

Implementation of Electronic Medical Records on Clinical Workflow and Quality of Health Services in Balikpapan

Amalia Tanjung, Zainal Abidin, Herry Ramadhani

Corresponding Author: Amalia Tanjung
Mulawarman University, Samarinda - Indonesia

ABSTRACT: *This study investigates the impact of Electronic Medical Records (EMR) implementation on clinical workflow and the quality of healthcare services at primary healthcare facilities in Balikpapan. Specifically, it aims to assess the influence of EMR implementation on clinical workflow, the quality of the EMR system on clinical workflow, clinical workflow on healthcare quality, and the direct and mediated effects of EMR implementation and system quality on healthcare quality via clinical workflow. Utilizing a quantitative research design with a Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, data were collected through online surveys distributed via purposive sampling to healthcare professionals, including doctors, nurses, and laboratory and pharmacy staff. Findings indicate a positive and significant relationship between EMR implementation, system quality, and clinical workflow, with system quality fully mediating the effect on healthcare service quality. Recommendations for improvement include enhancing EMR infrastructure, ongoing training for healthcare professionals, effective clinical workflow integration, and regular evaluations to maintain system adaptability and efficiency. Future research should explore additional mediating variables and the long-term impact of EMR on healthcare service quality.*

KEY WORD: *Electronic Medical Records, Clinical Workflow, Healthcare Quality, System Quality*

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I. INTRODUCTION

Indonesia faces complex challenges in enhancing healthcare quality, requiring collaborative efforts from various stakeholders and the government to improve services, patient satisfaction, and public health outcomes amidst diverse geographic, economic, and social factors. Despite these challenges, the government has made strides in healthcare infrastructure and access improvements (Surya et al., 2017). Pinsonneault et al. (2017) found that integrating health information technology, including Electronic Medical Records (EMR), significantly enhances patient safety by reducing medication errors and minimizing redundant information, ultimately improving care quality. A study in Saudi Arabia also demonstrated that EMR enhances various aspects of healthcare, including physician productivity and information accessibility (Khalifa, 2017). The Indonesian Ministry of Health Regulation No. 24/2022 mandates that all healthcare services, including government institutions, clinics, and private practices, implement EMR by December 31, 2023, aiming to improve the quality and efficiency of medical record usage in Indonesia (Ministry of Health Republic of Indonesia, 2022). As EMR demand grows in Indonesia, the need to assess its success and predict adoption rates among healthcare professionals becomes critical. However, there is limited information on EMR effectiveness in practical use by health professionals, and EMR adoption in developing countries like Indonesia requires strategic implementation models (Tilahun & Fritz, 2015).

In 2022, there were 188 primary healthcare centers (Puskesmas) across 10 districts in East Kalimantan. In Balikpapan, with 27 districts covering 509.70 km², healthcare facilities serve a population of 703,611, averaging a household density of 2.8 people per household and a population density of 1,380 people per km² (Provincial Health Office, Kalimantan, 2022, 6). By 2019, 34.6% of 26 Puskesmas in Balikpapan had adopted EMR (Research and Development Agency, Ministry of Health, 2019). Scott et al. (2018) noted that EMR implementation significantly affects labor costs and time allocation for healthcare providers in outpatient orthopedic clinics, with labor costs per patient visit rising from \$36.88 to \$46.04 during the first two months due to increased documentation time, which normalized after a six-month adjustment period. Bisrat et al. (2021) reported that EMR adoption significantly improved healthcare quality in two Ethiopian hospitals, though challenges such as inadequate training and network infrastructure persisted. Ancker et al. (2015) highlighted that specific EMR features, like best-practice alerts, positively impact clinical outcomes in chronic disease management. Porterfield et al. (2014) revealed that e-prescribing within EMR systems improves safety and

efficiency in outpatient prescribing. Similarly, Jheeta and Franklin (2017) found that EMR reduces medication errors in hospitals, though documentation inconsistencies arose due to staff adjusting to new workflows.

In developing countries, the quality of system, information, and service significantly impacts EMR use and satisfaction, emphasizing the importance of high-quality systems and information (Biruk et al., 2014). Change management models, like Kotter's, are vital for successful EMR implementation (Arabi et al., 2022). Integrating EMR into clinical workflows improves documentation efficiency and patient interaction time (Tanny et al., 2023), while a task taxonomy approach enhances workflow reliability (Schwartz et al., 2019). Clinical workflow serves as a mediator between EMR implementation and healthcare quality, as a well-integrated EMR workflow boosts documentation and patient interaction efficiency, benefiting healthcare quality (Schwartz et al., 2019). Existing research shows limited understanding of the relationship between EMR implementation, system quality, clinical workflow, and healthcare quality. Specifically, the mediating role of clinical workflow between EMR and service quality remains unexplored (Scott et al., 2018). Theoretical and practical knowledge gaps highlight the need for a comprehensive model linking EMR implementation, system quality, clinical workflow, and healthcare quality. While past research shows EMR's positive impact on healthcare, there is a lack of theoretical models explaining how EMR mediates the relationship between system quality and workflow in achieving better service quality (Scott et al., 2018; Tilahun & Fritz, 2015). Practical gaps include the need for strategies to minimize workflow disruptions during EMR transition and effective ways to support healthcare professionals (Adler-Milstein et al., 2015). The novelty of this study lies in examining the relationship between EMR implementation, system quality, and healthcare quality mediated by clinical workflow. This research adds a new dimension by integrating system quality and clinical workflow, contributing to a deeper understanding of these interactions in healthcare settings (Salleh et al., 2021).

This research explores the effects of Electronic Medical Records (EMR) on clinical workflow and healthcare quality in Balikpapan's primary healthcare facilities. Key questions include whether EMR implementation and system quality impact clinical workflow and healthcare quality, and if clinical workflow mediates these relationships. Objectives are to assess the impact of EMR and system quality on both clinical workflow and healthcare quality, directly and with mediation. The research benefits researchers by revealing EMR-related challenges and solutions, academic institutions by enhancing curriculum relevance, and healthcare facilities by guiding efficient EMR use to improve service quality. Contributions include empirical data for health technology optimization, critical success factors for EMR implementation, and insights into the local-level impact of EMR on service quality. Scope limitations include focusing only on Balikpapan's primary care facilities, with data from healthcare professionals using EMR for over six months, excluding patient perceptions, and emphasizing user experiences over technical evaluations.

II. LITERATURE REVIEW

The Influence of Electronic Medical Record (EMR) Implementation on Clinical Workflow

The successful implementation of Electronic Medical Records (EMR) systems has a considerable impact on clinical workflow, an outcome that depends heavily on how effectively the system is integrated into existing clinical processes. As observed by Cresswell et al. (2011), EMR systems can yield significant benefits, but only when they are seamlessly incorporated into the day-to-day clinical activities of healthcare providers. Cresswell highlights the necessity of actively involving end-users, such as doctors, nurses, and administrative staff, in both the design and implementation stages to prevent potential disruptions to established clinical workflows. Without this active involvement, there is a higher risk that the introduction of EMR could lead to interruptions in clinical processes, resulting in inefficiencies and even potential declines in patient care quality. Supporting this view, Janssen et al. (2021) and Schwartz et al. (2019) underscore that the implementation of EMR systems has a notable effect on key aspects such as data standardization, workload distribution, and the learning curve that users must navigate to adapt to the new system. These studies collectively point to a pattern where EMR systems, when effectively implemented, not only enhance the accuracy and completeness of patient data but also streamline the flow of information across clinical departments. This, in turn, influences overall workflow efficiency, staff productivity, and, consequently, the quality of healthcare services. As such, a logical hypothesis that arises from this body of research is that the effective implementation of EMR systems has a positive influence on clinical workflow by improving standardization, data availability, and workflow efficiency. **H₁**: The implementation of Electronic Medical Records (EMR) has a positive effect on clinical workflow.

System Quality's Impact on Clinical Workflow

Another critical aspect that significantly affects clinical workflow is the quality of the EMR system itself. High-quality EMR systems are defined by several attributes, including usability, reliability, accessibility, and the security of stored information. Research by Tanny et al. (2023) and Scott et al. (2018) indicates that EMR systems which exhibit these qualities tend to be better integrated into clinical workflows, reducing the

time healthcare professionals spend on documentation. This saved time allows providers to focus more on direct patient care, thereby improving the efficiency of patient interactions and supporting a more productive clinical environment. In particular, Tanny and Scott's findings suggest that after an initial period of adaptation to the EMR system, healthcare providers begin to experience enhanced workflow efficiencies, as documentation processes are streamlined and easier to manage. Additionally, Tilahun and Fritz (2015) found that the quality of information generated by EMR systems plays a crucial role in determining user satisfaction, which, in turn, affects system adoption and continued use. High-quality information—accurate, comprehensive, and easily accessible—enables healthcare providers to work more effectively and make informed clinical decisions promptly. Therefore, the quality of the EMR system itself plays a crucial role in enhancing clinical workflow, supporting the hypothesis that system quality positively influences clinical workflow by ensuring ease of use, data security, and information reliability. **H₂**: System quality has a positive effect on clinical workflow.

Clinical Workflow's Impact on Healthcare Quality

The integration of EMR systems into clinical workflows also brings about significant changes in healthcare quality, extending beyond basic administrative improvements to positively affect the quality of clinical interactions and patient care. Menon et al. (2014) emphasize the importance of efficient communication and coordination within clinical workflows, particularly in follow-up processes, such as test result reviews and treatment adjustments, which are essential for achieving better healthcare outcomes. Their study illustrates how EMR-enhanced communication channels can reduce errors in clinical follow-ups and help ensure that patients receive timely and accurate care. Furthermore, effective clinical workflow structures allow for better organization and prioritization of clinical tasks, ultimately leading to higher healthcare quality. By improving workflows, EMR systems enable healthcare providers to focus on delivering patient-centered care rather than spending excessive time on documentation or manual data entry. Therefore, an improvement in clinical workflow is expected to correlate with a corresponding improvement in healthcare quality, based on the hypothesis that a well-structured clinical workflow contributes positively to service quality by enhancing the effectiveness, efficiency, and reliability of healthcare delivery. **H₃**: Clinical workflow has a positive effect on healthcare service quality.

System Quality's Impact on Healthcare Quality

System quality, particularly in EMR systems, is consistently found to have a strong impact on the overall quality of healthcare services delivered. Studies by Tilahun and Fritz (2015), along with findings from Tsai et al. (2020), highlight that a high-quality EMR system with adequate technical support is essential for improving healthcare service quality. High-quality systems not only provide technical capabilities and functionalities but are also designed to be user-friendly and dependable, which is critical in busy healthcare environments where accuracy and reliability are paramount. These studies underscore the importance of not only the technical aspects of EMR systems but also the user experience, which directly impacts healthcare providers' ability to utilize the system effectively in their everyday tasks. Furthermore, technical support, which provides assistance with troubleshooting and system updates, is another critical component of a quality EMR system, enabling healthcare providers to maintain uninterrupted clinical workflows. The hypothesis that emerges from these findings is that improvements in system quality, including reliability, usability, and support services, have a significant positive impact on healthcare service quality by ensuring seamless integration into clinical practice and allowing healthcare providers to perform their duties more effectively. **H₄**: System quality has a positive effect on healthcare service quality.

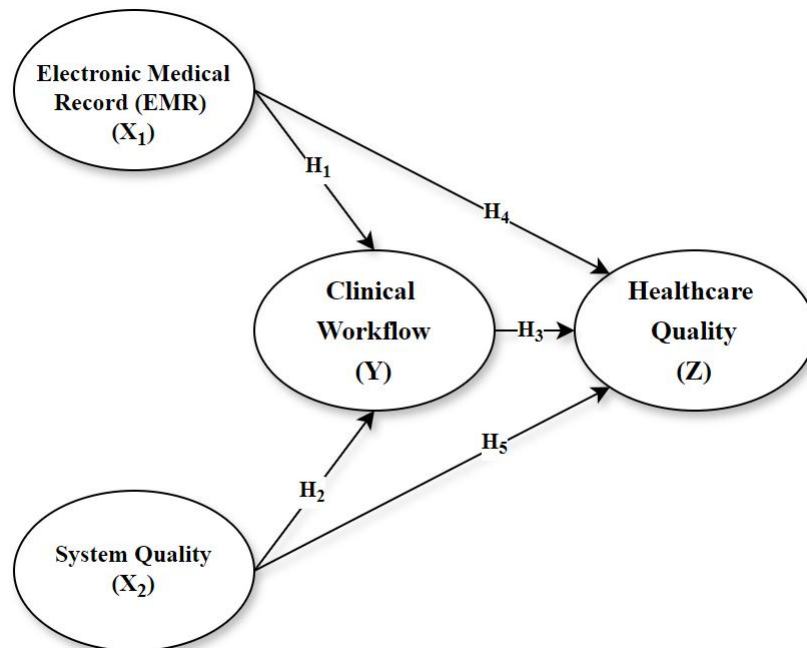
EMR Implementation's Impact on Healthcare Quality

The effective implementation of EMR systems has been shown to yield positive outcomes in healthcare quality, with research indicating that adherence to proper use criteria significantly impacts healthcare processes and patient outcomes. Lin et al. (2019) highlight that when EMR systems are used as intended—following appropriate training and with management's full commitment—these systems can improve both the efficiency and quality of healthcare services. Studies by Birsat et al. (2021) and Arabi et al. (2022) further emphasize that comprehensive training and committed leadership are essential factors in ensuring successful EMR implementation, particularly in healthcare environments where changes in workflow can be challenging to manage. Supporting this perspective, Scott et al. (2018) and Tanny et al. (2023) found that EMR systems, when integrated effectively, lead to improvements in workflow efficiency, reducing the time required for documentation and allowing healthcare providers more time for direct patient care. This increased interaction time is essential for patient satisfaction and healthcare outcomes, as it fosters stronger patient-provider relationships and allows providers to offer more personalized care. The overall conclusion drawn from these studies is that well-planned EMR implementation contributes significantly to improvements in healthcare quality, supporting the hypothesis that EMR positively influences healthcare service quality by optimizing

workflow processes, enhancing data access, and improving documentation efficiency, which together create a better environment for patient care. **H5:** EMR has a positive effect on healthcare service quality. **H6:** The implementation of EMR has a positive effect on system quality with mediation by clinical workflow. **H7:** The implementation of EMR has a positive effect on healthcare service quality with mediation by clinical workflow.

Based on the formulation of hypotheses, the research model proposed by the authors is as shown in Figure 1.

Figure 1: Conceptual Framework



Source: Result of author's analysis, 2024

III. RESEARCH METHODOLOGY

This quantitative research employs Partial Least Squares (PLS) to examine the influence of Electronic Medical Records (EMR) implementation on clinical workflow and the quality of healthcare services in primary healthcare facilities across Balikpapan. The core variables in this study include EMR Implementation (X_1) and System Quality (X_2) as independent variables, Clinical Workflow (Y) as a mediating variable, and Service Quality (Z) as the dependent variable. Data collection relies on purposive sampling, which selects participants based on specific inclusion and exclusion criteria to ensure relevance and alignment with the study's objectives. The inclusion criteria for the sample consist of primary healthcare facilities in Balikpapan that have been using EMR for over six months, provide outpatient services in general or dental practices, and offer laboratory and pharmacy services. Additionally, selected facilities must have professional care providers, including doctors, nurses, midwives, pharmacists, and medical laboratory technologists. Facilities that do not meet these conditions, such as those that have been using EMR for less than six months or lack laboratory and pharmacy services, are excluded. Given the complexity of the model and the number of indicators in the study, PLS-SEM was chosen for its adaptability to small sample sizes and its suitability for complex, multi-layered models. Following Hair et al. (2017), the sample size guideline recommends a minimum of 10 times the largest number of structural paths directed at any construct in the model. For this study, the minimum recommended sample size is calculated based on 20 indicators, suggesting a sample range of 100–200 respondents to ensure statistical reliability and validity. This range allows for robust model testing and helps enhance the reliability of results by reducing potential biases due to insufficient sample sizes.

Data collection utilizes an online survey structured with Likert-scale questions to gauge participant responses, allowing respondents to express agreement or disagreement across a scale from "strongly agree" to "strongly disagree." This structured approach enables a detailed and quantifiable analysis of perceptions toward EMR implementation, system quality, clinical workflow, and service quality. PLS-SEM analysis is conducted in two stages: the outer model and the inner model. The outer model assesses construct validity and reliability using convergent and discriminant validity tests to confirm that the indicators accurately measure the intended constructs. Meanwhile, the inner model evaluates the strength and significance of relationships among the

variables by examining R^2 , Q^2 predictive relevance, t-statistics, and p-values. A statistically significant path coefficient ($p < 0.05$) supports the hypothesized relationships, while R^2 values provide insight into the explanatory power of the independent variables on the dependent variables. The structural model created through PLS-SEM presents the interconnected pathways between EMR implementation, system quality, clinical workflow, and service quality. By modeling these pathways, the study captures the direct, indirect, and total effects of EMR implementation and system quality on service quality, with clinical workflow acting as a mediator. This detailed structural model allows for a comprehensive understanding of how improvements in EMR implementation and system quality contribute to enhanced clinical workflows and, ultimately, to higher healthcare service quality in primary healthcare settings.

IV. RESULT AND DISCUSSION

Data Analysis

The first-stage model evaluation focuses on the measurement model. Examination of the PLS-SEM estimation for the measurement model allows the researcher to evaluate the reliability and validity of the constructs. Multivariate measurement involves using multiple variables to measure a concept indirectly. Evaluation of the measurement model includes tests of internal consistency reliability, indicator reliability, convergent validity and discriminant validity as shown in Table 1. There are two methods that can be used to measure reliability of a construct, namely Cronbach's alpha or composite reliability. However, the use of Cronbach's alpha tends to provide a lower estimated value so that PLS-SEM is recommended to use composite reliability. Indicator reliability on PLS-SEM is measured from the outer loading value which shows the correlation between the indicator and its construct. Convergent validity in constructs can be measured using AVE. Discriminant validity can be measured from cross loading or the loading value of other constructs is a comparison to the value of the outer loading indicator associated with a construct where the required loading indicator value must be more than the cross-loading value.

Table 1: Evaluation of Measurement Model

Variables	Indicators	Loadings	Composite Reliability	AVE	Cross Loading
Electronic Medical Record (EMR)(X_1)	$X_{1,1}$	0.749	0.877	0.642	Yes
	$X_{1,2}$	0.805			
	$X_{1,3}$	0.816			
	$X_{1,4}$	0.832			
System Quality(X_2)	$X_{2,1}$	0.770	0.876	0.638	Yes
	$X_{2,2}$	0.802			
	$X_{2,3}$	0.801			
	$X_{2,4}$	0.821			
Clinical Workflow(Y)	Y_1	0.807	0.936	0.746	Yes
	Y_2	0.894			
	Y_3	0.861			
	Y_4	0.872			
	Y_5	0.881			
Healthcare Quality (Z)	Z_1	0.849	0.948	0.721	Yes
	Z_2	0.878			
	Z_3	0.872			
	Z_4	0.845			
	Z_5	0.807			
	Z_6	0.840			
	Z_7	0.851			

Source: Calculated using SmartPLS, 2024

The information presented describes the results of factor analysis conducted to examine the relationship between several variables measured in a study. The variables observed consisted of electronic medical record (EMR), system quality, clinical workflow, healthcare quality. Each of these variables has several indicators that are used to measure or represent certain aspects of that variable. Given loadings indicate how strong the relationship between each indicator and its associated variables is. Composite reliability is a measure of the combined reliability of the indicators in a variable, while Average Variance Extracted (AVE) measures how well the indicators represent that variable. Cross loading indicates whether certain indicators have a significant correlation with other variables, which may indicate a problem in construct validity. By examining this information, researchers can evaluate the reliability and validity of the measurement instruments used in the study.

Hypothesis Test

After ensuring that the measurement model of the construct is reliable and valid, then hypothesis testing is carried out. Hypothesis testing in this study is carried out on a structural model or inner model which shows a direct or indirect relationship between exogenous and endogenous latent variables. The statistical test used is the t test with a confidence level of 95% or a significance level of 5%. The hypothesis is accepted if the t value is more than the t-table value for the two-tailed test, namely 1,96. Direct effects refer to the influence or relationship between one variable and another without any intermediate variables.

1. EMR Implementation →Clinical Workflow (Direct Effect). The result indicates a positive and significant impact of EMR implementation on clinical workflow, with a regression coefficient of 0.244 and a T statistic of 3.413 (p < 0.05). This suggests that EMR implementation contributes to improved workflow processes by streamlining documentation and enhancing information flow within clinical settings.

2. EMR Implementation →Healthcare Service Quality (Direct Effect). With a regression coefficient of 0.088, a T statistic of 1.503, and a P value of 0.134 (p > 0.05), the direct relationship between EMR implementation and healthcare service quality is not statistically significant. This implies that EMR implementation alone may not directly impact service quality but could do so through indirect effects.

3. System Quality →Clinical Workflow (Direct Effect). A significant and strong positive effect is observed between system quality and clinical workflow, with a regression coefficient of 0.486, a T statistic of 8.253, and a P value of 0.000. This highlights that high system quality enhances workflow efficiency by ensuring reliability, ease of use, and security, which facilitate smoother clinical operations.

4. System Quality →Healthcare Service Quality (Direct Effect). The direct effect of system quality on healthcare service quality is significant, with a regression coefficient of 0.193, a T statistic of 3.412, and a P value of 0.001 (p < 0.05). This finding indicates that improvements in system quality positively contribute to healthcare service quality, suggesting that reliable and secure systems support better patient care and satisfaction.

5. Clinical Workflow →Healthcare Service Quality (Direct Effect). Clinical workflow has a strong positive influence on healthcare service quality, with a regression coefficient of 0.629, a T statistic of 11.546, and a P value of 0.000 (p < 0.05). This result demonstrates that optimized workflow processes are crucial for high-quality healthcare services, as they enable timely and accurate patient care.

Indirect effects involve the influence of one variable on another variable through mediating variable. The information provided for indirect effects includes the original sample size, T statistics, P values, and explanations about the significance of the indirect effects.

1. EMR Implementation →Healthcare Service Quality (Indirect Effect). The indirect effect of EMR implementation on healthcare service quality, mediated by clinical workflow, shows significance with a regression coefficient of 0.154, a T statistic of 3.144, and a P value of 0.002 (p < 0.05). This suggests that EMR implementation enhances healthcare quality indirectly by improving clinical workflow, emphasizing the importance of workflow efficiency in realizing the benefits of EMR.

2. System Quality →Healthcare Service Quality (Indirect Effect). The indirect impact of system quality on healthcare service quality, mediated through clinical workflow, is strong and significant, with a regression coefficient of 0.306, a T statistic of 6.791, and a P value of 0.000. This finding underscores the critical role of system quality in achieving better healthcare outcomes by facilitating an efficient workflow, ultimately leading to enhanced service quality.

Table 2.
Bootstrapping Results

Hypothesis	Coefficient	T Statistic	P Values
EMR Implementation → Clinical Workflow	0.244	3.413	0.001
EMR Implementation → Healthcare Service Quality	0.088	1.503	0.134
System Quality → Clinical Workflow	0.486	8.253	0.000
System Quality → Healthcare Service Quality	0.193	3.412	0.001
Clinical Workflow → Healthcare Service Quality	0.629	11.546	0.000
EMR Implementation →Healthcare Service Quality (Indirect)	0.154	3.144	0.002
System Quality → Healthcare Service Quality (Indirect)	0.306	6.791	0.000

Source: Calculated using SmartPLS, 2024

Discussion

The implementation of Electronic Medical Records (EMR) positively influences clinical workflow, as confirmed by the path analysis results. The hypothesis regarding the impact of EMR implementation on clinical workflow is supported with a T-statistic of 3.413 (exceeding the critical threshold of 1.96) and a significant P-value of 0.001. A positive regression coefficient of 0.244 further demonstrates a direct relationship between EMR implementation and clinical workflow, suggesting that improvements in EMR systems correlate with more streamlined and efficient clinical workflows. This result aligns with findings from Tanny et al. (2023), who

noted that integrating EMR systems within clinical workflows significantly reduces documentation time and increases patient interaction time. This outcome can be explained from a managerial perspective, highlighting how EMR systems support healthcare facilities in optimizing their resource allocation and operational efficiency. By automating and centralizing medical records, EMR systems reduce the need for manual record-keeping and data entry, which are traditionally time-intensive tasks that can detract from time spent on patient care. For managers, this shift represents an opportunity to redistribute healthcare providers' time towards higher-value activities, directly impacting both clinical effectiveness and patient satisfaction. Furthermore, EMR systems enhance information accessibility and data sharing, which is crucial for collaborative care. Managers are able to foster an environment where healthcare professionals have real-time access to comprehensive patient histories, test results, and treatment plans, minimizing delays in decision-making and enabling faster responses to patient needs. This accessibility reduces redundant processes, such as repeated data collection or error-prone paper records, which can lead to inconsistencies. From a managerial standpoint, the reduced error rates and improved consistency in data handling translate into fewer bottlenecks within clinical workflows, allowing a smoother flow of operations and quicker turnover in patient consultations. Moreover, EMR systems provide valuable data for performance monitoring and quality improvement, allowing managers to track workflow efficiency, identify bottlenecks, and address areas of improvement in real-time. This data-driven approach facilitates proactive management practices where operational decisions are informed by concrete metrics, such as time spent per patient interaction, documentation efficiency, and error reduction rates. These insights empower healthcare managers to implement targeted training and support for staff on EMR use, thereby improving adoption rates and overall system effectiveness. The positive correlation observed in this study between EMR implementation and clinical workflow reflects these managerial strategies and underscores how well-implemented EMR systems can create a more organized, responsive, and patient-centered healthcare delivery model. In summary, the positive impact of EMR implementation on clinical workflow stems from managerial efforts to streamline operations, enhance data accessibility, and utilize data for continuous improvement. EMR systems provide the structural and informational backbone that allows managers to create a more efficient workflow, thus optimizing both staff productivity and patient care quality. This strategic alignment of technology and clinical operations not only improves workflow efficiency but also supports long-term objectives in healthcare quality and patient satisfaction.

The hypothesis that system quality positively influences clinical workflow is supported, with a T-statistic of 8.253 (exceeding the critical threshold of 1.96) and a P-value of 0.000, indicating strong statistical significance. A positive regression coefficient of 0.486 further confirms the positive relationship between system quality and clinical workflow, suggesting that improvements in system quality lead to more efficient and effective workflows in healthcare operations. This finding implies that a robust, reliable, and user-friendly system significantly enhances the workflow within clinical settings, as higher system quality supports smoother, more coordinated processes. This aligns with the study by Tilahun and Fritz (2015), which demonstrated that system, information, and service quality play a critical role in the successful implementation of EMR and in increasing user satisfaction with the system. From a managerial perspective, this result can be explained by the operational efficiencies that high-quality systems provide within a healthcare environment. When a system is built with strong reliability, security, and usability, it reduces the time healthcare staff spend troubleshooting or dealing with technical disruptions, allowing them to focus more on patient care rather than on system-related issues. High-quality systems also facilitate easier access to and retrieval of patient information, which improves the speed and accuracy of clinical decisions. This is particularly valuable in healthcare, where delays or errors can have significant consequences. By ensuring a smooth flow of information through a well-functioning system, managers can foster an environment in which clinical tasks are handled efficiently, resulting in better care coordination and a reduction in redundant processes. A high-quality system also provides a structured and reliable framework for information sharing and collaboration among healthcare providers, enhancing teamwork and communication. For managers, this means that medical staff can rely on the system to access consistent and updated patient information, avoiding unnecessary duplications in tests or treatments and improving overall care efficiency. This seamless communication facilitated by a high-quality system ensures that workflows are not only faster but also more cohesive, with all team members aligned on patient care processes. Managers are thus able to leverage system quality to create a more integrated approach to healthcare delivery, where each team member's contribution is optimized through clear, accurate, and accessible information. In addition, high-quality systems allow managers to monitor workflow performance closely. Reliable data from system reports and usage logs provide insights into bottlenecks, user interactions, and specific areas where workflow could be further optimized. Managers can use this information to identify areas where training might be needed or where certain system features could be enhanced to improve clinical workflows further. This feedback loop is invaluable, as it allows continuous improvements to workflow efficiency through data-driven decision-making. Overall, the positive effect of system quality on clinical workflow reflects the critical role of system reliability, ease of use, and secure information sharing in healthcare management. Managers who invest in high-quality systems are

better positioned to facilitate smooth and effective workflows, minimize disruptions, and ultimately support an environment focused on high-quality patient care. By ensuring that the system quality meets these standards, healthcare providers can achieve operational excellence that not only benefits the clinical staff but also enhances the overall patient experience, creating a cycle of efficiency and satisfaction that underscores the value of system quality in healthcare operations.

The path analysis results support the hypothesis that clinical workflow has a significant positive effect on healthcare service quality. This hypothesis is accepted based on a T-statistic of 11.546 (well above the critical value of 1.96) and a P-value of 0.000, demonstrating strong statistical significance. A positive regression coefficient of 0.629 further reinforces the finding that improvements in clinical workflow lead to higher healthcare service quality, suggesting that streamlined, organized, and efficient workflows directly contribute to better patient care outcomes. This finding aligns with previous research, including Schwartz (2019), which showed that evaluating and improving clinical workflow strengthens team efficiency and leads to enhanced healthcare outcomes. From a managerial perspective, this relationship is significant as it highlights the direct operational benefits of refining workflow processes within healthcare settings. Effective clinical workflows reduce redundancies, minimize waiting times, and ensure that healthcare providers can complete tasks promptly. Managers in healthcare facilities benefit from investing in workflow optimization because it enables healthcare staff to allocate more time to patient care activities, reduces administrative burdens, and minimizes time lost on inefficient processes. For example, by streamlining the steps involved in patient admissions, medical evaluations, and discharge processes, managers can help ensure a smoother transition through each stage of the patient experience, ultimately resulting in quicker and more effective care delivery. Furthermore, an optimized clinical workflow fosters better communication and coordination among healthcare teams, which is crucial for delivering high-quality care. In complex healthcare environments where interdisciplinary teams are common, seamless communication and coordination ensure that each provider has up-to-date patient information, thereby reducing errors and avoiding duplicated work. From a managerial standpoint, a well-designed workflow allows each team member to understand their role and responsibilities within the patient care process, reducing misunderstandings and enhancing accountability. This coordination is especially beneficial in situations where timely decisions are essential, as it enables healthcare providers to act swiftly and confidently based on shared information, which directly impacts service quality and patient safety. An effective clinical workflow also improves resource management within healthcare facilities. By identifying and addressing workflow bottlenecks, managers can better allocate resources—such as personnel, equipment, and treatment rooms—to areas where they are needed most. This proactive management approach helps prevent resource shortages or overloads, ensuring that patients receive the necessary care without unnecessary delays. Additionally, optimized workflows support more accurate forecasting and scheduling, allowing managers to anticipate peak periods and adjust staffing levels accordingly. The result is a more balanced and responsive healthcare environment that can maintain high service standards even during high-demand periods, which contributes to greater patient satisfaction and trust in the healthcare facility. Moreover, improving clinical workflow leads to measurable enhancements in healthcare service quality because it allows healthcare providers to focus on the quality of their interactions with patients rather than being distracted by logistical or administrative challenges. Managers who emphasize workflow improvements empower their staff to engage more effectively with patients, providing not only the technical care required but also emotional and interpersonal support, which is essential for positive patient experiences. As staff members are less burdened by procedural inefficiencies, they can focus more on personalized care, which is a key factor in patient satisfaction and perceived quality of service. Finally, clinical workflow improvements provide a foundation for data collection and performance measurement. Optimized workflows enable healthcare facilities to track key performance indicators (KPIs) such as patient wait times, treatment times, and discharge efficiency. This data allows managers to continually monitor workflow effectiveness and make informed decisions to address emerging issues or further improve processes. By aligning clinical workflow optimization with data-driven insights, healthcare managers can sustain long-term quality improvements and maintain high service standards, ensuring that patients consistently receive the best possible care. In conclusion, the positive effect of clinical workflow on healthcare service quality underscores the importance of managerial initiatives focused on optimizing internal processes. When clinical workflows are structured to maximize efficiency and coordination, healthcare providers can deliver higher-quality care more consistently, enhancing patient outcomes and overall service quality. By implementing and refining effective workflows, healthcare managers create an environment that supports both staff efficiency and patient satisfaction, driving long-term success for the healthcare facility.

The path analysis results confirm that the hypothesis of system quality positively affecting healthcare service quality is accepted. This conclusion is supported by a T-statistic of 3.412 (exceeding the critical threshold of 1.96) and a P-value of 0.001, indicating a statistically significant relationship. A positive regression coefficient of 0.193 demonstrates that improvements in system quality directly enhance healthcare service quality, suggesting that reliable and high-performing systems play a critical role in the overall effectiveness and

efficiency of healthcare services. This finding aligns with previous research, including studies by Tilahun and Fritz (2015), which emphasize the importance of system quality in facilitating data access, streamlining workflows, and supporting healthcare providers in delivering high-quality services. In a managerial context, this result highlights the strategic value of investing in robust, user-friendly, and dependable healthcare information systems. When system quality is high, healthcare providers experience fewer disruptions, have faster access to accurate patient data, and are better equipped to make informed clinical decisions. This reduction in technical barriers allows healthcare professionals to focus more on patient care rather than dealing with system malfunctions or inefficiencies, directly contributing to improved service quality. From a managerial perspective, high-quality systems serve as the backbone for operational efficiency within healthcare facilities. Managers who invest in high-quality systems ensure that healthcare providers have consistent and reliable access to the information needed to perform their duties effectively. This continuous accessibility not only reduces wait times for patient data retrieval but also minimizes the likelihood of errors caused by outdated or inaccessible information. For example, a high-quality system that integrates seamlessly with other hospital departments allows providers to obtain real-time information on lab results, imaging, or past treatments, leading to quicker decision-making and enhanced patient safety. By optimizing system quality, managers are able to create a cohesive environment where information flows effortlessly across departments, supporting a higher standard of care. In addition, high system quality contributes to workflow efficiency, which in turn benefits both healthcare providers and patients. For managers, a reliable system reduces administrative delays, as staff no longer need to spend excess time troubleshooting or working around system flaws. This operational streamlining frees up resources and staff time that can be redirected towards direct patient care. High-quality systems also support clinical documentation by automating and simplifying data entry, ensuring that patient records are accurate and up-to-date without excessive manual input. This ease of documentation enables providers to maintain detailed patient records without sacrificing valuable time, further enhancing the quality and continuity of patient care. From a managerial standpoint, this improvement in workflow efficiency not only increases provider productivity but also ensures that patients receive timely and attentive service. Moreover, investing in system quality has a direct impact on patient experience and satisfaction, which are critical indicators of healthcare service quality. For healthcare managers, maintaining high system quality is a proactive measure that directly addresses patient expectations for smooth, efficient service. When system quality is high, patients benefit from shorter wait times, fewer administrative errors, and a more organized service delivery experience. This improvement in the patient journey often translates into higher satisfaction rates and a more favorable perception of the healthcare facility. Managers understand that patient satisfaction is closely tied to the efficiency and professionalism with which services are delivered, and a high-quality system plays an integral role in upholding these standards. As patients become increasingly aware of and sensitive to the quality of healthcare services, a well-functioning system becomes essential for meeting their needs and expectations. Furthermore, high-quality systems enable healthcare managers to monitor and evaluate service quality metrics more effectively. Reliable systems provide accurate, real-time data on key performance indicators (KPIs) such as patient wait times, treatment durations, and resource utilization. This data allows managers to identify patterns, forecast demand, and make data-driven adjustments to improve service quality continuously. By tracking and responding to these metrics, managers can identify areas for improvement, implement targeted interventions, and achieve measurable progress in service delivery. The ability to analyze and respond to system data in real-time is a major advantage in healthcare settings, where demand can fluctuate and efficiency is paramount. In conclusion, the positive impact of system quality on healthcare service quality underscores the strategic importance of high-performing, reliable systems in achieving operational excellence. Managers who prioritize system quality not only enhance the day-to-day efficiency of clinical workflows but also contribute to a higher standard of patient care. By facilitating quick, accurate access to information, improving workflow efficiency, enhancing patient experience, and enabling effective monitoring, high-quality systems serve as a cornerstone for sustainable improvements in healthcare service quality. This strategic focus on system quality ultimately allows healthcare managers to deliver consistent, reliable, and patient-centered care, reinforcing the healthcare facility's commitment to excellence.

The path analysis results indicate that the hypothesis proposing a positive effect of EMR implementation on healthcare service quality is rejected, with a T-statistic of 1.876 and a P-value of 0.061. This study reveals that the adoption of EMR in Indonesia has not yet fully achieved the anticipated improvements in healthcare service quality. While numerous prior studies highlight the potential benefits of EMR, the analysis suggests that EMR implementation in Indonesia does not yield a significant direct impact on service quality enhancement. Several barriers contribute to this lack of effectiveness, including underdeveloped infrastructure, limited training, and a low level of adaptation to the technology. These findings align with Tsai et al. (2020), who identified that disruptions in clinical workflows and limited technical support frequently hinder EMR efficiency and acceptance in developing countries. From a managerial perspective, this outcome underscores the critical importance of readiness and the supporting quality of the systems that accompany EMR. Healthcare

facilities in Indonesia may lack adequate infrastructure, such as stable internet connectivity, reliable hardware, and secure digital platforms that are necessary for smooth EMR operation. Without these foundational elements, EMR systems may experience frequent downtimes, data inaccuracies, and delays that prevent healthcare providers from fully leveraging the system to enhance service quality. This is particularly problematic in healthcare environments where the demand for speed and accuracy is paramount. Managers in facilities with limited infrastructure are likely to face persistent challenges as they attempt to implement EMR without sufficient resources, making it difficult to achieve the operational gains typically associated with high-quality healthcare service delivery. Another managerial challenge lies in insufficient training and support for healthcare staff, which limits the effectiveness of EMR systems. Many healthcare workers may lack familiarity with digital record-keeping, especially in facilities that have historically relied on paper-based documentation. This lack of digital fluency creates a steep learning curve, making it challenging for staff to transition smoothly to EMR. Inadequate training can lead to inconsistent data entry, increased administrative time, and workflow interruptions, which detract from patient care. Healthcare managers who do not prioritize comprehensive and ongoing training may find that their staff struggle to adapt to the system, resulting in underutilized EMR functionality and an inability to fully realize the system's intended benefits. This outcome underscores the managerial responsibility to allocate resources not only to system implementation but also to capacity-building initiatives that empower staff to use the technology effectively. Additionally, the limited impact of EMR on service quality can be attributed to the level of support from healthcare facility leadership. Strong managerial support is essential for guiding the transition to EMR and ensuring that the system is seamlessly integrated into existing workflows. In facilities where leadership is hesitant or lacks a proactive approach to system adoption, EMR implementation may be met with resistance or minimal buy-in from staff. Research by Bisrat et al. (2021) and Arabi et al. (2022) highlights that healthcare facilities with robust technical support and committed management achieve far greater EMR benefits compared to those with limited managerial engagement. Managers play a crucial role in driving organizational change and setting a positive tone for the transition; without their active involvement, the adoption of EMR can become fragmented, leading to disjointed workflows that do not improve service quality as intended. Furthermore, the initial stages of EMR implementation often increase the documentation burden on healthcare providers, which can paradoxically detract from service quality. Studies by Jheeta and Franklin (2017) suggest that EMR implementation tends to increase documentation tasks for clinical staff, reducing the time available for direct patient interaction, especially during the early adoption phase. This finding indicates that unless managed carefully, EMR may inadvertently lengthen administrative processes, pulling healthcare providers away from core clinical duties. Managers who do not anticipate and mitigate this adjustment period may encounter staff dissatisfaction and workflow inefficiencies, as providers face the dual challenge of learning new systems while maintaining high standards of patient care. This reinforces the need for healthcare managers to design effective training and phased-in implementation strategies that allow staff to adjust to EMR gradually, minimizing the impact on patient interactions. The findings also suggest that the broader organizational environment—including system quality, infrastructure readiness, and managerial support—plays a pivotal role in determining the success of EMR initiatives. Without a solid foundation of reliable infrastructure and skilled personnel, EMR systems may fail to deliver their promised benefits. For healthcare managers, this outcome highlights the importance of a comprehensive approach to EMR implementation, where system deployment is accompanied by strategic investments in infrastructure, workforce training, and ongoing technical support. Managers who overlook these elements are less likely to witness improvements in service quality and may instead face additional challenges related to system inefficiencies and staff adaptation difficulties. In summary, the lack of a significant positive impact of EMR implementation on healthcare service quality reflects the crucial managerial role in supporting successful system integration. By ensuring robust infrastructure, comprehensive training, committed leadership, and gradual adaptation, managers can better position their facilities to achieve the long-term benefits associated with EMR, ultimately enhancing healthcare service quality. This study underscores the importance of strategic planning and investment in resources beyond the technology itself, emphasizing that managerial foresight and support are indispensable to realizing the full potential of EMR systems in healthcare settings.

The hypothesis that EMR implementation has a direct positive effect on healthcare service quality was not supported. However, when EMR implementation is mediated by clinical workflow, its effect on healthcare service quality becomes significant, with a T-statistic of 3.144 and a P-value of 0.002. This suggests that much of the impact of EMR implementation on service quality can be attributed to improvements in clinical workflow efficiency, indicating a partial mediation effect. In other words, while EMR implementation may not directly elevate healthcare quality, it indirectly contributes to it by streamlining clinical workflow processes, which subsequently enhances the overall quality of healthcare services. This finding aligns with previous studies which highlight the challenges and gradual adaptation required for EMR systems to positively impact healthcare service quality. EMR implementation often involves complex changes to workflow, which can initially disrupt efficiency. Studies by Tanny et al. (2022) and Schwartz et al. (2020) observed that in the initial stages of EMR

implementation, documentation times might actually increase as staff adjust to new systems. However, these studies also reported long-term benefits, such as reduced documentation time and increased patient interaction, after an adaptation period. This indicates that while EMR systems do not immediately improve healthcare service quality, they lay the groundwork for substantial long-term benefits by fostering a more efficient clinical workflow. From a managerial standpoint, these findings underline the importance of a well-planned, gradual implementation process for EMR systems. Managers need to anticipate that EMR adoption will initially require staff to learn new documentation methods, integrate digital tools into existing workflows, and adapt to changes in their routine tasks. These adjustments, while temporary, can create challenges in maintaining service quality during the early phases of implementation. As a result, managers must provide adequate training and support to healthcare providers, ensuring they have the resources and knowledge needed to navigate this transition smoothly. By establishing clear training programs and offering continuous support, managers can mitigate the initial efficiency setbacks and foster a quicker adaptation process, allowing the EMR system to positively impact clinical workflow and ultimately service quality. Another managerial consideration is the need to optimize clinical workflow for maximum EMR effectiveness. High-quality EMR systems can only fully benefit healthcare services if they are embedded in an efficient, well-coordinated workflow. Managers play a crucial role in designing workflows that maximize the system's capabilities. For instance, by reorganizing tasks to reduce redundancies and streamline data entry points, managers can create a workflow that allows healthcare providers to enter information seamlessly while maintaining focus on patient care. This process optimization enhances the effectiveness of the EMR system, as it becomes an integral part of the daily workflow rather than a cumbersome addition. In this way, managers can create an environment where clinical workflow improvements are sustained, making the indirect benefits of EMR on service quality more substantial and lasting. Moreover, the managerial role involves fostering a culture that encourages staff adaptation to new technology, recognizing that changes in workflow are often met with initial resistance. Managers who emphasize the long-term benefits of EMR, communicate the advantages for patient care, and involve healthcare providers in the implementation process are more likely to see positive outcomes. Encouraging open communication about the challenges and adjustments needed for EMR integration helps build trust and acceptance among staff, making the transition less disruptive and more conducive to enhancing service quality through improved workflow. By promoting a supportive culture, managers facilitate a smoother implementation process, enabling EMR systems to enhance clinical workflow efficiency over time. This study's findings also suggest that the effectiveness of EMR implementation is significantly influenced by the system's ability to support and improve existing clinical workflows, which then indirectly boosts service quality. Managers should view EMR as an enabler rather than a standalone solution; it is most beneficial when it complements and enhances the efficiency of current processes. For example, an EMR system that integrates smoothly with laboratory information systems, radiology, and pharmacy departments allows for a more cohesive patient care experience. Managers can ensure that the EMR is fully integrated with these departments, allowing clinical workflow to operate efficiently across the facility. This integration not only supports real-time data access and reduces waiting times for patients but also improves communication among healthcare teams, which is essential for maintaining high-quality service. In summary, the positive impact of EMR on service quality through the mediation of clinical workflow highlights the importance of strategic managerial approaches to EMR implementation. Managers who prioritize training, optimize workflow design, foster a supportive culture, and ensure system integration can leverage the EMR's potential to improve healthcare service quality indirectly. By focusing on clinical workflow as the central mechanism through which EMR enhances service quality, managers can create a healthcare environment that is both efficient and patient-centered, ultimately achieving the desired improvements in service quality. This study reinforces that successful EMR implementation requires more than just technological investment—it requires thoughtful managerial strategies that align EMR with the organization's operational and clinical objectives, ensuring long-term benefits for both healthcare providers and patients.

The path analysis results reveal that System Quality has a significant positive impact on healthcare service quality, mediated entirely by clinical workflow. Specifically, the indirect effect of system quality on healthcare service quality through clinical workflow yielded a T-value of 6.791 and a P-value of 0.000, indicating a highly significant effect ($P < 0.05$). This full mediation means that system quality impacts healthcare service quality only through the enhancement of clinical workflow, underscoring the critical role of an optimized workflow in translating system quality into improved service outcomes. This finding reflects the central importance of system quality in the effective implementation of Electronic Medical Records (EMR) systems and aligns with the Information System Success Model (ISSM) by DeLone and McLean (1992, 2003). According to this model, key factors such as interoperability, security, compatibility, and information quality are essential for user satisfaction and system effectiveness. In modern healthcare settings, system quality elements like data security have become increasingly important, as emphasized by Schiza (2016), who highlights the need to protect patient data from unauthorized access to build trust and ensure user comfort in using EMR. When system quality is high, healthcare providers can trust the accuracy and availability of the information, which

enhances the utility of EMR systems in supporting clinical tasks and, consequently, improving patient care. From a managerial perspective, this research underscores the strategic role that system quality plays in driving healthcare service quality improvements via clinical workflow optimization. Managers in healthcare facilities are responsible for ensuring that EMR systems have strong interoperability and compatibility with other healthcare applications, as this integration facilitates a seamless flow of information across departments and minimizes disruptions in clinical workflows. For example, when an EMR system is compatible with laboratory and radiology systems, healthcare providers can access test results and patient histories in real time, which enables quicker, more accurate clinical decisions. Managers who prioritize such integration ensure that providers can spend less time searching for information and more time focusing on direct patient care, a shift that ultimately improves the quality of service provided. Furthermore, data security and reliability are essential components of system quality, and their role is crucial in shaping the effectiveness of clinical workflow. In healthcare, where sensitive patient data is handled daily, the assurance of secure and reliable systems enables providers to focus on patient care without worrying about data breaches or system downtimes. Managers are tasked with implementing security protocols, such as encryption and access controls, which protect patient information and comply with healthcare regulations. By ensuring these protocols are in place, managers build a foundation of trust in the EMR system among healthcare providers, which enhances their willingness to use the system consistently and effectively within their workflows. This consistent usage of a secure, high-quality system supports smoother workflows, minimizes the risk of errors, and thereby indirectly enhances the quality of patient services. Additionally, this study highlights the role of infrastructure and technical support in reinforcing the impact of system quality on clinical workflow. In many healthcare settings, the effectiveness of EMR systems depends on the underlying IT infrastructure, including network stability, hardware quality, and access to technical support. Managers who invest in robust infrastructure provide a stable platform for EMR systems to operate efficiently, reducing system downtimes and technical disruptions that can interrupt clinical workflow. According to studies by Scott et al. (2018) and Tanny et al. (2022), well-supported EMR systems are associated with reduced documentation times and increased patient contact time, both of which enhance the efficiency of clinical workflows. When technical support is readily available, healthcare providers experience fewer obstacles in using the system, allowing them to complete tasks more quickly and accurately. From a managerial standpoint, these infrastructure investments are not just technical requirements but strategic choices that directly contribute to improved service quality by supporting smooth, uninterrupted clinical workflows. Conversely, studies such as those by Tsai et al. (2020) show that without adequate technical support and resources, EMR systems can disrupt clinical workflows and reduce efficiency. In facilities where EMR systems lack proper support, providers may face frequent technical issues that detract from patient care, increasing frustration and reducing system acceptance. Managers who overlook the importance of support infrastructure risk creating an environment where EMR systems become a hindrance rather than an asset. Therefore, by investing in the necessary support infrastructure, managers can ensure that EMR systems function as intended, facilitating an efficient workflow that enhances service quality. The direct impact of system quality on clinical workflow, which subsequently enhances healthcare service quality, highlights the importance of effective EMR development and implementation strategies. Managers need to prioritize system quality elements that support clinical workflow to maximize the positive effects of EMR systems on service quality. This includes training healthcare providers on the EMR system to ensure they are proficient in its use and understand how it integrates with their workflow. Comprehensive training programs help providers become more comfortable with the system, reducing errors and increasing efficiency. For instance, managers might implement simulation training that allows providers to practice using the EMR system within clinical scenarios, reinforcing their skills in a risk-free environment. When healthcare providers feel confident and competent with EMR systems, they are better equipped to leverage the system's capabilities in supporting patient care, leading to a smoother, more effective workflow and ultimately enhancing service quality. In conclusion, the findings that system quality positively impacts healthcare service quality through clinical workflow mediation emphasize the importance of strategic managerial actions in healthcare settings. By ensuring high system quality, robust support infrastructure, comprehensive provider training, and data security, managers create an environment where EMR systems can enhance clinical workflows effectively. This approach positions healthcare facilities to realize the full potential of EMR systems in improving service quality, not only by optimizing workflow efficiency but also by creating a seamless, secure, and user-friendly system that healthcare providers can rely on.

V. CONCLUSION, LIMITATION AND FUTURE RESEARCH

The study concludes that implementing Electronic Medical Records (EMR) positively influences clinical workflow, enhancing efficiency when EMR systems are well-integrated into healthcare practices. System quality also plays a significant role, contributing to both workflow improvements and the overall quality of healthcare services. While EMR implementation does not directly impact healthcare service quality, its influence becomes apparent when mediated by clinical workflow, suggesting that a streamlined workflow is essential for realizing EMR's potential benefits in service quality. This finding underscores the critical role that clinical workflow plays in the relationship between system quality and healthcare service delivery, as high-quality systems create an optimal foundation for efficient workflows, which in turn elevate the quality of care provided.

To maximize EMR effectiveness, healthcare facilities should prioritize strengthening EMR-supportive infrastructure and ensuring systems are adaptable to specific clinical needs. Continuous training and technical support for healthcare staff are essential to help them fully utilize EMR capabilities without service disruptions. Integrating clinical workflows with EMR can reduce documentation time and enhance patient-provider interaction, thereby improving both operational efficiency and patient experience. Regular assessments of EMR performance and its impact on service quality can identify areas for improvement, enabling facilities to make timely adaptations that align with their specific requirements. Strategies to improve system quality, including investing in reliable network infrastructure, are vital for overcoming technical challenges, particularly in areas with limited technological resources.

This study has several limitations. The focus on primary healthcare centers may limit the generalizability of the findings to other healthcare settings, as different facilities may have varying infrastructure capabilities and operational challenges. Additionally, the study's cross-sectional design captures only an immediate view of EMR's effects, potentially overlooking long-term adaptation patterns as healthcare workers become more accustomed to the system. Important variables such as organizational culture, user satisfaction, and staff engagement, which may further influence EMR effectiveness, were also not explored, limiting the scope of the study's insights.

Future research should consider a broader range of healthcare environments, including hospitals and specialized clinics, to examine whether the results of this study apply across various healthcare contexts. Employing a longitudinal approach could provide a deeper understanding of how EMR impacts clinical workflow and healthcare service quality over time, offering insights into the progressive benefits of EMR as staff continue to adapt. Additionally, exploring complex relationships involving mediating and moderating variables like management support, quality of user training, and availability of IT resources could yield a more comprehensive understanding of EMR's role in enhancing healthcare service quality and guide more effective implementation strategies for sustainable improvements.

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