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The Role of Medical Laboratory, Pharmacy, Paramedic, Nursing, and Health Information Professionals in Supporting Patient Care and Improving Health Outcomes

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ABSTRACT: Contemporary health systems increasingly recognize that safe, effective, and patient-centered care is not the product of any single discipline but the outcome of coordinated action across the full allied health and clinical workforce. This paper examines the distinct yet interdependent contributions of five professional groups — medical laboratory professionals, pharmacists, paramedics, nurses, and health information management (HIM) professionals — to patient care and health outcomes. Drawing on Donabedian's structure-process-outcome model, the TeamSTEPPS framework, and the Interprofessional Education Collaborative (IPEC) competency domains, the paper develops an original conceptual model, SPARC (Surveillance, Pharmacotherapy, Acute Response, Recovery and Care Coordination, and Continuity of Information), to illustrate how each profession's core function integrates into a single continuum of patient safety and quality. The discussion is situated within the Saudi Arabian healthcare landscape, referencing regulatory and institutional structures including the Saudi Commission for Health Specialties (SCFHS), the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI), the Saudi Food and Drug Authority (SFDA), the Nphies platform, and the Mumaris+ licensing system, and considers how Vision 2030 workforce and digital transformation goals are reshaping interprofessional practice. The paper concludes with a discussion of persistent challenges — professional silos, workload pressures, and interoperability gaps — and offers recommendations for strengthening collaborative practice, competency-based education, and health information governance to sustain measurable improvements in patient outcomes.

1. INTRODUCTION

Health outcomes are rarely determined by a single point of intervention. A patient's journey through a modern hospital or primary care network passes through multiple hands: a phlebotomist who draws blood for a diagnostic panel, a laboratory scientist who processes and validates that panel, a pharmacist who reviews the resulting prescription for interactions, a paramedic who stabilizes the patient in transit, a nurse who delivers ongoing bedside care, and a health information professional who ensures that every data point generated along the way is captured accurately and made available to the next clinician who needs it. Each of these professions operates within its own scope of practice, licensing framework, and body of knowledge, yet

none functions in isolation. The quality, safety, and efficiency of patient care depend on how well these distinct contributions are coordinated.

This paper argues that improving health outcomes requires understanding these five professions not as parallel silos but as interdependent nodes within a single system of care. It examines the specific clinical and operational contributions of medical laboratory professionals, pharmacists, paramedics, nurses, and health information management professionals, and proposes an integrative framework — SPARC — that maps each profession's core function onto a shared continuum of surveillance, treatment, response, recovery, and information continuity. The discussion is grounded in established models of quality and teamwork and is contextualized within the ongoing healthcare transformation efforts of the Kingdom of Saudi Arabia under Vision 2030.

1.1 Purpose and Scope

The purpose of this paper is threefold: first, to describe the distinct scope of practice and outcome-relevant contributions of each of the five professions; second, to explain how their functions interconnect through interprofessional collaboration models; and third, to propose practical recommendations for strengthening this collaboration within the Saudi healthcare system. The scope is limited to hospital and emergency care settings, with reference to primary care and community health where relevant to health information continuity.

2. THEORETICAL AND CONCEPTUAL FRAMEWORK

The analysis in this paper is anchored in three complementary models that together explain how individual professional contributions translate into systemic quality and safety.

2.1 Donabedian's Structure-Process-Outcome Model

Donabedian's classic model conceptualizes healthcare quality as a function of structure (the resources and organization of care, including staffing and equipment), process (the actions taken by professionals, including diagnostic testing, medication management, and clinical documentation), and outcome (the resulting effects on patient health, including recovery, complication rates, and mortality). This paper applies the model to show how each of the five professions primarily contributes at the process level, with cumulative effects on outcome.

2.2 TeamSTEPPS and IPEC Competency Domains

TeamSTEPPS, developed by the U.S. Agency for Healthcare Research and Quality, identifies communication, leadership, situation monitoring, and mutual support as the core pillars of effective clinical teamwork. The Interprofessional Education Collaborative (IPEC) framework complements this with four competency domains: values and ethics for interprofessional practice, roles and responsibilities, interprofessional communication, and teams and teamwork. Together these models provide the behavioral and structural basis for understanding how laboratory, pharmacy, paramedic, nursing, and health information professionals coordinate their work in practice.

2.3 The SPARC Framework

Building on these established models, this paper proposes SPARC as an original organizing framework for the five professions under discussion:

- Surveillance — the diagnostic and monitoring function performed principally by medical laboratory professionals, generating the data that informs clinical decisions.
- Pharmacotherapy — the medication management function performed by pharmacists, ensuring safe, effective, and appropriate drug therapy.
- Acute Response — the time-critical stabilization and transport function performed by paramedics in prehospital and emergency contexts.
- Recovery and Care Coordination — the continuous, holistic bedside care function performed by nurses across the care trajectory.

- Continuity of Information — the data governance and interoperability function performed by health information management professionals, linking every other function into a coherent patient record.

SPARC frames five distinct professions as five stages of a single continuum — each one converting a patient's clinical need into the information, treatment, or intervention that the next stage depends on.

3. MEDICAL LABORATORY PROFESSIONALS: DIAGNOSTIC SURVEILLANCE

Medical laboratory professionals — including medical technologists, clinical laboratory scientists, and phlebotomists — generate the objective diagnostic data on which the majority of clinical decisions depend. Studies of clinical decision-making consistently estimate that a substantial majority of medical decisions rely at least in part on laboratory test results, ranging from routine metabolic panels to specialized microbiology and molecular diagnostics.

3.1 Core Contributions

- Specimen collection, handling, and quality control to ensure preanalytical accuracy.
- Timely and accurate analysis of blood, tissue, and fluid samples across chemistry, hematology, microbiology, and molecular diagnostics.
- Critical value reporting that enables rapid clinical intervention in life-threatening conditions such as sepsis, myocardial infarction, and severe electrolyte disturbances.
- Antimicrobial susceptibility testing that underpins antimicrobial stewardship programs and reduces inappropriate antibiotic use.

3.2 Impact on Outcomes

Diagnostic errors originating in the laboratory phase — whether from specimen mislabeling, analytic error, or delayed reporting — are a recognized contributor to adverse events and diagnostic delay. Conversely, robust laboratory quality systems, aligned with CBAHI accreditation standards and SFDA regulation of diagnostic reagents and devices, are directly associated with earlier diagnosis, more targeted treatment, and reduced length of stay.

4. PHARMACY PROFESSIONALS: MEDICATION SAFETY AND PHARMACOTHERAPY

Pharmacists occupy a pivotal position between diagnosis and treatment, translating clinical decisions into safe and effective medication regimens. Their role has expanded substantially beyond dispensing to encompass clinical pharmacy services, medication therapy management, and direct participation in multidisciplinary rounds.

4.1 Core Contributions

- Prescription verification, including dose checking, interaction screening, and allergy cross-referencing.
- Clinical pharmacy services such as therapeutic drug monitoring, anticoagulation management, and antimicrobial stewardship.
- Patient counseling and medication adherence support, particularly for chronic disease management.
- Participation in pharmacovigilance and adverse drug event reporting, aligned with SFDA post-marketing surveillance requirements.

4.2 Impact on Outcomes

Medication errors remain among the most common preventable causes of patient harm. Evidence from clinical pharmacy integration studies associates pharmacist-led medication reconciliation and bedside clinical pharmacy services with reductions in adverse drug events, shorter hospital stays, and improved chronic disease control. Within the Saudi context, the expansion of clinical pharmacy roles under SCFHS scope-of-practice regulations reflects a broader shift toward pharmacist involvement in direct patient care rather than dispensing alone.

5. PARAMEDIC PROFESSIONALS: ACUTE AND PREHOSPITAL RESPONSE

Paramedics operate at the earliest and often most time-critical point in the care continuum, providing assessment, stabilization, and transport for patients experiencing acute medical emergencies, trauma, and life-threatening conditions. In the Saudi context, this function is anchored institutionally by the Saudi Red Crescent Authority (SRCA) and regulated professionally through SCFHS licensing.

5.1 Core Contributions

- Rapid scene assessment and triage under time and resource constraints.
- Advanced life support interventions, including airway management, cardiac monitoring, and administration of emergency medications.
- Safe transport and handover communication that preserves clinical continuity between prehospital and in-hospital teams.
- Coordination with emergency dispatch and hospital emergency departments to optimize resource allocation for mass-casualty and high-acuity events.

5.2 Impact on Outcomes

For time-sensitive conditions such as ST-elevation myocardial infarction, stroke, and major trauma, prehospital response time and the quality of paramedic intervention are directly correlated with survival and functional recovery. The accuracy and completeness of paramedic handover documentation also materially affects the speed and safety of subsequent emergency department care, underscoring the connection between the Acute Response and Continuity of Information components of the SPARC framework.

6. NURSING PROFESSIONALS: CONTINUOUS CARE AND COORDINATION

Nurses provide the most continuous and sustained point of contact between the patient and the healthcare system, spanning assessment, direct care delivery, monitoring, education, and care coordination across the full duration of a hospital stay or care episode.

6.1 Core Contributions

- Ongoing clinical assessment and early recognition of patient deterioration.
- Direct administration of prescribed treatments, wound care, and symptom management.
- Patient and family education supporting self-management and discharge readiness.
- Coordination across the multidisciplinary team, serving as the primary communication link between physicians, pharmacists, laboratory staff, and health information systems.

6.2 Impact on Outcomes

Nurse staffing levels and nurse-to-patient ratios are among the most extensively studied structural determinants of patient outcomes, with robust evidence linking adequate staffing to lower rates of failure-to-rescue, hospital-acquired infection, and inpatient mortality. Nursing's continuous surveillance role also functions as a safety net that catches errors originating elsewhere in the system, reinforcing Reason's Swiss cheese model of layered defenses against harm.

7. HEALTH INFORMATION PROFESSIONALS: DATA INTEGRITY AND CONTINUITY

Health information management (HIM) professionals ensure that the clinical data generated by every other profession discussed in this paper — laboratory results, medication records, prehospital reports, and nursing documentation — is accurately captured, securely stored, and made accessible to the right clinician at the right time.

7.1 Core Contributions

- Maintenance of accurate, complete, and legally compliant medical records.
- Clinical coding and classification supporting reimbursement, quality reporting, and epidemiological surveillance.
- Data governance and privacy protection in compliance with national health data regulations.
- Interoperability support, including integration with national platforms such as Nphies for claims and eligibility exchange and Mumaris+ for licensing and credential verification.

7.2 Impact on Outcomes

Fragmented or inaccurate health information is a well-documented contributor to duplicated testing, delayed diagnosis, and medication errors arising from incomplete medication histories. As Saudi Arabia advances its digital health agenda under Vision 2030 — including the expansion of the Nphies platform and integrated electronic health record systems — the health information profession is increasingly central not only to administrative efficiency but to direct patient safety.

8. INTEGRATED SUMMARY: THE SPARC CONTINUUM IN PRACTICE

Table 1 summarizes how each profession's primary function, representative activities, and outcome linkage map onto the SPARC framework, illustrating the continuum from diagnosis through treatment, emergency response, ongoing care, and information continuity.

Table 1. Professional Roles Mapped to the SPARC Framework

SPARC Stage	Profession	Primary Function	Outcome Linkage
Surveillance	Medical Laboratory	Diagnostic testing and critical value reporting	Earlier diagnosis, targeted treatment
Pharmacotherapy	Pharmacy	Medication verification and clinical pharmacy services	Fewer adverse drug events
Acute Response	Paramedic	Prehospital stabilization and transport	Improved survival in time-critical conditions
Recovery & Coordination	Nursing	Continuous assessment and bedside care	Reduced failure-to-rescue and complications
Continuity of Information	Health Information Management	Record integrity and interoperability	Reduced duplication and documentation error

9. INTERPROFESSIONAL COLLABORATION AS THE INTEGRATING MECHANISM

The value of the SPARC framework lies not in the five professions individually but in the quality of collaboration between them. Interprofessional collaboration, as conceptualized by D'Amour and Oandasan and operationalized through the IPEC competency domains, depends on shared goals, mutual respect for scope of practice, structured communication, and joint accountability for outcomes.

9.1 Communication Structures

Structured handover tools, multidisciplinary rounds, and shared electronic health records are the principal mechanisms through which laboratory, pharmacy, paramedic, nursing, and health information functions are synchronized in daily practice.

Standardized communication formats such as SBAR (Situation, Background, Assessment, Recommendation) reduce the risk of information loss at transition points — precisely the points where the SPARC continuum is most vulnerable to breakdown.

9.2 Saudi Regulatory and Institutional Context

Interprofessional collaboration in Saudi Arabia is shaped by an evolving regulatory architecture. SCFHS sets scope-of-practice and continuing professional development requirements across all five professions. CBAHI accreditation standards embed interprofessional teamwork and communication requirements directly into hospital quality criteria. SFDA regulates the medications and diagnostic devices on which laboratory and pharmacy functions depend. The Nphies platform is progressively unifying claims, eligibility, and clinical data exchange across providers, directly supporting the Continuity of Information stage of the SPARC framework. Collectively, these structures are converting interprofessional collaboration from an informal cultural expectation into a regulated and measurable dimension of healthcare quality.

10. CHALLENGES TO INTEGRATED PRACTICE

- Professional silos: Distinct education pathways, licensing bodies, and workplace cultures can reinforce boundaries between professions rather than shared accountability for outcomes.
- Workload and staffing pressures: High patient volumes and staffing shortfalls, particularly in nursing and laboratory services, constrain the time available for collaborative communication.
- Interoperability gaps: Legacy health information systems and inconsistent data standards can limit the real-time exchange of laboratory, medication, and prehospital data across care settings.
- Role clarity: Overlapping responsibilities, particularly between nursing and paramedic handover processes, can create ambiguity about accountability during transitions of care.
- Training gaps: Interprofessional education remains unevenly integrated into undergraduate curricula across the five professions, limiting early exposure to collaborative practice models.

11. RECOMMENDATIONS

Building on the SPARC framework and the challenges identified above, this paper offers the following recommendations for strengthening interprofessional contribution to patient outcomes:

- Embed structured interprofessional education (IPE) across medical laboratory, pharmacy, paramedic, nursing, and HIM curricula, using shared simulation-based training to build early familiarity with cross-professional roles.
- Expand unified electronic health record access so that laboratory results, medication records, prehospital reports, and nursing documentation are visible in real time to all relevant team members.
- Strengthen CBAHI-aligned interprofessional rounding standards, requiring structured multidisciplinary review for high-risk patients.
- Invest in HIM workforce capacity to support the data governance demands of Nphies integration and national digital health expansion.
- Develop standardized handover protocols, particularly at the paramedic-to-nursing and laboratory-to-pharmacy interfaces, to reduce information loss at care transitions.
- Support continuing professional development, aligned with SCFHS requirements, that emphasizes team-based competencies alongside profession-specific clinical skills.

12. CONCLUSION

Medical laboratory, pharmacy, paramedic, nursing, and health information professionals each contribute a distinct and indispensable function to patient care, yet none of these contributions achieves its full impact on health outcomes in isolation. The SPARC framework proposed in this paper — Surveillance, Pharmacotherapy, Acute Response, Recovery and Care Coordination, and Continuity of Information — offers a way of understanding these five professions as sequential and interdependent stages of a single continuum of care rather than as separate disciplinary silos. Within the Saudi healthcare system,

the regulatory infrastructure provided by SCFHS, CBAHI, and SFDA, together with the digital integration efforts embodied in Nphies and Mumaris+, is progressively strengthening the conditions for this kind of integrated practice. Sustained improvement in patient outcomes will depend on continuing to invest in the interprofessional education, communication systems, and information infrastructure that allow these five essential professions to function as a coordinated whole.

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