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Analysis of National Drug Master Data Characteristics in Supporting Pharmaceutical Management through the Pharmaceutical Information System in Indonesia, 2020–2025

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Abstract: Digital health transformation requires accurate, complete, and standardized data to support information-based pharmaceutical management. The National Drug Master Data serves as a primary reference to maintain consistent drug information across pharmaceutical information systems. This study aimed to analyze the characteristics of the National Drug Master Data in supporting pharmaceutical information systems in Indonesia during 2020–2025. A quantitative descriptive design was applied using secondary data obtained from the E-Logistics Data Bank of the Ministry of Health of the Republic of Indonesia. A total of 470 drug records were analyzed using descriptive statistics based on object categories, administrative status, data creator organizations, update patterns, and attribute completeness. The results showed that 89.57% of records were categorized as Approved, with drug objects representing the largest proportion (70.43%). Primary identification attributes achieved 100% completeness, while generic name, drug category, and creator organization attributes reached 30%, 52.13%, and 78.72%, respectively. These findings indicate that the National Drug Master Data has a strong structural foundation but requires improvement in attribute completeness, metadata standardization, and data governance to enhance interoperability of national pharmaceutical information systems.

Keyword: National Drug Master Data, Pharmaceutical Management, Pharmaceutical Information System, Data Quality, Digital Health Transformation, E-Logistics Data Bank.

INTRODUCTION

Digital transformation has emerged as a major strategy for strengthening global health systems through the utilization of information technology, data integration, and the development of more adaptive health information infrastructures (Stoumpos et al., 2023). Modern health information systems no longer function merely as tools for administrative recording and reporting but have evolved into strategic infrastructures that facilitate evidence-based decision-making, improve healthcare efficiency, and strengthen health resource governance (Popescu et al., 2022). The availability of accurate, complete, and timely health data represents a critical determinant in developing responsive policies and enhancing the quality of healthcare delivery (World Health Organization (WHO, 2021)

Within pharmaceutical services, digital technology advancement has accelerated a paradigm shift from conventional drug management approaches toward data-driven pharmacy management. Drug management encompasses a comprehensive series of activities, including demand planning, procurement, storage, distribution, and drug utilization monitoring (Faradiba et al., 2023). Each stage requires reliable, consistent, and standardized information support to ensure effective decision-making processes (Faradiba et al., 2023). Therefore, data quality represents a fundamental component in achieving efficient pharmaceutical management, minimizing information-related errors, and improving the overall quality of pharmaceutical services (Ehrlinger & Wöß, 2022).

Pharmaceutical management involves systematic activities designed to ensure the availability of safe, high-quality, effective, and appropriate medicines according to healthcare service requirements (Sharma et al., 2024). In digitally enabled healthcare environments, the effectiveness of pharmaceutical management is determined not only by physical resources but also by the quality of information systems supporting drug management processes (Almeman, 2024). One essential component of such systems is master data, which refers to a set of core data elements that serve as authoritative references and are consistently utilized across various applications and healthcare units. In the pharmaceutical context, drug master data include essential attributes such as drug identity, generic name, reference codes, drug categories, administrative status, and other supporting characteristics (Newswire, 2018). Effective master data management reduces information duplication, enhances system interoperability, and maintains data consistency across different levels of healthcare services (DAMA International, 2017).

The concept of master data management positions reference data as a single source of truth, enabling multiple systems to utilize standardized information structures. The quality of master data is determined by several key dimensions, including accuracy, completeness, consistency, uniqueness, validity, and timeliness. Data that fail to meet these dimensions may generate information discrepancies, increase analytical errors, and hinder integration among information systems (ISO 8000-61, 2016) (DAMA International, 2017).

As part of accelerating national healthcare digital transformation, the Ministry of Health of the Republic of Indonesia has developed various digital platforms to support healthcare data integration, including SATUSEHAT as a national health data exchange ecosystem. The platform was designed to connect healthcare facilities through interoperability standards, enabling different information systems to exchange structured and consistent data. The implementation of interoperability requires standardized reference data, including pharmaceutical data, which represents an essential component of healthcare service delivery (Kesehatan, 2025)

In the national pharmaceutical logistics management system, the Ministry of Health has also developed the E-Logistics Data Bank, which provides reference data to support the management of medicines and medical supplies. One important component of this system is the National Drug Master Data, which contains information regarding drug identity, object categories, data status, managing organizations, and data update histories. The availability of such master data serves as a foundation for harmonizing pharmaceutical information across various healthcare information systems, thereby supporting data integration, improving information quality, and strengthening national drug logistics governance.

Despite continuous advancement in digital transformation within healthcare and pharmaceutical services, research in Indonesia has predominantly focused on operational aspects of drug management, such as medicine availability, distribution efficiency, inventory control, and drug utilization evaluation at healthcare facilities. Studies specifically examining the characteristics and quality of drug master data as the foundation of pharmaceutical information systems remain limited. However, master data quality directly influences

information validity, application interoperability, business process efficiency, and the accuracy of decision-making in pharmaceutical management.

Issues such as incomplete attributes, inconsistent classification, duplicated drug identities, and inadequate metadata may reduce information quality and impede the implementation of integrated healthcare information systems. Previous research on data quality has demonstrated that completeness and consistency are critical factors in ensuring that data can be optimally utilized for analytical processes and decision-making (Ehrlinger & Wöß, 2022), (Papastergios et al., 2026).

The increasing demand for complete, updated, and standardized drug master data has become more significant alongside the acceleration of digital transformation in the healthcare sector. Evaluating master data characteristics is necessary to provide insights into data structures, drug category distributions, administrative status, managing organizations, and data update patterns over specific periods. Such evaluation can identify data quality issues requiring improvement while supporting the implementation of more effective and sustainable data governance practices (DAMA International, 2017)

Based on this context, a research gap exists regarding the analysis of National Drug Master Data characteristics as a foundation for pharmaceutical information systems in Indonesia. Previous studies have largely emphasized operational drug management aspects, whereas investigations into the quality and characteristics of reference data supporting healthcare information system integration remain insufficient. Therefore, a comprehensive evaluation of drug master data from a data quality perspective is required to strengthen digital-based pharmaceutical management.

This research analyzes the characteristics of National Drug Master Data in supporting pharmaceutical management through pharmaceutical information systems in Indonesia during the 2020–2025 period. The analysis utilizes secondary data obtained from the E-Logistics Data Bank managed by the Ministry of Health of the Republic of Indonesia. The findings are expected to provide comprehensive insights into national drug master data characteristics, evaluate data attribute quality, and formulate recommendations for developing more integrated, interoperable, and data-driven pharmaceutical information systems capable of supporting national pharmaceutical governance.

METHOD

Researh Design

This study employed a quantitative descriptive design using secondary data to evaluate the characteristics, distribution patterns, and quality attributes of the National Drug Master Data without examining causal relationships (Martono, 2014), (Ritter, 2025). Secondary data analysis was selected to provide an evidence-based assessment of existing pharmaceutical information systems and support data-driven decision-making (WHO, 2021). The dataset was obtained from the E-Logistics Data Bank managed by the Ministry of Health of the Republic of Indonesia. Data processing included acquisition, validation, cleaning, and descriptive analysis using National Drug Master Data records updated during the 2020–2025 period.

Data Source, Population and Sample

The study utilized secondary data from the National Drug Master Data dataset, which functions as a reference database within pharmaceutical information systems. The dataset contains drug identity, object classification, administrative status, data creator information, and metadata related to data creation and updates. The study population included all drug records registered during 2020–2025. A total sampling technique was applied, and after extraction and validation processes, 470 records with complete and valid attributes were included in the final analysis (Martono, 2014), (Ritter, 2025).

Researh Variables and Attributes

The analysis focused on descriptive characteristics of National Drug Master Data, including drug identity, classification, administrative status, organizational information, update patterns, and attribute completeness. Data quality evaluation followed established data quality dimensions, including accuracy, completeness, consistency, uniqueness, validity, and timeliness (ISO 8000-61, 2016), (DAMA International, 2017). The analyzed attributes consisted of drug ID, drug name, generic name, Binfar code, barcode, object category, data status, organization creator, create time, and update time.

Table 1. Analyzed Attributes of National Drug Master Data

No	Attribute	Description	Data Type
1	Drug ID	Unique drug identifier	Nominal
2	Drug Name	Registered drug name	Text
3	Generic Name	Generic drug information	Text
4	Binfar Code	Drug identification code	Text
5	Barcode	Product identification	Text
6	Object Category	Drug/BMHP/medical device classification	Categorical
7	Data Status	Administrative data status	Categorical
8	Organization Creator	Data-producing organization	Categorical
9	Create Time	Data creation timestamp	Date/Time
10	Update Time	Data update timestamp	Date/Time

Data Collection and Analysis

Data were collected through documentation by extracting the National Drug Master Data dataset from the E-Logistics Data Bank. The original JSON dataset was converted into Microsoft Excel format for processing. Data preparation involved structural examination, duplicate removal, format correction, and attribute validation. Descriptive statistical analysis was conducted using frequencies, percentages, mean, median, standard deviation, minimum, and maximum values where applicable. Data quality assessment focused on completeness and consistency to evaluate the readiness of National Drug Master Data in supporting pharmaceutical information systems. Findings were presented through tables and descriptive visualizations.

Researh Workflow

The research process consisted of problem identification, literature review, dataset acquisition, data cleaning and validation, descriptive statistical analysis, visualization, and interpretation of findings. This methodological framework was designed to evaluate the characteristics and quality of National Drug Master Data as a foundation for digital pharmaceutical management in Indonesia during 2020–2025.

RESULTS AND DISCUSSION

Overview of Research Data

This study utilized secondary data in the form of the National Drug Master Data obtained from the E-Logistics Data Bank of the Ministry of Health of the Republic of Indonesia. The dataset represents a reference data source supporting the national pharmaceutical information system, containing information related to drug identity, object categories, administrative status, data-creating organizations, and records of data creation and updating activities.

A total of 470 drug records were analyzed using a total sampling approach. The initial dataset, provided in JSON format, was converted into Microsoft Excel format for data cleaning, validation, and descriptive statistical analysis. The general characteristics of the dataset are presented in Table 2

Table 2 Characteristics of the Research Dataset

variable	description
data source	e-logistics data bank, ministry of health
data type	secondary data
data period	2020–2025
unit of analysis	national drug master data
number of records	470 drug records
data format	json converted into excel

Source: Research analysis, 2026

The dataset characteristics indicate that all analyzed records originated from an official government data source and were used to describe the structure, distribution, and attribute quality of the National Drug Master Data as a supporting foundation for pharmaceutical information systems.

General Characteristics and Distribution of National Drug Master Data

The analysis of general characteristics revealed that most records contained clearly defined administrative status information and complete timestamp records. Among the 470 analyzed records, 421 records (89.57%) were classified as Approved, indicating that the majority of drug information had passed administrative validation within the system. Based on object categories, the dataset was predominantly composed of Drug (OBAT) records, accounting for 331 entries (70.43%), followed by Medical Consumable Supplies (BMHP) with 134 entries (28.51%), and Medical Devices (ALKES) with 4 entries (0.85%). All records contained both create time and update time attributes, enabling traceability of data creation and modification histories.

Table 3 General Characteristics of National Drug Master Data

Variable	Frequency	Percentage (%)
Total Records	470	100
Approved Status	421	89.57
Drug Object Category	331	70.43
BMHP Object Category	134	28.51
Medical Device Category	4	0.85
Available Create Time	470	100
Available Update Time	470	100

Source: Research analysis, 2026

The Result indicate that the fundamental administrative structure of the National Drug Master Data has been established, particularly in relation to record identification, approval status, and temporal tracking. These elements represent essential components for maintaining data lineage and supporting information reliability within pharmaceutical information systems.

Distribution of Drug Categories

The distribution analysis based on drug categories showed that generic medicines represented the largest identified category, comprising 202 records (42.98%). This was

followed by branded generic medicines with 27 records (5.74%) and patented medicines with 16 records (3.40%). However, 225 records (47.87%) did not contain category information, indicating a considerable limitation in the completeness of drug classification attributes.

Table 4 Distribution of Drug Categories

Drug Category	Frequency	Percentage (%)
Generic	202	42.98
Branded Generic	27	5.74
Patent Medicine	16	3.40
Missing/Other Categories	225	47.87

Source: Research Analysis 2026

The high proportion of missing category information suggests that although the core structure of drug master data has been established, classification attributes require further improvement. Incomplete classification may reduce analytical accuracy and limit the ability of information systems to support pharmaceutical planning and decision-making.

Administrative Status Distribution

The distribution of administrative status demonstrated that most records had achieved validation status within the system. The Approved category represented the majority of records, with 421 entries (89.57%), followed by Pending status with 20 records (4.26%), Still Circulating with 14 records (2.98%), and Withdrawn status with 13 records (2.77%). Other statuses were recorded in relatively small proportions. These findings indicate that the majority of drug records have undergone administrative processing. Nevertheless, the presence of pending and withdrawn records highlights the importance of continuous monitoring mechanisms to maintain the accuracy and relevance of pharmaceutical reference data.

Distribution of Data-Creating Organizations and Data Updates

Analysis of data-creating organizations revealed that drug records originated from multiple organizations with varying levels of contribution. A total of 276 records (58.72%) were categorized under other organizations, while the largest individually identified contributors included PT Indonesia Farma Medis (Indofarma) with 39 records (8.30%), PT Bio Farma with 20 records (4.26%), PT Phapros Tbk with 19 records (4.04%), and PT Kimia Farma Tbk with 16 records (3.40%). However, 100 records (21.28%) did not specify the data-creating organization.

Table 5 Distribution of Data-Creating Organizations

Organization	Frequency	Percentage (%)
Not specified	100	21.28
Indofarma	39	8.30
Bio Farma	20	4.26
Phapros	19	4.04
Kimia Farma	16	3.40
Other organizations	276	58.72

Source: Research analysis, 2026

The existence of unidentified organizations indicates a limitation in metadata completeness. Organization-related attributes are important elements in pharmaceutical data governance because they provide accountability, traceability, and information ownership throughout the data lifecycle.

Distribution of Data Updates During 2020–2025

The analysis of update patterns during the 2020–2025 period showed that the highest data updating activity occurred in 2020, involving 186 records (39.57%), followed by 2023 with 121 records (25.74%). Data updates continued in subsequent years, although at lower frequencies, with 44 records recorded in both 2024 and 2025.

Table 6 Distribution of Data Updates (2020–2025)

Year	Frequency	Percentage (%)
2020	186	39.57
2021	42	8.94
2022	33	7.02
2023	121	25.74
2024	44	9.36
2025	44	9.36

Source: Data analysis results

The observed pattern indicates that maintenance activities for the National Drug Master Data have been conducted continuously, although the intensity of updates varied across periods. The concentration of updates in specific years may reflect major data synchronization activities, system adjustments, or administrative validation processes.

Evaluation of National Drug Master Data Attribute Completeness

Attribute quality evaluation was conducted to determine the level of information completeness within each drug record. The results showed that essential attributes, including Drug ID, Drug Name, Status, and Update Time, achieved 100% completeness. This finding demonstrates that fundamental identity and administrative elements have been consistently maintained. However, several supporting attributes demonstrated lower completeness levels. The Data-Creating Organizationattribute reached 78.72% completeness, the Drug Category attribute achieved 52.13%, while the Generic Name attribute showed only 30% completeness. These results indicate that although the structural foundation of the master data has been established, improvements in supporting attributes are required to strengthen information quality, interoperability, and analytical capability within pharmaceutical information systems.

Table 7 Completeness of National Drug Master Data Attributes

Attribute	Completed Records	Completeness (%)
Drug ID	470	100
Drug Name	470	100
Generic Name	141	30
Drug Category	245	52.13
Status	470	100
Data-Creating Organization	370	78.72
Update Time	470	100

Source: Data processing results, 2026

Overall, the findings demonstrate that the National Drug Master Data has established a strong structural foundation through complete primary identifiers and administrative attributes. Nevertheless, improvements in supporting attributes, particularly generic drug names, drug classifications, and organization metadata, remain necessary to enhance interoperability and facilitate data-driven decision-making within Indonesia's national pharmaceutical information system.

DISCUSSION

Characteristics of National Drug Master Data as the Foundation of Pharmaceutical Information Systems

The findings demonstrate that the analyzed National Drug Master Data consisted of 470 drug records containing essential attributes, including drug identification, object categories, administrative status, data-creating organizations, and timestamps related to data creation and updates (Kesehatan, 2025). All records achieved 100% completeness for key attributes, including drug ID, drug name, administrative status, create time, and update time. This finding indicates that the master data structure has established the fundamental components required to function as a reference dataset within pharmaceutical information systems.

The availability of consistent data structures represents a critical factor in digital health information systems because system performance is determined not only by technological infrastructure but also by the quality of underlying data. The World Health Organization emphasizes that strengthening health information systems requires the capacity to generate, manage, and utilize high-quality data to support evidence-based decision-making (WHO, 2021). Within pharmaceutical management, reliable drug data play an essential role in supporting medicine demand planning, procurement processes, distribution monitoring, and drug utilization evaluation.

These findings suggest that the National Drug Master Data has partially fulfilled the principles of master data management by providing standardized reference information as a single source of truth. According to DAMA International (2017), master data management ensures information consistency across interconnected systems, minimizes data duplication, and improves interoperability (Chen & Fang, 2025), (Hikmawati et al., 2021). This concept has become increasingly important within Indonesia's healthcare digital transformation, particularly through the development of integrated ecosystems such as *SATUSEHAT*, which require standardized reference data to enable consistent information exchange among healthcare applications (Kesehatan, 2025), (Uslu & Stausberg, 2021)

Nevertheless, the readiness of master data is not determined solely by the availability of primary attributes but also by the quality of supporting attributes. The study identified several attributes with relatively low completeness levels, indicating the need to strengthen data governance mechanisms to ensure that master data can optimally support pharmaceutical information systems.

Data Quality and Completeness of Drug Master Data Attributes

The evaluation of data quality revealed considerable variation in attribute completeness among the analyzed records. Core attributes, including Drug ID, Drug Name, Status, and Update Time, achieved 100% completeness, whereas Data-Creating Organization reached 78.72%, Drug Category reached 52.13%, and Generic Name achieved only 30%. These findings indicate that while essential identification and administrative information have

been adequately maintained, several supporting attributes with significant informational value require further improvement (Hosseinzadeh et al., 2025).

From a data quality perspective, completeness represents one of the fundamental dimensions determining dataset readiness and usability. ISO 8000 identifies several critical dimensions of data quality, including accuracy, completeness, consistency, uniqueness, validity, and timeliness, which collectively determine data reliability (ISO 8000-61, 2016) Incomplete data may reduce analytical capability, decrease information accuracy, and limit the effectiveness of system integration (Fu et al., 2024).

The low completeness level of the Generic Name attribute represents a significant finding because this information has strategic importance in pharmaceutical management (Idris et al., 2024). Generic names are essential for identifying active pharmaceutical ingredients, analyzing medicine utilization patterns, developing formularies, and supporting rational drug use policies. Incomplete generic name information may limit the capability of information systems to perform drug-level analysis and generate evidence-based pharmaceutical decisions (Idris et al., 2024).

From a Master Data Management perspective, this condition highlights the necessity of implementing automated validation mechanisms, data profiling processes, and business validation rules before data are incorporated as national reference information (Hikmawati et al., 2021). Improving supporting attributes will strengthen the role of master data as a foundation for digital pharmaceutical logistics management and pharmaceutical service delivery.

Data Governance, Administrative Status, and Master Data Accountability

The study findings indicate that most records possessed clear administrative status, with 421 records (89.57%) categorized as Approved. In addition, all records contained update time information, allowing changes and modifications to be traced throughout the 2020–2025 period. The high proportion of approved records suggests that most drug information had undergone administrative validation before being utilized within the system. Within the data governance framework, status validation and change control mechanisms represent essential components for maintaining data quality and reliability (Antar et al., 2025). DAMA International (2017) emphasizes that data governance encompasses policies, standards, organizational roles, and monitoring mechanisms designed to ensure that data remain accurate, consistent, and accountable throughout their lifecycle (Antar et al., 2025).

The observed update patterns indicate that the National Drug Master Data represents a dynamic dataset requiring continuous maintenance. The highest update activities occurred in 2020 and 2023, suggesting periods of intensive data management, synchronization, or improvement processes. The principle of timeliness in data quality emphasizes that information must remain current and updated to ensure its relevance for operational activities and decision-making processes (Ahluwalia et al., 2022). Beyond administrative status, information regarding data-creating organizations represents an important component of data accountability. The findings indicate that 21.28% of records lacked information regarding the responsible organization. This condition suggests that metadata completeness and data lineage mechanisms require further improvement to ensure that every drug record has a clearly identifiable source and can be effectively traced (Netinant et al., 2023).

Implications for Strengthening Digital-Based Pharmaceutical Management

Overall, the findings demonstrate that the National Drug Master Data has established a relatively strong foundation for supporting pharmaceutical information systems through the availability of primary identifiers, clear administrative status, and continuous data updating mechanisms. Well-structured master data can improve information consistency, enhance system interoperability, and strengthen data-driven decision-making processes (Beierle et al.,

2023). However, several areas require further improvement, particularly the completeness of Generic Name, Drug Category, and Data-Creating Organization attributes. These findings highlight that healthcare digital transformation requires not only technological advancement but also continuous strategies for improving data quality and governance (Hikmawati et al., 2021).

Within modern pharmaceutical management, drug master data function as an information infrastructure supporting the entire medicine management lifecycle, from demand forecasting and procurement to distribution monitoring and utilization evaluation (Beierle et al., 2023). Therefore, the development of National Drug Master Data should be directed toward implementing continuous data quality improvement strategies through automated validation, metadata standardization, strengthened source data management, and integration with national health information systems (Idris et al., 2024), (Faradiba et al., 2023), (Beierle et al., 2023)

Such approaches will reinforce the role of master data as a fundamental component in establishing pharmaceutical information systems that are interoperable, accurate, reliable, and sustainable within Indonesia's healthcare ecosystem.

CONCLUSION

Based on the analysis of National Drug Master Data characteristics in supporting pharmaceutical management through pharmaceutical information systems in Indonesia during the 2020–2025 period, it can be concluded that the dataset has established a fundamental structure supporting healthcare digital transformation. Among the 470 analyzed drug records, essential attributes including drug ID, drug name, administrative status, create time, and update time achieved 100% completeness. The data characteristics indicated that most records were categorized as Approved (421 records; 89.57%) and predominantly classified under the Drug (OBAT) category (331 records; 70.43%). Data maintenance activities continued throughout the 2020–2025 period, indicating ongoing management and updating processes.

Nevertheless, data quality evaluation identified limitations in several supporting attributes, particularly Generic Name (30%), Drug Category (52.13%), and Data-Creating Organization (78.72%). These findings demonstrate that although the fundamental structure of the dataset is well established, improvements in metadata quality and data governance are required to strengthen pharmaceutical information system interoperability. Overall, the National Drug Master Data has become an important foundation for supporting digital pharmaceutical management. However, its effectiveness depends on continuous improvement in validation mechanisms, attribute standardization, and sustainable data maintenance practices.

Recommendations

Based on the findings, strengthening the National Drug Master Data should focus on several strategic aspects. Pharmaceutical information system managers should improve the completeness of supporting attributes, particularly generic drug names, drug categories, and data-creating organizations, to optimize the quality and usability of pharmaceutical information. Furthermore, automated validation mechanisms and standardized attribute-entry procedures should be implemented to ensure that each drug record meets predefined quality requirements before being utilized as national reference data.

The management of National Drug Master Data should also be reinforced through the implementation of a comprehensive data governance framework by establishing clear roles for data owners and data stewards. These mechanisms are necessary to ensure data accuracy, accountability, and traceability throughout the information lifecycle. Future development of drug master data should prioritize interoperability improvement across digital health information systems through the adoption of standardized data structures and reference

frameworks, enabling consistent and reliable information exchange among healthcare platforms. Future research is recommended to conduct more comprehensive data quality assessments by incorporating additional dimensions, including accuracy, consistency, validity, uniqueness, and timeliness. Comparative analyses across different periods and pharmaceutical information systems should also be considered to identify improvement trends and governance challenges.

Through continuous enhancement of data attributes, strengthened governance mechanisms, and sustainable maintenance strategies, the National Drug Master Data is expected to provide more accurate, integrated, and evidence-based pharmaceutical information to support the advancement of national pharmaceutical management.

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