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Research article

Towards a net-zero healthcare system in Kenya: Stakeholder perspectives on opportunities, challenges and priorities

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ABSTRACT

Introduction: Kenya's healthcare system committed to achieving net-zero greenhouse gas emissions by 2030 as part of the UNFCCC COP26 Health Program. To turn these ambitious commitments into outcomes and share learnings with other nations, a comprehensive assessment of the perspectives of key stakeholders likely to be involved in implementing the transition of the healthcare system is needed.

Methods: This study employs qualitative methods, including 21 semi-structured interviews with key stakeholders and a Delphi consensus process, to explore stakeholder perspectives on Kenya's journey to a net-zero healthcare system.

Results: Stakeholders identified and validated 14 process components crucial for this transformation, ranging from leadership and financing to behavioral change and monitoring. Critical barriers, such as infrastructure limitations, competing health priorities, financial constraints, and gaps in strategy coordination, were highlighted. Stakeholders ranked three interventions as the highest priority: implementing clean energy solutions in healthcare facilities, developing national sustainable healthcare policies that are informed by existing evidence on climate benefits, and generating localized data to guide actionable policies. Ranking interventions based on feasibility, however, produced different results that favored simpler, more immediately actionable measures like hospital vegetable gardens and the creation of guidelines for health facilities.

Conclusion: While the transition to net-zero poses challenges, stakeholders expressed optimism about the potential of current strong leadership, strategic partnerships, and the growing momentum for action on climate change and health. This research provides actionable insights and recommendations to guide Kenya's transition to a sustainable, resilient healthcare system, while offering valuable lessons for other countries facing similar challenges.

1. Introduction

Climate change poses a critical challenge to healthcare systems worldwide. Healthcare systems themselves account for approximately 5% of global greenhouse gas (GHG) emissions [1], requiring a dual approach of mitigation and adaptation to safeguard health outcomes. In Low- and Middle-Income Countries (LMICs), the burden of climate change intersects with existing systemic health vulnerabilities, such as inadequate healthcare infrastructure, limited access to essential medicines, and shortages of health workforce, driving an urgent need for resilient, strengthened and expanded healthcare infrastructures that can operate sustainably [2].

Kenya, a lower-middle-income country with a growing population of approximately 56 million, is characterized by a diverse healthcare system encompassing public (47% of facilities) and non-state actors such as private (46% of facilities), faith-based and non-governmental organization (NGO)-operated facilities (8% combined) [3,4]. The country faces diverse healthcare challenges, including a low doctor-to-patient ratio estimated at approximately one doctor per 5,000 inhabitants and an annual healthcare expenditure of 95 USD per capita in 2021, compared to Canada which holds the highest Universal Health Coverage Index at 12 doctors per 5,000 inhabitants and an

annual health expenditure of around 6,500 USD per capita [5–10]. These factors contribute to significant disparities in healthcare quality and accessibility across different regions and facility types. Kenya has committed to establishing a net-zero emissions healthcare system by 2030 as part of the UNFCCC COP26 Health Program in 2021 [11]. The pledge sits within a broader climate policy framework for Kenya including the National Climate Change Response Strategy (2010), the National Climate Change Action Plan (2013, 2023) which recognizes health as a key sector, a National Adaptation Plan (2016), the Climate Change Act (2016), Kenya's Nationally Determined Contribution (NDC) to the UNFCCC (2020), and Kenya's amended Long-Term Low-Emission Development Strategy with the goal of a net-zero emissions future by 2050 (2023), which collectively underscore Kenya's commitment to climate action [12–17].

The establishment of the Climate Change and Health Strategic Working Group by the Kenyan Ministry of Health in 2017 marked a pivotal moment, bolstering Kenya's progress towards a comprehensive health system approach to climate action. Subsequent years have seen significant progress, such as the execution of the first Health, Environment & Climate Change Conference by the Kenya Medical Research Institute in 2019 and the incorporation of environmental health into the COVID-19 response in 2020 [18,19]. Kenya's ambitious target is supported by high-level engagements with international partners, including the World Bank, the Aga Khan Development Network and the World Health Organization. Beyond potential benefits of improving provision of healthcare, the implications of Kenya's transition toward a net-zero healthcare system could potentially extend beyond national borders, offering valuable lessons for similar LMICs facing parallel challenges. Successes in this area could unlock further international support and funding, while also providing global inspiration to adopt innovative approaches to sustainable healthcare. This study setting, therefore, provides a critical backdrop for understanding the dynamics of integrating climate action nationally with healthcare planning and execution in a complex, multi-layered health system environment.

This study critically analysed the progress and prospects of Kenya's commitment to a net-zero, resilient healthcare system. Adopting a health policy and systems research approach, the study used qualitative methods, including in-depth interviews and a Delphi consensus process with workshop, to gather diverse stakeholder perspectives. We examined the integration of interventions within Kenya's healthcare system, focusing on the design, implementation, and evaluation of interventions. The study also assessed key barriers and identifies facilitators of the process. Finally, we provided actionable recommendations aimed at informing both national policy and practical steps for advancing Kenya's transition to a sustainable, resilient healthcare system.

2. Material and methods

This study explored synergies, co-benefits, conflicts, and trade-offs between climate adaptation and mitigation actions to operationalize the net-zero health system commitment of Kenya [11]. We employed semi-structured interviews and a Delphi consensus process to gather diverse stakeholder perspectives on healthcare system mitigation strategies.

Participants were purposively sampled based on Robinson's guide to ensure theoretical saturation and diverse representation across Kenya's healthcare system [20]. Stakeholders were selected through expert consultations and a mapping exercise of key actors, targeting individuals aged 18 and above with significant roles or influence in healthcare sustainability and climate change mitigation. Stakeholder groups included representatives from government, academia, development agencies, healthcare providers, and supply chain managers.

Table 1
Participant numbers and their respective affiliation and gender.

Participant number	Affiliation	Gender
01	Academia	Man
02	Academia	Man
03	Building design	Man
04	Building design	Man
05	County government representative	Man
06	Development agency	Woman
07	Development agency	Woman
08	Environmental researcher	Man
09	Faith based health services	Man
10	Health workforce	Woman
11	Health workforce	Woman
12	Health workforce	Man
13	Intergovernmental organization	Man
14	Intergovernmental organization	Woman
15	National government representative	Man
16	National government representative	Woman
17	National government representative	Man
18	NGO providing health services	Woman
19	Supply chain	Man
20	Supply chain	Woman
21	Tertiary private hospital	Woman

2.1. Semi-structured interviews

We conducted 21 interviews (June 2023–January 2024) with stakeholders, including 9 women and 12 men (Table 1). Interview guides were informed by a theory of change framework for GHG mitigation in LMIC healthcare systems [21]. Topics covered included intervention planning, implementation, and evaluation; barriers and opportunities; and adaptation strategy interactions. Interviews (45–60 min) were conducted in person (10) and virtually (11), recorded, transcribed verbatim, and analyzed using NVivo software. Thematic analysis included coding, theme identification, and narrative synthesis to ensure findings reflected participant insights.

2.2. Delphi consensus process

A January 2024 workshop engaged 12 decision-makers (7 also interviewed previously), to refine and prioritize interventions identified during interviews. The iterative Delphi method facilitated consensus-building on key strategies and barriers to achieving net-zero healthcare. Sessions included an overview of the interview findings, discussion on stakeholders and prioritization of actions. Three voting rounds ranked interventions by impact and feasibility. Discussions addressed implementation practicality, concluding with a strategic synthesis of findings for future actions. Workshop transcripts were analyzed using NVivo.

2.3. Recruitment & informed consent

Participants were recruited via direct outreach and snowballing, with no financial incentives provided, though workshop subsistence costs were covered. Informed consent was obtained in writing and verbally, with confidentiality upheld through anonymized data collection and storage. An information sheet (Appendix A) detailed study objectives and potential benefits, and participants had opportunities to ask questions throughout.

3. Results

3.1. Interviews

While there was a consensus on the necessity and potential benefits of this transformation, discussions revealed a complex landscape

of opportunities and barriers across five emerging themes: infrastructure; competing priorities; finances; awareness, knowledge and engagement; and strategy, coordination and leadership. Stakeholders further emphasized the importance of building a healthcare system that is resilient to Kenya's unique climate vulnerabilities.

'We are making sure that we are minimizing our carbon footprint from the beginning and doing it in a way that is protective of our planet rather than following the historical approach to maximize everything and then think 'how do we reverse the damage'.' – Health Worker

3.1.1. Strategy, coordination and leadership

The Ministry of Health's ongoing efforts to finalize a climate change strategy work plan illuminates the challenge of formulating a clear and actionable blueprint towards health system mitigation and adaptation (Participant 15). Indeed, even when strategies have been formulated, administrative complexities and implementation delays occurred, such as county project timelines not being honored (Participant 18).

The gap between strategic formulation and implementation suggests inherent challenges in coordination and leadership (Participant 18). The multifaceted nature of GHG mitigation interventions implies the need to engage several sectors. Pivotal entities to facilitate this, such as the Ministry of Health and the Ministry of Environment, face resource constraints. These constraints, both in terms of finance and human resources, significantly impair the translation of policies into tangible actions (Participant 16). The current policy architecture does not prioritize reducing GHG emissions unless aligned with cost savings or other near-term benefits, and there are evident discrepancies between legislative frameworks and the lived experiences on the ground (Participant 03 & Participant 10). Specifically, there are no frameworks that can be implemented by counties towards these efforts resulting in limited translation into county legislation (Participant 05).

From an operational lens, the lack of baseline measurements, such as vulnerability and adaptation assessments or carbon benchmarking, raises questions about the strategic alignment and real-world feasibility of current measures. The private sector, with potential for innovation, finds its contributions impeded by systemic issues such as corruption (Participant 01).

Unique to its health system is the devolution of powers to the county level, allowing counties to tailor policies to their specific contexts. This decentralized system presents both challenges and opportunities. If a particular policy becomes successful in one county, others might emulate it, promoting broader policy adoption (Participant 11). Moreover, an opportunity exists to create regional blocks with several counties to stimulate exchange of learned lessons and access to funding (Participant 05).

National prioritization of climate change by the current leadership, as well as global partnerships, like the Alliance for Transformative Action on Climate and Health (ATACH), spotlight Kenya's commitment and offer platforms for advocacy and collaboration. Such global endorsements and initiatives could serve as catalysts for driving domestic agendas (Participant 13). The country's flexibility and receptiveness to bilateral donors and international funding partners also hold promise, as collaborative discussions could yield support (Participant 18). Additionally, the current global emphasis on climate change can be leveraged, especially considering the increasing donor inclination towards climate and health work (Participant 12).

'Now is the time to take advantage because everyone now knows about climate change because of all the attention it has gotten politically. Even 2–3 years ago that landscape was different. Now is the time to have this conversation, because of the buzz around it.' – Health Worker

3.1.2. Finances

Finances consistently emerged as both barriers and enablers in achieving a net-zero healthcare system in Kenya by 2030. Participants underscored the substantial financial challenges associated with implementing mitigation measures. Stakeholders from diverse backgrounds, including development agencies, faith-based health services, and national government representatives, echoed concerns over financial constraints. The threefold greater cost of sevoflurane, an anesthetic gas commonly used in surgery with similar clinical outcomes as nitrous oxide, was highlighted as a significant challenge, despite its lower global warming potential. Furthermore, transitioning to solar energy, despite its long-term benefits, necessitates substantial initial capital investments in panels, batteries, and distribution systems which participants identified as burdensome given the prevailing limited health system funding. Several interviewees indicated challenges with the financing and allocation of funds for waste management, while others highlighted the limited funding specifically dedicated to climate and health.

Some stakeholders pinpointed potential financial enablers. For instance, they viewed increasing cost of grid electricity as a push factor driving interest in solar energy. Others alluded to the promising return on investment of solar initiatives, suggesting payback periods as short as 18–20 months (Participant 03). The potential of carbon trading emerged as an intriguing concept, with some stakeholders arguing for the commercialization of carbon credits as a pathway to drive decarbonization targets. Solar energy was repeatedly highlighted as both an ecologically sound and financially viable solution, given Kenya's heavy reliance on renewable energy sources. Several interviewees emphasized the potential cost-saving benefits of solar energy in the long term, provided initial capital investments can be managed – explored in the government's Energy System and Transition Plan.

'The universal language the world understands is the language of commerce.' – Supply Chain Expert

3.1.3. Competing priorities

Insights from a Development agency stakeholder emphasized that Kenya grapples with competing health priorities (Participant 06). Adding layers to this argument, a participant providing health services discussed inherent systemic constraints in Kenya; from struggling referral systems, lack of ambulances to lack of access to healthcare for pastoralist communities, highlighting that often, the provision of necessities supersedes broader sustainability goals (Participant 09).

A narrative from a private hospital respondent identified a disparity in acceptance rates, with administrative staff showing more willingness to adopt sustainable practices, while healthcare workers in clinical settings, such as operating theatres, were less inclined (Participant 21). This was further echoed by insights from the health workforce commenting on work in regions facing scarcity, where the immediate concern revolves around providing basic levels of care rather than sustainability (Participant 11). Healthcare delivery, access, and affordability often take precedence over other priorities (Participant 04).

External influences, particularly from the private sector, often conflict with sustainability efforts, evidenced by the tendency to promote single-use equipment over reusable alternatives because of patient perception of safety (Participant 11). The national government faces challenges including slow acceptance from healthcare managers and industry players (Participant 15).

This web of competing priorities was summarized by a member of the health workforce, underscoring the immediate challenges of hospitals grappling with medicinal shortages and the overarching government focus on opinion polls, often overshadowing the long-term

repercussions of climate change. The urgency of the issue, they noted, struggles to resonate at the grassroots level where the effects of climate change are not immediately palpable. Thus, bringing climate change to the forefront of the healthcare agenda necessitates not only systemic change but also heightened advocacy and awareness campaigns (Participant 12).

'If you market love to people that are heartbroken you will never get them to understand it. If you talk about carbon for people that need oxygen, they will not get it.' – Supply Chain Expert

'There is a lot of growth in our health system and a lot of investment coming up, but we have a long way to go.' – Faith Based Health Services Provider

3.1.4. Infrastructure

An interviewee from the faith-based health services (Participant 09) highlighted challenges in accommodating healthcare facilities that are part of larger, multi-use structures, such as clinics situated in high-rise buildings, because of dependency on other users in the building. An academic (Participant 02) noted that one of Kenya's leading hospitals has outdated infrastructure, affecting waste management and diversion from landfills. A development agency stakeholder (Participant 06) pointed to market challenges, such as the unavailability of more sustainable technologies in Kenya. Limited availability and poor-quality medicines can lead to ineffective treatments, increasing emissions through additional interventions (Participant 09 & Participant 21).

These challenges are compounded by the need for facilities that can withstand Kenya's climate pressures, such as frequent heavy rainfall. For example, an academic (Participant 02) noted the importance of integrating green spaces within hospital designs, not only for patient well-being but as a form of adaptation to enhance local climate resilience. These adaptive measures align closely with the need for sustainable infrastructure development that Participant 09 and Participant 21 discussed, particularly in terms of energy and water efficiency.

Conversely, the increased accessibility and availability of photovoltaic equipment, particularly from countries like China, supports a growing momentum in sustainable energy solutions and health delivery. As new healthcare facilities emerge, they present unique opportunities. Such facilities can leverage innovative designs, materials, and technologies to enhance energy efficiency and long-term planning. This includes considering architectural elements, including passive ventilation, cool roofs and rammed earth construction, utilizing less power-consuming machinery, and focusing on energy-saving practices.

3.1.5. Awareness, knowledge and engagement

A development agency representative (Participant 06) highlighted that many within the healthcare system do not yet understand the urgent need to reduce GHG emissions. This sentiment is echoed by representatives from faith-based health services (Participant 09) and supply chains (Participant 19), who pointed out the lack of knowledge and sensitization required for unified action. Participants from building design (Participant 03), health workforce (Participant 10), and academia (Participant 02) emphasized that the complexity of information related to GHG emissions and mitigation strategies needs simplification to be more comprehensible to a wider audience.

The lack of tailored roadmaps for Kenyan hospitals is another barrier. Representatives from tertiary private hospitals (Participant 21) mention that existing guidelines, often developed with Western hospitals in mind, might not be directly applicable in Kenya. Furthermore, the current curricula in medical and nursing schools do not adequately cover climate change and its relation to health, leading to a gap in education. An academic (Participant 01) emphasized the challenge of CEOs with clinical backgrounds lacking managerial insight and the necessity to sensitize the board management.

Stakeholder engagement also emerges as a concern, with representatives from the health workforce (Participant 11) highlighting that Kenya's commitments have not been adequately communicated or implemented at subnational levels. Similarly, siloed operations among partners (Participant 07) and a lack of intersectoral communication between climate change and public health professionals (Participant 01) were identified as barriers. Finally, engagement with community has been identified to be lacking – with an underrepresentation of traditional knowledge in research (Participant 08).

A representative from building design (Participant 03) emphasized the advantage of Kenya's educated and professional workforce as an opportunity, suggesting that, given proper resources and direction, they are poised to drive the transition. The current leadership's commitment to the climate and health agenda, as described by a national government representative (Participant 15), also presents an opportunity for accelerated progress. Moreover, the possibility of international collaboration and partnerships is a promising avenue, offering both resources and expertise.

'Yes, Kenya needs to have a strategic change when it comes to allocation of resources in the health sector and there is a need for [healthcare workers] to realize that the climate change crisis is a health crisis.' – National Government Representative

3.2. Workshop

A thematic analysis conducted on the interviews identified 14 key process components towards a net-zero healthcare system in Kenya (Table 2, Appendix B). These components, ranging from leadership and political will to financing and stakeholder engagement, were collectively validated by the workshop participants.

Emphasizing a whole-of-society approach, the workshop participants underscored the necessity of engaging a diverse array of stakeholders to ensure the successful transformation of Kenya's healthcare system. Fig. 1 illustrates identified stakeholders, categorized by their impact, power, and relevance to each of the 14 process components. The workshop discussions revealed that stakeholders with high-power and high influence required close management to harness their potential effectively, whereas those with high power but low influence needed strategies tailored to maintain their support and involvement.

A perceived underrepresentation of large sources of emissions in implemented actions, such as the supply chain, was identified in the workshop. Building on this, the workshop participants ranked actions necessary for achieving net-zero emissions in the healthcare system through a Delphi process. When deciding on priority based on impact, participants initially focused on developing comprehensive national healthcare policies supported by existing evidence. As the workshop progressed, generating actionable, localized data to inform policies and actions emerged as the top priority in the eventual consensus reached after three rounds of voting, because of larger potential for impact. The discussions further highlighted the importance of leveraging local resources and technologies to build resilient healthcare infrastructures that not only withstand climate-related challenges but also contribute to reducing emissions. The workshop addressed the transformative potential of integrating renewable energy solutions, such as solarization of health facilities, to ensure reliable energy supply and reduce dependency on unsustainable power sources.

In terms of feasibility, early discussions favored the implementation of clean energy solutions in health care facilities, reflecting the sector's readiness and the supportive policy environment for

Table 2
Process components identified through interviews and validated by workshop towards a net-zero healthcare system in Kenya.

Component	Description
1. Leadership & Political Will	Effective leadership must transcend organizational boundaries, promoting net-zero healthcare that overcomes system fragmentation and aligns with national climate goals.
2. Goal Setting & Action	Setting clear, actionable goals is vital, reflecting a commitment that aligns with Kenya's structured policy environment for effective implementation.
3. Financing	Addressing financial barriers through innovative funding solutions and government incentives for renewables, ensuring sustainable investments.
4. Awareness and Sensitization	Enhancing understanding through targeted awareness campaigns and education, crucial for engaging all healthcare stakeholders in the climate agenda.
5. Baseline Data	Collecting and utilizing baseline data to inform and tailor interventions, essential for accurate monitoring and effective mitigation and adaptation strategies.
6. Research & Innovation	Encouraging robust research initiatives and innovative solutions that can be practically applied to mitigate climate impacts within healthcare settings.
7. Strategic Planning	Developing comprehensive strategic plans, ensuring plans are actionable and aligned with broader health goals.
8. Legislation, Policies, and Guidelines	Establishing supportive legislative and policy frameworks that ensure compliance across the healthcare system.
9. Education and Capacity Building	Building capacity through education and training, integrating climate change into healthcare curricula to foster a knowledgeable workforce ready to implement sustainability initiatives.
10. Engagement	Promoting broad-based engagement strategies that include all levels of government and the community, essential for the widespread adoption of measures.
11. Implementation	Ensuring that policies and guidelines are translated into actions that result in tangible, measurable outcomes.
12. Behavioral Change	Supporting behavioral change initiatives that address cultural norms and practices.
13. Monitoring and Follow-up	Implementing rigorous monitoring and follow-up mechanisms to ensure ongoing compliance and adaptation of strategies to emerging challenges.
14. Reporting, Transparency, and Recognition	Maintaining high standards of transparency in reporting and recognizing efforts to meet sustainability benchmarks, essential for accountability and continuous improvement.

renewable energy initiatives. However, eventual consensus after two rounds of voting favored simpler and immediately impactful actions, such as establishing hospital vegetable gardens and internal guidelines for departmental behavior change. These actions were seen as quicker to implement and requiring fewer resources, making them practical choices given the current barriers. By the conclusion of the workshop, there was a consensus that while long-term, strategic policy development is crucial, the integration of directly actionable items that yield tangible results is equally vital. This balanced approach ensures immediate, practical benefits while laying the groundwork for sustained systemic change. Table 3 showcases the ranking results of each round of voting, both for ranking based on impact (three rounds) and ranking based on feasibility (two rounds).

4. Discussion

This study marks an effort towards understanding and delineating the pathway for Kenya to establish a net-zero healthcare system by 2030. To our knowledge, this is the first comprehensive qualitative exploration focusing on this transformative goal in Kenya. Our results indicate a shared optimism among stakeholders about the potential for transformation, albeit tempered by the recognition that significant barriers must be addressed.

A central challenge identified is the tension between immediate healthcare needs and long-term sustainability goals. In Kenya, priorities such as basic service provision and addressing shortages of medicines, especially during climate emergencies, often overshadow sustainability initiatives. Systemic issues, including strained referral systems and a shortage of healthcare workers, further compound this challenge, with immediate concerns about access to care and workforce capacity taking precedence over long-term climate goals [22−24]. Additionally, external pressures, such as the preference for single-use equipment in the private sector due to perceived safety by patients, conflict with efforts to reduce waste [25]. Limited availability of sustainable technologies and poor-quality medicines can further increase emissions through ineffective treatments and additional interventions [26,27]. Financial barriers, such as the high cost of sevoflurane and the upfront investments required for solar energy, exacerbate the challenge, particularly given the limited

funding dedicated to climate and health [28−30]. However, rising electricity costs and increased availability of solar technologies are driving interest in solar energy, with returns on investment potentially seen within 18−20 months [31−33]. Engaging stakeholders to explore these financial implications and co-benefits, including their connectedness with adaptation, could provide necessary insights for policymakers. For example, in Guinea, the Ministry of Health and Public Hygiene, in collaboration with the Ministry of the Environment and Rural Development, has undertaken a comprehensive emissions evaluation covering major public and private healthcare facilities to identify potential for carbon footprint reductions, cost savings, and improved operational efficiency − with cost savings likely being a major driver of change. In turn, this initiative is intended to support fund mobilization and engage experts towards implementation of interventions [34].

Effective governance is pivotal in driving the transition to a net-zero healthcare system. Results indicate the critical need of the national government to harmonize efforts with county-level administrations, linking national policies to actionable county-level strategies. Kenya's decentralized health system presents both opportunities and challenges. The devolution of powers allows counties to tailor policies to their specific contexts, potentially accelerating localized success. However, the lack of baseline measurements and standardized frameworks poses significant barriers, as operational gaps in carbon benchmarking and vulnerability assessments undermine strategic alignment and real-world feasibility [35−37]. Additionally, relevant ministries and healthcare institutions face resource constraints—both financial and human—which further impair the translation of policies into tangible actions [38,39]. Delays in county-level project timelines and administrative complexities have hindered the effective execution of climate strategies [22,40], while discrepancies between legislative frameworks and ground realities remain evident [41]. Furthermore, systemic corruption impedes private-sector innovation in advancing GHG mitigation efforts [42,43]. Inspiration can be drawn from structures in other countries, as this dynamic is similar to South Africa, where the Presidential Climate Commission was established to coordinate between national, provincial, and local governments to integrate climate policies into various sectors, including health, through five-year integrated
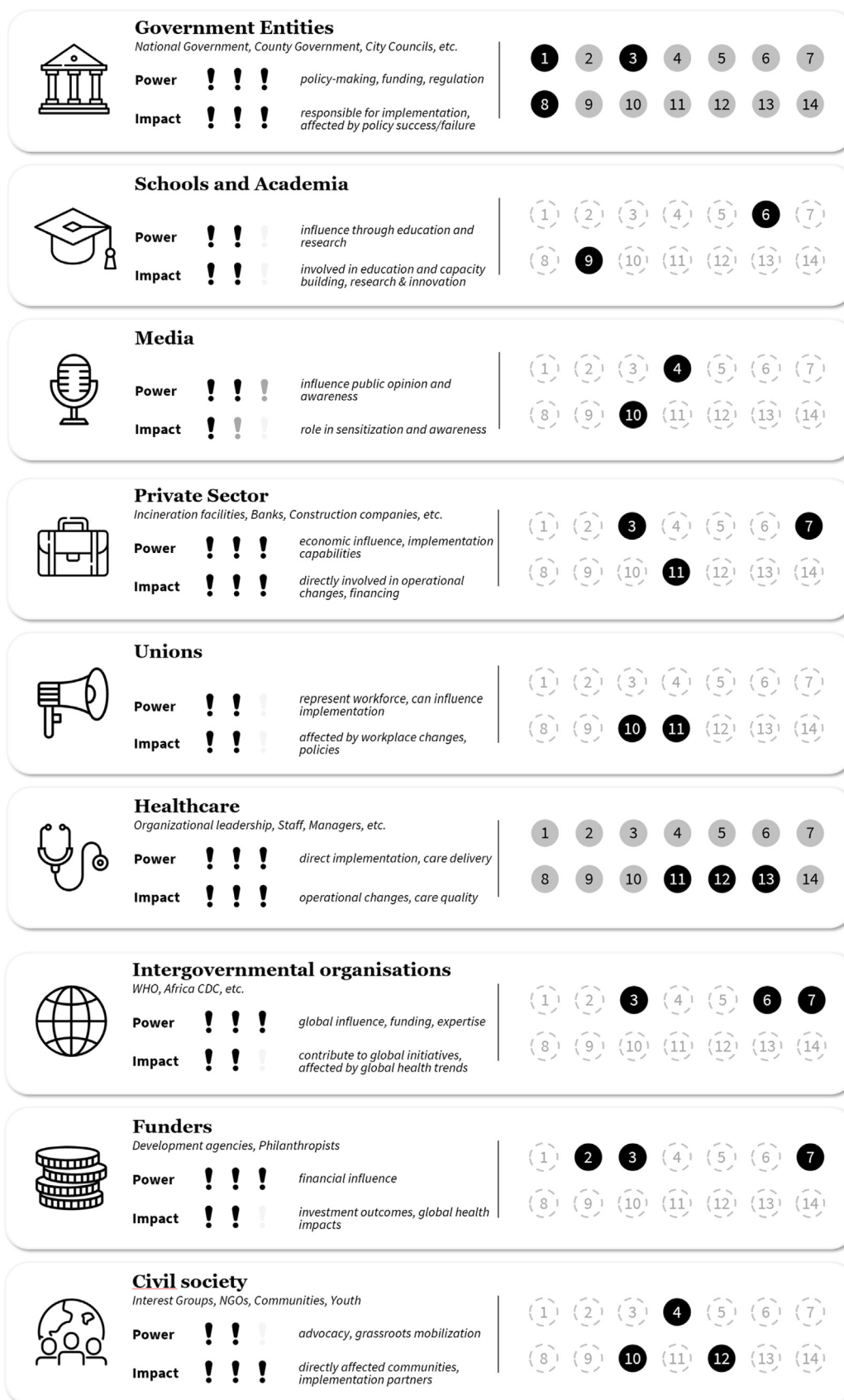
Fig. 1. Overview of stakeholders relevant to the transformation of Kenya's healthcare system to net-zero. For each group of stakeholders their power and impact are illustrated with exclamation marks, ranging from 1 (low power/impact) to 3 (high power/impact). Their relevance to several process components is illustrated, with grey indicating intermediate relevance and black indicating high relevance. Process components are: 1. Leadership & Political Will, 2. Goal setting & action, 3. Financing, 4. Awareness and sensitization, 5. Baseline data, 6. Research & Innovation, 7. Strategic planning, 8. Legislation, policies and guidelines, 9. Education and capacity building, 10. Engagement, 11. Implementation, 12. Behavioral change, 13. Monitoring and follow-up, 14. Reporting, transparency and recognition.

Table 3

Outcomes of Delphi ranking exercise, where participants scored various healthcare sustainability actions based on priority and feasibility. Each option was ranked by participants, with points awarded in descending order (the top-ranked option received the most points). The sum of these points for each option was then divided by the number of participants to calculate the average ranked score for each round.

Actions (alphabetical)	Impact Priority Ranking out of 12 (average score)			Feasibility Ranking out of 12 (average score)	
	Round 1	*Round 2*	*Round 3*	*Round 1*	*Round 2*
A. Clean energy implementation for facilities.	6 (7)	2 (7.89)	2 (9.38)	1 (10.13)	6 (7)
B. Developing national sustainable healthcare policies based on existing evidence.	1 (8.88)	3 (7.78)	3 (8.88)	9 (5.63)	8 (5.71)
C. Developing requirements for green building.	8 (5.75)	10 (5.44)	11 (4.5)	6 (6.38)	7 (6.43)
D. Establishing monitoring and follow-up committees.	10 (5.38)	11 (5)	7 (5.5)	5 (6.75)	2 (9.14)
E. Generate evidence that influences policy decisions and action.	2 (8.63)	1 (9.33)	1 (10.88)	3 (8)	4 (7.86)
F. Hospital vegetable gardens for organic foods.	12 (2.25)	12 (2.89)	12 (2)	4 (7.63)	1 (9.57)
G. Incentivization of healthcare facilities that adopt GHG mitigation strategies through lower taxes.	3 (8)	4 (7.56)	4 (8.25)	11 (4.13)	12 (2.14)
H. Internal guideline for department/unit behavior change.	10 (5.38)	7 (6.22)	7 (5.5)	2 (8.13)	3 (9)
I. Limit use of one time use equipment in surgical practice.	9 (5.5)	9 (5.78)	6 (5.88)	7 (6.25)	9 (4.86)
J. Reuse and recycling of medical waste.	4 (7.13)	6 (6.33)	10 (4.88)	10 (5.5)	9 (4.86)
K. Sustainable healthcare education for practicing healthcare professionals	6 (7)	7 (6.22)	5 (7)	8 (6)	5 (7.29)
L. Sustainable healthcare education in the medical curriculum.	4 (7.13)	4 (7.56)	9 (5.38)	12 (3.5)	11 (4.14)

development plans [44,45]. In Togo, the Ministry of Health and Public Hygiene oversees the climate and health agenda, with a scientific committee in charge of involving regional and district healthcare directors to integrate sustainability practices [34]. Additionally, Kenya's involvement in global partnerships, such as the ATACH, offers platforms for collaboration, which could drive domestic agendas and mobilize international funding support [46]. Coordinating national policies based on locally relevant evidence through the Climate Change and Health Strategic Working Group can play a significant role in establishing a robust framework for implementing sustainable healthcare practices.

The contrast between feasibility and impact, as showcased by the workshop outcomes, highlight difficulties for policymakers to make informed choices that optimize impact without exceeding current capabilities. A notable shift in rankings between the first and second part of the workshop reflected that, as discussions progressed, participants discussed the practical barriers more deeply such as financial and operational constraints. Three interventions stand out for their high rankings across both impact and feasibility in the final rounds of voting in the workshop. Generating evidence that influences policy decisions and action, and developing policies based on existing evidence, emerged as two of these three. By analyzing ongoing initiatives through robust data collection, targeted, evidence-based interventions can be identified, implemented more widely, and incorporated into national policies. Clean energy implementation for facilities also ranked highly, with a strong potential for substantial benefits despite moderate implementation challenges. In regions with high solar and wind potential, these systems have demonstrated significant greenhouse gas reductions, cost savings, and improved health outcomes. For instance, in a rural health facility in the Philippines, a solar photovoltaic system is modelled to enable continuous healthcare delivery even during climate-related disruptions, highlighting dual benefits for mitigation and adaptation [21].

The limitations of this study include that it may not fully represent all views within Kenya's diverse healthcare landscape. Furthermore, the findings are constrained by the temporal scope of the study and might not reflect continuous changes in policy or practice. Complementing qualitative insights with quantitative studies could offer a more detailed assessment of emissions reductions and intervention effectiveness. The Aga Khan Development Network, through the ENBEL project in partnership with Kenya's Ministry of Health, has contributed to this process by training Kenya's County Public Health Officers in the use of their Carbon Management Tool in June 2023 [47,48]. It is also important to consider the political economy of translating workshop and interview insights into practice. While stakeholders in engagement settings, such as workshops, may express ambitious goals for GHG reduction, the realities of policy implementation could lag. Political, financial, and institutional barriers can significantly slow or alter the trajectory of these ambitions, and this should be considered when interpreting the study's findings.

5. Conclusion

The pathway to a net-zero healthcare system in Kenya is contingent upon a strategic synthesis of policy, practice, and partnership. Each step forward must carefully consider the interplay of immediate feasibility and long-term impact, harnessing both governmental support and international best practices to build a resilient and sustainable healthcare infrastructure. [47,48].

The integration of climate action with health system planning presents an opportunity to enhance public health outcomes while contributing to national climate goals. The continued exploration, evaluation and reporting of these themes and navigation of their related complexities, both within and outside of Kenya, are essential for refining strategies and achieving the ambitious targets set forth by Kenya.

Ethics

The proposal for this research was approved by the Research Ethics Committee of the London School of Hygiene & Tropical Medicine (Ref. 28,210) and the Kenya Medical Research Institute (KEMRI, Ref. 4662), and licensed by the National Commission for Science, Technology and Innovation (NACOSTI, Ref. 519,115).

Declaration of competing interest

All authors have completed the ICMJE uniform disclosure form at https://www.icmje.org/disclosure-of-interest/ with completed forms

attached. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. The authors declare no other support from any organization for the submitted work; no other financial relationships with any organizations that might have an interest in the submitted work in the previous 36 months, no other relationships or activities that could appear to have influenced the submitted work. All authors have had final responsibility for the decision to submit for publication.

CRediT authorship contribution statement

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Supplementary materials

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