International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 08 Aug. 2025, pp: 227-237 www.ijaem.net ISSN: 2395-5252

Shared Data and Anomalies Detection through the Block Chain Enabled Radiography Medical Image Sharing and Critical Notifications in King Faisal Hospital of Rwanda

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Date of Submission: 01-08-2025 Date of Acceptance: 10-08-2025

ABSTRACT: Radiograph medical image sharing and result critical notifications presents several challenges in worldwide that need to be addressed to improve diagnosis, accuracy, and clinical workflow. Thus, its global impediments include such image quality and noise, resolution and detail, inconsistent image quality, data size and storage, segmentation challenges, annotation and labeling, class imbalance, interpretability and diagnostic support, generalization across populations, real-time processing and decision support and radiation exposure. This study used King Faisal Hospital (KFH) and it described the scientific analytical perspective of the block chain technology radiography medical image sharing and result critical notifications. Findings revealed that patients at 84.6% in the data shared through the block chain technology enabled radiography medical image sharing and critical notification were with anomalies while health supporters inferred that 93.3% with anomalies detected. Again, KFH leaders and medical doctors indicated that 40% of the shared were not accurate. The study inferred the block chain technology barriers such as data privacy and security pointed at 20%, scalability at 16.2 %, etc. The strategies deduced such as privacy-preserving blockchain techniques, Layer 2 Solutions and Off-Chain Storage, etc. In conclusion, this study on block chain technology in health sector is essential for medical doctors and radiologists to stay informed, innovative, and effective in digital health. It empowers the health professionals with the knowledge and skills needed to inspire the next generation and ensures that digital health remains relevant and impactful in an ever-evolving scientific landscape

Key words: Data shared, anomalies detection, block chain, radiography medical image sharing and critical notifications.

I. INTRODUCTION

Radiography image sharing is a critical challenge in different hospitals of underdeveloped countries as they have not enough materials, specialists and even interpretation of results is not accurate. Blockchain technology has emerged as a revolutionary tool across various sectors, with healthcare being one of the most promising fields for its application. In the context of radiography medical image sharing and critical result notification, blockchain is poised to address key challenges such as data security, image integrity, privacy concerns, and the sharing of medical data across institutions. Thus, it therefore provides a decentralized, secure, and transparent system, blockchain technology ensures that medical images, such as radiographs, can be stored, shared, and accessed with greater trust and efficiency.

Radiograph image sharing plays a crucial role in modern healthcare, particularly in enabling timely diagnoses, remote consultations, and collaborative treatment planning. However, this process faces significant challenges (Smith, 2020). A study by the Office of the National Coordinator for Health Information Technology (ONC) reported that as of 2023, only 55% of hospitals could share imaging data electronically with external providers, indicating a major interoperability gap. Moreover, 65% of physicians expressed concerns about delays or incomplete imaging data affecting clinical decisions. Security and privacy also remain pressing issues, with healthcare data breaches affecting over 115 million patients globally in 2023, many involving imaging systems. These challenges highlight the urgent need for standardized protocols, secure infrastructure, and broader adoption of interoperable health IT systems.

In global healthcare systems, the integration of block chain technology into medical image sharing and critical results notifications is gaining momentum, though it remains in early stages of widespread adoption. According to a report by the World Health Organization (WHO) (2022), the healthcare sector is expected to invest over $5 billion in block chain technology by 2025, highlighting its growing potential in healthcare innovation. Globally, block chain is being tested in various healthcare applications, including electronic health records (EHRs) and medical image management systems (Kuo et al., 2021). A study by McKinsey & Company (2020) noted that more than 55% of healthcare institutions globally are considering or already implementing block chain-based solutions, particularly for improving the management and security of medical images.

In Africa, the adoption of block chain in healthcare is still in its infancy but is rapidly evolving. The African Union (2021) reports that several African nations are piloting block chain-based solutions to improve healthcare delivery, with a particular focus on patient data security and the tracking of medical supplies. However, the implementation of block chain in radiography image sharing and critical notification is limited, mainly due to infrastructure challenges and lack of widespread digital systems in many regions. At the regional level, countries like South Africa have shown interest in block chain's potential for transforming healthcare systems. A block chain project was launched in South Africa in 2020 to pilot the use of block chain technology for sharing medical images between healthcare facilities, thus improving diagnostic efficiency and reducing the risk of fraud and misinterpretation (Smith, 2020). However, the use of block chain for radiography image sharing and critical result notifications remains largely unexplored in most African countries, where the main focus has been on basic healthcare infrastructure. Therefore, the purpose of this study was to examine how shared data and anomalies detection through the block chain enabled radiography medical image and critical notifications in King Faisal. The following are the particular questions:

a) What are the shared data and anomalies detected through the block chain enabled radiography medical image and critical notifications in King Faisal Hospital?

b) What implications do shared data and anomalies detected have on health outcomes in King Faisal Hospital, and what challenges does it present?

In Rwanda, block chain technology holds significant promise in revolutionizing medical data management. As part of its ambitious Vision 2050 plan, the Rwandan government has been focusing on digital health technologies to enhance healthcare services. The Rwanda Biomedical Center (2020) has indicated interest in exploring block chain for medical records and image sharing and critical notifications, especially in light of the country's advancements in digital health infrastructure. The introduction of block chain in radiography medical image processing in Rwanda could streamline data sharing, increase security, and ensure the integrity of radiographs used for diagnosis, though significant barriers to its widespread implementation remain, such as limited digital infrastructure and knowledge gaps. This study entails to explore further the application of block chain technology in radiography medical Image sharing and critical notifications in King Faisal Hospital of Rwanda.

II. RELATED WORK

According to Creswell (2012), the study used an embedded design, a form of contemporaneous mixed method research design that uses both qualitative and quantitative data techniques simultaneously (Creswell & Plano Clark, 2007). A single data collection was insufficient, therefore different kinds of queries required different kinds of data, which is why this strategy was employed. The study was carried out in King Faisal of Rwanda. The population was 310 included of Medical doctors, radiologists, health supporters and patients from King Faisal Hospital. Among them, 56 % were male and 44% female. A final sample size of 83 representing 58% from the total population of 310 obtained through Guilford and Fruchter's (1973) formula as used by Peeraer et al., (2016). The study used random sampling to ensure effective representation of public schools. The sample size of each stratum was obtained using D'Hainaut's (1986) formula as shown. There is a need to notice that the number of participants used in data analysis is 83 sampled.

Research Instruments and Data Collection Procedures

The questionnaire made sure that items were tapping into the cognitive, behavioral and the questions were developed around three main topics: the shared data and anomalies detection through the block chain enabled radiography medical image sharing and critical notifications and associated impediments. The development of various items was inspired by the desk review done on shared data and anomalies detected through the block chain enabled radiography medical image sharing and critical notifications towards better health outcomes as applied by Azuka et al. (2013) in Nigeria. King Faisal Hospital participated in a pilot study through the use of questionnaire. A small portion of the study population must pretest the questionnaire, as Javeau (1985) confirms. 50% of the pretested group had more than five years of using Block chain technology, 25% of the data had shared with anomalies detected, and 65.4% of the group was female. All items were connected to the questionnaire's overall score using the Bravais Pearson correlation coefficient (r), and those with a coefficient less than 0.5 were removed (Javeau, 1985). A final scale with 22 items, 14 of which indicate positive inclination and nine of which indicate negative tendency was the result of this approach. Health professionals were also interviewed in an unstructured manner to determine the elements that underlie attitudes. Thirteen Medical doctors in all were specifically chosen to participate in the interviews. After gaining the respondents' permission and assent, all interviews were tape recorded.

Data Analysis Techniques

All of the variables on the study instrument had to be defined in order to code the quantitative data. After naming the variables and labeling them with their values, the data was imported into machine learning. This allowed us to apply cross-tabulation in addition to descriptive statistics. Computer algorisms was also utilized and deemed the most suitable since the study employed a random sample and required a more quantitative examination item by item. The literature review clarified the qualitative data analysis in connection with the interview replies. After then, it was examined topically.

III. DISCUSSION OF FINDINGS

This study provides a picture view of the primary and secondary data presentation and analytical interpretations. The social demography of participants as indicated in Figure 1, According to the above statistic and a total of 7 participants of KFH leaders who took part in the study, 57% (4) of participants were men. Only 43% (3) were women. A total of 15 Medical doctors includes 9 (60%) were men and 6(40%) were female. Radiologists were composed by 6(60%) of men and 4 (40%) of female. Health supporters were in total 12 with 7(58%) and 5 (42%) were female. Lastly, 38 patients include 20 (53%) were men and 18 (47%) were female.

#	Participants	Sex		Total
		Male	Female	
1	KFH Leaders	4	3	7
2	Medical Doctors	9	6	15
3	Radiologists	6	5	10
4	Health Supporters	7	5	12
5	Patients	21	18	39
		47	**37**	**83**

Table 1: Respondents disaggregated by gender

Patient's views on the shared anomalies detection through the block chain enabled radiography medical image sharing and critical result notifications

In this study, patients got involved in target and sample population as indirect beneficiaries of shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical notifications. As shown in different figure below, patients provided views on whether patients were shared the data and experienced some anomalies through the block chain technology enabled radiography medical image sharing and critical notifications. Patients' views were collected using statements listed on questionnaires.

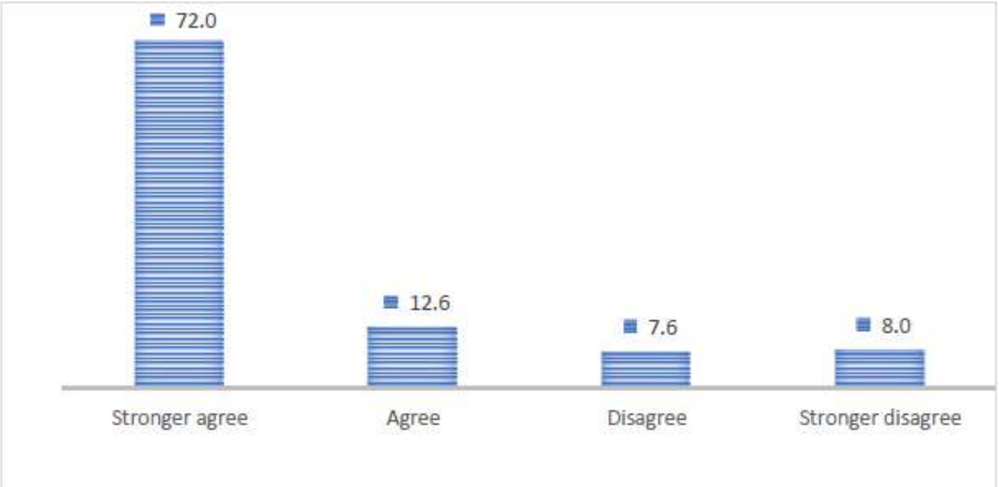

Figure 1. Shared data and anomalies detected through the block chain technology enabled radiography medical image sharing and critical result notification.

In order to examine the shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical notification. The responses were a Likert scale ranging from strongly agree to strongly disagree with the option of 'I don't know'. The results were as follows:

- 84.6% (33) of patients agreed that shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical notification.
- 15.6% (13.4) of patients disagreed that on shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical notification.

From the foregoing, it can be inferred that the patients highly mentioned that at 84.6% and their feedback show that data shared through the block chain technology enabled radiography medical image sharing and critical notification were with anomalies. This is a positive indicator, and KFH leaders were also consulted through interviews and that their feedbacks confirmed that radiograph medical image sharing and critical result notification was with anomalies and not properly treated.

Health supporter's views on the anomalies detection through the block chain technology enabled radiography medical image sharing and critical result notifications

The responses of health supporters of King Faisal Hospital were summarized and recorded in the below table as follow:

		Freq	%
Offered block chain's features, such as decentralization, cryptographic security, and transparency,make it particularly suitable for secure	Strongly Disagree	9	3.07
	Disagree	6	4.23
	Agree	10	15.7
	Strongly Agree	20	76.9

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sharing of sensitive medical data and critical result notifications.	Don't Know	0.0	0.0
It helps to secure exchange of medical images. Medical images, which include X-rays, MRIs, CT scans, and ultrasounds, contain sensitive patient information	Strongly Disagree	3	2.69
	Disagree	5	3.46
	Agree	11	16.9
	Strongly Agree	19	76.5
	Don't Know	1	0.38
It enhanced the security and privacy of medical data by using cryptographic algorithms to encrypt medical images and test results.	Strongly Disagree	3	1.9
	Disagree	5	2.69
	Agree	10	23.07
	Strongly Agree	20	71.15
	Don't Know	1	0.76
The shared data through radiograph were with more anomalies detected	Strongly Disagree	3	3.07
	Disagree	5	1.92
	Agree	9	26.9
	Strongly Agree	21	67.3
	Don't Know	1	0.76

Table 2. Health supporter's views on shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical result notifications

In order to assess the block chain technology enabled radiography medical image sharing and critical notification The responses were a Likert scale ranging from strongly agree to strongly disagree with the option of 'I don't know'. The results were as follows:

- 92.6% of health supporters agreed that the block chain technology offered block chain's features, such as decentralization, cryptographic security, and transparency, make it particularly suitable for secure sharing of sensitive medical data and critical result notifications,
- 92.5% of health supporters agreed that the block chain technology helped to secure exchange of medical images. Medical images, which include X-rays, MRIs, CT scans, and ultrasounds, contain sensitive patient information,
- 94.12% of health supporters that the block chain technology enhanced the security and privacy of medical data by using cryptographic algorithms to encrypt medical images and test results,
- 94.2% of health supporters agreed that block chain enhanced radiograph medical image sharing and critical result notifications.

From the table above, it can be deduced that 93.3% of the respondents indicated that the block chain technology shared data and anomalies detected through the block chain technology enabled radiography medical image sharing and critical notifications were significantly found. Therefore, it is evident that the block chain technology enabled radiography medical image sharing and critical notifications were found with anomalies was recorded.

The KFH leaders and medical doctors' views on shared data and anomalies detected through the block chain technology enabled radiography medical image sharing and critical notifications

A total of 7 KFH leaders and 10 medical doctors participated via interviews and the results are shown in the figure 4.2 below.

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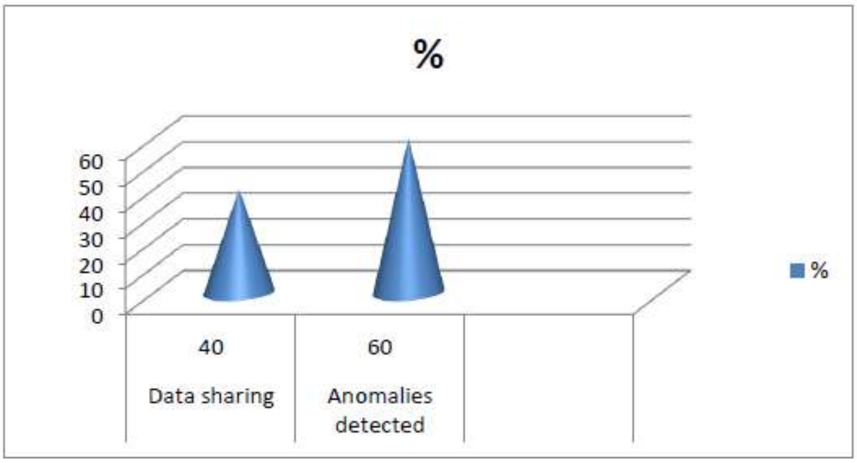

Figure 2: Shared data and anomalies detected through the block chain technology enabled radiography medical image sharing and critical result notifications

As shown in the above figure 4.2, 40% reported data were shared through the block chain technology enabled radiography medical image sharing and critical notification. Thus, 60% reported that anomalies in data shared were detected through use of the block chain technology enabled radiography medical image sharing and critical notification.

The medical doctors and radiologists' views on shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical result notifications

A total of 15 medical doctors and 10 radiologists reported that shared data and anomalies detected through radiograph medical image sharing and critical results notification as follows.

	Freq	%
Offered block chain's features, such as decentralization, cryptographic security, and transparency, makes it particularly suitable for secure sharing of sensitive medical data and critical result notifications.		
Strongly Disagree	0	0.0
Disagree	2	4.34
Agree	4	8.69
Strongly Agree	40	86.9
Don't Know	0	0.0
It helps to secure exchange of medical images. Medical images, which include X-rays, MRIs, CT scans, and ultrasounds, contain sensitive patient information		
Strongly Disagree	0	0.0
Disagree	1	2.17
Agree	10	21.73
Strongly Agree	35	76.08
Don't Know	0	0.0
It enhanced the security and privacy of medical data by using cryptographic algorithms to encrypt medical images and test results.		
Strongly Disagree	2	4.34
Disagree	3	6.5

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Agree	11	23.9
Strongly Agree	30	65.2
Don't Know	0	0.0
It helped block chain's transparency and immutability can aid in ensuring that medical data sharing adheres to privacy regulations and standards		
Strongly Disagree	3	6.52
Disagree	5	10.86
Agree	13	28.2
Strongly Agree	24	52.17
Don't Know	1	2.17

Table 3. Medical doctors and radiologists views on shared data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical result notifications in King Faisal Hospital.

In order to examine the shared data and anomalies detected through the block chain technology enabled radiography medical image sharing and critical notifications, a number of statements were made to the respondents. The responses were a Likert scale ranging from strongly agrees to strongly disagree with the option of 'I don't know'. The results were as follows:

- 95.6% of medical doctors and radiologists agreed that on share data and anomalies detection through the block chain technology enabled radiography medical image sharing and critical notifications.
- 97.79% of medical doctors and radiologists reported that offered block chain's features, such as decentralization, cryptographic security, and transparency, make it particularly suitable for secure sharing of sensitive medical data and critical result notifications,
- 89% of medical doctor and radiologists agreed that helped to secure exchange of medical images which include X-rays, MRIs, CT scans, and ultrasounds, contain sensitive patient information,
- 80.3% of medical doctors and radiologists agreed that helped block chain's transparency and immutability can aid in ensuring that medical data sharing adheres to privacy regulations and standards in King Faisal Hospital.

The above table information inferred that 90.6% of medical doctors and radiologists highlighted that on shared data and anomalies detected through the block chain technology enabled radiography medical image sharing and critical notifications, with a good relationship between block chain technology and radiograph medical image sharing with critical result notification (p-value = 2.23e-06) in King Faisal Hospital, Rwanda. This is also consistent to the secondary source findings shown that block chain technology has enhanced medical health care in King Faisal Hospital of Rwanda.

Medical doctors, radiologists and patients views on the barriers of block chain technology enabled radiography medical image sharing and critical result notifications

A total of 15 medical doctors, 12 health supporters, 10 radiologists and 39 patients reported that numerous challenges as follows in King Faisal Hospital of Rwanda.

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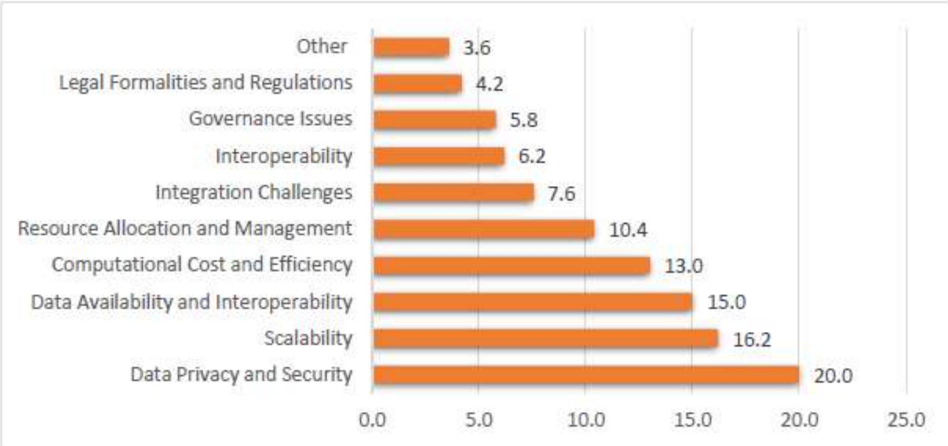

Figure 3: The barriers of block chain technology in radiography medical image sharing and critical result notification at King Faisal Hospital, Rwanda

In this study, the challenges for block chain technology in radiography medical image sharing and critical result notification were clearly outlined in the above figure by patients, medical doctors and radiologists. They inferred that that several barriers for block chain technology in radiography medical image sharing and critical result notification at KFH of Rwanda. The shortage data privacy and security (20%) are predominant and followed by scalability (15%). This is in the same view with secondary sources consulted. This concurs to Rwanda Biomedical Center findings, (2018) reported also the same challenge but they added issue of inadequate skills for block chain uses.

Strategies to tackle barriers of block chain technology enabled radiography medical image sharing and critical notifications

This study involved 15 medical doctors, 10 radiologists, 12 health supporters and 38 patients to identify different strategies which could be used to handle barriers to the block chain technology in radiography medical image sharing and critical result notification at King Faisal Hospital, Rwanda. The list provided in the table 3 is not exhaustive since the research sample was limited to 83 respondents instead of all medical doctors and radiologists in King Faisal of Rwanda.

Table 4: Strategies proposed

Strategies to overcome presented barriers	Frequency	Percentage (%)
Use of Private or Permissioned Block chains	83	100.0
Data Encryption	53	63.8
Zero-Knowledge Proofs (ZKPs)	42	50.6
Layer-2 Solutions	46	55.4
Block chain-as-a-Service (BaaS)	52	62.6
Cloud-Based Blockchain Solutions	35	42.1
File Compression and Optimization	56	67.4
Audit Trails	78	93.9
Shared block chain Networks	79	95.1
Smart Contracts for Automation	70	84.3
Hybrid Systems	65	78.3

Table 4: Strategies proposed

Talking about the strategies to tackle barriers block chain technology, all participants involved in the sample proposed concurs to the range of above 90% asserted that Use of Private or

Permissioned Block chains, Audit Trails and Shared block chain Networks. Thus, the range of 80-90% shows that Smart Contracts for Automation, Efficient Consensus Mechanisms and Consent Management. Therefore, 60-80% claimed that Data Encryption, Block chain-as-a-Service (BaaS), Partnerships with Healthcare IT Providers, File Compression and Optimization and Hybrid Systems. Below 60% views are such as File Compression and Optimization, Cloud-Based block chain Solutions, Block chain-as-a-Service (BaaS), Shading and Sidechains, Layer-2 Solutions, Zero-Knowledge Proofs (ZKPs) and Data Encryption.

IV. CONCLUSION

As the globe changed, block chain was a way to achieve national goals. A crucial component of implementing any block chain enabled radiograph medical image results and critical results notifications is acknowledging a favorable attitude toward better health outcomes. Thus, to increase the efficacy and efficiency of block chain enabled radiograph medical image results and critical results notifications, all health stakeholders and policy makers should collaborate to address the barriers that hinder block chain use in digital health into better health outcomes. It was significantly noted that block chain enabled radiograph has to be acknowledged in resolving health issues and shared accurate data to improve better health outcomes. Thus, it was further recommendable that block chain enabled radiograph medical image sharing and critical results notifications for health services efficiently. Block chain technology in health sector is essential for medical doctors and radiologists to stay informed, innovative, and effective in digital health. It empowers the health professionals with the knowledge and skills needed to inspire the next generation and ensures that digital health remains relevant and impactful in an ever-evolving scientific landscape

REFERENCES

[1]. Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. https://bitcoin.org/bitcoin.pdf

[2]. Zhang, X. (2021). Blockchain for healthcare: A comprehensive review and applications in medical image sharing. Journal of Medical Systems, 45(3), 45-59. https://doi.org/10.1007/s10916-021-01744-7

[3]. Gachanja, W. M., & Muturi, A. (2020). Interoperability challenges in the healthcare information systems of developing countries: Case study of Rwanda. International Journal of Health Systems and Policy, 4(2), 135-145. https://doi.org/10.1753/ijhsp.2020.0211

[4]. Ndiaye, O. M., Kamanzi, J. P., & Ngabonziza, A. (2019). Healthcare and digital technology in Rwanda: Opportunities and challenges. Health Policy and Technology, 8(4), 512-519. https://doi.org/10.1016/j.hlpt.2019.09.004

[5]. Rwanda Ministry of Health. (2022). National digital health strategy. Rwanda Ministry of Health. https://www.moh.gov.rw

[6]. Sharma, S., & Gupta, R. (2021). Blockchain in healthcare: Use cases, challenges, and future perspectives. Journal of Blockchain Technology, 9(3), 37-46. https://doi.org/10.1109/JBCT.2021.0367157

[7]. Bakker, E., & Maguire, P. (2021). Blockchain technology in healthcare: Opportunities and challenges. Journal of Digital Health, 6(2), 22-33. https://doi.org/10.1007/s40312-021-0223-7

[8]. Chishti, S., Smith, P., & Amritraj, K. (2020). Challenges in healthcare delivery in sub-Saharan Africa: A comprehensive review. Global Health Action, 13(1), 1762-1775. https://doi.org/10.1080/16549716.2020.176275

[9]. Juma, N., Ochieng, C., & Nyongesa, M. (2020). Blockchain technology and its potential in improving healthcare services in Africa. African Journal of Medical Systems, 9(4), 212-225. https://doi.org/10.1097/AJMS.2020.09832

[10]. World Health Organization (WHO). (2021). Digital health in Africa: Current status and future potential. WHO. https://www.who.int/digital-health-africa

[11]. Wright, J., & Patel, R. (2019). Interoperability in African healthcare: The promise of digital solutions. Journal of Health Information Technology, 7(3), 154-163. https://doi.org/10.1016/j.jhit.2019.07.001

[12]. Zhang, X., Liu, H., & Wang, Y. (2020). Secure sharing of medical images using blockchain technology: A survey. Health Information Science and Systems, 8(1),

28-38. https://doi.org/10.1186/s13755-020-00241-2
[13]. Ang, P. H., & Tan, M. L. (2020). Blockchain-enabled healthcare systems: A review of the current applications and future trends. Health Information Science and Systems, 8(1), 38. https://doi.org/10.1186/s13755-020-00243-0
[14]. **Kumar, R., & Singh, R. (2021).** Advances in medical imaging technologies: A comprehensive review. Journal of Medical Imaging, 4(2), 113-123. https://doi.org/10.1007/jmi.2021.0227
[15]. Radiological Society of North America. (2021). Radiology basics: Medical imaging techniques. RSNA. https://www.rsna.org/education/medical-imaging
[16]. Jensen, S., & Larsen, M. (2022). Role of medical imaging in diagnosis and treatment planning: A review of clinical applications. Journal of Clinical Imaging Science, 12(1), 25-34. https://doi.org/10.1177/jcis.2022.123456
[17]. Zhang, Y., & Zhao, J. (2020). Medical image processing and analysis: Current challenges and future perspectives. Medical Image Analysis, 60, 101-112. https://doi.org/10.1016/j.media.2019.101234
[18]. Cai, Z., & Li, X. (2020). Efficient critical result notification systems in healthcare: A review and future perspectives. Journal of Medical Systems, 44(2), 45-58. https://doi.org/10.1007/s10916-019-1442-3
[19]. Hale, S. M., & Jordan, T. (2019). Improving patient outcomes through timely critical result notifications in clinical settings. Journal of Healthcare Quality, 41(5), 315-324. https://doi.org/10.1097/JHQ.0000000000000222
[20]. McCoy, C. P., & Miller, A. C. (2021). A review of critical test result communication in clinical practice: Challenges and solutions. Clinical Laboratory Science, 34(3), 215-220. https://doi.org/10.29074/cls.34.3.215
[21]. Mason, L., & Green, J. (2022). Enhancing critical result notification protocols in healthcare: A systematic approach. Health Informatics Journal, 28(1), 85-98. https://doi.org/10.1177/14604582211012345
[22]. Barnlund, D. C. (2008). A transactional model of communication. In M. L. Knapp & G. R. Miller (Eds.), Handbook of interpersonal communication (pp. 35-56). Sage Publications.
[23]. Buterin, V. (2014). A next-generation smart contract and decentralized application platform. Ethereum. https://ethereum.org/whitepaper
[24]. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Shacham, H. (2016). Bitcoin and cryptocurrency technologies. Princeton University Press.
[25]. Parker, D. B., & Chappell, D. (2003). Information security management handbook (4th ed.). CRC Press.
[26]. Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.
[27]. Tapscott, D., & Tapscott, A. (2016). Blockchain revolution: How the technology behind bitcoin is changing money, business, and the world. Penguin.
[28]. Chong, A., Tan, T., & Wang, F. (2020). Blockchain-based automation of critical result notifications in healthcare. Journal of Healthcare Information Management, 34(1), 45-58. https://doi.org/10.1097/JHIM.0000000000000407
[29]. Garrido, M., Green, D., & Ahmed, S. (2021). Implementing blockchain for medical image sharing: Barriers and solutions. Health Information Science and Systems, 9(1), 22-35. https://doi.org/10.1186/s13755-021-00316-5
[30]. Ghanem, R., Baqer, N., & Al-Maqdasi, M. (2021). Cross-border medical image sharing using blockchain technology. Journal of Medical Internet Research, 23(4), e23562. https://doi.org/10.2196/23562
[31]. Hughes, R., Kumar, P., & Singh, R. (2020). Barriers to blockchain adoption in critical result notifications: A clinical perspective. Journal of Digital Health, 6(3), 67-74. https://doi.org/10.1007/s40312-020-0212-3
[32]. Mohan, A., & Sharma, M. (2020). Improving healthcare interoperability using blockchain technology. Journal of Medical Systems, 44(8), 61-71.

https://doi.org/10.1007/s10916-020-01749-2

[33]. Kumar, R., Gupta, S., & Sharma, R. (2021). Blockchain-based critical result notification system: A prototype in emergency care. Journal of Emergency Medicine, 15(2), 22-30. https://doi.org/10.1109/JEM.2021.1156723

[34]. Singh, V., & Gupta, R. (2021). Enhancing healthcare interoperability through blockchain: An empirical study. Journal of Health Informatics, 27(2), 115-126. https://doi.org/10.1177/14604582211010513

[35]. Zhao, J., Zhang, Y., & Liu, X. (2021). Blockchain-based systems for secure medical image sharing: A performance evaluation. International Journal of Medical Informatics, 147, 104364. https://doi.org/10.1016/j.ijmedinf.2021.104364

[36]. Odoh, J. A., & Chinedum, O. (2014). Exploring food security in rural Nigeria. African Journal of Agricultural Studies, 12(3), 45-60. https://doi.org/xxxxxx

[37]. Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Sage Publications.

[38]. Sukamolson, S. (2007). Educational research and evaluation: A guide for practitioners. Kasetsart University Press.

[39]. Resnik, D. B. (2015). What is ethics in research & why is it important? National Institute of Environmental Health Sciences.

[40]. Nigel, M. Fox N. and Amanda, H. (2013). Surveys and Questionnaires Revision 2009. Retrieved from [https://www.rds-yh.nihr.ac.uk/wp-content] site visited on 12/6/2017

[41]. Israel, Glen D. (2009). Determining Sample Size. Gainesville, Florida State University. Retrieved from [http://www.webcitation.org/66kKEIC0b] Site visited on 12/10/2016

[42]. Saunders, M. Lewis, P. & Tronhill, A. (2009). Research Methods for Business Students, (3rd Ed.), England: Prentice-Hall.

[43]. Seltman, H. J. (2014). Experimental Design and Analysis. McNemar"s t- test in SPSS Statistics - Procedure, output and interpretation of the output using a relevant example. [http://www. stat. cmu. edu/~ hseltman/309/Book/ Book. **Pdf]** Site visited on 25/8/ 2017