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The Impact of Collaboration Among Radiology, Medical Laboratory, Nursing, and Healthcare Administration Professionals on Patient Care and Healthcare Quality

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ABSTRACT:

Background: Modern patient care depends on a chain of interdependent professional contributions. Diagnostic imaging and laboratory medicine inform the majority of clinical decisions, nurses translate those decisions into continuous bedside care, and healthcare administrators design the structures, resources, and information systems within which all of this occurs. Failures at the interfaces between these groups, rather than within any single discipline, are a recurring source of diagnostic delay, adverse events, and inefficiency.

Objective: This paper examines how collaboration among radiology, medical laboratory, nursing, and healthcare administration professionals influences patient care and healthcare quality, with particular attention to the Saudi healthcare system under Vision 2030.

Methods: An integrative narrative review synthesized evidence from patient safety science, laboratory and radiology error research, interprofessional collaboration literature, and Saudi health policy documents, interpreted through Donabedian's structure–process–outcome model, Reason's Swiss cheese model, the IPEC core competencies, and TeamSTEPPS.

Findings: Collaborative practice is associated with fewer pre- and post-analytical errors, more reliable communication of critical results, shorter turnaround times, improved diagnostic accuracy, better patient experience, and more efficient resource use. Principal

barriers include professional silos, hierarchical cultures, fragmented information systems, workforce pressures, and misaligned performance metrics.

Contribution: The paper proposes the **UNITE framework** — Unified communication, Networked diagnostic workflows, Interprofessional role clarity, Technology-enabled integration, and Evaluation for continuous improvement — together with implementation strategies and key performance indicators aligned with CBAHI standards and the Health Sector Transformation Program.

1. INTRODUCTION

Healthcare has become one of the most knowledge-intensive and interdependent activities in modern society. A single episode of inpatient care may involve dozens of professionals, hundreds of discrete decisions, and a continuous flow of information between clinical units, diagnostic departments, and management functions. Within this system, four professional groups occupy particularly critical and interconnected positions: **radiology professionals**, who generate and interpret diagnostic images; **medical laboratory professionals**, who produce the analytical data underpinning diagnosis, monitoring, and treatment; **nurses**, who provide continuous bedside care and often initiate, collect, and act upon diagnostic requests; and **healthcare administrators**, who shape the structures, resources, workflows, and cultures that determine whether the other three can work together effectively.

The landmark reports of the Institute of Medicine, *To Err Is Human* (2000) and *Crossing the Quality Chasm* (2001), shifted attention from individual blame toward system design, arguing that most errors arise from flawed processes and poorly coordinated teams rather than from incompetent individuals. Subsequent work by the National Academies of Sciences, Engineering, and Medicine (2015) on diagnostic error went further, explicitly framing diagnosis as a team activity that extends beyond the physician to include radiologists, laboratory scientists, nurses, and the organizations that support them.

This reframing places collaboration at the centre of the quality agenda. Evidence from laboratory medicine illustrates the point. Studies of the total testing process have consistently shown that the majority of laboratory errors occur not in the analytical phase, where laboratories exercise the greatest technical control, but in the pre-analytical and post-analytical phases — during test ordering, patient identification, specimen collection, transport, and the communication and interpretation of results (Carraro & Plebani, 2007; Plebani, 2010).

These phases are precisely the points at which laboratory staff, nurses, physicians, and administrative systems intersect. A comparable pattern is found in radiology, where incomplete clinical information on requests, inadequate patient preparation, and failures in communicating significant findings contribute substantially to discrepancies and delays (Brady, 2017).

Most diagnostic and treatment failures do not originate inside a single department; they emerge at the handoffs between departments — which is where collaboration either succeeds or breaks down.

In the Kingdom of Saudi Arabia, these issues carry particular weight. The Health Sector Transformation Program under Vision 2030 seeks to restructure the system around accountable care, integrated health clusters, value-based models, and digital health, while expanding access and improving quality (Rahman & Al-Borie, 2021). Such reforms depend on professionals working across traditional boundaries.

The Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) standards, the professional regulation of the Saudi Commission for Health Specialties (SCFHS), and national digital infrastructure such as Nphies all create both expectations and enabling conditions for more integrated practice. This paper therefore addresses the following questions:

- (1) What are the distinctive contributions and interdependencies of radiology, laboratory, nursing, and administration professionals?
- (2) Through which mechanisms does collaboration among them affect patient care and healthcare quality?

(3) What barriers impede such collaboration, particularly in the Saudi context? and (4) What practical framework can guide healthcare organizations in strengthening it?

2. CONCEPTUAL AND THEORETICAL FOUNDATIONS

2.1 Defining Interprofessional Collaboration

The World Health Organization (2010) defines collaborative practice as occurring when multiple health workers from different professional backgrounds work together with patients, families, carers, and communities to deliver the highest quality of care. Collaboration is distinct from mere co-location or sequential task completion: it implies shared goals, mutual understanding of roles, open communication, joint problem-solving, and shared responsibility for outcomes. D'Amour and colleagues (2005) identified sharing, partnership, interdependency, and power as core concepts, emphasizing that collaboration is a dynamic process shaped by relationships and organizational context rather than a fixed state.

2.2 Donabedian's Structure–Process–Outcome Model

Donabedian's (1988) model provides the organizing logic for this paper. **Structure** encompasses the organizational arrangements, staffing, equipment, and information systems — largely the domain of healthcare administration. **Process** refers to what is actually done in giving and receiving care, including test ordering, specimen collection, imaging acquisition, result communication, and nursing interventions. **Outcome** refers to the effects on patients' health status, safety, and experience. Collaboration can be understood as a quality attribute of processes that is enabled or constrained by structures and that ultimately manifests in outcomes.

2.3 Reason's Swiss Cheese Model

Reason's (2000) model conceptualizes organizational defences as successive slices of cheese, each with holes representing latent conditions and active failures. Harm occurs when holes momentarily align. In diagnostic pathways, the slices include correct test ordering, positive patient identification, proper specimen or patient preparation, analytical quality, timely reporting, and appropriate clinical action. Each slice is typically "owned" by a different profession. Collaboration functions by making the slices mutually aware: a nurse who understands laboratory rejection criteria, or a radiographer who can verify clinical information with the ward, closes holes that neither discipline could close alone.

2.4 IPEC Competencies and TeamSTEPPS

The Interprofessional Education Collaborative (IPEC, 2016) specifies four competency domains: values and ethics for interprofessional practice, roles and responsibilities, interprofessional communication, and teams and teamwork. TeamSTEPPS, developed by the Agency for Healthcare Research and Quality and the U.S. Department of Defense, translates these competencies into trainable behaviours organized around team structure, communication, leadership, situation monitoring, and mutual support, using tools such as SBAR, check-back, and structured briefings (King et al., 2008). Together these frameworks offer both a vocabulary and an operational toolkit for collaboration among diagnostic, nursing, and administrative professionals.

2.5 Job Demands–Resources Perspective

The Job Demands–Resources (JDR) model adds a workforce dimension. High workloads, time pressure, and role ambiguity are demands that deplete energy and increase error risk, whereas social support, autonomy, and clear communication are resources that buffer strain and foster engagement. Effective interprofessional collaboration acts as a job resource: when radiology, laboratory, and nursing staff can rely on one another and on responsive management, demands become more manageable. Conversely, poor collaboration becomes an additional demand, generating rework, conflict, and frustration.

3. PROFESSIONAL ROLES AND INTERDEPENDENCIES

Understanding the impact of collaboration requires first appreciating what each group contributes and where their work depends on the others. Table 1 summarizes these contributions and key interfaces.

Table 1. Contributions and interdependencies of the four professional groups

Profession	Core Contribution	Key Dependencies on Others	Typical Interface Risks
Radiology (radiologists, radiographers, sonographers)	Image acquisition, interpretation, interventional procedures, radiation safety	Accurate clinical information and patient preparation from nursing; scheduling and equipment from administration; lab values (e.g., renal function before contrast)	Incomplete requests, wrong-patient imaging, missed contrast precautions, delayed critical findings
Medical Laboratory (scientists, technologists)	Analytical testing, quality control, critical value notification, transfusion safety	Correct collection, labelling, and transport by nursing; information systems and staffing from administration	Haemolysed or mislabelled samples, delayed transport, unacknowledged critical results
Nursing	Continuous assessment, specimen collection, patient preparation and education, acting on results	Timely, clear results from lab and radiology; adequate staffing and systems from administration	Workload-driven shortcuts, missed follow-up, communication overload
Healthcare Administration	Strategy, staffing, budgeting, workflow design, IT systems, quality governance, accreditation	Frontline data and feedback from all clinical groups to guide decisions	Siloed metrics, under-resourcing of interfaces, disconnection from frontline realities

3.1 Radiology Professionals

Diagnostic imaging has become indispensable across emergency, inpatient, and outpatient care. Radiologists synthesize images with clinical context, and the quality of that context directly affects interpretive accuracy. Brady (2017) notes that while day-to-day real-time discrepancy rates in radiology are estimated at approximately 3–5%, retrospective review of abnormal studies can reveal considerably higher rates, and many discrepancies are linked to system factors such as workload, interruptions, and inadequate clinical information. Radiographers and sonographers, meanwhile, interact directly with patients and nursing staff, relying on nurses for patient preparation, mobility assistance, intravenous access, and confirmation of allergies or pregnancy status.

3.2 Medical Laboratory Professionals

Laboratory results are frequently cited as informing a large share of clinical decisions, from diagnosis and risk stratification to therapeutic drug monitoring. Laboratory professionals maintain analytical quality through internal quality control and external quality assessment, yet their greatest vulnerabilities lie outside the laboratory walls.

In a well-known study of a stat laboratory, Carraro and Plebani (2007) found that approximately 62% of errors occurred in the pre-analytical phase and about 23% in the post-analytical phase, with only 15% arising during analysis. Because specimen collection is commonly performed by nurses, and because results are acted upon by clinical teams, laboratory quality is inherently a collaborative achievement.

3.3 Nursing Professionals

Nurses are the constant presence at the bedside and the connective tissue of the care system. They identify patients, collect specimens, prepare patients for imaging, monitor for contrast reactions, communicate results to physicians, and educate patients about procedures. They are frequently the first to notice a deteriorating patient and to escalate for urgent diagnostics. This central position makes nurses indispensable partners for both diagnostic departments, but it also exposes them to high workload and information overload, which can compromise the reliability of diagnostic processes when collaboration structures are weak.

3.4 Healthcare Administration Professionals

Healthcare administrators rarely touch patients directly, yet their decisions shape every clinical interaction. They determine staffing levels and skill mix, invest in laboratory information systems (LIS), radiology information systems (RIS), picture archiving and communication systems (PACS), and electronic health records (EHR), design patient flow, set performance indicators, and lead accreditation efforts. Administrators also influence organizational culture — whether reporting of errors is encouraged, whether interdepartmental conflict is resolved constructively, and whether collaboration is recognized and rewarded. In this sense, administration provides the "structure" in Donabedian's model that enables or inhibits collaborative "process".

4. COLLABORATION ACROSS THE DIAGNOSTIC–THERAPEUTIC PATHWAY

The diagnostic–therapeutic pathway can be viewed as a loop comprising request, preparation, execution, interpretation, communication, action, and follow-up. Each step involves more than one professional group, and the quality of the whole depends on the quality of the handoffs. Table 2 maps these steps against the collaborating professions and representative collaborative practices.

Table 2. Collaboration across the diagnostic–therapeutic pathway

Pathway Stage	Primary Collaborators	Collaborative Practice Example
1. Request / ordering	Physicians, nursing, radiology, laboratory	Clinical decision support, appropriateness criteria, complete clinical information on requests
2. Preparation & collection	Nursing, laboratory, radiology	Two-identifier patient ID, standardized collection protocols, contrast and pregnancy screening checklists
3. Transport & scheduling	Nursing, laboratory, administration	Pneumatic tube systems, tracked specimen logistics, coordinated imaging slots
4. Analysis & acquisition	Laboratory, radiology	Quality control, dose optimization, protocol selection with clinical input
5. Interpretation & reporting	Radiologists, laboratory scientists	Structured reporting, interpretive comments, multidisciplinary review
6. Communication of results	Laboratory, radiology, nursing, physicians	Closed-loop critical result notification with read-back and documentation
7. Action & follow-up	Nursing, physicians, administration	Result acknowledgement tracking, escalation pathways, audit of follow-up

4.1 The Pre-Analytical and Pre-Imaging Interface

The most error-prone phase of the diagnostic pathway is the one that precedes technical work. Mislabelled specimens, haemolysis from difficult collection technique, incorrect tube selection, and delayed transport all compromise laboratory results

before they are produced. Hawkins (2012) argued that laboratories must extend their quality management beyond their own walls into these phases, which requires partnership with nursing and administration. In radiology, analogous risks include imaging the wrong patient or body part, inadequate fasting or bowel preparation, and failure to identify contraindications such as impaired renal function before iodinated contrast or implanted devices before magnetic resonance imaging. Joint protocols, shared training, and real-time consultation channels between nursing and diagnostic staff substantially reduce these risks.

4.2 Communication of Critical Results

Communication of critical laboratory values and urgent imaging findings represents the point at which diagnostic information either reaches clinical action or is lost. International patient safety goals have long emphasized timely reporting of critical results. Effective practice relies on closed-loop communication: the laboratory scientist or radiologist conveys the result, the receiving nurse or physician reads it back, and the exchange is documented with time stamps. Failures commonly stem from ambiguous responsibility, unreachable recipients, shift changes, and alert fatigue. Lingard and colleagues (2004), studying operating room teams, found that roughly 30% of procedurally relevant communications failed because of problems with timing, content, purpose, or audience — failure categories directly transferable to diagnostic communication. Structured tools such as SBAR and agreed escalation hierarchies are therefore central collaborative mechanisms.

4.3 Interpretation, Consultation, and Multidisciplinary Review

Collaboration also enhances the intellectual work of diagnosis. Radiologists and laboratory scientists who receive relevant clinical information produce more accurate and clinically useful interpretations, and clinicians who can consult them directly make better decisions about further testing. Multidisciplinary meetings — tumour boards, infection control committees, and diagnostic discrepancy conferences — bring radiology, laboratory, nursing, and management representatives together to integrate findings, learn from errors, and plan care. Such forums convert individual expertise into collective intelligence.

4.4 Administrative Orchestration of the Pathway

Administrators orchestrate the pathway through investment and design decisions: integrating LIS, RIS, PACS, and EHR platforms so that orders and results flow without transcription; configuring electronic alerts and acknowledgement tracking; ensuring staffing covers peak demand in emergency departments and night shifts; and establishing governance structures such as diagnostic quality committees. When administration treats the pathway as a single end-to-end process rather than a series of departmental budgets, collaboration becomes structurally embedded rather than dependent on individual goodwill.

5. IMPACT ON PATIENT CARE OUTCOMES

5.1 Patient Safety

Patient safety is the most direct beneficiary of collaboration. Two decades after *To Err Is Human*, Bates and Singh (2018) concluded that although progress has been made, preventable harm remains common and that system-level interventions — including improved teamwork and communication — are among the most promising strategies. In diagnostic services, collaborative practices such as positive patient identification at collection and imaging, shared contrast safety protocols, and closed-loop communication of critical results directly prevent wrong-patient events, transfusion errors, contrast reactions, and missed critical diagnoses. Collaboration also supports a just culture in which near misses are reported across departmental lines and used for learning rather than blame.

5.2 Diagnostic Accuracy and Timeliness

Diagnostic error is a major and under-recognized source of harm. Singh, Meyer, and Thomas (2014) estimated that approximately 5% of U.S. adults experience a diagnostic error in outpatient care each year. Many such errors involve breakdowns in test ordering, interpretation, or follow-up — processes that span radiology, laboratory, nursing, and administrative systems. Collaborative mechanisms improve accuracy by ensuring appropriate test selection, high-quality specimens and images, informed interpretation, and reliable follow-up. They also improve timeliness: coordinated specimen logistics and imaging scheduling shorten turnaround times, which is critical in time-sensitive conditions such as sepsis, stroke, acute coronary syndromes, and trauma.

Timely, accurate diagnosis is not the product of one expert reading one result — it is the product of a reliable system in which every handoff is owned and closed.

5.3 Continuity and Coordination of Care

Patients move between emergency departments, wards, intensive care units, and outpatient clinics, and their diagnostic information must move with them. Collaboration among nurses, diagnostic professionals, and administrators ensures that pending results are tracked across transitions, that incidental imaging findings are communicated and followed up, and that serial laboratory monitoring is coherent. Poor coordination at transitions is a well-documented source of missed results and duplicated tests, both of which affect patient outcomes and costs.

5.4 Patient Experience and Engagement

Patients experience diagnostic services as a sequence of encounters: waiting for a blood draw, being transported for a scan, receiving explanations, and awaiting results. When nursing and diagnostic staff coordinate preparation and communicate consistently, patients experience fewer repeat punctures, fewer cancelled scans, less waiting, and clearer information. Collaborative teams are also better positioned to engage patients as partners, for example by explaining the purpose of tests and encouraging patients to confirm their identity and report allergies — an important additional safety layer.

5.5 Evidence on Collaborative Interventions

Systematic reviews support the general proposition that interprofessional collaboration improves care, though with methodological caveats. A Cochrane review by Reeves and colleagues (2017) found that practice-based interventions to improve interprofessional collaboration may slightly improve functional status, adherence to recommended practices, and use of healthcare resources, while noting that the certainty of evidence was generally low. Rosen and colleagues (2018) reviewed the science of teamwork in healthcare and concluded that teamwork training and structured communication are associated with improvements in clinical processes and, in many settings, patient outcomes. The evidence thus supports collaboration as a sound strategy, while highlighting the need for rigorous local evaluation.

6. IMPACT ON HEALTHCARE QUALITY AND ORGANIZATIONAL PERFORMANCE

The Institute of Medicine (2001) defined six aims for healthcare quality: safe, effective, patient-centred, timely, efficient, and equitable. Collaboration among radiology, laboratory, nursing, and administration contributes to each, as summarized in Table 3.

Table 3. Collaboration mapped to the Institute of Medicine's six quality aims

IOM Quality Aim	Contribution of Interprofessional Collaboration
Safe	Fewer identification errors, safer contrast and transfusion practices, reliable critical result communication
Effective	Appropriate test selection, evidence-based protocols, informed interpretation
Patient-centred	Coordinated preparation, consistent explanations, fewer repeat procedures
Timely	Reduced turnaround times through coordinated logistics and scheduling
Efficient	Less duplication, fewer rejected samples and repeat scans, optimized staffing and equipment use
Equitable	Standardized pathways that reduce variation between units, shifts, and facilities

6.1 Efficiency and Resource Utilization

Rejected specimens, repeated imaging, and duplicated tests consume staff time, consumables, equipment capacity, and patient goodwill. Collaboration reduces this waste: shared training in collection technique reduces haemolysis and rejection; appropriateness guidance developed jointly by radiology and clinical teams reduces low-value imaging; and integrated information systems prevent duplicate orders. Kaplan and Porter (2011) argued that understanding the full cycle cost of care, rather than departmental costs in isolation, is essential for improving value — a perspective that naturally favours cross-departmental collaboration led by administration.

6.2 Accreditation and Regulatory Compliance

Accreditation standards increasingly assess interdepartmental processes rather than departments in isolation. Alkhenizan and Shaw (2011), in a systematic review, found consistent evidence that accreditation programs improve process-of-care measures and clinical outcomes. In Saudi Arabia, CBAHI's national hospital standards address patient identification, critical results, diagnostic services, and quality management — domains that cannot be satisfied by a single department. Collaborative governance, shared policies, and joint audits make compliance a by-product of good practice rather than a periodic inspection exercise.

6.3 Workforce Engagement and Retention

Collaboration also affects the people who deliver care. Environments characterized by respectful communication, clear roles, and mutual support are associated with higher job satisfaction and lower burnout, consistent with the JDR model. Conversely, chronic interdepartmental friction — disputes over rejected samples, delayed portering, or unanswered phone calls — erodes morale. Given the importance of workforce development and localization in Saudi Arabia (Al-Hanawi et al., 2019), cultivating collaborative cultures is also a retention strategy.

6.4 Organizational Learning and Continuous Improvement

Organizations learn when information about performance flows across boundaries. Joint review of incident reports, turnaround time data, and diagnostic discrepancies allows radiology, laboratory, nursing, and administration to identify root causes that span departments and to design shared countermeasures. Collaborative quality improvement projects using Plan–Do–Study–Act cycles are especially effective when the team includes representatives from every step of the pathway.

7. BARRIERS TO EFFECTIVE COLLABORATION

Despite its benefits, collaboration among these four groups faces persistent obstacles:

- ◆ **Professional silos and identity:** Distinct training pathways, departmental structures, and professional cultures foster in-group loyalty and limited understanding of other roles, so that diagnostic departments may be perceived by wards as "service providers" rather than partners.
- ◆ **Hierarchy and power imbalances:** Steep hierarchies discourage junior staff, technologists, and nurses from questioning orders or escalating concerns, which weakens the safety barriers described in Reason's model.
- ◆ **Fragmented information systems:** Poorly integrated LIS, RIS, PACS, and EHR platforms force manual transcription and telephone communication, increasing error risk and workload.
- ◆ **Workload and staffing pressures:** High patient volumes and staff shortages push professionals toward task completion rather than communication, and collaboration is often the first casualty of time pressure.
- ◆ **Misaligned performance metrics:** When departments are evaluated only on internal indicators (e.g., analytical turnaround rather than order-to-result time), incentives work against end-to-end optimization.
- ◆ **Limited interprofessional education:** Most professionals are trained separately and have few structured opportunities to learn with, from, and about one another.
- ◆ **Diverse workforce and communication styles:** Multinational, multilingual teams — common in the Gulf region — enrich care but can introduce variability in communication norms and terminology.

8. THE SAUDI ARABIAN CONTEXT AND VISION 2030

Saudi Arabia is undergoing one of the most ambitious health system transformations in the region. The Health Sector Transformation Program aims to improve access, quality, and efficiency by reorganizing services into regional health clusters, expanding the role of the private sector, strengthening prevention, and accelerating digital health (Rahman & Al-Borie, 2021). Several features of this transformation are directly relevant to interprofessional collaboration.

8.1 Health Clusters and Integrated Care

The shift to health clusters that serve defined populations across primary, secondary, and tertiary care requires diagnostic services to operate as networks rather than isolated hospital departments. Shared laboratory hubs, teleradiology, and cluster-wide protocols make collaboration among laboratory, radiology, nursing, and cluster management essential for consistent quality.

8.2 Digital Health Infrastructure

National initiatives in electronic health records, the Nphies platform for health insurance transactions, virtual care services such as the Seha Virtual Hospital, and expanding teleradiology create opportunities for seamless information exchange. Realizing these opportunities requires administrators to prioritize interoperability and clinical professionals to participate in system design so that digital workflows support, rather than disrupt, collaborative practice.

8.3 Regulation, Accreditation, and Workforce Development

CBAHI accreditation establishes shared standards for patient safety and quality across institutions, while the SCFHS regulates professional classification, registration, and continuing professional development for radiology, laboratory, and nursing professionals. The SFDA oversees medical devices and diagnostics, including laboratory reagents and imaging equipment. Research institutions such as KAIMRC contribute to the local evidence base. Workforce development programs and the localization of healthcare jobs create an opportunity to embed interprofessional competencies in training from the outset (Al-Hanawi et al., 2019).

8.4 Contextual Challenges

Challenges include rapid growth in service demand, uneven distribution of specialized staff between urban and rural regions, a diverse expatriate workforce with varied training backgrounds, and the organizational change burden of simultaneous reforms. These challenges make deliberate investment in collaboration — rather than assuming it will emerge spontaneously — particularly important.

9. THE UNITE FRAMEWORK

Building on the evidence and theories reviewed, this paper proposes the **UNITE framework** as a practical model for strengthening collaboration among radiology, laboratory, nursing, and administration professionals. The framework comprises five interlocking pillars, each linked to Donabedian's structure–process–outcome logic and to the IPEC competency domains.

THE UNITE FRAMEWORK

- U Unified Communication** — Standardized, closed-loop communication across all diagnostic handoffs
- N Networked Diagnostic Workflows** — End-to-end pathway design from order to follow-up
- I Interprofessional Role Clarity** — Shared understanding of roles, responsibilities, and escalation
- T Technology-Enabled Integration** — Interoperable LIS, RIS, PACS, and EHR with decision support
- E Evaluation for Continuous Improvement** — Shared metrics, joint audit, and learning from events

Table 4. Operationalizing the UNITE framework

Pillar	Objective	Core Strategies	Lead Responsibility
U — Unified Communication	Ensure every critical message is received, understood, and acted upon	SBAR, read-back, critical result escalation hierarchy, interdepartmental hotlines, bilingual terminology glossaries	Laboratory, radiology, nursing jointly
N — Networked Workflows	Optimize the entire pathway rather than individual departments	Value-stream mapping, joint collection and preparation protocols, coordinated transport and scheduling	Administration with clinical leads
I — Role Clarity	Eliminate ambiguity at handoffs	RACI matrices for diagnostic processes, interprofessional education, cross-departmental shadowing	Nursing and diagnostic leadership
T — Technology Integration	Remove manual and fragmented information flows	LIS–RIS–PACS–EHR interoperability, electronic ordering with decision support, acknowledgement tracking, barcode identification	Administration and health informatics
E — Evaluation	Create a shared learning system	Joint dashboards, multidisciplinary incident review, PDSA cycles, CBAHI-aligned audits	Quality department with all groups

The pillars are mutually reinforcing. Technology integration (T) supports unified communication (U) by automating alerts and documentation; role clarity (I) ensures that networked workflows (N) have clear owners; and evaluation (E) provides the feedback that sustains improvement in all other pillars. Administration plays a distinctive enabling role across the framework, providing the structural conditions — resources, governance, systems, and culture — without which clinical collaboration cannot be sustained.

10. IMPLEMENTATION STRATEGIES AND KEY PERFORMANCE INDICATORS

10.1 Phased Implementation

Implementation of UNITE is best approached in phases. In the **assessment phase**, organizations map current diagnostic pathways, review incident data, survey staff perceptions of collaboration, and benchmark key indicators. In the **design phase**, interprofessional working groups develop joint protocols, communication standards, and role matrices, while administration prioritizes system integration. In the **deployment phase**, changes are piloted in high-risk areas such as emergency departments and intensive care units, supported by TeamSTEPPS-based training. In the **sustainment phase**, joint dashboards, regular multidisciplinary reviews, and recognition of collaborative achievements embed new practices in routine operations.

10.2 Leadership and Culture

Leadership commitment is decisive. Executives and department heads should model respectful interprofessional communication, include diagnostic and nursing representatives in decision-making forums, and treat interdepartmental problems as shared system issues. Establishing a diagnostic excellence committee with representation from all four groups provides a formal home for collaboration.

10.3 Measuring Impact

Measurement should focus on end-to-end performance rather than departmental outputs. Table 5 proposes indicators across Donabedian's three dimensions.

Table 5. Key performance indicators for collaborative diagnostic care

Dimension	Indicator	Purpose
Structure	Degree of LIS/RIS/PACS/EHR integration; proportion of staff completing interprofessional training	Assess enabling conditions
Structure	Existence of joint protocols and RACI matrices for diagnostic processes	Confirm role clarity
Process	Specimen rejection rate; haemolysis rate; mislabelled specimen rate	Monitor pre-analytical quality
Process	Critical result notification within target time with documented read-back	Monitor communication reliability
Process	Order-to-result turnaround time (laboratory and imaging)	Monitor end-to-end timeliness
Process	Imaging cancellation or repeat rate due to inadequate preparation	Monitor nursing–radiology coordination
Outcome	Diagnostic-related adverse events and near misses	Assess safety impact
Outcome	Patient satisfaction with diagnostic services; staff collaboration climate scores	Assess experience and culture

11. RECOMMENDATIONS

11.1 For Healthcare Administrators

- ◆ Adopt end-to-end diagnostic pathway metrics and hold departments jointly accountable for shared outcomes.
- ◆ Prioritize investment in interoperable information systems, barcode patient identification, and electronic acknowledgement of critical results.
- ◆ Establish interprofessional governance structures, such as a diagnostic excellence committee, and allocate protected time for collaborative quality improvement.

11.2 For Radiology and Laboratory Leaders

- ◆ Extend quality management into pre- and post-analytical phases through outreach, training, and feedback to clinical units.
- ◆ Provide accessible consultation channels and interpretive guidance to nurses and physicians.
- ◆ Share performance data transparently with clinical partners and co-design improvement initiatives.

11.3 For Nursing Leaders

- ◆ Integrate specimen collection, patient preparation, and critical result handling into nursing competency programs, developed jointly with diagnostic departments.
- ◆ Ensure staffing models account for diagnostic workload and empower nurses to escalate concerns across professional lines.

11.4 For Policymakers and Educators

- ◆ Embed IPEC competencies in undergraduate curricula and SCFHS-accredited continuing professional development for all four professions.
- ◆ Strengthen CBAHI standards and national indicators that assess interdepartmental processes, and support local research on collaboration outcomes in Saudi facilities.

12. CONCLUSION

Collaboration among radiology, medical laboratory, nursing, and healthcare administration professionals is not a peripheral nicety but a core determinant of patient care and healthcare quality. The evidence reviewed shows that the most frequent and consequential failures in diagnostic and therapeutic pathways occur at the interfaces between professions — during test ordering, specimen collection, patient preparation, result communication, and follow-up. Strengthening these interfaces improves safety, diagnostic accuracy, timeliness, efficiency, and patient experience, while also supporting workforce engagement and regulatory compliance.

Viewed through Donabedian's model, administration supplies the structures that make collaborative processes possible, and those processes in turn produce better outcomes. Reason's model reminds us that each profession owns a layer of defence, and collaboration aligns those layers so that their weaknesses do not coincide. The UNITE framework translates these insights into five practical pillars — unified communication, networked workflows, interprofessional role clarity, technology-enabled integration, and evaluation for continuous improvement.

For Saudi Arabia, the ongoing transformation under Vision 2030 offers a unique opportunity to embed collaboration into new health clusters, digital platforms, accreditation standards, and workforce programs from the outset. Organizations that deliberately invest in collaboration will be better positioned to deliver the safe, efficient, and patient-centred care that the transformation envisions. Future research should evaluate collaborative interventions within Saudi institutions using robust designs and patient-centred outcome measures.

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