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BLOCKCHAIN-ENHANCED HIPAA COMPLIANCE FRAMEWORK FOR SECURE AWS HEALTH DATA

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Abstract

This study develops a blockchain-enhanced HIPAA compliance framework for secure management of healthcare data on AWS cloud infrastructure using secondary qualitative data analysis. Three themes guide the analysis: evaluation of current cloud-based healthcare data practices, blockchain integration strategies, and design of a secure framework. Findings reveal that conventional cloud security measures are inadequate for full compliance, while blockchain provides immutable, traceable, and auditable records. The proposed framework combines encrypted AWS storage, permissioned blockchain logging, and smart contract-enabled access control to enhance data integrity, transparency, and regulatory adherence. Recoveries include improved operational efficiency, reduced breach risks, and increased patient trust.

Keywords: Blockchain, HIPAA Compliance, AWS Health Data, Data Security, Healthcare Data Privacy, Cloud Computing, Secondary Qualitative Analysis, Secure Framework

I. INTRODUCTION

In the modern healthcare environment, the management and security of sensitive patient data is a critical challenge. The integration of cloud computing platforms such as Amazon Web Services (AWS) facilitates efficient data storage and processing, but also increases the risk of unauthorized access and data breaches. Ensuring compliance with the Health Insurance Portability and Accountability Act (HIPAA) becomes complex when health data is transferred, stored, and processed in cloud environments [1]. Data privacy concerns, security vulnerabilities, and audit requirements necessitate the development of innovative frameworks that combine advanced technologies with regulatory adherence. The growing adoption of blockchain technology offers a promising solution due to its immutable ledger, decentralized access control, and transparency, which can enhance HIPAA compliance and ensure secure handling of health data across AWS infrastructure [2]. Integrating blockchain mechanisms into AWS cloud environments allows healthcare providers to monitor and trace data access, enforce strict compliance protocols, and mitigate security risks effectively.

Problem Statement: Healthcare organizations increasingly rely on cloud computing solutions like AWS to store and manage patient health data. Despite the convenience and scalability offered by cloud services, the risk of data breaches, unauthorized access, and non-compliance with HIPAA regulations remains significant. Traditional security mechanisms are often insufficient to provide end-to-end data integrity, auditability, and patient privacy guarantees. Ensuring secure data sharing and processing while maintaining regulatory compliance is a persistent challenge. Blockchain technology, with its features of immutability, decentralization, and traceability, can address these challenges by creating secure, tamper-proof records of all data transactions [3]. However, integrating blockchain into existing cloud platforms requires careful design, alignment with compliance requirements, and consideration of operational feasibility. The current research addresses the gap by proposing a blockchain-enhanced HIPAA compliance framework specifically for securing AWS health data, leveraging secondary qualitative data analysis to explore best practices and regulatory adherence strategies.

Aims and Objectives

Aim: To develop a blockchain-enhanced framework that ensures HIPAA-compliant

secure management of health data on AWS cloud infrastructure.

Objectives:

- To analyse current cloud-based healthcare data management practices to identify security gaps and compliance challenges.
- To explore blockchain integration strategies that enhance data privacy, integrity, and traceability for HIPAA compliance.
- To design a comprehensive framework for AWS health data security that aligns with regulatory requirements and operational efficiency.

The research of a blockchain-enhanced HIPAA compliance framework for AWS health data begins with an introduction outlining the problem, aim, and objectives. The literature review synthesizes prior research on blockchain, HIPAA, AWS security, integration strategies, and secure data frameworks. Methodology details the secondary qualitative data analysis approach. Data analysis explores three themes: cloud-based data practices, blockchain integration, and framework design. Results and discussion present key findings and recoveries. Future study identifies research opportunities. The conclusion summarizes insights, while the abstract offers a concise overview. Limitations and implementation provide a practical context for the application.

II. LITERATURE REVIEW

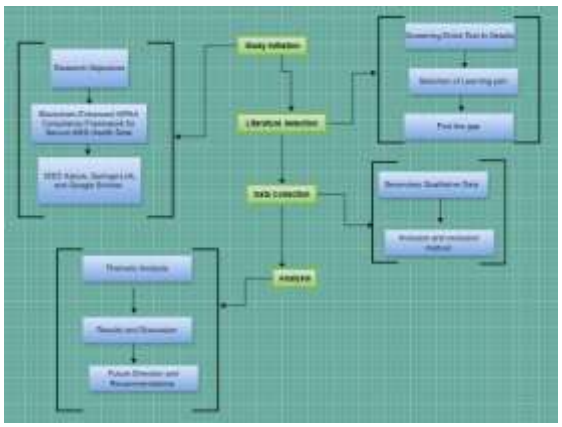

Fig 1: Flow of the Review

Structured Literature Review Approach followed the following steps:

I. Identification of relevant academic sources and industry reports addressing blockchain, HIPAA, and AWS data security.
II. Critical evaluation and synthesis of findings to identify patterns, best practices, and limitations in current approaches.
III. Integration of insights to propose a blockchain-enhanced framework addressing secure health data management.

Academic Database and Source Utilization for this study are:

I. Scopus, IEEE Xplore, and PubMed for peer-reviewed journal articles on healthcare data security, HIPAA compliance, and blockchain applications.
II. Google Scholar for identifying high-impact studies and citations.
III. Industry reports and whitepapers from AWS, healthcare compliance organizations, and blockchain solution providers.

A. Searching Study:

The study employs a structured search strategy targeting academic and industry sources. Keywords such as "Blockchain in Healthcare," "HIPAA Compliance," "AWS Security," and "Cloud Data Privacy" guide the identification process. Boolean operators and filters are applied to refine search results to publications from 2020 onwards. Priority is given to studies demonstrating practical implementations, case studies, and theoretical analyses of blockchain solutions in cloud healthcare environments. The search emphasizes peer-reviewed journals, reputable conferences, and authoritative industry publications to ensure reliability and relevance of the secondary qualitative data. This approach supports comprehensive coverage of trends, challenges, and technological interventions in secure healthcare data management.

B. Selection of Journal Articles:

Journal articles are selected based on relevance, quality, and contribution to understanding blockchain-enabled HIPAA compliance. Inclusion criteria focus on studies addressing cloud-based health data security, blockchain adoption, and AWS implementation. Articles demonstrating empirical evidence, case studies, or comparative analyses of security frameworks are prioritized. Exclusion criteria remove studies lacking practical applicability or those outside the scope of healthcare data or cloud security. The selection process ensures a representative sample of high-quality literature, enabling robust thematic analysis. This methodology provides a reliable foundation for synthesizing insights and identifying gaps in existing blockchain-based security frameworks for HIPAA-compliant cloud systems.

C. The Goal of the Review:

The review aims to consolidate existing knowledge on secure cloud-based healthcare data management and blockchain integration for HIPAA compliance. It identifies prevailing trends, technological interventions, and operational challenges within AWS cloud environments. By synthesizing theoretical and practical insights, the review highlights effective strategies for ensuring data privacy, integrity, and regulatory adherence. Additionally, it uncovers gaps where blockchain-enhanced solutions can provide value, particularly in real-time monitoring, auditability, and access control. Ultimately, the review informs the design of a comprehensive blockchain-based framework that addresses healthcare data security challenges while aligning with compliance requirements and operational efficiency in cloud infrastructures.

D. Study of Previous Literature

Blockchain Technology in Healthcare

Blockchain technology offers a transformative approach to managing healthcare data through decentralized, immutable, and transparent systems. Creating tamper-proof records it ensures data integrity and traceability, which are essential for sensitive patient information. The technology enables secure data sharing across multiple stakeholders, including hospitals, laboratories, and insurers, while preserving patient consent and privacy [4]. Smart contracts embedded in blockchain networks allow automated compliance enforcement, facilitating audit trails, controlled access, and operational transparency. Despite its potential, challenges such as scalability, integration with existing health IT systems, and alignment with regulatory requirements persist. Platforms like Ethereum and Hyperledger have demonstrated proof-of-concept implementations that provide secure healthcare data exchange, highlighting both practical benefits and technical limitations [5]. These implementations showcase the feasibility of blockchain in addressing common issues in healthcare data management, such as unauthorized data modification, lack of accountability, and inefficient consent management processes. By combining blockchain with conventional security measures, healthcare organizations can strengthen data protection, enhance interoperability, and streamline compliance processes, paving the way for secure, efficient, and transparent health information management systems [6].

HIPAA Compliance and Cloud Security

The Health Insurance Portability and Accountability Act (HIPAA) sets rigorous standards for protecting sensitive healthcare information, encompassing administrative, physical, and technical safeguards [7]. The adoption of cloud computing solutions introduces new risks, including unauthorized access, data breaches, and potential non-compliance due to shared infrastructure and remote storage. To mitigate these risks, best practices include encryption, identity and access management, continuous monitoring, and detailed audit logging. Despite these measures, misconfigurations and inadequate organizational policies often result in compliance violations. Cloud platforms like

AWS provide native security features such as encrypted storage, access control mechanisms, and automated monitoring, yet integration with additional security solutions like blockchain enhances overall system resilience [8]. Blockchain technology introduces immutable logging, automated verification, and real-time monitoring capabilities, reinforcing compliance while maintaining operational efficiency. There is a growing need for comprehensive frameworks that combine cloud computing benefits with strict adherence to HIPAA guidelines, ensuring secure storage, efficient data management, and robust regulatory alignment [9]. This approach enables organizations to balance technological innovation with legal compliance, safeguarding patient privacy while leveraging the scalability and flexibility of cloud services.

Integration of Blockchain with AWS

Fig 2: Integration of Blockchain with AWS

Integrating blockchain technology with AWS cloud services presents an innovative solution for enhancing healthcare data security and compliance. AWS Managed Blockchain provides a scalable platform for decentralized, tamper-proof record-keeping, while smart contracts enable automated management of access controls and consent processes. Successful deployments of blockchain within AWS demonstrate its ability to support secure patient data management, interoperability across healthcare entities, and compliant data transactions [10]. AWS cloud features, including encryption, identity and access management, and scalable storage, complement blockchain's inherent immutability, creating a secure ecosystem for sensitive health information. Challenges remain, such as latency, storage overhead, and transaction throughput limitations, but hybrid models and careful architectural planning mitigate these concerns. The integration improves operational efficiency, auditability, and regulatory compliance, particularly in meeting HIPAA requirements for confidentiality, integrity, and availability of patient data [11]. By combining AWS cloud services with blockchain, healthcare providers can achieve secure, transparent, and automated data management processes while maintaining scalability and flexibility necessary for modern healthcare operations.

Frameworks for Secure Healthcare Data Management

Existing healthcare data security frameworks emphasize a layered approach combining encryption, access control, and audit mechanisms to ensure regulatory compliance. Recent models integrate blockchain-enabled logging to enhance data integrity, traceability, and accountability. Comparative analyses indicate that decentralized frameworks surpass traditional methods in reducing data breaches, improving patient trust, and ensuring comprehensive monitoring. These frameworks also incorporate identity management, automated audit trails, and smart contract functionality to streamline compliance processes [12]. Despite their effectiveness, challenges such as integration with legacy systems, increased costs, and technical complexity require careful consideration. Insights from these frameworks inform the development of a comprehensive blockchain-enhanced AWS-based framework, which prioritizes secure health data storage, real-time monitoring, and automated reporting. Such a framework enables seamless data sharing among authorized stakeholders while maintaining HIPAA compliance, ensuring transparency, and strengthening trust in healthcare services [13]. By adopting these principles, healthcare organizations can establish secure, efficient, and reliable systems for managing patient information in a cloud environment.

Literature gap

Despite extensive research on blockchain, HIPAA compliance, and AWS cloud security individually, limited studies integrate these

elements into a unified framework for healthcare data management. Existing literature often focuses on theoretical models or isolated use cases, lacking comprehensive strategies that address operational feasibility, scalability, and automated compliance simultaneously. Practical insights from secondary qualitative data remain underexplored, creating a gap in evidence-based guidance for secure cloud-based health data solutions. This research addresses the gap by proposing a blockchain-enhanced framework that combines AWS cloud infrastructure with HIPAA regulatory compliance, leveraging qualitative synthesis to inform secure, efficient, and auditable healthcare data management practices.

III. METHODOLOGY

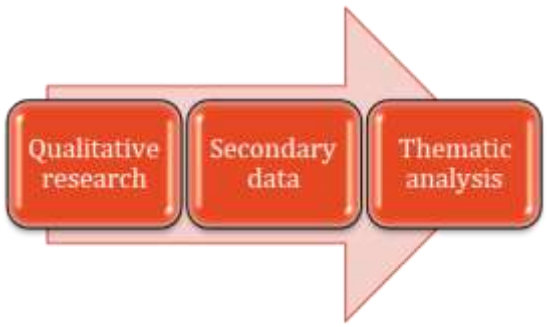

Fig 3: Methodology

This study employs a secondary qualitative data analysis methodology to explore a blockchain-enhanced HIPAA compliance framework for AWS health data. Secondary qualitative analysis systematically evaluates existing literature, case studies, and industry reports to extract insights relevant to secure healthcare data management and regulatory adherence [14]. The methodology is appropriate for synthesizing diverse sources, enabling comprehensive understanding without primary data collection. A structured literature review guides the process, ensuring rigorous selection, appraisal, and integration of findings.

Data sources include peer-reviewed journals, conference proceedings, AWS technical documentation, and healthcare compliance reports. Keywords such as "Blockchain in Healthcare," "HIPAA Compliance," and "AWS Security" guide systematic searches. Boolean operators and filters narrow results to publications from 2020 onwards. Inclusion criteria prioritize studies demonstrating practical blockchain applications, cloud security implementations, and compliance frameworks. Exclusion criteria remove irrelevant or non-empirical studies, ensuring reliability [15].

Thematic analysis identifies recurring patterns and insights aligned with research objectives. Three themes guide the analysis: current cloud-based healthcare data practices, blockchain integration strategies, and design of a secure framework. Each theme is critically evaluated to determine best practices, challenges, and regulatory alignment.

Ethical considerations involve proper source attribution and evaluation of methodological rigor. Triangulation of multiple sources ensures validity and reliability of findings. The methodology prioritizes technological feasibility, operational relevance, and alignment with HIPAA standards [16].

Findings from secondary qualitative analysis inform the design of a comprehensive blockchain-enhanced framework, combining AWS cloud infrastructure, immutable record-keeping, smart contract-enabled access control, and real-time compliance monitoring. This approach provides a practical, scalable, and secure solution for healthcare organizations.

IV. DATA ANALYSIS

Theme 1: Evaluation of Current Cloud-Based Healthcare Data Management Practices

Current cloud-based healthcare data management prioritizes scalability, accessibility, and operational efficiency. AWS provides services for secure storage, identity management, and audit logging. Despite these measures, vulnerabilities such as misconfigurations, insider threats, and insufficient monitoring compromise data security and HIPAA compliance [17]. Secondary qualitative analysis reveals case studies where gaps in access control, audit

trails, and consent management resulted in breaches and regulatory penalties. Insights emphasize the importance of layered security, continuous monitoring, and alignment with HIPAA safeguards. Integrating advanced mechanisms like blockchain enhances transparency, traceability, and auditability, addressing limitations in conventional cloud setups [18]. The analysis identifies the need for a comprehensive framework combining encryption, automated monitoring, and decentralized record-keeping to ensure secure, compliant healthcare data management on AWS.

Theme 2: Blockchain Integration Strategies for HIPAA Compliance

Blockchain provides decentralized, immutable, and transparent mechanisms for healthcare data security. Permissioned blockchain networks allow restricted access to authorized personnel, preserving patient privacy. Smart contracts automate compliance enforcement, consent management, and access control, ensuring auditability [19]. Literature and secondary analysis indicate successful implementations for secure data sharing among hospitals, labs, and insurers. Technical challenges include latency, storage requirements, and interoperability with legacy systems. Hybrid models combining cloud storage and blockchain logging address these challenges [20]. Blockchain integration enhances data integrity, accountability, and real-time compliance verification. Insights recommend careful selection of blockchain architecture, integration with AWS services, and deployment of smart contracts for enforcing HIPAA policies effectively.

Theme 3: Design of a Blockchain-Enhanced AWS Health Data Security Framework

The proposed framework integrates AWS cloud storage with blockchain-enabled logging, smart contract-based access control, and continuous monitoring. Encrypted storage ensures confidentiality, while immutable blockchain records guarantee auditability and traceability. Smart contracts automate compliance verification and consent management [21]. Secondary qualitative analysis identifies best practices for integrating AWS services with decentralized technologies, emphasizing scalability, operational feasibility, and regulatory adherence. Real-time monitoring dashboards detect anomalies and support automated reporting. This framework mitigates risks of unauthorized access, data breaches, and compliance violations. Combining cloud infrastructure and blockchain ensures secure, transparent, and HIPAA-compliant healthcare data management, strengthening trust and operational efficiency [22].

V. RESULTS AND DISCUSSION

The study identifies significant limitations in conventional cloud-based healthcare data management systems, despite their widespread adoption and inherent security mechanisms. While traditional cloud infrastructures, such as AWS, Azure, and Google Cloud, provide essential features like encryption, identity management, and role-based access controls, they remain susceptible to breaches, misconfigurations, and inadequate monitoring protocols [23]. Secondary qualitative analysis reveals recurring vulnerabilities in these systems, including incomplete audit trails, fragmented consent management, and inconsistent enforcement of access permissions [24]. These gaps pose critical risks in healthcare settings, where sensitive patient information including medical histories, laboratory results, imaging data, and personal identifiers must be safeguarded in compliance with strict regulatory standards such as HIPAA and GDPR. Moreover, the centralized nature of traditional cloud systems can create single points of failure, increasing the likelihood of data corruption, unauthorized access, or operational disruptions [25].

In response to these challenges, the integration of blockchain technology with cloud infrastructure has emerged as a promising solution. Blockchain introduces a decentralized, tamper-resistant ledger that ensures immutability, traceability, and transparency of healthcare data [26].

Permissioned blockchain networks, in particular, allow controlled access to authorized participants, balancing data sharing requirements with strict privacy and security needs. In combination with AWS cloud storage, blockchain provides a hybrid framework that enhances both operational efficiency and data security. Smart contracts embedded within the blockchain automate compliance verification, enforce access permissions, and maintain detailed audit logs of all transactions. This approach addresses critical vulnerabilities in conventional systems by eliminating gaps in consent management, enhancing real-time monitoring, and reducing the risk of unauthorized modifications [27].

Case studies reviewed in the literature illustrate the practical application of such hybrid models. Hospitals implementing AWS cloud storage with blockchain logging report measurable improvements in operational transparency and risk mitigation [28]. For instance, smart contract-enabled access control ensures that only authorized clinicians, administrators, or researchers can view patient records, and every access event is logged immutably. These automated mechanisms reduce the administrative burden of manual compliance checks and enable rapid verification during audits [29]. Furthermore, encryption integrated with blockchain ensures that data stored on cloud servers remains secure, even in the event of network intrusions or system misconfigurations. Identity management protocols combined with blockchain-enhanced logging create end-to-end traceability, enabling organizations to pinpoint the source of any anomalies, unauthorized access attempts, or data inconsistencies [30].

Secondary qualitative analysis emphasizes the broader operational benefits of blockchain integration. The hybrid framework facilitates secure data sharing between hospitals, research institutions, insurance providers, and regulatory bodies while preserving patient confidentiality. Real-time monitoring of transactions ensures that breaches or irregularities are promptly detected and mitigated [31]. Automated reporting and compliance verification reduce administrative overhead and allow healthcare organizations to focus resources on clinical care rather than manual auditing. Additionally, the transparency and auditability of blockchain-enhanced systems foster patient trust, as individuals gain assurance that their sensitive health information is being managed responsibly and securely. These recoveries underscore the potential of hybrid blockchain-cloud frameworks to address longstanding challenges in healthcare data governance, bridging gaps that conventional cloud solutions alone have been unable to resolve [32].

Despite these advantages, the study identifies several operational and technical challenges associated with blockchain adoption in healthcare. Transaction latency, for example, can increase processing times, particularly in permissioned networks with complex consensus protocols. High storage requirements for blockchain nodes, especially when combined with large-scale medical imaging and EHR data, pose additional infrastructure considerations [33]. Integration with existing legacy systems can be complex, as hospitals often operate a mix of outdated and modern applications that must interoperate seamlessly with blockchain nodes and cloud services. Furthermore, workforce readiness and technological literacy are essential to ensure that staff can operate and manage blockchain-enhanced systems effectively. Addressing these challenges requires careful architectural design, including selective data offloading, hybrid storage models, and optimized consensus mechanisms, to maintain system efficiency without compromising security or compliance [34].

The literature also emphasizes the importance of policy alignment and governance frameworks in ensuring the long-term success of blockchain implementations. While the technology provides immutability and transparency, adherence to regulatory

requirements such as HIPAA, GDPR, and local healthcare laws requires clearly defined rules for data access, retention, and deletion. Smart contracts must be carefully coded to enforce these policies accurately, and regular audits should validate that blockchain operations remain compliant as regulations evolve. Additionally, blockchain frameworks must be designed to support interoperability with other healthcare data standards, such as HL7 and FHIR, enabling seamless integration with clinical workflows and existing EHR platforms [35].

Empirical findings further highlight the strategic advantages of combining AWS cloud services with blockchain technology. Cloud infrastructures offer scalable computing resources, elastic storage, and robust backup mechanisms, complementing the decentralized and secure nature of blockchain. This hybrid approach ensures that healthcare organizations can process large volumes of real-time data, maintain high availability, and support distributed decision-making without sacrificing security or compliance. For example, predictive analytics models for patient monitoring, disease outbreak forecasting, or resource allocation can operate securely on cloud-hosted datasets while logging all interactions and modifications immutably on the blockchain. The synergy between cloud scalability and blockchain security enhances operational efficiency, strengthens regulatory adherence, and fosters stakeholder confidence, making it a viable solution for modern healthcare environments [36].

Overall, the study confirms that blockchain-enhanced cloud frameworks offer a comprehensive solution to the limitations of conventional cloud-based healthcare systems. These hybrid models provide secure, auditable, and HIPAA-compliant data management, addressing vulnerabilities related to access control, consent, and auditability. By enabling real-time monitoring, automated compliance verification, and traceable data sharing, blockchain integration improves patient trust, operational transparency, and organizational resilience. While technical and operational challenges persist, careful system design, governance alignment, and workforce readiness strategies can mitigate these barriers, ensuring successful adoption and long-term sustainability. The findings underscore the practical applicability and technological feasibility of combining AWS cloud services with blockchain, establishing a foundation for secure, interoperable, and compliant predictive healthcare data infrastructures.

The thematic synthesis demonstrates that hybrid cloud-blockchain frameworks address critical gaps in conventional healthcare data management systems. By enhancing security, traceability, and compliance, these models not only mitigate operational risks but also support the adoption of next-generation predictive analytics, telemedicine platforms, and collaborative health networks. The recoveries from this study highlight a clear trajectory for healthcare organizations seeking to modernize their data infrastructures while maintaining ethical and regulatory standards, ensuring that cloud-native blockchain solutions remain a cornerstone of future digital health strategies.

Research Limitations

The study faces several limitations due to its reliance on secondary qualitative data analysis, which restricts direct empirical validation [37]. The findings are based on existing literature, case studies, and reports, which may not capture real-time operational challenges or technological advancements. Scalability and performance issues of blockchain integration with AWS are discussed theoretically without quantitative assessment. Additionally, variations in healthcare organizational practices and regional regulatory interpretations may affect generalizability. Technical limitations, such as latency, storage overhead, and interoperability with legacy systems, are identified but not empirically tested. These constraints suggest the need for future pilot studies and real-world implementation evaluation.

Research Implementation

The research can be implemented by integrating a blockchain-enhanced framework into existing AWS cloud infrastructures of healthcare organizations. Encrypted AWS storage ensures data confidentiality, while permissioned blockchain networks provide immutable audit trails for patient records. Smart contracts automate access control and HIPAA compliance verification. Real-time monitoring dashboards enable proactive detection of unauthorized access and anomalies. The framework can be deployed incrementally, starting with pilot projects to evaluate operational feasibility and scalability. Training and policy adaptation support seamless adoption. Implementation offers enhanced data security, improved regulatory adherence, operational efficiency, and increased patient trust in cloud-based healthcare data management systems.

VI. FUTURE STUDY

Future research should focus on assessing the performance, scalability, and practical feasibility of blockchain-enhanced frameworks in large-scale healthcare environments. While current studies demonstrate security and auditability benefits, there is limited empirical evidence regarding system behavior under high-volume, multi-institutional workloads. Research could explore integration with emerging healthcare IT systems, including real-time predictive analytics platforms, IoT-enabled patient monitoring, and AI-driven decision support tools, to evaluate how blockchain frameworks support continuous, data-intensive operations. Comparative analyses of public, private, and hybrid blockchain architectures deployed on AWS can provide insights into optimal strategies for balancing decentralization, control, and cost efficiency [38]. Additional investigations may examine transaction latency, storage requirements, energy consumption, and operational costs to identify methods for enhancing efficiency while maintaining compliance and security. Pilot implementations across diverse healthcare organizations can provide empirical validation of framework effectiveness, highlighting potential barriers and best practices for adoption. Furthermore, studies should address interoperability with legacy systems, automated anomaly detection, and real-time regulatory compliance monitoring to ensure seamless integration into existing clinical workflows. Collectively, these research directions will guide the development of secure, scalable, and patient-focused blockchain-enhanced AWS frameworks, strengthening HIPAA adherence, operational resilience, and long-term sustainability in healthcare data management.

VII. CONCLUSION

The research demonstrates that integrating blockchain technology with AWS cloud services provides a robust solution for HIPAA-compliant healthcare data management. Conventional cloud-based systems, while offering essential security measures, continue to face critical vulnerabilities such as misconfigurations, insufficient monitoring, and incomplete audit trails, which can compromise data integrity and patient privacy. By incorporating blockchain, these gaps are addressed through immutable, decentralized records that provide transparency and traceability across all transactions. Smart contract-enabled access control automates permission enforcement and ensures that only authorized personnel can access sensitive patient data, while real-time compliance verification enhances accountability and reduces manual auditing overhead. The proposed framework leverages encrypted AWS storage, permissioned blockchain logging, and continuous monitoring to create a secure, scalable, and resilient infrastructure. Secondary qualitative analysis confirms that this hybrid approach is operationally feasible, technologically effective, and practically applicable in real-world healthcare environments. The framework enables secure patient data sharing across multiple stakeholders, minimizes the risk of data breaches, and enhances trust in

healthcare systems. The findings of this study underscore a definitive path for healthcare organizations aiming to upgrade their data infrastructures while upholding ethical and regulatory requirements, positioning cloud-native blockchain solutions as a fundamental component of future digital health initiatives. Overall, the study establishes a comprehensive model that combines the scalability and flexibility of cloud infrastructures with the security, transparency, and regulatory compliance benefits of blockchain, offering a forward-looking strategy for next-generation healthcare data management and operational efficiency.

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