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Healthcare Data Governance in The AI Era: A Review of Privacy, Quality, Security, And Regulatory Compliance

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ABSTRACT: The significance of healthcare data governance has grown in tandem with the widespread use of AI and ML inside healthcare systems. Healthcare data management at its best involves following best practices to safeguard patient information, keep data accurate, keep it secure, and meet all applicable regulations. The trustworthiness of AI-powered healthcare apps, however, is susceptible to threats including data fragmentation, lack of interoperability, missing or inaccurate medical information, algorithmic bias, and privacy concerns. With an eye on healthcare data sources, data management techniques, governance frameworks, and new technology, this analysis delves into the essentials of healthcare data governance in the age of artificial intelligence. Topics covered include artificial intelligence's function in healthcare decision assistance, data purification, quality improvement, and information extraction. Additionally, methods that safeguard sensitive patient data while processing data and developing collaborative models are investigated. These methods include federated learning, secure multi-party computing, homomorphic encryption, and differential privacy. The assessment also discusses the ethical and regulatory concerns with AI deployment and how blockchain helps with data integrity and auditability. In order to ensure that AI-enabled healthcare systems are accountable, safe, and trustworthy, it is necessary to have well-coordinated policies, dependable data management, strong security measures, and stakeholder participation.

KEYWORDS: Healthcare, Governance, Privacy, Security, Compliance, Interoperability, Blockchain, Federated, Encryption, Differential.

1. Introduction

Healthcare is essential because it helps keep people healthy, stops illnesses in their tracks, and improves people's quality of life via early detection, efficient treatment, and ongoing care. The need of effective and accurate health information management has grown in response to the rising demand for evidence-based clinical choices and healthcare services. Structured, semi-structured, and unstructured data is rapidly expanding in the healthcare industry. Medical records, insurance claims, surveys, biobanks, lab results, radiography, pharmaceutical transactions, and environmental and behavioral monitoring devices are all sources of health data [1]. Data is increasing in volume, yet the healthcare business has several problems with data dependability, correctness, and quality. Hospital Administration's View on Health Data Governance Challenges in Healthcare Organizations. Improving patient care, healthcare efficiency, healthcare research, and national health planning and monitoring are all aided by health data collected by healthcare providers. In order to reach the end result, organizations also established unique compliance standards for analytics, protection, and sharing. An further hurdle when obtaining healthcare can be the fact that compliance regulations can vary among organizations [2]. The One Data Indonesia initiative, which includes health data, was officially introduced in Indonesia in 2019 through the data.go.id portal. The overarching goal of this policy is to facilitate the development, accessibility, and sharing of high-quality data among federal, state, and local agencies.

There have been revolutionary improvements across several industries as a result of the use of AI, but this is especially true in healthcare. There is an immediate need for creative solutions to efficiently handle and utilize healthcare data, since its quantity and complexity are increasing at an exponential rate. AI has evolved as a formidable technology that might transform the way hospitals handle patient data in response to this dilemma [3]. A hospital's data manager is responsible for a broad variety of tasks, such as the gathering, archiving, processing, and use of administrative, clinical research, patient, and medical record data. These duties have

historically required a lot of human effort and consumed a lot of time, which frequently resulted in mistakes, inefficiencies, and lost chances to enhance patient care. We want to learn all we can about the revolutionary effects of AI on healthcare data management in this in-depth examination [4]. Try to shed light on the possible advantages, disadvantages, and future consequences of AI in this field by looking at present trends, technology, and case studies. Artificial intelligence (AI) has the ability to completely transform the way hospitals handle and use data in order to provide top-notch care, from simplifying administrative tasks to facilitating personalized medicine and predictive analytics. It is also crucial to think about the social, ethical, and regulatory effects of AI as its use becomes more widespread [5]. The goals of healthcare data governance include patient privacy, data quality, security, and regulatory compliance [6]. Accurate and trustworthy healthcare choices are supported by high-quality data, while privacy protects sensitive patient information. Regulatory compliance guarantees ethical data treatment and conformity to healthcare data protection regulations, while security safeguards forestall cyber risks and unauthorized access.

A. Structure of the Paper

The rest of the paper is structured like this: Section II delves into the topic of healthcare data governance in the age of AI. Data quality enhancement and privacy-preserving strategies are some of the AI applications examined in Section III's healthcare data management applications. The literature review and research gaps are presented in Section IV. Lastly, the work is concluded and future research goals are outlined in Section V.

2. Healthcare Data Governance in The Ai Era

The notion of data ownership in health care is not novel, but the rise of AI has increased its complexity and stakes exponentially [7]. In the past, regulations such as the GDPR in Europe and the Health Insurance Portability and Accountability Act (HIPAA) in the US mainly addressed the privacy and security of records kept within specialized institutions.

A. Data Sources in Healthcare

The healthcare industry relies on a wide and diversified data ecosystem to provide effective patient care and drive progress [8]. There are a variety of viewpoints offered by this data, which comes in organized, semi-structured, and unstructured formats, about healthcare operations and the health of patients [9].

1) Data Privacy and Security Breaches

A fundamental human right, privacy allows individuals to determine whether or not to disclose themselves to the public and the entire world [10]. Privacy concerns really shine when it comes to sensitive medical records. Big data analytics tools are widely believed to have a positive impact on healthcare.

2) Lack of Data Interoperability

Data quality and continuity of treatment might be affected by health information systems' incapacity to be interoperable. Sharing and integrating patient data is made more difficult by information fragmentation across healthcare institutions such as laboratories, hospitals, and other similar facilities [11]. Incomplete patient profiles, erroneous data, and diminished trust in AI-powered health analytics are all possible outcomes of these obstacles.

3) Data Bias and Discrimination

The current health inequalities in these areas could be exacerbated by the lack of adequate rules for the gathering of healthcare data and the use of biased algorithms, which could lead to discrimination [12]. Prediction mistakes made by an AI tool for specific patients might be the result of a biased data collection.

4) Data Quality Issues

Healthcare data is notorious for having inconsistent, missing, or incomplete information that can compromise the accuracy of analytics [13]. An education on data quality reveals that electronic health records are a source of data for healthcare data analytics, and completeness is an important factor in this data.

5) Health Insurance

The health insurance sector is being transformed by data analytics in healthcare, which are introducing personalized coverage and targeted marketing that are based on customer-specific data. Helps with effective risk appraisal by enabling telematics, genetic data, and real-time input from wearable devices, boosting pricing and underwriting.

B. Iot, AI, and Blockchain in Modern Healthcare

Blockchain, artificial intelligence, and the internet of things are changing the healthcare industry. Technology like this is revolutionizing healthcare by fixing problems like data fragmentation, accessibility, and security. They have the potential to revolutionize healthcare by improving diagnostic accuracy, streamlining processes, and protecting sensitive patient information. Healthcare services that priorities patients may now be data-driven, personalized, efficient, and secure thanks to advancements in IoT, AI, and blockchain.

1) IoT in Healthcare

IoT devices link together and exchange data digitally using various software, sensors, and other technologies. IoT devices in healthcare include facilities, diagnostic tools, wearables, implanted devices, and remote monitoring systems [14]. One of the most important parts of contemporary healthcare systems is the IoMT.

2) AI in Healthcare

AI is the process of teaching computers to think, learn, and adapt in the same way that humans can. AI has already revolutionized healthcare [15]. The capacities of medical professionals are enhanced, diagnostic accuracy is optimized, treatment planning is expedited, and routine administrative duties are automated.

3) Blockchain in Healthcare

The distributed ledger system known as blockchain provides immutability, transparency, and tamper-resilience [16]. It is often praised for its crucial role in cryptocurrency ecosystems. Blockchain technology has great promise in the healthcare industry for resolving long-standing issues including data silos, privacy breaches, and limited interoperability.

4) Real-Time Monitoring

The fast adoption of IoMT devices has transformed healthcare by allowing for evidence-based patient therapy through data analytics [17][18]. The efficient use of IoMT data has become more challenging due to new obstacles, despite the fact that healthcare systems have undergone such advances.

C. AI Data Governance

Rules and practices are included to ensure that healthcare data is handled responsibly during its full life cycle [19]. Data accessibility, security, privacy, and quality as well as regulatory compliance are cornerstones of AI data governance. Responsible data usage by AI systems is the result of good data governance.

1) Regulatory Gaps and Uncertainty

The absence of defined rules pertaining to artificial intelligence in healthcare was one of the main obstacles found in the research and main data [20]. Data privacy and security legislation do not always tackle the intricacies of AI systems, such their capacity to learn from data over time, the possibility of bias, and the requirement for constant oversight.

2) Ethical Concerns and Bias Mitigation

The problem of bias in AI models has not been solved yet. Historical data, which is frequently employed by AI systems in healthcare, may include biases including demographic imbalances in training datasets [21]. These biases in healthcare decision-making can be reinforced or even intensified when AI algorithms learn from this data.

3) Integration of Data Governance Frameworks

Conventional data governance frameworks must be reconsidered in light of AI's inclusion into healthcare systems [22]. Privacy and security in conventional IT systems may be adequately addressed by current standards, but AI technologies are inherently dynamic; they change and adapt over time.

4) Policy Development

Data privacy, security, and ethical concerns are just a few of the unique issues that artificial intelligence (AI) presents to the healthcare industry, and lawmakers must craft transparent and thorough rules to address these concerns [23].

5) Education and Training

Healthcare organizations, particularly smaller ones, need to put money into training and education programs so they can have the right people in charge of AI data governance [24]. Thus, medics, data privacy officials, and IT specialists will be prepared to handle the intricacies of AI systems.

6) Collaboration Across Stakeholders

Regulatory agencies, healthcare providers, AI developers, and patients must work together to ensure effective data governance in AI-driven healthcare systems [25]. A collaborative approach is crucial for the development and deployment of AI systems to priorities privacy, justice, and patient safety.

3. Artificial Intelligence in Healthcare Data Management

Privacy, security, compliance with regulations, and quality of data are the four pillars upon which healthcare data governance rests. The purpose of data quality is to guarantee that patient records are accurate, whereas the purpose of privacy is to safeguard all patient information. Data security is about keeping data secure from harm, whereas regulatory compliance is about following all the requirements.

A. Artificial Intelligence in Healthcare

The advent of AI has been a game-changer in the medical field [26]. Fig 1 displays some of the various ways in which artificial intelligence (AI) has benefited the healthcare industry, including health information systems, syndromic and epidemic monitoring, medical imaging, predictive modelling and decision assistance, and geocoding health data.

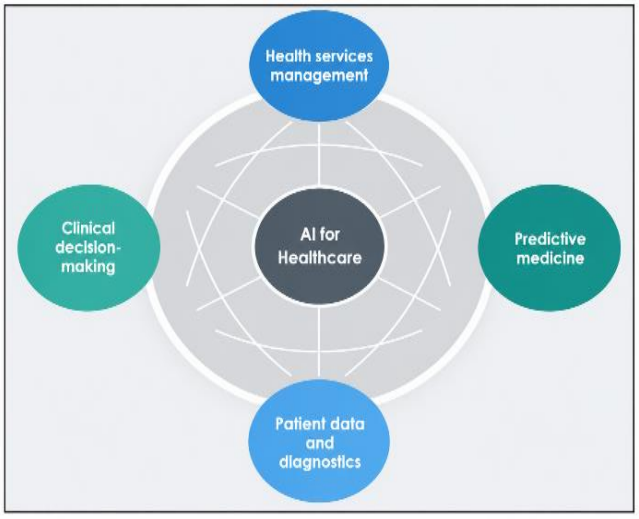


Fig. 1. Artificial Intelligence in Healthcare

1) Management of Health Services

The possibility for AI methods to improve holistic health care management is a prominent feature of these techniques. A variety of medical professionals and administrative staff can benefit from these apps [27]. Using data culled from a variety of sources, such as scholarly articles, textbooks, and actual patient care, an AI system may provide healthcare providers with up-to-the-minute, consistent, and even real-time updates on medical topics.

- Data may be obtained instantly by clinicians as needed.
- Medication administration is an area where nurses can improve patient safety.
- Patients have the opportunity to actively participate in their healthcare by communicating with their healthcare teams while they are in the hospital.

2) Clinical Decision Making

The idea that artificial intelligence (AI) tools may aid doctors and researchers in making better healthcare decisions is central to keyword analysis. believe that AI has the ability to aid doctors in making better clinical decisions and might even replace human judgement in certain areas of healthcare [28].

3) Patient Information and Diagnosis

Patient data and diagnostics are a significant challenge for AI applications. Doctors and other healthcare professionals can benefit from artificial intelligence techniques that can help them manage the massive amounts of patient data, sometimes known as medical big data. Data generated by screening, diagnosis, and therapy allocation are all within the purview of AI systems [29]. This allows medical practitioners to learn more about related subjects and the relationships between relevant variables and their outcomes of interest.

B. Artificial Intelligence in Healthcare Data Management

The field of healthcare data science has seen a dramatic shift with the advent of artificial intelligence (AI) [30]. With developments in machine learning (ML) and natural language processing (NLP), artificial intelligence (AI) holds the potential to automate repetitive processes, increase data accuracy, and improve system interoperability. Artificial intelligence (AI) may improve healthcare organizations' data processing, categorization, and extraction capabilities, allowing for smarter decision-making.

1) Data Fragmentation and Silos, and Evaluation

Healthcare data stored in separate systems makes it difficult to discern patterns over time, fails to take the whole patient into account, and makes it impossible to assess the patient's present state of health. As a result of data silos caused by non-care-oriented systems, patients who visit different hospitals are unable to receive coordinated treatment.

2) Traditional Data Management Systems

Traditionally, documents are in paper form and maintained in traditional data management systems, which use outdated software designed solely for record keeping and billing. Concerning administration, these methods are effective [31]. Unfortunately, they aren't very useful because they can't handle complicated data sets or combine data from different clinical and patient sources.

3) Machine Learning for Data Cleansing and Quality Improvement

Machine learning (ML) is being used more and more in healthcare records to identify and fix errors in data, which is a way to enhance data quality. Machine learning

algorithms are able to identify and remove duplicate entries, fill in missing values, and understand data from more than one system.

4) Natural Language Processing (NLP) for Unstructured Data

The use of natural language processing (NLP) in healthcare is particularly useful because of the unstructured nature of healthcare data storage. Plus, natural language processing (NLP) tools might pave the way for narrative data analysis and patient profile creation if interoperability issues are resolved.

C. Applications of AI in Healthcare

There have been several game-changing healthcare applications made possible by incorporating AI into hospital data management systems. Hospitals are transforming patient outcomes, operational efficiency, and medical innovation by using AI to gather, process, and use data.

- Predictive Analytics: Predictive analytics models driven by AI examine enormous volumes of patient data to predict the course of diseases, identify groups that are at risk, and anticipate the demand for healthcare resources [32][33].

- Medical Imaging: Artificial intelligence systems are revolutionizing the field of medical imaging interpretation by automating processes like picture segmentation, tumor diagnosis, and anomaly identification [34].

- Clinical Decision Support: Clinical decision support systems driven by AI help doctors make better evidence-based judgements by compiling patient records, scientific research, and industry standards. These technologies improve the consistency and quality of care delivery by offering real-time suggestions for diagnosis, treatment planning, and drug selection [35].

- Electronic Health Records (EHR) Management: Automating data input, streamlining paperwork, and providing intelligent insights into patients' health state and treatment history are all benefits of EHR management systems enabled by AI [36].

- Drug Discovery and Development: Artificial intelligence (AI) analyses molecular data, predicts medication interactions, and identifies possible therapeutic targets, all of which speed up the drug research and development processes. Virtual screening, lead optimization, and the repurposing of existing medications are all made easier with the use of machine learning algorithms, which speed up the delivery of new therapies to patients [37].

D. Privacy-Preserving Machine Learning Techniques

Data governance in healthcare has several challenges, one of the most significant being the need to strike a balance between patient privacy and the accessibility of massive volumes of healthcare data [38][39]. There are still a number of ethical and legal concerns with data centralization, even after de-identification, due to the possibility of re-identification.

1) Federated Learning

Multiple healthcare facilities can work together to build a machine learning model using the federated learning (FL) approach, all without physically transferring patient data. Each participating institution does its own model training and updates the aggregated server accordingly [40]. As a result, healthcare organizations are better able to work together, protect patients' privacy, and limit the amount of data that may be exposed.

2) Secure Multi-Party Computation and Homomorphic Encryption (HE)

Two forms of cryptography: SMPC and HE, are used to compute health care data in a way that keeps it private [41]. Multiple healthcare organizations can pool their data sets for computation using SMPC, all while protecting their patients' privacy. Among the methods employed in SMPC are Secret Sharing and Oblivious Transfer.

3) Differential Privacy (DP)

A mathematical method for assessing and managing privacy issues associated with healthcare data analysis. A person's involvement in a dataset is less likely to be inferred when it incorporates calibrated noise into model training or query results [42]. In general, smaller values of the parameter epsilon (ε) give higher privacy protection, but they may also decrease the accuracy of the model. This parameter controls the amount of privacy.

4. Literature Review

Recent research has focused on ethical AI, privacy protection, regulatory compliance, and healthcare data governance. In order to facilitate trustworthy analytics and safe data exchange, researchers are looking into federated learning, blockchain technology, and differential privacy. The necessity for integrated, transparent, and privacy-preserving healthcare AI systems is underscored by the persistence of issues related to data security, regulatory complexity, and effective deployment.

Y. Shahsavari, et al. (2026) Introduced a thorough architecture that integrates federated learning (FL) with blockchain for safe and private healthcare analytics; it is clinically focused and compliance aware. To comply with privacy rules like HIPAA and GDPR, FL allows for cross-

institutional training without exposing any actual data. Model poisoning and gradient leaking are still threats to FL, though. To tackle these issues, we can offer blockchain-based FL (BCFL). This kind of FL uses blockchain technology to improve trust, verifiability, and auditability by using its immutable ledger and decentralized consensus [43].

S. Rahul, et al. (2026) dealt with the primary issues raised by healthcare providers using AI systems in relation to data privacy and security legislation that are applicable. Worldwide, healthcare facilities face two sets of regulations: the General Data Protection Regulation (GDPR) of the EU and the Health Insurance Portability and Accountability Act (HIPAA) of the US. This data is frequently needed in large quantities by AI systems, which can make intra-organizational operations more complicated. These regulations address the subject of sharing, accessing, and securing sensitive patient information. It is critical to have good data governance in place to ensure that information remains accurate, private, secure, and uncompromised [44].

S. Pahune, et al. (2025) examine the background, essential elements, categories, best practices, case studies, obstacles, and potential future paths of data governance in LLMs as it pertains to artificial intelligence. In order for LLMs to acquire a reliable approach for the end user, it is necessary to undertake a thorough and extensive examination of data governance as well as the efficiency with which AI data governance must be integrated. Lastly, consider the data governance framework's applicability to the present state of LLMs in healthcare, pharmaceuticals, banking, supply chain management, and cybersecurity; discuss the key responsibilities needed to benefit from this approach; and address the framework's strengths and weaknesses [45].

K. Hartomo, et al. (2025) investigated AI's role in health data governance, with a focus on striking a balance between privacy, security, ethical concerns, and technical advancement. Data privacy, security measures, permission, and the moral consequences of healthcare choices influenced by artificial intelligence are some of the topics covered in this study [46].

B. Mangalampalli (2024) Compliance automation within the framework of Healthcare Analytics Platforms may now be addressed, thanks to the extensive infrastructure for AI-enhanced data governance that has already been created. The implementation of such platforms has a tendency to change the benefit-cost ratio of utilizing personal data in data analytics, which is why data governance is being prioritized. But privacy regulations are still complicated and disjointed, and it's still a lot of work to make sure people are actually following them. Some have suggested that AI-enhanced data governance may alleviate the need to carry out the menial, low-value activities that are necessary for compliance. The many responsibilities that must be fulfilled in order to ensure privacy are illustrated by a simplified conceptual model of a Healthcare Analytics Platform [47].

K. Maguluri, et al. (2024) resolve the legitimate worries of all stakeholders regarding the confidentiality and integrity of patient information. Also, the recent explosion of digital health apps and predictive models is driving AI and might be causing it to miss the point of recent regulatory efforts, so it's even more important to combine advanced technologies like deep learning quickly. On the whole, research and regulation need to move in slow motion. Further, it delves into the gap between the law and technology in its present form, and it talks about the future stages for using deep learning to prove compliance with the law while also catering to other ethical concerns [48].

M. Badawi (2023) explored the important moral questions that come with using them. Included on this list are the fundamental values of healthcare fairness, privacy, trustworthiness, and explain ability. To guarantee the ethical deployment of these technologies, it is crucial to have implementation techniques that are open, responsible, and strong in terms of ethics. In addition, the article delves into the privacy and security concerns that come with AI and big data in healthcare, outlining possible dangers such data breaches, abuse of data, and threats to patient confidentiality. Furthermore, this research emphasizes the value of federated learning and differential privacy for privacy-preserving AI and large data analytics [49].

Previous research emphasizes the significance of data governance, ethical AI, regulatory compliance, and privacy-preserving technology in the healthcare industry. While healthcare fraud detection is an important topic, the majority of research focuses on healthcare analytics in general. Secure data sharing is made possible by blockchain and federated learning, but there are still obstacles like model poisoning, gradient leaks, and complicated regulations. There hasn't been nearly enough research into how current governance frameworks—which stress openness, responsibility, and privacy—can be integrated with explainable AI, ensemble models, and graph learning. In addition, issues including interpretable forecasts, unbalanced claims data, and real-time fraud detection receive less focus. Table I summarizes the comparative findings that show these limitations and show that in order to offer transparent and reliable healthcare fraud detection, an integrated framework is needed that combines ensemble approaches, privacy-preserving data governance, explainable AI, graph learning, and ensemble learning.

TABLE I. SUMMARY OF KEY STUDIES ON HEALTHCARE DATA GOVERNANCE IN THE AI ERA

Author & Year	Objective / Approach	Technology / Method	Key Findings	Advantages	Limitations
Y. Shahsavari et al. (2026)	Develop a secure and privacy-preserving healthcare analytics framework.	Federated Learning, Blockchain, HIPAA, GDPR	Combines distributed model training with blockchain-based verification and auditing.	Improves privacy, trust, and accountability.	Vulnerable to model poisoning and gradient leakage.
S. Rahul et al. (2026)	Examine legal requirements for healthcare AI data privacy and security.	GDPR, HIPAA, Data Governance	Highlights the importance of protecting sensitive patient information and maintaining data integrity.	Supports secure and compliant data management.	Regulatory requirements complicate data sharing and institutional processes.
S. Pahune et al. (2025)	Review AI data governance principles and their applications across sectors.	AI Data Governance, LLMs, Governance Frameworks	Discusses governance components, best practices, challenges, and future directions.	Provides broad insights into trustworthy AI data management.	Specific limitations of healthcare fraud detection are not discussed.
K. Hartomo et al. (2025)	Explore ethical issues in AI-based health data governance.	Data Privacy, Security, Consent, Ethical Governance	Emphasizes balancing ethical responsibilities, privacy, security, and technological innovation.	Highlights responsible healthcare AI practices.	Fraud-specific applications and model evaluation are not specified.
B. Mangalampalli (2024)	Develops a conceptual architecture for AI-enhanced data governance in healthcare analytics.	AI-Enhanced Governance, Compliance Automation	Identifies opportunities to reduce routine compliance efforts while supporting privacy responsibilities.	Supports efficient privacy management and compliance processes.	Complex and fragmented privacy laws continue to create challenges.
K. Maguluri et al. (2024)	Investigate healthcare data privacy, security, and regulatory challenges in deep learning.	Deep Learning, Data Security, Regulatory Compliance	Highlights the gap between technological development and existing regulatory frameworks.	Identifies compliance and ethical considerations for healthcare AI.	Regulatory adaptation and implementation remain challenging.
M. Badawy (2023)	Examine ethical considerations associated with AI and big data in healthcare.	Explainable AI, Differential Privacy, Federated Learning	Emphasizes trustworthiness, transparency, healthcare equity, and privacy-preserving techniques.	Supports responsible and privacy-aware AI deployment.	Healthcare fraud detection applications are not specifically addressed.

5. Conclusion and Future Work

Healthcare data governance is critical to guaranteeing the ethical usage of artificial intelligence in current healthcare systems. Issues with patient confidentiality, data integrity, security, interoperability, and regulatory conformity were the focus of this analysis of key governance concerns. This conversation brought to light the ways in which security flaws, data bias, inadequate information, and healthcare records that are fragmented might impact the dependability of AI-driven systems. Data cleaning, NLP, and machine learning powered by AI present possibilities to enhance data quality and information management. Moreover, methods that preserve privacy, such as differential privacy, homomorphic encryption, secure multi-party computing, and federated learning, help to safeguard sensitive patient data. Integrity and auditability of data may also be improved with blockchain technology. Clear governance rules, suitable regulatory frameworks, stakeholder engagement, and ongoing monitoring are necessary for effective execution. There has to be a fusion of technical protections, ethical standards, and organizational responsibility in healthcare organizations. All things considered, safe, dependable, and accountable AI-enabled healthcare systems cannot exist without robust data governance, which is critical for preserving patient confidence and safeguarding sensitive information.

Privacy, data quality evaluation, security, and regulatory compliance should all be a part of future healthcare data governance systems. Additional research can assess methods that protect patients' privacy in actual medical environments. Encouraging trustworthy and ethical AI use also requires standardized governance principles, better interoperability, bias detection, and regular audits.

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