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Data Governance Design for Optimization of Hospital Management Information System (SIM-RS) at ABC Regional Hospital

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Abstract

The increasing complexity of hospital data management requires a robust Data Governance (DG) framework to ensure data quality, security, and compliance. This study focuses on developing a DG framework tailored to the Hospital Management Information System (SIM-RS) at RSUD ABC to enhance data integration, accessibility, and regulatory adherence. A qualitative approach with a case study method was employed, involving interviews and document analysis to identify key challenges in data management. The proposed DG framework aligns with ICD-10 and regulatory requirements, ensuring interoperability and efficient data processing. Implementing the Master Patient Index (MPI) reduces duplicate records, while Two-Factor Authentication (2FA) and AES-256 encryption strengthen data security. FHIR standards facilitate seamless data exchange across healthcare systems, optimizing operational efficiency. AI-driven data analytics further enhances clinical decision-making and administrative workflows. Evaluation of the framework demonstrates significant improvements in data quality, regulatory compliance, and risk management, leading to improved patient care and reduced medical errors. The High-Level Roadmap outlines a phased implementation strategy for sustainable DG adoption. Future research may explore performance metrics, Blockchain integration, and organizational change management to refine DG practices in healthcare institutions further.

Keywords: *Data Governance, SIM-RS, Hospital Data Management, Interoperability, Regulatory Compliance*

1. Introduction

Digital transformation has become a significant focus in various sectors, including Healthcare [1]. Hospitals are now facing considerable challenges in managing the growing amount of data from multiple sources, such as electronic medical records, billing systems, and other operational data [2]. Hospital Management Information System (HIMS) is essential for integrating and managing this data [3]. However, the success of SIM-RS is highly dependent on the quality of data governance that supports it [4]. Data can become a poorly managed asset without good governance, undermining healthcare efficiency and quality [5][6]. The need for solid data governance is increasingly felt given the highly sensitive and critical nature of health data [7]. Inaccuracies or data loss can result in serious repercussions, such as errors in the diagnosis or treatment of patients [8]. Research shows that data fragmentation is common in health systems that lack an adequate data governance framework [9]. This fragmentation results in information redundancy and the inability to share data between units effectively, and with data governance, hospitals can address these challenges through a more structured and systematic approach [10][11].

Interviews with IT staff at ABC Hospital showed that although the hospital has been trying to manage data manually and electronically, data governance is still in the development stage and faces challenges related to evolving regulations and improving data quality, which must be given more attention. The need for solid data governance is increasingly urgent due to the highly sensitive and crucial nature of health data [12]. Inaccuracies or data loss can lead to serious repercussions, such as misdiagnosis or treatment of patients [13]. Interviews with IT staff revealed that despite efforts to ensure data quality, challenges include the consistency of medical record data and managing data redundancy. ABC Hospital has attempted to address these issues by ensuring each patient has one unique identifier to avoid duplication. However, security data management and user awareness of data privacy are still obstacles. In addition, although the hospital has followed standard accreditation procedures and has governance documents, data protection awareness still needs to be improved among staff, especially in using more secure systems.

In Indonesia, especially in RSUD ABC, implementing data governance is a strategic step in supporting an effective SIM-RS. Hospitals need a framework that enables standardized data management so that every operational unit can access consistent and accurate data. Data Governance (DG) helps ensure that data is not only securely stored but also optimally used to support clinical and administrative decision-making [14][15]. Studies in South Africa show that DG-based data management can improve operational efficiency by up to 30%, especially in hospital data source management [16]. However, implementing data governance is not a simple process [17]. Hospitals need to build a clear implementation roadmap, starting from an assessment of existing capacity to fully adopt the DG framework [18]. This roadmap involves strategic steps such as staff training, policy development, and technology integration [19]. Research shows that hospitals that successfully implement DG usually have a high commitment from top management and involve all relevant units from the beginning [20].

Previous research shows that many health data governance frameworks consider data privacy and security as an *afterthought*, even though it is an integral part of dealing with the challenges of data fragmentation that are common in health systems [15]. Previous research has focused on the general benefits of data governance for data quality, without addressing how to adapt the framework for different types of hospitals, like referral hospitals in resource-limited areas. In addition, research has primarily focused on health systems in developed countries, while the application of data governance in developing countries such as Indonesia, which has different regulatory and resource challenges, has not been explored. Therefore, this study will explore the implementation of data governance that is relevant to the needs of RSUD ABC, considering resource limitations and the need to improve data quality that supports clinical and administrative decision-making [6].

The research also showed that healthcare facilities tend to focus more on data completeness for financial purposes, such as insurance claims, rather than the accuracy and veracity of data needed to support research and strategic decision-making. This challenge is exacerbated by the limited number and expertise of existing IT staff, which hinders the development of information systems that can support more efficient data management. This research will fill the gap by designing a data governance framework that prioritizes technical standards to improve the quality and efficiency of data management at ABC Hospital and ensure data can be used optimally to support better health services [21]. This research aims to design a data governance framework suitable for ABC Hospital, which does not yet have systematic and formal data governance. This framework will include various vital elements that can address the challenges faced by the hospital in data management. Through a qualitative approach to a case study, this research will dig deeper into the needs, challenges, and obstacles at ABC Hospital in implementing data governance. The output of this research is a framework model that can be adapted by other hospitals in the digital transformation stage, as well as providing practical solutions to improve the quality and efficiency of data management to support better clinical and administrative decision-making.

2. Research Methods

This research belongs to the category of research that uses a qualitative approach with a case study method that will be used to analyze and design a suitable data governance framework for

ABC Hospital. This approach was chosen because it is explorative and able to identify challenges, obstacles, and needs in hospital data management, especially those without structured and systematic data governance [22]. The research process followed systematic stages, starting with a literature study to build a theoretical foundation, followed by primary and secondary data collection, data analysis, and preparation of framework recommendations. Research stages are visualized in the research flowchart in Figure 1, which provides a clear picture of the process and approach used.

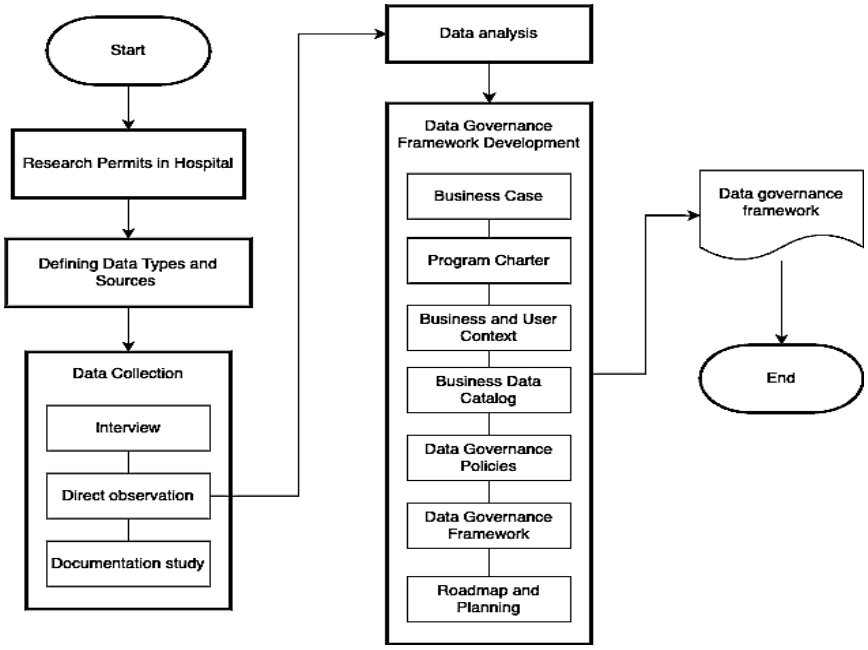

Figure 1. Research Flow Chart

2.1. Research Permits in the Hospital

Conducting research at ABC Hospital begins with obtaining a research permit through the applicable procedures at the institution, which is then reviewed by the research ethics committee to ensure compliance with appropriate ethical standards and regulations [23]. Approval from the ethics committee is a crucial step to ensure that the research is carried out with respect for ethical principles, including data confidentiality, consent from participants, and protection of respondents' rights [24]. After obtaining approval, the hospital issued an official research permit document as authorization to begin data collection activities. This permission included limited access to primary and secondary data sources required to support the research, such as interviews with relevant staff and review of internal documents.

2.2. Defining Data Types and

This research uses two main types of data: primary and secondary. First, primary data was obtained through in-depth interviews with various parties directly involved in data management at the hospital. Respondents included information technology (IT) staff responsible for the infrastructure and operations of the Hospital Management Information System (SIM-RS), data managers who manage data strategy and policy, and key users of SIM-RS, such as medical and administrative personnel. This primary data collection aimed to understand the main needs and challenges faced and identify weaknesses in current data management practices [25]. Secondly, secondary data was obtained from relevant supporting documents, such as hospital annual reports, standard operating procedures (SOPs), policy guidelines, and other documents that regulate or record data management activities at ABC Hospital. These documents provide additional insights into the existing structures, policies, and frameworks, although they have not yet been formalized in the form of systematic data.

Governance. Combining primary and secondary data allows for a more comprehensive analysis [26] while ensuring that the proposed framework can answer the needs and align with the existing conditions at RSUD ABC.

2.3. Data Collection

Data was collected through interviews, direct observation, and documentation studies to obtain a comprehensive picture of data management at ABC Hospital. First, in-depth interviews were conducted involving various parties with a significant role in hospital data management, such as information technology (IT) staff, data managers, and key Hospital Management Information System (SIM-RS) users. The interviews aimed to extract detailed information about how data is currently managed, the operational and strategic constraints faced, and the perceived need to develop a more structured and effective data governance framework [27]. Questions were designed to explore the technical, managerial, and policy aspects of data management. Second, direct observation was conducted in the hospital environment to understand the operational practices of data management firsthand. This involved observing daily data management, storage, and distribution activities in various units. Observation also serves to identify potential shortcomings, such as a lack of system integration, technological barriers, or inefficiencies in data workflow.[28]. Third, documentation studies involve analyzing available documents such as internal policies, annual reports, or other documents relevant to data management. This study aims to assess the maturity level of the existing data management system, evaluate the completeness of policy documents, and identify gaps that need to be addressed to support the implementation of the data governance framework.

2.4. Data Analysis

The data collected was analyzed qualitatively to understand patterns, relationships, and key issues in data management at ABC Hospital. The analysis was descriptive and interpretive to extract insights from primary and secondary data, resulting in relevant and contextualized findings. Interview data was analyzed, and respondents' views on data management challenges were compared with direct observations to validate findings. Secondary data from official hospital documents was used to evaluate existing policies and procedures and identify gaps in the ideal framework. The results of this analysis became the basis for developing recommendations for a data governance framework that suits the needs of ABC Hospital.

2.5. Data Governance Framework Development

The data governance framework was developed based on the results of data analysis from various data collection methods. This framework aims to provide systematic guidance in effective and efficient hospital data management, according to the operational needs, regulations, and organizational strategies at ABC Hospital. In this research, the framework used refers to John Ladley’s [29] Data Governance Framework, which emphasizes five main pillars in data governance: Data Strategy, Data Quality, Data Compliance, Data Security, and Data Operations. This model ensures data is well managed in terms of strategy, quality, regulatory compliance, security, and data operations.

The framework improves data management efficiency by implementing data standardization, reducing information redundancy, and integrating disparate information systems. With this approach, medical personnel can access patient data in real-time and accurately, thus speeding up the diagnosis and treatment process. In addition, the framework also reduces the time required in hospital administrative management, such as the generation of medical reports and insurance claims, which were previously done manually or separately in various systems.

The first step in the framework is to develop a Business Case, which explains the urgency and benefits of implementing formal data governance to improve operational efficiency, data-driven decision-making, and reduce the risk of data leakage or inaccuracy. A Program Charter is developed as a strategic document that details the vision, mission, goals, scope, and roles and responsibilities of stakeholders in data governance implementation. The framework also considers the hospital's operational context and the specific needs of data users, such as medical and administrative personnel, and ensures accurate, real-time, and secure data access. Data Governance Policies are designed to provide guidelines related to data collection, storage, and

use, as well as monitoring and evaluation mechanisms, to ensure compliance with standards. The organizational structure in the framework explains the roles and responsibilities of data management in each unit to provide holistic and secure management. In addition, a Business Data Catalog was developed to map the data owned, including data descriptions and sources, to improve understanding of data assets. The final stage of the framework development was the development of the Roadmap and Planning, which covers the phased steps in adopting data governance, including identifying priorities and transition plans towards better data management.

2.6. Data Governance Framework

The data governance framework proposed in this study is designed to provide strategic and operational guidance in managing data holistically at ABC Hospital. This framework aims to improve the efficiency of data management, ensure regulatory compliance, and maximize the value of data in supporting decision-making. This data governance framework is designed to adapt to the specific needs of RSUD ABC and evolve along with changes in regulations or hospital operational needs. With the implementation of this framework, RSUD ABC is expected to manage data more effectively, support data-based decision-making, and improve the quality of service to patients.

3. Results and Discussion

Based on all the research stages previously described, the research results are then obtained based on data analysis accompanied by a discussion to interpret the findings in the context of data governance at ABC Hospital. The research results include identifying the current state of data management, the main challenges, and the need to develop a structured data governance framework. The results of all data governance framework development stages are explained as follows.

3.1. Business Case

Based on interviews with stakeholders at ABC Hospital, the main challenges in data management include a lack of clear data ownership, unclear SOPs, unintegrated data, and low data quality. To overcome this, the implementation of data governance is proposed to improve operational efficiency, data security, and data quality, as well as support data-driven decision-making and compliance with regulations such as HIPAA and Permenkes. The benefits of implementing data governance at ABC Hospital include increased revenue growth, operational efficiency, and reduced operational and compliance risks. In addition, data governance also supports other strategic initiatives and helps avoid future data debt. Tangible direct benefits show that data governance can significantly impact organizational performance through business process optimization and better risk management. Meanwhile, Tangible Indirect Benefits illustrates the role of data governance as a strategic foundation that supports current operations and ensures the organization's sustainability and readiness to face future challenges.

3.2. Program Charter

The Charter Program at ABC Hospital aims to make ABC Hospital a pioneer of integrated and secure data management, with a mission to improve the integrity and security of patient data, ensure medical regulatory compliance, and support data-based decision-making. The program identifies risks and designs mitigation strategies through staff training, SOPs, and resource optimization, with implementation involving cross-functional teams.

3.3. Business and User Context

The Business and User Context document analysis showed that ABC Hospital needed structured data governance to improve operational efficiency, service quality, and regulatory compliance. This need was triggered by the increasing number of patients, the volume of medical data, and the demands of health service standards. Business and user context analysis became essential in designing a relevant, efficient, and customized solution, covering workflows, inter-departmental interactions, user data needs, and barriers to data management. This context-based approach, ensured that the solution could be implemented effectively, considering resource limitations, technological capabilities, and operational needs.

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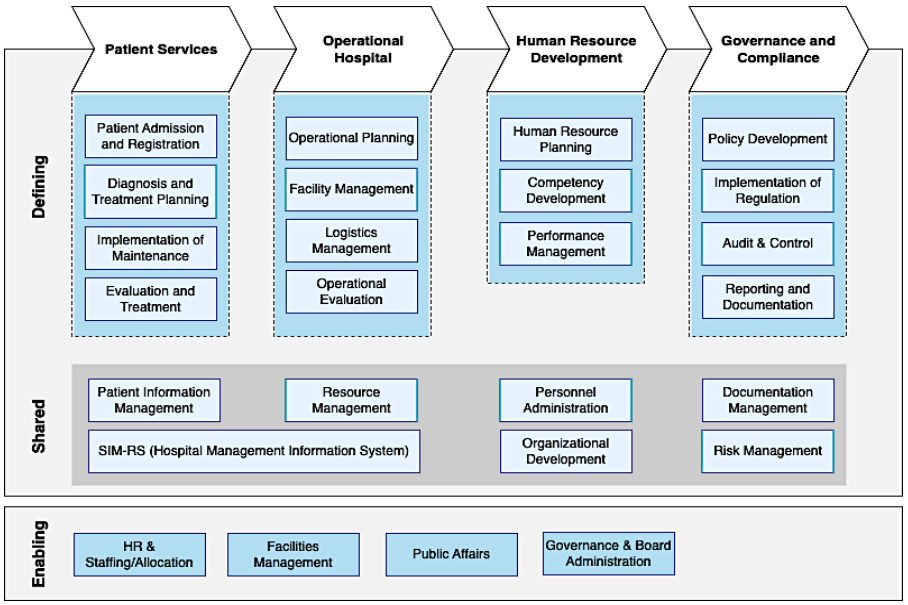

Figure 2. Business Capability Map and Value Streams

Figure 2 shows the identification of the business capability map that supports the implementation of data governance at ABC Hospital. These business capabilities were selected based on data from interviews and existing documents regarding data management at the RSUD. Based on some of these capabilities, several were selected as priorities. The reason for choosing priority capabilities is based on discussions with the RSUD on current priorities and analyzing the problems previously described in the Business Case subchapter. The priority capabilities are:

a. Patient Admission and Registration
b. Diagnosis and Treatment Planning.
c. Hospital Management Information System (SIM-RS).
d. Risk Management.
e. Regulation Implementation.

A data governance strategy must be designed to support the implementation of data governance aligned with business and user needs. Figure 3 below presents a *Data Governance Strategy Map* that connects the organization's strategic goals with relevant *value streams*, key capabilities, and data initiatives.

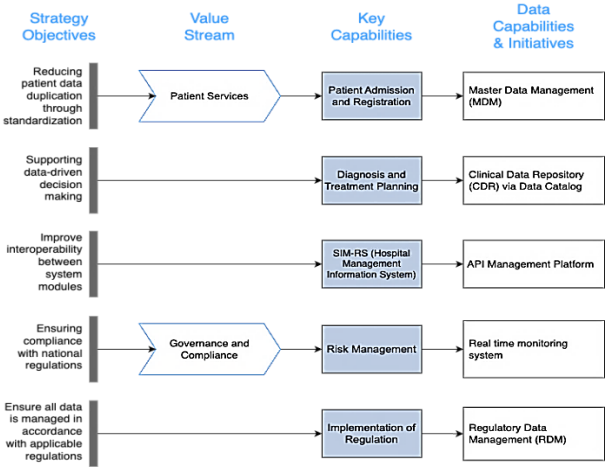

Figure 3. Data Governance Strategy Maps

This strategy map explains how various data initiatives, such as Master Data Management (MDM) and Regulatory Data Management (RDM), can help meet an organization's strategic needs, from reducing data duplication to ensuring regulatory compliance. The map guides the effective integration of data flows into business operations by identifying key capabilities such as hospital management information systems (SIM-RS) and risk management. Not all initiatives have the same value and difficulty level in data governance implementation. It is therefore essential to conduct a *Value-to-Difficulty* analysis to prioritize the implementation of initiatives based on the value generated and effort required. Figure 4 below shows the mapping of initiatives based on two main dimensions, namely value and difficulty. The initiatives are grouped into four quadrants: prioritize, be selective, reconsider or outsource, and deprioritize.

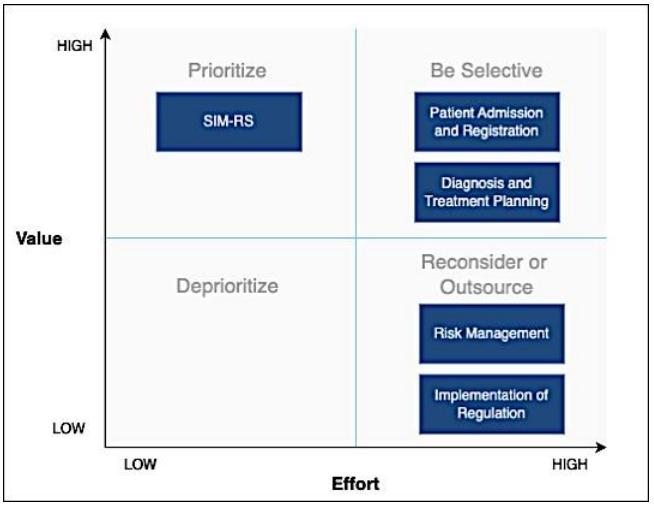

Figure 4. Value to Difficulty Analysis

Based on Figure 4 above, five capability points have been prioritized and are described previously in Figure 2, which are mapped into four quadrants. The basic data used for selecting Value to Difficulty Analysis is taken from Figure 2, where the results of Figure 2 are obtained from the results of interviews and documents at the RSUD. The explanation of the five points is as follows: Prioritize, SIM-RS is a top priority because it acts as the backbone of hospital operations. Implementation is relatively easy because many commercial systems are available with vendor support. To be selective, there are two strategic capabilities: Patient Admission and Registration and Diagnosis and Treatment Planning. Patient admission and registration are highly valued as they affect the entire hospital process, but this process requires significant effort for integration, HR training, and cross-platform automation. Meanwhile, Diagnosis and Treatment Planning are key for diagnosis accuracy and optimal clinical outcomes. However, it requires the integration of technologies such as CDSS and the implementation of international data standards. Deprioritize, none as all selected capabilities have high relevance to the hospital's main value stream. Reconsider or Oursource, there are Risk Management and Regulation.

Implementation. Risk Management has a low score because the focus is on mitigating organizational risks, not directly on patient services, and requires a significant effort to build a standards-based framework, such as ISO 31000 and others, such as ICD-10. The proposed framework has been aligned with the applicable health data standards in Indonesia, namely ICD-10 (International Classification of Diseases, 10th Revision). This standardization ensures that the developed system can facilitate interoperability with the national health system, support the accuracy of diagnosis recording, and improve the efficiency of insurance claims and hospital administration. Implementing the Regulation also scored low because it is more compliance-oriented than direct service, and requires regular policy changes and staff training.

3.4. Business Data Catalog

Implementing the Business Data Catalog at ABC Hospital aims to manage data in a structured manner and ensure maximum data utilization in supporting hospital operations. In the era of healthcare digitization, data has become a vital element that determines the quality and efficiency of hospital operations. RSUD ABC realizes that effective data management not only

supports the smooth running of daily activities but also plays a strategic role in improving the quality of patient care and ensuring compliance with applicable regulations. Therefore, the principles in data management based on the Business Data Catalog at RSUD ABC include Data as an Asset, where patient and operational data are considered strategic assets that must be carefully protected and managed to support public trust. Furthermore, data intrinsic value indicates that data improves clinical and managerial decisions and provides a competitive advantage for the hospital. Then, Data Risk Management manages risks such as data leakage or inconsistency with strict security protocols. In addition, Data Quality Assurance focuses on maintaining accuracy, relevance, and consistency of data to support safe and effective healthcare.

Finally, Clear Responsibility emphasizes that each data element has an owner responsible for its management, maintenance, and security. Thus, implementing the Business Data Catalog at ABC Hospital is a strategic step in building a structured, secure, and sustainable data governance foundation. In addition, by adopting strict and measurable data management principles, the hospital can ensure that every data element is managed as an asset that supports operational efficiency, improved service quality, and more accurate decision-making.

The data catalog needed to develop this data governance is a collection of data from various activities at the RSUD, such as patient medical data, where patient medical information includes identity, medical history, diagnosis, treatment plan, and laboratory results. This element's name reflects the data category focusing on clinical information to support patient care at RSUD ABC. This data is available in real time once the patient is registered. The data is stored until the patient is discharged and used for predictive analysis for up to 5 years into the future for disease trend needs. Data is retained for 20 years after the patient's last treatment, by the RSUD's retention policy and national health regulations. After that, the data will be permanently deleted from the system.

Then the required catalog data is audit compliance data, where compliance data contains records of data access, data changes, and regular audits conducted to ensure compliance with health regulations and internal standards of RSUD ABC. Audit data is collected automatically through a logging system that records access activities and data changes by each user. Access to this data is restricted to compliance and audit teams through layered authentication to maintain data integrity. Data is retained for at least 5 years per regulation, with additional retention for investigation in case of a security incident.

Furthermore, the catalog data needed is access activity security data, where security data records access activities to information systems, including logins, logouts, and suspicious access attempts. This data is used to detect potential threats and maintain the security of the RSUD ABC hospital system. This data is collected automatically from user activity logs and checked by the security team. The system uses multifactor authentication to allow only authorized access and logs invalid access attempts. Data is retained for 5 years by security and audit policies, with the option of longer retention if there is a need for investigation.

Implementing a Business Data Catalog in hospital data governance enables more structured data classification so medical personnel can easily find relevant information without searching in various separate systems. Thus, doctors and nurses can access patients' medical records quickly, reduce patient waiting time, and improve accuracy in providing diagnosis and treatment. In addition, this data catalog also supports better analysis of clinical data to support evidence-based decision-making.

3.5. Data Governance Framework

Implementing the Data Governance Framework at ABC Hospital aims to improve the quality of health services through more effective, secure, and integrated data management. This framework serves as a guideline for managing data as a strategic asset, with the primary objective of ensuring quality, security, and compliance with applicable regulations. The main objectives of this Data Governance Framework include Improving Data Quality and Accuracy, Compliance with Regulations, and optimizing the Use of SIM-RS. Data governance in hospitals depends not only on technology but also on clear leadership structures and responsibilities. Data leadership, ownership, and stewardship roles must be identified and well-defined to ensure

effective data management. Each system has a Data Steward whose job is to provide the quality, security, and accessibility of data within their respective domains. An operational framework is key to ensuring success in hospital data governance. This framework is designed to optimize SIM-RS by emphasizing the integration of policy, strategic functions, and tactical execution. Key elements of the framework include executive-level oversight, cross-functional management, and execution based on the role of the data custodian. Figure 6 describes the Design DG Operating Framework, designed to drive hospital data management.

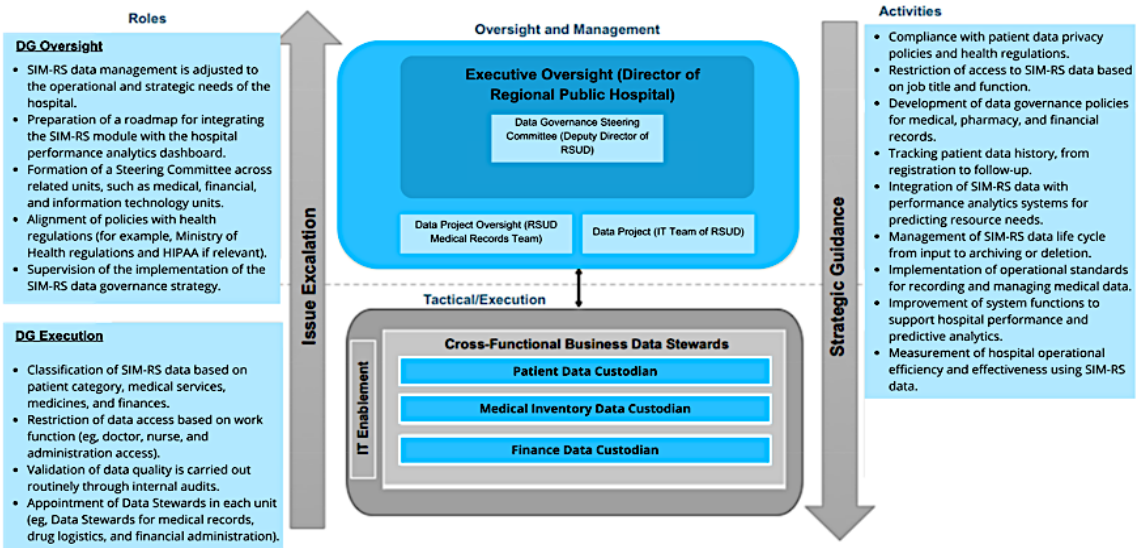

Figure 5. Design DG Operating Framework

As shown in Figure 5, the Design DG Operating Framework emphasizes the critical roles of various parties, such as Executive Oversight and Cross-Functional Business Data Stewards, to ensure coordinated data governance. DG Oversight directs strategic policies and regulations, while DG Execution handles daily execution, such as data classification, access restrictions, and data quality validation. This framework can bridge strategic and operational needs in data governance, support decision-making, and ensure efficiency in SIM-RS management. To ensure the sustainability of data governance in hospitals, an operational model is needed that supports the effectiveness, security, and sustainability of data management. The Design Minimum Sustainable Operating Model is designed to facilitate the implementation of data governance through cross-functional collaboration, strategic oversight, and ongoing initiatives. This structure ensures the data governance process runs efficiently and supports the hospital's strategic goals.

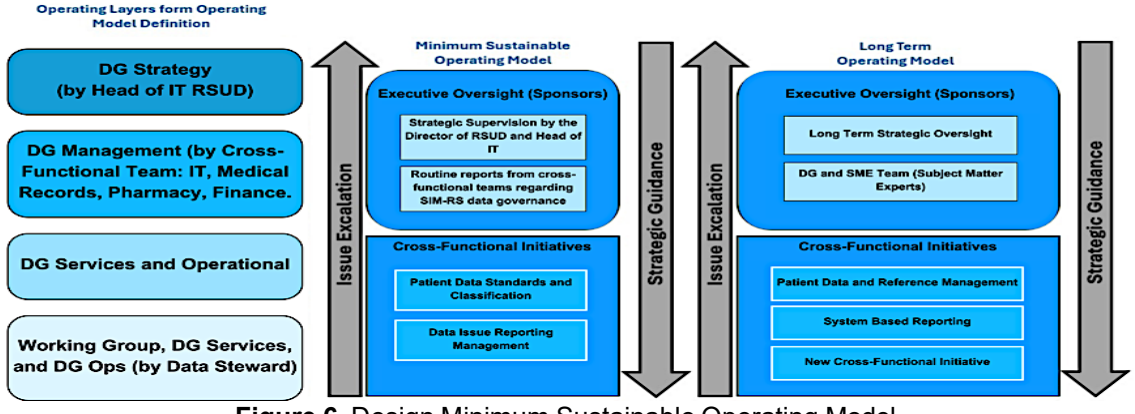

Figure 6. Design Minimum Sustainable Operating Model

The Minimum Sustainable Operating Model includes key components such as Executive Oversight for strategic oversight, Cross-Functional Initiatives that support cross-functional data management, and the role of Working Groups and Data Stewards in daily operations. The model collaborates with Subject Matter Experts (SMEs) for long-term strategies to optimize data management to support patient care, regulatory compliance, and sustainable operational

efficiency. Relevant policies and procedures, such as data validation and role-based access arrangements, ensure consistent and effective data governance.

Table 1. Policies and Procedures

Policy Category	Policies	Description/Details	Status of Existing Policies	Gaps	Action Required
Data Governance	Data Validation Policy	Organize data validation and cleansing processes and standard procedures for electronic data.	Partial Implementation	The validation process is still manual in some SIM RS modules.	Implemented automated tools for data validation.
	Access Role Policy	Define access roles according to the acceptable use policy.	Not Available	There is no role-based data access policy.	Create policies and access control mechanisms.

Based on Table 1 above, it can be seen that the main priorities in the *Data Governance* project are in the policy categories of *Data Validation Policy* and *Access Role Policy*. The main gaps identified include the ongoing manual validation process in some SIM-RS modules and the absence of role-based access policies. Therefore, measures such as the implementation of automated tools for data validation, staff training, and the development of role-based access control policies are crucial to support the achievement of Data Governance objectives. This ensures that data management is more secure, structured, and standardized.

3.6. Data Governance Policies

Furthermore, after the Data Governance Framework stage is carried out, enter the Data Governance Policies stage. The policies used are those formulated at the previous stage. These policies must be implemented as part of a comprehensive strategy for managing hospital data that is integrated and compliant with regulatory standards. The data governance policies implemented in this framework also ensure compliance with health.

Regulations, such as HIPAA and Permenkes standards, establish data validation procedures, role-based access, and periodic audit mechanisms. With strict policies, hospitals can reduce the risk of patient data leakage and increase transparency in medical information management. This also strengthens the hospital's readiness to face regulatory audits and increases patient confidence in the health information system.

3.6.1. Data Governance Policies: Data Validation Policy

This policy ensures that data in SIM-RS, including patient, clinical, operational, and financial data, is processed according to quality standards to support the accuracy, security, and reliability of data in decision-making at ABC Hospital. This policy also ensures privacy and health regulations compliance to support efficient hospital operations through data governance principles. This policy covers all clinical, administrative, financial, and operational data in SIM-RS and related parties such as staff and partners. The points that form part of the policy statements for this policy are detailed in Table 2 below, which includes the rules, responsibilities, and steps to be followed by all relevant parties in data management.

Table 2. Policies Statements

Statements	Operational Steps
1. **Data Validation**	a. Set a regular schedule for data validation. b. Use automated tools for data entry validation. c. Apply real-time validation for data input.
2. Data Cleansing Initiative	a. Conduct a monthly data review. b. Coordinate with clinical and administrative departments to correct incorrect entries. c. Update and keep a log of all data cleansing activities.
3. Training and Awareness	a. Provide annual training for all staff involved in data entry and management. b. Developed an orientation program for new employees.
4. Reporting and Accountability	a. Requires monthly reports from the data manager. b. Establish a clear escalation process for data issues.
5. Audit and Compliance	a. Conduct quarterly audits. b. Review compliance with this policy.

The Policy Statements in Table 2 provide a comprehensive framework to ensure that data management at RSUD ABC follows the principles of good data governance. Each policy point is designed to improve the reliability of the data used, minimize the risk of errors, and meet applicable regulations. Implementing this policy requires commitment from all relevant parties to carry out the steps that have been set consistently.

3.6.2. Roadmap and Planning

Implementation of Data Governance at ABC Hospital involves the creation of roadmaps and planning. The Roadmap and Planning stage at ABC Hospital involves a Gap Analysis to evaluate the difference between the current data governance condition and the expected target. The following figure shows the results of the Gap Analysis, which is the basis for developing a strategy to improve data governance. The CMMI template arrangement provides 12 Functions of data governance for measuring the current maturity level of data governance at RSUD ABC.

Data Governance Area	Function of Data Governance	Current Level	Target Level	Gap	Performance	Summary
Planning	Vision	1,6	2,6	1,0	Underperforming	There is still a gap in defining a strong data governance vision to support the organization's strategy.
	Roles and Structure	2,0	3,0	1,0	Underperforming	There is a need to strengthen data governance roles and structures to ensure clear responsibilities across the organization.
	Policies, Procedures & Standards	2,0	3,0	1,0	Underperforming	Current policies, procedures and standards are not fully adequate to support effective data governance.
	Projects & Services	2,3	3,3	1,0	Underperforming	The implementation of data governance related projects and services requires improvements in coordination and management.
Control	Supervise and Control	1,8	2,8	1,0	Underperforming	The data governance monitoring and control mechanisms are not yet fully structured and need to be strengthened.
	Manage & Resolve	2,5	3,5	1,0	Underperforming	The ability to handle and resolve data governance issues is still limited and requires significant improvement.
	Monitor	3,0	4,0	1,0	Underperforming	Data governance monitoring is going well, but still needs improvement to reach optimal levels.
	Oversee & Communicate	2,0	3,0	1,0	Underperforming	Communication and oversight regarding data governance is not optimal to encourage understanding and support across the organization.
DG Engine Room	Data Architecture	1,0	2,0	1,0	Underperforming	The data architecture is not well defined, so that data integration and management between systems is ineffective.
	Data Quality	1,0	2,0	1,0	Underperforming	The quality of the managed data does not meet the required standards, thus requiring intervention to improve data accuracy and reliability.
	Master and Reference Data Management	1,0	2,0	1,0	Underperforming	Master data management is still less effective, causing problems such as data duplication and inconsistency.
	Data Security, Risk, and Audit	1,3	2,3	1,0	Underperforming	Data security, risk management, and auditing are not sufficient to protect organizational data from threats and ensure regulatory compliance.

Figure 7. Gap Analysis

The analysis shows that all data governance functions at ABC Hospital are in the Underperforming category, with a gap of 1.0 in each function. The Planning area requires improvements in vision, roles, and policies. In the Control area, supervision and problem-solving need to be strengthened. Meanwhile, the DG Engine Room shows the need for data architecture and quality improvement. RSUD ABC must adopt a comprehensive improvement strategy, from training and policy updates to system development, to achieve more effective and integrated

data governance.

In the Data Governance planning stage, the preparation of the High-Level Roadmap aims to provide strategic guidance regarding the implementation of Data Governance functions. This roadmap covers a period systematically designed to ensure each function is implemented according to predetermined priorities and time targets. The roadmap is described in Figure 9 below.

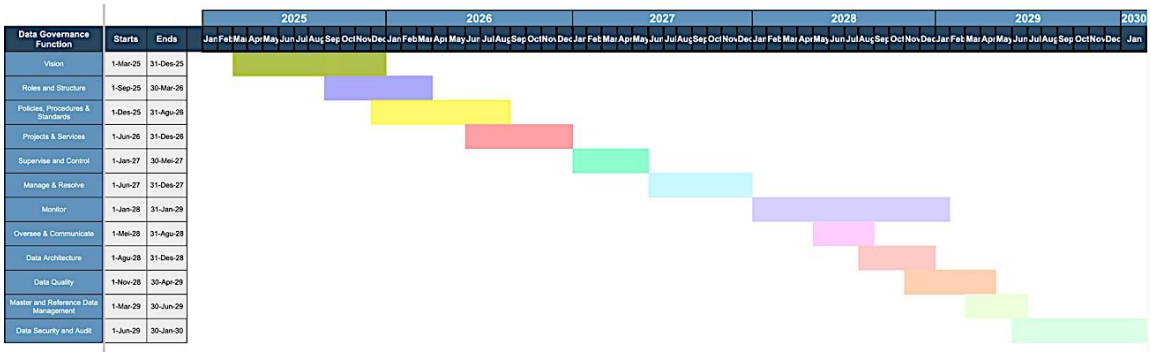

Figure 8. High-Level Roadmap

As shown in Figure 8, this roadmap starts with formulating the vision in 2025. It is followed by implementing various functions such as Roles and Structure, Policies, Procedures, and standards until reaching the final stage in 2030. This approach is designed to ensure that every aspect of Data Governance is implemented sustainably and integrated to support effective and efficient data management.

4. Conclusion

This research emphasizes the importance of data governance implementation as a framework for organized, consistent, and quality data management that supports organizational goals. All stages of the study, from visioning to evaluation, were designed to achieve holistic data governance. The resulting High-Level Roadmap provides strategic direction in the phased implementation of Data Governance, with oversight that ensures sustainability and improved data quality. By implementing the data governance framework at ABC Hospital as outlined in the roadmap, the hospital is expected to enhance its data management processes significantly. Specifically, the framework aims to reduce information fragmentation by integrating various siloed data sources into a unified system, ensuring that all departments and personnel have consistent access to the same set of accurate patient information. This integration will accelerate access to patient data, enabling quicker decision-making and improving patient outcomes by reducing delays in medical treatments. Moreover, the framework's focus on data validation and access control mechanisms ensures that data is accurate and secure, which is crucial for meeting regulatory standards such as HIPAA and national health regulations. These measures also support periodic audits, enhancing the hospital's ability to maintain compliance and manage risks effectively. From a clinical perspective, the framework's implementation improves the quality of patient care by enabling medical staff to access real-time, reliable data, thus minimizing the risks of medical errors. The system’s streamlined workflows also reduce administrative overhead, allowing hospital staff to focus more on patient care than on administrative tasks. These improvements are backed by primary data (interviews with hospital staff and users of the Hospital Management Information System) and secondary data (policy documents and existing reports), highlighting the operational inefficiencies and risks associated with unintegrated data systems. The data governance framework directly addresses these challenges, improving the quality of service and the hospital's ability to comply with regulations, thus fostering a more secure, efficient, and patient-focused healthcare environment. Suggestions for future research include developing measurement tools to evaluate implementation success, exploring new technologies such as Blockchain and AI, conducting change management studies for Data Governance adoption, conducting comparative case studies of organizations, and conducting more in-depth research on data security and auditing amid cyber threats.

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