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Interprofessional Collaboration in Emergency Care: A Systems Approach Integrating Pharmacy, Radiology, Health Informatics, Nursing, and Medical Sterilization

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ABSTRACT

Emergency departments (EDs) are complex, high-risk environments where patient outcomes depend on rapid, coordinated work across multiple professions. A systems approach to interprofessional collaboration recognizes that pharmacy, radiology, health informatics, nursing, and medical sterilization (central sterile services) form an interconnected network rather than isolated departments. Evidence shows that interprofessional teamwork improves quality of care, reduces medication errors, enhances antimicrobial stewardship, improves imaging safety and communication, and strengthens infection prevention and control. This paper applies a systems lens to describe how these five disciplines contribute to safe, effective emergency care and how their collaboration can be intentionally designed. The body of the paper (1) outlines key roles and evidence for impact in each profession, (2) proposes a socio-technical systems model for ED collaboration, and (3) presents practical strategies for implementation, supported by tables and conceptual figures. The paper concludes with specific recommendations on shared governance, digital infrastructure, joint training, and standardized workflows that support interprofessional practice.

KEYWORDS: Pharmacy: Medication Safety and Therapeutic Optimization in the ED.

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INTRODUCTION

Emergency departments operate as complex adaptive systems: multiple professional groups, technologies, and processes interact under conditions of uncertainty, crowding, and time pressure. Failures in communication or coordination at any point—medication ordering, imaging, documentation, or instrument reprocessing—can rapidly escalate into harm. Studies consistently associate poor interprofessional collaboration in EDs with inefficient care, higher error rates, and reduced staff satisfaction (Bekkink et al., 2018; Milton et al., 2023).

Interprofessional collaboration is defined as professionals from different backgrounds working together with patients, families, and communities to deliver the highest quality care, supported by shared goals, mutual respect, and effective communication (Kobrai-Abkenar et al., 2024; Pan American Health Organization [PAHO], 2024). In the ED, this includes a wide range of staff, but five disciplines are particularly central in a systems sense:

- Pharmacy – ensuring safe, timely, and appropriate use of medications.
- Radiology – providing rapid, accurate imaging and communicating critical findings.
- Health Informatics – enabling integrated EHRs, clinical decision support, and real-time data.
- Nursing – leading triage, bedside care, and coordination across the team.
- Medical Sterilization / CSSD – supplying sterile, functional instruments and devices to support safe procedures.

A systems approach focuses not only on individual professional roles but also on the relationships, information flows, and feedback loops between them. Frameworks for interprofessional team collaboration emphasize shared goals, clear roles, interdependence, and supportive organizational structures (McLaney et al., 2022).

1. Interprofessional Collaboration in Emergency Departments: Evidence and Rationale

Multiple studies show that interprofessional teamwork in EDs improves communication, collective decision-making, and

perceived quality of care. Nurses and physicians describe more efficient triage and better handling of complex older patients when working in interprofessional triage teams (Dreher-Hummel et al., 2021). Mixed-methods evaluations of teamwork modules in EDs report sustained improvements in observed team behaviors when staff receive role-based training and practice scenarios across professions (Liu et al., 2021).

Healthcare workers also identify enablers of interprofessional teamwork in EDs: ergonomic workplace design, standardized communication tools, supportive leadership, and shared mental models about patient flow and safety priorities (Milton et al., 2022; Milton et al., 2023). Conversely, poor interprofessional communication has been linked with critical incidents and near misses in emergency care (Bekkink et al., 2018; Elsharkawy, 2023).

Table 1. Key Contributions of Core Professions to ED System Performance

Profession	Core ED Activities	Main Collaboration Partners	Primary Outcomes Supported
Pharmacy	Medication reconciliation; verification; dosing; antimicrobial stewardship; toxicology support	ED physicians, nurses, informatics, radiology (contrast agents)	Reduced medication errors, optimized therapy, shorter time to critical drugs
Radiology	Imaging acquisition; protocol selection; report generation; communication of critical findings	ED physicians, nurses, anesthetists, CSSD (equipment), informatics	Faster and safer diagnosis, reduced missed injuries, lower radiation risk
Health Informatics	EHRs; clinical decision support; dashboards; real-time alerts; telemedicine	All clinical departments; administration; quality and safety	Improved information continuity, fewer documentation errors, better coordination
Nursing	Triage; bedside monitoring; coordination; patient/family communication; infection prevention	Physicians, pharmacy, radiology, CSSD, informatics	Safe flow, early deterioration detection, adherence to IPC, patient experience
Medical Sterilization (CSSD)	Decontamination; packaging; sterilization; distribution of instruments/devices	ED, radiology, operating room, ICU	Prevention of device-related infections, procedure readiness, reduced delays

(Table created by the author, synthesizing multiple sources such as Atey et al., 2023; Emmerson et al., 2023; Liang & Khair, 2018; Shuai et al., 2025.)

2. Pharmacy: Medication Safety and Therapeutic Optimization in the ED

2.1 Roles and Impact

Systematic reviews show that integrating clinical pharmacists into ED teams significantly improves medication safety. An umbrella review of ED pharmacist interventions reported reductions in medication errors, improved accuracy of medication histories, and more appropriate prescribing (Roman et al., 2018; Tong et al., 2020). A meta-analysis of 31 studies found that pharmacist-provided interventions in EDs reduced the proportion of patients with at least one medication error by about 73% and increased the appropriateness of prescriptions by 58% (Atey et al., 2023).

Pharmacists in EDs typically perform:

- Best possible medication history (BPMH) and reconciliation. Pharmacists use multiple sources (patient interview, community pharmacy records, prior EHR entries) to correct omissions and dosing errors; one study found that 93% of patients had at least one medication history error when histories were taken only by physicians, many of which were corrected by pharmacists (Goulas et al., 2023).
- Real-time clinical decision support. Pharmacists advise on dosing in renal/hepatic impairment, drug–drug interactions, and antidote use (e.g., in toxicology and overdoses), and support complex antimicrobial therapy for sepsis or meningitis (Schmid et al., 2022; Koh et al., 2025).
- Participation in resuscitation and trauma teams. Presence of pharmacists in resuscitation bays facilitates accurate, timely preparation of high-risk medications and advanced cardiovascular life support drugs (Alotaibi, 2020).
- Contribution to geriatric medication safety programs. In older adults, pharmacist review in ED-based programs has been associated with a 32% reduction in potentially inappropriate medications (Skains et al., 2025).

2.3 Interprofessional Interfaces

Pharmacy's systems-level impact depends on tight coupling with:

- Nursing, embedding double-checks, standardized labelling, and bedside verification.
- Radiology, to manage contrast agents, renal risk, and premedication in high-risk patients.
- Informatics, to ensure order sets, drug libraries in smart pumps, and clinical decision support tools are up to date and aligned with local formularies (Born et al., 2024).

3. Radiology: Imaging, Communication, and Patient Safety

Timely imaging is central to emergency diagnosis. However, the benefit of imaging is highly sensitive to communication quality and systems for handling critical or unexpected findings.

3.1 Safety and Communication Challenges

Radiology contributes to patient safety both through accurate image acquisition/interpretation and through reliable communication of results. Communication errors in radiology have been associated with direct or potential harm in the majority of cases in one large analysis of departmental errors (Siewert et al., 2016). Audits of communication systems show that even when policies exist for urgent and unexpected findings, implementation can be inconsistent (Duncan et al., 2016). A recent scoping review of emergency radiology highlighted variability in classification and communication standards for non-routine (e.g., critical) findings, calling for clearer protocols and interoperable systems (Corallo et al., 2025).

The style and clarity of patient communication in radiology also influences safety and patient satisfaction. Reviews emphasize that imaging staff need communication training and that the physical environment and workflows should support privacy and information exchange (Rockall, 2022).

3.2 Table 2. Radiology–ED Collaboration Processes and Safety Outcomes

Process	Radiology Role	ED / Other Partners	Safety Impact
Critical findings alert	Flagging and classifying high-risk results (e.g., intracranial bleed)	ED physicians, nurses, and informatics	Reduced delays to life-saving interventions (e.g., neurosurgery)
Imaging protocol selection	Choosing modality and parameters suited to the indication	ED physicians, pharmacists (contrast), CSSD (device availability)	Reduced radiation exposure, contrast nephropathy, and unnecessary repeat imaging
Image sharing and access	Timely report availability in EHR/PACS	Informatics, ED clinicians, and inpatient teams	Fewer lost reports, better continuity of care
Infection-safe imaging	Cleaning/disinfection of scanners and accessories; coordination with CSSD	CSSD, infection prevention, nursing	Reduced imaging-related healthcare-associated infections

(Table synthesized from Emmerson et al., 2023; Rockall, 2022; Duncan et al., 2016; Siewert et al., 2016.)

Figure 1: ED–Radiology Workflow with Interprofessional Safety Checks

4. Health Informatics: The Digital Backbone of Interprofessional Collaboration

Health informatics in the ED encompasses EHRs, computerized provider order entry, clinical decision support systems (CDSS), real-time dashboards, and increasingly, AI-based prediction models. Informatics is both an enabler and a potential barrier to interprofessional collaboration.

4.1 EHRs and Collaboration

Systematic reviews show that EHRs can both facilitate and constrain interprofessional practice. They improve information sharing and allow asynchronous collaboration, but may reduce rich face-to-face communication and create new workload and alert fatigue (Robertson et al., 2022; Vos et al., 2020; Amano et al., 2023). However, well-designed ED information systems can support triage, tracking, order entry, and discharge planning, and can integrate with radiology and laboratory systems (Emergency medicine informatics reviews: Conforti et al., 2024; Born et al., 2024).

4.2 Clinical Decision Support and Real-Time Analytics

Clinical decision support in the ED has been used to:

- Improve triage accuracy and resource allocation (Fernandes et al., 2020).

- Support safer prescribing, such as increasing naloxone co-prescribing or reducing potentially inappropriate medications in older adults (Sommers et al., 2024; Skains et al., 2025).
- Identify high-risk patients using AI-based models, for example, predicting need for ICU admission or risk of cardiac arrest (Choi et al., 2023; Kareemi et al., 2025).

Informatics also supports novel ED clinical decision support for social determinants of health, integrating routine screening and referral pathways into workflow (Mazurenko et al., 2024).

5. Nursing: Coordination, Triage, and Infection Prevention

Nurses are often the first and last professionals patients encounter in the ED and play a central role in coordinating interprofessional care.

5.1 Triage and Teamwork

Qualitative work with ED nurses and physicians shows that interprofessional triage systems improve shared decision-making and safety, especially for older adults with complex needs (Dreher-Hummel et al., 2021). Studies of emergency nurses highlight that teamwork, clear communication, and effective leadership are essential for managing critical incidents, and that physical layout and staffing influence interprofessional collaboration (Grover et al., 2017; Milton et al., 2022, 2023).

Nurses often act as "boundary spanners" between ED physicians, pharmacists, radiology staff, and CSSD—translating care plans into observable tasks and monitoring their completion. Interprofessional communication quality is strongly associated with perceived collaboration among nurses and physicians (Elsharkawy, 2023).

5.2 Infection Prevention and Control (IPC)

EDs are high-risk environments for transmission of infectious diseases. Core IPC practices include hand hygiene, PPE use, safe injection, environmental cleaning, and proper reprocessing of equipment (Liang & Khair, 2018; Centers for Disease Control and Prevention [CDC], 2024). Checklists and structured guidelines for ED IPC emphasize room cleaning, surface disinfection, cohorting, and equipment management (Sasaki et al., 2020; Institut national de santé publique du Québec, 2014).

Recent studies of ED nurses show relatively high self-reported adherence to IPC practices but highlight the need for ongoing training, adequate supplies, and supportive management (AlAnazy, 2024).

5.3 Table 3. Nursing-Led Interprofessional Safety Practices in Eds

Practice	Nursing Role	Interprofessional Partners	System-Level Effect
Sepsis screening at triage	Early recognition, protocol activation	Physicians, pharmacy, lab, radiology	Shorter time to antibiotics and imaging; reduced mortality
Bedside medication administration checks	Verify drug, dose, route, time; communicate issues	Pharmacy, physicians	Reduced administration errors; feedback to prescribers
Isolation and cohorting	Identify suspected infection; implement PPE and room placement	Infection prevention team, environmental services, CSSD	Lower risk of healthcare-associated infection
Post-resuscitation debriefs	Facilitate reflection on teamwork and processes	Physicians, pharmacists, radiology staff, informatics	Continuous learning and systems improvement

(Based on Liang & Khair, 2018; Elsharkawy, 2023; Milton et al., 2023.)

6. Medical Sterilization / CSSD: The Hidden Backbone of Safe Emergency Care

The Central Sterile Services Department (CSSD) is often physically distant from the ED, but it plays a critical role in patient safety across all acute care areas. CSSD is responsible for receiving, cleaning, decontaminating, packaging, sterilizing, storing, and distributing reusable medical devices and instruments (World Health Organization, 2016; Ministry of Health & Social Services, 2023).

6.1 Responsibilities and Patient Safety

CSSD/sterile processing departments:

- Ensure that all instruments and devices used in ED procedures (suturing sets, laryngoscope blades, minor surgical packs, orthopedic splints, imaging accessories, etc.) are sterile, functional, and traceable (Shuai et al., 2025; Bal et al., 2025).
- Maintain standardized workflows for cleaning, disinfection, packaging, sterilization (e.g., steam, low-temperature systems), and storage.
- Collaborate with infection prevention teams to minimize the risk of device-related infections and ensure compliance with national and international guidelines (CDC, 2024; Cisa Group, 2023).

Many hospital departments—ED, operating room, radiology, ICU—depend on CSSD for procedure readiness. Any breakdown in sterile supply can delay emergency interventions or lead to the use of suboptimal equipment, increasing risk.

6.2 Interprofessional Collaboration

Effective collaboration between ED and CSSD requires:

- Clear communication about demand patterns, including peak times and emergency sets that must always be available.
- Standardized processes for tracking and returning used instruments, including from radiology and ED procedure rooms.
- Inclusion of CSSD representatives in hospital infection prevention and emergency preparedness committees, recognizing that sterilization is a systems-level safety function rather than a purely technical back-office role (Innovaarabia, 2023; B. Braun, 2020).

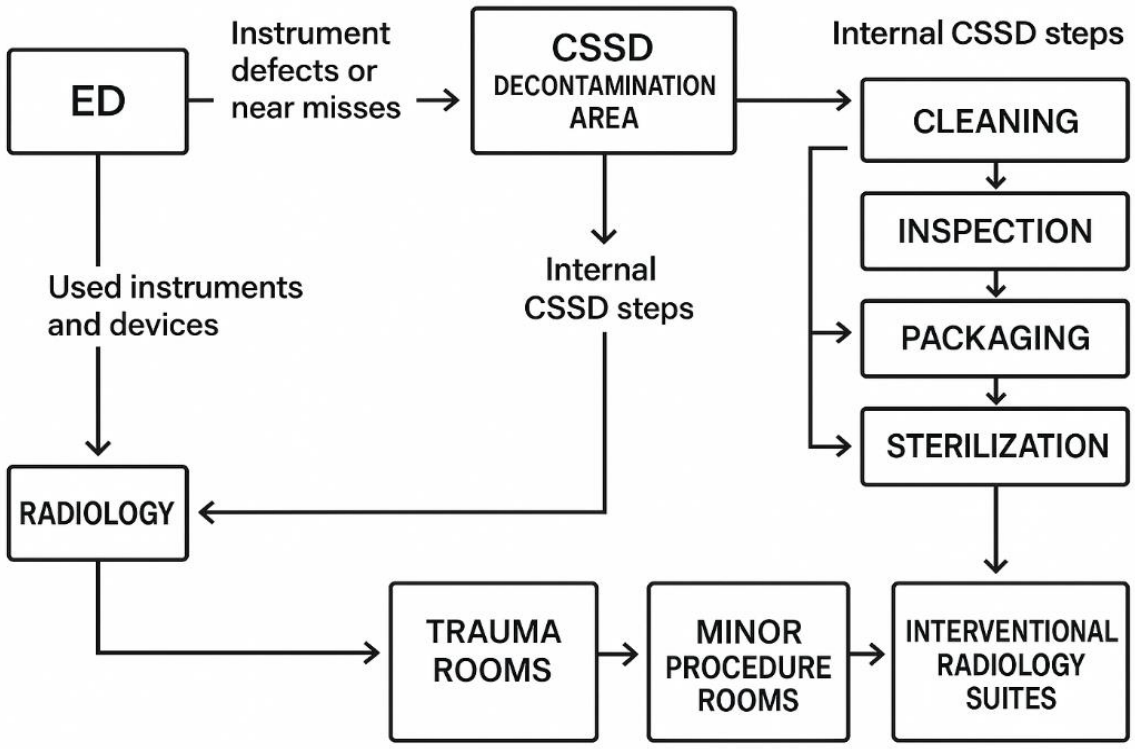

Figure 2: Equipment and Instrument Flow Between ED, Radiology, and CSSD

- Outgoing flow from ED and radiology: used instruments and devices → CSSD decontamination area.
- Internal CSSD steps: cleaning → inspection → packaging → sterilization → storage.
- Return flow: sterile sets delivered to ED trauma rooms, minor procedure rooms, and interventional radiology suites.
- Feedback arrows: ED and radiology report instrument defects or near misses back to CSSD to trigger quality improvements.

This figure underscores that sterilization quality and capacity are integral components of ED systems design and should be considered in interprofessional planning.

7. Systems Approach: Integrating Pharmacy, Radiology, Informatics, Nursing, and CSSD

A systems approach conceptualizes the ED as part of a larger **socio-technical network**: people, tasks, technologies, physical environment, and organizational structures interact to produce outcomes. Interprofessional collaboration becomes a **property of the system**, not just a behavior of individuals.

Key systems-level principles include:

1. Shared goals and metrics. All five professions should be aligned around common outcomes—e.g., time to critical treatment, medication safety, infection rates, patient flow—monitored via shared dashboards (McLaney et al., 2022; Conforti et al., 2024).
2. Standardized work with local adaptability. Protocols for sepsis bundles, stroke pathways, critical imaging alerts, medication reconciliation, and high-level disinfection should be jointly developed and regularly updated based on local data (Liang & Khair, 2018; Duncan et al., 2016).
3. Robust communication infrastructure. EHR messaging, paging/alert systems, structured handovers (e.g., SBAR), and huddle structures should support rapid, closed-loop communication between ED, radiology, pharmacy, CSSD, and nursing teams (Bekkink et al., 2018; Emmerson et al., 2023; Vos et al., 2020).
4. Learning and feedback loops**.** Regular review of incidents, near misses, and process measures in multidisciplinary forums enables continuous adaptation.

Table 4. Examples of Cross-Departmental Interventions Using a Systems Approach

Intervention	Professions Involved	Informatics Role	Measured Outcomes
ED sepsis pathway	Nursing, physicians, pharmacy, radiology, CSSD	Triage alerts, sepsis order sets, timers	Time to antibiotics and imaging, sepsis mortality
Medication reconciliation at triage	Nurses, pharmacists, physicians	EHR medication history modules; reconciliation tools	Number of errors per patient, ADE-related return visits
Critical imaging communication policy	Radiology, ED, nursing, informatics	Automated alerts in EHR/PACS; acknowledgement tracking	Time from report to intervention, missed critical findings
Instrument tracking system	CSSD, ED, radiology, OR	Barcode/RFID tracking in EHR or separate system	Procedure delays, device-related infection rates

(Based on Atey et al., 2023; Corallo et al., 2025; Shuai et al., 2025; Born et al., 2024.)

8. Implementation Strategies and Barriers

8.1 Implementation Strategies

1. **Interprofessional education and simulation.**
   - Joint training modules for ED staff on teamwork, role clarity, and communication have been shown to maintain improved behaviors over multiple years (Liu et al., 2021).
   - Simulations involving pharmacy, nursing, radiology, CSSD, and informatics teams help identify latent safety threats and improve coordination in scenarios such as mass casualty incidents or infectious disease outbreaks.
2. **Co-location and team-based workspaces.**
   - Physical proximity of ED providers, pharmacists, and radiology liaison staff facilitates informal communication, reduces delays, and supports shared mental models (Milton et al., 2023; Grover et al., 2017).
3. **Shared governance structures.**
   - Creating ED quality and safety committees with representation from pharmacy, radiology, nursing, CSSD, and informatics allows joint prioritization of improvement projects and alignment of policies (McLaney et al., 2022).
4. **Data-driven quality improvement.**
   - Using EHR data, ED dashboards, and CDSS logs to monitor time-sensitive pathways, adherence to IPC bundles, and communication metrics (e.g., proportion of critical imaging results acknowledged within specified time frames) enables targeted interventions (Born et al., 2024; Conforti et al., 2024).

8.2 Barriers

Common barriers to interprofessional collaboration in EDs include:

- **Hierarchical cultures and professional silos**, which may discourage nurses, pharmacists, or CSSD staff from speaking up.
- **Technical limitations**, such as poor EHR interoperability or clumsy alerting systems, which can hinder communication instead of supporting it (Robertson et al., 2022; Vos et al., 2020).
- **Resource constraints**, particularly in low- and middle-income settings, where staffing shortages and limited informatics infrastructure impede the ideal systems design.
- **Change fatigue**, where staff are overloaded with new protocols, digital tools, and documentation requirements.

Overcoming these barriers requires leadership commitment, attention to workload and well-being, and meaningful involvement of frontline staff from all professions in redesign efforts (Milton et al., 2022; Bekkink et al., 2018).

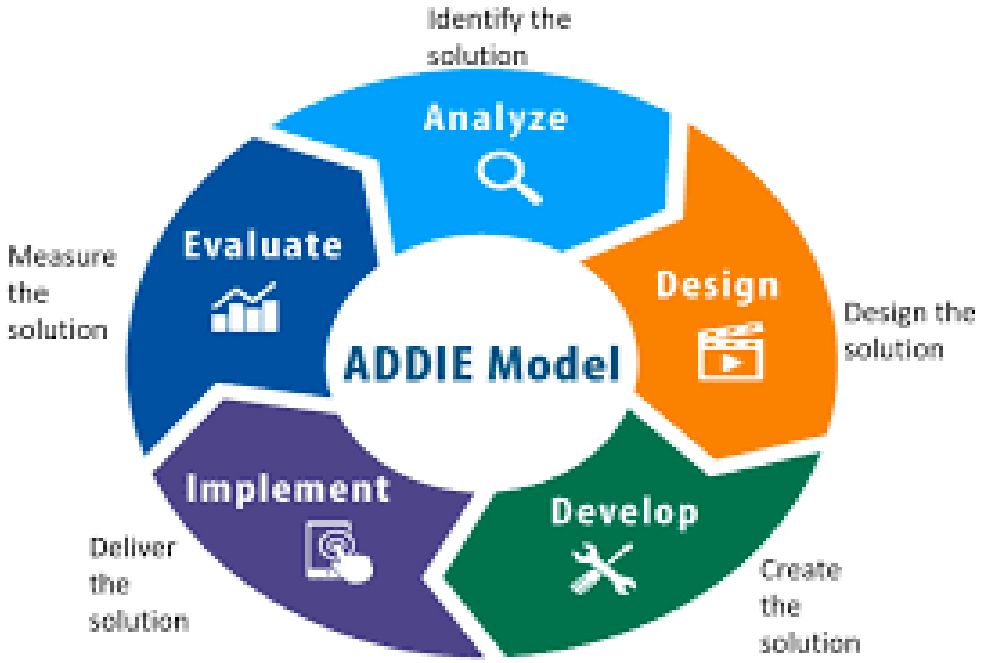

Figure 3: Phased Implementation Roadmap for Interprofessional Systems Integration in the ED

1. **Phase 1 – Mapping and Measurement**
   - Map current workflows linking ED with pharmacy, radiology, informatics, nursing, and CSSD.
   - Identify key indicators (e.g., time to critical imaging, medication error rates, IPC compliance, sterile set availability).
2. **Phase 2 – Quick-Win Interventions**
   - Implement or refine sepsis and stroke pathways integrating all disciplines.
   - Introduce structured critical result communication and simple pharmacist-supported medication reconciliation at triage.
3. **Phase 3 – Digital and Structural Integration**
   - Enhance EHR and CDSS tools that serve all professions (shared dashboards, closed-loop alerts).
   - Co-locate key staff or create virtual hubs for rapid consultation.
4. **Phase 4 – Continuous Learning and Culture Change**
   - Establish regular interprofessional morbidity and mortality meetings, debriefs, and QI projects.

CONCLUSION

A systems approach to interprofessional collaboration in emergency care reveals that pharmacy, radiology, health informatics, nursing, and medical sterilization are deeply interdependent. Medication safety, diagnostic accuracy, infection prevention, and timely interventions emerge not from isolated excellence within each profession, but from deliberately designed interactions between them. Evidence shows that ED pharmacists reduce medication errors and optimize therapy; radiology teams that communicate effectively prevent delays and missed diagnoses; informatics teams build digital platforms that support teamwork; nurses coordinate care and uphold infection control; and CSSD ensures that instruments and devices are safe and available when needed.

RECOMMENDATIONS

1. Make interprofessional collaboration an explicit ED strategic priority, with shared goals covering medication safety, imaging communication, IPC, and equipment readiness.
2. Integrate ED pharmacists into frontline teams, focusing on medication reconciliation, high-risk prescribing, and antimicrobial stewardship.
3. Standardize radiology communication pathways, incorporating CDSS-supported ordering and automatic critical result alerts with acknowledgement tracking.
4. Invest in interoperable EHR and CDSS systems that are designed with input from all professions and embed interprofessional workflows.
5. Strengthen nursing-led coordination and IPC, using checklists, training, and feedback loops that involve pharmacy, radiology, CSSD, and informatics partners.
6. Elevate CSSD to a visible safety partner, ensuring representation in ED planning, infection prevention committees, and emergency preparedness.
7. Use simulation and interprofessional education to practice complex emergency scenarios involving all five disciplines and to surface system weaknesses.

8. By intentionally designing and continuously improving the interfaces between pharmacy, radiology, informatics, nursing, and medical sterilization, EDs can move from ad-hoc collaboration to a resilient, high-reliability system that consistently delivers safe, efficient, and patient-centered emergency care.

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