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The Role of Blockchain Technology in Promoting Health Services in Africa: A Literature Review Perspective

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Abstract

The delivery of adequate healthcare services in Africa has remained a significant problem that keeps leading to high mortality levels and affects the achievement of the Sustainable Development Goals in Africa. The healthcare industry in Africa still faces many challenges that have prevented the delivery of adequate health services. The paper found that using blockchain technology ensures the integrity of all medical records. It can secure the transfer of patient medical records from one hospital to another. It can strengthen healthcare data defences and manage the medicine supply chain. Moreover, the paper found that blockchain can prevent the circulation of fake drugs and unlawful tax evasion schemes. The use of blockchain technology in healthcare was found helpful in reducing the illegal trading of medical products, counterfeit drugs, and corruption and can speed up medical treatments, as well as lower financial costs. It increases accountability and transparency of recorded health information and creates a common source of truth, identity, authentication, and verification. The role of blockchain technology in healthcare has proved to be significant. Hence, there is a need for the governments in Africa to adopt blockchain technology in healthcare services to achieve good health and well-being for sustainable development. To achieve those assertions, the paper adopted a qualitative research methodology with an explanatory approach.

Keywords: *Africa, Blockchain technology, Health services, Medical records, Sustainable Development Goals.*

1. Introduction

Delivering adequate and quality healthcare services in Africa has remained a significant challenge in Africa. Most African states, mainly in the sub-Saharan region, cannot deliver health services and meet basic requirements for sound healthcare systems. The issues of poor governance, financial constraints, corruption, excessive waiting time when one is in the hospital, and human resources have intensified the delivery of inadequate health services in Africa. Other healthcare system problems prevalent in Africa include chronic poverty that has deepened financial constraints. These problems have affected the effectiveness of national health insurance systems, thus leading to the delivery of poor health services (Romdhane et al., 2015). It has been noted that the healthcare industry in Africa has failed to deliver adequate health services because of a lack of personnel, inadequate finances, incomplete medical

records, counterfeit drugs, corruption within the industry, and lack of governance (WHO, 2007, p.4).

This paper aims to conduct a literature review analysis to understand the role of blockchain in healthcare. The research question the paper sought to answer is: What is the role of blockchain in promoting healthcare services in Africa? The paper is structured into five main sections. While the first section provides an introduction and background, the second section explains the research methodology used to collect and analyse data. The third section explains the theoretical framework underpinning blockchain technology use. The fourth section assesses the role of blockchain in the healthcare sector and in enhancing the provision of adequate health services. The fifth section consists of concluding remarks on the paper.

2. Introduction and Background

Globally, financing the healthcare industry takes a lot of the gross domestic product (GDP) and its time-consuming (OECD, 2018). This industry includes the generalisation and commodification of goods and services to treat patients with curative, preventive, rehabilitative, and palliative care. Katuwal et al. (2018, pp. 2-3) argued that transparency in the whole process of enabling data sharing between multiple parties, even though supposedly beneficial to the patient, still lacks full transparency and control from the patient's view (Katuwal et al., 2018, pp. 2-3). Nonetheless, numerous patients have echoed that their medical data have been used by for-profit entities (Bell et al., 2014).

Healthcare data management is being revolutionised, it aims to provide improved tracking of diseases, treatment, quality of medical care, and drugs (Ismail et al., 2019). The quick take-up of digitalisation in medical administrations has stirred up the time of vast electronic records about patients. Such development presents extraordinary requests for healthcare information security while being used and traded. Certainly, blockchain technology applications to healthcare industry would promote medical research and promote the delivery of adequate health services (Yli-Huumo et al., 2016, pp. 12-13). According to Attaran (2020, pp. 3-4), the following reflect the status of healthcare record keeping and medical history in Africa:

- relying on the interaction between the physician and the patient;
- not taking advantage of data;

- creating a long and tiring process of attaining healthcare;
- important patient information being spread in various systems;
- lack of data availability, hence failure to provide the required treatment for patients;
- most stakeholders in the healthcare industry not being equipped with the correct information, negatively impacting the management system; and
- poor data reliability and security.

Thus, vast opportunities are opened for healthcare computing (Yli-Huumo et al. 2016: 13). In developing countries, particularly in African countries, the healthcare system is in dire need, an issue that continues to lead to high levels of mortality and low life expectancy. Kaseje (2006) argued that overall, the healthcare sector in sub-Saharan Africa continues to show less signs of growth. For example, the South African healthcare system suffers from poor management, underfunding, and deteriorating infrastructure and is increasingly inequitable and inaccessible to many South Africans (Health et al., 2017). One can see the above challenges have intensified the burden of diseases and a shortage of essential medical personnel. It is significant to note that this problem does not only present itself in South Africa and Kenya, but it cuts across the continent.

For example, in African countries like Kenya, there has been a lack of health measures that would increase the sharing of public health expenditure in primary healthcare. The introduction of the Health Sector Services Fund (HSSF) was aimed to promote good health services to the citizens and enable them to achieve good health. However, due to the lack of health facilities, coupled with corruption and counterfeited drugs in the market, the above goal has not yet been achieved. There are still gaps in addressing corruption, counterfeit drugs, and facilities to keep and maintain medical health records. These gaps have led to numerous patients failing to pay for healthcare services and promoted increased fraud and fake drug circulation in the country. It has compromised the citizens' health and, therefore, resulted in high mortality levels in the country. McClean et al. (2014, p. 192) argued that delivering adequate health services at global level has encountered problems frequently, leading to increased costs. The healthcare sector is complicated with fewer medical practitioners that possess lesser expertise (McClean et al. 2014:192), including other physicians, researchers, and patients facing several challenges related to patient data and workflow. For instance,

information security concerns are intensified by information sharing instructions, and the 'fear of monetary consequences associated with information splitting' stymies the exchange of helpful health data (Zhang, 2018).

As argued by Kaseje (2006), an appropriate, robust, and sustainable model for improvement in health system performance is essential to overturn the declining trends in health and development status and break the vicious cycle of poverty and ill health in Africa (Beegle et al., 2016). However, the healthcare system in Kenya presents a gap between the patient, the doctor, and the government as well. This gap has made it unfeasible for the country to achieve an improved healthcare system that would benefit human development (World Bank, 2013). Doctors in Kenya are not well paid, leading to social protests in the country. Some medical doctors have sought employment in private hospitals (Okech, 2017). Countries are not sufficiently equipped to handle industrial unrest of this magnitude, creating yet another gap. While many policymakers and analysts have expressed fears of a high mortality rate in the country, however, there has been no solution advanced to address this problem.

Other scholars have equally argued that Africa will not be able to provide a satisfactory healthcare system to its inhabitants by 2020 because of the prevalence of poverty. It is through human solid resources that poverty can be overcome and strategic development goals achieved (WHO, 2019). One of the solutions to this persistent problem advanced in this study is the application of blockchain in the healthcare system in Africa, particularly in Kenya. Medical research scholars in the country have not yet paid attention to the blockchain's role in leading to a robust healthcare system that supports the government, protects the patients, and enables them to pay their medical bills. It also secures the patients' information and stops the use of fraudulent drugs, hence the subsequent reduction of the high rate of mortality in the country. The study will, therefore, contribute to a new body of knowledge on the relationship between the effects of blockchain and health outcomes.

3. Blockchain Defined

Attaran (2020, p. 2) defined blockchain as a "decentralised, continuously growing list of records, called 'blocks,' that are linked together in the chain through a process called mining." It is used in the healthcare; it presents a smart healthcare that depends of chains of technology that enable the delivery of health services (McClean et al., 2014, p. 191).

Blockchain technology has entered the healthcare sector (Courbe, 2016), and is revolutionising the healthcare industry. Flament (2015:7) suggested that blockchain is a general-purpose technology (GPT). This financial public registry can disrupt societies and their governments like the steam engine, internal combustion engine, and electricity and information technologies. However, much of the attention around blockchain has focused on cryptocurrency, primarily Bitcoin, and the effect that blockchain is predicted to have on the financial sector (Nakamoto, 2008). The healthcare sector has various problems that blockchain technology can resolve (Petersson & Baur, 2018).

4. Research Methodology

The study adopted a qualitative methodology to collect data (Bangani & Vyas-Doorgapersad, 2020, p. 2) to comprehend the role and effects of blockchain technology in promoting adequate delivery of health services. Qualitative research methodology was used because of its inductiveness and the fact that the aim was to explore meanings and insights (Levitt et al., 2017) on blockchain technology's role and effects in delivering adequate healthcare services. The paper used secondary data drawn from existing literature. This is to say that the paper did not venture into the use of primary data collected via interview processes. Secondary data collected from literature that exists in the public domain (Pederson, Vingilis, Wickens, Koval, & Mann, 2020). This type of data in the paper enabled us to explore and analyse the effects and role of blockchain technology in promoting adequate health services. This data helped explore events and trends related to the causes of inadequate healthcare services and understand the effects of such inadequacy on people's well-being and health (Pederson et al., 2020). Moreover, secondary data is already available, enabling the researchers to conduct the study on time without longer timelines (Pederson et al., 2020). In this paper, secondary data became administrative data, making the researchers gather data that enabled them to answer the research question of this paper.

4.1 Data collection

Data was collected from secondary data sources. Secondary data is data that individuals or agencies have collected for purposes other than our research study. Secondary data is data that persons or agencies collect for purposes other than solving the problem (Aaker et al., 2001). Punch

(2005) defined it as reanalysing previously collected and analysed data. It plays a significant role in public health research and practice. Data collected from the literature review provided enough information to understand the role of blockchain technology in promoting quality healthcare services. This paper's data was sourced from scholarly articles and media reporting from the Internet. The initial research was done to learn more about the role and prospects of blockchain technology in promoting quality healthcare services. The researchers decided to opt for secondary data because of time constraints and the fact that it was cost-effective. Literature was easy to access on the Internet, and there was enough information to peruse and analyse the data that address the topic.

Taylor (2021) argued that online data gathering is a prevalent method for secondary data. Online data gathering offered access to a high volume of free and paid sources that enabled the researchers to collect information that helped them understand the potential of blockchain technology in healthcare. For this paper, online data collection saved time and enabled the collection of a more extensive data set (Taylor, 2021). Vartanian (2011, pp. 13-14) stated that secondary data is cost-effective and takes less time to organise. Using secondary data was beneficial because data was already in the public domain, and requesting permission or consent from participants was not required (Taylor, 2021). Therefore, this paper's information was collected and explained without an intrusion of social conflict (Hyman, 1972, p. 8).

4.2 Data interpretation techniques

William (2003) and Kiecolt and Nathan (1985) argued that secondary data interpretation means analysing findings collected from data collected from sources that were in the public domain. Bradbury (2001) stated that secondary data interpretation is data analysis by anyone other than those initially responsible for its original commissioning. The findings were interpreted through qualitative content analysis techniques. The collected data were compiled and analysed to answer the research question and understand blockchain technology's role in the healthcare sector. During the data analysis, qualitative content analysis became a flexible method that helped in studying and analysing collected data from the literature (Cavanagh, 1997). The use of this technique was supported by McTavish and Pirro (1990, p. 251) who argued that it is a technique used to analyse the text data collected from literature reviews. The technique was strictly used to analyse textual findings (Rosengren, 1981; Downe-Wamboldt,

1992). It helped understand the role of blockchain technology in improving the provision of adequate healthcare services to the people. Qualitative content analysis helped to understand blockchain technology's role in the healthcare sector. Researchers were able to construct specific frameworks of thinking that assisted in understanding the challenges within the healthcare sector in Africa and the factors making blockchain offer sustainable solutions to them.

5. Theoretical Framework

The paper adopted innovation theory to understand blockchain technology's role in promoting healthcare services in Africa. Innovation theory is made of diffusion and innovation. The theory was understood as the ability and capacity to see connections (Bessant & Tidd, 2007). It is a process of "changing and turning ideas into concrete realities" (Kingston, 2012). This means that innovation always brings something new into existence (Sloane, 2003). Innovations are driven mainly by market demand and technological shifts (Chidamber, 1993). In its characteristics, Sahin (2006, p. 1) noted that innovation theory enables one to understand the reasons that digital technologies increase openness, transparency, and public participation.

The theory enables one to understand that applying blockchain technology to healthcare would enhance good governance within the sector. It would lead to openness and transparency, thus increasing trust between patients and medical practitioners. However, obstacles such as the digital gap, financial constraints, weak Internet infrastructure, digital illiteracy, and uncertainty among ordinary citizens or patients may hinder the effective and efficient implementation of blockchain technology innovation in the healthcare industry. Rogers (2003) opined that the time component during public service delivery is frequently overlooked in behavioural studies. Blockchain technology applied to healthcare would enable the delivery of health services in a short time, thus reducing mortality rates in Africa.

6. The Role of Blockchain Technology in the Healthcare Sector

The use of blockchain in the healthcare sector is vital and timely. Blockchain technology has paved the way for new capabilities in dealing with vast amounts of data security, security problems, and honesty in medical treatment (Yaeger et al., 2019, p. 2). Blockchain is an

extraordinary force in health care (Yaeger et al., 2019, p. 2). It protects Electronic Health Records (EHRs) and uses cryptography to help safeguard patient data (Koteska & Mishev, 2017). Blockchain technology has transformed the delivery of adequate health services such that medical personnel and other healthcare institutions benefit from its promising competence within the healthcare industry. Its use has authenticated records storage of medical records, and interoperability security system (Kuo et al., 2017, pp. 1220-1221).

6.1 Blockchain technology in healthcare insurance

Blockchain technology used in the healthcare industry addresses fraud claims, as it keeps track of medical data or information and any illegal transaction that may entrench corruption and corrupt arrangements. It is only logical to use blockchain in health insurance to streamline the routine check-up process correctly. It would help the user choose a doctor based on the doctor's experience and the patient's history, judging the insurance policies imposed. Insurance companies can rely on blockchain technology to verify resistant records and stop their illegal use without the consent of the patients (Zhou et al., 2018, p. 149). Insurance claims shall take full advantage of blockchain's features like transparency, suitability, etc. On the Ethereum blockchain, a blockchain-based clinical protection stockpiling architecture was suggested. The medical insurance data stored is encrypted and immutable.

6.2 Role of blockchain technology in health information exchange

Health information exchange (HIE) is a data exchange mechanism that improves healthcare services and reduces medical errors that may affect the delivery of quality health services (Edaibat et al., 2017). It means the transfer of patient health records to other medical practitioners and institutions via online platforms (Vest & Gamm, 2010, p. 291). Public and private healthcare organisations utilise different sharing mechanisms to accelerate information exchange initiatives (Lenert et al., 2012, p. 493). Past research in HIE indicates that healthcare entities mainly apply the following three exchange models to transmit patient health information electronically: (1) direct, (2) query-based, and (3) patient-centred exchange (Campion et al., 2013, p. 815). A health provider using blockchain technology can share encrypted patient medical records with a known recipient (Williams et al., 2012, p. 530). The use of blockchain

technology can keep medical health records and prevent any unauthorised use in hospitals. Moreover, the technology can give researchers access to medical data for a certain period. This is termed "patient-centred interoperability, which differs from the current institution-driven interoperability" (Yoon, 2019, p. 1).

Patients' concerns in medical practices include the volume of medical records collected and stored in healthcare organisations' databases and the possibility of privacy violations (Agaku et al., 2014, p. 374). Khezr et al. (2019:7) argued that "the technology used in cloud storage has the following advantages: fast transmission, easy access, good sharing capacity, large storage capacity, dynamic association, and is less expensive". It has been noted that the character of therapy is influenced by clinical records in well-being information (Subramanian et al., 2020). Consequently, adequately informed knowledge allows the patient to receive the appropriate therapy. This shows that accurate medical health records is crucial in achieving good and quality health services that lead to well-being and good health.

Yue et al. (2016, p. 218) further stated that blockchain technology protects and validates medical data exchange among different stakeholders. Blockchain technology has been suggested as an underpinning infrastructure for health information exchange to improve medical data storage, information exchange, and medical record management (Mettler, 2016, pp. 1–3). Recent studies also advance the adoption of blockchain-based data-sharing networks to analyse secondary medical data for biomedical research purposes (Peterson et al. 2016).

According to Crosby et al. (2016, p. 7), blockchain's underlying features make it possible to transform current business models fundamentally. As the interest in this technology has been rising, blockchain is stimulating a great deal of attention and investment from numerous projects in different sections (Nofer et al., 2017, pp. 183-187). The technology uses the immutability and built-in autonomy features of the blockchain to efficiently enable the access to medical data stored in online stores (Giungato et al., 2017). According to Xia et al. (2017, p.44), the blockchain technology used in healthcare organisations can hasten control of medical data sharing with other institutions. This technology provides secure cryptographic techniques to control access to medical health data stored in online stores. Moreover, the cryptographic protocol used by blockchain technology permits communications security over a computer network. Using smart contracts embedded in blockchain

technology, healthcare institutions can tap into the automated execution of business interactions to notably decrease the need for most office operations in the sharing process (Fromknecht et al., 2014, p. 13).

Blockchain technology is efficient and effective in record keeping, older information is less essential, and data growth is steady and continuous. Therefore, blockchain technology is being recommended to secure DNA data, healthcare records, personal information, and other important medical history data. This enables medical practitioners and researchers to access the records anytime and anywhere in the world. Blockchain technology, therefore, puts patients at the centre because it enables them to have access to their data. The integrated systems of blockchain help pacify records and eliminate fraudulent activities (Attaran, 2020, p. 4).

Blockchain Technology	Type of Data	Merits	Limitations
• The MultiChain platform do not rely on the Proof-of-work. • Private blockchain.	EHR	• Sharing of health data and securely improving audit logging.	• Except for the EU, no other cross border country is discussed.
• Private blockchain.	EHR and PHR	• Smart App based on blockchain to control and share healthcare data.	• No consideration for scalability and availability. • Data sharing is limited.
• Proof-of-stake. • Private blockchain.	Medical image records	• Securely sharing medical images.	• No consideration of data searching [73].
• Hybrid consensus mechanism based on practical byzantine fault tolerance. • Proof-of-stake.	EMR	• Securely sharing of healthcare data.	• Medblock failed to provide enough privacy for the patient's identity and energy efficiency [88].
• Proof-of-work.	Location	• Multi-layer location sharing schema.	• No discussion provided about under which critical condition a patient's location data will be retrieved.
Undefined.	EHR	• Securely sharing of healthcare data.	• High storage overhead and the breadcrumbs mechanism is looking up a single record.
• Ethereum platform. • Proof-of-work.	Medical records	• EHR management and sharing of healthcare data.	• No consideration of key replacement capability.
• Ethereum platform.	EHR	• Data management in the cloud environment. • High scalability.	• Practically not feasible.
• Hyperledger platform.	Medical records	• Managing personal data in the e-health.	• There is no access control and exhaustive authorization consideration [90,91].
• Ethereum platform.	Healthcare data	• Cost effective smart contracts.	• No consideration of interoperability between different parties.
• Undefined.	EMR	• Store and manage EMR in a cloud environment.	• The exact cost of the system is not known.
• Undefined	PHR	• Patients control their personal medical data.	• Interoperability is not tested across several healthcare parties.
• Undefined.	EHR	• Facilitate the privacy of patients and maintain the immutability of EHRs by attribute-based signature scheme.	• This system is not cost-effective for large number of users.
• Consortium blockchain.	Medical records	• Coupling encryption, and signature for robust security.	• The system is not fully automated.
• Undefined.	PHR and EHR	• High control access-enhanced mobility.	• The input data to OmniPHR framework must be in the format of OmniPHR standard otherwise rejected [54].
• Undefined.	Medical records	• Securing and managing medical records by using a genetic algorithm.	• It is very difficult to verify the level of security offered by this system.

Merits and limitations of blockchain in healthcare, adapted from Khezr et al. (2019, p. 9).

The key characteristics of blockchain, from now on referred to as "effects," are immutability, data provenance, decentralisation, transparency, open source, and anonymity. It is vital to note that blockchain's effects help overcome challenges in the healthcare industry today. These challenges include interoperability, security, integrity, traceability, and universal access (Rawal et al., 2018). Thus, blockchain technology enables transparency by eliminating third-party middlemen using consensus mechanisms, including cryptography, to confirm the legitimacy of various transactions (Khezr et al., 2019, p. 1). The effects of blockchain in the healthcare sector seem imminent. Blockchain technology used in healthcare enhances the protection of medical health records; data privacy and ownership; data sharing; traceability; and accountability of data (Frost & Sullivan, 2017).

One of the significant problems facing the healthcare industry is the existence of counterfeit drugs, where 15% of drugs sold in the Third World countries are fake; blockchain encourages security, visibility, and drug traceability (Attaran, 2020, p. 6). Pharmaceutical companies sustain losses of millions annually due to counterfeit drugs (Behner et al., 2017). It is important to note that the product's journey from the manufacturer to the consumer has multiple stages: transportation, handling, storage, redistribution, and retail. Things can go wrong during these stages, from a simple human error to malicious intent or fraud. Blockchain helps address supply chain issues by providing a distributed ledger shared among all the stakeholders within the supply chain (Kuo et al., 2017).

Any medical records entered in the blockchain at each stage in the supply chain are immutable, permanent, and decentralised, and limit any possibility of introducing errors or fraud. It prevents counterfeit drugs by keeping a chain of custody log that lets organisations track each supply chain step at an individual drug or product level (Petersson & Baur, 2018). With a blockchain system in place, even the end consumer now has all the information regarding the product, from creation to consumption (Waruingi et al., 2019). With trust built into the blockchain database, there is a high degree of transparency. Records are publicly writable by anyone, owned and stored by no one, with data security being provided through encryption. Blockchain technology, through the application of private and public key cryptography, a shared ledger, can foster information sharing and community-driven clinical study (Emem, 2018). It enables the patients to directly control their medical data and

rights to grant or withdraw data access to caregivers and organisations. This becomes crucial in providing quality health services and helps research centres to secure access to a vast repository of holistic and accurate clinical data, thus promoting adequate health services (Waruingi et al., 2019).

Blockchain trusted systems would also help drive medical research for concepts such as precision medicine, population health research, and clinical trials (Chandler, 2019). Blockchain technology helps to maintain the authenticity of documents as they can be confirmed and data integrity because the distributed network makes sure that data cannot be changed without authorised access (Attaran, 2020, pp. 6-7). Blockchain network consensus with innovative contrasting features would help in maintaining a benefits database and determining patient insurance for self-execution as per pre-programmed terms and conditions (Ancapetre, 2018). It can also advance pay for outcomes and incentive-based behavioural health programmes and peer-to-peer insurance models (Hans et al., 2017).

Blockchain-based distributed network consensus with cryptography techniques would provide an additional layer of trust to decrease cyber security threats for medical devices and embedded IT systems (Chandler, 2019). Blockchain systems could also provide a more dependable and secure strategy for medical device identity management to promote Internet of Medical Technology (IoMT) applications and smart contracts to automate device life cycle management (Puthal et al., 2018). Blockchain would also help to upgrade patient privacy by providing secure and selective access to patient-generated health data. No other known blockchain study that covers these gaps has been undertaken in healthcare. For physicians and care providers, blockchain helps achieve a complete view of individual health history with longitudinal health records, improved clinical care coordination, and effective management of emergency medical situations, and helps the transfer of relevant patient data from one provider to another (Brodersen et al., 2016; Hammadeh, 2018). Blockchain in pharmaceutical and clinical research increases drug supply chain provenance and checks drug counterfeiting. It enhances overall marketing efforts and reduces leakages. It enables access to anonymised medical metadata and clinical trial integrity and provenance of data trails (Chandler, 2019).

In hospitals, blockchain eliminates the burden and cost of data reconciliation, resulting in a seamless health data exchange across health systems. It facilitates care coordination for population health

management, improves revenue cycle management, and reduces payment disputes/frauds (Culver, 2016). It further promotes value-based care platforms such as pay for outcomes with smart contracts; it equally improves utilisation for healthcare capacity and resources. For the patients, blockchain increases patients' control over their health data. It directs payment of incentives and health tokens towards positive and healthy behaviour and encourages concepts such as Quantified-self and DIY Health (Landiyanto, 2010). It prices transparency for drug and healthcare services and data for research commons under remunerative models (Votta et al., 2018). Using blockchain technology ensures that knowledge is not tampered with and remains in its original state, improving the quality of medical education and enhancing security (Khezr et al., 2019, p. 10).

Graham (2018) argues that academia has a great responsibility to ensure that blockchain, a cutting-edge tool, is placed in the hands of billions of people. UNECA (2017, p. 12) urges Africa to take full advantage of blockchain, the "bedrock of the New Industrial Revolution (Industry 4.0)". The scant literature on the role of blockchain technology in healthcare in Africa has made the governments and policymakers fail to utilise the technology to improve the delivery of adequate health services. This failure has adversely affected the delivery of adequate health services that promote good health and well-being for sustainable development in Africa (Hammond et al., 2010). Medeiros and Schwierz (2015, p. 6) revealed that "there is substantial evidence of pervasive inefficiency in the process of transforming resources into health outcomes". Efficiency is one of the five dimensions of health system performance and is defined as the ability to use the available resources to generate high-quality care (World Bank 2017:12). Pervasive inefficiency, therefore, means that the inputs into the healthcare systems are not delivering optimum health outcomes.

Owing to poor governance of public healthcare information management, tracking of development assistance, validity of drugs, and BIR process efficiencies has become a herculean task. The US national health wasteful spending sum of midpoint estimates was $910 billion per year in the form of overtreatment, care coordination failures, care process execution failures, pricing failures, administrative complexity, and fraud (Berwick & Hackbarth, 2012). In Europe, wasteful costs of inefficient hospital care, corruption, and a sub-optimal mix of preventative versus curative care could be lowered by between five and 48%. The US and OECD studies provide evidence that minimising waste

in healthcare would help achieve better health outcomes by between 34 and 48% (Berwick & Hackbarth, 2012). Blockchain technology allows patients to own their medical information and to be in control of how the information is used. Blockchain technology ensures security; health records are time-stamped as soon as they become part of the distribution ledger, thereby hindering others from tampering with the data. The major challenge of blockchain technology in the healthcare industry is cross-border sharing; thus, due to different jurisdictions, it may inhibit the sharing of data (Khezr et al., 2019, p. 19).

7. Conclusion

The paper has shown that the healthcare sector faces many challenges that have hindered the delivery of health services that lead to good health and well-being. It has been presented in this paper that blockchain ensures the integrity of all medical records and provides absolute proof because, through this technology, it becomes impossible and challenging to change patients' data. Blockchain technology also proves to be handy for medical research purposes for scholars and researchers because it keeps health data information to effectively study the impact of any specific treatment over a massive fraction of the patient population. Moreover, it is evident that blockchain enables difficult-to-access or transmit HIE framework, which in turn allows reliable access to patient health information and eliminates the costs and burden of an information breach. It provides a simple method for charging the board and practical solutions for preventing fakes and unlawful tax evasion schemes. It also helps reduce the illegal trading of medical products such as drugs and eliminates any counterfeit drugs that are harmful to the health of the patients. It aids in designing a decentralised record of patient information that is simple to access and accessible to all emergency clinics. Technology usage in the healthcare sector increases the transparency of recorded health information and data in an immutable manner. It also allows health data access and transfer between multiple parties. This, therefore, creates a common source of truth, identity, authentication, and verification. Therefore, the role of blockchain in healthcare is impeccable and significant, and there is a need for the governments in Africa to adopt it in public healthcare so that the achievement of good health becomes possible and a reality.

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