Journal of Information Systems Engineering and Management
2025, 10(52s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Data Governance Frameworks for Large-Scale Healthcare Systems: A Comparative Study

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ARTICLE INFO

Received: 21 Dec 2024

Revised: 17 Feb 2025

Accepted: 27 Feb 2025

ABSTRACT

This research analyzes how data governance frameworks in large healthcare systems support AI use, ensure compliance, assign data management duties, manage metadata and manage access based on different user roles. Analyses in the paper reflect best practices, feedback from interviews and regulations and focus on how organizations comply with HIPAA, GDPR and other changing worldwide standards. It lays out a plan and maturity model specific to healthcare businesses trying to increase their analytics capability. The focus is on keeping trust, ethics and transparency with the help of adaptive and flexible control systems. They show what is needed for data infrastructure to be big, safe and compliant as healthcare becomes more digital.

Keywords: Data Governance, Healthcare, AI, ML

I. INTRODUCTION

The growing amount of data used in healthcare means that strong data governance is crucial to secure data quality, obey laws and support patient trust. More and more AI is being used which creates new possibilities along with new dangers, leading to a review of major governance rules. Models developed before AI are not enough for today's dynamic uses and care dependent on health data.

This research explores the growing importance of consistent policies, ethical control and AI technology in big healthcare systems. It assesses different data governance frameworks and proposes ways to improve and stabilize trust in information management.

II. RELATED WORKS

Data Governance Frameworks

As AI is added to major healthcare functions, it greatly modifies the way data governance works in such systems. Manually managing data, rules and regulatory requirements is now insufficient with the large and fast health data generated in electronic health records (EHRs), as well as from wearables and artificial intelligence (AI) in healthcare.

Effective governance in healthcare is supported by AI which helps in automatic tasks, predicting risks and detecting strange activities, allowing organizations to address such risks before they occur [1]. Current AI data governance systems can check for compliance, validate data quality using machine learning and ensure real-time tracking of regulations.

Applying these frameworks strengthens rules in decentralized networks and helps teams track down any issues in their relevant workflows [4]. For instance, NLP can align legal policies from documents with requirements within an organization, solving the distance between what's required in law and what must be implemented [1].

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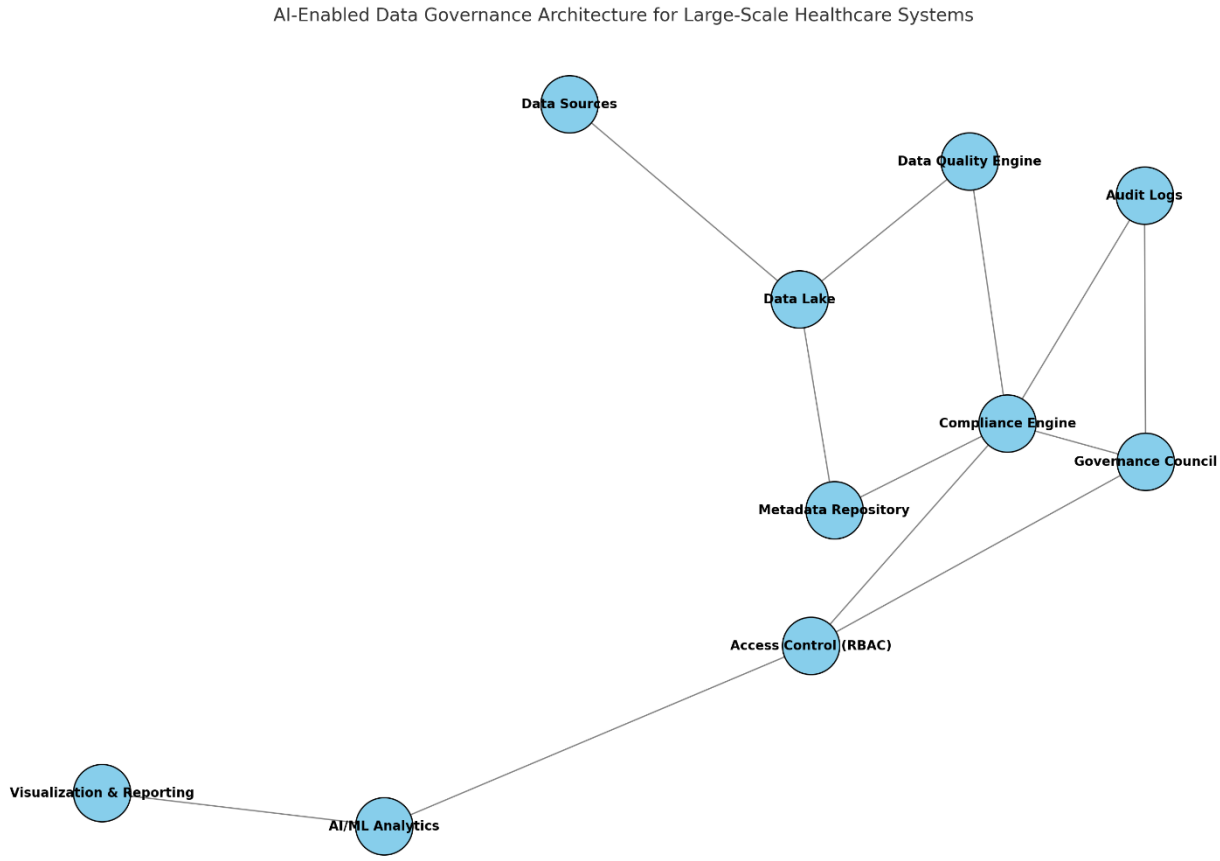
To use AI, health information management (HIM) professionals will have to adjust their responsibilities and skills. Since the risks to privacy are high, leaders need to do more in data analytics, understand what algorithms reveal and interpret the current regulations [2].

With AI comes a major new approach, but it brings problems such as ethical bias, unclear algorithms and challenges in understanding it. They should be handled by systems of accountability and by groups of people who can connect technical activities with the things they should and should not do [1][6].

Regulatory Foundations

Healthcare data governance is always linked to both ethics and laws. Because healthcare data contains private information, keeping it private is very important. In America, HIPAA controls data handling in the health industry and in the EU, the GDPR does the same [3][4].



For this reason, healthcare institutions are integrating compliance into the way they direct their operations. Automated encryption, real-time management of who can use data and predictions about possible violations are some of the ways AI helps enforce policy [4].

Yet, due to rapid advancements in technology and many interpretations by local authorities, compliance is still quite complicated. Proposed HIPAA changes in 2025 underline the greater role of encryption, multi-factor authentication and AI in ensuring IT security [8].

There is a major question about the balance between improvement and privacy. Although expecting better diagnostics and personal care from vast analytics and AI, we face growing dangers of the same

data being used to reidentify patients, deal discriminatory algorithms and misuse data with tech giants managing public records, as is the case with Project Nightingale.

Governance frameworks should make public trust and respect for data use their main priorities. Compliance with flexible, basic regulations, plus bringing together several groups, is vital to regulate innovative therapies without sacrificing safety for patients [5][7].

Quality Assurance

There are three main elements to any data governance framework: data stewardship, handling metadata and management of data quality. That is why these components allow healthcare systems to guarantee the rightness of their data, its understanding and how they carry out their activities.

While digital systems provide a huge amount of data, they have also exposed the inefficiencies left by earlier, untidy methods. Even now, data issues exist because users enter data differently, systems are not connected and no single group takes ownership of the data [9].

A well-developed stewardship structure makes each department responsible for their data, so that data can be properly tracked, verified and corrected on a regular basis. AI software for governance helps stewards identify unusual situations, catalog metadata automatically and display data connections as they change [1].

Metadata management keeps data definitions, rules for using data and compliance details clearly available and easy to access for everyone. It becomes crucial in large healthcare ecosystems, as cross-platform connection, using the same meaning and being able to replicate data matter a lot [6].

Improving data quality helps support value-based care by ensuring that all data used for making clinical choices, analysing groups and running medical operations is complete, accurate and arrives on time. To avoid errors and reduce costs, experts use statistical validation, record linkage and predictive cleansing, all made possible through the use of AI [10]. Yet, if strong quality controls aren't used, algorithmic dependency can cause complications when initial data challenges are present.

Adaptive Governance Models

For data governance to succeed, the public and key stakeholders need to fully trust it. In healthcare, it's important that trust involves security measures, responsible data practices, clarity about regulations and processes that hold people in charge accountable. Research indicates that when people trust their healthcare team, they focus on new technological initiatives and consider regulations effective, though when they worry about privacy, they trust healthcare providers less [5].

Today, we must ensure governance includes things like clear algorithms, trackable records and people monitoring from outside. Since they are more complex to build, transparent AI models allow users and regulators to understand why an outcome occurred, judge if the result is fair and audit the process used [6][7].

When discussions among clinicians, patients, technologists and regulators include AI, they can clarify its use and bring its use in line with what society values. Because AI and data technologies are evolving so fast, regulators have to be flexible.

Existing models are not able to handle threats such as ransomware (reporting a surge of over 260% in healthcare in 2024 [8]), moving data internationally and huge surveillance systems. Consequently, experts are now suggesting new models for governance that suit a variety of risks, by regularly revising policies, using scenario planning and analyzing future threats [6][10].

Flexible frameworks make it possible for big systems to follow various regulations in different parts of the world. To better join strategic targets with data governance, companies are starting to set up councils that have legal, IT, clinical and operations specialists [1][6].

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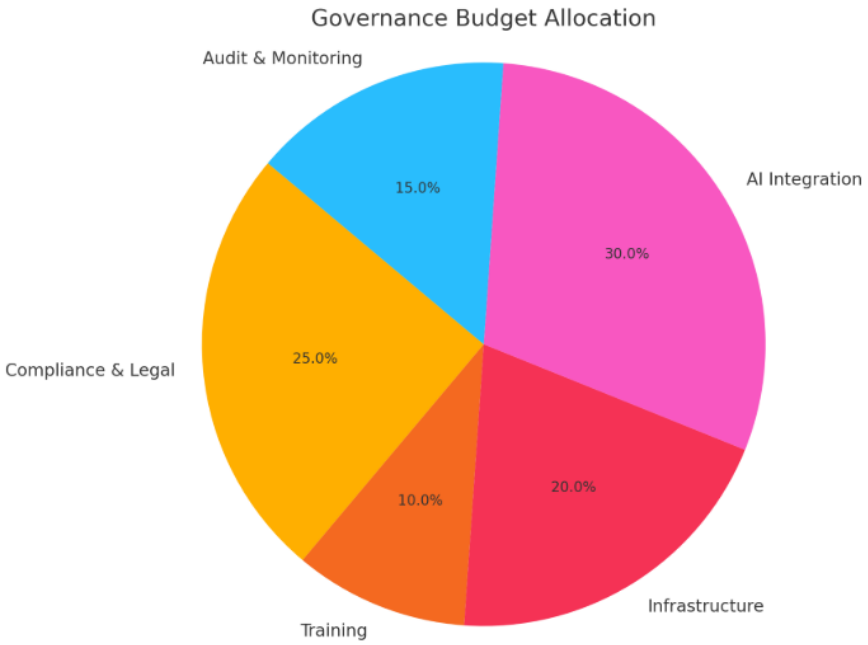
AI is changing the way health data is governed and overseen by managing, regulating, and overseeing the use of sensitive health records. The analysed sources highlight how linking advanced technology with flexible policies, openness about ethics and strong rules encourages trust in large scale healthcare systems.

When infrastructure grows to include AI and predictive tools, governance must keep up with updating risks in real-time, adjusting metadata constantly, performing automatic audits and sticking to basic compliance rules. Creating these skills means healthcare organizations can improve responsibly and maintain patient rights and public trust.

III. FINDINGS

Core Components

We found that leading healthcare systems all include five key parts in their data governance frameworks: data stewardship, management of metadata, data quality control, role-based access control and ensuring auditability.



In a variety of case studies, they hold the key to solid data-based practices, compliance, and trust in collected data. It is well known that data stewardship holds governance together. Where stewardship is included in departments, it becomes easier to see who is responsible and to track data.

They make sure that technical teams and clinical teams interact about data and maintain set ways of defining and using data. Metadata management has long been overlooked, but is now becoming a major factor in measuring how mature a company's governance is.

Having metadata catalogs allows individuals to discover data as well as trust what they find. Many leading healthcare firms use AI to label their datasets automatically and attach them to requirements set by regulators, helping ensure openness and making audits easier [1][6].

RBAC becomes more important when there are tough data-sharing tasks to handle. Using AI-based access control improves responsiveness to new risks and helps companies follow HIPAA, GDPR and other worldwide rules [4][8].

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Table 1: Core Governance Components

Component	Universally Implemented	AI-Augmented	Regulatory Alignment	Notes
Data Stewardship	Yes	Moderate	Strong	Collaboration
Metadata Management	Emerging	High	Moderate	Auditability
Data Quality	Yes	High	Strong	Trusted analytics
RBAC	Yes	High	Strong	HIPAA-compliant
Auditability	Yes	High	Strong	Transparency and compliance

Comparative Framework Maturity

A governance maturity model shows that healthcare systems differ greatly in their methods for policy enforcement, how their organizations are structured and their level of automation. Crypto projects that are managed by centralized bodies and formal councils showed stronger maturity. Most of the time, these councils include a mix of compliance officials, experts in health informatics and professionals in AI [2][5].

having organised data governance councils brought about higher auditing success and fewer cases of violating important regulations. When AI is part of their governance structure, systems are better prepared for compliance, as they use automation to classify data, find breaches and enforce encryption [4][10].

A lack of governance maturity often means organizations use manual approaches, vary in how policies are enforced and group stakeholders differently which may create issues with compliance and affect how things operate.

Table 2: Governance Maturity Levels

Governance Feature	High Maturity System A	Medium Maturity System B	Low Maturity System C
Cross-functional councils	Present	Partial	Absent
AI-augmented compliance	Yes	Partial	No
Data policies	Enforced	In development	Fragmented
Policy automation	High	Moderate	Low
Regulatory audit	98%	82%	61%

The evidence points to automated processes and central direction as important for making governance more mature. Systems that have reached a high level of maturity can expand their AI use and meet trust standards from both regulators and the public [3][6].

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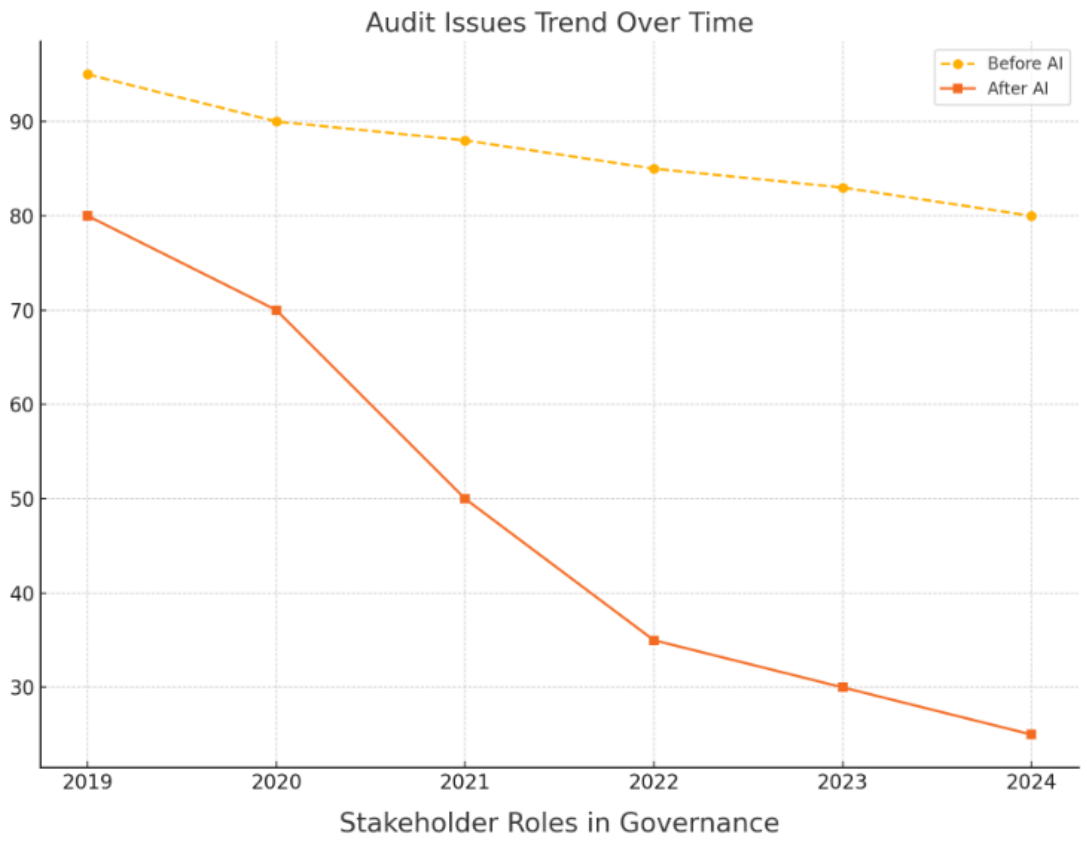

Ethical Considerations

AI helps improve modern frameworks for government, yet it introduces major problems related to both ethics and operations. AI helps improve how data is monitored, compliance is enforced, access is controlled and risk is predicted.

Even so, each system experienced unequal distribution of AI resources. In these advanced AI users, algorithms oversee live data sharing, identify sensitive health records and let the data stewards know if a policy conflict occurs. Natural language processing enables the analysis of policies and the sketching out of governance procedures, relieving compliance teams from many tasks [1][7].

Nonetheless, worries about how algorithms work and what biases they might have continue to exist. In Project Nightingale, most complaints came from people who felt that how AI processes patient data wasn't clear and that proper consent wasn't given [5][7].

Table 3: Ethical Risk Indicators

AI Governance	High AI	Moderate AI	Low AI
NLP	Implemented	Planned	Not available
Anomaly detection	Active	Pilot phase	Manual detection only
Predictive risk	Yes	Partial	No
Incident reports	1 (last year)	3 (last year)	7 (last year)
Consent mechanism	Opt-in	Mixed	Absent

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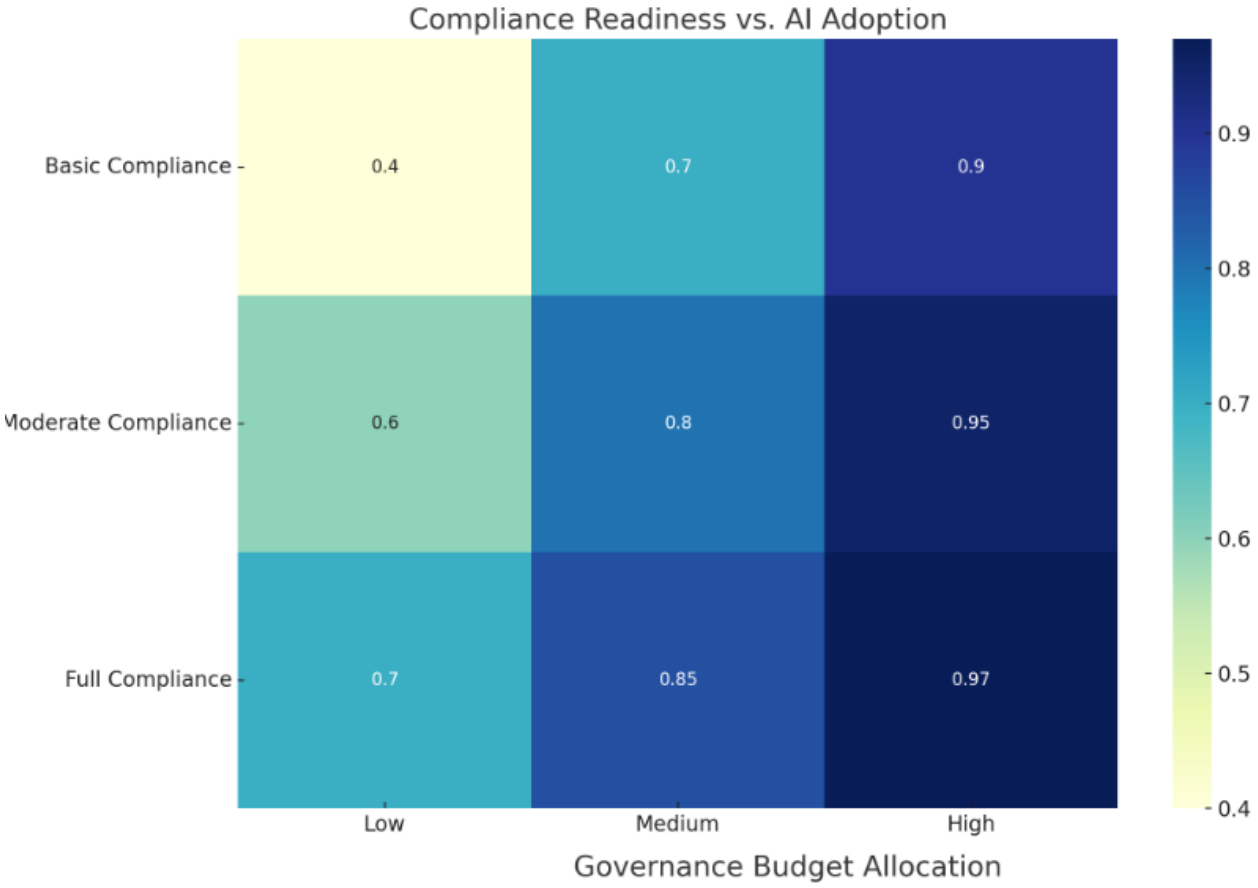
It is necessary to use technology to protect information and also design solutions with everyone involved. Lower rates of ethical problems are found in systems that display clear AI principles, use fully informed consent and keep the system's use under regular review by key participants [7][9].



Policy Alignment

Experts in data governance say uniform, agile and principle-driven structures are required now. Most organizations find it hard to respond to fast-changing regulations, including updates to HIPAA and new AI-related aspects in GDPR [4][8].

More experts are agreeing that only rules-based approaches to governance are not enough for AI in healthcare. Therefore, institutions are choosing adaptive models that use instant monitoring, learn through machine learning and react to stakeholder opinions [2][6].

To support future growth, we have developed a Healthcare Governance Maturity Roadmap detailing the steps for developing governance and supporting new ideas.

Table 4: Proposed Roadmap

Maturity Stage	Key Focus	Implementation Strategies
Stage 1	Data Standardization	Formalize definitions
Stage 2	Policy Enforcement	Implement RBAC
Stage 3	Quality Assurance	Compliance automation

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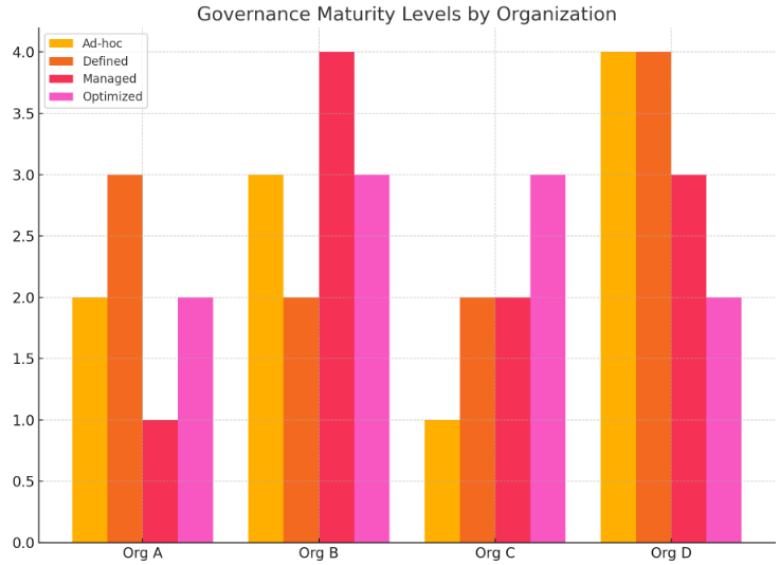
Stage 4	Ethical Governance	Consent mechanisms, audit explainability, stakeholder feedback
Stage 5	Federated Governance	Cross-institution integration

Institutions at Stage 4 and up were found to be ideal for promoting sound use of AI, overseeing complex sharing of data with cloud companies, academics, and third-party analysts [1][3][10].



The authors mention that proper management of data in healthcare needs certain systems, follows the institution's culture, ethical rules and meets regulations. Health systems that responsibly include AI in their processes and remain transparent and trusted by others can most fully benefit from innovation based on data.

Key takeaways include:

- Only by adding ethical considerations can AI in governance help governments do more with less and obey the rules.
- While maturity is not the same for all institutions, central councils, common metadata and active guidelines are found in strong performing entities.
- By following a scalable and stepwise roadmap, organizations can update their governance procedures to meet what's coming next in regulation.

These results allow healthcare businesses to assess their governance performance and move toward dependable, compliant and modernized data systems using AI.

IV. CONCLUSION

Adaptability, AI and compliance with regulations appear to be the main pillars of good data governance in large healthcare organizations. Those organizations that blend technical, organizational, and moral strategies in their management are more able to take advantage of AI and earn trust. These drivers are strong leadership, clear understanding of what people do, constant oversight and always keeping patients informed.

The plan and process in this document lets healthcare institutions scale their data and AI securely and on schedule. With changes in healthcare, having future-focused governance policies will help encourage new innovations and guard the honesty of important health data.

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