

Issue Brief 8

Distributed Cognition and the Role of Nurses in Diagnostic Safety in the Emergency Department



PATIENT SAFETY

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Prepared by:

Milisa Manojlovich, Ph.D., RN
University of Michigan School of Nursing

Sarah L. Krein, Ph.D., RN
Department of Veterans Affairs Center for Clinical Management Research
University of Michigan Department of Internal Medicine

Steven L. Kronick, M.D., M.S.
University of Michigan Department of Emergency Medicine

Prashant Mahajan, M.D., M.P.H., M.B.A.
University of Michigan Department of Emergency Medicine

Mark L. Graber, M.D., FACP
Society to Improve Diagnosis in Medicine, Plymouth MA



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Introduction

Each year, approximately 141 million emergency department (ED) visits occur in the United States. The decision making needed to make a diagnosis for a patient who presents to the ED occurs in a time- and information-constrained environment.¹⁻³ Therefore, the ED creates a high-risk environment where physicians and nurses are particularly susceptible to making a diagnostic error.

The inherent uncertainty of the diagnostic process makes it highly susceptible to errors.⁴ The National Academies of Sciences, Engineering, and Medicine (NASEM) defines diagnostic error as “the failure to (a) establish an accurate and timely explanation of the patient’s health problem(s) or (b) communicate that explanation to the patient.”⁵ Even a conservative estimate of diagnostic error occurring in 5 percent of ED visits translates to about 7 million cases of ED-based diagnostic error per year, with nearly half having the potential for patient harm.⁶

Diagnosis occurs as a collective exchange of facts, findings, and strategies within a defined structure (e.g., presentation of the patient who arrives in the ED) and hierarchy (e.g., nurse or physician). In this view, diagnosis is not the result of solitary thinking but rather a process that occurs through interactions with others who contribute their own unique perceptions and conclusions in a world that is “thick with artifacts.”⁷

Known as distributed cognition,⁸ this view of the diagnostic process is especially salient because various involved parties (patients/family members, nurses, physicians, other clinicians) have different knowledge by virtue of their experiences, disciplinary training, or physical location in time and space. Since no single individual can grasp everything,⁹ distributed cognition allows involved parties to share understanding of goals, plans, and details from all sources to arrive at a diagnosis.

Traditionally, the diagnostic process has been viewed as an individual cognitive activity of information processing, usually performed by physicians.^{10,11} This view does not capitalize on the wisdom of other members of the ED diagnostic team, such as nurses, consultants, and trainees. These individuals have unique, valuable knowledge that should be considered when making diagnoses in the ED.

Departing from the traditional view of diagnosis as an individual effort, diagnosis should be viewed as a team effort, with an integral and consistent part being nursing involvement.^{12,13} Nurses’ input can be critical because nursing knowledge complements yet is different from medical knowledge and is based not only on principles of science but also on holism and intuition.^{14,15} Patients and family members are another crucial group whose input is essential to optimize diagnosis.

This issue brief discusses the nurse’s role in diagnostic safety, using the conceptual lens of distributed cognition. We begin by describing the theory of distributed cognition, move on to discuss the nurse’s role in diagnosis through that conceptual lens, and conclude with some suggestions for future areas of practice and research.

The Theory of Distributed Cognition

Distributed cognition is a theory of human cognition that describes how information processing is dispersed across people and their workplace, their technologies, and their social organization and how information processing evolves over time.¹⁶ Essentially, distributed cognition describes how information is transformed and propagated throughout a system.¹⁷ It is one of a family of social cognitive theories known as situativity theory,¹⁸ all involving interactions between people, their environment, and the resources at hand.¹⁸

Social cognitive theories are increasingly popular in healthcare, and a recent special issue of the journal *Diagnosis* was devoted to considerations of how situativity theories (including distributed cognition) could be applied to understand and improve diagnosis.¹⁸ Principles of distributed cognition cross disciplinary boundaries and fall into three main categories: physical organization of work, information flow, and artifacts.¹⁷

The physical organization of work refers to the structure and context of care and the things that can be physically heard, seen, and accessed by the people doing the work. These all have a direct impact on cognition and will shape clinical reasoning, for better or worse.¹⁷ For example, nursing work is structured so that nurses have frequent patient interactions throughout a shift; that design gives nurses an advantage over physicians, whose interactions with a patient are likely to be less frequent.

This structure means that a nurse taking care of a patient is more likely than a physician to observe overt and many times more subtle clues, such as changes in vital signs, sensorium, or events such as active seizures, that will enhance the diagnostic process. In addition, the nurse is more likely to establish rapport with the patient and caregiver, thus being more likely to elicit additional historical or social details or clinical examination findings that may facilitate arriving at the correct diagnosis.

The physical organization of work influences how information flows throughout a system. Information flow itself is a specific category of distributed cognition because it defines the mechanism by which a system operates.¹⁷ At the most basic level, information flows through the process of communication, defined as an interpersonal process where shared understanding develops between communicators, to generate an effect or action.^{19,20}

Communication breakdowns are consistently among the top system-related causes of diagnostic error, thus underscoring the importance of optimizing communication as a priority for improving diagnostic quality.^{5,21-24} In the ED, factors such as time pressure, numerous interruptions, and lack of a historical relationship with the patient form barriers to effective communication with patients.¹ Nurses can help overcome these barriers because their relationship with patients/caregivers facilitates trust and information sharing.

Distributed cognition also maintains that to fully appreciate how information flows across people, places, and time, we need to understand all aspects of communication, from the mediums used to transmit information (e.g., pagers, telephone, face to face) to the type of communication used (e.g., verbal, nonverbal).

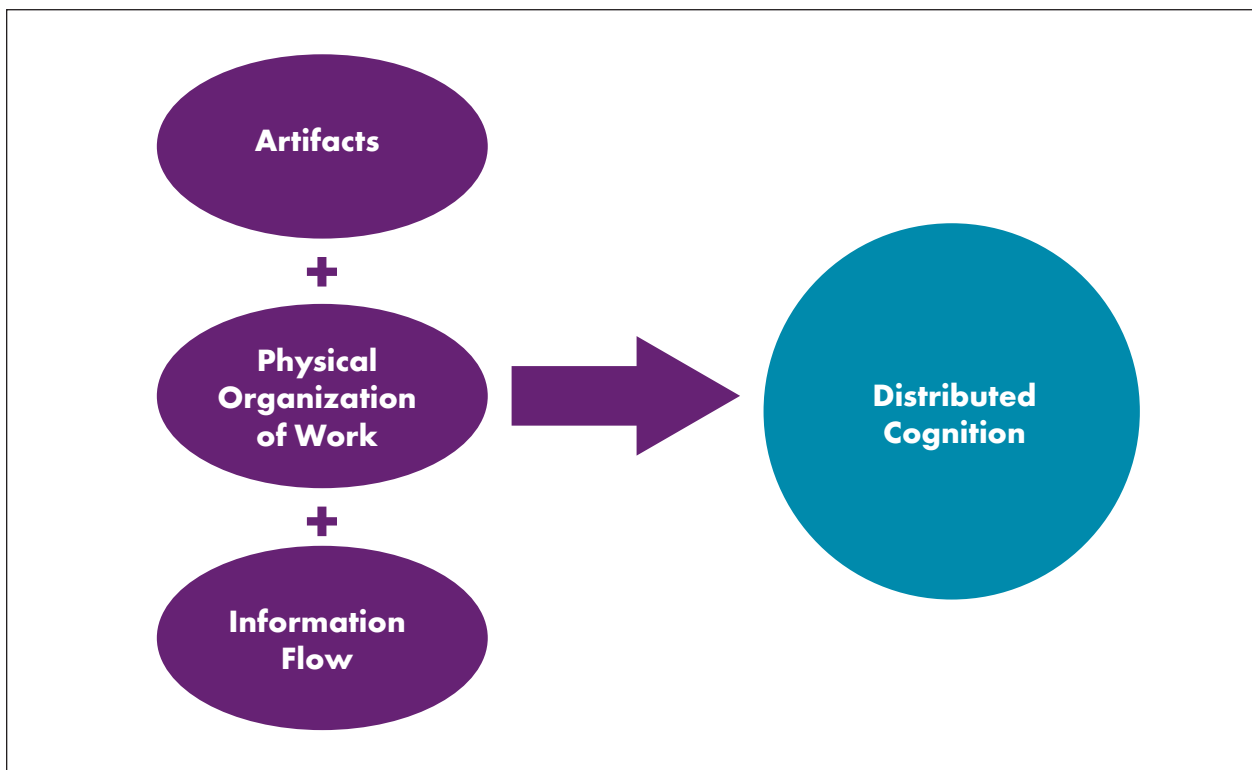
The final category of distributed cognition has to do with how artifacts are designed to support cognition.¹⁷ Artifacts refer to cognitive supports such as paper or electronic reminders and coordination tools, as well as such things as computers and software applications, including the electronic health record (EHR). For example, paper and electronic tools developed to facilitate handoffs between clinicians are a type of artifact.

Another artifact is the paper-based task sheet nurses frequently develop at the beginning of a shift. This sheet may include information such as medications that are due, when medication should be given, other therapies and treatments nurses are responsible for, and timing of all these treatments. Nurses often refer to these sheets as their “brain,” highlighting the link between artifact and cognition.²⁵

Figure 1 displays the three principles of distributed cognition. When each principle is manifested independently, distributed cognition does not develop because no opportunity arises for input from another source. For example, a nurse assesses the patient upon initial presentation to the ED, demonstrating the physical organization of a nurse's work, but without discussing assessment findings with another clinician or documenting findings in the EHR. Thus, distributed cognition will not occur.

The combination of all three principles results in distributed cognition. For example, as part of a newly established workflow, the nurse and physician go into a patient's room together and jointly review new medication orders on the EHR before sending the patient home.

Figure 1. Principles of Distributed Cognition



Nurses' Role in Diagnosis, Through the Lens of Distributed Cognition

The landmark report on diagnostic error NASEM published in 2015 made eight recommendations to improve the quality and safety of diagnosis.⁵ More research is needed that addresses the first recommendation, to facilitate more effective teamwork in the diagnostic process among healthcare professionals, patients, and their families, because diagnosis is a social phenomenon.¹⁰

Nurses and physicians represent the two largest groups of healthcare professionals in a hospital setting, and one way to think about a “team” in the context of the ED and diagnosis is to begin with the physician-nurse dyad. According to the theory of distributed cognition, the physical organization of work in an ED is such that nurses are usually the first point of contact between a patient and the ED.

When a patient arrives, nurses are typically the first to assess the patient and estimate the severity of illness.²⁶ Nursing assessment is used to triage patients and prioritize those who may have a significant risk of morbidity and mortality. Thus, nurses have a critical role in diagnosis by virtue of the nursing knowledge that develops as nurses interact with patients to recognize patterns and trends in patient behavior and disease presentations.²⁷ However, there is risk as well because incorrect recognition can play a role in misdiagnosis.

Nurses are uniquely positioned to gather patient input because of the monitoring and surveillance functions that put nurses in frequent close contact with patients and allow them to see and hear things the physician does not.²⁸ As part of the monitoring function, nurses assess trends in quantifiable physiological parameters such as vital signs and other less perceptible manifestations of illness such as anxiety or depression.

Nurses also play an important role in how communication affects diagnosis, such as acting as patient advocates, answering patient questions, providing support, and educating patients about their conditions. Physicians at times use language that is not easily understood by lay people, and time pressures or frequent interruptions in the ED further restrict physicians from fully engaging with each patient. Therefore, nurses often fill the gaps and translate jargon into terms the patient can comprehend.²⁹

Any shortcomings in eliciting all relevant information from a patient can contribute to diagnostic error.²⁹ In one study, about 10 percent of diagnostic errors were attributable to breakdowns in history taking.³⁰ By encouraging patients to become more actively engaged, nurses can help assess how well a patient's clinical course aligns with the presumed diagnosis and identify cases where the diagnosis may need to be revised or reconsidered.^{12,29}

For example, because nurses care for fewer patients than physicians, they have more time with patients to allow them to tell their story fully without interruptions, which demonstrates respect for the patient and may increase patient engagement.²⁹ However, patients who are frequently interrupted by clinicians (or even family members) or are not given time to talk about their symptoms in their own words may limit discussion of their symptoms, which can result in significant diagnostic possibilities being missed.²⁹

The relationship between distributed cognition and the role of nurses in the diagnostic process is not without its challenges. It has been said that nurses make up a key part of “the diagnostic safety net,”¹² because they often identify key signs and symptoms (e.g., cardiac arrhythmias, hypoglycemia) that contribute to a diagnosis before a physician or advanced practice provider sees the patient. Yet many nurses do not view themselves as key players in the diagnostic process or believe they should have a role in diagnosis because they do not view it as being within their scope of practice.¹³

Gleason and colleagues briefly describe the historical, regulatory, ethical, and legal precedents contributing to this stance and conclude that “this is clearly a misperception.”¹³ The misperception comes in part from using different terms for the same function. For example, identifying illness severity is a nursing role and part of nursing assessment but also part of the diagnostic process. In addition, ongoing professional silos and disparate workflows create barriers to nurses’ sharing ideas and impressions about a patient’s presentation with physicians, so nurses do not receive feedback that could help them refine or enhance their clinical reasoning.

Finally, communication and hence information flow between physicians and nurses is critical to the diagnostic process. Several factors create barriers to effective communication but two are especially relevant when viewed through the lens of distributed cognition: differences in perspective and the words or language each group uses.

ED physicians use a hypothetical-deductive model of clinical reasoning almost exclusively in generating possible diagnoses.³¹ However, nurses include an inductive approach, aggregating specific observations to make ever broader categories of information to understand the symptoms and their impact on the patient.³² This difference has implications for information flow and communication because while physicians’ clinical reasoning is grounded in objective data, nurses also incorporate subjective impressions such as intuition into the overall gestalt of what they observe.

In addition, physicians and nurses do not always use the same language when they speak to one another; even the word “diagnosis” can have very different meaning depending on whom one asks.¹³ These differences arise because nurses do not “see” the world through the same lens as physicians. Differences in perspective and language use contribute to framing effects and context errors that may lead to diagnostic error.²⁹ One study, for example, found that physicians and nurses had different perspectives on the same clinical situation that affected perceptions of what was important or urgent.³³

Recommendations and Areas for Future Research

Theoretical or conceptual models are used in research to organize complex and abstract concepts and describe relationships among them so that those relationships can be tested, which facilitates advancement in a field.³⁴ Several conceptual models in the literature provide guidance on how to reduce diagnostic error. NASEM developed a conceptual model to describe the diagnostic process,⁵ which was further refined for the ED context.³⁵

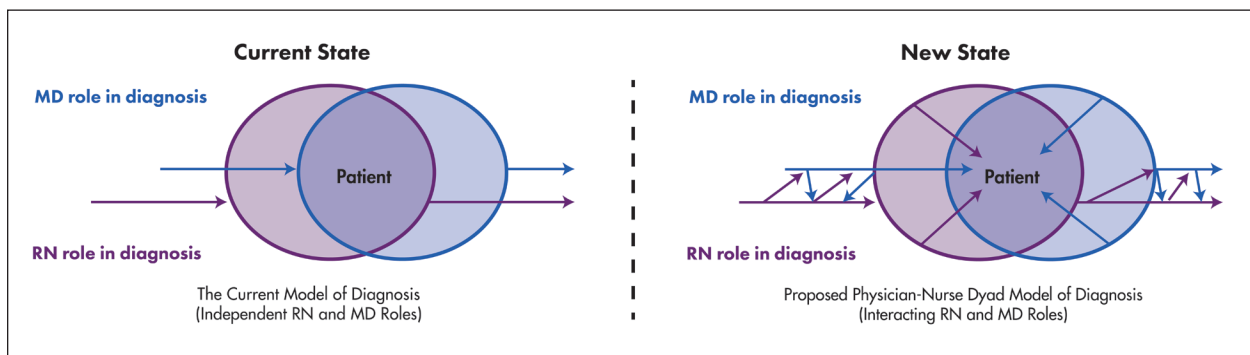
The Safer Dx framework provides a comprehensive overview of how to reduce diagnostic error specifically.³⁶ Gleason and colleagues provided the first conceptual model that illustrates the critical roles nurses can play in the diagnostic process and all the touch points in the NASEM process map of diagnosis where nurses are involved.¹³

A major shortcoming of all these models, however, is that because of differences in workflow, many actions nurses take are not in sync with those of their physician colleagues. Therefore, no standard mechanism exists for bringing the nursing perspective to a physician’s attention. Using an approach grounded in distributed cognition could address this critical flaw in diagnostic processing to help prevent and catch diagnostic errors. **Figure 2** illustrates this point.

In the current model of diagnosis (left side of the model), horizontal arrows represent individual workflows and activities of physicians and nurses before and after seeing the patient. The nurse usually sees the patient first and gathers information, integrates and interprets that information, and frequently comes up with a working diagnosis. There is no expectation of interacting with the physician, although the circles overlap because sometimes the physician and nurse see the patient at the same time. In general, though, the physician sees the patient later and goes through the same process as the nurse while also ordering diagnostic tests and consulting with others as needed.

The current approach is in contrast with our proposed physician-nurse dyad model of diagnosis (right side of the model) that uses a distributed cognition framework to insert deliberate interactions between physician and nurse before, during, and after patient contact, as indicated by the slanted arrows. While overlap in patient interactions still occurs, the physician and nurse make a deliberate effort to see the patient together, which standardizes the message the patient receives and decreases the need for clarification of the plan later in the patient's stay.³⁷ Our dyad model is a direct application of studies on how to optimize joint decision making; the best decisions come from allowing individuals to first think on their own, before collaborating to arrive at a final answer.³⁸

Figure 2. Application of Distributed Cognition to Model of Diagnosis



Research studies will need to evaluate and compare the best ways to achieve effective integration of physician and nursing input. One possible intervention would be to reconfigure the physical organization of work to bring physicians and nurses physically together at specific stages of the patient's journey through the ED, as depicted in **Figure 2**.

Such an approach would serve multiple purposes. First, it would foster the teamwork NASEM recommends, providing opportunities to discuss a patient's presentation and how each member of the physician-nurse dyad views it. Without scheduled interactions, physician and nurse workflows are asynchronous³⁹ and disconnected, resembling parallel play.^{40,41}

The potential value of teamwork of this sort was demonstrated in a cluster randomized crossover trial conducted in six EDs, where physicians cross-checked their diagnosis with another physician by presenting a case and receiving feedback.⁴² The study reported a significant reduction in adverse events and near-misses,⁴² suggesting that distributed cognition played a role by having the physician summarize information for the peer cross-checker or by having the cross-checker's fresh "outsider" perspective bring new insights to the discussion. Although in this study cross-checking was done between physicians, a similar strategy could be trialed between physicians and nurses.

Second, bringing clinicians of various types together more than once reflects the temporal nature of both the diagnostic process and a patient's journey through the ED and may help prevent the anchoring bias that can occur early in a patient's presentation. Nurses can be just as susceptible to anchoring bias as physicians. For example, the triage process can be anchoring when a nurse elicits a chief complaint that is really secondary or incorrectly triages a patient to a lower priority category. Multiple interactions may be useful in mitigating bias effects.

Finally, many aspects of distributed cognition overlap with concepts inherent in "Safety-II" science, such as teamwork and feedback mentioned above, providing yet another avenue for intervention development.⁴³

Another area that would benefit from additional research involves optimizing information flow, specifically by improving communication. The explicit role of communication in diagnostic processes, as well as the impact of suboptimal communication on patient harm, has been well documented but solutions to the problem are sparse.⁴⁴⁻⁴⁶ For example, communication breakdowns can occur at multiple levels and at varied points during the patient's diagnostic journey in the ED. Patients arriving via ambulance often have no previous relationship with the transporting clinicians, who can only base their medical decisions on what is being told to them or what they observe.²

The EHR is also becoming increasingly important for information flow. For example, although they have been available for years, the implementation of communication devices that accept messages has led to a huge increase in the use of secure chat messaging between providers and nurses in the EHR. But given differences in perspective between providers and nurses, we know little about whether secure chat messaging via the EHR is an effective communication medium.

Once in the ED, patients, nurses, and physicians all engage in framing.⁴⁷ Furthermore, patients may not be able to accurately communicate their symptoms or history to clinicians for many reasons (e.g., low health literacy, mistrust, language barriers, cognitive impairment due to illness). Not enough research attention has been paid to differences in communication that can contribute to the framing biases or context errors that lead to diagnostic error. As described above, differences in perspective contribute to the framing effect, but instead of minimizing those differences, a distributed cognition approach would seek to bridge them, recognizing the value in bringing all perspectives to bear on a specific problem.

Several strategies can be used to bridge differences in perspective and improve communication, such as:

- Interprofessional education in the health professions that could provide formal training in communication between nurses and physicians and develop a shared, common language for diagnosis.⁴⁸
- A system in place where nursing input is actively solicited in the diagnostic process, possibly during an ED huddle.⁴⁹
- A requirement that physicians communicate their plan to patients in the presence of nurses.⁴⁹ Although this strategy might be difficult to implement when the ED is very busy, the patient would derive benefit from hearing the physician and nurse perspective at the same time and possibly allow more meaningful dialogue among them.

Research into artifacts and how they can be used to facilitate diagnosis through a distributed cognition lens is a final area of research that would benefit from further development. A tragic example of the need for research in this area was provided several years ago by a patient who had been traveling in Africa and presented to an ED in Dallas, Texas, with signs and symptoms of Ebola.⁵⁰

Although the nurse documented the patient’s travel history in the nursing notes in the EHR, the nurse did not otherwise communicate this information to the treating physician. The patient was discharged from the ED only to return 2 days later, much sicker. Known as “Patient Zero” because they were the first patient diagnosed with travel-associated Ebola in the United States, the patient was admitted but died within a few days.

This case revealed numerous system failures that contributed to the initial misdiagnosis and needless exposure of others to the Ebola virus.⁵⁰ Ineffective communication between the nurse and the physician was the dominant issue, and a central problem in this regard was the failure of the EHR to serve as an effective artifact for communication between them. From a distributed cognition perspective, the EHR was not then—and still is not—configured to optimize information sharing between members of a physician-nurse dyad, because they either view or have access to different screens, and information is not shared.

Other types of artifacts include schedules, white boards, and worksheets, all of which contribute to distributed cognition but only if they are shared. These artifacts mediate collective work but need to be shared as a way to maintain an overview of the total activity.⁹ Schedules that include both nurse and physician activities and worksheets that can be used by both physicians and nurses are just two ways artifacts can be used to promote distributed cognition. **Table 1** summarizes our recommendations, organized by distributed cognition concepts, and provides associated rationales.

Table 1. Recommendations To Improve Interprofessional Diagnosis in the ED

Distributed Cognition Concept	Recommendation	Rationale
Physical organization of work	Reconfigure physical organization of work by bringing physicians and nurses together at specific stages of a patient’s journey through the ED.	Bringing nurses and physicians together: <ul style="list-style-type: none"> • Fosters teamwork. • Better integrates disparate workflows. • Allows various perspectives to be heard. • Acknowledges the temporal nature of the diagnostic process. • Helps reduce anchoring bias on the part of both physician and nurse.
Information flow	Optimize information flow by improving communication. Examples include: <ul style="list-style-type: none"> • Providing formal training in communication. • Having periodic ED huddles. • Encouraging joint discussion of the plan with patients. 	<ul style="list-style-type: none"> • Formal training in communication for nurses and physicians (ideally jointly) helps to develop a shared, common language for diagnosis and a shared mental model of a situation. • Periodic ED huddles during a shift actively solicit nursing input and ensure that multiple perspectives are heard. • Joint discussion of the plan with patients helps to clarify next steps and avoid misunderstanding.
Artifacts used in care	Incorporate artificial intelligence tools into the EHR that can interpret the context of a presentation and provide cues that guide the clinician.	<ul style="list-style-type: none"> • Reworking the EHR promotes information sharing and helps to build a shared mental model.
	Incorporate artificial intelligence tools into the EHR that can interpret the context of a presentation and provide cues that guide the clinician.	<ul style="list-style-type: none"> • Such tools reduce a clinician’s cognitive load.

Anecdotally, in our experience, a physician-nurse dyad approach is best for bringing the nursing perspective to bear so that it contributes to diagnosis. However, this hypothesis has not been tested, and a physician-nurse dyad approach may have negative aspects:

- First, a dyadic approach takes time to establish, which is always in short supply in the ED.
- Second, with so much nursing staff turnover (especially post-COVID), dyad stability may weaken.
- Third, in some cases, a dyadic approach may introduce biases, including “group think” effects if the same physician and nurse work together frequently.

Finally, dyad combinations are not fixed and may change frequently during an ED shift, with one physician needing to establish a dyad with several nurses at the same time and vice versa because of differences in shift length or patient assignment.

Conclusion

The ED is a complex, chaotic environment unlike any other in healthcare. Clinicians who work there must make diagnoses under trying circumstances while patients who seek care give up their autonomy and control in an effort to get relief for whatever ails them. Thus, it is no wonder that diagnostic errors occur.

Addressing the problem of diagnostic error by understanding and optimizing the diagnostic process in this unique setting is a challenge. The theory of distributed cognition recognizes the collective, social nature of cognition in context and provides a particularly appropriate and useful framework, suggesting how nurses can promote diagnostic quality. Emphasizing the role of nurses in diagnostic safety through the lens of distributed cognition would be a major advance in the quest to limit harm associated with these errors.

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