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Assessing the Quality Gap in Medical Record Data between Underdeveloped and Non-Underdeveloped Regions based on National Health Reporting Quality Indicators

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ABSTRACT

Accurate medical record data is crucial for effective healthcare and evidence-based policy in Indonesia. This study aimed to quantify the significant quality discrepancies—in completeness, accuracy, and timeliness—persisting between the underdeveloped 3T regions (Tertinggal, Terdepan, Terluar) and non-3T counterparts. We utilized a comparative design and analyzed multisource secondary data from the Ministry of Health, BPS, and BPJS Kesehatan (2023–2024), employing ANOVA and regression analysis on validated national reporting quality indicators. Results unequivocally demonstrate that 3T regions significantly lag non-3T areas across all metrics ($p < 0.001$). Regional classification was a powerful predictor, independently accounting for 38\% of the variance in overall data quality (Adjusted R^2 = 0.57). These findings underscore the urgent need for targeted resource allocation toward digital infrastructure and capacity building in 3T regions to foster equity in health information systems, which is paramount for advancing Indonesia's commitments to Universal Health Coverage (UHC) and the SDGs.

Keywords: *Medical Record Data Quality, Health Information Systems, 3T Regions, Indonesia, Data Completeness, Data Accuracy, Health Reporting*

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INTRODUCTION

High-quality medical record data constitutes the essential foundation for efficient healthcare delivery, precise epidemiological surveillance, and informed policy formulation worldwide (Bernardi, 2023). To enable comprehensive health system oversight and ensure an equitable distribution of resources, health information systems must generate data that is accurate, complete, and readily available. Nevertheless, marked discrepancies in the quality of medical record data persist between developed and less-developed regions, a challenge particularly acute in low- and middle-income countries, including Indonesia (Wu et al., 2020; Kemenkes, 2023). In Indonesia, this difference is most pronounced between areas categorized as 3T (Tertinggal, Terdepan, Terluar, or Disadvantaged, Frontier, Outermost) and non-3T regions, where deficits in infrastructure, limitations in human capital, and inadequate adoption of digital health solutions compromise data completeness and accuracy (Aisyah et al., 2024; CISDI, 2024).

Recent global and national studies have illuminated the complex, multifactorial issues degrading health data quality in these underdeveloped areas. These factors include restricted health information technology infrastructure, insufficient training for health personnel in data management, inconsistent application of standardized data quality metrics, and logistical hurdles impeding timely data submission (Wu et al., 2020; Ibrahim, 2021). Documentation from Indonesia's Ministry of Health (Kemenkes, 2023) and various research entities confirms that health facilities within 3T regions systematically lag behind their non-3T counterparts in the adoption of Electronic Medical Records (EMR), data completeness, and the punctuality of health reporting. The resulting incomplete and delayed medical documentation presents critical barriers to effective disease surveillance and essential healthcare planning for the most vulnerable populations (Purwandani et al., 2025).

Despite several advancements in digital health integration, the extant literature seldom offers a comprehensive evaluation of quality deficiencies in medical record data explicitly differentiated by regional development status, based on consistent national health reporting quality indicators such as completeness, accuracy, and timeliness of reports. Many existing evaluations tend to concentrate either on technological uptake or clinical outcomes without robustly distinguishing between underdeveloped and non-underdeveloped regions. Furthermore, these studies often fail to incorporate secondary official data sources that could provide definitive, comparative evidence of these disparities (Wulandari, 2025; Hu, 2024). Crucially, the potential of national datasets sourced from Pusdatin Kemenkes, BPS regional indices, and BPJS Kesehatan claims data remains insufficiently harnessed for spatial quality disparity analyses relevant to Indonesia's public health equity mandate (Kemenkes, 2023; BPS, 2024).

In recognition of this significant knowledge gap, this research is designed to conduct a rigorous assessment of the medical record data quality gap existing between underdeveloped (3T) and non-underdeveloped regions using validated national reporting quality indicators. By leveraging multisource official secondary data and applying spatial classification of Indonesian

regions, this study seeks to quantify and clearly explain regional disparities in data quality, pinpoint contributing factors, and generate evidence to support policy development for the equity-oriented enhancement of health information systems. This integrated empirical methodology and the reliance on data triangulation render this research novel, promising to generate actionable insights for targeted interventions aimed at improving data quality and, consequently, healthcare outcomes in Indonesia's most underserved areas (CISDI, 2024; Hu, 2024).

METHODS

This investigation utilizes a quantitative research design based on secondary data analysis to rigorously evaluate the quality disparity in medical record data between Indonesia's underdeveloped (3T) and non-underdeveloped regions. The core methodology involves a comparative analysis of validated national health reporting quality indicators, specifically data completeness, accuracy, and timeliness, leveraging official aggregated data from authoritative government entities. This research strategy facilitates a comprehensive and replicable assessment grounded in national-level datasets, bypassing the need for primary data collection.

The primary secondary data for this research were compiled from three key official data repositories:

1. Ministry of Health of Indonesia (Kemenkes) – Center for Health Data and Information (Pusdatin) Annual Reports (2023–2024): These documents provide aggregated metrics on health service performance, including the completeness and timeliness of medical record reporting. The data is disaggregated by administrative regions, aligning with the 3T and non-3T classifications, serving as core indicators of subnational health reporting quality (Kemenkes, 2023).
2. Badan Pusat Statistik (BPS) – Regional Human Development Index (IPM) and Community Health Development Index (IPKM) (2021–2024): BPS datasets furnish comprehensive socioeconomic and demographic indices at the provincial and district levels. These indices are critical for stratifying and classifying regions into underdeveloped versus non-underdeveloped areas (BPS, 2024), thereby supporting subsequent correlation analyses between regional development status and observed medical record data quality.
3. BPJS Kesehatan – Claims and Service Utilization Database (2023): Aggregated data concerning health service utilization and the completeness of submitted claims act as proxy indicators for the accuracy and completeness of underlying medical record data. This information is particularly valuable for reflecting patient-level health encounter recording in both 3T and non-3T regions, and was accessed via formal collaborative agreements (BPJS Kesehatan, 2023).

Regional demarcation was established strictly according to the official government criteria for 3T (Tertinggal, Terdepan, Terluar) underdeveloped regions, as defined by the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration (Kemendesa, 2023). Non-3T regions comprise all remaining areas not officially designated as underdeveloped. This binary

regional classification serves as the foundation for all subsequent comparative and inferential analyses.

1. Research Procedure

The research followed a structured procedural flow:

a. Data Extraction and Cleaning: Raw data procured from the three official sources were extracted, thoroughly cleaned, and subsequently harmonized. This process ensured temporal alignment (focusing on the 2023–2024 period) and geographic congruence across the disparate datasets using unique, consistent regional identifiers.

b. Indicator Operationalization: The national health reporting quality indicators were precisely defined for quantitative measurement:

   1) Completeness: Defined as the percentage of expected medical record reports submitted compared to the number of actual submissions.
   2) Accuracy: Defined as the proportion of records verified as error-free via standard data validation processes, as reported by the respective health information systems.
   3) Timeliness: Defined as the percentage of reports submitted within the nationally mandated deadlines.

c. Statistical Analysis: Descriptive statistics were used to summarize the data quality indicators within the 3T and non-3T regional groupings. Inferential statistics, including independent t-tests (for normally distributed data) and Mann-Whitney U tests (for non-normally distributed data), were applied to compare the group means. Furthermore, multivariate regression models were employed to control for known confounding variables, such as regional socioeconomic scores (IPM and IPKM), in order to isolate and estimate the specific effect of the regional classification on observed data quality.

The study operates exclusively on publicly available or officially authorized secondary data. Therefore, per standard institutional guidelines, formal ethical approval was determined to be unnecessary (Institutional Review Board, 2025). Nonetheless, all data usage strictly adheres to established confidentiality and data protection regulations stipulated by the respective data providers.

RESULTS

The initial analysis revealed marked differences in health reporting quality indicators when comparing 3T and non-3T territories. Data were compiled from Pusdatin Kemenkes, BPJS Kesehatan, and BPS datasets for the 2023–2024 timeframe. Table 1 summarizes the descriptive statistics for the five principal indicators assessed: data completeness, data accuracy, timeliness of reporting, report submission delay, and percentage of error reports.

Table 1. Descriptive Statistics of Key Health Reporting Indicators in Underdeveloped (3T) and Non-Underdeveloped Areas

Indicator	Underdeveloped (3T) Mean ± SD	Non-underdeveloped Mean ± SD	p-value (t-test / Mann-Whitney)
Data Completeness (%)	65.2 ± 8.7	88.7 ± 5.1	<0.001
Data Accuracy (%)	70.4 ± 10.3	91.3 ± 4.9	<0.001
Timeliness (%)	60.8 ± 9.5	85.4 ± 6.3	<0.001
Report Submission Delay (days)	12.4 ± 7.2	4.3 ± 2.1	<0.001
Percentage of Error Reports	9.8 ± 3.7	2.6 ± 1.5	<0.001

Data completeness, measured as the ratio of fully-documented medical record reports to the expected total volume, averaged 65.2% in 3T regions. This figure is statistically significantly lower than the 88.7% observed in non-3T areas. Primary drivers of this deficient completeness include factors such as restricted access to technology, insufficient staff training, and logistical hurdles related to data aggregation (Aisyah et al., 2024). Furthermore, the distribution of completeness within the 3T cohort was more dispersed, indicated by a standard deviation of 8.7 compared to 5.1 in the non-3T group, suggesting uneven capacity even amongst the underdeveloped territories themselves.

Data accuracy reflects the correlation between the reported data and field verification conducted via internal audits by Pusdatin Kemenkes. The 3T regions exhibited a critical challenge in data accuracy, potentially leading to misinformed data-driven policy decisions. The stark difference 91.3% accuracy in non-3T regions versus 70.4% in 3T regions indicates a dramatic quality gap. Key contributing factors include the lack of integrated validation systems and technological limitations within 3T areas to promptly detect and correct data input errors.

Timeliness of reporting emerged as another critical quality determinant. Reports from 3T regions were, on average, delayed by 12.4 days, which is substantially higher than the 4.3 days recorded for non-3T territories. This extensive reporting lag contributes directly to public health policy response delays. The finding points toward underlying obstacles related to data transport and suboptimal communication network infrastructure in remote areas (Kemenkes, 2023).

The percentage of error reports in 3T regions reached 9.8%, notably higher than the 2.6% in non-3T areas. These documented errors typically encompass issues like duplicate entries, patient misidentification, or incomplete fields. The magnitude of this error rate signals an urgent need for significant remediation of Standard Operating Procedures (SOPs) pertaining to medical record management within underdeveloped regions.

A multiple linear regression model was constructed to assess the factors significantly influencing overall data quality. The model incorporated the Human Development Index (IPM), the Community Health Development Index (IPKM), and the regional classification (3T vs. non-3T) as independent variables:

$$Quality\ Score\ =\ \beta_0\ +\beta_1(\text{IPM})\ +\ \beta_2\ (\text{IPKM})\ +\ \beta_3\ (\text{Regional Classification})\ +\ \varepsilon$$

Legend:
β0: The intercept (constant term) of the model.
β1: The regression coefficient associated with the Human Development Index (IPM).
β2: The regression coefficient associated with the Community Health Development Index (IPKM).
β3: The regression coefficient corresponding to the regional classification variable (e.g., 0 = non-3T, 1 = 3T).
ε: The residual error term (unexplained variance).

The regression results indicated that IPM and IPKM were significant contributors to data quality variables ($p<0.001$). Crucially, the regional classification itself was identified as a strong predictor, explaining a deficit of approximately 38% of the variance in data quality (Adjusted $R2=0.57$). This empirically confirms that shortcomings in both social and health development directly undermine the quality of health reporting data.

A thematic map (Figure 1) illustrates that lower medical record data quality scores are primarily concentrated within 3T territories, specifically across the eastern regions and certain remote islands. Such spatial detection provides a concrete geographical illustration of the inter-regional disparity, offering guidance for location-based intervention strategies.

In summary, these findings comprehensively reveal a clear and significant quality disparity in medical record reporting between underdeveloped (3T) and non-3T regions. This gap is demonstrably exacerbated by underlying socioeconomic development and infrastructure limitations in the disadvantaged areas.

DISCUSSION

This study offers an in-depth empirical understanding of the persistent disparity in medical record data quality between Indonesia's underdeveloped 3T regions and the more developed non-3T regions, as evaluated by validated national health reporting quality indicators. These observed quality gaps are multifaceted, stemming from a convergence of socio-economic, infrastructural, technological, and human resource limitations that characteristically burden disadvantaged territories.

Our findings strongly corroborate that structural and socio-economic metrics, specifically the Human Development Index (IPM) and the Public Health Development Index (IPKM), exert a

significant influence on the resultant health data quality. This conclusion is consistent with international evidence indicating that regions marked by low socio-economic development frequently exhibit poorer performance in health information systems, largely due to systemic shortages in infrastructure and qualified personnel (Ibrahim, 2021; CISDI, 2024). The regression analysis, with an Adjusted R2 of 0.57, quantitatively demonstrates that over half the variance in data quality can be statistically attributed to these fundamental structural determinants. This socio-structural perspective compels policymakers to recognize that health data inequity is a direct reflection of broader disparities in social development, urging the adoption of integrated social and health development strategies to bolster data systems.

The significantly lower data completeness (65.2%) and accuracy (70.4%) documented in 3T regions clearly reveal underlying operational and systemic deficiencies. A common challenge in primary health facilities in these areas is the presence of poor internet connectivity, the lack of requisite Electronic Health Record (EHR) technology, and a deficit of continuous training for health personnel regarding proper data management protocols (Aisyah et al., 2024; Kemenkes, 2023). These operational gaps critically impair routine data collection and submission, consequently exacerbating the fragility of local health information systems and limiting the utility of the collected data for decision-making purposes.

Furthermore, reporting timeliness is severely compromised, with an average delay of 12.4 days in 3T areas, compared to a mere 4.3 days in non-3T regions. This substantial logistical delay severely undermines the functionality of early warning and response mechanisms for public health threats and reduces the overall responsiveness of the health system. This delay is most likely a consequence of transportation difficulties, challenges associated with decentralized management, and inefficient data submission workflows, all of which are amplified in remote settings (Farida Sibuea, 2023; WHO-Kemenkes, 2023).

The results unequivocally call for targeted and prioritized investment in both digital infrastructure and capacity building across Indonesia's 3T regions. Digital health initiatives, such as the development and deployment of the e-Modul Pelatihan Penilaian Kualitas Data Rutin (e-Module Training for Routine Data Quality Assessment) referenced by Kemenkes and WHO, are vital for standardizing quality assessments and effectively empowering local health workers (Kemenkes, 2023). Additionally, enhancing the interoperability of local health information systems with national platforms like Satu Sehat and DHIS-2 is crucial for facilitating more efficient and accurate data flow.

Training curricula must emphasize proficiency in routine data quality evaluation, error detection, and cultivating a data utilization culture among health workers to foster competence and accountability. Integrating community-based data collection methods and incorporating local governance oversight may also contribute to optimizing both data validity and completeness (Pusdatin Kemenkes, 2023).

The improvement of medical record data quality is pivotal to Indonesia's national progress toward achieving Universal Health Coverage (UHC) and the Sustainable Development Goals (SDG

The availability of reliable data enables equitable resource distribution and the effective monitoring of health outcomes, which is particularly essential for the vulnerable populations residing in 3T areas (WHO Indonesia, 2023). The study's findings reinforce the necessity of prioritizing the strengthening of health information systems as a foundational component of comprehensive health sector reform.

While this investigation employed robust secondary data sources offering national coverage, it is constrained by potential limitations such as inherent under-reporting or inconsistencies within the source data itself, which may introduce bias. Future research should include qualitative explorations to capture the lived experiences and perspectives of health workers regarding data management challenges in 3T areas. Moreover, longitudinal studies are required to better elucidate the causal effects of recent digital health interventions on sustained data quality improvement over time.

CONCLUSIONS

This investigation delivers a comprehensive and rigorous assessment of the enduring quality discrepancies in medical record data between Indonesia's underdeveloped 3T regions and the more socio-economically advanced non-3T regions, anchored by national health reporting quality indicators like completeness, accuracy, and timeliness. The empirical results concretely establish that underlying structural socio-economic disadvantages, precisely measured by lower scores on the Human Development Index (IPM) and the Community Health Development Index (IPKM), severely compromise the performance capabilities of health information systems in these vulnerable areas.

The quantification of these quality gaps reveals that data completeness and accuracy in 3T territories fall significantly below national benchmarks. The adverse consequences of these deficiencies extend beyond mere administrative inefficiencies, directly impacting the integrity of clinical decision-making, the efficacy of health surveillance activities, and the fairness of resource distribution. Moreover, sustained delays in reporting further diminish the health system's ability to respond promptly, creating critical blind spots essential for the early detection and effective management of disease outbreaks or other acute public health crises.

This profound disparity in data quality underscores that efforts to strengthen the health system must extend beyond the provision of clinical services alone. It necessitates robust, integrated investments in digital health infrastructure, continuous development of capacity for health workers in data management protocols, and the institutionalization of systematic quality assurance frameworks, such as the Penilaian Mandiri Kualitas Data Rutin (PMKDR) employed by Indonesia's Ministry of Health. The phased implementation and scaling of interoperable electronic health record systems, specifically engineered for remote and low-resource settings, are essential next steps.

Beyond technological solutions, this study provides strong evidence for the inherent link between broad social determinants including poverty, education attainment, and access to telecommunications infrastructure and health information system capacity. To successfully close

these data quality divides, multisectoral collaboration spanning health, education, telecommunications, and governance sectors is paramount. This holistic approach is required to equitably reduce systemic inequities.

The implications of these findings resonate deeply with Indonesia's commitments toward achieving Universal Health Coverage (UHC) and the Sustainable Development Goals (SDGs), where reliable and high-quality health data form the bedrock for effective policy formulation, targeted program design, and institutional accountability. Future scholarly work should prioritize the longitudinal monitoring of health information system interventions in 3T regions, coupled with qualitative explorations to understand the contextual barriers faced by frontline health workers.

In summary, raising the standard of medical record data quality in underdeveloped regions constitutes more than just a technical challenge; it is fundamentally an ethical imperative that demands systemic social investments and demonstrated political will. This effort is a non-negotiable prerequisite for building an inclusive, data-driven, and resilient national health system in Indonesia.

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