare employees, and the community. Environmentally sustainable health care facilities are those that improve, maintain or restore health, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve. Facilities need to also optimize their use of natural resources, principally that of water and energy, ensuring a balance that is not too low to maintain good functioning, nor too high to waste and deplete resources.

CONCEPT OF SUSTAINABILITY

Sustainability, in one form or another, has been a concern for economists for well over 200 years. The concept of sustainability was originally coined in forestry, where it means never harvesting more than what the forest yields in new growth. The term “sustainability” has become popular in policy-oriented research as an expression of what public policies ought to achieve. The principal inspiration came from the Brundtland Report of 1987. Since then, the concept has shifted in meaning [5]. The meaning of sustainability is constantly evolving in this rapidly changing world.

The “Three Pillars of Sustainability” describes what sustainable development is all about. This tool conveys that sustainability consists of environmental, social, and economic factors that are vital when discussing the topic. The pillars (or dimensions) are explained as follows [6,7]:

- Environmental sustainability symbolizes the importance of things like natural resources and biodiversity to support life on Earth. This seems to be the most obvious pillar. Environmental sustainability is about the natural environment and how it remains productive and resilient to support human life. It occurs when humanity’s rate of consumption does not exceed nature’s rate of replenishment and when humanity’s rate of generating pollution and emitting greenhouse gases does not exceed nature’s rate of restoration. It relies on governmental initiatives to orient production and consumption into less environmentally destructive channels. For example, the effects of climate change provide a convincing argument for the need for environmental sustainability. Environmentally-friendly infrastructure is needed for increased economic output and productivity.
- Social sustainability places importance on social structures, well-being, and harmony; all factors that poverty, wars, and injustices can affect. It encompasses notions of equity, empowerment, accessibility, participation, cultural identity, and institutional stability. This is the ability of a society to uphold universal human rights and meet people's basic needs, such as healthcare, education, and transportation. Social sustainability is not about ensuring that everyone’s needs are met. Rather, it aims at providing enabling conditions for everyone to have the capacity to realize their needs.

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- Economic sustainability implies a system of production that satisfies present consumption levels without compromising future needs. Economics is the study of the allocation of limited resources across unlimited wants. Economies consist of markets where transactions occur. We cannot have it all because there is not enough land, labor or capital (economic resources) to do so. Thus, we must decide what resources are best used to produce what goods [8]. Economic sustainability is the ability of human communities around the world to maintain their independence and have access to the resources required to meet their needs. This is especially important in today's societies, at a time when many sustainable initiatives require financing and a strong economic rationale.

Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations. There is no hard and fast rule towards sustainability; it is a long-term process. Numerous practices are cited as threats to sustainability, such as political corruption, social inequality, the arms race, and profligate government expenditures. Health is central to the 2030 Agenda for Sustainable Development as it relates to many of the Sustainable Development Goals (SDGs) and is the specific focus of Goal 3. The health-related SDGs redefine the three functions of primary health care as: service provision, multisectoral actions, and the empowerment of citizens. Governments have recently reaffirmed their commitment to the SDGs.

WHAT IS SUSTAINABLE HEALTHCARE?

Healthcare professionals and administrators are responsible not only to follow best practices but also to manage environmental and economic impact for the benefit of the larger community. Hospitals, health practitioners, and laboratory community should lead the shift to carbon neutrality and to safer, more creative, and more viable goods and services. They can achieve this by decreasing their environmental footprint and implementing efficient approaches to address the effects of climate change and pollution without compromising the quality of healthcare.

Sustainability and healthcare are intricately related since the quality of our environment affects public health. From a clinical perspective, considering sustainability means allocating resources appropriately (both human and material) and considering the health and wellbeing of staff. In addition to the traditional pillars of sustainability (social, environmental and economic), we have systems sustainability in the context of healthcare as the fourth pillar, as shown in Figure 3 [9]. The healthcare system is regarded as a four-level framework: the patient, the care providers and staff, the organization, and the operations. Healthcare systems can be described as all the activities whose primary purpose is to promote, restore and maintain health. Figure 4 shows the sustainable healthcare system [10]. Healthcare systems need to address some key factors in order to develop towards sustainability. They can only be considered sustainable where all three elements (also termed "People, Planet and Profits") intersect and are upheld. In a sustainable healthcare system, the ecological environment must be recognized and addressed as a crucial factor.

Healthcare is a significant contributor to climate change and environmental degradation. The World Health Organization (WHO) has described climate change as the biggest health threat facing humanity, highlighting that those in low-income and disadvantaged communities are being affected first and hit the hardest . WHO defines an environmentally sustainable health care system "as a health system that improves, maintains or restores health, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, to the benefit of the health and well-being of current and future generations" [11]. Sustainable healthcare is about understanding that our health and that of our environment around us are intrinsically linked. It refers to a system that meets the health needs of the present, without compromising the health of future generations. An environmentally sustainable health system is one that improves, maintains or restores health, while minimizing negative impacts on the environment.

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SUSTAINABLE HEALTHCARE PRINCIPLES

In practice, sustainable healthcare is underpinned by three core principles [12]:

1. Sustainable prevention: Keeping people as healthy as possible for as long as possible – and empowering them to take an active role in their health and wellbeing – reduces the risk of them becoming unwell
2. Sustainable pathways: When access to healthcare services is required, getting people to the right service at the right time and making healthcare pathways more efficient and joined-up can reduce healthcare's environmental footprint through reductions in patient travel.
3. Sustainable practice: When care or treatment is being delivered to patients, it is vital that the carbon footprint and wider environmental impacts of are kept to a minimum. Minimizing the environmental impact of care must not compromise the health outcomes or quality of care.

Sustainable health is a personal commitment to maintaining and taking responsibility for your own health, through preventative means. This implies having regular exercise, taking care of what we eat, and maintaining a healthy and balanced state of mind. Sustainable health is leading and maintaining a balanced life, by taking a "middle road" approach. Not too little, not too much is the key. The 10 principles of sustainable health [13]:

1. Maintain a balanced life, (middle road approach)
2. Have a healthy diet
3. Exercise regularly
4. Sleep well
5. Maintain a regular rhythm in life
6. Take preventative natural medicines to maintain health
7. Engage in spiritual practices manifested through meditation, mind training, and raising personal consciousness
8. Learn to live and laugh more
9. Build discipline in our selves through mind training and raising awareness
10. Take a simpler approach to life

The avenues for action for fostering environmental sustainability in health systems are the following [14]:

- adopting a national environmental sustainability policy for health systems
- minimizing and adequately managing waste and hazardous chemicals
- promoting an efficient management of resources
- promoting sustainable procurement
- reducing health systems' emissions of greenhouse gases and air pollution
- prioritizing disease prevention, health promotion and public health services
- engaging the health workforce as an agent of sustainability
- increasing community resilience and promoting local assets
- creating incentives for change
- promoting innovative models of care

Sustainable principles can be used to improve the quality of healthcare systems around the world.

APPLICATIONS OF SUSTAINABLE BUSINESS

Healthcare systems around the world are undergoing major changes in public policies to offer a better health service to their population. In healthcare, sustainability refers to the integration of environmental stewardship, social equity, and fiduciary responsibility to support healthy, equitable, and resilient environments. The following are some of the applications of sustainable healthcare [15]:

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- Sustainable Hospitals*:* Within the healthcare sector, hospitals account for the majority of CO2e emissions and there has been considerable research on improving sustainability outcomes for them. There is momentum for hospitals to reduce their ecological footprint and to decarbonize. Corporate sustainability is an important way to make hospitals more sustainable and competitive. The main objective for building sustainable healthcare facilities is [16]: (a) to enhance their capacity to protect and improve the health of their target communities in an unstable and changing climate; and (b) to empower them to optimize the use of resources and minimize the release of pollutants and waste into the environment. America's hospitals are working together to become more sustainable by adopting environmental, social, and economic practices. The sustainability of hospitals is crucial to promoting human well-being and health. Hospital buildings and laboratories can use renewable energy sources, including wind, solar photovoltaics, and solar thermal energy. Operating rooms are 3–6 times more energy intensive than the rest of the hospital. Renewable power sources should become the main sources of energy. An operating room can save thousands annually through sustainable procurement. Figure 5 shows the potential cost savings from sustainable procurement in hospitals (practice green health) [17]. The medical facility shown in Figure 6 is located in Saint Vincentt in the Caribbean, installed a renewable energy system to improve its access to reliable energy [18].
- Sustainable Laboratories*:* There is a relationship between laboratory strategies and sustainability. Sustainable thinking has already been introduced in the medical laboratory community. Sustainability could be applied to reduce the environmental impact of clinical laboratories by ensuring that resources are used efficiently and responsibly. Laboratory medicine can contribute to a sustainable healthcare system through integration of innovation and emerging technologies while providing high-quality services to patients and caregivers. Clinical laboratories can establish sustainable development goals and reduce their environmental impact. They use far more energy and water than a typical office building. Thus, there is a need to adopt good environmental practices in clinical laboratories. Emerging technologies in clinical laboratories (such as telemedicine, e-health, and mobile health) can play a role in disease prevention and thus healthcare sustainability.
- Sustainable Waste Management*:* An important issue to be tackled regarding sustainability in the healthcare sector is the management of waste disposal and air pollution. Medical waste can be classified as hazardous or non-hazardous (general) waste. Hazardous medical waste is 15% of all medical waste generated and can cause diseases and environmental hazards. Medical waste problems are due to lack of awareness and willingness on the part of healthcare employees and ambiguous policies and laws about proper management of medical waste. With the increasing concerns regarding contagious and infectious diseases, due to climate change as well as resistance to medications and treatments, the effective management of medical waste has become a strategic priority for healthcare providers [19]. Improper healthcare waste management can occur for several reasons, such as lack of awareness about the health hazards related to health care waste, inadequate training in proper waste management, lack of infrastructure or energy, and lack of appropriate regulations or enforcement of existing regulations. Medical waste has become one of the top pollutant sources worldwide and is a major factor affecting disease spread and air, water, and soil quality in and around healthcare structures. Sustainable practices in healthcare waste disposal should be implemented. Holding of meetings, seminars, conferences, and other events virtually can also help reduce carbon emissions and footprints to a great extent. Healthcare institutions generally use disposable products to minimize infection while treating patients. Figure 7 shows medical waste disposal [20].
- Green Surgery*:* Operating theatres contribute towards carbon emissions as significant users of medical equipment and supplies. The surgical community recognized the value of sustainable healthcare for surgical conditions: to share and promote ways of practicing that are less harmful to the environment and to continue to transform surgery for the future. Within surgical services there are opportunities for ensuring lean surgical pathways, including identifying and avoiding unnecessary procedures or unused single-use items in surgery. The green or sustainable surgery challenge in UK is illustrated in Figure 8 [21].

Other areas of application of sustainable healthcare include sustainable dentistry, sustainable anesthetic, medical transportation, sustainable workplace, pharmacology, psychology, ambulances, and burials.

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BENEFITS

Great strides have been made in improving people's health in recent years. Climate change is the biggest global health threat of the 21st century. Sustainability in healthcare is based on a simple principle: Everything that humans need for their survival and well-being depends on the natural environment. There is growing motivation among the health-care community to reduce the negative environmental impact of health care. Digital technology routinely may bring broader societal and environmental benefits, that if not embedded may lead to unnecessary risk to all. The Race to Zero initiative has also seen health-care systems across 18 countries, including state-level systems within the US, commit to reducing emissions. The UK's National Health Service (NHS) was the first health-care system to commit to reaching net zero carbon emissions. The NHS and Public Health England lead the world in sustainable health care. Healthcare without Harm is a nongovernmental organization (NGO) that aims to reduce the environmental impact of healthcare around the world. It seeks to transform global healthcare so that the sector reduces its environmental footprint and becomes a leader in the global movement for environmental health and justice.

CHALLEGES

Good health for all in our time requires handling of a number of challenges: demographic changes, empowerment of citizens, changing illness patterns, traumatic events and organizational coordination. The societal challenges evolving from global health are complex and require commitment and engagement from multiple perspectives [22]. Sustainable healthcare continues to attract controversy around the world. Inequalities continue to be a fundamental challenge for universal health coverage, which aims to ensure that everyone can access quality health services without facing financial hardship. The management of test ordering to monitor chronic diseases in primary care can also improve overall healthcare quality and reduce cost. Other challenges include [1,17,23]:

- Awareness*:* A lack of awareness about sustainability among clinical laboratory employees is currently one of the most commonly barriers for sustainability in healthcare. Being environmentally aware and accountable is something that is increasingly being demanded by our society. National and international scientific societies have a fundamental role to play in reducing this awareness gap by providing educational materials and conducting continuing education sessions. This should increase awareness about sustainability in healthcare from a holistic point of view.

- Unnecessary Tests*:* A revision of the existing laboratory test ordering policy and avoidance of unnecessary laboratory tests would strongly contribute to healthcare sustainability. It is important to have optimization and standardization of blood test ordering for monitoring chronic conditions.

- Energy: Energy use in clinics can be reduced through energy efficiency measures and behavior change. Examples of behavior changes include turning off computer monitors overnight, turning off lights and machines when not needed, using low-power lighting, and agreeing to run air-conditioning/heating as needed. For clinics that are not within a larger complex, installing solar on the roof will decrease electricity used.

- Water*:* Much of the health care delivery in developing countries still takes place in settings with inadequate or non-existent municipal water supply or water and wastewater treatment facilities. In many nations, it is mandatory to reduce biological loading, and then treat the water in a municipal system. However, this is not always possible in rural areas where no service is available or in cities where the municipality requires on-site treatment.

- Healthcare Waste*:* Over half of the world's population is estimated to be at risk from environmental, occupational or public health threats resulting from improperly treated health care waste. Reducing waste from a healthcare setting has been shown to be one of the more effective measures a facility can take to help decarbonize. Reduction and efficient management of medical waste ensures healthcare hygiene and safety of employees and communities, and controls pollution through reduction or prevention of harmful emissions. As climate change, air pollution, plastic waste, and medical waste threaten human health and environmental sustainability.

- Chemicals*:* An estimated 1.6 million lives were lost in 2016 due to exposure to selected chemicals. Chemicals are used for unique purposes, such as in chemotherapy to treat cancer, or as disinfectants for cleaning and sterilization. In addition, many medical devices such as thermometers, which contain mercury, are still in use

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- Radiation*:* Direct patient exposure to ionizing radiation during medical procedures constitutes the largest anthropogenic source of population radiation exposure overall. The majority of healthcare emissions relate to the healthcare supply chain, including the production, transport, and disposal of goods.

- Air quality*:* Healthcare contributes to air pollution and greenhouse gases (GHGs) through energy consumption (transport, electricity, heating, and cooling) as well as product manufacture, use, and disposal. Ambient air pollution, which is principally driven by fossil fuel combustion, kills an estimated 4.2 million people annually. Its health impacts, which include damage to the heart, lungs, and every other vital organ, are exacerbated by climate change.

- Food*:* Climate threats to health systems are particularly disruptive for individuals and communities when they affect health care facilities (HCFs). Iin many nations, HCFs are major consumers of food and can therefore model and promote health and sustainability through their food choices. An HCF can reduce its GHGs and become more resilient to electricity grid disruptions and unreliability.

- Leadership*:* A health system that is socially, environmentally, and financially sustainable requires clinical leadership. Few healthcare workers possess the practical skills for creating new models of care. Practical skills for the transition to environmentally sustainable health care are not commonly known by or taught to healthcare professionals. Educating and training the healthcare workforce has been identified as a key priority for the transition to environmentally sustainable healthcare. There is a concern that medical educators may not be sufficiently informed to teach students well about sustainable healthcare.

- Healthcare Facilities*:* These provide an interesting challenge, as they often include specific design constraints that are highly regulated and materially intensive. Reduction of the embodied carbon of building materials is a major focus to decarbonize the built environment. In new clinical infrastructure, the baseline goal is net-zero energy or net negative emissions. Increasing the longevity and life span of the healthcare facilities would reduce the need for future construction. In the US, the Energy Star program provides accounting tools for estimating energy use of individual healthcare facilities.

- Decarbonization Cost*:* Another challenge to reducing carbon emissions in the healthcare sector is the lack of information on the cost of carbon emissions and the cost of decarbonization interventions. Such science-based knowledge is critical input in cost-benefit analyses in designing decarbonization strategies. The social cost of carbon is largely uncertain. Tracking the cost of decarbonization techniques is a prerequisite for allocating limited healthcare resources.

CONCLUSION

As healthcare systems face enormous challenges, sustainability is regarded as a crucial requirement for making them fit for the future. The healthcare industry has begun to embrace a sustainability mindset as the linkage between greener operations, improved health care, and lower operating costs is becoming more apparent. Sustainable healthcare is regarded as healthcare services of better quality, more affordable, with less impact on the planet, and that can be accessed by people equally and efficiently. It should be able to avoid unnecessary treatment and inadequate use of resources. To pursue sustainability is to create and maintain the conditions under which humans and nature can coexist in productive harmony. The most cost-effective way to achieve sustainable health care is to keep people healthy.
Sustainable healthcare in medical education remains a relatively novel concept. It is now a General Medical Council requirement to incorporate education for sustainable healthcare into medical curricula, emphasizing the need to close the gap between educational rhetoric and action [24]. Since quality improvement is an increasingly feature in health professions education, this presents a ripe opportunity for integrating sustainability into the curriculum in a meaningful and practical way.
Although there has been some progress on improving global health in recent years, there is a long way to go for environment-friendly hospitals, healthcare systems, and clinical laboratories to become the norm. Sustainability practices should be an essential element of healthcare's strategic business plans. For more information on sustainable business, one should consult books in [25-40] and the following related journals:

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- Sustainability
- Sustainable Hospitals
- Sustainability Analytics and Modeling
- Future Healthcare Journal.

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ABOUT THE AUTHORS

Matthew N. O. Sadiku is a professor emeritus in the Department of Electrical and Computer Engineering at Prairie View A&M University, Prairie View, Texas. He is the author of several books and papers. His areas of research interests include computational electromagnetics, computer networks, and marriage counseling. He is a fellow of IEEE.

Philip O. Adebo is an Adjunct Professor at Texas Southern University. He completed his PhD in Electrical and Computer Engineering Department, Prairie View A&M University with emphasis on power systems. His research interests include power systems, renewable energy, microgrids, smart-grid systems, restructuring power system, and optimization of power systems.

Janet O. Sadiku holds Bachelor degree in Nursing Science in 1980 at the University of Ife, now known as Obafemi Awolowo University, Nigeria and Master's degree from Juliana King University, Houston, TX in December 2022. She has worked as a nurse, educator, and church minister in Nigeria, United Kingdom, Canada, and United States. She is a co-author of some papers and books.

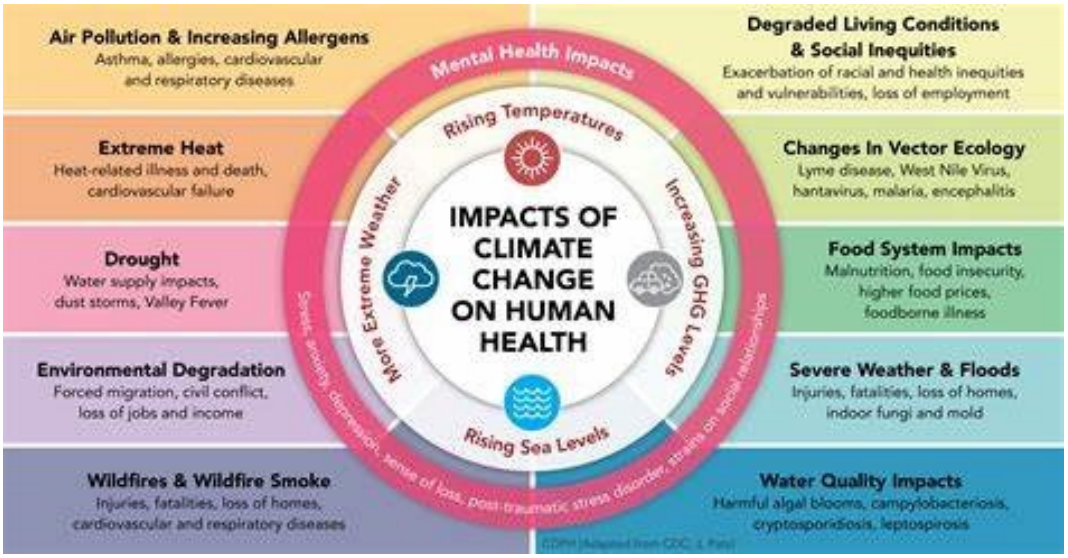

Figure 1 Impacts of climate change on human health [1].

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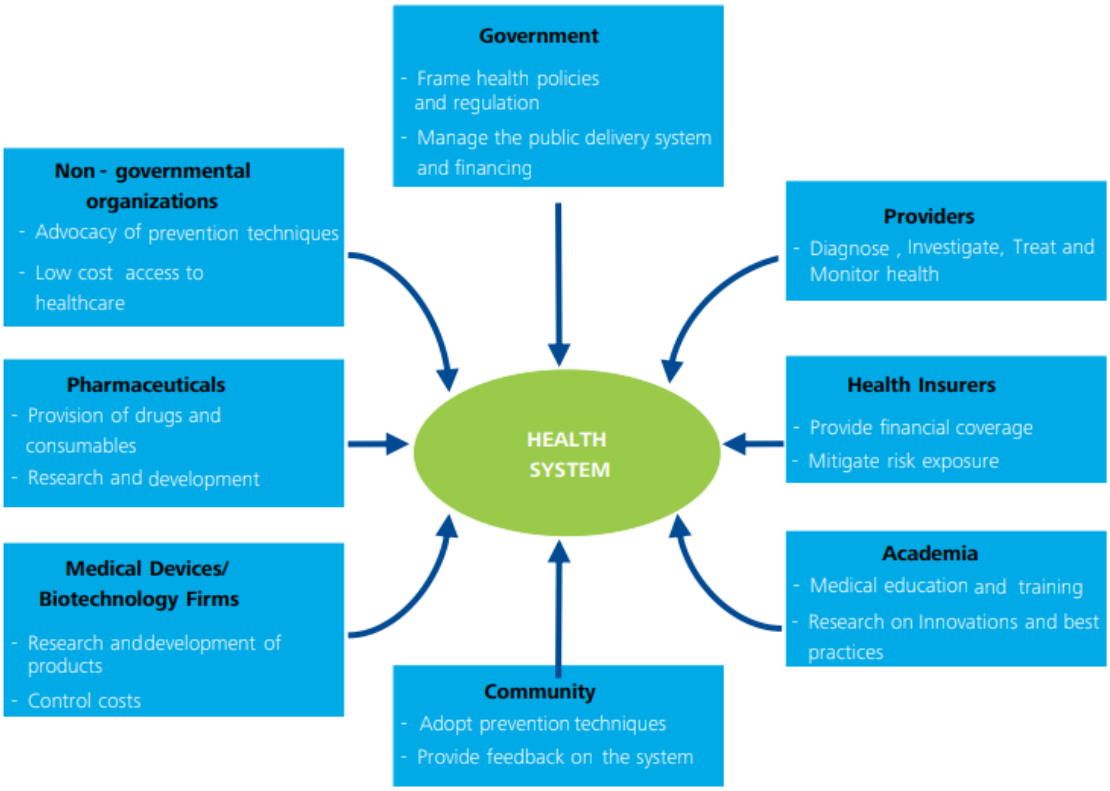

Figure 2 The various stakeholders and their functions in the healthcare system [3].

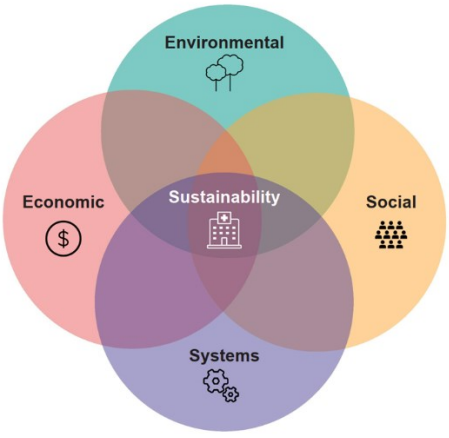

Figure 3 Four pillars of sustainability [9].

Figure 4 Sustainable healthcare system [10].

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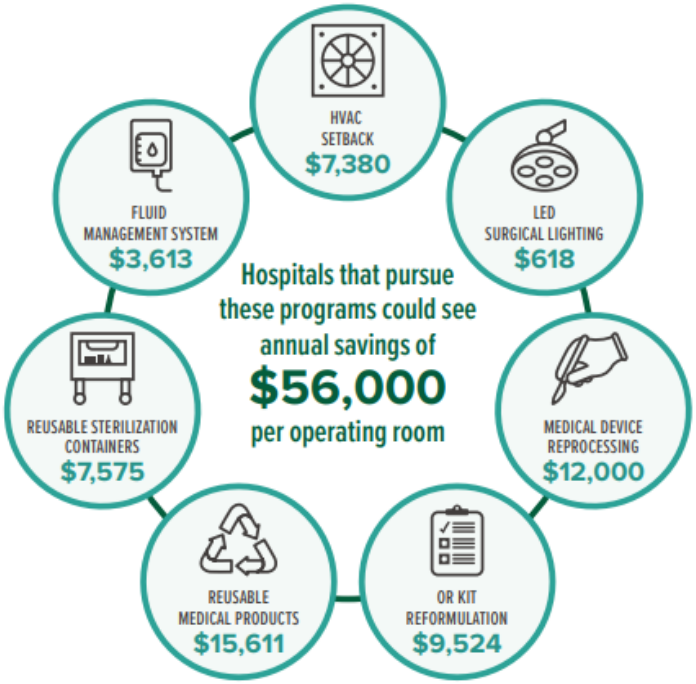

Figure 5 Potential cost savings from sustainable procurement in hospitals [17].

Figure 6 A medical facility uses a renewable energy [18].

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Figure 7 Medical waste [20].

Figure 8 The Green surgery challenge in UK [21].