

Decarbonising the Healthcare Sector: A Critical Review

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Summary:

It is an undeniable fact that the healthcare sector is vulnerable to climate change, but at the same time it is also a significant contributor. As a result of decarbonisation of the healthcare sector, the terms ‘climate change, net-zero carbon emission,’ and ‘renewable energy’ are used more frequently and often interchangeably. The research has noted that there is limited review available on the challenges the healthcare sector face in its effort to decarbonise. This implies that there have not been successful decarbonisation undertakings by many healthcare organisations. Therefore, in order to identify the challenges, the healthcare sector face in its effort to decarbonise, the healthcare sector must take aggressive step towards decarbonisation. The novelty of this paper is stem from its synergistic combination of large-scale literature review analysis and systematic expert elicitation to meticulously examine the decarbonisation of the healthcare sector through a macro lens. The healthcare sector is known to have high energy consumption, due to complex building functions, continuous hours of operation, and high density of electrical equipment for diagnosis and treatment. After an attempt has been made to decarbonise the healthcare sector, the study has identified some challenges the healthcare could face in its attempt to decarbonise.

Keyword: Climate change, healthcare sector, decarbonisation, AI and renewable energy.

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Track 30: Sustainable and responsible business

Introduction

Historically, with a primary focus on human health, the healthcare sector has been less focused on environmental health, including its own substantial and rapidly increasing environmental footprint (Karlner et al. 2019). The World Health Organization (WHO) considers global warming to be the single biggest health threat facing humanity (Climate change and health, 2023). The Intergovernmental Panel on Climate Change (IPCC) states that the scientific evidence is unequivocal: Any delay in global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all (Portner et al. 2022). All IPCC modelled pathways that limit global warming to 1.5 °C, involve rapid, deep, and in most cases immediate, greenhouse gas emission reductions in all sectors (Shukla et al. 2022). Climate change involves heightened temperatures across numerous worlds (Schuurmans, 2021). The Intergovernmental Panel on Climate Change (IPCC) forecasts a 2 °C temperature increase by 2050 without immediate mitigation, and urges governments to alter or enhance their climate change (CC) strategies, a challenge observed at various Conferences of the Parties (COPs) (IPCC, 2021). Climate change is an inter-governmental complex challenge globally with its influence over various components of the ecological,

environmental, socio-political, and socio-economic disciplines (Leal Filho et al. 2021; Feliciano et al. 2022).

It is not plausible to interpret the exact consequences of climate change on a sectoral basis (Izaguirre et al. 2021). The irregular weather patterns, retreating of global ice sheets, and the corresponding elevated sea level rise are among the most renowned international and domestic effects of climate change (Michel et al. 2021; Murshed and Dao 2020). Approximately 60,000 people globally died from natural disasters each year on average over the past decade (Wiranata and Simbolon 2021). But shock events have a devastating impact: the 1983–1985 famine and drought in Ethiopia; the 2004 Indian Ocean earthquake and tsunami; Cyclone Nargis, which struck Myanmar in 2008; and the 2010 Port-au-Prince earthquake in Haiti and now recent example is COVID-19 pandemic (Erman et al. 2021). These events pushed global disaster deaths to over 200,000 more than 0.4% of deaths in these years.

Potentially, climate change threatens to disrupt health systems' ability to deliver high-quality care and undermine the past 50 years of gains in public health, with more intense heatwaves, higher risks of flooding and damaging storms, and a changing pattern of emerging infectious diseases (Watts et al. 2019). For instance, in France the healthcare is responsible for nearly 8 % of national GHG emissions (The Shift Project, 2021). The NHS generates 18% of all emissions deriving from the UK non-domestic buildings (NHS, 2020). Whereas the US healthcare sector's contribution to GHG is the highest in the world, being responsible for about a quarter of all global healthcare GHG emissions and 8.5% of all US emissions (Eckelman et al. 2020). This is the reason why global greenhouse gas emissions from the healthcare system is responsible for some 4–5% greenhouse gas emissions, the health-care sector has a vital role to play in climate change mitigation efforts, which will not only result in substantial reductions in emissions, but can often lead to enhanced patient care, staff satisfaction, and cost savings (Karliner et al. 2020).

Romanello et al. (2022) has noted that the healthcare sector is a significant contributor to greenhouse gas (GHG) emissions, contributing 5% of worldwide GHG emissions. In 2019, the National Health Service (NHS) in England was estimated to contribute 25 mega tons (Mt) of CO₂e to the environment (Tennison et al. 2021). Medicines and chemicals were found to attribute 20% to this total, with a further 10% due to medical equipment (Greener NHS, 2020). The shift in narrative of healthcare sector role in addressing climate change was largely amplified after a 2018 study found that 4.4% of total global greenhouse gas emissions (GHGs) were derived from the healthcare sector (Eckelman et al. 2018).

Methodology

The research has presented quality and quantity of evidence on ways in which healthcare systems contribute to climate change and the approaches, models, and systems that can be used to decarbonise healthcare systems. The research has conducted review with a subsequent thematic and descriptive analysis based on best practice guidelines from the Joanna Briggs Institute (JBI) (Aromataris and Munn, 2020) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al. 2021). A systematic literature review yields several benefits, including comprehensive coverage of relevant literature, identification of knowledge gaps and recommendations for future research to assist in evidence-based decision-making (Aromataris and Munn, 2020). The methodology has been designed to enhance transparency and reproducibility to generate credibility of the findings and to minimise bias since the search is conducted in a standardised manner based on pre-defined criteria to

meet the unit of study aims and objectives: Decarbonisation of the healthcare system a renewable energy strategy.

Study findings

Decarbonisation is refers to the actions humans undertake to cut back greenhouse gas emissions from human activities, this is crucial for mitigating climate change and protecting planetary health (Mirow et al. 2024). Decarbonization represents a broad array of activities that institutions can participate in to reduce their GHG emissions and mitigate their contributions to climate change (Dzau et al. 2021). The healthcare sector has a critical role to play, both in promoting awareness of the inextricable links between human and environmental health, and by reducing its own environmental impacts (Karliner et al. 2019).

The first step to be taken in the process of decarbonisation of the healthcare sector, noted by this study will be the importance of the involvement of health care professionals. Like the saying goes, charity begins at home. Similarly, Lindholm et al. (2023) noted that raising the voice of health professionals has been identified as paramount to achieving the wide-scale and urgent response required to limit the consequences of climate change for health. For instance, anesthetic practitioners can play a pivotal role in the transition to climate resilient and low-carbon health care. As front-line health professionals they may witness the acute health effects of climate change worldwide, anesthetic practitioners also make day-to-day decisions with considerable implications for healthcare sector emissions (Pradere et al. 2022).

Sustainable Development Unit of the National Health Service (NHS) in the UK estimated that 5% of the CO₂ from acute health organizations is attributable to anesthetic gasses (Campbell and Pierce, 2014). Drug waste and urinary excretion of drugs and metabolites causes pollution in soil and ground water (Shelton et al. 2022). Finally, anesthetic and surgical procedures and their associated single-use equipment lead to substantial amounts of waste (Wyssusek et al. 2019). In the UK, it was estimated that each operating theatre on average left behind 2300 kg of waste annually, and that only 10% of this was recycled (Campbell and Pierce, 2014). Previous studies among anaesthesiologists indicate a lack of sustainable practice and a large potential for improvement (McGain et al. 2020). Encouragingly, health professionals in a multinational survey believe that continuing professional education on climate change and health, as well as patient education materials and specific training to communicate effectively about this issue, would be useful to their practice (Kotcher et al. 2021).

A number of environmentally responsible nursing practices have been reported in the literature such as shutting down computers when not in use, placing used items in appropriate bins, shared transport services, tele-conferencing to replace staff meetings (Barracough et al. 2020), editing files electronically rather than printing, and using waste paper to print a draft (Norton et al. 2017). Reduction of waste during care and asking leaders to help create a less polluted environment are also seen as sustainable practices (Schenk et al. 2021). For instance, in a study from China, not using disposable supplies, garbage classification, waste recycling, and green travel, which have positive effects on the planet were reported as sustainable practices among nurses (Li M et al. 2021).

The healthcare system is complex, and any decarbonisation strategies must ensure a systems approach in other to have meaningful impact. For this reason many healthcare sector has taken initiatives to prepare for such disasters through implementing carbon emission reduction practices and infrastructure reinforcement, through globally recognized frameworks and

strategies known as Scopes 1, 2, and 3, and decarbonization. Generally, decarbonisation of the health system entails three emissions scopes which involves:

- Scope 1 emissions such as on-site fuel combustion, fleet vehicles and anaesthetic gas leaks fall under the direct control of the healthcare system.
- Scope 2 emissions can be derive from electricity purchased by the healthcare system
- Scope 3 emissions includes carbon that are contained in purchased supplies and equipment. This also include employee commute and waste disposal.

Scope 1 emissions can be decarbonise by using clean energy such as; electric vehicle and renewable energy or hybrid renewable energy. On the energy sector, renewable energy innovations are reshaping how we can decarbonise the healthcare system. Solar panels efficiency has significantly improve. This implies that they can capture more sunlight and convert it into energy for longer periods. Whereas, offshore wind turbines can harness the powerful ocean winds, this will contribute to more steady and reliable energy capture.

Solar Photovoltaic (PV) electricity holds advantage over other energy technologies. This is because Solar Photovoltaic electricity produces direct current (DC). For example, digital devices such as cameras, phones and computers ultimately use low voltage DC (LVDC) power and not AC, therefore, in a contemporary house or building AC power is passed through a transformer rectifier combination to convert AC to DC power. Whereas, the PV generated electricity can be used to directly power digital devices at a reduce cost. One potential usage of solar PV could be to power these devices and data servers throughout the NHS system. Wave energy technology is slowly coming to the forefront by promising a new wave of clean energy. Adopting a hybrid renewable energy will lead to significant reductions in the carbon footprint of the healthcare sector. A hybrid renewable energy system (HRES) can be defined as an energy system with more than one source and at least one renewable generator (Sinha and Chandel, 2014).

Hybrid renewable energy can be grid-connected or stand-alone. The impact will be clear, lowering greenhouse gas coming from the healthcare system. However, most importantly, from a technical perspective, steps towards decarbonising the healthcare sector begins with identifying and then quantifying the sources of CO₂ emissions, known as the carbon footprint and of other GHG emissions. This requires defining system boundaries, which encompass the production and transport of medical supplies, patient and staff transportation, energy use in medical facilities, the investment portfolios of health care organisations, and more (BMJ, 2020).

The paper has noted that over 70% of healthcare emissions arises from diverse categories in scope 3, and with a very few health sector report. The research has noted that significant amount of the NHS carbon emissions are coming from staff commute 40%, patient travel 50% and visitor travel 10%. The healthcare sector can decarbonise this sector by adopting electric vehicles for its ambulances and staff commute where it can have direct control. The advancements in battery technology, particularly the development of solid-state batteries, have made this technology a formidable force to reckon with. These batteries can offer a longer range, quicker charging, and more durability, making electric vehicles more practical and affordable. With the healthcare system adopting more EVs on the road, the healthcare system can reduced air pollution, leading to cleaner, healthier living environments.

Another technology that the healthcare system can deploy to aide it decarbonisation is artificial intelligence. Artificial intelligence can be a powerful tool in the field of climate modelling.

With its massive datasets, AI can aid renewable energy by predicting weather patterns, sea-level rises, and the impacts on ecosystems with a degree of accuracy. AI has a super-brain with the ability to process vast amounts of data in seconds, transforming complex climate phenomena into understandable predictions. This technology can help scientists, governments, and policymakers with the insights needed for better decision-making. Finally, the healthcare sector can decarbonise Scope 3 emissions by Carbon Capture and Storage (CCS) technology. This technology is aimed at mitigating the effects of industrial pollution. This technology includes a giant vacuum cleaner that can capture the carbon dioxide coming out from factories and store it underground instead of letting it escape into the atmosphere. By storing captured carbon dioxide in geological formations, the emissions coming from the healthcare system are significantly reduced, contributing to the global fight against climate change.

Conclusion and recommendation

There has been a general consensus that climate change has a drastic impact on the healthcare sector. In the face of climate change, the healthcare sector stakeholders together with help from the government must tackle both the increasing consequences for health and also to reduce its own carbon footprint, which is estimated at 4.4% of global emissions. Modern healthcare system activities can generate environmental disruptions, including climate change which can potentially affect public health. Decarbonisation of the healthcare sector is needed to meet the rising demand for health services related to the climate crisis. However, this paradox can be solved with aggressive decarbonisation strategies and with these recommendations presented in this study. The research has noted that there are limited reviews available on the challenges the healthcare system face in its effort to decarbonise. This implies that there has not been successful decarbonisation undertakings by many healthcare systems. Therefore, in order to identify the challenges the healthcare system will face in its effort to decarbonise, the healthcare system must take aggressive steps towards decarbonisation. The research has noted and will recommend that AI should not be considered as a tool to decarbonise the healthcare system.

The study has noted that AI can assist the process of decarbonisation of the healthcare system if integrated well. It is imperative to note that the deployment of AI in the process of decarbonising the healthcare system needs further study. Taking into consideration the size and scope of the NHS trust, especially its complexity, the study will recommend a systematic approach towards decarbonising the NHS. This implies that the NHS must be able to identify and then quantify the sources of CO₂ emissions from each trust and systematically take steps towards decarbonising them. The study will further recommend that the process of decarbonisation of the healthcare system must be academic. However, the involvement of the government must not be underestimated. Therefore, the government involvement in making policies and providing the necessary funds will be highly needed.

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