Harnessing Sustainable Healthcare through the Synergy of Artificial Intelligence (AI) and Blockchain Technologies in Kenya

Tlhokomelo R.B. Monethi

tlhokomelomonethi@gmail.com

Abstract

Embarking on the frontier of healthcare transformation, the fusion of Artificial Intelligence (AI) and blockchain technologies in Kenya promises to redefine medical landscapes and serves as a beacon for sustainable development in a rapidly evolving digital era. The study employs a comprehensive approach, evaluating economic, social, and environmental dimensions to assess the impact of these technologies. Through a mixed-methods research strategy focusing on key healthcare projects, including *AfyaRekod, Tambua Health, Ilara Health, PanaBIOS,* and *Sophie Bot*, the research navigates challenges and highlights opportunities for transformative change. Key themes include; economic sustainability, emphasizing cost-effectiveness, resource optimization, and equitable growth. The study addresses social impact, focusing on healthcare access, patient experiences, and ethical considerations, and evaluates the environmental footprint, promoting strategies for minimizing energy use and adopting eco-friendly practices. Despite challenges in technology infrastructure and regulatory frameworks, the study underscores the transformative potential of AI and blockchain technologies. The findings provide crucial insights for informed decision-making, policy formulation, and the harmonious integration of technology with regulatory frameworks, ultimately contributing to a sustainable and balanced healthcare ecosystem.

Keywords

Artificial Intelligence, *Blockchain Technology, Economic Sustainability, Environmental Sustainability, Kenya, Social Sustainability*

Introduction

Integrating Artificial Intelligence (AI) and blockchain technologies in healthcare has gained increasing significance, driven by a growing awareness of sustainability and the imperative to preserve resources for future generations. Sustainability, as defined by the United Nations Brundtland Commission (1987: 16-27), involves the responsible use of natural resources to meet present needs without compromising the ability of future generations to meet their own. This comprehensive evaluation explores economic, social, and environmental dimensions to assess the effective integration of these technologies into healthcare systems, aiming to ensure integration without depleting resources, causing harm to the environment, and concurrently promoting economic growth and social well-being (United Nations Brundtland Commission, 1987: 78, 141-167).

Aligned with the goal of sustainable development, as articulated by Moore (2015), which seeks to enhance the socio-economic well-being of humanity, this assessment adopts a multifaceted and all-encompassing approach. Social impact encompasses healthcare access, patient experiences, equity, and ethical considerations, assessing how these technologies can improve access for underserved populations and address disparities among different social groups (Bompelli *et al*., 2021; McFarlane et al., 2020: 1-8). Economic impact pertains to cost-effectiveness, financial benefits, and efficiency in resource allocation, aiding policymakers and healthcare professionals in decision-making (Cheikosman and Mulligan, 2023: 19-23; Garikapati *et al*., 2022: 4, 7). Environmental impact focuses on ecological footprint and sustainability, emphasising strategies to minimise energy use and adopt environmentally friendly practices (Munir *et al*., 2022: 1-19). This multidimensional approach provides a holistic understanding of the potential benefits and challenges of AI and blockchain in healthcare. The knowledge derived from this evaluation is crucial for informed decision-making, policy formulation, and sustainable practices that maximise positive impacts while minimising potential risks and drawbacks.

AI and blockchain technologies align with the broader goals and strategies of Kenya's healthcare system, offering improved service efficiency, reduced costs, and democratised healthcare (Tagde *et al*., 2021: 52810). Addressing the crucial need for AI applications, blockchain technology provides a secure and immutable platform for data storage and sharing, enhancing the reliability and trustworthiness of AI-based healthcare (Tagde *et al*., 2021: 52827). A conceptual framework by Shinde et al. (2022) integrates AI and blockchain

technologies effectively, aligning capabilities with the specific requirements of different AI domains. Through this integration, healthcare systems can support their broader goals and strategies. AI in telehealth aligns with broader healthcare goals, positively impacting sustainability by reducing the carbon footprint, optimising resources, improving outcomes, and enhancing accessibility to quality care (Amjad, Kordel, and Fernandes, 2023). The combination of telehealth and AI addresses environmental sustainability by minimising patient travel-associated emissions, optimising resource allocation, and improving access to care, particularly in remote areas.

However, challenges such as technology infrastructure, expensive internet access, and inadequate regulatory frameworks pose significant hurdles (Baker, Breitsprecher, and Guthoff, 2022). Targeted support is essential to ensure the sustainable implementation of healthcare technologies. The adoption of blockchain technology introduces legal and regulatory challenges due to its decentralised nature, necessitating governance approaches for decentralised entities (Baker, Breitsprecher, and Guthoff, 2022: 47). Regulators in Kenya must understand, monitor, and influence this transformation, considering varying regulations related to AI usage across countries (Frąckiewicz, 2023). Legal, regulatory, and policy considerations are crucial for measuring sustainable healthcare products, processes, and organisations. Determining data for evaluating Environmental, Social, and Governance (ESG) criteria becomes a crucial question, with Baker, Breitsprecher, and Guthoff (2022: 46) emphasising the preference for primary data continuously measuring factors such as CO2 emissions or electricity consumption. Comprehensive legislation, such as the European Union's General Data Protection Regulation (GDPR), safeguards individual privacy and provides guidelines for data collection and processing (Amjad, Kordel, and Fernandes, 2023: 17). Tailored solutions, including voluntary privacy regulations for mobile health apps, are necessary to address specific challenges (Amjad, Kordel, and Fernandes, 2023: 17). Legal and regulatory support is crucial for the development trajectory of blockchain technology, addressing issues such as privacy, money transmission, anti-money laundering, and information reporting (Yeoh, 2017, in Kawabata and Acharya, 2019: 6).

In essence, the integration of AI and blockchain technologies within Kenya's healthcare sector signifies a significant stride towards fostering sustainable development, aligning with the objectives of Sustainable Development Goal 3 (SDG 3). Despite challenges, the potential impact of these technologies on reshaping healthcare delivery, ameliorating healthcare outcomes, and advancing sustainable agendas is profound. Projects like PanaBIOS, Ilara

Health, Sophie Bot, Tambua Health, and AfyaRekod exemplify the transformative potential of AI and blockchain technologies in the healthcare landscape, enhancing accessibility, and patient experiences, contributing to a more balanced and sustainable healthcare ecosystem. The intricate interplay of technological infrastructure, regulatory frameworks, and institutional capabilities necessitates a holistic approach to ensure sustainable implementation, emphasising the importance of harmonising technological advancements with regulatory frameworks for responsible and ethical implementation. The integration of AI and blockchain technologies in Kenya's healthcare landscape holds substantial promise for achieving sustainable development objectives, contributing to a healthier, more equitable, and enduring future.

Materials and Methods

This research employs a mixed-methods approach to investigate the impact of AI and blockchain technologies on healthcare in Kenya. Qualitative analysis, guided by Graf, Tuly, and May (2021), delves into literature, policies, and organisational statements. The study utilises a case study method, focusing on five key healthcare projects, including AfyaRekod's EHR management, Tambua Health's AI-driven lung-sound analysis, Ilara Health's AI diagnostics, PanaBIOS' disease surveillance with AI and blockchain, and Sophie Bot's AI chatbot for sexual health. Quantitative analysis assesses numerical data, tracking changes in health outcomes post-technology implementation (Nowell *et al*., 2017; Kiernan, 2014). Thematic and descriptive analysis handle qualitative and quantitative data, respectively (Nowell et al., 2017; Kiernan, 2014). Data collection focuses on the period after 2015, aligning with the introduction of the United Nations SDGs.

The integration of qualitative and quantitative methods aims for a comprehensive understanding of technology implications. Triangulation enhances data reliability, aligning with mixed methods' efficacy in health sciences (Guetterman, Fetters, Creswell, 2015). Stakeholder engagement, even in desktop research, ensures contextual relevance, credibility, and ethical conduct. Qualitative analysis examines literature, policies, and vision statements, offering rich insights (Dalglish, Khalid, McMahon, 2020; Martínez-García et al., 2019; Bowen, 2009). Acknowledging potential biases, the researcher commits to objectivity and a balanced perspective. Quantitative analysis, crucial for assessing technology impacts, relies on statistical methods and addresses efficiency, risks, costs, and benefits. It aids in understanding trends and providing structured insights (Gupta et al., 2023; Chan, 2023; Li et al., 2023; Erol et al., 2020;

Parker and Bach, 2020). Quantitative research involves systematic collection and analysis of numerical data, ensuring generalisability through probability sampling (Sheard, 2018; Williamson et al., 2018). The case study approach explores specific healthcare projects, offering a deep, multi-faceted understanding (Bowen, 2009). Its historical significance and evolution highlight its effectiveness in testing theories and presenting solutions (Rivero, 2022; Freemantle, 2016). Case studies facilitate intensive analysis of unique phenomena, promoting a holistic understanding and uncovering nuanced details (Drew, 2023; Gaille, 2018). The study's case selection includes diverse projects, ensuring a comprehensive exploration of healthcare innovation in Kenya.

Case studies are instrumental when researchers lack control over variables, enabling immersion in real-life settings for natural observation (Tetnowski, 2015, in Drew, 2023). They aid in developing new theories and hypotheses, exemplified by the Eisenhardt Method (Rivero, 2022), which transforms detailed case studies into concrete organisational theories (Rivero, 2022). However, case studies have limitations, such as limited generalisability and potential bias in qualitative data analysis (Drew, 2023; Williamson et al., 2018: 537-564). Replicating results can be challenging, underscoring the need for careful consideration when employing case studies (Drew, 2023; Morse, 2021, in Sheard, 2018: 2). To address these limitations, combining case studies with quantitative analysis becomes essential for a comprehensive exploration of healthcare innovation in Kenya, particularly the impact of AI and blockchain technology. Criteria for selecting case studies in this research include the projects based on AI and blockchain, operating in Kenya, founded by Kenyan individuals after 2015, and addressing healthcare challenges. The five selected projects – AfyaRekod, Tambua Health, Ilara Health, PanaBIOS, and Sophie Bot – contribute significantly to improving healthcare outcomes in Kenya through technology integration and partnerships, contradicting dependency theory.

Thematic analysis is employed for document analysis around case studies, utilising the Large Language Model (LLM) ChatGPT. Thematic analysis, introduced by Braun and Clarke in 2006, identifies patterns or themes in qualitative data, offering flexibility but lacking a specific structure (Braun and Clarke, 2006). ChatGPT is used effectively when guided by well-designed prompts, addressing human analysts' concerns (Zhang et al., 2023: 22). The study employs descriptive analysis to evaluate health indicators before and during the implementation of AI and blockchain projects, measuring changes in behaviour resulting from these interventions. Rigorous evaluation methods and advanced statistical analyses are considered to determine the projects' impact on health outcomes. Descriptive statistics are used to summarise and interpret

research data efficiently, providing numerical or graphical representations of data. Google Sheets is employed for organising and analysing numerical changes in health indicators over time, extracting trends to assess improvements since the introduction of eHealth projects.

Discussion

In Kenya's healthcare sector, the integration of AI and blockchain technologies by AfyaRekod, Tambua Health, Ilara Health, PanaBIOS, and Sophie Bot is reshaping the approach to sustainable healthcare. These platforms use blockchain for transparent and ethical supply chains, emphasising social sustainability. The combination of electronic health records (EHRs) and AI addresses Social Determinants of Health (SDoH), impacting health outcomes. Barriers to blockchain adoption include social factors and developmental challenges, highlighting the delicate balance needed between innovation and societal acceptance. Economic sustainability is explored, focusing on ethical technology use, resource optimisation, and equitable growth for healthcare goals. Alignment with the United Nations' Sustainable Development Goals is evaluated, addressing potential risks of economic instability and environmental degradation. Moving to environmental sustainability, the discussion examines the environmental impact of AI and blockchain, emphasising the need to balance technological progress with ecological preservation. Economic sustainability is then dissected, unravelling factors influencing healthcare outcomes within economic constraints.

Challenges in healthcare infrastructure underscore the need to increase GDP allocation to the sector. In AI integration, the often-underestimated long-term costs and potential economic opportunities at the local level are explored. The role of blockchain and AI-driven technologies in streamlining financial processes, reducing costs, and improving service efficiency contributes to overall sustainability objectives. Challenges related to poverty reduction, digital literacy, and literacy levels highlight the necessity for a comprehensive approach. This discussion concludes by emphasising the pivotal roles of perceived financial costs, innovativeness, governmental pressure, incentives, and regulatory support in shaping AI implementation in healthcare, providing a nuanced understanding of the transformative potential and challenges in Kenya's healthcare ecosystem.

Social and Political Sustainability

The multifaceted applications of AI and blockchain technologies in Kenya's healthcare system align with the principles of social sustainability, as highlighted by Kumar and Dagar (2021: 1138-1141). They emphasise the potential of blockchain, as a disruptive technology, to enhance the social sustainability of supply chains. Blockchain's unchangeable data and consensus-based decision-making mitigate unethical practices in supply chain management. Research indicates that social and behavioural determinants of health (SBDH) or SDoH significantly impact health outcomes. Bompelli et al. (2021: 1-7) emphasise the use of electronic health records in observational studies during the AI era. However, effectively leveraging SBDH information from EHRs through AI approaches remains an underexplored area. Social determinants contributing up to 40% to health outcomes (Dankwa-Mullan et al., 2021: 308) necessitate an in-depth analysis of blockchain technology, and the current state of SDoH to accelerate its adoption for improved health outcomes (McFarlane et al., 2020: 2-6).

Despite the potential benefits, barriers to the adoption of blockchain technology in healthcare exist. Social factors, including concerns about trust, workplace dynamics, and vulnerability of lower-level workers, present challenges (Kumar and Dagar, 2021: 1138-1141). In addition, developmental immaturity poses technical challenges, requiring specialised attention for effective integration (Kumar and Dagar, 2021: 1138-1141). Akinradewo *et al*. (2022: 925-926) identify societal challenges, including social acceptance, high energy consumption, legal uncertainties, system complexity and cost, transactional-level uncertainties, vague supportive data regulation, and poor economic behaviour, which impede blockchain adoption. Companies like AfyaRekod, Tambua Health, Ilara Health, PanaBIOS, and Sophie Bot illustrate how technology can address social challenges. They prioritise accessibility, inclusivity, and ethical considerations, ensuring the privacy and security of patient data, delivering accurate medical insights to underserved areas, and addressing information gaps on reproductive health. These efforts contribute to social sustainability by promoting equitable healthcare delivery.

The sustainability of AI and blockchain technology in Africa faces challenges related to legal, regulatory, and policy considerations. While blockchain has transformative potential in healthcare, integrating it requires alignment with existing regulatory frameworks (Amenta, Sanseverino, and Stagnaro, 2021). Internationally, the lack of consensus on governance mechanisms for AI technologies in healthcare poses technical and social barriers (Morley *et al*., 2022). Efforts by the Kenyan government to regulate AI and blockchain technologies

through the Data Protection Act and other acts impact the operations of platforms operating at the intersection of technology and healthcare. At the regional level, the African Union's initiatives—such as the Malabo Convention and the AI Continental Strategy—aim to regulate AI and blockchain technology, promoting ethical use and data privacy. Internationally, the European Union's AI Act provides a regulatory framework for AI systems, emphasising risk categorisation and stringent requirements for high-risk applications. Platforms like these case studies are directly affected by evolving regulatory frameworks, influencing their operations and social sustainability. Adhering to these regulations is crucial for ethical technology usage, building user trust, and ensuring social sustainability in the healthcare sector. The ability of these platforms to navigate and comply with national, regional, and international regulations profoundly influences their ethical innovation and contributes to achieving SDG 3. Successfully adhering to regulations promotes accessible, ethical, and effective healthcare solutions, benefiting individuals and societies at large.

Environmental Sustainability

Enhancing healthcare access, optimising data management, improving diagnostics, and facilitating digital information dissemination all have the potential to minimise resource wastage and enhance the efficiency of healthcare delivery, aligning with broader sustainable development objectives. However, the deployment of Tambua Health, AfyaRekod, Ilara Health, PanaBIOS, and Sophie Bot in various ways could either positively or negatively impact the environment. While these AI- and blockchain-backed projects hold the potential to significantly advance healthcare in Kenya, they must also prioritise environmental responsibility. This section aims to explore these implications.

The concept of sustainable AI has gained critical attention, emphasising the need to ensure that advancements in AI technology prioritise energy efficiency (Zia, 2023). Despite the positive impacts of AI developments, they contribute to environmental concerns, particularly the escalation of carbon footprint (Marr, 2023; Zia, 2023; Bhat, 2022). The research community is actively exploring secure, privacy-preserving, and sustainable healthcare systems by leveraging emerging technologies like blockchain. As climate engagement becomes a focal point for regulators, investors, and the public, there is a growing need for impactful green investments (Cheikosman and Mulligan, 2023; Amenta, Sanseverino, and Stagnaro, 2021). Alzubi et al. (2021: 1-14) emphasise the essential roles that the Internet of Things (IoT) and AI

play as fundamental pillars in creating innovative, sustainable computing solutions for e-healthcare applications. In a sustainable healthcare system enabled by IoT, patient data collected by IoT devices is transmitted to the cloud for processing. Similarly, blockchain technology enables organisations to contribute to a low-carbon future by leveraging environmentally friendly solutions supported by transparent data (Amenta, Sanseverino, and Stagnaro, 2021). This combination empowers the establishment of sustainable practices and facilitates the transition towards a greener economy. Richie (2022: 1-2) emphasises that the primary consideration in AI use in healthcare should be the environmental impact, rather than solely focusing on software vulnerabilities like data manipulation and privacy breaches. Waiting for empirical data on carbon emissions before implementing changes in consumption habits is not prudent; addressing climate change requires immediate action to reduce carbon emissions (Richie, 2022: 3). These perspectives underscore the need for prioritising sustainability and considering environmental impacts in the development and implementation of AI and related technologies within the healthcare sector.

Bhat (2022) highlights that AI model training demands significant energy, prompting consideration of benefits versus environmental costs. While AI offers eco-benefits, it also requires a careful energy balance. AI workflows use much energy yearly, requiring efficiency enhancement. Tambua Health can enhance its commitment to sustainable AI by optimising its AI model training techniques and minimising energy consumption during diagnostic procedures. Ilara Health, through its innovative medical diagnostics platform, can adopt energy-efficient AI model training strategies to ensure technological progress aligns seamlessly with sustainable AI principles. Ironically, AI itself can play a role in addressing its own environmental impact by optimising processes and making decisions that reduce energy consumption (Bhat, 2022). The exponential growth of data and its subsequent rise in energy consumption may have an adverse effect on global efforts to combat climate change (Podder, 2021 in Marr, 2023). Incorporating energy consumption measurements alongside performance and accuracy metrics in AI research publications can raise awareness of the environmental impact of AI technology and foster greater accountability.

Zia (2023) highlights the significant environmental impact of AI arising from its intensive computing power and energy demands. Training a single large-scale language model can emit a substantial amount of CO^2, stressing the need to balance AI progress with environmental responsibility. Similarly, the energy-intensive nature of blockchain network mining presents a significant consideration, emphasising the need to minimise the carbon footprint associated

with energy-intensive blockchain-based Electronic Health Record (EHR) systems. While blockchain technology holds the potential for positive contributions to healthcare, the substantial energy consumption associated with public blockchains raises significant concerns. Public blockchains used for cryptocurrencies, characterised by high operational costs and energy usage, could hinder progress towards achieving sustainable healthcare, especially in regions with limited energy resources. Despite concerns about blockchain's carbon footprint and costs, studies indicate that blockchain could yield a 20% reduction in carbon emissions when using energy from renewable sources (Coutinho *et al*., 2022: 12). When implementing such systems, addressing challenges becomes paramount. Unequal healthcare resource distribution, substantial carbon emissions, and possible distrust among health providers and patients towards blockchain technology need collective efforts from various communities. Trust in the security, privacy, and integrity of such systems is vital for their successful adoption and widespread use (Han, Zhang, and Vermund, 2022: 5). Blockchain technology has the potential to contribute to the circular economy, reducing transaction costs, enhancing supply chain performance, and lowering carbon footprint (Upadhyay *et al*., 2021: 6). Further, AfyaRekod's partnership with IndyGene US exemplifies this by building a blockchain-encrypted repository of indigenous African data, positively impacting the environment. By addressing energy consumption and environmental implications, these initiatives can ensure that their technological advancements align with Kenya's broader sustainable development goals, fostering a balance between technological progress and ecological preservation.

Economic Sustainability

The economic sustainability of AfyaRekod, Tambua Health, Ilara Health, PanaBIOS, and Sophie Bot, in achieving sustainable healthcare, hinges on their ability to enhance healthcare outcomes while operating within economic constraints. Adhering to ethical use of technology, resource optimisation, and equitable growth contributes to of sustainable healthcare goals. The impact on poverty reduction, healthcare quality, and alignment with Kenya's economic landscape determines the extent of their success. However, the development and deployment of artificial intelligence and blockchain technology in healthcare raise concerns about economic viability, compatibility with existing frameworks, and potential legal and ethical implications (Garikapati *et al*., 2022: 133-134). It is essential to evaluate whether these

advancements align with the United Nations' Sustainable Development Goals (SDGs) or could lead to economic instability and environmental degradation (Garikapati *et al*., 2022: 133-134).

Economic sustainability, defined as meeting present needs without compromising the ability of future generations to meet their own, is critical (Garikapati *et al*., 2022: 133-134; Moore, 2015). It encompasses aspects related to management, technology, and clinical practices within the healthcare system (Dicuonzo *et al*., 2021). The link between economic security and health outcomes is well-recognised, and with anticipated population growth and advancements in healthcare technology, innovative approaches are needed to deliver better healthcare and improve outcomes while optimising resource use (McFarlane *et al*., 2020: 4). Decentralisation is inherent in healthcare, but not a requirement for leveraging SDoH. Blockchain technology accommodates a decentralised organisational model without enforcing a decentralised system of care. Blockchain-based systems have the potential to reduce costs, eliminate intermediaries, and enhance interoperability in health information exchange, aligning with social sustainability (Deloitte, 2016: 11). However, challenges associated with inadequate healthcare infrastructure in Kenya, such as limited resources, unreliable electricity, and poor transportation systems, could hinder the economic sustainability of these platforms (DBSA, 2023; Phelan, Yates and Lillie, 2022: 501-503; Clausen, 2015). To effectively implement these technologies in healthcare, it is crucial to increase the percentage of GDP allocated to the healthcare sector. Investment in AI is crucial for sustainable development globally, serving as a key driver of productivity and economic growth (Damoah, Ayakwah and Tingbani, 2021: 1). The Kenyan government's current allocation to the healthcare sector is significantly lower than other developing countries, highlighting the need for increased investment (Garikapati *et al*., 2022: 134; Trading Economics, 2023).

Despite the initial enthusiasm surrounding AI integration, the economic sustainability of AI in healthcare is often underestimated. The long-term costs associated with data acquisition, system training, and continuous evolution can be significant. Establishing a specialised centre of excellence or hiring experienced personnel is advisable to manage these costs effectively (Krishna, 2023). The potential economic opportunities and sustainable development at the local level through AI adoption, as seen in medical drone activities involving local communities, demonstrate the social responsibility of organisations (Damoah, Ayakwah and Tingbani, 2021: 3). Blockchain and AI-driven technologies have the potential to streamline financial processes, reduce costs, and improve service efficiency. Ilara Health's strategic partnerships showcase how AI-driven technologies optimise resource allocation, generate cost savings, and improve

service efficiency (Frąckiewicz, 2023; Awosanya, 2019; Mwololo, 2018). These technologies contribute to healthcare access, diagnostics, and patient outcomes, aligning with overall sustainability objectives. Medical drones, for example, contribute to long-term corporate sustainability and socio-economic benefits. They save staff hours, create employment, reduce mortality rates, and improve socio-economic conditions (Damoah, Ayakwah and Tingbani, 2021). However, challenges related to reducing individuals below the poverty line, promoting digital literacy, and increasing overall literacy levels need to be addressed for widespread access to these technologies. The perceived financial costs, innovativeness, governmental pressure, incentives, and regulatory support play crucial roles in AI implementation in healthcare. Effective risk management and strategic implementation are essential for assessing and managing potential risks and uncertainties (Choi, 2022). Blockchain's potential to improve traceability, information sharing, transparency, and decentralisation in supply chains aligns with efforts to enhance efficiency and accountability (Munir *et al*., 2022: 1-18). However, concerns about the economic and social sustainability of blockchain are raised, emphasising the need for careful analysis and management of risks.

Conclusion

AI and blockchain technologies in Kenya's healthcare system represent a multifaceted approach to achieving social, economic, and environmental sustainability. These innovative technologies have the potential to revolutionise healthcare delivery, improve diagnostics, and streamline processes. However, several challenges and considerations must be addressed to ensure their sustainable and responsible implementation.

From a social sustainability perspective, the platforms under consideration demonstrate a commitment to equitable healthcare delivery, privacy, and security of patient data. By addressing social challenges, such as accessibility and inclusivity, these technologies contribute to building a healthcare system that serves a diverse population. Furthermore, the emphasis on ethical considerations, inclusivity, and user trust aligns with the principles of social sustainability, fostering a healthcare environment that benefits individuals and communities. The regulatory landscape poses challenges to the social sustainability of these platforms, requiring adherence to evolving national, regional, and international frameworks. Striking a balance between innovation and compliance is crucial for ethical technology usage and user trust, ultimately contributing to the achievement of Sustainable Development Goal 3.

Environmental sustainability considerations highlight the need for a careful balance between technological progress and ecological preservation. While AI and blockchain have the potential to enhance healthcare efficiency, their energy-intensive nature raises concerns about carbon emissions. The deployment of these technologies must prioritise energy efficiency, incorporating sustainable practices to minimise environmental impact. Initiatives like blockchain-encrypted repositories of indigenous African data showcase how technology can positively impact the environment. Economic sustainability, a critical aspect of the platforms' success, hinges on their ability to enhance healthcare outcomes within economic constraints. Managing costs associated with AI model training and blockchain deployment is crucial for long-term economic viability. The potential economic opportunities at the local level, such as medical drone activities involving local communities, exemplify the social responsibility of these organisations and contribute to sustainable development.

In sum, the successful integration of AI and blockchain technologies in Kenya's healthcare system requires a holistic approach that addresses social, environmental, and economic dimensions. By navigating regulatory challenges, optimising energy consumption, and ensuring ethical and inclusive practices, these platforms can contribute to a sustainable and resilient healthcare ecosystem in Kenya.

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