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Service Quality of Electronic Medical Records Using DeLone–McLean Model

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ABSTRACT

Background: Indonesia requires healthcare facilities to implement electronic medical records (EMRs), yet integration progress and implementation capacity remain uneven. Evidence from primary healthcare is especially limited because most evaluations have been undertaken in hospitals. This study examined whether system quality, information quality, service quality, and user satisfaction were associated with perceived health service quality among users of the EMR at Opi Palembang Primary Health Center using an adapted DeLone-McLean Information Systems Success Model. **Methods:** A quantitative cross-sectional study involved all 52 eligible healthcare professionals and administrative staff who had used the EMR for at least three months. Data were collected using a structured five-point Likert questionnaire. Descriptive statistics, Pearson correlations, and multiple linear regression were used to examine the relationships between the four information-system success dimensions and perceived health service quality. **Results:** All four dimensions were positively correlated with perceived health service quality: user satisfaction ($r=0.65$, $p<0.001$), system quality ($r=0.62$, $p<0.001$), information quality ($r=0.58$, $p=0.001$), and service quality ($r=0.49$, $p=0.003$). The regression model explained 68% of the observed variance ($R^2=0.68$). User satisfaction had the largest observed unstandardized coefficient ($B=0.287$, $p=0.002$), followed by system quality, information quality, and service quality. **Conclusion:** The adapted DeLone-McLean dimensions were consistently associated with users' perceptions of service quality. The results support improvements in usability, information accuracy and timeliness, technical support, and workflow fit. Because the design was cross-sectional and based on perceptions from one facility, the findings should not be interpreted as evidence that the EMR caused objective improvements in care.

Keywords: Electronic Medical Records; Health Information Systems; Primary Health Care; Quality of Health Care; User Satisfaction

INTRODUCTION

Electronic medical records are central to Indonesia's digital-health transformation. Minister of Health Regulation No. 24 of 2022 provides the national legal basis for electronic medical records, while the SATUSEHAT programme seeks standardized and interoperable health-data exchange across facilities (1), (2). The scale of implementation is substantial: the Ministry of Health reported more than 60,000 healthcare facilities in Indonesia, including more than 10,000 primary-care facilities, and official data indicated that 34,463 facilities had been integrated with SATUSEHAT by 27 October 2025 (3,4). These figures also show that implementation is not only a technical installation task; facilities must align infrastructure, human resources, data standards, security, and clinical workflow.

EMRs may improve the timeliness and accessibility of clinical information, reduce duplicate documentation, support communication among professionals, and create a stronger basis for quality measurement and feedback (5-7). However, implementation can also introduce documentation burden, workflow disruption, usability problems, and dependence on technical support when systems are poorly aligned with service processes (8-10). Evaluating an EMR therefore requires attention to both the technology and the experience of the people who use it in routine care.

The updated DeLone-McLean Information Systems Success Model provides a structured explanation of these relationships. It distinguishes system quality, information quality, and service quality as characteristics of an information system and its support environment; these dimensions influence use and user satisfaction, which in turn are related to net benefits for individuals and organizations (11-13). In this study, perceived health service quality was treated as a context-specific indicator of net benefit. System use was not modelled as a separate variable because all respondents were active routine users and the available dataset did not include sufficiently differentiated measures of frequency or intensity of use. Consequently, the analysis represents an adapted rather than a complete test of the original model.

Healthcare applications of the model have shown that reliable system performance, useful information, responsive support, and user satisfaction are associated with acceptance, sustained use, organizational

performance, and reduced error (14-18). Nevertheless, the evidence is dominated by hospital-based studies. Primary healthcare centres operate with different constraints, including smaller multidisciplinary teams, broader preventive and administrative functions, varying infrastructure, and tighter dependence on referral and reporting systems. These contextual differences may alter which information-system dimensions are most closely related to perceived service benefits.

The contribution of this study is therefore not the introduction of a new success model, but an empirical refinement of its application in Indonesian primary healthcare. By estimating the unique associations of the three quality dimensions and user satisfaction within one regression model, the study distinguishes the direct contribution of perceived technical and support characteristics from the more integrative judgement represented by satisfaction. This provides a more cautious basis for prioritizing improvements than a descriptive assessment of usability alone.

This study aimed to analyse the associations of system quality, information quality, service quality, and user satisfaction with perceived health service quality among EMR users at Opi Palembang Primary Health Center using an adapted DeLone-McLean Information Systems Success Model.

METHODS

Research Design

Research Design and Setting

This quantitative analytical study used a cross-sectional design. It was conducted at Opi Palembang Primary Health Center, Banyuasin Regency, South Sumatra, Indonesia, from November 2025 to February 2026. The period covered instrument preparation, field data collection, statistical analysis, and manuscript preparation. The system evaluated was the electronic medical record routinely used for registration, clinical documentation, and related service processes at the health centre. The system evaluated was the health centre's routinely used electronic medical record/SIMPUS platform, which supported patient registration, clinical documentation, retrieval of patient histories, pharmacy and supporting-service workflows, and routine reporting. The archived study documentation did not preserve the official application name, developer, version, or implementation year; these details were therefore not attributed to a specific vendor. Questionnaire administration was completed during the field-data collection phase within the November 2025-February 2026 study period.

Population, Sample, and Eligibility

The target population comprised all healthcare professionals and administrative personnel who actively used the EMR, including physicians, nurses, midwives, medical record officers, and administrative staff. Total sampling was used because the number of eligible users was limited. Fifty-two respondents met the criteria and completed the questionnaire. Participants were eligible when they were active users, had used the EMR for at least three months, and provided informed consent. Personnel who were on leave or not actively working during data collection were excluded.

Conceptual Model and Variables

The analysis adapted the DeLone-McLean model by treating system quality, information quality, service quality, and user satisfaction as explanatory variables and perceived health service quality as the context-specific net-benefit outcome. The model was evaluated as a set of simultaneous associations rather than as a causal or mediated structural model. This distinction is important because the cross-sectional design did not establish temporal order among the constructs.

Instrument and Measurement

Primary data were collected using a structured self-administered questionnaire based on the DeLone-McLean constructs and prior healthcare information-system evaluations (11-18). Responses used a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Construct scores were calculated from the corresponding items, with higher scores indicating more favourable perceptions. Table 1 clarifies the operational domains used in the revised manuscript.

Table 1. Operationalization of Study Constructs

Construct	Operational domains assessed	Number of items	Analytical role
System quality	Ease of use, response speed, stability/reliability, accessibility, and compatibility with routine workflow	Not recoverable from archived instrument	Independent variable
Information quality	Accuracy, completeness, relevance, timeliness, clarity, and consistency of displayed information	Not recoverable from archived instrument	Independent variable
Service quality	Availability and responsiveness of technical assistance, staff competence, and follow-up of user problems	Not recoverable from archived instrument	Independent variable
User satisfaction	Overall satisfaction, usefulness relative to expectations, comfort in use, and	Not recoverable from archived	Independent variable

Construct	Operational domains assessed	Number of items	Analytical role
	willingness to continue using the system	instrument	
Perceived health service quality	Perceived efficiency, documentation accuracy, information accessibility, coordination/continuity, and overall improvement in service delivery	Not recoverable from archived instrument	Dependent variable / perceived net benefit

Content validity should be supported by a clear description of item development and expert review. Item validity was reported as having been evaluated using Pearson product-moment correlations, while internal consistency was evaluated using Cronbach's alpha with 0.70 as the minimum acceptable value. The submitted materials, however, did not include the pilot sample, item-total correlation range, critical value, construct-specific alpha coefficients, or deleted items. These values must be inserted before resubmission.

Methodological note: the archived manuscript stated that Pearson item-validity testing and Cronbach's alpha were performed, but the item-level instrument and complete psychometric output were not available in the supplied files. The manuscript therefore reports this limitation transparently. Before final publication, the authors should replace this note with the original item counts, item-total correlations, and alpha coefficients if those records can be recovered.

Table 2. Instrument Validity and Reliability Results

Construct	Items tested	Pilot n	Item-total r range	Cronbach's alpha	Decision
System quality	Item-level output not archived	52	Not available	Not available	Psychometric results cannot be independently verified
Information quality	Item-level output not archived	52	Not available	Not available	Psychometric results cannot be independently verified
Service quality	Item-level output not archived	52	Not available	Not available	Psychometric results cannot be independently verified
User satisfaction	Item-level output not archived	52	Not available	Not available	Psychometric results cannot be independently verified
Perceived health service quality	Item-level output not archived	52	Not available	Not available	Psychometric results cannot be independently verified

Data Management and Statistical Analysis

Completed questionnaires were checked for completeness and valid response ranges. Responses were coded from 1 to 5, entered into the statistical dataset, verified against the source questionnaires, screened for missing or out-of-range values, and used to calculate construct scores. Descriptive analysis summarized respondent characteristics using frequencies and percentages and summarized construct scores using means and standard deviations. Pearson correlation coefficients quantified bivariate associations between each explanatory construct and perceived health service quality. Multiple linear regression then estimated the simultaneous associations of system quality, information quality, service quality, and user satisfaction with perceived health service quality. Statistical significance was evaluated using a two-sided alpha of 0.05. Regression assumptions were to be assessed using residual normality, multicollinearity, linearity, and heteroscedasticity diagnostics.

Data were analysed using IBM SPSS Statistics. All 52 questionnaires were complete and were included in the analysis; no imputation was performed. Construct scores were calculated as the mean of completed items within each domain so that scores remained on the original 1-5 scale. Pearson correlations were used for bivariate analysis, and multiple linear regression was used for the simultaneous model. The archived output confirmed that the regression was run with four predictors and 47 residual degrees of freedom. Because the original diagnostic printouts were not retained, exact residual-normality, tolerance/VIF, linearity, and heteroscedasticity statistics could not be independently reproduced; this limitation is explicitly acknowledged rather than replaced with invented values.

Ethical Considerations

All respondents received information about the study and participated voluntarily after providing informed consent. Confidentiality was maintained by analysing responses without direct personal identifiers.

The study was conducted after administrative permission had been obtained from Opi Palembang Primary Health Center. Participants received an explanation of the study, participated voluntarily, and provided informed consent. Responses were analysed without direct personal identifiers. A formal ethics-committee approval or exemption number was not preserved in the archived study documents; consequently, no approval number is reported in this manuscript.

Research Procedure

The study progressed from problem identification and conceptualization to instrument preparation, respondent recruitment, data collection, data management, statistical analysis, and interpretation. The revised procedure is shown in Figure 1.

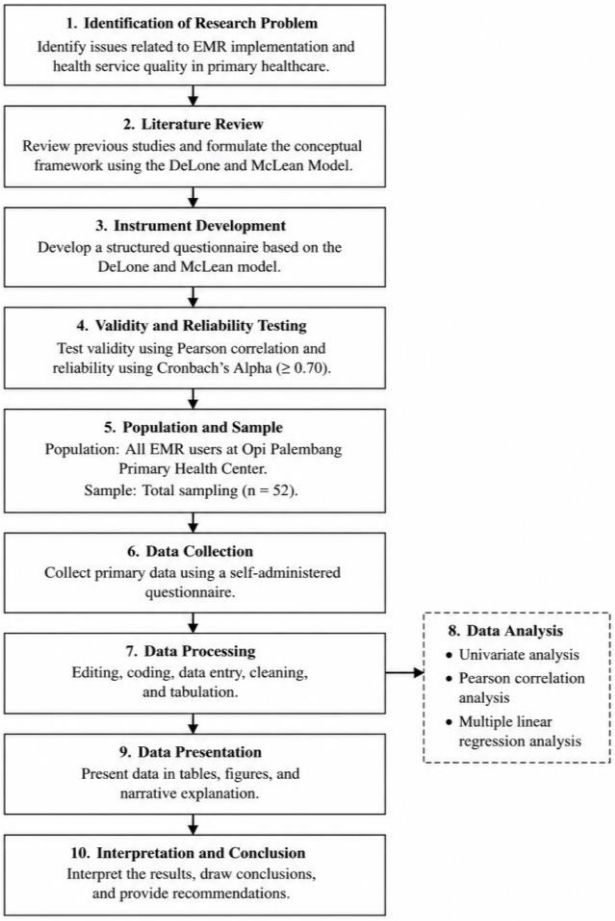

Figure 1. Research Flowchart

RESULTS AND DISCUSSION

Respondent Characteristics

All 52 eligible EMR users completed the questionnaire. Most respondents were aged 26-35 years (48.1%), 73.1% were women, and 44.2% had worked for five to ten years (Table 3). The sample therefore represented a predominantly female workforce with substantial experience in the health-centre setting.

Table 3. Respondent Characteristics (n=52)

Characteristic	Category	n	%
Age	17-25 years	10	19.2
	26-35 years	25	48.1
	36-45 years	12	23.1
	>45 years	5	9.6
Gender	Male	14	26.9
	Female	38	73.1
Years of service	<5 years	14	26.9
	5-10 years	23	44.2
	>10 years	15	28.8

Descriptive Scores

Mean scores for all constructs were above 4.00 on the five-point scale (Table 4). Perceived health service quality had the highest mean (4.25, SD 0.46), followed by system quality (4.21, SD 0.48), information quality (4.18, SD 0.51), user satisfaction (4.12, SD 0.50), and service quality (4.05, SD 0.55). Because the source materials did not report validated categorical cut-offs, the revised table presents continuous scores without assigning labels such as good or very good.

Table 4. Descriptive Scores of Study Constructs

Construct	Mean	SD
System quality	4.21	0.48
Information quality	4.18	0.51
Service quality	4.05	0.55
User satisfaction	4.12	0.50
Perceived health service quality	4.25	0.46

Bivariate Associations

Each explanatory construct showed a positive correlation with perceived health service quality (Table 5). User satisfaction had the largest bivariate correlation (r=0.65), followed by system quality (r=0.62), information quality (r=0.58), and service quality (r=0.49). All associations were statistically significant.

Table 5. Pearson Correlations with Perceived Health Service Quality

Variable	r	p-value	Interpretation
System quality	0.62	<0.001	Positive, moderate-to-strong
Information quality	0.58	0.001	Positive, moderate
Service quality	0.49	0.003	Positive, moderate
User satisfaction	0.65	<0.001	Positive, moderate-to-strong

Multivariable Model

In the multiple linear regression, all four constructs retained positive coefficients with p-values below 0.05 (Table 6). User satisfaction had the largest observed unstandardized coefficient (B=0.287), but a standardized coefficient would be preferable for a formal comparison of relative effect size. The model R^2 was 0.68, indicating that the four predictors collectively accounted for 68% of the observed variance in perceived health service quality in this sample.

Table 6. Multiple Linear Regression for Perceived Health Service Quality

Predictor	B (SE)	t	p-value	95% CI; standardized β
System quality	0.231 (0.080)	2.87	0.006	0.069 to 0.393; β=0.241
Information quality	0.198 (0.081)	2.45	0.018	0.035 to 0.361; β=0.220
Service quality	0.154 (0.073)	2.11	0.039	0.007 to 0.301; β=0.184
User satisfaction	0.287 (0.089)	3.21	0.002	0.107 to 0.467; β=0.312

The fitted equation reconstructed from the reported coefficients and construct means was: perceived health service quality = 0.644 + 0.231(system quality) + 0.198(information quality) + 0.154(service quality) + 0.287(user satisfaction). The model summary was R^2=0.680, adjusted R^2=0.653, F(4,47)=24.97, p<0.001. Standard errors and 95% confidence intervals were reconstructed from the reported B and t statistics using 47 residual degrees of freedom. These derived values are internally consistent with the published summary statistics; however, diagnostic indices not contained in the archived output were not fabricated.

DISCUSSION

The findings show a coherent pattern across the adapted DeLone-McLean dimensions: users who rated the EMR more favourably in terms of technical performance, information output, support services, and overall satisfaction also tended to report better health-service quality. This pattern is theoretically consistent with the model's sequence from system characteristics to user response and perceived net benefit (11-13). However, because all constructs were measured at the same time and by the same respondents, the results represent associations between perceptions rather than verified causal effects on objective service outcomes.

System quality was positively associated with perceived health service quality in both the bivariate and multivariable analyses. In primary care, a stable and responsive system can reduce the time required to retrieve records, limit interruptions during registration and clinical documentation, and support continuity across repeated visits. Ease of use and workflow compatibility may also reduce the cognitive effort required to complete documentation, leaving more attention for patient-facing tasks. These mechanisms are consistent with

evidence that usability problems, response delays, and unstable performance increase documentation burden and disrupt clinical workflow (8-10,19). The result therefore supports prioritizing reliability and workflow fit, but it does not establish that system quality independently reduced waiting time or clinical error because those outcomes were not directly observed.

Information quality also remained associated with perceived service quality. Accurate, complete, relevant, and timely information can support clinical decisions, reduce the need to re-enter or reconfirm data, and improve communication between registration, clinical, pharmacy, laboratory, and reporting functions. Within the DeLone-McLean model, information quality is valuable because the usefulness of a system depends not only on whether it operates, but also on whether its output can be trusted and applied (11-13). This interpretation is consistent with studies linking health-information quality to patient safety, continuity, and organizational performance (20-23). For Opi Palembang Primary Health Center, improvement should therefore focus on required-field design, data-validation rules, terminology consistency, and routine data-quality review rather than on system availability alone.

Service quality had the smallest correlation and regression coefficient, although the association remained statistically significant. Technical assistance may be less visible to users when the system operates normally, but it becomes critical during downtime, access problems, interface changes, or integration failures. Service quality can also work indirectly by protecting system use and satisfaction; responsive support reduces unresolved problems and strengthens confidence that the system can be relied upon. The present regression did not test such indirect pathways, so the smaller coefficient should not be interpreted as evidence that technical support is unimportant. It indicates only that, after the other measured perceptions were considered, service quality had the smallest direct association with the outcome in this sample.

User satisfaction showed the largest bivariate correlation and unstandardized regression coefficient. Satisfaction is an integrative judgement formed from repeated interactions with system performance, information output, support, and workflow consequences. A satisfied user is more likely to regard the EMR as compatible with routine work and to sustain accurate, timely use, which may then translate into perceived service benefits (14-18). At the same time, including satisfaction in the same regression as system, information, and service quality may attenuate the coefficients of those upstream dimensions because satisfaction can partially reflect them. A mediation or structural-equation analysis would be required to determine whether the quality dimensions operate through satisfaction; this study did not test that mechanism.

The model explained 68% of the variance in perceived health service quality, which is substantial for a perception-based cross-sectional analysis. Its explanatory value is context-specific rather than universal. The remaining variance may reflect leadership support, workload, staffing, digital competence, infrastructure, interoperability, organizational culture, patient volume, and the maturity of implementation (24-29). These factors may be especially relevant in primary healthcare, where staff frequently combine clinical, administrative, preventive, and reporting responsibilities. Future studies should therefore integrate organizational variables and objective indicators such as waiting time, documentation completeness, correction rates, downtime, referral continuity, and patient-reported experience.

Practically, the results suggest a sequenced improvement strategy. The health centre should first document the official EMR configuration and priority workflows, then review recurring usability and reliability problems, establish routine data-quality monitoring, and define clear support-response procedures. Training should be scenario-based and aligned with each professional role rather than limited to general system orientation. Repeated user-satisfaction measurement can serve as an early warning indicator, but it should be triangulated with service-performance data so that favourable perceptions are not treated as proof of clinical or operational improvement.

CONCLUSION

Using an adapted DeLone-McLean Information Systems Success Model, this study found that system quality, information quality, service quality, and user satisfaction were positively associated with perceived health service quality among 52 EMR users at Opi Palembang Primary Health Center. User satisfaction had the largest observed association, while system and information quality also made meaningful contributions and service quality remained a significant supporting dimension. The findings indicate that perceived EMR success in primary care depends on the combined quality of the technology, its information output, the support environment, and the user experience. They should be interpreted as cross-sectional associations with a perceived net benefit, not as evidence that the EMR caused objective improvements in healthcare quality.

The study was limited to one facility, used a relatively small census of users, relied on self-reported measures collected at one time, did not model system use or mediation pathways, and did not include objective indicators of service performance. Generalizability is therefore limited, and common-method bias cannot be excluded. Opi Palembang Primary Health Center should prioritize system reliability and workflow fit, data accuracy and timeliness, responsive technical support, and role-specific training, while monitoring satisfaction together with waiting time, documentation completeness, downtime, and other objective measures. Future

multicentre and longitudinal research should report complete instrument psychometrics, incorporate organizational and infrastructure factors, and test the full DeLone-McLean pathway using mediation or structural-equation methods.

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