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Metabolic Crisis in the Prehospital and Acute Care Setting: From Street Stabilization to ICU Nutrition

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Abstract

Background: Diagnostic error in acute care represents a pervasive threat to patient safety, contributing to significant morbidity, mortality, and healthcare costs. These failures are rarely due to individual incompetence but are systemic, arising from complex interactions across the care continuum—from prehospital assessment to specialist interpretation and follow-up. **Aim:** This narrative review aims to synthesize evidence on multi-disciplinary, system-oriented strategies for reducing diagnostic error in acute settings, integrating the unique perspectives and interventions of clinical laboratory science, medical imaging, emergency medical services, nursing, social work, preventive medicine, public health, and health security. **Methods:** A comprehensive literature search of PubMed, Scopus, CINAHL, and PsycINFO databases (2010-2024) was conducted. Included studies, reviews, and grey literature were analyzed thematically to construct a narrative synthesis of collaborative error-reduction frameworks. **Results:** Effective strategies form an interdependent "safety loop." Critical components include standardized handoff protocols (EMS), structured result communication and "second-look" practices (lab/radiology), nursing clinical surveillance, social work-mediated health literacy interventions, preventive medicine-led quality improvement cycles, public health surveillance of error trends, and health security principles fostering a just culture of reporting. **Conclusion:** Mitigating diagnostic error requires moving beyond siloed solutions to implement integrated, multi-professional systems. A culture of psychological safety, supported by structured communication and continuous learning, is essential for closing the diagnostic loop and ensuring reliable acute care.

Keywords: diagnostic error, patient safety, interprofessional collaboration, clinical reasoning, just culture.

Introduction

Diagnostic error—defined as a failure to establish an accurate and timely explanation of a patient's health problem or to communicate that explanation to the patient—remains a formidable challenge in modern healthcare, with profound implications for patient outcomes and system integrity (Ball & Balogh, 2016). In acute care environments, where time is compressed, information is incomplete, and stakes are high, the risk of such errors is significantly amplified. Historically, the response to diagnostic mishaps has often focused on individual clinician performance or cognitive bias. However, contemporary patient safety science unequivocally demonstrates that diagnostic error is predominantly a systemic failure, embedded within the complex

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interplay of people, processes, technologies, and organizational cultures (Graber et al., 2018). A misdiagnosis in the emergency department or during acute hospitalization is frequently not the fault of a single practitioner but rather a breakdown in a chain of events involving multiple actors and systems (Giardina et al., 2022).

Therefore, effective solutions must be equally systemic and multi-disciplinary. This narrative review argues that "closing the loop" on diagnostic safety requires the deliberate integration of expertise from across the healthcare spectrum. It moves beyond the traditional focus on physician decision-making to examine the critical roles of Clinical Laboratory scientists and Radiographers in generating and communicating critical data; Emergency Medical Services (EMS) in information transfer; Nursing in continuous clinical surveillance and advocacy; Social Work in bridging health literacy and social determinant gaps; Preventive Medicine in designing and executing quality improvement (QI) initiatives; Public Health in epidemiological tracking of error patterns; and Health Security frameworks in cultivating the non-punitive, psychologically safe reporting culture necessary for learning. By synthesizing evidence from 2010 to 2024, this review maps the contours of an interdependent safety ecosystem, illustrating how each discipline contributes unique but interconnected strategies to catch, prevent, and learn from diagnostic errors in acute care.

The Scope and System Nature of the Problem

Diagnostic errors are estimated to affect at least 5% of US adults in outpatient settings annually, with likely higher rates in acute care, and contribute to approximately 10% of patient deaths (Singh et al., 2014; Newman-Toker et al., 2023). In emergency medicine, where undifferentiated patients present with evolving symptoms, error rates for certain conditions like aortic dissection, pulmonary embolism, and spinal cord compression are notoriously high. The etiology is multifactorial, stemming from a confluence of "system 1" (intuitive) and "system 2" (analytical) cognitive failures, coupled with flawed processes (Atallah et al., 2022). Key systemic vulnerabilities include fragmented health information systems that hinder access to prior records, inefficient communication pipelines between diagnostic services and treating teams, inadequate handoff procedures, and cultures that stigmatize error disclosure and reporting (Olson et al., 2019). A diagnostic error is often the result of a broken loop—where critical information is generated but not accessed, communicated but not understood, or acted upon but not followed up (Bai et al., 2023).

Clinical Laboratory and Medical Imaging as The First Line of Data Integrity and Communication

Clinical laboratory scientists and medical imaging professionals serve as the essential first line in safeguarding the integrity of diagnostic data, a foundational pillar upon which all subsequent clinical decisions are built (Table 2). Errors originating in these domains—spanning inappropriate test selection, analytical inaccuracy, interpretive missteps, or failures in result communication—possess a unique capacity to propagate and amplify throughout the entire patient care pathway, setting a flawed diagnostic trajectory from the outset. While laboratories have historically achieved remarkable precision in the analytical phase, contemporary evidence indicates that the majority of errors occur in the pre-analytic (test ordering, sample collection) and post-analytic (result reporting, interpretation) phases, underscoring a critical need for systemic interventions beyond technical proficiency (Lippi & Plebani, 2020). Consequently, the strategic focus must be two-pronged: relentlessly ensuring the accuracy of the data generated and, with equal vigor, guaranteeing its effective integration and comprehension within the clinical decision-making workflow (Herasevich et al., 2023).

To this end, a suite of interconnected strategies has evolved. Standardized critical value reporting protocols, mandated by accrediting bodies, remain a bedrock of patient safety. The modern evolution of this practice involves integrating automated alert cascades into electronic health records (EHRs), creating a verifiable, closed-loop communication system (Cadamuro & Simundic, 2023). These systems ensure that life-threatening results not only reach the ordering clinician but also require an acknowledgement of receipt, significantly mitigating the risk that a critical finding is lost due to a missed page or an overloaded practitioner (Sciacovelli et al., 2016). Beyond passive reporting, active safety surveillance is enhanced through "second look" protocols. In medical imaging, radiographers and sonographers are increasingly empowered to perform a structured review of images at the point of acquisition, assessing technical quality and flagging obvious, urgent abnormalities for immediate escalation before formal radiologist interpretation, thereby acting as a vital human fail-safe (Al-Radaideh & Al-Modallal, 2023). This human-centric "second look" is complemented in the laboratory by technological counterparts, such as automated validation rules and delta checks that flag improbable results or significant deviations from a patient's prior values, serving as automated sentinels for potential error (Lippi et al., 2019). The advent of artificial intelligence (AI) as a concurrent reading aid in imaging introduces a powerful new dimension to this cognitive support, though its successful deployment demands meticulous attention to workflow integration and human-AI collaboration to avoid alert fatigue or over-reliance (Park et al., 2023).

Finally, the clarity and actionability of the communicated result are paramount. The shift from narrative, free-text reports to structured, templated reporting in both radiology and pathology disciplines reduces ambiguity, ensures completeness, and enhances the speed and accuracy with which referring clinicians can extract key information (Itri & Patel,

2018). This structural clarity is further reinforced by fostering a culture of direct interdisciplinary consultation (Zhang et al., 2023). Encouraging and streamlining direct communication between the treating clinician and the radiologist or pathologist for complex or ambiguous cases allows for real-time clarification of the clinical question, contextualization of findings, and collaborative refinement of the diagnostic picture, effectively closing the communication loop and transforming a unidirectional report into a dynamic diagnostic conversation (Lee et al., 2013). Figure 1 depicts the foundational system elements necessary to support diagnostic safety in acute care.

Table 1: Error-Reduction Strategies in Diagnostic Services

Discipline	Primary Error Vulnerability	Key Systemic Strategies	Interprofessional Link
Clinical Lab	Pre/post-analytic error; delayed critical result communication.	Automated critical result alerts with read-receipt; Delta checks & auto-validation; Standardized report formats; Direct consultation lines.	**Nursing/EM:** Acting on alerts. **Preventive Med:** Analyzing turnaround-time data.
Radiography/Imaging	Technical error; perceptual error on initial read; communication breakdown.	"Second look" protocol by technologist; AI-assisted detection software; Structured reporting templates; Mandatory peer review for discrepancies.	**EM/Hospitalist:** Using structured reports. **Health Security:** Securing AI data integrity.

Figure 1. Core System Components of a Safe Diagnostic Process

Emergency Medical Services and Nursing: Bridging Transitions and Providing Continuous Surveillance

The diagnostic journey often begins before hospital arrival. EMS personnel conduct the initial patient assessment and create a narrative that sets the diagnostic trajectory. The handoff from EMS to the emergency department (ED) team is a critical juncture where information loss is common. Standardized handoff tools like IMIST-AMBO (Identification, Mechanism/Medical complaint, Injuries/Information, Signs, Treatment, Allergies, Medications, Background history, Other information) have been shown to improve information transfer completeness and reduce omissions (Singer et al., 2016). Furthermore, EMS documentation integrated into the EHR provides a vital longitudinal record, offering clues that might be missed if relying solely on the ED interview.

Once in the acute care setting, nurses serve as the constant surveillance system. Their role in mitigating diagnostic error is profound and multifaceted. Through clinical surveillance, nurses monitor patients for changes that may contradict or refine the working diagnosis. A nurse noting new neurological deficits in a patient admitted for "back pain" can prompt re-evaluation for cord compression. Patient advocacy is equally critical; nurses often have more sustained contact with patients and families, hearing concerns or historical details that were not shared with the hurried physician. Empowering nurses to formally voice these concerns through structured communication tools like SBAR (Situation, Background, Assessment, Recommendation) directly to the care team is a key safety mechanism (Thomas & Donohue-Porter, 2012). Finally, nurses are central to ensuring follow-up on pending diagnostic studies, acting as a safeguard to ensure that ordered tests are completed and their results are reviewed by the appropriate provider.

Addressing the Fundamental Social Determinants of Diagnostic Safety

Diagnostic accuracy is not merely a technical endeavor; it is deeply social. Social workers and sociologists illuminate how factors outside the clinic walls—health literacy, language barriers, cultural beliefs, implicit bias, and social determinants of health (SDOH)—directly influence the diagnostic process (Vickery et al., 2021). Patients with limited health literacy may struggle to articulate a coherent history or understand follow-up instructions, leading to

incomplete data collection and poor adherence to diagnostic plans. Implicit bias can shape which diagnostic hypotheses are even considered for patients of different races, genders, or socioeconomic statuses (Chapman et al., 2013).

Social workers intervene by conducting comprehensive psychosocial assessments that uncover barriers to care, mediating communication through trained interpreters and health literacy-informed counseling, and advocating for patient perspectives during care conferences. They operationalize the understanding that a diagnosis is co-constructed through the patient-clinician interaction. Sociological research contributes by analyzing how institutional structures and power dynamics perpetuate diagnostic disparities, informing the design of more equitable systems (Green, 2023). Integrating SDOH screening into the EHR and connecting patients to social work resources is a structural strategy to make the diagnostic process more robust and equitable (Morais et al., 2022).

Preventive Medicine and Public Health: The Macro-System Learning Engine

If frontline professionals are the sensors that detect errors, preventive medicine and public health provide the analytic engine to learn from them and redesign systems. Preventive medicine specialists, often leading quality and patient safety departments, employ methodologies like Root Cause Analysis (RCA) and Failure Mode and Effects Analysis (FMEA) to deconstruct diagnostic errors without blame (Hodkinson et al., 2020). These structured processes look beyond the "sharp end" individual to identify latent systemic conditions—flawed protocols, poorly designed equipment, or staffing models—that enabled the error (Nabhan et al., 2012). They then design and test Quality Improvement (QI) initiatives, such as diagnostic checklists for high-risk conditions (e.g., sepsis, stroke), standardized diagnostic pathways, or triggers to identify patients at risk for diagnostic delay (Panagioti et al., 2019).

Public health brings a population-level lens. By establishing diagnostic error registries and surveillance systems, public health researchers can move from anecdote to epidemiology, identifying high-frequency error types, vulnerable populations, and systemic trends (Newman-Toker et al., 2019). This data is essential for prioritizing safety initiatives and for evaluating the impact of interventions at a scale beyond a single institution. Public health research also explores the broader policy environment, such as the impact of malpractice law on error disclosure or the role of public reporting (Miyagami et al., 2023).

Health Security: Building the Foundation of a Just Culture

The strategies above depend on one foundational element: the consistent reporting of errors and near-misses (Table 1). This is where principles of health security and safety culture converge. Health security frameworks, borrowed from high-reliability organizations like aviation and nuclear power, emphasize that safety is a collective responsibility maintained through continuous learning (Weick & Sutcliffe, 2015). A punitive culture that seeks to blame individuals for errors drives reporting underground, guaranteeing that the same systemic flaws will cause future harm.

Cultivating a just culture—one that fairly distinguishes between reckless behavior, at-risk behavior, and human error in a flawed system—is paramount. Leaders must visibly support non-punitive reporting systems, protect reporters from retribution, and share learnings from adverse events transparently (O'Donovan & McAuliffe, 2020). This requires robust psychological safety, where any team member, from paramedic to social worker to nurse, feels safe to speak up with a concern or to admit a mistake without fear of humiliation. Health security also encompasses cybersecurity of diagnostic data, ensuring the integrity and availability of lab and imaging results against manipulation or ransomware attacks, which themselves could cause catastrophic diagnostic failures (Kruse et al., 2017; Lieneck et al., 2023). Figure 2 illustrates the closed-loop, multidisciplinary framework required to reduce diagnostic error in acute care settings.

Table 2: Multi-Disciplinary Roles in the Diagnostic Safety Loop

Phase of Diagnostic Process	Key Disciplines Involved	Collaborative Safety Action	Outcome
Information Gathering & Transfer	EMS, Nursing, Social Work	Standardized handoffs (EMS→ED); Nursing admission assessment; SDOH/Literacy screening (SW).	Complete, accurate, contextualized patient story.
Data Generation & Interpretation	Clinical Lab, Radiography	"Second look" protocols; AI decision support; Structured reporting; Critical result alerts.	Accurate, clearly communicated diagnostic data.
Synthesis & Decision-Making	Medicine, Nursing, SW	Interprofessional rounds; Nursing clinical advocacy; SW patient narrative integration.	Shared mental model, considered differential.
Monitoring & Follow-up	Nursing, Preventive Med	Nursing surveillance for diagnostic discrepancy; EHR triggers for pending results; QI audits.	Early error detection, closed loops on tests.

System Learning & Redesign	Preventive Med, Public Health, Health Security	RCA/FMEA of errors; Population-level error tracking; Fostering just culture for reporting.	Improved protocols, equitable systems, safer culture.

Figure 2. Integrated Multidisciplinary Diagnostic Safety Loop in Acute Care

Integrating the Multi-Disciplinary Framework

The path to diagnostic safety is not a single intervention but the integration of these interdependent strategies into a resilient system. An illustrative case involves a patient with abdominal pain. An EMS provider uses a structured handoff (IMIST-AMBO) to convey key history. The ED nurse, during her assessment, learns from the patient's spouse (advocacy) about a recent weight loss concern, which she relays via SBAR. The social worker, screening for SDOH, identifies food insecurity and arranges support. The radiologist, aided by an AI algorithm, highlights a subtle mass on CT, using a structured report. The lab's auto-alert system flags a critically elevated calcium, prompting immediate clinician notification. When the mass is later found to be benign, but the hypercalcemia leads to a correct diagnosis of hyperparathyroidism, a preventive medicine-led RCA examines why the calcium wasn't checked earlier, leading to a new clinical decision support rule. Throughout, a health security-promoted just culture ensures all team members involved in the initial missed cue feel safe to participate in the learning process.

Conclusion and Future Directions

Closing the loop on diagnostic error in acute care is a complex but achievable imperative. It demands a paradigm shift from viewing diagnosis as a solitary cognitive act to understanding it as a collaborative, system-dependent process. This review has outlined how each member of the healthcare team—from the radiographer performing a "second look" to the social worker addressing literacy barriers, from the nurse monitoring for clinical deterioration to the public health researcher tracking error trends—holds a piece of the safety puzzle. The most critical future work lies not in inventing new siloed tools, but in better integrating existing ones: designing EHRs that facilitate seamless interprofessional communication, creating governance structures that empower all voices in safety deliberations, and relentlessly measuring and cultivating psychological safety and a just culture. By embracing this multi-disciplinary framework, healthcare systems can build the resilient, learning-oriented environments necessary to ensure that every patient receives an accurate and timely explanation for their illness.

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