



Training, Technological Infrastructure, and Electronic Medical Record User Satisfaction: A Cross-Sectional Study in Ibu Kota Nusantara, Indonesia

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ABSTRACT

The implementation of Electronic Medical Record (EMR) is an important part of the digital transformation of hospitals to improve operational efficiency. The success of EMR adoption is heavily influenced by human resources readiness and information technology infrastructure support. This study aimed to examine the associations of EMR training and technological infrastructure with perceived service efficiency and user satisfaction, including the potential mediating role of perceived service efficiency, among EMR users at Hospital X in Ibu Kota Nusantara. This quantitative research employed an analytical cross sectional survey design. The data collection was conducted from November 2025 to January 2026 at a private Type D general hospital in Ibu Kota Nusantara, Indonesia, involving 46 hospital employees selected through a census technique. Data were gathered using structured questionnaires and evaluated via path analysis. The results showed that EMR training ($\beta = 0.327$, $p = 0.007$) and technological infrastructure ($\beta = 0.529$, $p < 0.001$) significantly affect perceived service efficiency. Furthermore, training ($\beta = 0.348$, $p = 0.005$), infrastructure ($\beta = 0.558$, $p < 0.001$), and perceived service efficiency ($\beta = 0.790$, $p < 0.001$) exhibit significant positive direct associations with user satisfaction. Perceived service efficiency also significantly mediates the indirect relationships within the structural model. In conclusion, both training and technology infrastructure are critical drivers that optimize perceived service efficiency, which ultimately maximizes EMR user satisfaction.

INTRODUCTION

Hospitals as complex healthcare centers face multifaceted operational challenges that span administrative processes, clinical tasks, and resource management (Sunaryo et al., 2024). In the era of global health digitization, the implementation of Electronic Medical Records (EMRs) has emerged as a pivotal strategy to improve the overall quality, safety, efficiency, and continuity of patient care (Salendra et al., 2024). EMR systems streamline clinical workflows, reduce medical errors, enhance coordination among multidisciplinary teams, and ensure seamless information exchange across different care settings. As an integrated information system, however, the ultimate success of an EMR application is heavily dependent on user

satisfaction and acceptance, as even the most sophisticated digital framework cannot yield clinical benefits without the active, proficient role of its daily users (Nida et al., 2024).

Accumulating empirical evidence indicates that user capabilities and technical infrastructure are the foundational determinants influencing successful EMR implementation (Saputri et al., 2024). In the national context, the Indonesian Ministry of Health issued Regulation Number 24 of 2022, mandating all healthcare facilities to transition to digital medical records (Wijaya and Arifin, 2022). This structural shift requires substantial human resource readiness; national studies highlight that comprehensive EMR training is vital to improve staff digital literacy, secure data accuracy, and accelerate operational tasks (Mirza et al., 2023). Concurrently, the quality of information technology (IT) infrastructure including robust hardware, high-speed network stability, and timely technical support serves as an absolute prerequisite to prevent systemic latency, minimize user frustration, and foster high user satisfaction within digital hospital environments (Astuti and Fahyudi, 2023; Salendra et al., 2024).

Despite these established benchmarks, a significant research gap exists regarding EMR performance within newly constructed healthcare facilities in rapidly developing administrative zones. As an early adopter in Indonesia's new capital, Hospital X in the Ibu Kota Nusantara (IKN) region integrated an EMR curation platform upon its opening on October 11, 2024, converting disparate medical data into unified Health Electronic Records (HER). However, operating in a newly established territory presents unique local challenges, such as migrating workflows amidst fluctuating regional IT infrastructure and managing varying degrees of digital readiness among newly recruited medical personnel. While existing literature heavily examines EMRs in long-established urban centers, there is a scarcity of empirical evidence tracking how initial user training and nascent IT frameworks interact to generate service efficiency in a completely new, digitally mandated smart city jurisdiction.

The urgency of addressing this gap relates to the fact that perceived operational time remains a critical barometer of institutional efficacy, wherein service promptness directly impacts user comfort and patient delivery outcomes (Jannah et al., 2017). Suboptimal training programs (e.g., lasting less than four hours) coupled with frequent network drops can trigger intense user resistance, bottleneck clinical flows, and threaten the continuity of patient care (Saputri et al., 2024). Consequently, evaluating these elements simultaneously provides essential insights into how technological investments translate into functional workplace advantages during a major regional transition.

Based on these considerations, this study examined the associations of EMR training and technological infrastructure with perceived service efficiency and user satisfaction, including the potential mediating role of perceived service efficiency, among EMR users at Hospital X in Ibu Kota Nusantara. To guide the investigation, the following hypotheses were formulated:

- H1: EMR training is positively associated with perceived service efficiency.
- H2: Technological infrastructure is positively associated with perceived service efficiency.
- H3: EMR training and technological infrastructure are simultaneously associated with perceived service efficiency.
- H4: EMR training is positively associated with EMR user satisfaction.
- H5: Technological infrastructure is positively associated with EMR user satisfaction.

- H6: Perceived service efficiency is positively associated with EMR user satisfaction.
- H7: Perceived service efficiency mediates the association between EMR training and EMR user satisfaction.
- H8: Perceived service efficiency mediates the association between technological infrastructure and EMR user satisfaction.

METHODS

An analytical cross-sectional survey was conducted to investigate the structural relationships among Electronic Medical Record (EMR) training, technological infrastructure, perceived service efficiency, and user satisfaction. Given the single-time-point nature of the data collection, this design focuses on assessing the strength, direction, and significance of statistical associations rather than establishing definitive temporal causality or experimental intervention effects. Path analysis was employed to map out and evaluate both the direct and indirect relationships within the hypothesized structural model.

This study was conducted at Hospital X, a private Type D general hospital located in the Ibu Kota Nusantara (IKN) region, Indonesia. This site was selected due to its strategic position as a newly operational digital healthcare facility mandated to operate under smart-city digital healthcare regulations. The field research and data collection period spanned three months, from November 2025 to January 2026.

The target population comprised all institutional employees at Hospital X who interact with the integrated EMR platform in their daily routines. A total sampling (census) technique under a non-probability sampling framework was applied. The inclusion criteria were: (1) active clinical or administrative staff at Hospital X, (2) formal employment duration of at least one month prior to the study, and (3) daily operational utilization of the EMR system for patient registration, clinical documentation, laboratory requests, or pharmacy verification. The exclusion criteria applied to staff on prolonged medical leave, interns, and external technical consultants. Out of 46 eligible staff members identified, all 46 individuals fully participated and completed the survey instruments, yielding a 100% response rate.

Data were gathered using a self-administered, structured questionnaire measured on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The conceptual definitions and operational indicators were adapted from established information systems evaluation frameworks. EMR Training (X_1) and Technological Infrastructure (X_2) scales were adapted from Saputri et al. (2024) and Salendra et al. (2024), focusing on training quality and system stability. The intervening variable, Perceived Service Efficiency (Y), was measured using operational time-timeliness indicators developed by Jannah et al. (2017). The dependent variable, User Satisfaction (Z), was operationalized based on the End-User Computing Satisfaction (EUCS) instrument by Nida et al. (2024). A pilot pre-test conducted on a similar cohort confirmed adequate construct validity (all item-to-total correlations $r > 0.361$) and high internal reliability, with Cronbach's alpha (α) coefficients exceeding the 0.70 threshold for all constructs: EMR Training ($\alpha = 0.82$), Technological Infrastructure ($\alpha = 0.85$), Perceived Service Efficiency ($\alpha = 0.79$), and User Satisfaction ($\alpha = 0.88$).

Statistical computations were executed using IBM SPSS Statistics software (version 26.0). Prior to executing path analysis, a rigorous evaluation of classical linear regression

assumptions was performed. Data distribution normality was verified using the one-sample Kolmogorov–Smirnov test. Model linearity was assessed via deviation from linearity tests ($p > 0.05$). Multicollinearity was evaluated using the Variance Inflation Factor (VIF), ensuring all values remained well below the threshold of 5.0. Homoscedasticity was verified through the Glejser test, while the independence of residuals was checked using the Durbin-Watson statistic (target range between 1.5 and 2.5). Multivariate outliers were assessed using Mahalanobis distance criteria. Hypotheses testing was conducted using two-stage ordinary least squares (OLS) regression to map the path coefficients (β). The significance level for all statistical tests was set a priori at $\alpha = 0.05$ ($p < 0.05$), and all parameter estimates were evaluated alongside their corresponding 95% Confidence Intervals (CIs).

This study was conducted in strict compliance with the Declaration of Helsinki guidelines for research involving human subjects. The research protocol was formally reviewed and approved by the Institutional Review Board and Health Research Ethics Committee of the Pancasakti Health Sciences Institute, under the official Ethical Clearance Certificate Number: Ref-No: 104/KEPK-PS/XI/2025. Prior to data collection, all participants were provided with a written explanation regarding the study's purpose, the voluntary nature of their participation, and the strict anonymity and confidentiality protocols governing their responses. Written informed consent was obtained from each respondent before administering the questionnaires.

RESULTS

Data collection in this study managed to capture all members of the population who meet the criteria of the sample, namely as many as 46 respondents who are active users of the Electronic Medical Record (EMR) system at hospital X, Ibu Kota Nusantara. The demographic profiles of the respondents were grouped according to four main characteristics, namely age, gender, type of occupation and last but not least level of Education. Details of the frequency distribution and percentage of the characteristics of the respondents are summarized comprehensively in Table 1.

Table 1. Demographic and Professional Profile of Respondents (n = 46)

Characteristic	Category	n	%
Age	23-33 year	38	82.6
	34-43 year	8	17.4
Gender	Male	11	23.9
	Female	35	76.1
Occupation	General Practitioner	4	8.7
	Pharmacy Staff	7	15.2
	Nursing Staff	16	34.8
	Laboratory Technician	4	8.7
	Radiographer	3	6.5
	Medical Record Officer	2	4.3
	Administration Staff	8	17.4
	Nutritionist	1	2.2

Characteristic	Category	n	%
Education	Physiotherapist	1	2.2
	Diploma	12	26.1
	Bachelor's Degree	33	71.7
	Master's Degree	1	2.2

Source: Primary Data, 2026

Hypothesis testing in this study was conducted using the method of path analysis to determine the direct and indirect influence of variables in this study. Based on the built model, path analysis is divided into two stages of regression model. Model 1 (structure I) examines the effect of training (X1) and technology infrastructure (X2) on service speed (Y). Furthermore, Model 2 (Structure II) tested the effect of training (X1), Technology Infrastructure (X2) and service speed (Y) on user satisfaction (Z). The results of parameter estimation for Model 1 path analysis that places service speed as a dependent variable are summarized in detail in Table 2.

Table 2. Path Coefficients for Model 1

Model	Unstandardized Coefficients (B)	Standardized Coefficients (β)	T Value	Sig
1 (Constant)	0.330		0.148	0.883
Training (X1)	0.312	0.327	2.811	0.007
Technology Infrastructure (X2)	0.605	0.529	4.549	0.001

Source: Primary Data (Processed), 2026

Based on the results of regression analysis of Model 1 in Table 2, the structural equation of path I can be formulated as follows:

$$Y = 0.327X_1 + 0.529X_2 + \varepsilon_1$$

The findings indicate that EMR training (X1) exhibits a positive association with perceived service efficiency (Y), supported by a standardized coefficient (β) of 0.327, t-value of 2.811, and a significance value of 0.007 ($p < 0.05$). Similarly, technological infrastructure (X2) demonstrates a positive association with perceived service efficiency (Y), with a standardized coefficient (β) of 0.529, t-value of 4.549, and a significance value of less than 0.001 ($p < 0.05$). The 95% confidence intervals for both independent factors do not cross the value of zero.

The second stage regression analysis was conducted on Model 2 (Structure II) to evaluate the individual and simultaneous associations of EMR training (X1), technological infrastructure (X2), and the intervening variable, perceived service efficiency (Y), with the primary dependent variable, user satisfaction (Z). The precise, recalculated parameter estimates, standardized coefficients, standard errors, and distinct significance levels for Model 2 are presented in Table 3.

Table 3. Path Coefficients for Model 2

Model	Unstandardized Coefficients (B)	Standardized Coefficients (β)	T Value	Sig
1 (Constant)	1.543		0.708	0.483
Training (X1)	0.317	0.348	2.930	0.005
Technology Infrastructure (X2)	0.609	0.558	4.689	0.001

Perceived Efficiency (Y)	0.753	0.790	8.535	0.001
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Source: primary data, 2026

Based on the results of regression analysis in Table 3, the structural equation of path II can be formulated as follows:

$$Z = 0.348X_1 + 0.558X_2 + 0.790Y + \varepsilon_2$$

The findings for the direct pathways in Model 2 indicate that EMR training (X1) is positively associated with user satisfaction (Z), showing a standardized coefficient (β) of 0.348, t-value of 2.930, and an exact significance value of 0.005 ($p < 0.05$). Technological infrastructure (X2) also exhibits a positive association with user satisfaction (Z), with a standardized coefficient (β) of 0.558, t-value of 4.689, and a significance value of less than 0.001 ($p < 0.05$). Lastly, the intervening factor of perceived service efficiency (Y) demonstrates a positive direct association with user satisfaction (Z), supported by a standardized coefficient (β) of 0.790, a t-value of 8.535, and a significance value of less than 0.001 ($p < 0.05$).

To evaluate the structural mechanisms of the intervening variable, an indirect effect analysis was performed using the product of coefficients method. The magnitude of the mediation was determined by multiplying the standardized coefficient of the pathway from the predictor to the mediator (Path a) by the standardized coefficient of the pathway from the mediator to the primary dependent variable (Path b). The comprehensive summary of direct, indirect, and total associations, alongside their corresponding structural paths and distinct significance levels, is detailed in Table 4.

Table 4. Summary of Direct and Indirect Effects Analysis

Model	Direct Effect	Path a Sig	Path b Sig	Indirect Effect	Total Effect	Decision
Training (X1) on user satisfaction (Z) through Perceived Efficiency (Y)	0.348	0.327 (0.007)	0.790 (0.001)	0.258	0.606	Significant Mediation
Technology infrastructure (X2) to user satisfaction (Z) through Perceived Efficiency (Y)	0.558	0.529 (0.001)	0.790 (0.001)	0.418	0.976	Significant Mediation

Source: primary data, 2026

The statistical metrics presented in Table 4 outline the specific patterns of mediation within the structural model. The indirect relationship between EMR training (X1) and user satisfaction (Z) through the mediating role of perceived service efficiency (Y) yielded an indirect coefficient of 0.258. Given that both foundational components (Path a = 0.327, $p = 0.007$ and Path b = 0.790, $p < 0.001$) are statistically significant, the framework confirms a significant mediation. Similarly, the indirect relationship between technological infrastructure (X2) and user satisfaction (Z) mediated by perceived service efficiency (Y) produced an indirect coefficient of 0.418. Since both analytical pathways defining this mechanism are significant ($p < 0.001$), the framework establishes a statistically reliable mediation effect.

DISCUSSION

The institutional analysis indicates that the EMR training program provided to the medical and administrative staff at Hospital X acts as a primary driving factor in enhancing perceived service efficiency. When frontline clinicians, nursing staff, and administrative personnel receive comprehensive orientations regarding EMR functionalities, they demonstrate higher operational dexterity and a lower incidence of routine technical errors. This structured practical understanding facilitates seamless patient data registration and efficient clinical history curation. Empirically, these tactical competencies are reflected in the census profile, where the vast majority of users are productive young adults (82.6% aged 23–33 years) possessing a higher educational baseline (71.7% holding an S1 degree). This demographic composition provides a highly adaptable baseline for digital systems adoptions, directly contributing to minimized documentation backlogs and reduced patient waiting times. This finding aligns with the theoretical consensus that expanding human resource competencies through targeted information systems training significantly elevates staff operational knowledge, thereby securing greater data accessibility and perceived service timeliness (Mirza et al., 2023).

This operational linkage is further reinforced by contemporary evidence across Indonesian digital healthcare settings, which indicates that formal training history holds a robust positive association with healthcare workers' professional comfort and overall satisfaction when navigating electronic records (Tarigan et al., 2026). Methodologically, structured educational programs deliver an in-depth understanding that extends beyond basic software navigation and entry protocols; they equip healthcare providers with the problem-solving capabilities required to troubleshoot minor systemic disruptions independently during active patient care shifts (Romadhon, 2024). Consequently, this localized competency mitigates daily operational bottlenecks, substantially shortens waiting queues during critical registration and triage phases, and fosters a strong sense of institutional system ownership alongside heightened psychological satisfaction across all operational tiers (Putri, 2025).

Concurrently, the availability of a resilient and modern technological infrastructure serves as a vital foundation for optimizing perceived service efficiency at Hospital X. Operating within a digitally integrated territory like the Ibu Kota Nusantara (IKN) necessitates an uncompromised baseline of advanced hardware configurations and high-speed network stability. A robust technical infrastructure guarantees that the centralized EMR platform remains fully responsive when accessed concurrently by multiple multidisciplinary units across various clinical wards without inducing systemic latency or server timeouts. The uninhibited flow of digitized clinical data moving dynamically from outpatient registration to laboratory diagnostics and pharmacy dispensing significantly diminishes administrative friction. This environment corroborates prior research emphasizing that IT infrastructure quality is a critical prerequisite for accelerating clinical team coordination and streamlining patient pathways within modern healthcare facilities (Salendra et al., 2024). Furthermore, these dynamics parallel the findings of Jayanthi and Lazuardi (2023), which confirm that information technology infrastructure quality exhibits a substantial positive correlation with the functional efficiency of hospital information systems. When a digital health facility secures high-capacity servers and optimal network configurations, the typical time-lag constraints associated with inter departmental medical data transfers are successfully minimized.

Ultimately, the empirical architecture of this study demonstrates that high perceived service efficiency cannot be achieved if an institution focuses exclusively on an isolated operational component. Competently trained personnel and reliable technological frameworks must operate in close synergy. The advanced technical skills acquired by healthcare professionals during training sessions remain latent and unexploited if they are constrained by outdated, slow computing terminals or unstable network connections that suffer from frequent dropouts (Ikawati dan Ilmawati, 2025). Therefore, the structural alignment between human resource readiness and physical technological support stands as the definitive benchmark for healthcare organizations seeking to harness the full capability of integrated EMR applications to optimize operational efficiency and maximize end-user satisfaction (Suwarti et al., 2025).

Furthermore, the empirical findings demonstrate that the EMR training program exhibits a positive direct association with the psychological comfort of the staff, which closely relates to overall job satisfaction at Hospital X. The transitional phase from manual documentation to an integrated electronic architecture often induces workplace anxiety and technological resistance among healthcare employees. Through structured and ongoing training initiatives, however, the medical personnel at Hospital X feel institutionally supported and adequately equipped with functional expertise. Consequently, they perceive the EMR framework as a supportive tool that facilitates clinical tasks rather than an additional administrative burden. This enhanced self-confidence and operational ease foster a positive user perception toward the platform, reinforcing the scientific consensus that initial training support acts as a primary predictor in determining user satisfaction and the successful adoption of health information systems (Saputri et al., 2024). Staf yang menerima asistensi intensif secara konsisten menunjukkan literasi komputer yang lebih adaptif, yang secara bertahap menggeser persepsi mereka terhadap kegunaan sistem ke arah yang lebih positif (Normawati, 2025). This inflation in psychological satisfaction aligns with Sofyan et al. (2026), confirming that user mental readiness established through periodic education correlates strongly with the practical realization of EMR system benefits. When healthcare providers feel digitally skilled, the electronic workload ceases to be perceived as an operational stressor and instead serves as an enabling instrument for effective service professionalism.

Similarly, a stable and resilient technological infrastructure contributes directly to the professional satisfaction of Hospital X employees operating at the forefront of clinical delivery. When managing diverse patient pathways, particularly within critical emergency scenarios, frontline medical personnel require a highly responsive and dependable digital system (Salsabila et al., 2026). The elimination of technical glitches, such as frozen terminal screens or unexpected server downtime, allows the clinical staff to focus their cognitive resources entirely on patient care rather than experiencing workplace stress due to device constraints. End-user satisfaction emerges naturally because the deployed technology successfully meets their daily operational requirements, supporting the conclusion that information technology infrastructure quality within digital hospitals exerts a tangible impact on workplace comfort and user satisfaction (Astuti and Fahyudi, 2023). This is congruent with Hairul et al. (2026), which notes that poorly aligned or immature IT infrastructure components often trigger severe operational barriers that degrade the daily work experience of clinical personnel. Digital system instability poses a high risk of triggering occupational burnout among emergency and

outpatient staff due to the compounding delay in patient documentation time (Mesa et al., 2025). Therefore, reinforcing the technological foundation is not merely a matter of hardware procurement, but a critical structural investment necessary to eliminate workflow disruptions and maintain the professional comfort of frontline employees.

At the operational level, a streamlined and efficient operational timeframe stands as a highly valued indicator among the staff in determining their evaluation of the EMR framework at Hospital X. When the integrated processes of inputting medical charts, verifying pharmaceutical prescriptions, and retrieving laboratory diagnostics run with precision and promptness, the daily clinical workload becomes substantially more organized and efficient. This optimized operational efficiency provides internal satisfaction for the employees, as they perceive the technology to be highly adaptive to their professional routines, reaffirming that the dimensions of accuracy and perceived service timeliness are inextricably linked to user satisfaction (Jannah et al., 2017).

Crucially, the structural relationship between the EMR training received by the staff and their subsequent job satisfaction is strongly mediated by the perceived service efficiency factor. The path analysis confirms that educational programs do not automatically translate into instant user satisfaction; rather, they must first be manifested as enhanced workplace productivity in the field. Competently trained employees are able to utilize the data curation features fluidly, thereby accelerating data conversion and reducing patient processing times. This functional transformation of digital skills into rapid, responsive workplace actions is what ultimately drives a sense of professional pride and satisfaction among medical personnel utilizing hospital information systems (Nida et al., 2024).

Finally, perceived service efficiency acts as a definitive bridge connecting the quality of the technological infrastructure with end-user satisfaction. The robust IT infrastructure deployed within the new capital region serves as the structural enabler that allows for the creation of an accelerated, seamless clinical workflow. When servers and local networks function at an optimal baseline, electronic medical charts can be retrieved instantly without aggravating time lags. This consistent, perceived efficiency in data access provides immediate practical utility to the employees, which consequently carries broad positive implications for achieving the highest levels of user satisfaction regarding EMR implementation at Hospital X (Salendra et al., 2024).

CONCLUSION

This study demonstrates that EMR training and technological infrastructure are positively associated with both perceived service efficiency and user satisfaction among healthcare personnel at Hospital X in Ibu Kota Nusantara. Furthermore, the path analysis confirms that perceived service efficiency plays a critical mediating role within the structural model. This architectural mechanism highlights that while initial institutional training and a resilient computing framework are vital, their capability to maximize user satisfaction is significantly amplified when they are successfully translated into enhanced workplace productivity, characterized by streamlined clinical workflows and reduced operational time lags.

Based on these findings, the management of Hospital X should maintain its commitment to providing structured, continuous EMR training programs to lower initial system resistance and enhance digital literacy among newly recruited staff. Concurrently, strategic investments in high-capacity server redundancy and high-speed network stability must be prioritized to sustain the digital demands of a modern healthcare facility operating in the new capital region. However, this study acknowledges a limitation regarding the demographic profile of the respondents, as the initial instrument did not capture granular professional variables such as length of employment, specific service units, and prior EMR operational experience. Future health services research in rapidly developing administrative zones should incorporate these professional characteristics to provide a more comprehensive analysis of digital health systems adaptation.

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