SMART INTERNATIONAL MANAGEMENT JOURNAL (SIMJ)

Vol. x No. x (2025) 48 – 55 | ISSN: 3048-0019 (Media Online)

Digital Transformation in Primary Health Care: Evaluation of Information Technology Adoption and Management Practices

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Article Information

Received: November 26, 2025
Revised: December 28, 2025
Online: December 30, 2025

ABSTRACT

Primary Health Care (PHC) serves as the frontline of national health systems, making digital transformation essential for improving service quality, efficiency, and coverage. This study aims to assess the level of Information Technology (IT) adoption and evaluate supporting management practices at Pusat Kesehatan Masyarakat (Puskesmas) in Indonesia. A descriptive quantitative approach was employed using official secondary data obtained from government institutions, including the Ministry of Health, BPJS Kesehatan, and the Central Statistics Agency, with West Java Province designated as the study area. The analysis encompassed five dimensions: infrastructure availability, utilization of clinical information systems (SIMPUS/ASIK), IT human resource capacity, service performance indicators, and IT management maturity. The results indicate a high adoption rate of basic infrastructure such as internet access and computers; however, the utilization of core clinical systems, including ASIK and PCare, varies considerably across Puskesmas. Limited availability of dedicated IT personnel and insufficient IT management training for leadership were identified as key constraints. Overall, successful digital transformation in PHC depends not only on adequate infrastructure but also on strengthened management practices, particularly in human resource capacity, data governance, and effective use of clinical information systems to achieve improved service outcomes.

Keywords: digital transformation; primary health care; information technology adoption; management practices; Puskesmas; clinical information systems

PUBLISHED BY : http://doi.org/10.70076/simj.v2i4.129
https://heijournal.id/index.php/simj

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1. Introduction

The effects of globalization and rapid technological advancement have prompted the healthcare sector to proactively embrace digital solutions to address contemporary challenges, including service accessibility, quality, and operational efficiency [1]. Primary Health Care (PHC) plays a fundamental role in achieving Universal Health Coverage (UHC), making digital transformation at this level particularly through the adoption of Information Technology (IT) within the Puskesmas a decisive strategic imperative [2]. This transformation encompasses the deployment of Electronic Health Records (EHRs), comprehensive management information systems, and telemedicine services. The core objective of these initiatives is to foster data-driven decision-making, streamline clinical and administrative workflows, and ultimately improve the patient experience.

In Indonesia, the government, primarily through the Puskesmas network, is rigorously implementing integrated health information systems, such as the national SIK and the Sehat Indonesiaku (ASIK) application, which is used for immunization records and non-communicable disease (NCD) screening [3]. Nevertheless, effective IT adoption relies not only on the existence of hardware and software but also on supportive organizational management practices [10]. This investigation is critical because a recognized gap persists between the mere availability of technology and its optimal utilization, particularly within Puskesmas, due to variations in geographic conditions, human resource capacity, and organizational readiness [4].

Strengthening IT adoption in PHC requires a dual-focus evaluation: technical aspects (infrastructure and system utilization) and non-technical aspects (management maturity, human resources, and governance). This study aims to (1) assess the current level of IT infrastructure adoption and the utilization of clinical information systems in Puskesmas, (2) evaluate associated IT management practices, such as specialist HR availability, staff training, and data governance, and (3) establish the relationship between these factors and primary service performance indicators. The analysis concentrates on official secondary data from West Java Province, chosen for its operational diversity, to provide an accurate reflection of the challenges and opportunities for national PHC IT implementation [5].

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2. Materials and Method

Study Design and Data Sources

This study employed a descriptive quantitative design based exclusively on official secondary data obtained from authorized government institutions. The analysis utilized verified raw data sourced from the Ministry of Health, BPJS Kesehatan, the Central Statistics Agency, and other relevant agencies, without involving primary surveys or simulated datasets. West Java Province was selected as the study area due to its large population and substantial number of Puskesmas, providing a representative overview of PHC diversity in Indonesia.

Variables and Raw Data Sources

The variables and official data sources used to evaluate digital transformation in Puskesmas across West Java Province are presented in Table 1. The analysis focused on data from the year 2023 and covered five major categories: facility and infrastructure readiness, clinical system utilization, human resource and management capacity, service performance indicators, and IT adoption and governance practices.

Table 1. Variables and Official Raw Data Sources

Data Category	Measured Variables (Example)	Official Data Source (Institution)
A. Facility & Infrastructure	Internet connectivity (*yes*/*no*), Availability of management PC/Laptop, Presence of Local Server/Cloud Computing.	Ministry of Health of the Republic of Indonesia: SIK Dashboard.
B. Clinical System Utilization	No. of Patient Medical Records logged in ASIK/SIMPUS per month, No. of PCare visits per period, Percentage of Puskesmas with consistent ASIK usage.	BPJS Kesehatan: PCare Utilization Statistics; Ministry of Health of the Republic of Indonesia: ASIK Application Reports.

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C. HR & Management Capacity	No. of IT Personnel/SIK Operators, IT Management Training for Puskesmas Head (*0/1*), Existence of Internal IT Policy.	BPS: Health Statistics; Provincial Health Office Internal Reports (HR Data Aggregation); WHO (Capacity Indicators).
D. Service Performance Indicators (Outcome)	Full Basic Immunization Coverage (%), Mean Time Service, Controlled Rate of Non-Specialist Referrals.	Ministry of Health of the Republic of Indonesia: Program Outcomes Data; World Bank Project Reports.
E. Adoption Level & IT Practices	Presence of active EHR (*0/1*), % of Digitized Services, Monthly Data Backup Frequency, Presence of formal IT SOPs.	Internal Audit (BPK/Inspectorate General, related to IT Governance); Ministry of Health Regulation (Permenkes) on SIMPUS Implementation.

Data Analysis Method

Data collected from the various official sources were aggregated, cross-validated, and processed using descriptive statistical analysis. This analysis included calculating frequencies, percentages, and summary statistics (mean and standard deviation) for each IT adoption and management practice variable. The descriptive analysis served as an initial step to identify general patterns, distribution, and variability of IT adoption and management practices across Puskesmas. Subsequently, a bivariate correlation analysis was performed to test the relationship between management practice variables (C & E) and service performance indicators (D). In this study, no inferential statistics requiring degrees of freedom were conducted; the focus was strictly on the clear presentation of accurate secondary data from official institutions.

3. Result

Infrastructure Adoption and Clinical System Utilization

The evaluation of infrastructure adoption among Puskesmas in West Java Province indicates a high level of basic hardware availability. According to Ministry of Health data for 2023, 98.2% of Puskesmas had active internet connectivity, and

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99.5% were equipped with at least one computer or laptop for reporting and recording activities [3]. However, only 45.1% of Puskesmas reported having a local server, while the majority relied on cloud-based systems.

Analysis of clinical information system utilization revealed substantial variability. On average, 1,520 patient records (SD = 788) were entered into the ASIK system per Puskesmas each month. Despite this, consistent and regular ASIK utilization was observed in only 71.3% of Puskesmas, indicating that compliance and routine use remain significant challenges even when systems are available [5].

IT Human Resource Capacity and Management Practices

Human resource data indicate a limited availability of dedicated IT personnel in Puskesmas. Only 18.7% of facilities had formally appointed IT officers with relevant technical qualifications, while IT-related responsibilities were commonly assigned to administrative staff or healthcare workers without specialized training. This finding highlights a critical gap in IT human resource capacity.

Table 2. Percentage of Puskesmas with Key IT Management Practices

Key IT Management Practice (BPK Audit Data)	Percentage of Presence (n=780 Puskesmas West Java)
Active EHR (SIMPUS/ASIK) Presence	98.7%
IT Management Training for Puskesmas Head	62.4%
Standardized Monthly Data Backup Frequency	55.9%
Availability of Formal IT Standard Operating Procedures (SOPs)	31.2%

Source: BPK Audit Data (2022)

As summarized in Table 2, although the presence of active electronic health record systems is nearly universal, the availability of formal IT Standard Operating Procedures (SOPs) and compliance with standardized data backup practices remain relatively low. These results suggest that IT governance and operational sustainability have not yet reached an optimal level [6].

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Correlation between Management Practices and Service Performance

The correlation analysis demonstrates a positive and statistically meaningful relationship between strong IT management practices and improved service performance indicators. Puskesmas that adhered to standardized monthly data backup protocols achieved an average full basic immunization coverage of 84.5%, compared to 75.2% in facilities that did not comply with these practices [3]. This finding underscores the importance of sound data governance in supporting public health program effectiveness [7].

4. Discussion

The findings indicate that digital transformation in PHC within West Java Province has progressed substantially in terms of infrastructure deployment but remains constrained by limitations in management maturity and depth of system utilization. High levels of hardware availability and system implementation reflect strong governmental commitment to digital health development [3], consistent with previous studies emphasizing infrastructure as a prerequisite for successful e-health initiatives [8].

Nevertheless, inconsistencies in clinical system utilization and the low prevalence of formal IT SOPs and dedicated IT personnel highlight ongoing challenges related to governance and human–technology interaction. Irregular system use may result in incomplete or inaccurate data, ultimately undermining the core objective of digital transformation, namely data-driven decision-making [4].

The observed positive relationship between IT management practices and service performance reinforces the notion that investments in human resources and organizational processes are as critical as investments in technological platforms [9]. Effective IT governance enhances data quality and continuity, which in turn supports improved health service outcomes, such as immunization coverage [7]. Addressing deficiencies in IT human resources and data governance is therefore essential to ensuring sustainable and reliable digital health services in PHC settings.

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5. Conclusions

Digital transformation in Primary Health Care in West Java Province has achieved near-universal adoption of basic IT infrastructure and broad implementation of key clinical information systems. Nevertheless, the effectiveness of this transformation remains limited by insufficient IT management maturity, particularly the shortage of specialized IT personnel, the limited availability of formal standard operating procedures, and inconsistent compliance with data governance practices. The positive association between robust IT management practices and improved service performance confirms that human resources and organizational processes are critical in maximizing the benefits of digital health investments. To address these challenges, policymakers should prioritize the provision of qualified IT personnel at the Puskesmas level or through shared regional support mechanisms, accompanied by regular IT governance audits and leadership training focused on data-driven management. This study is limited by its reliance on secondary data and its focus on a single province, which may not fully represent the diversity of Primary Health Care settings across Indonesia.

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