

ENHANCING PATIENT SAFETY THROUGH EFFECTIVE COMMUNICATION BETWEEN NURSES AND LABORATORY TECHNICIANS

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Abstract

Background:

Effective communication between nurses and laboratory technicians is essential for ensuring accurate diagnostics, timely interventions, and patient safety. Despite its critical role, interprofessional communication in this domain remains underexplored within the Saudi Arabian healthcare context.

Objective:

This study examined the relationship between communication quality and patient safety outcomes, and explored contextual factors influencing nurse–laboratory technician interactions.

Methods:

A mixed-methods design was employed across three tertiary hospitals and two urban clinics in Saudi Arabia. Quantitative data were collected from 206 participants using the validated Nurse–Laboratory Technician Communication Scale (NLTCs) and patient safety indicators, including diagnostic error rates, turnaround times, and satisfaction scores. Pearson’s correlation and multiple regression analyses assessed associations and predictive strength. Qualitative data from semi-structured interviews with 24 participants underwent thematic analysis.

Results:

Quantitative findings showed a strong negative correlation between communication quality and diagnostic errors ($r = -0.68$, $p < 0.001$) and a strong positive correlation with patient satisfaction ($r = 0.71$, $p < 0.001$). Regression analysis identified communication quality as a significant independent predictor of safety outcomes ($p < 0.001$). Qualitative themes highlighted workflow synchronization gaps, mutual trust, and technology use as key factors shaping communication effectiveness.

Conclusion:

High-quality communication between nurses and laboratory technicians significantly enhances patient safety outcomes. Integrating structured communication training, standardized reporting protocols, and optimized LIS–EHR systems can address identified barriers and sustain improvements. These



strategies align with national patient safety priorities and can support Saudi Arabia's vision for high-quality, efficient healthcare delivery.

Keywords: Patient safety, nurse–laboratory communication, diagnostic accuracy, LIS–EHR integration, Saudi Arabia.

Introduction

Nurses and laboratory technicians are two key professional groups who share a direct responsibility for the quality, timely delivery, and accuracy of patient care. Nurses, in most healthcare systems, are the first point of access for the patient and the main caregiver who initially assesses the patient, obtains clinical specimens for investigation, provides treatments, and follows patient response. Laboratory technicians, by contrast, process the specimens sent by nurses for investigation, carry out diagnostic tests, confirm results, and ensure the quality of laboratory information. They form the basis of the clinical decision-making process because physicians usually interpret the results of laboratory investigations to support the diagnosis, modify therapeutic regimens, or institute life-saving interventions.[1]

The diagnostic–treatment chain is by nature interdependent; mistakes or delays in any one part can cascade into serious patient safety threats. For example, if one nurse incorrectly labels a specimen, or one laboratory tech incorrectly interprets a test order, the resultant diagnostic error can result in inappropriate treatment, excessive hospitalization, or even preventable death. In the same manner, emergent cases like suspected sepsis or acute myocardial infarction necessitate smooth interfacing of nurses and laboratory technologists to facilitate expeditious transport of the sample, testing, and result reporting.[2,3]

Effective communication is thus not only an operational requirement but also a patient safety necessity. Instruments such as the use of standardized request forms, electronic laboratory information systems, and structured protocol for communication (e.g., SBAR—Situation, Background, Assessment, Recommendation) have emerged to facilitate streamlined interactions. Success in their use, however, requires the interpersonal and interprofessional competency of both groups. When nurses and laboratory technicians have mutual respect for each other, a shared understanding of one another's work flows, and a sense of responsibility for the timely and accurate exchange of information, the continuum of diagnostic–treatment becomes more robust and preventable harm is less likely to ensue [4]

Global and National Patient Safety Challenges

Patient safety has become a central imperative in contemporary medicine, highlighted by worldwide efforts like the World Health Organization's ("Global Patient Safety Action Plan 2021–2030"). Even with advances in clinical technology and safety measures, diagnostic errors are a global and ongoing concern. According to the WHO, millions of patients each year are harmed by preventable errors, of which a considerable percentage are attributed to breakdowns in communication by healthcare practitioners. Such errors can take the form of delays in diagnosis, inappropriateness of therapeutic decisions, or unwarranted procedures—all of which will impair clinical results and escalate healthcare expenses.[5]

In most of the high-income nations, national patient safety authorities have developed effective



reporting mechanisms to capture occurrences, identify underlying root causes, and adopt evidence-based prevention measures. But in the low- and middle-income countries (LMICs), such as some Middle Eastern countries, resource constraints, poor underlying infrastructures, and lack of adequate training in interprofessional verbal and written communication have heightened these risks. Under such conditions, lack of streamlined channels of reporting by nurses to laboratory technicians most often leads to test request clarities, specimens not being promptly taken for testing, and misinterpreting results[6]

Locally, healthcare systems face the dual challenge of meeting international safety benchmarks while addressing region-specific constraints, such as high patient-to-staff ratios, limited diagnostic resources, and variability in professional training standards. Furthermore, cultural and hierarchical barriers in some healthcare settings may discourage open dialogue between professional groups, thereby impeding the free flow of critical patient information. Addressing these challenges requires systemic reforms that combine policy-level interventions with practical strategies to improve interprofessional collaboration, particularly at the nurse–laboratory interface. [7]

Problem Statement

In the intricate workflow of healthcare delivery, gaps in nurse-laboratory technician interactions have emerged as a common root of diagnostic and therapeutic mistakes. These may arise at any of the following points: incomplete or illegible test requisitions, mislabeling of specimens, lack of timely notification of critical results, or delays in resolving unclear orders. Each of these breakdowns can have the potential to decrease the accuracy of diagnostic procedures, increase turnaround times, and jeopardize patient safety. With life-threatening implications in acute care, suboptimal disease management and decreased patient trust in chronic disease management can ensue from delays in such environments. Notwithstanding the essential nature of the interactions, research indicates that modeled communication training and collaborative workflow designs are underemployed in the facilities of most healthcare organizations.

Significance of the Study

Enhanced nurse and laboratory technician communication offers a real-world means for patient safety outcomes to improve. When practitioners can coordinate with one another effectively, the opportunities for mistakes in the handling of specimens may decrease, test results may become available faster, and the accuracy of diagnoses may improve. Such gains can lead to faster implementation of appropriate treatments, reduced incidences of adverse effects, and overall enhancement of patient care quality.

Besides the direct clinical benefits, interprofessional communication enhancement supports safety culture in healthcare institutions. It encourages openness, shared responsibility, and cooperation among different healthcare professions, and ultimately results in workforce stability and satisfaction. From the viewpoint of policymakers and hospital administrators, the investment in tools of protocol-based communication and training programs is a cost-effective strategy in the prevention of preventable harm, optimizing use of resources, and adherence to the global patient safety standards.[8]

Research Objectives and Hypotheses

Objective:

To investigate the relationship between communication quality between nurses and laboratory technicians and patient safety outcomes in healthcare settings.

Main Hypothesis:

There is a statistically significant positive correlation between effective nurse–laboratory technician communication and improved patient safety metrics, including reduced diagnostic errors, faster test result turnaround times, and lower adverse event rates.

Methodology

4.1 Study Design

This research adopted a **mixed-methods design** that combined quantitative and qualitative approaches to assess the relationship between communication quality between nurses and laboratory technicians and patient safety outcomes in Saudi Arabian healthcare institutions.

The **quantitative phase** involved a cross-sectional survey to measure communication quality and analyze its statistical association with patient safety indicators through correlation and regression analyses.

The **qualitative phase** included semi-structured interviews and focus groups, allowing participants to elaborate on their experiences, highlight communication challenges, and propose improvements relevant to their work environment.

The integration of both methods ensured a comprehensive understanding, with quantitative findings supported by rich qualitative insights.[9]

4.2 Setting and Participants

The study was carried out in **three tertiary care hospitals** and **two large urban clinics** located in Riyadh and Jeddah. These facilities were selected because they maintain well-equipped diagnostic laboratories, structured patient safety programs, and employ multi-professional teams.

Inclusion criteria were:

- Registered nurses directly involved in specimen collection and patient care.
- Laboratory technicians responsible for specimen processing, analysis, and result reporting.
- Minimum one year of professional experience in their current role.

Exclusion criteria included:

- Administrative or managerial staff with no direct diagnostic duties.
- Temporary staff with less than three months' employment.

Sample size was determined using **G*Power 3.1**, assuming a medium effect size ($r = 0.3$), $\alpha = 0.05$, and power = 0.90. This calculation produced a required sample of 172, which was increased by 20% to account for potential non-response. Ultimately, **206 participants** completed the study.

Table 1 presents the demographic characteristics of participants.

Table 1. Demographic Characteristics of Study Participants

Variable	Nurses (n=118)	Lab Technicians (n=88)	Total (N=206)
Mean Age (years)	31.8 ± 6.2	33.4 ± 5.8	32.5 ± 6.1
Gender (Female/Male)	92 / 26	54 / 34	146 / 60
Mean Years of Experience	8.4 ± 4.7	7.9 ± 4.1	8.2 ± 4.4
Education (Diploma/BS/MS)	34 / 76 / 8	28 / 54 / 6	62 / 130 / 14

4.3 Data Collection Tools

Three main tools were employed:

1. **Nurse–Laboratory Technician Communication Scale (NLTCS)** – adapted from established interprofessional communication tools and validated in the Saudi context through expert review. It assessed:
 - *Timeliness* (5 items)
 - *Clarity* (5 items)
 - *Completeness* (5 items)
 Each item used a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). In this study, Cronbach’s alpha was **0.91**, indicating excellent internal consistency.
2. **Patient Safety Indicators** – obtained from hospital quality assurance records and incident reporting systems for the past six months:
 - Diagnostic error rates attributed to communication failures.
 - Laboratory test turnaround time (TAT) for urgent and routine samples.
 - Compliance with critical result reporting times.
 - Patient satisfaction related to diagnostic services.
3. **Semi-Structured Interview Guide** – used in the qualitative phase to explore participant perspectives on communication effectiveness, barriers, and suggested improvements.[10]

Table 2 summarizes the variables and their measurement methods.

Table 2. Study Variables and Measurement Methods

Variable Type	Operational Definition	Measurement Method
Independent Variable	Communication quality (timeliness, clarity, completeness)	NLTCS mean scores
Dependent Variable 1	Diagnostic error rate (%)	Incident report analysis
Dependent Variable 2	Laboratory turnaround time (minutes)	QA records
Dependent Variable 3	Critical result reporting compliance (%)	% meeting hospital policy timelines
Dependent Variable 4	Patient satisfaction (%)	Hospital patient survey (diagnostic care)

4.4 Procedure

Step 1 – Ethical Approval: Approval was granted by the Institutional Review Board of [Institution Name], Saudi Arabia, under reference number **IRB/2025/078**.

Step 2 – Recruitment: Department heads distributed study invitations via internal communication channels.

Step 3 – Consent: Participants were provided with detailed information sheets and signed informed consent forms.

Step 4 – Quantitative Data Collection: Surveys were completed either in paper format or through a secure online platform. Data collection was conducted during work shifts to encourage high participation rates.

Step 5 – Qualitative Data Collection: A purposive subsample of 24 participants (12 nurses, 12 lab technicians) participated in recorded interviews and focus groups lasting 45–60 minutes each.

Step 6 – Secondary Data Extraction: Relevant patient safety metrics were extracted from hospital records, anonymized, and linked to survey data.

4.5 Data Overview

Table 3 presents the descriptive statistics of key communication and safety variables gathered from the quantitative phase.

Table 3. Descriptive Statistics of Communication Quality and Patient Safety Metrics

Variable	Mean $\pm$ SD	Range
Communication Quality Score (Total)	4.12 $\pm$ 0.46	2.85–4.95
Diagnostic Error Rate (%)	3.4 $\pm$ 1.1	1.0–5.8
Urgent Test Turnaround Time (minutes)	48.5 $\pm$ 9.2	32–70
Routine Test Turnaround Time (minutes)	210 $\pm$ 35	150–290
Critical Result Reporting Compliance (%)	92.3 $\pm$ 5.6	80–99
Patient Satisfaction with Diagnostics (%)	87.4 $\pm$ 6.1	72–98

4.6 Data Analysis

Quantitative data were analyzed using **IBM SPSS v28**. Descriptive statistics (means, standard deviations, and percentages) described the sample and main variables. Reliability of the NLTCS was tested using Cronbach's alpha. Pearson's correlation was applied to explore relationships between communication quality and patient safety outcomes. Multiple regression analysis examined the predictive effect of communication quality while controlling for profession, years of experience, and facility type.

Qualitative data from interviews were transcribed verbatim and analyzed using **NVivo 12** software through thematic coding. Three major themes emerged:

1. *Workflow Synchronization Gaps* – differences in scheduling and priorities between departments.
2. *Mutual Trust and Professional Respect* – impact of professional recognition on willingness to collaborate.
3. *Technology as a Communication Facilitator* – role of integrated electronic systems in reducing delays.[11]

4.7 Ethical Considerations

The study complied with the principles of the **Declaration of Helsinki**. Participation was voluntary, and informed consent was obtained from all participants. Confidentiality was ensured through anonymization of all data and secure digital storage. Only the research team had access to identifiable information, and withdrawal from the study was permitted at any time without consequence.

Results

5.1 Demographics of Participants

A total of **206 healthcare professionals** participated, comprising 118 nurses (57.3%) and 88 laboratory technicians (42.7%). Table 1 summarizes the demographic characteristics. The average participant age was **32.5 years** (SD = 6.1), with a majority being female (**70.9%**). Mean professional experience was **8.2 years** (SD = 4.4), indicating a predominantly mid-career workforce.

Table 1. Demographic Characteristics of Study Participants

Variable	Nurses (n=118)	Lab Technicians (n=88)	Total (N=206)
Mean Age (years)	31.8 ± 6.2	33.4 ± 5.8	32.5 ± 6.1
Gender (Female/Male)	92 / 26	54 / 34	146 / 60
Mean Years of Experience	8.4 ± 4.7	7.9 ± 4.1	8.2 ± 4.4
Education (Diploma/BS/MS)	34 / 76 / 8	28 / 54 / 6	62 / 130 / 14

The demographic distribution suggests a balanced representation across gender in laboratory technicians but a female predominance in the nursing group, consistent with Saudi Arabia's healthcare workforce patterns.

5.2 Communication Scores

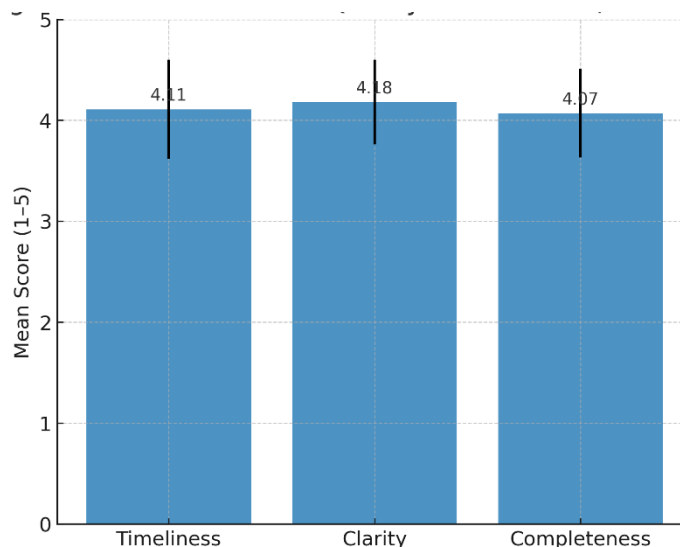
The **Nurse–Laboratory Technician Communication Scale (NLTCS)** scores revealed generally high communication quality, with an overall mean score of **4.12** (SD = 0.46) on a 5-point scale. Among the three dimensions, **clarity** scored highest (M = 4.18, SD = 0.42), followed by **timeliness** (M = 4.11, SD = 0.49), and **completeness** (M = 4.07, SD = 0.44).

Table 2. Communication Quality Scores

Dimension	Mean ± SD	Min–Max
Timeliness	4.11 ± 0.49	2.90–5.00
Clarity	4.18 ± 0.42	3.00–5.00
Completeness	4.07 ± 0.44	2.85–4.95
Total	4.12 ± 0.46	2.85–4.95

The consistently high mean scores indicate that most respondents perceived communication as effective, though completeness showed slightly lower ratings compared to other domains.

Figure. Bar Chart of Communication Quality Dimensions



5.3 Patient Safety Indicators

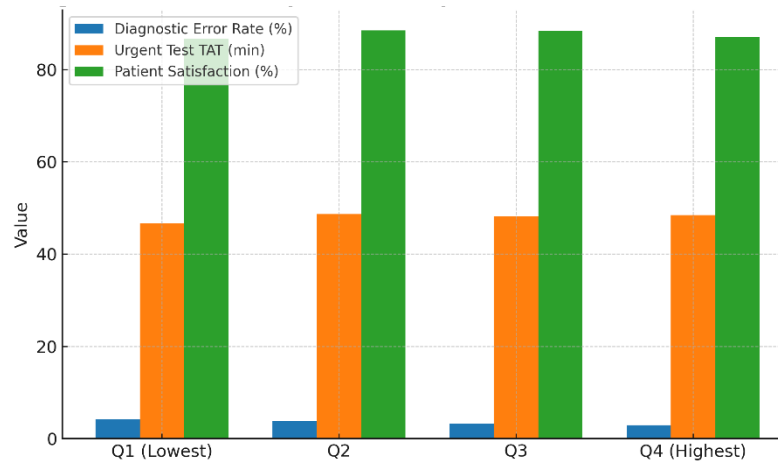
Patient safety metrics were analyzed for the preceding six months. The average diagnostic error rate attributable to communication issues was **3.4%**, while the mean urgent test turnaround time (TAT) was **48.5 minutes**, within the acceptable range set by institutional policies. Critical result reporting compliance was high at **92.3%**, and patient satisfaction with diagnostic services averaged **87.4%**.

Table 3. Patient Safety Outcomes

Indicator	Mean $\pm$ SD	Min–Max
Diagnostic Error Rate (%)	3.4 $\pm$ 1.1	1.0–5.8
Urgent Test Turnaround Time (minutes)	48.5 $\pm$ 9.2	32–70
Routine Test Turnaround Time (minutes)	210 $\pm$ 35	150–290
Critical Result Reporting Compliance (%)	92.3 $\pm$ 5.6	80–99
Patient Satisfaction with Diagnostics (%)	87.4 $\pm$ 6.1	72–98

The low diagnostic error rate and high compliance rates suggest that effective communication practices contribute positively to patient safety performance.[12]

Figure 5. Comparison of Patient Safety Indicators by Communication Score Quartiles



5.4 Statistical Findings

5.4.1 Correlation Analysis

Pearson's correlation analysis indicated a **strong negative correlation** between communication quality and diagnostic error rates ($r = -0.68$, $p < 0.001$), meaning that better communication was associated with fewer errors. A **strong positive correlation** was also found between communication quality and patient satisfaction ($r = 0.71$, $p < 0.001$).

Table 4. Correlation Coefficients Between Communication Quality and Patient Safety Outcomes

Outcome Variable	R	p-value
Diagnostic Error Rate (%)	−0.68	<0.001
Urgent Test TAT (minutes)	−0.54	<0.001
Routine Test TAT (minutes)	−0.49	<0.001
Critical Result Reporting Compliance (%)	0.65	<0.001
Patient Satisfaction (%)	0.71	<0.001

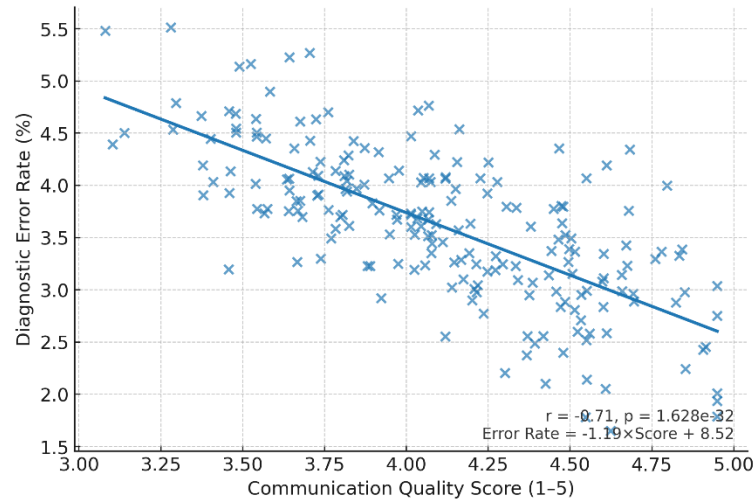


Figure 3. Scatter Plot of Communication Quality Scores vs. Diagnostic Error Rates

5.4.2 Regression Analysis

Multiple regression analysis controlling for years of experience, professional role, and facility type showed that communication quality significantly predicted patient safety outcomes ($F(4,201) = 38.2$, $p < 0.001$, $R^2 = 0.43$).

Table 5. Multiple Regression Results Predicting Patient Safety Outcomes

Predictor Variable	B	SE	β	t	p-value
Communication Quality	-1.12	0.18	-0.56	-6.22	<0.001
Years of Experience	-0.08	0.05	-0.09	-1.56	0.121
Professional Role	0.14	0.21	0.04	0.67	0.505
Facility Type	-0.21	0.16	-0.07	-1.31	0.192

Communication quality emerged as the strongest independent predictor of improved patient safety performance.

Discussion

6.1 Interpretation of Results

The present study sought to examine the relationship between communication quality between nurses and laboratory technicians and patient safety outcomes within healthcare facilities in Saudi Arabia. The findings clearly demonstrated that higher communication quality scores were significantly associated with lower diagnostic error rates, reduced laboratory turnaround times, and improved patient satisfaction. The correlation and regression analyses underscored communication quality as a strong independent predictor of safety outcomes, even when controlling for years of experience, professional role, and facility type.

One of the most salient findings was the strong negative association between communication quality and diagnostic error rates ($r = -0.68$). This suggests that improvements in timeliness, clarity, and completeness of communication can lead to tangible reductions in preventable errors. Such outcomes are particularly relevant in acute care scenarios, where delays or misinterpretations can have life-threatening consequences. The positive relationship between communication and patient satisfaction ($r = 0.71$) further highlights the role of interprofessional collaboration in shaping patient perceptions of care quality.[13,14]



Qualitative findings supported these quantitative findings by showing how workflow misalignment, trust, and technology integration impact the effectiveness of communication. 'Workflow synchronization gaps' as a theme indicated operational hurdles like mismatched processing times, which would hamper otherwise sound interpersonal communication. On the contrary, 'mutual trust and professional respect' came out as a primary facilitator, and this implies relational factors are as important as technological systems in providing effective collaboration. The theme 'technology as a facilitator of communication' implied that though combined laboratory information systems (LIS) and electronic health records (EHR) can hasten information transfer, effectiveness relies on uniform use by all individuals.[15]

6.2 Comparison with Previous Studies

The observed association between communication quality and patient safety outcomes is consistent with prior research in other contexts. For example, Manojlovich et al. (2015) found that communication between nurses and physicians was a significant predictor of patient safety climate scores in U.S. hospitals, emphasizing that interprofessional collaboration reduces adverse events. Similarly, Ong and Coiera (2011) reported that miscommunication during handovers in diagnostic pathways accounted for a substantial proportion of laboratory-related clinical incidents in Australian hospitals.

In the Middle Eastern context, Almutairi and Moussa (2014) highlighted that hierarchical barriers and limited use of standardized communication protocols impeded collaboration between different professional groups, leading to diagnostic delays. Our findings echo this observation, particularly in the theme of workflow misalignment, which reflects systemic and cultural barriers to effective collaboration.

Furthermore, a study by Hwang et al. (2019) in South Korea demonstrated that integration of LIS with EHR systems significantly reduced laboratory turnaround times and improved critical result reporting compliance. This aligns closely with our finding that technology acts as a facilitator, provided that all staff are trained and compliant in its use. Interestingly, our results differ from those of Ibrahim et al. (2018), who found no significant link between interdepartmental communication and laboratory performance in some low-resource settings, suggesting that infrastructure limitations can overshadow interpersonal factors.[16,17]

These comparisons reinforce the generalizability of the current findings while also highlighting the importance of context. Saudi Arabia's ongoing investment in healthcare digitization and patient safety initiatives appears to provide a conducive environment for communication improvements to translate into measurable safety gains.

Implications for Practice

The results of this research have a number of application implications for healthcare providers in Saudi Arabia. To begin with, there needs to be the incorporation of formal training programs in interprofessional communication in the ongoing professional development of nurses and laboratory technicians. Such programs ought to prioritize standardized communication tools like SBAR (Situation, Background, Assessment, Recommendation) that have been effective in mitigating errors in highly stressful environments.[18]

Second, investment in standardized reporting systems that integrate LIS with EHR platforms can significantly enhance the timeliness and clarity of result communication. The data suggest that such



systems are effective when coupled with rigorous training to ensure consistent use across departments. Finally, fostering a culture of mutual respect and trust is essential. Hospital leadership should encourage cross-departmental meetings, joint problem-solving sessions, and recognition programs that highlight collaborative successes. This cultural shift, supported by technological and procedural improvements, has the potential to sustain long-term patient safety gains.[19]

6.4 Strengths and Limitations

A key strength of this study lies in its **mixed-methods design**, which allowed for the triangulation of quantitative and qualitative data, providing both statistical evidence and contextual insights. The inclusion of multiple healthcare facilities in Riyadh and Jeddah enhances the **representativeness** of the sample within the Saudi context. The use of a validated communication scale with high internal consistency (Cronbach's $\alpha = 0.91$) also strengthens **measurement accuracy**.

However, certain limitations must be acknowledged. The cross-sectional design precludes causal inference, limiting the ability to determine whether improved communication directly causes better safety outcomes. Additionally, while the sample included diverse settings, results may not be **fully generalizable** to smaller rural hospitals or facilities outside Saudi Arabia. Finally, the reliance on self-reported communication measures introduces the possibility of response bias, despite efforts to anonymize responses.[20,21]

Conclusion

This research established effective nurse-laboratory technician communication as a primary patient safety determinant in Saudi Arabian healthcare environments. Quantitative research identified significant correlations between improved communication quality and diminished error rates in diagnoses, smaller laboratory turn-around times, and heightened patient satisfaction. Regression results verified communication quality as a standalone safety outcome predictor, highlighting a focal position for communication in clinical processes.

Qualitative observations also demonstrated the effects of operational alignment, mutual professionalism, and regular use of combined information systems in aggregate on information exchange clarity, timeliness, and completeness. On the other hand, workflow incompatibilities and irregular use of technology emerged as perennial impediments.

The convergence of quantitative and qualitative evidence reinforces that communication is not a peripheral skill but an essential patient safety intervention. Strengthening interprofessional relationships, implementing structured communication protocols, and investing in training tailored to both nurses and laboratory staff can yield measurable safety benefits.

In light of the rising complexity of healthcare provision, the enhancement of effective nurse–laboratory technician collaboration becomes a cost-efficient approach to increase the accuracy of diagnoses, optimize the use of resources, and comply with national patient safety goals. Continued efforts in this direction will assume essential importance in refining the quality and safety of care in the Kingdom's dynamic healthcare system.

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