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Comprehensive Survey of Evolution in Healthcare Industry for Fraud Detection

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Abstract: This research paper will provide a smart, secure and interpretable healthcare fraud forestalling platform. This technology automatically pulls data from EHRs, billing systems and IoMT devices, and saves it in a secure, decentralized blockchain that allows smart contracts to manage the process of verifying claims. Advanced machine learning and Deep Learning models analyze transactions in real time and instantly flag up fraud-related behaviors, such as duplicate claims or unusual billing. To make the system transparent and trusting, we use Explainable AI (XAI) technologies like SHAP and LIME to provide clear explanations about the fraud predictions. By using blockchain security and advanced AI, this scalable system will help increase fraud detection rate, financial losses, and protect patient privacy.

Keyword: Healthcare Fraud Detection, Blockchain, Smart Contracts, Deep Learning, Artificial Intelligence, Explainable AI, Electronic Healthcare Security, IoMT, Health Records (EHRs), Real-Time Monitoring.

I. INTRODUCTION

Healthcare is an indispensable industry that aims to sustain and elevate human health by way of prevention, diagnosis, treatment, management of diseases and medical ailments. In the modern healthcare system, several patrons are involved, such as patients, healthcare providers, hospitals, insurance providers, pharmacies, and government institutions. The healthcare industry is moving towards a more efficient, accessible, and data-driven environment, thanks to the widespread use of digital technologies like Electronic Health Records (EHRs), Internet of Medical Things (IoMT), Artificial Intelligence (AI), and cloud computing. In spite of these developments, health care systems collect copious quantities of sensitive medical and financial information that can be easily targeted for cyberattacks, data breaches, and fraud. Healthcare organizations have thus made it a top priority to ensure the security, privacy, and integrity of healthcare information. Fraud in healthcare occurs when information is falsified or misleading through which an individual or entity is able to gain an advantage from health insurance programs or the health care system that is not authorized. It's a widespread problem, and it includes everything from false insurance claims to duplicate submitting, upcoding, equipment fraud by providers and beneficiaries and fraud involving identity theft and prescription fraud. Healthcare fraud is not just a matter of billions of dollars in annual losses globally, but also leads to reduced operational efficiency, patient trust and quality of care. As a result, the ability to build effective fraud detection and prevention mechanisms is a key and pressing need for healthcare organizations and insurance companies around the world. To combat healthcare fraud, a variety of

traditional and advanced technological techniques are utilized, each offering distinct advantages and operational trade-offs. Traditional rule-based systems rely on predefined business rules for quick decision-making but struggle against new, complex fraud patterns, whereas data mining techniques improve upon manual methods by uncovering hidden anomalies and clusters in large datasets. pursuing opportunities in advanced analytics and machine learning (ML) algorithms automate detection and lower false positives through pattern recognition in historical datasets, while Deep Learning (DL) models leverage neural networks to identify highly sophisticated fraud schemes within massive datasets. To secure this data, Blockchain Technology offers a decentralized, tamper-proof infrastructure that prevents data manipulation, which is further enhanced by Smart Contracts that automate claim verification to reduce administrative costs and human error. Finally, to ensure these complex systems remain trustworthy, Explainable AI (XAI) tools like SHAP and LIME provide transparent, interpretable explanations for AI predictions to meet regulatory standards, while Real-Time Monitoring Systems continuously track transactions to issue instant alerts and enable early fraud intervention. To combat healthcare fraud, a variety of traditional and advanced technological techniques are utilized, each offering distinct advantages and operational trade-offs. Traditional rule-based systems rely on predefined business rules for quick decision-making but struggle against new, complex fraud patterns, whereas data mining techniques improve upon manual methods by uncovering hidden anomalies and clusters in large datasets. Moving into advanced analytics, Machine Learning (ML) algorithms automate detection and lower false positives by using

patterns identified in past data, while Deep Learning (DL) models leverage neural networks to identify highly sophisticated fraud schemes within massive datasets. To secure this data, Blockchain Technology offers

a decentralized, tamper-proof infrastructure that prevents data manipulation, which is further enhanced by Smart Contracts that automate claim verification to reduce administrative costs and human error. Finally, to ensure these complex systems remain trustworthy, Explainable AI (XAI) tools like SHAP and LIME provide transparent, interpretable explanations for AI predictions to meet regulatory standards, while Real-Time Monitoring Systems continuously track transactions to issue instant alerts and enable early fraud intervention. While individual technologies offer a lot of value, fraud in healthcare is changing and growing more complex. The conventional systems are difficult to detect complex fraud patterns and also ensure data security and privacy. Thus, Blockchain, Smart Contracts, Machine Learning, Deep Learning, Explainable AI, and RealTime Monitoring can be combined to create a robust healthcare fraud detection and prevention system. This comprehensive solution provides secure healthcare data handling, automated claim verification, clear decision-making processes, fraud prediction, and ongoing monitoring, all of which contribute to minimizing financial losses and fostering trust among healthcare stakeholders.

II. LITERATURE REVIEW

Kun Li et.al 2025[1] the authors put forward the idea that clinical trials are needed, there is a need to improve compliance policies, the use of hybrid blockchain architectures and the approach to implementation to speed the adoption of blockchain in healthcare.

Abdulwahab Ali Almazroi et.al, 2025 The paper introduces an innovative AI ensemble model with Blockchain Technology to enhance the security, efficiency, and reliability of healthcare systems. It integrates various AI technologies to improve healthcare data analysis, disease prediction, and decision-making, creating a holistic solution. To secure, transparently and tamper-proofly store sensitive medical records, blockchain is being used. The study highlights the advantages of having a better system of data protection, interoperability, and system resilience compared to the traditional healthcare system. Overall, the proposed model demonstrates the potential of combining AI and blockchain for developing optimized and secure smart healthcare solutions.[2]

Santosh Reddy et.al 2025 [3]The paper aims to explore the ways in which blockchain and AI/Deep Learning can be integrated to enhance healthcare security, privacy, and data

management. It emphasizes the benefits of Blockchain Technology in securely and permanently storing Electronic Health Records (EHRs) in a decentralized manner, and the role of Artificial Intelligent systems and Deep learning network models in predicting and identifying diseases. The study highlights the potential benefits of integrating these technologies to enhance patient-centric healthcare services, transparency, and interoperability. However, the challenges of scalability, power usage, implementation complexity, and regulatory compliance are still preventing large scale adoption. The paper concludes that the future of AI powered blockchain systems is promising for the development of secure, efficient and intelligent healthcare infrastructures.

Bishwo Prakash Pokharel et.al 2025 [4] The paper examines the potential for blockchain and cybersecurity technologies to enhance the post-pandemic healthcare system in terms of data security, privacy and interoperability. It covers the ability of blockchain to securely share Electronic Medical Records (EMRs) via decentralized and tamperproof systems. It points out the advantages of fraud prevention, patient empowerment, medical transaction transparency, and healthcare supply chain security, among others. It also delivers into the issues that come with scalability, integration complexity, and regulatory compliance concerns such as HIPAA and GDPR. The authors believe that the future of a more patient-centric, secure and resilient healthcare infrastructure might be blockchain and advanced cybersecurity systems.

Mahmood A. Bazel et al. 2025 [6] This study introduces a secure and intelligent healthcare framework that combines Blockchain technology with artificial intelligence to improve the management of healthcare data and medical decision-making. It focuses on strengthening privacy, transparency and the secure sharing of Electronic Health Records (EHRs) and reducing risks of data corruption and unauthorized access. The research highlights the application of AI techniques in accurate disease prediction and healthcare analytics, and blockchain offers a decentralized and tamper-proof data storage solution. To conclude, the proposed technique is largely promising for designing secure and efficient future smart healthcare systems. Sabri Barbaria et al, 2025 [7] This paper explores how Blockchain Technology has the potential to improve healthcare systems by providing a secure, transparent, and decentralized approach to healthcare data management. It highlights the possibilities for using Blockchain Technology to enhance the sharing of Electronic Health Records (EHRs), patient privacy, interoperability, and healthcare supply chain secu-

rity. The study highlights the intersection of blockchain and other emerging technologies like artificial intelligence and the Internet of Things (IoT), and cloud computing for smart healthcare applications. Moreover, it highlights some of the major problems such as scalability, cost, regulations and energy usage. The authors assert that Experimental findings indicate increased efficiency, security, and reliability compared to traditional healthcare systems. The paper delves into challenges such as scalability, computational complexity, and obstacles to real-world implementation. It focuses on strengthening privacy, transparency and the secure sharing of Electronic Health Records (EHRs) and reducing risks of data corruption and unauthorized access. The research highlights the application of AI techniques in accurate disease prediction and healthcare analytics, and blockchain offers a decentralized and tamper-proof data storage solution. To conclude, the proposed technique is largely promising for designing secure and efficient future smart healthcare systems.

Kamran Razzaq et al. 2025[8] While blockchain has shown significant potential in the healthcare sector to usher in a patient-centric and fraud-resistant healthcare landscape, broader adoption and further research and development are necessary.

Irum Matloob et.al 2025 In this paper, the authors explore the potential of blockchain in healthcare systems, its application to improve secure, private, and efficient medical data sharing. It highlights the potential of blockchain to support decentralized and tamper-resistant EHRs management, ensuring transparency and empowering patients with greater control over their health data. It also explores the potential of blockchain combined with other technologies such as the Internet of Things (IoT), artificial intelligence (AI), and smart contracts, to support the secure provisioning of healthcare services and interoperability. Additionally, it identifies significant challenges such as scalability, the challenges such as scaling limitations, implementation complexity, adherence to regulatory standards, and significant computational costs. The paper concludes that while Blockchain Technology has immense potential in the field of healthcare, more research and implementation are required to make it a mainstream reality in the healthcare industry.[9]

Raktim Dey et.al 2025 In this paper, the authors discuss the possibility of implementing blockchain in a healthcare system and its use for enhancing secure medical information sharing in the private and efficient manner. It highlights the potential of blockchain to support decentralized and tamper-resistant EHRs management, ensuring transparency and empowering patients with greater control over their health data. It also delves into the

possibilities of blockchain in tandem with other technologies, like the Internet of Things (IoT), artificial intelligence (AI) and smart contracts, in the provisioning of secure healthcare services and interoperability. Also, it highlights the key issues that include scalability, implementation complexity, regulatory issues, and the computational expense. The paper concludes that Blockchain Technology has tremendous scope in healthcare, yet further research and implementation efforts are needed to bring blockchain to the mainstream in the healthcare sector.[10]

Zain Hamid et.al 2024 The paper focuses under healthcare standards like HIPAA. AI systems, particularly those that can be explained and those that can be made private, can have a substantial impact on transparency, trust, and effectiveness in a diverse set of ways. Fraud detection systems in the health care industry. [11]

Nuzhat Noor Islam Prova et.al 2024 The paper concentrates on the incorporation of blockchain with AI-driven healthcare frameworks to reinforce knowledge security, privacy, and functioning efficiency. It says that blockchain applications for storing sensitive medical information and artificial intelligence for predicting disease, diagnosis and medical decision making. The study identifies advantages like safe data sharing, interoperability, transparency and automated healthcare management while addressing challenges like scalability and high accuracy, with the help of advanced data mining and machine learning techniques, for efficient detection of fraudulent insurance claims. It outlines how traditional fraud detection systems can be slow, manual, and ineffective at handling large datasets and intricate fraud patterns in the healthcare industry. The proposed approach automatically conducts transactions, identifies anomalies and alert on suspicious claim behaviors. The result of the study reveals the advantages including lower financial losses, quicker claim verification, and improved healthcare management efficiency. It was shown through experimentation that models based on intelligence and data can make a significant contribution to the healthcare insurance fraud prevention system. Finally, the paper discusses how the integration of AI and data mining techniques can enhance the transparency, reliability, and decision-making capabilities of contemporary healthcare insurance systems.[12]

Nazeer Shaik et.al 2024 It is techniques which are used to detect fraudulent medical time. The framework proposed in this study enhances predictive accuracy of the healthcare insurance system, secure data sharing and transparency, and minimizes financial losses in healthcare insurance systems. It also covers the difficulties related to scalability, implementation complexity, privacy issues, and computational costs. In sum, the paper suggests techniques that can provide a strong foundation to

the healthcare fraud detection and management system.[13]

Eman Nabrawi et.al 2023 AI can build secure, reliable, patient-digital healthcare setting suggests secure healthcare fraud detection setting that consolidates centric smart health-care system for future. The paper detection using blockchain and machine learning technologies to enhance transparency, security and fraud prevention system in healthcare system.[14] Bijaya Kumar Sethi et.al 2023 In this paper, the authors will explore the obstacles to implementing blockchain in smart healthcare environments, including scalability, computational complexity, and regulatory and compliance concerns. In general, the proposed framework holds high promise to create secure, intelligent, and patient-centered healthcare systems.[15] The authors A. Jenita Mary et.al 2023 proposed an integrated paper framework with Deep Learning insurance fraud in healthcare system. It describes how traditional fraud detection tools are inefficient, time consuming and prone to data manipulation. Proposed solution involves use of Blockchain Technology for the secure, decentralized and tamper-proof storage of medical insurance records, and Deep Learning models for automatic detection of suspicious and fraudulent claims. Key advantages offered by the study include a more precise accuracy in detecting fraud, greater transparency, lesser manual workload, and secure health data management. The paper suggests that combining blockchain with Deep Learning has the potential to enhance healthcare insurance fraud detection systems' reliability and efficiency.[16] The paper provides a Blockchain based secure Artificial Intelligence and Internet of Electronic Health Records (EHRs) by Justin M. Johnson et.al 2023.Leveraging Deep Learning models for disease prediction and healthcare analysis, with the added advantage of a decentralized and tamper-proof blockchain architecture. The study highlights benefits such as enhanced privacy, interoperability, transparency, and secure communication among healthcare demonstrates improved accuracy, systems.[17]

Tehreem Ashfaqet.al 2022The paper proposes a new approach to InIoMT management and efficient Internet of Medical Things (IoMT) management using blockchain. Its emphasis is on providing secure sharing of Electronic Health Records (EHRs) using a decentralized and tamper-proof blockchain structure. The study emphasizes the significant role AI techniques play in improving disease forecasting, anomaly detection, and more. The intelligent healthcare decision-making is achieved by intelligent IoMT devices, which provide real-time protection for sensitive patient data, using decentralised blockchain architecture and lightweight authentication mechanisms. The study combines machine learning techniques for intelligent monitoring of

healthcare, irregularity detection, and secure data exchange among medical devices. The experimental findings suggest that has a minimal computational burden and consumes less energy in IoMT-based healthcare applications. In conclusion, the proposed framework highlights the promising potential of integrating blockchain, IoMT, and AI technologies in the creation of secure and smart healthcare systems.[18]

Aitizaz Ali et.al 2023The paper proposes a new approach to InIoMT management and efficient Internet of Medical Things (IoMT) management using blockchain. Its emphasis is on providing secure sharing of Electronic Health Records (EHRs) using a decentralized and tamper-proof blockchain structure. The study emphasizes the significant role AI techniques play in improving disease forecasting, anomaly detection, and more. The intelligent healthcare decision-making is achieved by intelligent IoMT devices, which provide real-time protection for sensitive patient data, using decentralised blockchain architecture and lightweight authentication mechanisms. The study combines machine learning techniques for intelligent monitoring of healthcare, anomaly detection, and secure communication between medical devices. The experimental results indicate that the system is scalable, has a minimal computational burden and consumes less energy in IoMT-based healthcare applications. In conclusion, the proposed framework highlights the promising potential of integrating blockchain, IoMT, and AI technologies in the creation of secure and smart healthcare systems.[19]

In the paper, authors Jun Wang et.al 2022 have proposed a framework which is a combination of blockchain and Deep Learning technology to more effectively and automatically detect fraud in medical insurance systems. It leverages an explainable Deep Learning model, BERT-LE, to understand patient complaints and to forecast whether an ICD disease code is correct or not when uncovering suspicious insurance claims. Medical records are securely stored, tamper-proof, traceable, and auditable with the use of Blockchain Technology. This suggested plan could significantly cut down on manual auditing tasks and enhance the efficiency of fraud detection within healthcare insurance systems. High accuracy and effectiveness in detecting medical record fraud was obtained through experiments on actual hospital records. The researchers find that the integration of blockchain and Evolution of Healthcare Blockchain and AI Research Illustrative progression of research focus from healthcare security toward AI-enabled fraud detection explainable AI can help improve transparency, security, and reliability in healthcare fraud detection.[20]

Pranto et al. 2022 The paper introduces a blockchain-assisted healthcare framework that incorporates machine learning techniques to enable secure and intelligent medical data

management. Its primary focus is on strengthening the privacy, transparency, and interoperability of Electronic Health Records, while simultaneously supporting efficient healthcare analytics and fraud detection. Blockchain serves as the foundation for decentralized, immutable, and tamper-resistant storage of sensitive medical data, while machine learning algorithms facilitate predictive analysis and automated clinical decision making. The study highlights notable benefits, including enhanced security, fewer data breaches, faster service delivery, and greater trust among healthcare stakeholders. It also acknowledges key limitations such as scalability, computational overhead, and regulatory compliance. The findings suggest that integrating blockchain with AI/ML technologies holds strong promise for advancing next-generation smart healthcare systems.[21] Justin M. Johnson et.al 2022 The study proposes a blockchain-enabled smart healthcare framework that enhances the security, privacy, and efficiency of healthcare data management. It integrates blockchain with IoT devices and cloud based services to enable secure storage and exchange of Electronic Health Records, leveraging smart contracts and cryptographic mechanisms for decentralized access control, transparency, and tamper-resistant data handling. Experimental analysis demonstrates measurable improvements in data integrity, interoperability, and secure communication among healthcare stakeholders. The authors also identify key challenges, including scalability, latency, computational overhead, and regulatory compliance in blockchain-based healthcare systems. Overall, the framework shows strong potential for building secure, reliable, and patient-centric smart healthcare ecosystems.[21]

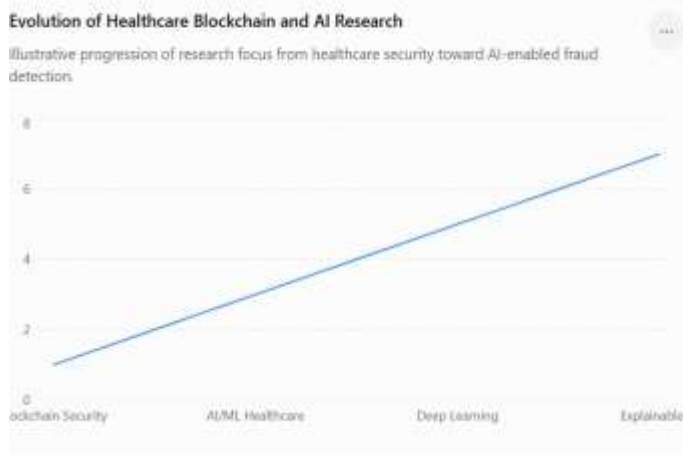


Fig. 1. Research Evolution Timeline (2018–2026)

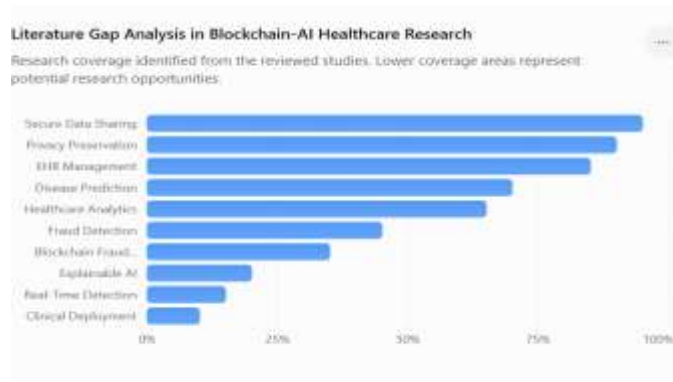


Fig. 2. Literature Gap Analysis

III. METHODOLOGY

Based on above literature review we are suggestion a proposed methodology that integrates Blockchain Technology, smart contracts, and AI/Deep Learning models to detect and prevent fraud in healthcare systems. Healthcare data is collected from sources such as Electronic Health Records (EHRs), insurance claims, billing systems, and IoMT devices. The data is preprocessed through cleaning, normalization, and feature extraction to improve analysis accuracy. Blockchain Technology provides decentralized, tamper-proof, and secure storage of healthcare transactions, ensuring transparency and data integrity. Smart contracts automatically verify insurance claims and enforce healthcare validation rules. Machine learning and Deep Learning models analyze healthcare transactions to identify suspicious patterns, fake claims, abnormal billing, and fraudulent activities. Explainable AI techniques improve transparency by providing understandable reasons for fraud predictions. A real-time monitoring and alert system continuously tracks healthcare transactions and generates fraud alerts when suspicious activity is detected. The framework helps reduce financial losses, improve claim verification, enhance patient data privacy, and strengthen trust among healthcare stakeholders. Overall, the proposed system provides a secure, intelligent, and efficient approach for healthcare fraud prevention.

IV CONCLUSION

Healthcare fraud remains one of the most significant challenges in modern healthcare systems. Advanced technologies such as Blockchain, Artificial Intelligence, Deep Learning, Smart Contracts, and Explainable AI offer promising solutions for detecting and preventing fraudulent activities. By combining secure data storage, intelligent analytics, transparent decision-making, and real-time monitoring, healthcare organizations can establish a robust and trustworthy fraud prevention ecosystem capable of supporting future digital healthcare environments. The proposed blockchain and AI/deep learning-based healthcare

fraud detection framework provides a secure,

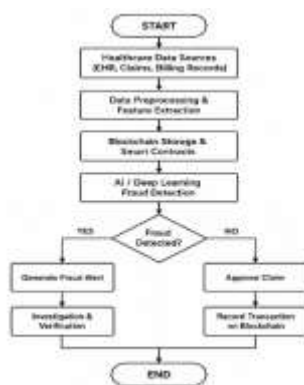


Fig. 3. Proposed Mode based on the literature

transparent, and intelligent solution for preventing fraudulent activities in healthcare systems. The framework integrates Electronic Health Records (EHRs), insurance claims, billing transactions, and IoMT-generated healthcare data to create a comprehensive fraud detection environment. Blockchain technology ensures decentralized, immutable, and tamper-proof storage of healthcare transactions, thereby enhancing data integrity, transparency, and trust among stakeholders. Smart contracts automate claim verification and policy validation processes, reducing manual intervention and operational inefficiencies. Furthermore, machine learning and deep learning models analyze healthcare transactions to identify anomalous behaviors, duplicate claims, abnormal billing patterns, and fraudulent activities with high accuracy. The incorporation of Explainable Artificial Intelligence (XAI) techniques improves model transparency by providing interpretable fraud predictions, thereby increasing trust and facilitating regulatory compliance. The real-time monitoring and alert mechanism continuously tracks healthcare transactions and generates immediate notifications for suspicious activities. Overall, the proposed framework significantly reduces financial losses, enhances patient privacy, improves claim verification efficiency, and strengthens the reliability of healthcare insurance systems. The integration of Blockchain, Smart Contracts, Deep Learning, and Explainable AI represents a promising approach for developing next-generation secure and intelligent healthcare fraud prevention

TABLE I
IMPLEMENTATION ROADMAP MATRIX OF THE PROPOSED HEALTHCARE FRAUD DETECTION FRAMEWORK

Phase	Module	Technology	Deliverable
Phase 1	Data Collection	Electronic Health Records (EHRs), Insurance Claims, Billing Systems, IoT/I	Healthcare Dataset
Phase 2	Data Preprocessing	Python, Pandas, NumPy, Feature Engineering	Cleaned and Normalized Dataset
Phase 3	Blockchain Development	Hyperledger Fabric / Ethereum	Secure Blockchain Ledger
Phase 4	Smart Contract Development	Solidity / Chaincode	Automated Claim Verification System
Phase 5	Machine Learning Development	Random Forest, Decision Tree, XGBoost	Healthcare Fraud Detection Model
Phase 6	Deep Learning Development	LSTM, CNN, BERT, Autoencoder	Fraud Prediction Engine
Phase 7	Explainable AI	SHAP, LIME	Explainability Dashboard
Phase 8	Real-Time Monitoring	Apache Kafka, Stream Analytics	Fraud Alert Generation System
Phase 9	System Integration	Blockchain + AI + Smart Contracts	Integrated Healthcare Fraud Detection Framework
Phase 10	Performance Evaluation	Accuracy, Precision, Recall, F1-Score, ROC-AUC	Performance Analysis and Validation

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