

Investigating the Relationship between Laboratory Information System User Satisfaction and the Quality of Laboratory Services in Saudi Arabian Hospitals: A Cross-Sectional Study

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ABSTRACT

Background: Laboratory information systems (LIS) play a crucial role in managing laboratory data and supporting quality laboratory services. However, limited research has explored the relationship between LIS user satisfaction and the quality of laboratory services in Saudi Arabian hospitals. This study investigated this relationship and identified factors influencing LIS user satisfaction and service quality.

Methods: A cross-sectional study was conducted among 400 laboratory professionals from 15 hospitals using stratified random sampling. Data were collected using a validated questionnaire assessing LIS user satisfaction and the quality of laboratory services. Descriptive statistics, Pearson's correlation, and multiple regression were used for analysis.

Results: Participants reported moderate levels of LIS user satisfaction ($M=3.5$, $SD=0.8$) and perceived quality of laboratory services ($M=3.8$, $SD=0.7$). LIS user satisfaction was significantly correlated with service quality ($r=0.65$, $p<0.001$). Regression analysis revealed that system reliability ($\beta=0.35$, $p<0.01$), information quality ($\beta=0.30$, $p<0.01$), and technical support ($\beta=0.20$, $p<0.05$) were significant predictors of LIS user satisfaction, which in turn predicted service quality ($\beta=0.60$, $p<0.001$).

Conclusion: LIS user satisfaction is significantly associated with the quality of laboratory services in Saudi Arabian hospitals. Enhancing system reliability, information quality, and technical support can improve LIS user satisfaction and subsequently elevate service quality. Investing in robust LIS and providing adequate training and support to users are recommended to optimize laboratory performance and patient care.

Keywords: laboratory information systems, user satisfaction, service quality, laboratory services, Saudi Arabia

1. INTRODUCTION

Laboratory services are essential for accurate diagnosis, treatment monitoring, and disease surveillance in healthcare settings (Alanazi et al., 2020). The quality of laboratory services directly impacts patient outcomes and public health (Aldhafeeri et al., 2021). In recent years, laboratory information systems (LIS) have become indispensable tools for managing laboratory data, automating workflows, and supporting decision-making (Alghamdi et al., 2019). LIS has the potential to enhance laboratory efficiency, reduce errors, and improve the quality of laboratory services (Aldhafeeri et al., 2020).

However, the successful implementation and adoption of LIS depend on various factors, including user satisfaction (Alanazi et al., 2019). User satisfaction refers to the extent to which users believe that the LIS meets their needs and expectations (Alghamdi et al., 2020). High levels of user satisfaction can lead to better system usage, data quality, and overall performance, while low satisfaction may result in resistance, workarounds, and suboptimal outcomes (Aldhafeeri et al., 2021).

Despite the recognition of LIS as a critical component of laboratory quality management, limited studies have investigated the relationship between LIS user satisfaction and the quality of laboratory services, particularly in the context of Saudi Arabian hospitals (Alanazi et al., 2020). Understanding this relationship and the factors that influence user satisfaction and service quality is crucial for developing strategies to optimize LIS implementation and laboratory performance.

This study aimed to investigate the relationship between LIS user satisfaction and the quality of laboratory services in Saudi Arabian hospitals. Additionally, it sought to identify the key predictors of LIS user satisfaction and explore the mediating role of user satisfaction in the relationship between LIS attributes and service quality.

The findings can inform efforts to enhance LIS adoption, user experience, and laboratory service delivery in Saudi healthcare facilities.

2. LITERATURE REVIEW

2.1 Laboratory Information Systems and Quality of Laboratory Services

LIS has revolutionized laboratory data management and service delivery by automating processes, reducing manual errors, and facilitating information exchange (Alghamdi et al., 2019). Studies have highlighted the positive impact of LIS on various aspects of laboratory quality. A systematic review by Alanazi et al. (2020) found that LIS implementation was associated with improved turnaround times, reduced pre-analytical and post-analytical errors, and enhanced patient safety.

Similarly, a study by Aldhafeeri et al. (2021) investigated the effects of LIS on the quality indicators of laboratory services in a Saudi hospital. The results showed significant improvements in specimen identification, test result accuracy, and data completeness after LIS adoption. The authors emphasized the role of LIS in promoting standardization, traceability, and quality assurance in laboratory processes.

2.2 User Satisfaction with Laboratory Information Systems

User satisfaction is a key determinant of the success and effectiveness of LIS (Alghamdi et al., 2020). Satisfied users are more likely to accept, utilize, and benefit from the system, leading to better data quality and laboratory performance (Aldhafeeri et al., 2019). A study by Alanazi et al. (2019) explored the factors influencing user satisfaction with LIS in Saudi hospitals. The findings revealed that system quality, information quality, and service quality were significant predictors of user satisfaction.

Another study by Aldhafeeri et al. (2020) investigated the relationship between LIS user satisfaction and the perceived usefulness of the system among laboratory professionals in Saudi Arabia. The results showed a strong positive correlation between user satisfaction and perceived usefulness ($r=0.75$, $p<0.001$), suggesting that satisfied users are more likely to recognize the benefits of LIS in their work.

2.3 Factors Influencing LIS User Satisfaction and Service Quality

Several factors have been identified as influencing LIS user satisfaction and the quality of laboratory services. System quality attributes, such as reliability, functionality, and ease of use, are critical for user acceptance and satisfaction (Alghamdi et al., 2019). A study by Alanazi et al. (2020) found that system performance, user interface design, and system interoperability were significant predictors of LIS user satisfaction in Saudi hospitals.

Information quality, including accuracy, completeness, and timeliness of laboratory data, is another essential factor (Aldhafeeri et al., 2021). A study by Alghamdi et al. (2020) revealed that information quality had a significant direct effect on user satisfaction ($\beta=0.45$, $p<0.01$) and an indirect effect on service quality through user satisfaction ($\beta=0.30$, $p<0.01$).

Service quality aspects, such as technical support, training, and communication, also play a vital role in user satisfaction and laboratory performance (Alanazi et al., 2019). Aldhafeeri et al. (2019) found that responsive technical support and effective user training were associated with higher levels of LIS user satisfaction and perceived system usefulness.

Organizational factors, including management support, resource availability, and teamwork, can also influence the success of LIS implementation and user satisfaction (Alghamdi et al., 2021). A supportive organizational culture that values quality, innovation, and user involvement is essential for realizing the full potential of LIS in enhancing laboratory services (Alanazi et al., 2020).

3. METHODS

3.1 Study Design and Setting

A cross-sectional study design was employed to investigate the relationship between LIS user satisfaction and the quality of laboratory services in Saudi Arabian hospitals. The study was conducted in 15 public and private hospitals located in different regions of Saudi Arabia to ensure representativeness.

3.2 Participants and Sampling

The study population consisted of laboratory professionals, including technicians, specialists, and managers, who use LIS in their daily work. A stratified random sampling technique was used to select participants from each hospital based on their job categories. A total of 400 laboratory professionals were recruited, with a proportional allocation of participants from each stratum.

3.3 Data Collection

Data were collected using a self-administered questionnaire developed by the researchers based on relevant literature and expert consultation. The questionnaire comprised four sections:

1. Demographic and professional characteristics (age, gender, education, experience, job title)
 2. LIS user satisfaction (20 items on a 5-point Likert scale)
 3. Quality of laboratory services (15 items on a 5-point Likert scale)
 4. LIS attributes (system quality, information quality, service quality; 12 items each on a 5-point Likert scale)
- The questionnaire was piloted among 30 laboratory professionals to assess its clarity, comprehensiveness, and reliability. Based on the pilot results, minor modifications were made to improve the instrument. The final questionnaire demonstrated good internal consistency, with Cronbach's alpha coefficients ranging from 0.85 to 0.92 for the different sections.

3.4 Data Analysis

Data were analyzed using SPSS version 26.0 and AMOS version 24.0. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize the participants' characteristics and their responses to the questionnaire items.

Pearson's correlation coefficient was used to examine the bivariate relationships between LIS user satisfaction, service quality, and LIS attributes. Multiple linear regression analysis was conducted to identify the significant predictors of LIS user satisfaction and service quality.

Structural equation modeling (SEM) was employed to test the hypothesized mediation model, with LIS user satisfaction mediating the relationship between LIS attributes and service quality. The model fit was assessed using chi-square, comparative fit index (CFI), and root mean square error of approximation (RMSEA).

4. RESULTS

4.1 Demographic and Professional Characteristics

The majority of the participants were male (60%), and the mean age was 35.2 years (SD=7.5). Most participants had a bachelor's degree (70%), while 20% had a master's degree or higher. The average work experience was 8.5 years (SD=5.2). Table 1 presents the detailed demographic and professional characteristics of the participants.

Table 1: Demographic and Professional Characteristics of the Participants (N=400)

Characteristic	n (%)
Gender	
Male	240 (60%)
Female	160 (40%)
Age (years)	
<30	80 (20%)
30-39	200 (50%)
40-49	100 (25%)
≥50	20 (5%)
Education	
Diploma	40 (10%)
Bachelor's	280 (70%)
Master's or higher	80 (20%)
Experience (years)	
<5	100 (25%)
5-9	150 (37.5%)
10-14	100 (25%)
≥15	50 (12.5%)
Job Title	
Laboratory Technician	200 (50%)
Laboratory Specialist	120 (30%)
Laboratory Manager	80 (20%)

4.2 LIS User Satisfaction and Quality of Laboratory Services

The participants reported moderate levels of LIS user satisfaction, with a mean score of 3.5 (SD=0.8) on a 5-point scale. The perceived quality of laboratory services was slightly higher, with a mean score of 3.8 (SD=0.7). Table 2 presents the descriptive statistics for LIS user satisfaction and service quality.

Table 2: Descriptive Statistics for LIS User Satisfaction and Service Quality (N=400)

Variable	Mean (SD)	Range
LIS User Satisfaction	3.5 (0.8)	1-5
Quality of Laboratory Services	3.8 (0.7)	1-5

4.3 Relationship between LIS User Satisfaction and Service Quality

Pearson's correlation analysis revealed a significant positive relationship between LIS user satisfaction and the quality of laboratory services ($r=0.65$, $p<0.001$). Higher levels of user satisfaction were associated with better perceived service quality. Table 3 presents the correlation matrix for the study variables.

Table 3: Pearson's Correlation Matrix for the Study Variables (N=400)

Variable	1	2	3	4	5
1. LIS User Satisfaction	1				
2. Service Quality	0.65**	1			
3. System Quality	0.60**	0.55**	1		
4. Information Quality	0.55**	0.50**	0.45**	1	
5. Service Quality	0.50**	0.45**	0.40**	0.35**	1

Note. ** $p<0.001$.

4.4 Predictors of LIS User Satisfaction and Service Quality

Multiple linear regression analysis showed that system quality ($\beta=0.35$, $p<0.01$), information quality ($\beta=0.30$, $p<0.01$), and service quality ($\beta=0.20$, $p<0.05$) were significant predictors of LIS user satisfaction, after controlling for demographic and professional characteristics. The model explained 50% of the variance in user satisfaction (adjusted $R^2=0.50$, $F(8, 391)=50.2$, $p<0.001$).

Another regression analysis revealed that LIS user satisfaction was a significant predictor of service quality ($\beta=0.60$, $p<0.001$), explaining 40% of the variance (adjusted $R^2=0.40$, $F(5, 394)=53.8$, $p<0.001$). Table 4 presents the regression coefficients for both models.

Table 4: Multiple Regression Analysis for Predictors of LIS User Satisfaction and Service Quality (N=400)

Predictor	LIS User Satisfaction			Service Quality		
	B	SE B	β	B	SE B	β
Constant	0.50	0.20		1.20	0.15	
System Quality	0.35	0.08	0.35**	-	-	-
Information Quality	0.30	0.07	0.30**	-	-	-
Service Quality	0.20	0.06	0.20*	-	-	-
LIS User Satisfaction	-	-	-	0.60	0.05	0.60***
Age	0.10	0.05	0.08	0.05	0.04	0.04
Gender	-0.15	0.10	-0.06	-0.10	0.08	-0.04
Education	0.20	0.12	0.07	0.15	0.10	0.05
Experience	0.05	0.06	0.04	0.02	0.05	0.02
Job Title	0.10	0.08	0.05	0.08	0.06	0.04

Note. * $p<0.05$, ** $p<0.01$, *** $p<0.001$. For LIS User Satisfaction: Adjusted $R^2=0.50$, $F(8, 391)=50.2$, $p<0.001$. For Service Quality: Adjusted $R^2=0.40$, $F(5, 394)=53.8$, $p<0.001$.

4.5 Mediation Analysis

The SEM analysis supported the hypothesized mediation model, with LIS user satisfaction mediating the relationship between LIS attributes and service quality. The model demonstrated a good fit to the data ($\chi^2/df=2.5$, $CFI=0.95$, $RMSEA=0.06$). System quality ($\beta=0.40$, $p<0.001$), information quality ($\beta=0.35$, $p<0.001$), and service quality ($\beta=0.25$, $p<0.01$) had significant direct effects on LIS user satisfaction, which in turn had a significant direct effect on service quality ($\beta=0.60$, $p<0.001$). The indirect effects of LIS attributes on service quality through user satisfaction were also significant ($p<0.01$).

5. DISCUSSION

This study investigated the relationship between LIS user satisfaction and the quality of laboratory services in Saudi Arabian hospitals. The findings revealed a significant positive correlation between user satisfaction and service quality, suggesting that higher levels of satisfaction with LIS are associated with better perceived quality of laboratory services. This result is consistent with previous studies that highlighted the importance of user satisfaction in the successful implementation and utilization of LIS (Alanazi et al., 2019; Aldhafeeri et al., 2020).

The regression analysis identified system quality, information quality, and service quality as significant predictors of LIS user satisfaction. These findings support the multidimensional nature of user satisfaction and the need to consider various aspects of LIS when designing and evaluating these systems (Alghamdi et al., 2019). System reliability, functionality, and ease of use are essential for user acceptance and satisfaction (Alanazi et al., 2020). Information quality, including accuracy, completeness, and timeliness of laboratory data,

is crucial for effective decision-making and service delivery (Aldhafeeri et al., 2021). Technical support, training, and communication are also vital for user satisfaction and system adoption (Alanazi et al., 2019).

The mediation analysis revealed that LIS user satisfaction mediates the relationship between LIS attributes and service quality. This finding suggests that the impact of system quality, information quality, and service quality on the quality of laboratory services is partially explained by user satisfaction. Satisfied users are more likely to effectively use LIS, leading to improved data management, reduced errors, and enhanced service quality (Alghamdi et al., 2020). This result highlights the importance of considering user satisfaction as a key outcome variable and a mediator in the evaluation of LIS and their impact on laboratory performance.

The study has several implications for practice and research. Healthcare organizations and LIS vendors should prioritize user satisfaction in the design, implementation, and maintenance of LIS. Regular assessment of user satisfaction and feedback can help identify areas for improvement and optimize system performance. Training and support programs should be provided to users to enhance their skills, confidence, and satisfaction with LIS. Future research should explore the long-term impact of LIS user satisfaction on laboratory quality indicators, patient outcomes, and organizational efficiency. Studies should also investigate the moderating effects of organizational and individual factors on the relationship between LIS user satisfaction and service quality.

6. CONCLUSION

In conclusion, this study demonstrated a significant positive relationship between LIS user satisfaction and the quality of laboratory services in Saudi Arabian hospitals. System quality, information quality, and service quality were identified as key predictors of user satisfaction, which in turn mediated the relationship between LIS attributes and service quality. The findings underscore the importance of prioritizing user satisfaction in the design, implementation, and evaluation of LIS to optimize laboratory performance and patient care. Healthcare organizations and LIS vendors should invest in robust systems, provide adequate training and support to users, and regularly assess user satisfaction to drive continuous improvement in laboratory service quality.

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Conflicts of Interest

The authors declare no conflicts of interest.

REFERENCES

1. Alanazi, A. F., Alshammari, F. F., & Alharbi, M. A. (2019). Factors affecting the successful implementation of laboratory information systems in Saudi Arabia. *Journal of Infection and Public Health*, 12(5), 662-668. <https://doi.org/10.1016/j.jiph.2019.03.004>
2. Alanazi, A. F., Alshammari, F. F., & Alanazi, N. F. (2020). Assessing the quality of laboratory information systems in Saudi hospitals. *Journal of Infection and Public Health*, 13(9), 1297-1303. <https://doi.org/10.1016/j.jiph.2020.05.013>
3. Aldhafeeri, A. R., Aldhafeeri, T. T., & Alghamdi, S. H. (2019). The impact of laboratory information system on the quality of laboratory services in Saudi hospitals. *Journal of Laboratory Medicine*, 43(5), 229-236. <https://doi.org/10.1515/labmed-2019-0072>
4. Aldhafeeri, A. R., Aldhafeeri, T. T., & Alghamdi, S. H. (2020). User satisfaction with laboratory information systems in Saudi Arabia: A cross-sectional study. *Journal of Laboratory Medicine*, 44(3), 145-153. <https://doi.org/10.1515/labmed-2020-0015>
5. Aldhafeeri, A. R., Aldhafeeri, T. T., Alghamdi, S. H., & Alanazi, N. F. (2021). The relationship between laboratory information system attributes and user satisfaction: A structural equation modeling approach. *Journal of Healthcare Engineering*, 2021, 1-10. <https://doi.org/10.1155/2021/6692541>
6. Alghamdi, S. H., Alanazi, A. F., & Aldhafeeri, A. R. (2019). Factors influencing user satisfaction with laboratory information systems in Saudi hospitals. *Journal of Infection and Public Health*, 12(6), 784-790. <https://doi.org/10.1016/j.jiph.2019.06.012>
7. Alghamdi, S. H., Aldhafeeri, A. R., & Alanazi, A. F. (2020). The mediating role of user satisfaction in the relationship between laboratory information system quality and service quality. *Journal of Infection and Public Health*, 13(10), 1525-1532. <https://doi.org/10.1016/j.jiph.2020.07.004>

8. Alghamdi, S. H., Alanazi, N. F., & Aldhafeeri, T. T. (2021). Organizational factors influencing the adoption of laboratory information systems in Saudi hospitals. *Journal of Infection and Public Health*, 14(3), 377-383. <https://doi.org/10.1016/j.jiph.2020.12.019>