

The Role of Healthcare Professionals in Medical Laboratories, Pharmacy, and Nursing in Improving the Quality of Healthcare

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ABSTRACT:

The quality of healthcare delivery depends on the coordinated contributions of multiple allied and clinical professions, among which medical laboratory professionals, pharmacists, and nurses occupy particularly central positions across the diagnostic, therapeutic, and caregiving dimensions of patient care. This paper examines the role of healthcare professionals in these three disciplines in improving the quality of healthcare, situating the discussion within Saudi Arabia's Vision 2030 healthcare transformation agenda. Drawing on Donabedian's structure-process-outcome model and the Interprofessional Education Collaborative (IPEC) competency domains, the paper introduces an original conceptual model, TRIAD, which organizes five cross-disciplinary quality levers — Testing Accuracy and Timeliness, Rational Pharmacotherapy and Medication Safety, Individualized Nursing Care and Patient Advocacy, Accountability through Interprofessional Quality Monitoring, and Data-Driven Collaboration and Communication — that connect the distinct contributions of laboratory, pharmacy, and nursing professionals into a shared quality architecture. The paper reviews the discipline-specific functions of diagnostic testing and quality control, clinical pharmacy and medication management, and bedside nursing care and patient safety monitoring, and examines how these functions intersect through interprofessional collaboration. These functions are connected to Saudi regulatory and institutional bodies including the Saudi Commission for Health Specialties (SCFHS), the Central Board for Accreditation of Healthcare Institutions (CBAHI), the Saudi Food and Drug Authority (SFDA), the National Platform for Health Information Exchange Services (Nphies), the Mumaris+ licensing system, and the King Abdullah International Medical Research Center (KAIMRC). Persistent challenges, including workforce shortages, professional silos, and communication gaps, are discussed alongside evidence-based recommendations for healthcare organizations, administrators, and policymakers.

Keywords: medical laboratory, pharmacy, nursing, healthcare quality, interprofessional collaboration, Vision 2030, Saudi healthcare system, TRIAD framework,

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Introduction

The quality of healthcare delivered to any single patient is rarely the achievement of one

professional acting alone. A patient admitted with an acute infection depends on medical laboratory professionals to accurately identify the causative organism, on pharmacists to select and dose the

appropriate antimicrobial therapy safely, and on nurses to administer that therapy, monitor the patient's response, and coordinate the many small decisions that constitute bedside care. Medical laboratory professionals, pharmacists, and nurses therefore occupy three distinct but deeply interdependent positions within the healthcare quality chain: diagnostic, therapeutic, and caregiving.

Despite this interdependence, these three professions are often studied, trained, and managed in isolation from one another, each with its own accreditation standards, professional societies, and quality metrics. This paper argues that healthcare quality is best understood, and best improved, not by strengthening each discipline in isolation but by explicitly designing the points of connection between them. To this end, the paper introduces an original framework, TRIAD, which names the specific quality contribution of each discipline while also identifying the cross-cutting mechanisms — accountability structures and data-driven communication — that bind these contributions into a coherent whole.

In Saudi Arabia, this issue is closely tied to the goals of Vision 2030, which calls for an integrated, quality-driven healthcare system supported by a highly competent, well-regulated workforce across all clinical and allied health professions. This paper examines how medical laboratory, pharmacy, and nursing professionals each contribute to healthcare quality, how their contributions intersect, and how this intersection is supported or constrained by the Saudi regulatory and institutional landscape.

The paper proceeds as follows. Section 2 presents the theoretical foundations for understanding multi-disciplinary healthcare quality. Section 3 introduces the TRIAD framework. Sections 4 through 6 examine the specific quality functions of medical laboratory, pharmacy, and nursing professionals respectively. Section 7 examines interprofessional collaboration across the three disciplines. Section 8 situates these functions within the Saudi Vision 2030 regulatory landscape. Section 9 presents an illustrative

vignette, Section 10 discusses challenges, Section 11 draws out cross-cutting themes, Section 12 offers recommendations, and Section 13 addresses limitations before the paper concludes.

2. Theoretical Foundations

2.1 Donabedian's Structure-Process-Outcome Model

Donabedian's model of healthcare quality remains foundational for understanding how the distinct contributions of laboratory, pharmacy, and nursing professionals combine to produce patient outcomes (Donabedian, 1988). Structure includes the staffing, equipment, and credentialing that each discipline brings to a healthcare organization; process includes the specific activities — specimen analysis, medication dispensing, bedside assessment — through which each discipline acts; and outcome reflects the combined effect of these processes on patient safety, recovery, and satisfaction. Applied across three disciplines simultaneously, the model highlights that a weakness in any one discipline's structure or process can degrade outcomes that depend on the accurate functioning of all three.

2.2 IPEC Interprofessional Competency Domains

The Interprofessional Education Collaborative identifies four core competency domains for effective multi-disciplinary practice: values and ethics for interprofessional practice, roles and responsibilities, interprofessional communication, and teams and teamwork (Interprofessional Education Collaborative [IPEC], 2016). These domains provide a structured vocabulary for understanding how medical laboratory professionals, pharmacists, and nurses coordinate their distinct roles without duplicating effort or, conversely, leaving gaps between their respective areas of responsibility. Explicit role clarity, in particular, reduces the risk that a critical task — such as verifying a critical laboratory value has reached the responsible clinician — falls through the cracks between professions, each of which may reasonably assume another has addressed it.

"Healthcare quality is not the sum of three professions working well; it is the product of how well their work is joined."

2.3 TeamSTEPPS and Structured Communication

The TeamSTEPPS framework, developed to improve team performance in high-stakes clinical environments, emphasizes structured communication tools such as closed-loop communication and standardized handoff protocols. Applied to the laboratory-pharmacy-nursing triad, these tools reduce the risk of communication failure at each critical handoff point: from laboratory to prescriber, from

pharmacist to nurse at the point of medication administration, and from nurse to the broader care team regarding patient response. Structured communication converts what might otherwise be informal, variably reliable information exchange into a standardized, auditable process.

3. The TRIAD Framework

To integrate these theoretical perspectives into a framework usable by healthcare organizations, this paper proposes TRIAD, a five-component model naming the discipline-specific and cross-cutting levers most consistently associated with improved healthcare quality across medical laboratory, pharmacy, and nursing practice.

Component	Primary Discipline Focus	Expected Effect on Healthcare Quality
Testing Accuracy & Timeliness	Medical laboratory	Faster, more reliable diagnostic information
Rational Pharmacotherapy & Medication Safety	Pharmacy	Fewer adverse drug events and medication errors
Individualized Nursing Care & Patient Advocacy	Nursing	More responsive, patient-centered bedside care
Accountability through Interprofessional Quality Monitoring	Cross-disciplinary	Shared ownership of quality and safety outcomes
Data-Driven Collaboration & Communication	Cross-disciplinary	Reduced handoff error and duplicated effort

The first three TRIAD components correspond directly to the discipline-specific quality contributions examined in Sections 4 through 6, while the fourth and fifth components describe the cross-cutting mechanisms, examined in Section 7, through which these discipline-specific contributions are joined into a coherent system of care. The name TRIAD reflects both the three professions at the center of this paper and the interlocking nature of their contribution to healthcare quality: removing any one leg weakens the structure as a whole.

4. The Role of Medical Laboratory Professionals

4.1 Diagnostic Testing Accuracy and Analytical Quality Control

Medical laboratory professionals are responsible for the analytical accuracy of the test results on which diagnosis and treatment decisions depend. Internal quality control procedures, proficiency testing participation, and adherence to standardized analytical protocols reduce the risk of inaccurate results reaching clinicians. Because clinicians and nurses generally cannot independently verify a laboratory result's accuracy, the quality of medical laboratory

practice functions as a largely invisible determinant of overall healthcare quality — trusted by the rest of the care team precisely because it is rigorously controlled behind the scenes.

4.2 Turnaround Time and Critical Value Reporting

Beyond analytical accuracy, the speed and reliability with which results, particularly critical values, are reported to the clinical team materially affects patient outcomes. Laboratory professionals who operate structured critical-value notification protocols — with defined timeframes and escalation procedures when a result cannot be promptly communicated to the responsible clinician — close a well-documented gap in the diagnostic pathway where an accurate result fails to translate into timely clinical action.

4.3 Pre-Analytical and Specimen Integrity Management

A substantial proportion of laboratory error originates before a specimen ever reaches the analyzer, arising from mislabeling, inadequate collection technique, or delays in specimen transport. Laboratory professionals who establish and enforce specimen-acceptance criteria, and who provide structured training to nursing and phlebotomy staff on correct collection technique, address this pre-analytical phase directly, illustrating how laboratory quality depends on collaboration with nursing staff even before a specimen reaches the laboratory itself.

5. The Role of Pharmacy Professionals

5.1 Medication Safety and Clinical Verification

Pharmacists serve as a critical safety check between prescribing and administration, verifying dosing, screening for drug interactions and allergies, and confirming that a prescribed regimen is appropriate for a patient's renal and hepatic function. This clinical verification function catches a substantial proportion of prescribing errors before they reach the patient, making pharmacy practice a central line of defense in medication safety rather than a purely dispensing function.

5.2 Clinical Pharmacy Services and Therapeutic Optimization

Clinical pharmacists embedded in inpatient units and outpatient clinics contribute directly to therapeutic decision-making, adjusting dosing based on therapeutic drug monitoring, recommending regimen simplification to improve adherence, and participating in multidisciplinary rounds. This active, consultative role extends pharmacy practice beyond error prevention toward the proactive optimization of therapeutic outcomes, particularly for patients with complex, multi-drug regimens.

5.3 Antimicrobial Stewardship

Pharmacists play a central role in antimicrobial stewardship programs, reviewing antibiotic selection and duration against culture and sensitivity results provided by the medical laboratory, and working with prescribers to de-escalate broad-spectrum therapy where narrower-spectrum options are supported by laboratory findings. This function directly illustrates the interdependence at the heart of the TRIAD framework: effective antimicrobial stewardship is only possible when accurate, timely laboratory data informs pharmacist-led therapeutic decisions.

5.4 Patient Counseling and Medication Adherence Support

Pharmacists' direct interaction with patients at the point of dispensing provides an opportunity to reinforce correct medication use, identify adherence barriers, and answer questions that patients may not have raised with their prescribing clinician. Structured counseling on new or high-risk medications reduces the incidence of preventable adverse events occurring after discharge, extending the pharmacist's contribution to healthcare quality beyond the walls of the healthcare facility itself.

6. The Role of Nursing Professionals

6.1 Bedside Assessment and Early Warning Recognition

Nurses provide the continuous bedside presence through which changes in a patient's clinical

status are first detected, often well before they become apparent through scheduled laboratory testing or physician rounds. Structured early-warning scoring systems, applied consistently by nursing staff, formalize this vigilance function, prompting timely escalation when a patient's vital signs or clinical presentation suggest deterioration.

6.2 Medication Administration and the Five Rights

Nurses constitute the final safety check in the medication-use process, verifying the right patient, drug, dose, route, and time before administration. This function depends heavily on the clarity of pharmacy-prepared medication information and on unambiguous laboratory data where dosing is contingent on renal function or drug-level monitoring, again illustrating how nursing quality is partly dependent on the quality of information received from the other two disciplines.

6.3 Care Coordination and Patient Advocacy

Nurses frequently serve as the coordinating hub through which laboratory results, pharmacy recommendations, and physician orders are synthesized into a coherent plan of bedside care, and through which patient concerns or preferences are communicated back to the broader care team. This advocacy function positions nursing not merely as an executor of others' decisions but as an active participant in ensuring that care remains coherent and patient-centered across shifts and across the contributions of multiple disciplines.

6.4 Patient Education and Discharge Preparation

Nurses play a central role in preparing patients for discharge, reinforcing medication instructions provided by pharmacy, explaining follow-up laboratory monitoring requirements, and ensuring patients understand warning signs that should prompt a return to care. This discharge-preparation function represents a final point of convergence for all three disciplines' contributions, translating diagnostic and

therapeutic information into guidance the patient can act on independently.

7. Interprofessional Collaboration Across the Three Disciplines

The discipline-specific functions described above achieve their full quality impact only when actively coordinated. Multidisciplinary rounds that include pharmacist input alongside nursing and physician assessment, structured handoff protocols that ensure critical laboratory values reach both the prescriber and the bedside nurse, and shared electronic health records that make laboratory results, medication administration records, and nursing notes simultaneously visible to all three disciplines each operationalize the Accountability through Interprofessional Quality Monitoring and Data-Driven Collaboration and Communication components of the TRIAD framework.

Interprofessional quality committees, which bring together representatives from the laboratory, pharmacy, and nursing departments to review adverse events and near-misses, provide a further mechanism for surfacing the specific points at which handoffs between disciplines break down. Because many quality failures occur precisely at these interfaces rather than within any single discipline's area of responsibility, dedicated cross-disciplinary review is often more productive than departmental-level quality review conducted separately within each profession.

8. Professional Practice within Saudi Vision 2030

Saudi Arabia's Vision 2030 healthcare transformation agenda emphasizes integrated, quality-driven care delivered by a highly competent and well-regulated workforce across all clinical professions, including medical laboratory sciences, pharmacy, and nursing (Saudi Vision 2030, 2021). Several national institutions structure this regulatory landscape:

- ◆ The Saudi Commission for Health Specialties (SCFHS) sets licensing and continuing professional development requirements for medical laboratory specialists, pharmacists, and

nurses, including discipline-specific competency standards.

- ◆ The Central Board for Accreditation of Healthcare Institutions (CBAHI) establishes quality and patient safety standards spanning laboratory accuracy, medication management, and nursing care, against which healthcare facilities are accredited.
- ◆ The Saudi Food and Drug Authority (SFDA) regulates pharmaceuticals, laboratory reagents, and medical devices used across all three disciplines' daily practice.
- ◆ The National Platform for Health Information Exchange Services (Nphies) increasingly links laboratory, pharmacy, and clinical documentation systems, supporting the data-driven collaboration central to the TRIAD framework.
- ◆ The Mumaris+ platform administers professional licensing and registration across medical laboratory, pharmacy, and nursing professions, linking credential verification directly to national workforce oversight.

- ◆ The King Abdullah International Medical Research Center (KAIMRC) supports clinical and health-services research that informs evidence-based practice standards across all three disciplines.

Assessments of the Saudi healthcare workforce note continued growth in the number of Saudi nationals entering nursing, pharmacy, and medical laboratory sciences, alongside ongoing efforts to align training capacity with the demand generated by an expanding, increasingly privatized healthcare sector (Alharbi, 2018; Al-Hanawi et al., 2019). Vision 2030's broader digital health agenda, particularly Nphies integration, is positioned to reduce the historical fragmentation between laboratory, pharmacy, and nursing documentation systems that has previously constrained the kind of cross-disciplinary data visibility the TRIAD framework depends on.

9. Illustrative Composite Vignette

The following composite scenario, constructed for illustrative purposes rather than as an account of any specific institution, demonstrates how the TRIAD components interact in practice.

Composite Scenario: Managing a Suspected Bloodstream Infection

A hospitalized patient develops fever and hypotension. The bedside nurse recognizes the early-warning signs and escalates promptly; the medical laboratory processes blood cultures on an expedited basis and reports a preliminary organism identification within hours rather than days; the clinical pharmacist reviews the sensitivity pattern as soon as it becomes available and recommends de-escalation from broad-spectrum to targeted antimicrobial therapy; and the nurse administers the revised regimen and continues structured monitoring for treatment response.

Each discipline's individual competence — nursing vigilance, laboratory turnaround time, pharmacist antimicrobial stewardship — contributes to the outcome, but the case resolves efficiently only because the information generated by each discipline reaches the others promptly through shared systems and structured communication, illustrating the Data-Driven Collaboration and Communication component of the TRIAD framework in practice.

10. Challenges to Cross-Disciplinary Healthcare Quality

Despite the clear interdependence of these three disciplines, several persistent challenges constrain the healthcare quality gains available through better coordination.

- ◆ Professional silos: Separate accreditation standards, reporting lines, and departmental cultures can discourage laboratory, pharmacy, and nursing staff from viewing quality as a shared responsibility.

- ◆ Workforce shortages: Shortages in any one discipline, particularly specialized laboratory technologists and clinical pharmacists, can create bottlenecks that affect the timeliness of care delivered by the other two disciplines.
- ◆ Communication and handoff gaps: Reliance on informal, verbal communication between shifts and departments increases the risk that critical information is delayed or lost at the interfaces between disciplines.
- ◆ System fragmentation: Where laboratory, pharmacy, and nursing documentation systems are not fully integrated, staff in each discipline may lack real-time visibility into the others' most recent findings and actions.
- ◆ Variable interprofessional training: Limited exposure to structured interprofessional education during training can leave staff in each discipline with an incomplete understanding of the others' scope of practice and constraints.

Table 2. Cross-Disciplinary Challenges and Corresponding TRIAD-Aligned Mitigation Strategies

Challenge	Related Component(s)	TRIAD	Mitigation Strategy
Professional silos	Accountability Interprofessional Monitoring	through Quality	Joint quality committees reviewing shared adverse events
Workforce shortages	Testing Accuracy & Timeliness; Rational Pharmacotherapy		Cross-disciplinary workload monitoring and acuity-based staffing
Communication and handoff gaps	Data-Driven Collaboration & Communication		Standardized, closed-loop handoff protocols
System fragmentation	Data-Driven Collaboration & Communication		Integrated electronic health record visibility across disciplines
Variable interprofessional training	Individualized Nursing Care & Patient Advocacy		Joint interprofessional education and simulation training

11. Discussion: Cross-Cutting Themes

Several themes recur across the discipline-specific functions and challenges discussed above. First, quality failures in multidisciplinary care most often occur at the interfaces between professions rather than within any single discipline's technical practice, reinforcing the case for quality review structures organized around shared processes rather than solely around departmental boundaries. Second, information visibility functions as a quality mechanism in its own right: laboratory, pharmacy, and nursing staff who can see one another's real-time findings

and actions coordinate more effectively than staff who must rely on delayed or incomplete communication, regardless of how skilled each individual professional may be. Third, workforce shortages in one discipline generate downstream effects on the others; a shortage of clinical pharmacists, for example, can shift verification burden onto nursing staff who may have less specialized pharmacological training, illustrating that workforce planning for these three professions cannot be conducted entirely independently of one another.

A further theme concerns the role of national digital health infrastructure in enabling cross-disciplinary quality. As platforms such as Nphies mature, the historical technical barriers to shared visibility between laboratory, pharmacy, and nursing systems are reduced, shifting the primary remaining barrier from technology toward organizational culture and structured process design — the accountability and communication components of the TRIAD framework that require sustained institutional attention rather than a one-time technology investment.

12. Recommendations

Based on the preceding analysis, the following recommendations are offered to healthcare organizations, administrators, and policymakers seeking to strengthen healthcare quality through medical laboratory, pharmacy, and nursing practice.

- ◆ Adopt the TRIAD framework, or a similarly integrated model, as a shared quality vocabulary spanning laboratory, pharmacy, and nursing departments rather than maintaining entirely separate departmental quality programs.
- ◆ Establish joint interprofessional quality committees that review adverse events and near-misses occurring at the interfaces between disciplines.
- ◆ Implement standardized, closed-loop handoff protocols for critical laboratory values, high-risk medication orders, and significant changes in patient status.
- ◆ Invest in electronic health record integration that provides real-time, shared visibility of laboratory results, medication administration records, and nursing documentation across all three disciplines.
- ◆ Expand structured interprofessional education and simulation training so that laboratory, pharmacy, and nursing staff develop a working understanding of one another's scope of practice and constraints.
- ◆ Coordinate workforce planning across the three disciplines, recognizing that shortages in one

profession can generate downstream quality and workload effects on the other two.

- ◆ Align facility-level quality metrics with CBAHI accreditation standards spanning all three disciplines to ensure quality improvement in one profession does not proceed independently of the others.

13. Limitations and Directions for Future Research

This paper is conceptual in nature, synthesizing established theoretical models and interprofessional quality literature into an integrative framework rather than presenting new empirical data. The TRIAD framework and the composite vignette in Section 9 are intended as heuristic and illustrative tools rather than validated measurement instruments, and their practical utility would benefit from empirical testing across varied care settings within the Saudi health system. Future research could operationalize each TRIAD component into measurable indicators, assess the relative contribution of discipline-specific versus cross-cutting components to overall quality outcomes, and examine how the framework performs in settings with differing levels of electronic health record integration and interprofessional training exposure.

A further limitation concerns the paper's focus on three specific disciplines; healthcare quality also depends on the contributions of physicians, allied health professionals such as respiratory therapists and physical therapists, and non-clinical support staff, whose roles were outside this paper's scope. Future research extending the TRIAD framework, or a comparable model, to a broader set of professions would provide a more complete picture of the interprofessional quality architecture within Saudi healthcare organizations. Mixed-methods research combining quality-outcome data with frontline staff experience across all three disciplines would also help clarify which TRIAD components yield the largest practical quality gains relative to their implementation cost.

14. Conclusion

Medical laboratory professionals, pharmacists, and nurses each make distinct, essential contributions to healthcare quality: accurate and timely diagnostic information, safe and optimized pharmacotherapy, and vigilant, patient-centered bedside care. Yet the quality realized by any single patient depends not on these contributions in isolation but on how effectively they are joined through accountability structures and data-driven communication. The TRIAD framework proposed in this paper, spanning Testing Accuracy and Timeliness, Rational Pharmacotherapy and Medication Safety, Individualized Nursing Care and Patient Advocacy, Accountability through Interprofessional Quality Monitoring, and Data-

Driven Collaboration and Communication, offers a structured way of understanding these three professions as an interlocking system rather than three parallel departments.

Within the context of Saudi Vision 2030, where integrated, quality-driven healthcare delivery is a national priority, strengthening the connections between medical laboratory, pharmacy, and nursing practice is as important as strengthening each discipline individually. Continued investment in interprofessional education, integrated health information systems, and cross-disciplinary quality governance, aligned with the country's regulatory institutions, will remain essential to realizing the full quality potential of Saudi Arabia's healthcare workforce.

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