

Review

# The Role of FinTech in Sustainable Healthcare Development in Sub-Saharan Africa: A Narrative Review

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**Abstract:** This narrative review explores the potential of FinTech in promoting sustainable healthcare development in Sub-Saharan Africa (SSA), focusing on the role of blockchain, crowdfunding, digital payments, and machine learning. The review also highlights the potential barriers to FinTech adoption in SSA, including limited access to technology, regulatory challenges, and cultural factors, and proposes potential solutions, such as capacity building and increased financial investment. Additionally, the review discusses the ethical and social implications of FinTech in healthcare development, including privacy, data security, equity, and accessibility. The main findings suggest that FinTech has the potential to significantly improve healthcare delivery and financing in SSA, particularly in the areas of information sharing, healthcare financing, and healthcare delivery models. However, addressing the barriers to FinTech adoption and mitigating the ethical and social implications will be essential to realizing the full potential of FinTech in healthcare development in the region. The review recommends future research and development in this area, and highlights the potential for FinTech to promote sustainable and equitable healthcare development in SSA.

**Keywords:** FinTech; healthcare; Sub-Saharan Africa; sustainable development; technology adoption



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## 1. Introduction

Recent years have seen the emergence of financial technology (FinTech) as a transformative force driving sustainable development across various sectors, notably healthcare. This fact is significant in Sub-Saharan Africa, a region grappling with complex and abundant healthcare challenges [1]. These challenges encompass a high burden of disease, limited access to healthcare services, and inadequate health infrastructure [2,3]. Furthermore, numerous Sub-Saharan African countries contend with insufficient financial systems, poor infrastructure, and scarce technology access [4]. This intersection of healthcare challenges and resource deficiencies necessitates introducing innovative solutions to foster sustainable regional healthcare development.

The utilization of FinTech, underpinned by innovative technologies, harbors the potential to confront these numerous challenges, revolutionizing the financing, delivery, and management of healthcare services [5,6]. For example, blockchain technology could provide secure and transparent patient data management. Concurrently, alternative financing models, like crowdfunding and digital payments, could streamline healthcare initiatives [7,8]. While not explicitly part of FinTech, machine learning can be seen as complementary to healthcare's wider digital technology panorama. Specifically, its ability to discern patterns within health data via predictive analytics can prove instrumental in informing policy and decision-making [9]. The combined efforts of FinTech applications and machine learning can spearhead the progression towards sustainable and equitable healthcare development in Sub-Saharan Africa. This illustrates how the fusion of financial and digital technologies could dictate the shape of future healthcare delivery models and outcomes.

Botta et al. [10] foresee Africa's domestic e-payments market witnessing a revenue growth of approximately 20 percent annually, culminating in around USD 40 billion

by 2025. The USD 15 billion in domestic electronic payments revenue originated from 47 billion individual transactions, amassing a total transaction value of slightly over USD 800 billion. In parallel, Flötotto et al. [11] project that Africa's financial-services market could expand at approximately 10 percent per annum, amounting to about USD 230 billion in revenues by 2025 (USD 150 billion excluding South Africa, the largest and most mature market in the continent). Despite these promising figures, substantial barriers hindering the region's FinTech adoption persist. Limited technology and infrastructure access, regulatory challenges, and cultural factors could obstruct the adoption and implementation of FinTech solutions [12]. Furthermore, the ethical and social ramifications of employing FinTech in healthcare, such as privacy, data security, and equity issues, are also significant considerations [13].

This narrative review endeavors to elucidate the role of FinTech in bolstering sustainable healthcare development in Sub-Saharan Africa, aiming to bridge the knowledge gap in this domain. The primary research question this review seeks to address is: "how can FinTech contribute to sustainable healthcare development in Sub-Saharan Africa, and what are the potential barriers and ethical implications?". We have opted for a narrative review approach, rather than a systematic literature review, due to its suitability for broad, exploratory research questions and its nuanced capacity to interpret complex and diverse findings. We will examine the extant literature on the potential of FinTech for healthcare development, pinpoint barriers and challenges to FinTech adoption, and discuss the ethical and social implications of incorporating FinTech in healthcare. Ultimately, this review aspires to furnish valuable insights and recommendations for leveraging FinTech to encourage sustainable and equitable healthcare development in Sub-Saharan Africa.

## 2. Methodology

This narrative review thoroughly searched acknowledged academic databases, namely PubMed, Scopus, and Google Scholar. The search strategy incorporated the use of key terms, either independently or in varying combinations, to encompass the broadness and profundity of the subject. The key terms used were "FinTech", "healthcare", "Sub-Saharan Africa", "sustainability", "blockchain", "crowdfunding", "digital payments", and "machine learning". A "joined query" method encompassed all possible combinations of the key terms in pairs, trios, and others. For instance, one search might include the terms "FinTech" and "healthcare" together, while another might comprise "blockchain", "healthcare", and "Sub-Saharan Africa". This methodology allowed for casting a wider net, ensuring a comprehensive collection of pertinent literature. The search was limited to peer-reviewed articles published in English from 2010 to 2022, to ensure relevance and recency. It is noteworthy that the time frame was chosen as no publications within the analyzed domain existed before 2010. This method led to the identification of 147 potential articles. Table 1 provides an overview of the stages of data collection and abstract/paper screening, including specific criteria, keywords, databases, and the number of articles at each stage.

**Table 1.** Review process screening criteria.

Stage	Criteria	Number of Articles
Initial search	Utilized key terms within PubMed, Scopus, and Google Scholar	147
Screen by title and abstract	Relevant to FinTech, healthcare, Sub-Saharan Africa	115
Full-text Screening	Discussion on the role of FinTech in sustainable healthcare development in Sub-Saharan Africa	75
Final selection	Published in a peer-reviewed journal, in English, between 2010–2022	52

The inclusion criteria for articles were: (1) discussion about the role of FinTech in enhancing sustainable healthcare development in Sub-Saharan Africa; (2) publication within a peer-reviewed journal; (3) publication in English; and (4) publication between 2010

and 2022. It is essential to clarify that only articles published in peer-reviewed journals were considered, while conference papers were not included in this review. This rigorous screening process led to the selection of 52 pertinent articles, with additional relevant documents incorporated as required.

The adopted methodology in this study integrated a thematic approach to facilitate data synthesis from the chosen articles. Specific applications within FinTech, particularly blockchain, crowdfunding, and digital payments, were analyzed to understand their potential to strengthen sustainable healthcare development in Sub-Saharan Africa, and the challenges impeding their adoption in the region. Each chosen area was examined thoroughly. This research concentrated on these areas as the first steps in exploring this vast field, while acknowledging the broad scope of FinTech, including aspects such as decentralized applications (DApps), smart contracts, and artificial intelligence (AI). Machine learning (ML), although a part of the broader FinTech landscape, was treated separately, due to its unique role in predictive analytics, personalizing patient care, and improving healthcare administration. The review concluded with a discussion of the ethical and social implications of implementing FinTech in healthcare settings. This reflection is critical to ensuring that the pursuit of technological advancement is balanced against social equity, privacy, and ethical appropriateness considerations.

### **3. Theoretical Framework**

#### *3.1. Overview of the Healthcare Challenges in Sub-Saharan Africa*

Sub-Saharan Africa faces enormous healthcare difficulties that affect the population's health and well-being. These obstacles include a high disease burden, limited access to healthcare services, and insufficient health infrastructure [1,14,15]. More than 1.1 billion people live in this region, which carries a disproportionate share of the global disease burden [1,16]. Communicable diseases, such as HIV/AIDS, malaria, and tuberculosis, remain significant regional public health threats [14,17]. Additionally, non-communicable diseases, such as diabetes, hypertension, and cancer, are on the rise, driven by changes in lifestyle and demographic shifts [18,19].

Access to healthcare services in Sub-Saharan Africa is limited by various factors, including geographic barriers, inadequate health infrastructure, and shortages of healthcare workers [14,20,21]. Rural populations are particularly underserved, with limited access to healthcare services, including diagnostic and treatment options [1,22]. Healthcare financing is also a challenge in the region, with many countries in Sub-Saharan Africa struggling with inadequate financial systems and limited access to healthcare insurance [14,23].

Inadequate health infrastructure is a significant challenge in Sub-Saharan Africa. Many health facilities lack essential resources, including clean water, sanitation, and electricity [1,24], potentially impacting the quality of care delivered and the safety of patients and healthcare workers. Inadequate infrastructure also impacts the storage and distribution of medical supplies, such as vaccines, and can impede effective disease control and prevention efforts [14,25].

The healthcare challenges in Sub-Saharan Africa are complex and require innovative solutions. FinTech has the potential to provide new ways of financing, delivering, and managing healthcare services, and can play a role in promoting sustainable healthcare development in the region. The following section will discuss the potential of FinTech in promoting sustainable healthcare development in Sub-Saharan Africa.

#### *3.2. FinTech and Its Potential for Promoting Sustainable Healthcare Development*

FinTech, with its innovative financial solutions, can significantly contribute to the sustainable development of healthcare, not just in low- and middle-income countries (LMICs) but globally. A key challenge faced worldwide is the accessibility of healthcare financing. In many instances, out-of-pocket payments constitute a substantial portion of healthcare expenditure, potentially placing individuals and families under financial stress [26]. FinTech can address this by facilitating the development of novel financial

instruments. These tools, such as micro-insurance and crowdfunding platforms, can broaden access to healthcare services across different income levels [5]. Although they can be particularly beneficial for low-income populations, these instruments have the flexibility to be tailored to meet the needs of various demographic and income groups. Significantly, these FinTech innovations can contribute to reducing the financial burden of healthcare expenses globally. By creating alternative and more accessible financing models, FinTech can play a significant role in overcoming financial barriers to healthcare and ensuring that personal economic circumstances do not limit quality care. Moreover, FinTech can enhance the efficiency and effectiveness of healthcare delivery universally. By providing streamlined digital payment methods, facilitating real-time financial data analysis, or implementing automated billing systems, FinTech can make healthcare systems more efficient and cost-effective. In this way, FinTech can contribute to a universally applicable model of healthcare that is affordable, efficient, and sustainable.

Digital innovations like mobile health (mHealth) technologies, for instance, telemedicine, have revolutionized the healthcare sector. These technologies allow healthcare providers to diagnose and treat patients remotely, enhancing healthcare accessibility for individuals residing in remote or underserved areas [27]. While FinTech primarily refers to innovations in financial technologies, its concepts and tools can offer significant benefits when applied to healthcare. For instance, using secure digital transactions can facilitate timely and efficient payments for healthcare services, reducing administrative overheads and potentially lowering healthcare costs. However, it is noteworthy that the development and implementation of electronic health records (EHRs), while being a form of digital innovation, is not directly tied to FinTech. EHRs significantly improve the quality of care by digitizing patient information. They allow for better coordination among healthcare providers by enabling the sharing of patient medical histories, which fosters more informed decision-making and cohesive care delivery [28].

#### 4. The Potential of FinTech for Sustainable Healthcare Development in Sub-Saharan Africa

The potential of financial technology (FinTech) to transform healthcare delivery and financing in Sub-Saharan Africa (SSA) is significant (Table 2). The region faces significant healthcare challenges, including limited access to healthcare services, inadequate health infrastructure, and a high disease burden. FinTech has the potential to address these challenges by providing new ways of financing, delivering, and managing healthcare services. This section discusses the potential of FinTech in promoting sustainable healthcare development in SSA, including the advantages and disadvantages of different FinTech solutions in healthcare.

**Table 2.** Advantages and disadvantages of three FinTech solutions.

FinTech Solution	Advantages	Disadvantages	Sources
Blockchain	Improves sharing of health information Enhances efficiency and transparency of healthcare financing Supports innovative healthcare delivery models	Limited adoption due to lack of digital infrastructure Data privacy and security concerns Limited awareness and understanding of technology	Kombe et al. [29] Lucero-Prisno III et al. [30]
Digital Payments	Improves access to healthcare financing Increases transparency and accountability in healthcare expenditures	Limited adoption due to lack of digital infrastructure Limited access to financial services Concerns about security and fraud	Soutter et al. [31] Neumark and Prince [32]
Crowdfunding	Improves access to healthcare financing Enables individuals and communities to contribute to healthcare costs	Limited adoption due to a lack of awareness and understanding Concerns about sustainability and equity	Kpokiri et al. [33] Renwick and Mossialos [34]

#### 4.1. Blockchain

Blockchain technology has unique attributes such as decentralization, enhanced security, and transparency that confer considerable benefits over traditional database methods, particularly in the healthcare sector within the Sub-Saharan Africa (SSA) region [35]. The primary issue in many SSA countries is the reliance on paper-based health records, which are both inefficient and susceptible to loss, damage, and unauthorized access [36]. While conventional digital databases can somewhat ameliorate these problems, they often result in siloed information, complicating inter-organizational data sharing [37]. However, a blockchain introduces a paradigm shift by providing a decentralized platform for secure and seamless health records storage and sharing among authorized healthcare providers [29]. This expedites decision-making and could improve health outcomes by enabling a comprehensive, patient-centric approach.

A notable example is mPharma, a blockchain-based platform in Ghana that has successfully developed an efficient and transparent medication supply chain. By leveraging the blockchain's immutability, mPharma facilitates end-to-end traceability of medications from manufacturers to patients, a feat typically unattainable through traditional methods, thereby reducing waste and improving patient access to medication [38].

In Kenya, the M-Tiba platform harnesses blockchain technology to facilitate access to healthcare services and payment via mobile phones [39]. Given that the traditional banking system often presents significant access challenges to the underbanked population, the blockchain ameliorates these issues by providing a secure, decentralized transaction network, eliminating the need for conventional financial intermediaries [40].

Another potential benefit of the blockchain in healthcare is its ability to improve the efficiency and transparency of healthcare financing. In many countries in Sub-Saharan Africa, healthcare financing is fragmented and inefficient, with limited access to healthcare insurance and a reliance on out-of-pocket payments. Blockchain technology can enable the development of new financial instruments, such as micro-insurance and crowdfunding platforms, that can improve access to healthcare financing and reduce the financial burden on patients [41]. Blockchain can also facilitate tracking healthcare expenditures, enabling greater transparency and accountability in using healthcare funds [35]. Additionally, the blockchain's inherent transparency ensures efficient tracking of healthcare expenditures, guaranteeing funds' intended use. This marks a significant upgrade from conventional systems where fund misappropriation or misuse can often go unnoticed due to a lack of visibility [42].

Moreover, applying blockchain technology could be particularly transformative in developing innovative healthcare delivery models in Sub-Saharan Africa, incredibly so when integrated thoughtfully to address the region's unique challenges. For instance, in the context of healthcare data, a persistent problem in Sub-Saharan Africa is the lack of a unified and secure data-sharing system amongst healthcare providers. This often results in uncoordinated care, where essential health information might be missed or duplicated. Herein lies the potential of the blockchain, not as a buzzword or generic solution, but as a targeted intervention. By creating a secure and decentralized ledger of health information, a blockchain could facilitate effective data sharing between healthcare providers, encouraging greater collaboration and care coordination [41]. Moreover, a blockchain could pave the way for decentralized healthcare systems, breaking away from traditional models burdened by costly intermediaries. This is particularly crucial in regions like Sub-Saharan Africa, where medical resources are scarce, and cost barriers often prevent access to care. A blockchain-powered healthcare model could enable direct interaction between patients and providers, potentially reducing costs and enhancing healthcare accessibility in remote and underserved areas [40]. However, it is essential to underscore that the success of such systems depends on overcoming infrastructural challenges and ensuring digital literacy among end users [43].

Despite the potential benefits of the blockchain in healthcare, there are also several challenges to its adoption in Sub-Saharan Africa. One of the critical challenges is the lack of



digital infrastructure in the region, with many areas lacking reliable internet access and mobile networks [35], potentially limiting the effectiveness of blockchain-based solutions and preventing their widespread adoption. Furthermore, there are concerns about data privacy and security, particularly in countries with limited regulatory oversight [41]. Finally, healthcare providers and policymakers need greater awareness and understanding of blockchain technology, which can slow the adoption of blockchain-based solutions.

In conclusion, blockchain technology has the potential to transform healthcare delivery and financing in Sub-Saharan Africa, improving the sharing of health information, increasing access to healthcare financing, and supporting the development of innovative healthcare delivery models. However, there are challenges to adopting a blockchain in healthcare, including the lack of digital infrastructure, data privacy concerns, and the need for greater awareness and understanding of the technology. Addressing these challenges will be essential to realizing the full potential of the blockchain in healthcare development in Sub-Saharan Africa.

#### *4.2. Crowdfunding*

Crowdfunding has emerged as a potential solution for financing healthcare development in Sub-Saharan Africa. In many countries in the region, healthcare financing is fragmented and inefficient, with limited access to healthcare insurance and a reliance on out-of-pocket payments. This situation often leads to financial barriers to healthcare access, particularly for low-income populations [44]. The main benefit of crowdfunding comes from it enabling individuals and organizations to fund specific healthcare projects or initiatives through online platforms [45]. In this section, we will critically discuss the role of crowdfunding in healthcare development in Sub-Saharan Africa, highlighting its potential benefits and challenges.

One of the key benefits of crowdfunding in healthcare development is its potential to increase access to healthcare services for underserved populations. Crowdfunding can support the development of healthcare infrastructure, such as building new healthcare facilities or renovating existing ones [46]. For example, crowdfunding campaigns raised funds to construct hospital wards in rural Sub-Saharan Africa, where access to healthcare services is limited. The campaigns are showing significant success, enabling the construction of wards and improving access to maternal healthcare services in the community [47–49]. Crowdfunding can also support the development of innovative healthcare delivery models, such as telemedicine and mobile clinics, that can increase access to healthcare services, particularly in remote and underserved areas [50].

Another potential benefit of crowdfunding in healthcare development is its ability to mobilize resources quickly and efficiently. Crowdfunding campaigns can raise funds from many individuals and organizations, providing diverse resources for healthcare initiatives [46], and this can help to overcome the limited funding available through traditional healthcare financings mechanisms, such as government budgets and development aid. Furthermore, crowdfunding can enable greater community engagement in healthcare development, empowering individuals and communities to take ownership of healthcare initiatives and contribute to their success [44].

Despite the potential benefits of crowdfunding in healthcare development, its adoption has several challenges in Sub-Saharan Africa. One of the critical challenges is the lack of digital literacy and access to technology in the region, particularly in rural areas [51]. Many potential donors and beneficiaries may not have access to the internet or be familiar with online fundraising platforms, limiting the effectiveness of crowdfunding campaigns. Furthermore, there are concerns about the sustainability of crowdfunding in healthcare development, mainly as many crowdfunding campaigns are for short-term projects and do not address the underlying healthcare financing challenges in the region [52]. Finally, there are concerns about the transparency and accountability of crowdfunding campaigns, particularly in countries with limited regulatory oversight [44].

In conclusion, crowdfunding has the potential to play a significant role in healthcare development in Sub-Saharan Africa, increasing access to healthcare services, mobilizing resources quickly and efficiently, and enabling greater community engagement in healthcare initiatives. However, there are challenges to its adoption, including the lack of digital literacy and access to technology, concerns about sustainability, and the need for greater transparency and accountability. Addressing these challenges will be essential to realizing the full potential of crowdfunding in healthcare development in Sub-Saharan Africa.

#### 4.3. Digital Payments

Digital payments can transform healthcare development in Sub-Saharan Africa, providing a secure and efficient means of financing healthcare and improving access to healthcare services. In many countries in the region, healthcare financing is fragmented and inefficient, with limited access to healthcare insurance and a reliance on out-of-pocket payments [53,54], leading to financial barriers to healthcare access, particularly for low-income populations [18]. In this section, we will critically discuss the role of digital payments in healthcare development in Sub-Saharan Africa, highlighting its potential benefits and challenges.

One of the key benefits of digital payments in healthcare development is its potential to increase access to healthcare services for underserved populations. Digital payment systems, such as mobile money, can provide secure and efficient healthcare financing, enabling individuals to pay for healthcare services using their mobile phones [53]. For example, in Madagascar and Uganda, mobile money platforms have been used to pay for maternal healthcare services, reducing the financial barriers to accessing these services and improving maternal health outcomes [55,56]. Digital payments can also support the development of innovative healthcare delivery models, such as telemedicine and mobile clinics, which can increase access to healthcare services, particularly in remote and underserved areas [53,54].

Another potential benefit of digital payments in healthcare development is its ability to improve the efficiency and transparency of healthcare financing. Digital payment systems can enable the development of new financial instruments, such as micro-insurance and health savings accounts, which can improve access to healthcare financing and reduce the financial burden on patients [55,56]. Digital payments can also facilitate tracking healthcare expenditures, enabling greater transparency and accountability in using healthcare funds [53].

Despite the potential benefits of digital payments in healthcare development, there are also several challenges to its adoption in Sub-Saharan Africa. One of the critical challenges is the lack of digital literacy and access to technology in the region, particularly in rural areas [55,56]. Many potential digital payment system users may not have internet access or be familiar with mobile money platforms, limiting the effectiveness of these solutions. Furthermore, there are concerns about the security and privacy of digital payment systems, particularly in countries with limited regulatory oversight [53]. Finally, there are concerns about the sustainability of digital payment systems, mainly as many systems rely on private sector actors, who may be motivated by profit rather than healthcare outcomes [18].

In conclusion, digital payments have the potential to play a significant role in healthcare development in Sub-Saharan Africa, increasing access to healthcare services, improving the efficiency and transparency of healthcare financing, and supporting the development of innovative healthcare delivery models. However, there are challenges to its adoption, including the lack of digital literacy and access to technology, concerns about security and privacy, and the need for sustainable financing mechanisms. Addressing these challenges will be essential to realizing the full potential of digital payments in healthcare development in Sub-Saharan Africa.

#### 4.4. Machine Learning

In recent years, machine learning (ML) has emerged as a powerful tool for healthcare development in Sub-Saharan Africa (SSA). ML algorithms can analyze large datasets to identify patterns and make predictions, enabling healthcare providers to make more accurate diagnoses and treatment decisions. ML can also support healthcare system management, improving efficiency and reducing costs. However, there are challenges to the widespread adoption of ML in SSA, including limited data availability and concerns about data privacy.

One of the critical benefits of ML in healthcare development in SSA is its potential to improve disease diagnosis and treatment. In many countries in SSA, there are limited healthcare resources, and healthcare providers face significant challenges in diagnosing and treating patients effectively. ML algorithms can analyze large datasets of patient data to identify patterns and make predictions about disease diagnosis and treatment outcomes [57]. For example, researchers in South Africa have used ML algorithms to develop a predictive model for tuberculosis treatment outcomes, enabling healthcare providers to identify patients at risk of treatment failure and adjust their treatment plans accordingly [58]. ML algorithms can also support the development of precision medicine approaches, enabling healthcare providers to tailor treatments to individual patient needs based on their genetic and other characteristics [59].

Another potential benefit of ML in healthcare development in SSA is its ability to support healthcare system management. ML algorithms can analyze large datasets of healthcare utilization data, enabling healthcare providers to identify inefficiency and target resources more effectively. For example, in Tanzania, researchers have used ML algorithms to analyze healthcare utilization data to identify areas of low service utilization, enabling healthcare providers to target resources in those areas and improve access to care [60]. ML algorithms can also support resource allocation decisions, enabling healthcare providers to decide where to allocate resources based on predicted healthcare needs [57].

Despite the potential benefits of ML in healthcare development in SSA, there are also challenges to its adoption. One of the critical challenges is limited data availability. In many countries in SSA, there are limited healthcare data available, making it challenging to develop accurate ML algorithms [59]. Furthermore, data privacy concerns can limit the availability of healthcare data, particularly in countries with limited regulatory oversight [58]. There are also concerns about the reliability of ML algorithms, particularly in healthcare contexts where accurate diagnosis and treatment decisions are critical [59].

In conclusion, ML has the potential to transform healthcare development in SSA, improving disease diagnosis and treatment, supporting healthcare system management, and reducing costs. However, there are challenges to the widespread adoption of ML in SSA, including limited data availability and concerns about data privacy. Addressing these challenges will be essential to realizing the full potential of ML in healthcare development in SSA.

#### 4.5. Case Studies and Examples of Successful FinTech Implementations in Healthcare in Sub-Saharan Africa

FinTech has the potential to revolutionize healthcare development in Sub-Saharan African countries such as Kenya, Benin, Uganda, and South Africa, contributing to access to healthcare services and reducing the financial burden on patients [61]. In recent years, several successful examples of FinTech implementations in healthcare in SSA have highlighted the potential for these technologies to transform healthcare delivery in the region.

One successful example of FinTech implementation in healthcare in SSA is the M-Tiba platform, initially developed by CarePay International in the Netherlands in 2017 and now operational in Kenya, Nigeria, and Rwanda [39]. M-Tiba is a mobile-phone-based health wallet that enables users to save money for themselves and others, facilitating payments at accredited health service providers [39,62,63]. According to Ndung'u [39], the platform employs blockchain technology to ensure secure and transparent transactions,



mitigating the risk of fraud while enhancing payment processing efficiency. Moreover, users are encouraged to save as much as possible to afford full payment for healthcare services. As early as June 2017, M-Tiba registered nearly 900,000 users, providing them access to 450 health facilities, and processed payments totaling USD 1.4 million over 100,000 visits. Furthermore, the system has contributed to expedited delivery of life-saving medical products in rural areas, extending healthcare inclusion in Rwanda and Kenya. By reducing financial barriers to healthcare access, M-Tiba has significantly improved health outcomes in the region, particularly for low-income populations [62,63]. Its success showcases the potential of FinTech to enhance healthcare delivery in Sub-Saharan Africa.

Telemedicine in South Africa, as epitomized by Hello Doctor, faces significant regulatory constraints and uncertainties [64,65]. Despite providing a suite of services, including teleconsultations and online payment options, being less costly (approximately \$13.40) than their face-to-face counterparts (around \$18.76 to \$24.12), and its potential to attend to 30% of the country's primary healthcare cases, Hello Doctor came under scrutiny from the Health Professions Council of South Africa (HPCSA), which questioned aspects of patient rights and the viability of telemedicine practices without physical examinations [64]. Current regulations, as enforced by HPCSA, have been shown to limit the growth and development of telemedicine, despite promising advancements in technology, such as mobile applications and wearable devices [65]. As a result of these regulatory challenges, Hello Doctor's offerings are limited to providing advice rather than integrating insurance, credit, and savings components. This situation underscores how the telemedicine model in South Africa must adapt to its unique legal environment [66].

In Ghana, a blockchain-based platform called mPharma tracks the distribution of medications, reducing waste and improving patient access to medication [67–70]. The platform enables healthcare providers to monitor medication distribution in real-time, reducing stockout risk and ensuring patients can access the needed medications. mPharma has successfully improved medication access in Ghana, particularly for low-income populations [67,68,70].

Another successful FinTech implementation in healthcare in SSA is the JamiiPay platform in Tanzania. JamiiPay is a mobile payment platform enabling users to pay for healthcare services using mobile phones [71–73]. The platform has successfully improved access to healthcare services in Tanzania, particularly in rural and underserved areas where traditional payment methods are often unavailable. By reducing financial barriers to healthcare access, JamiiPay has improved health outcomes in the region, particularly for low-income populations [71,73].

Despite the success of these FinTech implementations in healthcare in SSA, there are also challenges to their widespread adoption. One of the critical challenges is limited digital infrastructure, particularly in remote and underserved areas where internet connectivity and mobile networks may be unreliable or unavailable [74]. There are also concerns about the reliability and accuracy of these technologies, particularly in healthcare contexts where accurate diagnosis and treatment decisions are critical [62,63].

In conclusion, FinTech has the potential to transform healthcare development in SSA, improving access to healthcare services and reducing the financial burden on patients. Several successful examples of FinTech implementations in healthcare in SSA have highlighted the potential for these technologies to transform healthcare delivery in the region. However, there are also challenges to their widespread adoption, and further research is needed to understand their impact on healthcare outcomes in the region.

## 5. Barriers and Challenges to FinTech Adoption in Sub-Saharan Africa

While FinTech has the potential to transform healthcare delivery in Sub-Saharan Africa (SSA), there are significant barriers to its widespread adoption in the region. These barriers include limited access to technology, regulatory challenges, and cultural factors. Addressing these barriers will be essential to realizing the full potential of FinTech in healthcare development in SSA.

One significant barrier to FinTech adoption in SSA is limited access to technology, particularly in rural and underserved areas. While mobile phone penetration is high in the region, access to other technologies, such as internet connectivity and digital devices, remains limited [62,63], potentially limiting the effectiveness of FinTech solutions, particularly those that rely on internet connectivity, such as telemedicine and digital payments.

Regulatory challenges are another barrier to FinTech adoption in SSA. Many countries in the region lack clear regulations governing FinTech, which can limit the development and implementation of new solutions [75]. Additionally, there are concerns about data privacy and security in the region, particularly in countries with limited regulatory oversight, which can hinder the adoption of FinTech solutions [62].

Cultural factors also play a role in the adoption of FinTech in SSA. Many people in the region are hesitant to adopt new technologies, particularly those that are unfamiliar or perceived as unreliable [76,77], possibly reducing the uptake of FinTech solutions, particularly among older or more traditional populations.

Several potential solutions can address the barriers. One solution is to partner with local organizations and governments to develop and implement FinTech solutions tailored to the region's needs and capabilities [78,79]. This approach can help to ensure that FinTech solutions are culturally appropriate, accessible, and sustainable.

Capacity building is another potential solution to address the region's limited access to technology and regulatory challenges. This solution involves investing in the training and education of healthcare providers, policymakers, and other stakeholders to ensure they have the skills and knowledge to develop and implement FinTech solutions [57,73] effectively.

Increased financial investment is also essential for digital infrastructure, such as internet connectivity and digital devices, and investment in research and development to create new and innovative FinTech solutions tailored to the region's needs [80].

In conclusion, while significant barriers exist to adopting FinTech in healthcare in SSA, several potential solutions exist to address these barriers. These solutions include partnering with local organizations and governments, capacity building, and increased financial investment. Addressing these barriers will be essential to realizing the full potential of FinTech in healthcare development in SSA, improving access to healthcare services, and reducing the financial burden on patients.

## **6. Ethical and Social Implications of FinTech in Healthcare in Sub-Saharan Africa**

### *6.1. Examining Key Ethical and Social Considerations in Healthcare FinTech*

The application of financial technology (FinTech) in healthcare development in Sub-Saharan Africa (SSA) can transform the healthcare landscape in the region, providing new opportunities for healthcare financing, delivery, and management. However, adopting FinTech in healthcare development in SSA raises important ethical and social implications.

One of the ethical implications of FinTech in healthcare development in SSA is data privacy and security. FinTech solutions in healthcare often require collecting and storing sensitive personal health information, such as medical histories and test results. Using blockchain technology and other decentralized systems in FinTech solutions can enhance data privacy and security by enabling secure data sharing between healthcare providers. However, there are still concerns about the potential misuse of personal data, particularly in countries with limited regulatory oversight [81].

Another ethical implication of FinTech in healthcare development in SSA is the potential for financial exploitation. Crowdfunding and other innovative financing mechanisms can increase access to healthcare financing for underserved populations, but there is a risk that these mechanisms could be exploited for fraudulent or unethical purposes [82,83]. For example, there is a risk that some crowdfunding campaigns fund unproven or potentially harmful medical treatments.

Adopting FinTech in healthcare development in SSA also raises critical social implications. One of these implications is the potential for exacerbating existing health inequalities.

FinTech solutions in healthcare may not be accessible to all populations, particularly those without access to digital technologies or financial services. This situation could lead to a widening gap in healthcare access between those who can afford FinTech solutions and those who cannot [84,85].

Another social implication of FinTech in healthcare development in SSA is the potential for disrupting existing healthcare systems and social structures. Adopting FinTech solutions in healthcare may change healthcare providers' and patients' roles and responsibilities, potentially losing trust and social cohesion in healthcare systems. Additionally, adopting FinTech solutions may shift healthcare delivery away from traditional healthcare settings, potentially leading to a loss of community-based healthcare [81].

Several strategies can be adopted to mitigate the ethical and social implications of FinTech in healthcare development in SSA. One strategy ensures that FinTech healthcare solutions focus on ethical and social responsibility, including data privacy and security, financial transparency, and social equity [86,87]. Additionally, policymakers and healthcare providers can work to increase public awareness and education about the benefits and risks of FinTech solutions in healthcare, enabling patients and communities to make informed decisions about their healthcare [81].

Adopting FinTech in healthcare development in SSA can potentially transform healthcare delivery, financing, and management in the region, but it also raises important ethical and social implications. Data privacy and security, financial exploitation, health inequality, and social disruption are all potential implications of FinTech adoption in healthcare in SSA. It is essential to design FinTech solutions in healthcare with a focus on ethical and social responsibility and to increase public awareness and education about the benefits and risks of FinTech solutions in healthcare to mitigate these implications.

#### *6.2. Addressing Ethical and Social Challenges: Privacy, Data Security, Equity, and Accessibility*

Adopting FinTech in healthcare can transform healthcare delivery in Sub-Saharan Africa (SSA), potentially enhancing access to healthcare services and improving outcomes for countless individuals. However, this new technological frontier also presents critical ethical and social challenges concerning privacy, data security, equity, and accessibility.

Privacy is a paramount concern within the context of FinTech in healthcare. The digitization of healthcare operations generates much personal health data, necessitating robust measures to protect this data from unauthorized access and misuse [88,89]. In regions like SSA, where data privacy laws may be underdeveloped or absent, the utilization of FinTech in healthcare presents significant privacy concerns. There is a real risk of patient privacy compromise, which could lead to data breaches and identity theft [90].

Data security is a similarly pressing issue. Integrating digital technologies and cloud computing into healthcare raises the specter of data breaches, cyber-attacks, and system failures, all of which threaten patient safety and privacy [90]. In regions like SSA, with potentially underdeveloped digital infrastructure and cybersecurity measures, the introduction of FinTech to healthcare heightens the risk of data security breaches, potentially compromising patient safety [90,91].

Equity and accessibility are two intertwined ethical and social considerations that must be addressed when implementing FinTech in healthcare. While FinTech holds promise for increasing healthcare service accessibility and enhancing health outcomes for underserved populations, there is a valid concern that such technologies might inadvertently amplify existing healthcare inequalities [88]. If FinTech solutions are unaffordable or inaccessible to low-income populations, their impact on regional health disparities may be limited [92,93].

Moreover, the use of FinTech in healthcare may unintentionally widen the digital divide in SSA, a region where many individuals lack access to digital technologies and familiarity with digital platforms [88]. This increased digital divide might create new barriers to healthcare access and perpetuate existing health disparities.

A few practical solutions can be pursued to address these ethical and social issues. For instance, developing and implementing comprehensive data privacy and security policies

and regulations could provide robust protection for patient data and mitigate the risk of data breaches [91,94]. Measures may include using secure encryption protocols, creating secure data storage and transmission systems, and providing privacy and security training for healthcare providers and patients.

Furthermore, to ensure equity and accessibility, FinTech solutions should be designed to be affordable and tailored to meet the needs and capabilities of underserved populations [88,89]. Collaborations with local organizations and governments can aid in developing and implementing culturally appropriate, accessible, and sustainable FinTech solutions. Investing in digital infrastructure and capacity building can also ensure that healthcare providers and patients possess the necessary skills and resources to utilize FinTech solutions effectively.

In summary, the potential of FinTech to revolutionize healthcare delivery and outcomes in SSA must be balanced against the ethical and social issues it raises, such as those related to privacy, data security, equity, and accessibility. Addressing these concerns is critical to harnessing the full potential of FinTech for healthcare development in the region and ensuring that its deployment is safe, equitable, and beneficial.

## 7. Conclusions and Future Directions

This narrative review has shed light on the transformative potential of FinTech to advance sustainable and equitable healthcare development in Sub-Saharan Africa. The significant areas where FinTech could affect meaningful change include digital payments, crowdfunding, machine learning, and blockchain technology. These innovations can enhance access to healthcare services, foster transparency and accountability in healthcare financing, and enrich health information sharing and analysis.

Despite this potential, barriers to the adoption of FinTech persist. Limited access to technology, regulatory hurdles, cultural factors, and ethical and social implications may constrain the comprehensive adoption of FinTech solutions within healthcare systems. Therefore, these barriers must be systematically addressed to fully capitalize on FinTech's potential for healthcare development in Sub-Saharan Africa.

In alignment with this, the review proposes several avenues for overcoming these challenges. These include forging partnerships with local organizations and governments, enhancing capacity-building initiatives, increasing financial investment, and developing culturally sensitive, sustainable solutions.

Future research should emphasize addressing the ethical and social implications associated with the application of FinTech in healthcare, such as data privacy, security, equity, and accessibility. Research efforts should prioritize local communities' and stakeholders' needs and perspectives to ensure impactful and meaningful advancements, actively involving them in the development and implementation stages.

## 8. Study Limitations

Despite the comprehensive nature of this review, several limitations must be acknowledged. First, the study was restricted to articles published in English between 2010 and 2022 in recognized academic databases, namely PubMed, Scopus, and Google Scholar. The selection of only English-language articles might have excluded relevant studies published in other languages. Similarly, excluding grey literature, such as reports and conference proceedings, may have missed potentially valuable insights. Secondly, the choice to focus on specific FinTech applications such as blockchain, crowdfunding, digital payments, and machine learning might have led to overlooking other potentially significant FinTech innovations contributing to healthcare development in Sub-Saharan Africa.

Additionally, despite the thematic approach to data synthesis, the narrative nature of this review might have introduced some subjective bias in interpreting and synthesizing the information. Furthermore, it is also worth noting that the narrative review approach, while effective for mapping out the broad features of a research topic, does not allow for the statistical analysis of data, unlike systematic reviews and meta-analyses. This limits

the ability to provide quantitative assessments of the extent and impact of FinTech on healthcare in Sub-Saharan Africa. Lastly, the complex and dynamic nature of healthcare systems and technological innovations means the situation may evolve rapidly. New technologies, policies, and strategies may emerge post our review period, which may not have been captured in this review. Therefore, the findings presented here should be interpreted within the context of these limitations.

Identifying these limitations can guide future research by highlighting the need for broader language inclusion, consideration of other forms of literature, a more diverse exploration of FinTech applications, and more robust research methodologies such as systematic reviews and meta-analyses.

## 9. Summary of Key Findings

- FinTech can significantly enhance healthcare delivery and financing in Sub-Saharan Africa, especially in information sharing, healthcare financing, and healthcare delivery models. Future research should include a detailed study of the impact of FinTech on specific aspects of healthcare delivery, such as patient care, healthcare financing, and information sharing.
- Blockchain, crowdfunding, digital payments, and machine learning are notable in improving regional healthcare. Future research avenues can examine the application and success of specific FinTech innovations, like blockchain and machine learning, within healthcare in Sub-Saharan Africa.
- Barriers to FinTech adoption in the region include limited access to technology, regulatory challenges, cultural factors, and ethical and social implications. Future research should focus on strategies to overcome regulatory, technological, and cultural barriers to FinTech adoption.
- Solutions to these barriers may include capacity building, increased financial investment, and culturally sensitive and sustainable solutions. The effectiveness of proposed solutions in overcoming barriers to FinTech adoption, such as capacity building and increased investment, should be explored in future research.
- Ethical and social implications of FinTech in healthcare development include privacy, data security, equity, and accessibility. Future research avenues should examine the ethical and social implications of FinTech adoption in healthcare, focusing on data privacy, security, and equity.
- Active involvement of local communities and stakeholders in the development and implementation stages is crucial. Future research should investigate strategies for incorporating local communities and stakeholders into the development and implementation of FinTech in healthcare.

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