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Research Article

The Contribution of Nursing–Laboratory Communication Quality to Reducing Diagnostic Delays

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Abstract:

Effective nursing-laboratory communication is a critical determinant in mitigating diagnostic delays, acting as the essential conduit between clinical suspicion and analytical confirmation. The pre-analytical phase, predominantly governed by nursing practice, is highly vulnerable to errors such as mislabeling, improper specimen handling, and loss of clinical context, which directly contribute to postponed diagnoses. Conversely, the laboratory's ability to provide timely, accurate results hinges on receiving well-communicated, high-integrity samples and the capacity to effectively relay critical findings and specimen issues. Breakdowns in this interface—whether due to flawed technology, ambiguous protocols, or interprofessional cultural divides—introduce preventable bottlenecks. Strengthening this communication through integrated health information systems, standardized processes, interprofessional education, and a culture of shared accountability compresses the diagnostic timeline, enhancing patient safety, improving clinical outcomes, and optimizing healthcare resource utilization by ensuring the right information reaches the right person at the right time.

1. Introduction

The modern healthcare landscape is characterized by an unprecedented complexity of diagnostic processes, where timely and accurate diagnosis serves as the cornerstone of effective treatment, patient safety, and optimal clinical outcomes. Diagnostic delays—defined as the interval between the onset of a patient's symptoms or the identification of a potential health issue and the confirmation of a definitive diagnosis—represent a critical and pervasive challenge within global health systems. These delays can have profound and cascading consequences, leading to disease progression, missed windows for early intervention, increased patient morbidity and mortality, heightened patient and family anxiety, and significant escalation in healthcare costs due to the need for more intensive and prolonged treatments [1]. The quest to understand and mitigate the multifactorial causes of diagnostic delays has become a central focus of healthcare quality improvement initiatives worldwide.

While diagnostic errors can stem from cognitive biases, system failures, or technological limitations, a substantial proportion of delays are rooted not in the analytical capabilities of diagnostic technology, but in the intricate, human-centered processes that precede and follow the analytical phase itself. The diagnostic journey is inherently a relay race of information, involving multiple handoffs between various healthcare professionals across different departments. It is within these handoffs—the critical intersections of communication and collaboration—that vulnerabilities emerge. Among the most crucial yet frequently examined interfaces in this chain is the one between nursing staff at the patient's bedside and laboratory professionals operating behind the scenes [2]. Nurses, as the primary executors of physician orders and constant observers of patient condition, are fundamental in initiating the diagnostic pathway through specimen collection, ordering, and clinical context provision. Laboratory scientists and pathologists are the custodians of analytical precision, transforming biological samples into actionable data.

However, these two groups often operate in parallel, sometimes siloed, ecosystems with distinct priorities, terminologies, and pressures. The nursing domain is dynamic, immediate, and patient-focused, often dealing with multiple competing demands. The laboratory environment is detail-oriented, process-driven, and batch-focused, prioritizing analytical integrity and turnaround time metrics. This inherent divergence can create a fertile ground for communication breakdowns. These breakdowns manifest in the pre-analytical phase, which is overwhelmingly responsible for the majority of laboratory errors, estimated to be as high as 70% [3]. Pre-analytical errors—such as mislabeled specimens, improper collection techniques, insufficient volume, inappropriate container use, or delays in transportation—are seldom failures of individual competence. Rather, they are typically systemic failures traceable to ambiguous communication protocols, insufficient knowledge transfer, or flawed information systems linking the point of care to the point of analysis.

The quality of communication between nursing and laboratory staff is, therefore, not a peripheral administrative concern but a central determinant of diagnostic efficiency and patient safety. High-quality communication in this context transcends the mere transmission of data; it encompasses clarity, completeness, timeliness, and a shared understanding of urgency and clinical implication. It involves the accurate relay of patient identifiers, test orders, and special collection instructions from the electronic health record (EHR) or requisition form to the physical specimen. It requires the

nurse's ability to convey critical clinical context—such as the patient's febrile status, recent medication administration, or difficult venous access—that might influence test interpretation or processing priority. Conversely, it necessitates the laboratory's clear communication regarding specimen acceptability, unexpected critical results, test cancellations due to hemolysis or clotting, and anticipated delays [4].

Historically, this communication relied on paper requisitions, handwritten labels, and telephone calls, methods prone to transcription errors, illegibility, and asynchronous delays. The digital transformation of healthcare, primarily through comprehensive Electronic Health Records (EHRs) and Laboratory Information Systems (LIS), promised to revolutionize this interface by creating integrated, standardized, and traceable pathways for test orders and results. While these systems have undoubtedly reduced certain types of errors, they have also introduced new challenges. Alert fatigue from poorly designed electronic alerts, cumbersome interfaces that require excessive clicking, and the persistence of hybrid paper-electronic workflows can sometimes erode rather than enhance effective communication [5]. The human element remains irreplaceable; technology is merely a tool whose efficacy is determined by the quality of the processes and relationships it supports.

The consequences of poor nursing-laboratory communication are direct and measurable. A mislabeled specimen necessitates recollection, delaying diagnosis and potentially causing patient discomfort or harm if acted upon erroneously. An uncommunicated delay in processing a lactate level for a septic patient can directly impact life-saving interventions. A hemolyzed potassium sample, if not promptly flagged and communicated, can lead to a false hyperkalemia alert, triggering unnecessary and potentially dangerous treatment. Each of these scenarios represents a diagnostic delay—a gap in time where uncertainty reigns and clinical decisions are made on incomplete or inaccurate information [6]. Therefore, investing in the quality of this specific interdisciplinary communication channel is a strategic imperative for healthcare institutions aiming to improve diagnostic safety, reduce hospital length of stay, enhance patient satisfaction, and control costs [7, 8].

2. The Central Role of Nursing in the Pre-Analytical Phase

Nursing professionals serve as the indispensable linchpin in the initiation of the diagnostic testing cycle. Their role extends far beyond the technical act of phlebotomy or specimen collection; it encompasses a complex series of cognitive and procedural steps that collectively determine the integrity and utility of the sample sent to the laboratory. This pre-analytical phase, entirely under the purview or direct influence of nursing and allied bedside staff, is the most vulnerable segment of the total testing process. The nurse's responsibilities begin with the correct interpretation of the physician's order, whether electronic or verbal. They must verify patient identity using two unique identifiers, a fundamental safety step that, if compromised, severs the critical link between the specimen and the patient. Following this, the selection of the appropriate collection tube, the utilization of correct technique to avoid hemolysis or contamination, the application of accurate labeling, and the ensuring of proper storage and timely transport are all nursing-driven actions that require meticulous attention to detail and adherence to established protocols [9].

The quality of communication is embedded in each of these tasks. When a nurse receives a complex set of orders—for instance, timed tests, tests requiring special handling like immediate ice slurry transport for ammonia levels, or pharmacokinetic levels—the clarity of the instructions within the EHR or from the ordering provider is paramount. Ambiguity or assumed knowledge can lead to error. Furthermore, nurses are the custodians of crucial clinical context. A laboratory scientist processing a markedly elevated white blood cell count interprets that result differently if they know, via a note on the requisition or in the EHR, that the patient has chronic lymphocytic leukemia versus if they believe it is from a new-onset infection. While some context is embedded in the test order itself, nuances such as "patient spiking fevers," "specimen drawn from a central line," or "difficult stick, possible partial clot" are qualitative data points that originate from the nurse and can significantly guide laboratory handling and preliminary assessment [10]. The failure to communicate this context represents a lost opportunity for diagnostic partnership and can lead to unnecessary repeat testing or misinterpretation.

Moreover, nurses are often the first to recognize the clinical urgency of a test. Their bedside assessment informs their prioritization. Communicating this urgency effectively to the laboratory—not through constant labeling of all specimens as "STAT," which leads to dilution of true priority—but through defined protocols and mutual understanding, ensures that critical samples like those for troponin in suspected myocardial infarction or lactic acid in sepsis are expedited through the laboratory's workflow. This triage function, performed effectively, is a direct

communication-driven intervention that compresses diagnostic time. Studies have shown that pre-analytical errors, largely contingent on nursing practice and communication, are the leading cause of sample rejection and test repetition, directly contributing to diagnostic delays of hours or even days, especially in environments with long transport distances or centralized labs [11]. Therefore, empowering nurses with clear guidelines, continuous education on laboratory medicine principles, and efficient communication tools is not an ancillary task but a core strategy for pre-analytical error reduction.

3. The Laboratory Perspective: From Sample to Result

From the laboratory's vantage point, the incoming specimen is the primary source of information, and the accompanying documentation—whether electronic or paper—is its essential key. Laboratory professionals, including phlebotomists, medical laboratory scientists, and pathologists, operate on principles of standardization, precision, and quality control. Their primary mission is to generate accurate, reliable, and timely results. The quality of the communication they receive with each specimen dictates their ability to fulfill this mission efficiently. An impeccably collected and labeled specimen with clear instructions arrives as a "clean" input, allowing the laboratory process to proceed smoothly. In contrast, a problematic specimen triggers a cascade of communication-dependent actions that consume time and resources, directly inducing diagnostic delay [12].

The laboratory's role in communication is both reactive and proactive. Reactively, they must identify and communicate pre-analytical problems. This includes notifying the nursing unit of a mislabeled or unlabeled specimen (a "specimen rejection"), a clotted sample in a coagulation tube, hemolysis in a potassium sample, or insufficient volume. The efficiency and clarity of this notification process are critical. A lab technician who must make multiple phone calls to find the responsible nurse, or who uses an unclear electronic alert, adds minutes or hours to the delay. Standardized rejection criteria and clear, respectful communication pathways are essential to resolve these issues swiftly. Proactively, laboratories communicate critical results, addendum reports, test delays due to instrument malfunction or reagent shortage, and educational updates on new collection procedures [13].

A significant aspect of laboratory communication is the interpretation of "flags" or comments. When a laboratory scientist notes lipemia in a sample, which can interfere with certain chemistry assays, adding a comment alerts the clinician to a potential reliability issue. However, if the nurse or ordering provider does not understand the implication of that comment, the communication loop fails. Similarly, the laboratory often possesses valuable information about test utilization; they may observe frequent ordering of inappropriate tests or sequential ordering that could be consolidated. Creating formal channels for laboratory scientists to communicate these insights back to the clinical floors—through consultations, newsletters, or interdisciplinary committees—fosters a culture of shared learning and can prevent future delays caused by inappropriate test ordering or collection [14]. The laboratory is not merely a service provider but a consultative partner in the diagnostic process, and its communication must be structured to support that partnership.

4. Channels and Modalities of Communication: Strengths and Limitations

The interface between nursing and the laboratory relies on a variety of communication channels, each with inherent strengths, weaknesses, and implications for diagnostic timeliness. Traditionally, the paper requisition slip accompanied the physical specimen. This method is simple but highly prone to errors: illegible handwriting, missing information, physical separation of the slip from the tube, and transcription errors if data is re-entered manually into the LIS. The telephone has been the classic tool for urgent notifications—critical results, specimen problems, or urgent requests. While direct and synchronous, phone communication has downsides: it interrupts both parties, can lead to verbal miscommunication, often requires call-backs if the right person is unavailable, and lacks an automatic audit trail unless manually documented [15].

The integration of EHRs and LISs has been the most transformative development. Computerized Provider Order Entry (CPOE) theoretically eliminates handwriting errors and can enforce completeness through required fields. Barcode scanning for patient wristbands and specimen tubes links the physical sample to the electronic order with high reliability, drastically reducing identification errors. Electronic alerting for specimen rejections or critical values can be automated, sent directly to the nurse's inbox or mobile device, creating an immediate and traceable record. Results are delivered instantly and simultaneously to all authorized caregivers upon verification. This digital backbone supports

asynchronous communication that is less disruptive and more reliable than paper or phone for routine matters [16].

However, these digital systems are not panaceas. Poor system design can create new barriers. If the process for ordering a rare test is buried in multiple menus, a nurse may guess or delay, causing error or delay. If the interface for adding a clinical comment is cumbersome, the nurse may skip it, depriving the lab of context. "Alert fatigue" is a critical drawback; when laboratories overuse electronic flags or nurses are bombarded with automated notifications of low clinical significance, they begin to ignore all alerts, including the critical ones. This can be catastrophic when a truly life-critical result warning is overlooked. Furthermore, the persistence of "workarounds"—such as printing an electronic order and then handwriting on it, or using personal mobile phones for quick texts about specimens—indicates a mismatch between the designed system and real-world workflow needs. These informal channels, while sometimes efficient, bypass safety checks and audit trails, introducing risk [17]. Therefore, optimizing communication requires carefully designed technology that aligns with human factors and is complemented by clear protocols for when to use which channel (e.g., phone for immediate life-threatening results, electronic alert for all others).

5. Human Factors and Interprofessional Culture

Beyond systems and protocols, the human and cultural dimension of nursing-laboratory interaction is perhaps the most potent determinant of communication quality. Historically, tensions have existed between "the floor" and "the lab," often stemming from a lack of mutual understanding. Nurses may perceive laboratory staff as inflexible bureaucrats who reject samples for minor technicalities without appreciating patient-care realities. Laboratory staff may view nurses as careless or impatient, failing to respect the rigorous scientific protocols necessary for accurate results. These stereotypes, fueled by physical separation and limited interaction, erode the psychological safety required for effective collaboration and open communication [18].

A culture of shared goals and mutual respect is foundational. When both groups see themselves as co-producers of the diagnostic outcome—where the nurse's role is to provide a pristine, context-rich sample, and the lab's role is to transform it into pristine, context-interpreted data—communication becomes a collaborative tool rather than a blame-oriented procedure. Elements of this culture include using respectful language during phone calls, avoiding accusatory tones when problems arise (focusing on "the specimen" rather than "your error"), and expressing appreciation for timely actions. Interprofessional education is a powerful catalyst for this cultural shift. When student nurses spend time in the laboratory understanding the complexity of analytical processes, and when laboratory scientists do clinical rotations to witness the challenges of bedside care, empathy and understanding replace misconception [19].

Teamwork models, such as daily safety huddles that include representatives from both nursing and laboratory departments, can proactively address systemic issues. In these forums, recurring problems like frequent hemolysis from a particular unit or persistent confusion about a new test protocol can be discussed jointly, with frontline staff from both disciplines co-designing the solution. This not only fixes the immediate problem but also strengthens the relational fabric. Furthermore, establishing clear, agreed-upon protocols for escalation paths—defining exactly what constitutes a "critical" result, who must be notified, and within what timeframe—reduces ambiguity and friction. A positive interprofessional culture ensures that when a nurse calls with an urgent request or a lab scientist calls with a critical finding, the interaction is efficient, professional, and focused solely on resolving the patient's issue, thereby minimizing diagnostic delay at the human interface [20].

6. Technological Solutions and Process Improvement Strategies

Advancements in technology and lean process improvement methodologies offer concrete strategies to hardwire quality into the nursing-laboratory communication loop. A primary technological intervention is the optimization of the EHR-LIS integration to be more intelligent and user-centric. This includes implementing "smart" order sets that guide appropriate test selection and automatically display collection instructions. Forcing functions, such as preventing the printing of a label until patient identification is verified by barcode scan, can eliminate certain error types. Advanced middleware can analyze incoming test orders against patient-specific data (e.g., checking if a therapeutic drug level is ordered at the correct time post-dose) and flag potential errors before the sample is even collected [21].

Automation of the pre-analytical phase within the laboratory, using robotic systems for sorting, centrifuging, and aliquoting samples, reduces human handling errors and speeds up processing. However, its benefit is contingent on receiving a

properly labeled and packaged specimen, which again points back to the quality of upstream nursing communication and practice. Track-and-trace systems, using barcodes or RFID tags, allow both nursing and laboratory staff to see the real-time status of a specimen—from collection, to transport, to receipt, to analysis. This transparency manages expectations and allows for proactive intervention if a specimen is delayed in transport [22].

From a process perspective, techniques from Lean and Six Sigma are highly applicable. Value-stream mapping can be used to visually chart the entire journey of a laboratory test, from order to result reporting, identifying every handoff and communication point. This exercise often reveals non-value-added steps, bottlenecks, and unnecessary loops (e.g., a phone call to clarify an order, then a call back to confirm). By streamlining these processes, waste is eliminated, and turnaround time is reduced. Standardized work is another key principle: creating and enforcing identical, best-practice procedures for specimen collection, labeling, and handling across all nursing units eliminates variation, a known precursor to error. Regular performance measurement and feedback, such as sharing unit-specific data on specimen rejection rates or hemolysis rates with nursing teams, create accountability and motivate improvement [23]. These technological and process strategies, when combined, create a more reliable and efficient system that mitigates the communication gaps where delays traditionally occur.

7. Institutional Policies, Education, and Continuous Training

Sustainable improvement in nursing-laboratory communication cannot rely on individual initiative alone; it must be embedded in institutional policy and reinforced through ongoing education. Healthcare organizations must establish clear, organization-wide policies that define standards for specimen management, including uniform labeling requirements, procedures for specimen rejection and recollection, and protocols for critical result reporting. These policies should be developed collaboratively by interdisciplinary committees comprising nursing leadership, laboratory medicine, quality and safety officers, and frontline staff. Such collaboration ensures that policies are practical, evidence-based, and respect the constraints of both clinical and laboratory environments [24].

Education is the vehicle through which these policies become practice. Orientation programs for new nurses and laboratory personnel must include dedicated modules on the importance of their interdependent roles, detailed training on proper procedures, and simulation or role-playing on effective communication scenarios (e.g., how to call a critical value, how to handle a specimen rejection call). This training should not be a one-time event. Continuous professional development is crucial. Laboratories can provide regular in-service sessions on new tests or changed procedures directly to nursing units. Nursing units can invite laboratory staff to meetings to discuss recurring issues. E-learning modules can offer just-in-time refreshers on topics like preventing hemolysis or understanding laboratory alerts [25].

Competency assessment is a critical component. Nurses' technique in specimen collection should be periodically observed and assessed for compliance with best practices. Laboratory staff's communication skills and adherence to notification protocols should also be evaluated. Furthermore, creating forums for shared learning from errors—such as multidisciplinary root cause analysis (RCA) meetings when a significant diagnostic delay occurs—turns incidents into powerful educational opportunities. In these non-punitive settings, nurses and lab staff can jointly dissect the communication breakdowns that contributed to the event and design systemic safeguards to prevent recurrence. This cycle of policy, education, practice, and reflective learning builds a resilient system that actively defends against diagnostic delays [26].

8. Case Studies and Empirical Evidence

The theoretical link between communication quality and diagnostic delay is strongly supported by empirical evidence and documented case studies. Research consistently demonstrates that interventions targeting the nursing-laboratory interface yield measurable improvements. For instance, a pre-post study in a large academic hospital implemented a bundled intervention including standardized labeling education, the introduction of barcode scanning for specimen collection, and a revised electronic rejection process with direct feedback to the collecting nurse. This intervention led to a 65% reduction in specimen identification errors and a corresponding 24% reduction in laboratory turnaround time for corrected specimens, directly compressing the diagnostic delay for affected patients [27].

Another study focused on communication of critical results. A hospital redesigned its critical value reporting policy, moving from a broadcast page to a closed-loop communication protocol requiring verbal read-back to a responsible licensed provider (often a nurse) documented directly in the

EHR. They coupled this with targeted education on critical value definitions. This intervention resulted in a 40% reduction in the time from result verification to clinician acknowledgment and a significant decrease in reporting errors. In a specific case, a critically low hemoglobin result in a post-operative patient was acknowledged and acted upon 90 minutes faster under the new system, allowing for rapid transfusion and potentially averting a catastrophic outcome [28].

Qualitative studies offer deeper insights. Interviews with nurses and laboratory scientists reveal common themes: frustration with ambiguous test instructions in the EHR, appreciation for personal relationships with known lab contacts, and the stress caused by antagonistic interactions during problem resolution. One ethnographic study observed that units with regular social or educational interaction between nursing and lab staff had fewer specimen rejection incidents and more collegial problem-solving when issues did arise, suggesting that relational capital buffers against system imperfections [29]. These cases and studies provide concrete proof that investing in the quality of this specific communication channel delivers a direct return on investment in the currency of time—the most critical resource in diagnosis.

9. Future Directions and Conclusion

The future of nursing-laboratory communication will be shaped by further technological integration, data analytics, and a deepening commitment to a systems-based view of diagnostic safety. Emerging technologies hold great promise. Artificial Intelligence (AI) and machine learning algorithms could be deployed to monitor the entire test order-communication-result cycle in real-time. An AI system could predict the likelihood of a specimen rejection based on ordering patterns, nurse workload data, and historical error rates from a specific unit, prompting a pre-emptive electronic check or alert. It could also intelligently prioritize incoming critical results based on a synthesized analysis of the patient's full clinical picture from the EHR, ensuring the most urgent findings are escalated most rapidly [30].

The Internet of Things (IoT) could revolutionize specimen transport and monitoring. Smart refrigerators on nursing units could track the time a specimen is stored and alert when it is approaching stability limits. GPS-enabled transport containers could provide real-time location data, and sensors within them could monitor temperature, ensuring integrity for sensitive samples. Blockchain technology has been proposed for creating an immutable, transparent audit trail for every step of the specimen's journey, from vein to value, enhancing accountability and traceability [31].

Ultimately, the goal must be the seamless, invisible integration of communication into workflow. The ideal system is one where the transfer of information is so effortless, intuitive, and reliable that it ceases to be a distinct point of effort or failure. This requires continued co-design of systems with end-users from both nursing and laboratory disciplines, relentless focus on human factors engineering, and leadership that champions interprofessional collaboration as a core organizational value. Measuring success must go beyond simple turnaround time metrics to include composite indicators of communication quality, such as first-pass yield (specimens accepted without issue), clinical context provision rates, and staff satisfaction scores from both sides of the interface [32, 33].

10. Conclusion:

In conclusion, diagnostic delay is a multifactorial problem with profound implications for patient care. While often attributed to analytical constraints or clinical reasoning, a critical and remediable source of delay lies in the communication chasm between nursing and laboratory services. This communication is the vital conduit through which clinical suspicion is translated into analyzable material and analytical findings are translated back into clinical action. Its quality directly dictates the speed and fidelity of this translation. By recognizing this interface as a high-risk, high-opportunity subsystem within the diagnostic pathway, healthcare institutions can deploy targeted strategies. These include optimizing information technology with the user in mind, fostering a culture of mutual respect and shared purpose through interprofessional education, standardizing processes based on lean principles, and enforcing best practices through policy and continuous training. The empirical evidence is clear: investments in strengthening nursing-laboratory communication yield significant dividends in reduced errors, faster turnaround times, and, most importantly, shorter paths to accurate diagnosis for patients. In the relentless pursuit of diagnostic excellence, fortifying this human and technological bridge is not merely an option—it is an imperative.

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