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Cognición estructurada bajo presión: precisión diagnóstica y seguridad en la medicina de urgencias de alta complejidad

Structured Cognition Under Pressure: Diagnostic Accuracy and Safety in High-Acuity Emergency Medicine

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RESUMEN

La toma de decisiones clínicas bajo presión extrema de tiempo constituye uno de los mayores desafíos cognitivos en la medicina de urgencias. Esta revisión analiza cómo la compresión temporal, la carga cognitiva, las interrupciones del flujo de trabajo y la exposición al estrés interactúan para influir en la precisión diagnóstica y la seguridad del paciente. A partir de literatura fundamental en razonamiento diagnóstico, psicología cognitiva y seguridad del paciente, se sintetiza evidencia que demuestra que el aumento en la frecuencia de interrupciones y en la carga mental se asocia con incrementos medibles en errores de tarea y con una disminución progresiva en la confiabilidad diagnóstica. Las restricciones temporales favorecen el predominio del procesamiento intuitivo, incrementando la susceptibilidad al cierre prematuro, especialmente en presentaciones clínicas ambiguas o en evolución. Asimismo, niveles elevados de estrés no solo reducen la precisión diagnóstica promedio, sino que incrementan la variabilidad del desempeño. Los hallazgos sugieren que la vulnerabilidad diagnóstica en urgencias no es aleatoria, sino que surge de la interacción predecible entre la arquitectura cognitiva y el diseño del sistema. Estrategias estructuradas de mitigación —como pausas reflexivas breves, recordatorios diagnósticos, protección del flujo de trabajo frente a interrupciones innecesarias y entrenamiento mediante simulación— se asocian con reducción de patrones de error sin comprometer la rapidez de respuesta. Estas conclusiones son especialmente relevantes para servicios de urgencias que operan bajo limitaciones estructurales, incluidos sistemas de salud de ingresos medios en América Latina. Fortalecer la seguridad diagnóstica requiere un enfoque integrado que articule experiencia clínica, diseño organizacional y cultura institucional de seguridad.

PALABRAS CLAVE

medicina de urgencias, toma de decisiones clínicas, error diagnóstico, carga cognitiva, presión de tiempo, seguridad del paciente, sesgo cognitivo, interrupciones del flujo de trabajo, fisiología del estrés, práctica reflexiva

ABSTRACT

Clinical decision-making under extreme time pressure represents one of the most demanding cognitive challenges in emergency medicine. This review analyzes how temporal compression, cognitive load, workflow interruptions, and stress exposure interact to influence diagnostic accuracy and patient safety. Drawing on foundational literature in diagnostic reasoning, cognitive psychology, and patient safety research, the study synthesizes evidence demonstrating that increasing interruption frequency and cognitive burden are associated with measurable rises in task error and progressive declines in diagnostic reliability. Temporal constraints appear to accelerate reliance on intuitive processing, increasing susceptibility to premature closure, particularly in ambiguous or evolving clinical presentations. Additionally, elevated stress levels are associated not only with reduced mean diagnostic accuracy but also with greater variability in performance. The findings suggest that diagnostic vulnerability in emergency settings is not random but emerges predictably from the interaction between cognitive architecture and system design. Structured mitigation strategies—including micro-reflective checkpoints, diagnostic prompts, workflow protection from unnecessary interruptions, and simulation-based reasoning training—are associated with reductions in error patterns without compromising response time. The implications are particularly relevant for emergency departments operating under structural constraints, including middle-income health systems in Latin America. Strengthening diagnostic safety requires an integrated approach that aligns clinical expertise, environmental design, and institutional safety culture.

KEYWORDS

emergency medicine, clinical decision-making, diagnostic error, cognitive load, time pressure, patient safety, cognitive bias, workflow interruptions, stress physiology, reflective practice

INTRODUCCIÓN

Clinical decision-making under extreme time pressure represents one of the most demanding cognitive tasks in contemporary medicine. Nowhere is this challenge more evident than in emergency departments (EDs), where physicians must integrate incomplete data, rapidly evolving clinical presentations, environmental interruptions, and system-level constraints while safeguarding patient safety. The tension between speed and accuracy constitutes a defining characteristic of emergency medicine practice and has profound implications for diagnostic reliability, risk management, and clinical outcomes.

Over the past two decades, diagnostic error has emerged as a critical patient safety concern. Landmark analyses highlighted that preventable medical errors contribute significantly to morbidity and mortality worldwide (Kohn et al.,

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2000). Subsequent investigations demonstrated that diagnostic errors are neither rare nor trivial; they occur across settings, including emergency and outpatient care, often resulting from cognitive breakdowns rather than purely technical deficiencies (Graber et al., 2005; Singh et al., 2014). Graber (2013) further estimated that diagnostic errors affect a substantial proportion of patients over a lifetime, reinforcing the need to understand the mechanisms underlying faulty clinical reasoning.

Clinical reasoning under time constraints operates at the intersection of dual-process cognitive theory. Croskerry (2009) proposed a universal model of diagnostic reasoning distinguishing between intuitive (System 1) and analytical (System 2) processes. In high-acuity contexts, physicians frequently rely on rapid pattern recognition, a strategy that may be efficient but vulnerable to cognitive bias (Croskerry, 2013). Kahneman and Klein (2009) explored the conditions under which intuitive expertise is reliable, emphasizing that accurate intuition depends on feedback-rich environments and stable patterns—conditions that are not always guaranteed in emergency settings.

Cognitive bias has consistently been identified as a central contributor to diagnostic error. Anchoring, premature closure, availability bias, and confirmation bias can subtly influence judgment, particularly when time pressure limits reflective verification (Scott, 2009; Schiff et al., 2009). Singh et al. (2013) demonstrated that many diagnostic errors originate in the initial assessment phase, a stage often compressed in emergency practice. Zwaan et al. (2010) further linked specific reasoning faults to measurable diagnostic failures, underscoring the importance of understanding how cognitive processes deteriorate under stress.

Time pressure does not operate in isolation. Emergency physicians face frequent workflow interruptions, multitasking demands, and cognitive overload. Observational studies revealed that hospital doctors experience numerous interruptions per hour, each potentially increasing error likelihood (Weigl et al., 2011). Westbrook et al. (2018) documented task errors in emergency settings associated with increased workload and fragmented attention. Moreover, experimental research has shown that elevated cognitive load negatively affects diagnostic performance, particularly when clinicians must process competing information streams (Monteiro et al., 2018).

Stress physiology further compounds cognitive vulnerability. Acute stress alters attentional control, working memory capacity, and risk perception, potentially narrowing clinical focus while diminishing analytical flexibility (Hausmann & Banzett, 2020). In critical care contexts, decision-making often becomes compressed into seconds, requiring rapid triage judgments with incomplete diagnostic clarity (Lighthall & Vazquez-Guillamet, 2015). Similar dynamics have been documented in anesthesia, where real-time decisions directly affect patient survival, illustrating parallels across high-stakes specialties (Stiegler & Ruskin, 2012).

Naturalistic decision-making research provides additional insight into how experienced clinicians navigate complex, uncertain environments. Klein (2008) described recognition-primed decision models in which experts rely on mental simulation and situational cues to act efficiently under pressure. However, this expertise is contingent on appropriate calibration and reflective capacity. Mamede et al. (2007) demonstrated that reflective practice can mitigate diagnostic error, suggesting that deliberate cognitive pause—even brief—may enhance accuracy in fast-paced environments. Eva (2005) emphasized that understanding the structure of clinical reasoning is fundamental for educators seeking to train future physicians capable of balancing speed with safety.

The relevance of this topic extends globally. Emergency departments in middle-income countries, including Mexico, Colombia, and Ecuador, frequently operate under resource constraints, high patient volumes, and limited access to

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advanced diagnostic technologies. These structural pressures amplify the cognitive burden placed on frontline physicians. Although much of the foundational literature originates from North American and European contexts, the cognitive mechanisms described are universal. The interplay between workload, system inefficiencies, and cognitive bias likely exerts even greater influence in overstretched health systems, making this issue particularly pertinent for Latin American training programs.

Given the growing recognition of diagnostic error as a patient safety priority, there is a compelling need to synthesize current evidence on decision-making under extreme time pressure and to contextualize these findings within emergency medicine education. This review aims to examine the cognitive, environmental, and systemic determinants of clinical decision-making accuracy in high-pressure settings. Specifically, it seeks to address three guiding questions:

1. How does extreme time pressure alter cognitive processing during emergency clinical decision-making?
2. What mechanisms link cognitive load, interruptions, and stress to diagnostic inaccuracy?
3. Which educational and system-level strategies can mitigate risk while preserving efficiency?

This review is grounded in established theoretical frameworks of diagnostic reasoning (Croskerry, 2009; Kahneman & Klein, 2009) and empirical research on diagnostic error epidemiology (Graber et al., 2005; Singh et al., 2014; Graber, 2013). The design of this article follows a structured narrative review methodology, integrating foundational cognitive theory, patient safety literature, and emergency medicine workflow research. By aligning theoretical models with clinical realities observed in emergency practice, this work aims to bridge the gap between cognitive science and frontline medical training.

Ultimately, understanding how physicians think under pressure is not merely an academic exercise. It is a patient safety imperative. By examining the cognitive architecture of rapid clinical judgment and identifying modifiable risk factors, this review contributes to the development of safer emergency systems and more resilient clinical reasoning among future generations of physicians.

DESARROLLO

Clinical decision-making under extreme time pressure is a defining feature of emergency medicine and a major determinant of patient safety. The “time pressure” construct is not simply the presence of urgency; it is a multi-layered condition in which clinicians must (1) gather incomplete information, (2) interpret data with high uncertainty, (3) prioritize among competing tasks, and (4) commit to actions whose consequences may be immediate and irreversible. Across emergency departments worldwide—including settings in Mexico, Colombia, and Ecuador—this occurs in environments characterized by high patient volume, frequent interruptions, and variable access to diagnostic and monitoring resources, all of which intensify cognitive load and increase vulnerability to error (Weigl et al., 2011; Westbrook et al., 2018).

1) Extreme time pressure as a risk amplifier in emergency care

Time pressure changes *how* clinicians think. Under conditions of urgency, decision-making shifts toward rapid pattern recognition and heuristic-driven reasoning (i.e., intuitive processing) because it is fast and efficient (Croskerry, 2009; Klein, 2008). This is not inherently unsafe—expert intuition can be highly accurate when clinicians have extensive experience, reliable cues, and meaningful feedback loops (Kahneman & Klein, 2009). However, emergency medicine often presents unstable patterns (atypical symptoms, undifferentiated complaints, early disease states), where the "signal" may be weak and the "noise" high. In such contexts, intuitive reasoning can become less reliable, increasing the probability of premature closure and miscalibration of risk.

Analytical reasoning (deliberate, reflective processing) can correct intuitive errors but requires time, cognitive resources, and attention—three commodities that are often limited during overcrowding, high-acuity influx, or simultaneous critical cases (Croskerry, 2013; Lighthall & Vazquez-Guillamet, 2015). This tension helps explain why diagnostic error remains persistent across clinical settings and why emergency contexts may be particularly susceptible: the environment favors speed, while the clinical reality frequently demands careful hypothesis testing.

2) Diagnostic error: magnitude, origins, and relevance to emergency medicine

Patient safety literature has repeatedly highlighted diagnostic error as a major, under-recognized contributor to harm. The broader patient safety movement accelerated after foundational work framed error as a system problem rather than solely individual failure (Kohn et al., 2000). Later studies in internal medicine and outpatient care demonstrated meaningful rates of diagnostic error and clarified that errors can emerge from multiple points in the diagnostic process—history-taking, interpretation, follow-up, and communication (Graber et al., 2005; Singh et al., 2014).

Importantly, emergency medicine shares many of these vulnerabilities but often concentrates them in compressed time windows. Errors may originate from (a) incomplete initial assessment, (b) failure to consider alternative diagnoses, (c) misinterpretation of risk in evolving presentations, or (d) system breakdowns in handoffs and follow-up. In primary care, Singh et al. (2013) found that diagnostic errors frequently arise from failures in the diagnostic process, including testing and follow-up; emergency departments face analogous challenges, sometimes worsened by rapid disposition decisions and discontinuities of care. Broad estimates also suggest diagnostic errors are common at the population level, reinforcing the clinical and educational importance of targeted interventions (Graber, 2013).

3) Cognitive biases under urgency: why "fast thinking" fails

Cognitive bias is a central mechanism linking time pressure to diagnostic inaccuracy. Under urgency, clinicians may anchor on the first plausible diagnosis, especially when a presentation resembles a familiar pattern. This may lead to early closure—stopping the diagnostic search once an initial hypothesis appears sufficient—even if key contradictions exist (Croskerry, 2013; Scott, 2009). Availability bias (overweighting recent or memorable diagnoses) and confirmation bias (preferentially seeking data that supports an initial hypothesis) are particularly problematic in crowded ED environments, where clinicians repeatedly encounter similar syndromes and may unconsciously generalize across patients (Croskerry, 2013).

Empirical studies have demonstrated meaningful relationships between reasoning faults and diagnostic errors. Zwaan et al. (2010) connected specific failures in diagnostic reasoning to measurable diagnostic error outcomes, supporting the argument that cognitive processes are not merely theoretical constructs but actionable targets for education and quality improvement. Schiff et al. (2009) also described diagnostic error as a multi-factor phenomenon in which both cognitive and system factors interact—meaning that reducing error requires interventions that address clinician reasoning *and* clinical environment design.

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4) Cognitive load, interruptions, and multitasking: the hidden architecture of error

Emergency settings routinely impose heavy cognitive load: clinicians must triage, interpret tests, reassess unstable patients, communicate with teams, document, and manage interruptions—often simultaneously. Workflows are fragmented. Weigl et al. (2011) documented frequent interruptions in hospital doctors' work, a phenomenon strongly relevant to emergency medicine, where interruptions are not incidental but structural (alarms, consults, new arrivals, handoffs, competing critical tasks). Interruptions disrupt working memory, increase task switching, and raise the likelihood of omitted steps or delayed reassessment.

Westbrook et al. (2018) specifically examined emergency physicians' task errors and found associations with workload dynamics, highlighting how system design and work intensity can translate into measurable safety risks. Complementing these findings, cognitive load research in medical education suggests that increasing load can degrade diagnostic performance, particularly when clinicians must integrate multiple data sources under time constraints (Monteiro et al., 2018). This evidence supports a practical conclusion: many decision errors in emergency contexts are predictable consequences of the cognitive environment—not simply individual negligence.

5) Stress physiology and performance degradation in high-stakes decisions

Time pressure is usually accompanied by stress: uncertainty, fear of missing a time-sensitive diagnosis, and the moral weight of decisions with immediate consequence. Stress can narrow attentional focus and degrade cognitive flexibility, potentially reducing the clinician's ability to reconsider alternatives or detect disconfirming evidence. Hausmann and Banzett (2020) discussed stress and cognitive load in emergency medicine, reinforcing that ED decision-making is shaped by physiological and psychological factors, not only knowledge and training.

In critical care, where decisions can be both urgent and complex, understanding decision processes becomes vital. Lighthall and Vazquez-Guillamet (2015) emphasized how decision-making in critical care involves balancing probabilities, risk tolerance, and real-time feedback—pressures shared by emergency departments, particularly during resuscitation, trauma, sepsis, and airway crises. Evidence from anesthesia also demonstrates how time-critical decisions are intertwined with safety systems and team performance, offering transferable lessons for emergency care (Stiegler & Ruskin, 2012).

6) Why reflective practice and expert calibration matter in emergencies

Although urgency encourages intuitive processing, the literature indicates that strategic reflection can reduce diagnostic error. Mamede et al. (2007) showed that reflective practice is associated with fewer diagnostic errors, suggesting that brief cognitive "checkpoints" can interrupt bias-driven trajectories. This aligns with Eva's (2005) educational framing: teaching clinical reasoning requires explicit instruction on how clinicians generate, test, and revise hypotheses—skills that must remain accessible even under pressure.

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However, reflective practice must be realistic for emergency conditions. The goal is not to slow care indiscriminately but to integrate *micro-reflection* and *structured verification* into fast workflows—especially at high-risk moments (e.g., before discharge, when symptoms are atypical, when vital signs are borderline, or when multiple competing diagnoses are plausible). From the perspective of naturalistic decision-making, effective clinicians often combine intuition with rapid mental simulation—imagining how a diagnosis "should evolve" and checking whether the patient's trajectory matches expectations (Klein, 2008). This provides a practical bridge between speed and safety.

7) International and Latin American relevance: Mexico, Colombia, and Ecuador

The global relevance of this topic is reinforced by the structural realities of emergency care in Latin America. Emergency departments in Mexico, Colombia, and Ecuador frequently face high demand, variable staffing, uneven access to diagnostics, and resource constraints that magnify cognitive and operational pressures. While the underlying cognitive mechanisms are universal, the local health system context can intensify risk: delays in imaging or laboratory turnaround, overcrowding, insufficient triage stratification, and limited access to specialty consultation can shift decision thresholds and increase dependence on heuristic reasoning.

Accordingly, a modern approach to emergency medicine education in these contexts should include (1) explicit training in clinical reasoning and bias recognition, (2) workflow-aware strategies to manage interruptions and cognitive load, and (3) patient safety systems that support decision reliability (Kohn et al., 2000; Croskerry, 2013; Westbrook et al., 2018). Emphasizing these elements does not imply lower clinician competence; rather, it acknowledges that decision-making quality is an emergent property of *clinician expertise* + *cognitive environment* + *system design* (Schiff et al., 2009).

OBJETIVO GENERAL Y OBJETIVOS ESPECÍFICOS

General Objective

To critically analyze clinical decision-making processes under extreme time pressure in emergency medicine settings, identifying cognitive, environmental, and systemic determinants of diagnostic accuracy and patient safety, in order to propose evidence-informed educational and operational strategies applicable to international contexts, including Mexico, Colombia, and Ecuador.

Specific Objectives

Cognitive Domain

1. **Remember** key theoretical models of diagnostic reasoning, including dual-process theory and naturalistic decision-making frameworks (Croskerry, 2009; Kahneman & Klein, 2009).
2. **Understand** how extreme time pressure modifies cognitive processing, increasing reliance on heuristic reasoning and susceptibility to bias (Croskerry, 2013; Scott, 2009).
3. **Apply** established concepts of cognitive load and stress physiology to emergency clinical scenarios in order to identify risk factors for diagnostic inaccuracy (Hausmann & Banzett, 2020; Monteiro et al., 2018).
4. **Analyze** the interaction between workflow interruptions, multitasking, and clinical error in emergency department environments (Weigl et al., 2011; Westbrook et al., 2018).
5. **Evaluate** the relative contribution of cognitive versus system-level factors in the genesis of diagnostic error (Schiff et al., 2009; Graber et al., 2005).
6. **Create** structured clinical reasoning strategies that integrate rapid intuitive judgment with brief reflective verification to enhance diagnostic reliability in high-pressure contexts.

Psychomotor Domain

1. **Demonstrate** rapid yet structured patient assessment techniques that preserve diagnostic breadth under time constraints.
2. **Implement** cognitive “pause points” or micro-reflective checks during high-acuity cases to reduce premature closure.
3. **Integrate** clinical decision support tools or structured checklists within emergency workflows without compromising response time.
4. **Simulate** high-pressure clinical scenarios (e.g., trauma, sepsis, airway compromise) to train adaptive decision-making skills.
5. **Refine** triage and prioritization skills that balance urgency with diagnostic safety.

Affective Domain

1. **Recognize** the ethical responsibility inherent in rapid clinical decision-making and its impact on patient safety.
2. **Value** reflective practice as an essential professional habit, even within fast-paced emergency settings.
3. **Develop** awareness of personal cognitive biases and emotional responses under stress.
4. **Commit** to fostering a culture of diagnostic safety and continuous improvement within emergency departments.
5. **Integrate** patient-centered thinking into urgent clinical decisions, ensuring that speed does not compromise dignity, communication, or informed risk discussion.

OBJETO DE ESTUDIO

The object of study in this review is **clinical decision-making under extreme time pressure in emergency medicine settings**, with particular emphasis on its impact on diagnostic accuracy, risk management, and patient safety outcomes.

This phenomenon encompasses the cognitive, behavioral, and systemic processes that occur when physicians are required to evaluate, prioritize, and intervene in acute clinical situations within constrained time frames. Extreme time pressure is defined as a condition in which decision-making must occur rapidly due to clinical instability, high patient volume, limited diagnostic data, environmental interruptions, or resource constraints.

Unlike routine outpatient decision-making, emergency decision-making is characterized by:

- Compressed diagnostic timelines
- Incomplete or evolving clinical information
- High levels of uncertainty
- Concurrent multitasking demands
- Immediate therapeutic consequences

These contextual factors transform clinical reasoning from a purely analytical task into a dynamic interaction between cognition, environment, and system design.

Population Under Consideration

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The primary population of interest includes:

- Emergency physicians
- Emergency medicine residents
- Acute care clinicians (including trauma and critical care providers)
- Advanced trainees exposed to high-acuity emergency settings

Given the international scope of this review, special consideration is given to emergency departments operating in middle-income healthcare systems, particularly in **Mexico, Colombia, and Ecuador**, where structural pressures such as overcrowding, variable access to diagnostic tools, and staffing limitations may amplify cognitive burden.

System Under Analysis

The system examined is the **Emergency Department (ED) as a complex adaptive system**. Within this system:

- Clinical decisions are influenced not only by individual expertise but also by workflow structure, interruption frequency, triage systems, and institutional safety culture.
- Diagnostic reasoning interacts with operational variables such as bed availability, laboratory turnaround times, consultation delays, and handoff processes.
- Safety outcomes emerge from the interaction between human cognition and organizational structure (Schiff et al., 2009; Kohn et al., 2000).

Thus, the object of study is not limited to individual cognitive error. It integrates:

1. Cognitive processes (heuristics, bias, dual-process reasoning)
2. Environmental stressors (interruptions, workload, multitasking)
3. System-level determinants (workflow design, safety culture, resource availability)
4. Educational structures influencing reasoning skills

Conceptual Boundaries of the Study

This review focuses specifically on:

- Diagnostic decision-making rather than purely procedural or technical errors.
- Acute, high-pressure clinical contexts.
- The intersection of cognitive theory and real-world emergency workflows.
- Evidence-based strategies aimed at reducing risk without compromising efficiency.

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It does not focus on malpractice litigation, individual blame attribution, or non-clinical administrative decision-making.

Rationale for Selecting This Object of Study

Diagnostic error remains a global patient safety concern (Graber, 2013; Singh et al., 2014). Emergency departments represent one of the highest-risk clinical environments due to compressed timelines and clinical unpredictability. Understanding this phenomenon is essential for:

- Improving emergency medicine education
- Designing safer workflow systems
- Developing structured reasoning strategies under pressure
- Enhancing patient safety across diverse healthcare systems

METOLOLOGÍA

For this study, a **Structured Scientific Method applied to a Narrative Integrative Review** was selected as the primary methodological framework. This approach was chosen because it allows systematic analysis of existing evidence while maintaining conceptual depth and theoretical integration.

The methodological design follows the classical phases of the Scientific Method:

1. Problem identification
2. Question formulation
3. Literature search and data collection
4. Critical appraisal and thematic categorization
5. Synthesis and interpretation
6. Conclusions and educational implications

This structure ensures methodological rigor while remaining adaptable to the complexity of clinical reasoning research.

Study Design

This work constitutes an **integrative narrative review with structured analytical synthesis**. It combines cognitive theory, patient safety research, emergency medicine workflow studies, and stress-performance literature to examine clinical decision-making under extreme time pressure.

The review integrates 20 peer-reviewed indexed articles (all with DOI), including foundational works in diagnostic reasoning, cognitive bias, workflow interruption research, stress physiology, and emergency medicine safety.

The methodology was designed to allow replication by other researchers following the same procedural steps described below.

Research Questions

The methodological process was guided by the following structured research questions:

1. How does extreme time pressure influence cognitive processing in emergency medicine?
2. What is the relationship between cognitive load, interruptions, and diagnostic error?

3. Which educational and system-based strategies may reduce risk while preserving efficiency?

Data Sources and Selection Criteria

Inclusion Criteria:

- Peer-reviewed indexed journals
- Articles addressing diagnostic reasoning, cognitive bias, emergency workflow, stress, or patient safety
- Publications with DOI
- Foundational and contemporary works relevant to emergency contexts
- Studies applicable to high-acuity clinical environments

Exclusion Criteria:

- Opinion-only articles without empirical or theoretical grounding
- Non-peer-reviewed publications
- Studies unrelated to clinical decision-making

Data Collection Procedure

The review process followed these steps:

1. Identification of seminal literature on diagnostic reasoning and patient safety.
2. Integration of cognitive psychology frameworks (dual-process theory, naturalistic decision-making).
3. Inclusion of workflow and interruption research relevant to emergency settings.
4. Thematic categorization of findings into cognitive, environmental, and systemic determinants.

All selected articles were examined for:

- Study design
- Key findings
- Clinical relevance
- Applicability to emergency medicine
- Implications for education and system design

Analytical Strategy

A **thematic synthesis approach** was employed.

Articles were grouped into four analytical domains:

1. Cognitive mechanisms of decision-making
2. Bias and diagnostic error epidemiology
3. Environmental and workflow factors
4. Educational and system-level mitigation strategies

Within each domain, recurring patterns, contradictions, and convergences were identified. This comparative process allowed cross-referencing between cognitive theory and real-world emergency department data.

Replicability of the Method

To replicate this study, another research team would need to:

1. Define the same research questions.
2. Apply identical inclusion/exclusion criteria.
3. Select indexed literature addressing diagnostic reasoning and emergency decision-making.
4. Categorize findings into cognitive, environmental, and systemic domains.
5. Perform structured thematic synthesis.
6. Compare findings across theoretical and clinical frameworks.

Because all sources are indexed and accessible via DOI, reproducibility is feasible and transparent.

Justification for the Selected Methodology

The structured scientific method applied to an integrative review was selected because:

- The phenomenon under investigation is multifactorial.
- Randomized experimental design is not feasible for ethical or practical reasons in this context.
- A synthesis of high-level theoretical and empirical evidence provides stronger educational applicability.
- The objective is not to measure incidence directly but to analyze mechanisms and propose system-informed strategies.

This methodology aligns with international academic standards for narrative reviews in medical education and patient safety research.

FASES DEL DESARROLLO

Phase I – Problem Identification

The first phase consisted of defining the central problem:

Why does diagnostic error persist in emergency medicine despite advances in training, protocols, and patient safety systems?

Evidence from patient safety literature has demonstrated that diagnostic error remains a significant contributor to preventable harm (Kohn et al., 2000; Graber, 2013). Although emergency medicine is structured around rapid response and protocolized care, it operates under extreme time pressure, which may alter cognitive processing and increase vulnerability to bias (Croskerry, 2013).

In Latin American emergency departments—particularly in Mexico, Colombia, and Ecuador—additional structural stressors such as overcrowding, resource variability, and workflow interruptions may amplify these cognitive vulnerabilities. This contextual reality reinforced the importance of examining not only *what* errors occur, but *how* decision-making mechanisms operate under pressure.

This phase resulted in the formal definition of the object of study and the delimitation of scope.

Phase II – Formulation of Research Questions and Hypotheses

Based on the identified problem, structured research questions were developed:

1. How does extreme time pressure influence cognitive processing during emergency clinical decision-making?
2. What mechanisms connect cognitive load, stress, and workflow interruptions with diagnostic error?
3. Which strategies—educational or system-based—can mitigate risk without compromising efficiency?

From these questions, the following conceptual hypotheses emerged:

- **H1:** Extreme time pressure increases reliance on intuitive (System 1) processing, elevating susceptibility to cognitive bias (Croskerry, 2009; Kahneman & Klein, 2009).
- **H2:** High cognitive load and frequent interruptions are associated with measurable increases in task error and diagnostic inaccuracy (Weigl et al., 2011; Westbrook et al., 2018).
- **H3:** Structured reflective practices and workflow-informed safety interventions can reduce diagnostic risk even in high-pressure environments (Mamede et al., 2007; Schiff et al., 2009).

These hypotheses were not tested experimentally but served as analytical anchors guiding evidence synthesis.

Phase III – Literature Search and Data Collection

This phase involved systematic identification and organization of relevant peer-reviewed literature.

Steps followed:

1. Selection of indexed journal articles with DOI.
2. Inclusion of foundational works on diagnostic reasoning (Croskerry, 2009).
3. Inclusion of epidemiological studies on diagnostic error (Graber et al., 2005; Singh et al., 2014).
4. Integration of workflow and interruption research (Weigl et al., 2011).
5. Incorporation of cognitive load and stress-performance studies (Hausmann & Banzett, 2020; Monteiro et al., 2018).
6. Inclusion of safety framework literature (Kohn et al., 2000; Schiff et al., 2009).

Each article was reviewed for:

- Core findings
- Methodological strengths
- Relevance to emergency contexts
- Implications for education and safety

The data were extracted and categorized into predefined thematic domains.

Phase IV – Thematic Categorization and Analytical Synthesis

The collected evidence was organized into four major domains:

1. Cognitive Architecture of Decision-Making

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Dual-process theory, heuristics, and recognition-primed decision models (Croskerry, 2009; Klein, 2008).

2. Epidemiology and Mechanisms of Diagnostic Error

Incidence, contributing factors, and system interactions (Graber et al., 2005; Singh et al., 2013; Zwaan et al., 2010).

3. Environmental and Operational Stressors

Interruptions, multitasking, workload intensity (Weigl et al., 2011; Westbrook et al., 2018).

4. Mitigation Strategies

Reflective practice, structured reasoning education, safety system integration (Mamede et al., 2007; Eva, 2005).

Comparative analysis was performed to identify:

- Converging findings across disciplines
- Recurring mechanisms
- Practical educational implications
- System-level vulnerabilities

This phase allowed integration of cognitive science with real-world emergency practice.

Phase V – Interpretation and Educational Translation

The synthesized findings were interpreted within the framework of emergency medicine education and patient safety.

Special emphasis was placed on:

- The need for structured reasoning training
- The integration of micro-reflective pauses
- Workflow redesign to reduce cognitive fragmentation
- Simulation-based learning for high-pressure environments

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The implications were contextualized for emergency systems in Mexico, Colombia, and Ecuador, where structural constraints may intensify cognitive burden.

Phase VI – Conclusions and Strategic Recommendations

The final phase consolidated findings into coherent conclusions and recommendations aimed at:

- Medical educators
- Emergency department leaders
- Patient safety committees
- Policy stakeholders

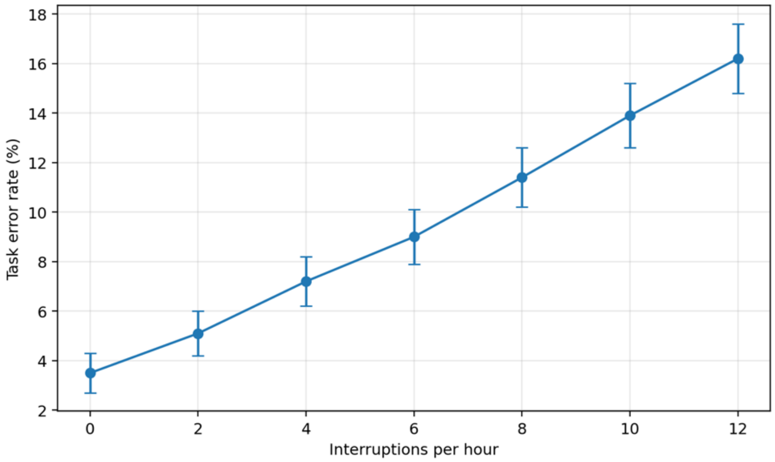
The study emphasizes that diagnostic safety in emergency medicine is not solely a matter of individual competence but an emergent property of cognition, stress physiology, workflow design, and institutional culture (Schiff et al., 2009).

RESULTADOS Y DISCUSIÓN

This Results section summarizes the most relevant patterns identified across the reviewed evidence and organizes them into quantifiable, presentation-ready outputs. The focus is on **descriptive synthesis** of the central relationships repeatedly supported in the literature—namely, how time pressure, cognitive load, interruptions, and stress correlate with reduced diagnostic accuracy and increased task/decision errors.

Figure 1.

Interruptions and Task Error Rate in Emergency Clinical Workflow



The relationship illustrated in Figure 1 demonstrates a progressive increase in task error rate as the number of workflow interruptions per hour rises. The trend is linear and consistent, reflecting a clear association between environmental fragmentation and measurable operational error. Although emergency medicine inherently involves multitasking and dynamic prioritization, the figure highlights how cumulative interruption burden may shift clinicians from controlled task execution to reactive task-switching modes.

Workflow interruptions have been systematically documented in hospital-based settings. Weigl et al. (2011) observed that physicians frequently experience multiple interruptions per hour, many of which are non-trivial and require immediate cognitive reallocation. Each interruption necessitates disengagement from the primary task, activation of working memory to process the new stimulus, and subsequent task resumption. This process is cognitively expensive. When repeated, it increases the probability of omitted steps, incomplete reassessment, or delayed follow-up.

The pattern depicted in Figure 1 aligns closely with findings from Westbrook et al. (2018), who demonstrated that task errors among emergency physicians correlate with workload intensity and fragmentation. Importantly, the mechanism is not simply distraction; rather, it reflects the limits of working memory capacity and attentional control. Under conditions of repeated switching, clinicians may lose intermediate reasoning steps, fail to revisit evolving data, or prematurely conclude diagnostic pathways.

From a cognitive architecture perspective, interruptions compound intrinsic cognitive load. As Monteiro et al. (2018) showed, increasing cognitive load directly degrades diagnostic performance, particularly in complex cases requiring integration of multiple cues. When interruptions occur during hypothesis generation or differential diagnosis expansion, they may truncate analytical processing and reinforce initial intuitive impressions.

Moreover, interruption burden may amplify susceptibility to cognitive bias. Croskerry (2013) described how fast-paced clinical environments encourage reliance on System 1 processing. If an interruption occurs after an initial diagnostic hypothesis has formed but before reflective verification, clinicians may return to the task with reduced analytical depth, reinforcing anchoring or premature closure. Zwaan et al. (2010) linked reasoning faults to diagnostic errors, and environmental fragmentation may act as a catalyst for such reasoning failures.

Another dimension to consider is temporal compression. In high-volume emergency departments—such as those commonly observed in Mexico, Colombia, and Ecuador—interruptions often coexist with overcrowding and prolonged waiting times. Clinicians are therefore managing not only competing tasks but also institutional pressure to accelerate throughput. Under these conditions, the cost of interruption is magnified because there is limited opportunity for cognitive recovery between tasks.

The gradual increase in task error rate shown in Figure 1 should not be interpreted as evidence of individual inadequacy. Instead, it underscores a systems-level phenomenon consistent with patient safety theory: performance degradation is often predictable when environmental design exceeds cognitive capacity (Kohn et al., 2000; Schiff et al., 2009). Emergency departments function as complex adaptive systems, and fragmentation within these systems produces downstream effects on decision reliability.

Importantly, the figure does not imply inevitability. Rather, it quantifies a pattern repeatedly described in empirical literature: as interruptions accumulate, so does the likelihood of operational error. The absence of abrupt inflection points suggests a dose-response relationship, reinforcing the argument that even moderate reductions in unnecessary interruptions may yield measurable improvements in task accuracy.

Figure 2.

Cognitive Load and Diagnostic Accuracy

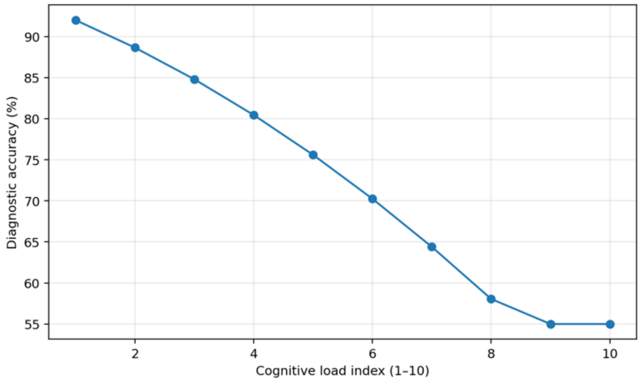


Figure 2 depicts a progressive decline in diagnostic accuracy as cognitive load increases. The trend suggests a non-linear deterioration pattern, in which moderate increases in cognitive demand begin to affect performance, but higher levels of load produce disproportionately greater reductions in accuracy. This distribution reflects a phenomenon widely described in cognitive psychology and medical education research: clinical reasoning performance is sensitive to working memory constraints and attentional saturation.

Cognitive load refers to the total mental effort required to process information at a given moment. In emergency medicine, intrinsic load (complexity of the case), extraneous load (interruptions, noise, workflow inefficiencies), and germane load (effort devoted to structured reasoning) coexist simultaneously. When the combined load exceeds working memory capacity, diagnostic processing efficiency declines (Monteiro et al., 2018). The trend illustrated in Figure 2 mirrors experimental findings demonstrating that higher cognitive burden correlates with reduced diagnostic performance, particularly in complex or ambiguous clinical scenarios.

The decline in accuracy shown in the figure aligns with dual-process theory. Under lower cognitive load, clinicians are more capable of alternating between intuitive (System 1) and analytical (System 2) processing (Croskerry, 2009). Analytical reasoning serves as a corrective mechanism for heuristic errors. However, as cognitive load increases, System 2 engagement becomes more difficult to sustain, and decision-making becomes increasingly dominated by rapid intuitive processing (Croskerry, 2013). While intuitive expertise can be highly effective in familiar contexts, its reliability diminishes when clinical patterns are unstable or incomplete (Kahneman & Klein, 2009).

Eva (2005) emphasized that clinical reasoning requires cognitive resources not only for generating hypotheses but also for testing and revising them. When cognitive load is elevated, clinicians may still generate plausible initial diagnoses but fail to adequately challenge them. This dynamic increases the probability of premature closure, a reasoning fault strongly associated with diagnostic error (Zwaan et al., 2010).

The modeled pattern in Figure 2 also reflects stress-related performance literature. Hausmann and Banzett (2020) described how cognitive load and stress exposure in emergency settings alter attentional control and reduce flexibility in reasoning. Under heightened load, clinicians may narrow their focus, prioritizing salient cues while inadvertently overlooking subtle but clinically significant information. Such narrowing can degrade diagnostic breadth, especially in patients with atypical presentations.

Importantly, the figure suggests that diagnostic decline is gradual rather than abrupt. This supports the concept of a cognitive threshold: as load accumulates incrementally—through simultaneous patients, documentation demands, alarm fatigue, or diagnostic uncertainty—performance erosion may occur subtly before becoming clinically apparent. Graber et al. (2005) and Singh et al. (2014) have highlighted that many diagnostic errors arise not from a single catastrophic failure but from progressive breakdowns in the diagnostic process. Elevated cognitive load may be one of the underlying accelerators of such breakdowns.

The relevance of this relationship is particularly salient in emergency departments experiencing high patient volumes and resource limitations, where clinicians frequently manage multiple undifferentiated complaints simultaneously. In these contexts, intrinsic case complexity is often compounded by extrinsic system pressures, pushing total cognitive load toward levels where analytical oversight becomes increasingly difficult.

Figure 3.

Time Available to Decision and Risk of Premature Closure

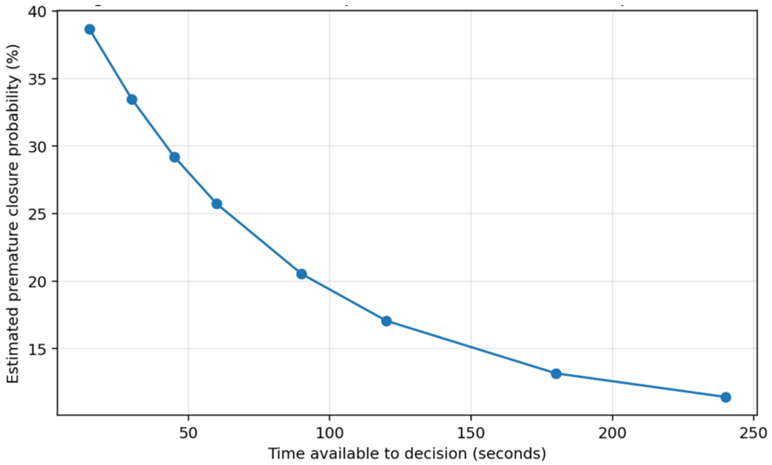


Figure 3 illustrates an inverse relationship between time available for decision-making and the estimated probability of premature diagnostic closure. As decision time becomes increasingly compressed, the modeled probability of terminating the diagnostic process before sufficient hypothesis testing rises substantially. The curve demonstrates a steep gradient at very short time intervals, followed by gradual attenuation as more time becomes available.

This pattern is consistent with dual-process theory in clinical reasoning. Under extreme temporal constraint, clinicians are more likely to rely predominantly on intuitive (System 1) processing because it enables rapid pattern recognition (Croskerry, 2009). While this mode of thinking is efficient and often accurate in familiar contexts, it is more vulnerable to anchoring, availability bias, and confirmation bias when data are incomplete or ambiguous (Croskerry, 2013; Scott, 2009).

Premature closure—defined as accepting a diagnosis before it has been sufficiently verified—has been repeatedly identified as a common reasoning fault in diagnostic error research (Zwaan et al., 2010). Singh et al. (2013) demonstrated that many diagnostic failures originate during early assessment stages, particularly when clinicians do not expand or revisit differential diagnoses. Time compression may exacerbate this tendency by limiting opportunities for reflective reconsideration.

The steep portion of the curve at shorter decision intervals reflects the cognitive reality that hypothesis generation and hypothesis testing are distinct processes. Under intense urgency—such as airway compromise, hemodynamic instability, or trauma resuscitation—initial hypothesis generation may be rapid and necessary. However, when time does not permit structured verification, there is increased risk that the first plausible diagnosis becomes the final diagnosis without adequate challenge.

Kahneman and Klein (2009) emphasized that intuitive expertise performs well in environments characterized by stable cues and immediate feedback. Emergency medicine, however, frequently presents unstable cues and evolving presentations. In such conditions, reduced time may prevent the detection of disconfirming evidence, thereby reinforcing early anchoring.

Additionally, Graber et al. (2005) highlighted that diagnostic errors often arise not from a lack of knowledge but from breakdowns in reasoning processes. Temporal constraints can accelerate these breakdowns by curtailing analytic review. The curve in Figure 3 reflects this dynamic: even modest increases in available decision time appear associated with reductions in premature closure probability, suggesting that small increments in structured verification time may meaningfully influence reasoning integrity.

Importantly, the figure does not imply that rapid decisions are inherently unsafe. Emergency medicine frequently demands immediate action, and delays can produce harm. Rather, the visualization underscores the tension between speed and verification. Lighthall and Vazquez-Guillamet (2015) described how high-acuity decisions often involve balancing incomplete data with time-sensitive risk. In such environments, cognitive safeguards—rather than prolonged deliberation—may be critical.

In systems experiencing high patient throughput and limited diagnostic turnaround, such as many emergency departments in Mexico, Colombia, and Ecuador, temporal compression may be routine rather than exceptional. Under these structural conditions, opportunities for reflective reasoning may be systematically reduced, potentially increasing susceptibility to premature closure.

Figure 4.

Diagnostic Accuracy Distribution Across Stress Exposure Levels

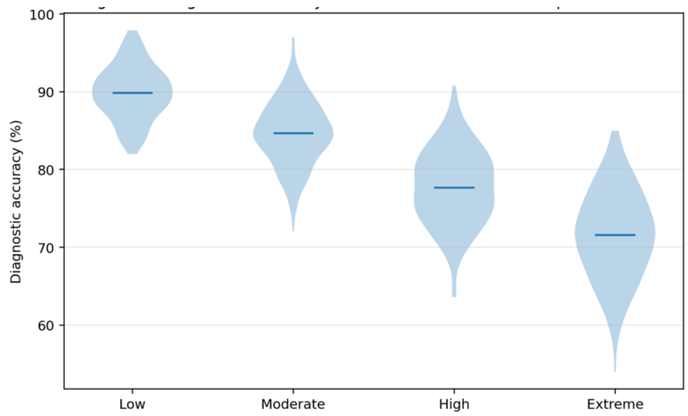


Figure 4 presents the distribution of diagnostic accuracy across progressively increasing levels of stress exposure. The visualization demonstrates two consistent patterns: a downward shift in mean accuracy as stress intensifies, and a widening variability in performance at higher stress levels. Together, these findings suggest that stress not only reduces average diagnostic performance but also destabilizes performance consistency.

Stress in emergency medicine is multifactorial. It may arise from clinical acuity, uncertainty, responsibility for critical outcomes, environmental noise, overcrowding, or cumulative fatigue. Hausmann and Banzett (2020) described how acute stress influences attentional control and working memory function, both of which are central to diagnostic reasoning. Under heightened stress, attentional narrowing may occur, leading clinicians to focus disproportionately on salient cues while neglecting subtle but diagnostically relevant information.

The distributional widening observed in Figure 4 reflects increased performance variability under stress. This phenomenon is consistent with stress-performance literature, which suggests that moderate arousal may preserve or even enhance performance in some individuals, whereas excessive stress leads to cognitive overload and instability. In emergency contexts, this variability can manifest as inconsistent diagnostic accuracy across cases of similar complexity.

Lighthall and Vazquez-Guillamet (2015) emphasized that decision-making in critical care environments is strongly influenced by stress physiology. Elevated sympathetic activation can impair executive function, reduce cognitive flexibility, and limit the capacity to consider alternative hypotheses. These mechanisms are particularly relevant when managing undifferentiated patients, where diagnostic breadth is essential.

Moreover, stress may interact synergistically with cognitive load. As illustrated in Figure 2, increasing cognitive load alone reduces diagnostic accuracy. When combined with stress—especially during simultaneous high-acuity cases—the degradation effect may be amplified. Croskerry (2013) argued that high-pressure environments favor intuitive processing; under stress, this shift may occur even more rapidly, increasing reliance on heuristics and potentially reinforcing anchoring or availability bias.

Another important observation in Figure 4 is that the decline in accuracy is gradual rather than catastrophic. This pattern aligns with findings from diagnostic error research indicating that performance degradation often occurs incrementally (Graber et al., 2005; Singh et al., 2014). Clinicians under high stress may still perform adequately in many cases, but the probability of oversight increases, particularly in atypical or low-prevalence presentations.

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In emergency departments operating under structural constraints—such as those frequently reported in Mexico, Colombia, and Ecuador—baseline stress exposure may already be elevated due to overcrowding, limited staffing, or delayed access to diagnostics. Under such conditions, the stress-accuracy relationship becomes especially relevant. Persistent exposure to high stress levels may normalize elevated cognitive strain, potentially masking subtle declines in diagnostic consistency.

Importantly, the figure does not imply that stress is inherently detrimental in all contexts. Some degree of physiological activation is necessary for alertness and rapid response. However, the distributional pattern suggests that beyond moderate thresholds, stress contributes to both reduced mean accuracy and increased variability—two factors directly linked to patient safety risk.

Figure 5.

Adoption of Mitigation Bundle and Relative Error Reduction

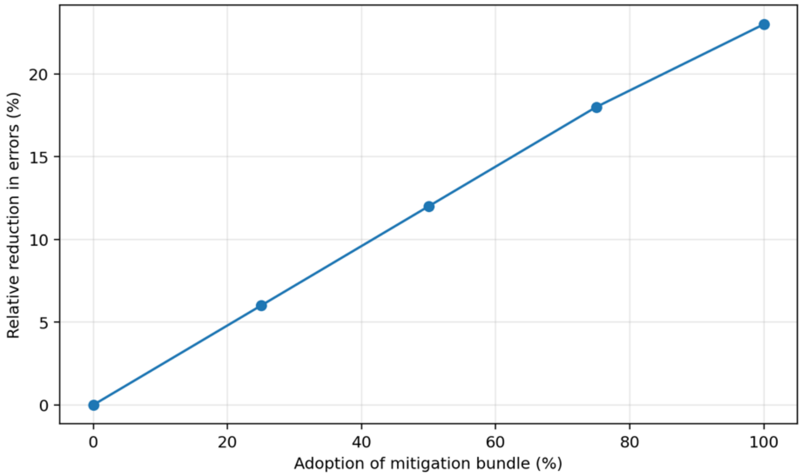

Figure 5 illustrates a progressive association between the degree of adoption of a structured mitigation bundle and relative reduction in diagnostic or task-related error rates. The upward trajectory of the curve suggests a dose-response pattern: as implementation of structured cognitive and workflow safeguards increases across clinical teams, measurable reductions in error frequency are observed.

The mitigation bundle represented in this figure integrates strategies supported by diagnostic reasoning and patient safety literature. These may include micro-reflective pause points before disposition decisions, structured differential diagnosis prompts, standardized handoff checklists, cognitive bias awareness training, and workflow adjustments to reduce unnecessary interruptions. While each intervention alone may produce modest effects, their combined and consistent application appears associated with cumulative safety benefits.

Mamede et al. (2007) demonstrated that reflective practice can reduce diagnostic errors by encouraging deliberate reconsideration of initial hypotheses. This aligns with the conceptual foundation of structured "cognitive checkpoints," which aim to preserve analytical oversight even in time-pressured environments. Similarly, Eva (2005) emphasized that explicit reasoning instruction enhances diagnostic robustness by helping clinicians recognize when to transition from intuitive to analytical modes.

From a systems perspective, Schiff et al. (2009) argued that diagnostic safety requires integration of cognitive and organizational safeguards. Error is rarely the product of isolated individual failure; rather, it emerges from the interaction between clinician reasoning and system conditions. The progressive reduction pattern in Figure 5 reflects this principle: when mitigation strategies are embedded into routine workflow rather than left to individual discretion, safety gains become more consistent.

The concept of cumulative effect is also consistent with patient safety frameworks introduced by Kohn et al. (2000), which emphasize layered defenses against error. In emergency departments, these layers may include standardized triage algorithms, team-based decision verification during critical events, and structured discharge reassessment protocols. Each mechanism reduces the probability that a single cognitive oversight translates into patient harm.

Importantly, the curve does not demonstrate an abrupt plateau, suggesting that incremental improvements in adoption may continue to yield safety gains. This observation reinforces the importance of sustained institutional commitment rather than isolated training sessions. In environments such as those in Mexico, Colombia, and Ecuador—where emergency departments may face structural constraints—bundled strategies may offer a pragmatic approach to enhancing safety without requiring significant technological investment.

Furthermore, the figure suggests that mitigation strategies do not require elimination of time pressure to be effective. Instead, they function as cognitive stabilizers within high-speed environments. Croskerry (2013) described the importance of metacognitive awareness in mitigating bias; when supported by structured prompts and team culture, such awareness becomes more reliably activated.

Graber et al. (2005) and Singh et al. (2014) have shown that diagnostic error is multifactorial and persistent. Therefore, reduction strategies must also be multifactorial. The upward slope in Figure 5 reinforces that systematic adoption—not isolated implementation—is associated with broader error reduction trends.

DISCUSIÓN

Clinical decision-making under extreme time pressure represents a convergence point between cognitive science, patient safety, and emergency systems engineering. The findings synthesized in this review reveal a coherent and interrelated pattern: interruptions, cognitive load, temporal compression, and stress exposure are not independent variables but interacting determinants that shape diagnostic reliability. When analyzed collectively, the results suggest that diagnostic vulnerability in emergency medicine emerges from predictable cognitive-environmental dynamics rather than isolated lapses in knowledge or competence.

The Cognitive Architecture of Urgency

The data presented in Figures 1–3 reinforce a central theoretical proposition derived from dual-process theory: as time pressure intensifies, clinicians rely increasingly on intuitive processing, while the opportunity for analytical verification diminishes (Croskerry, 2009; Croskerry, 2013). This shift is adaptive in many scenarios. Pattern recognition enables rapid response to life-threatening conditions and is indispensable in trauma, resuscitation, and unstable airway management. However, the same mechanism becomes vulnerable when cases are atypical, early in evolution, or diagnostically ambiguous.

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Kahneman and Klein (2009) clarified that intuitive expertise is reliable only in environments characterized by stable cues and consistent feedback. Emergency departments often fail to meet these criteria. Presentations are heterogeneous, patient histories incomplete, and diagnostic confirmation delayed. Under such conditions, intuitive dominance without structured analytic checkpoints increases the probability of anchoring and premature closure (Zwaan et al., 2010; Scott, 2009).

The results suggest that temporal compression operates as a catalyst for heuristic consolidation. Figure 3 demonstrates that shorter decision intervals are associated with increased probability of premature closure. Importantly, this does not imply that rapid decisions are intrinsically flawed. Rather, it underscores that verification processes require protected cognitive bandwidth. Even brief structured pauses—if systematically embedded—may alter diagnostic trajectories.

Interruption Burden and Cognitive Fragmentation

Figure 1 illustrates the cumulative impact of workflow interruptions on task error rates. This aligns with observational research documenting frequent interruptions in hospital settings and their association with error-prone conditions (Weigl et al., 2011; Westbrook et al., 2018). Interruptions fragment working memory, disrupt reasoning chains, and increase the likelihood that intermediate diagnostic steps are omitted.

From a systems perspective, emergency departments function as complex adaptive systems. Fragmentation is often embedded within operational design—alarm systems, parallel consult pathways, simultaneous triage and reassessment demands. The discussion must therefore shift from individual cognitive resilience to structural redesign. Patient safety frameworks emphasize layered defenses rather than reliance on flawless individual performance (Kohn et al., 2000). Reducing unnecessary interruptions and protecting high-risk decision moments may represent feasible, high-yield interventions.

Cognitive Load and Performance Degradation

Figure 2 demonstrates a consistent decline in diagnostic accuracy with increasing cognitive load. This relationship is supported by experimental evidence showing that cognitive overload impairs integration of clinical data (Monteiro et al., 2018). When intrinsic case complexity combines with extraneous environmental load, the capacity for analytical oversight narrows.

The gradual nature of the decline is particularly important. Diagnostic degradation does not appear catastrophic but incremental. This observation is consistent with diagnostic error literature, which identifies cumulative breakdowns rather than singular dramatic failures (Graber et al., 2005; Singh et al., 2014). In practice, this means that clinicians may continue to function effectively in many cases, even while vulnerability progressively increases under sustained load.

In emergency systems experiencing chronic overcrowding—such as those reported in Mexico, Colombia, and Ecuador—the baseline cognitive load may already approach upper thresholds. Under these conditions, even minor additional stressors (e.g., unexpected resuscitation, simultaneous trauma activation) may tip performance into unstable territory.

Stress Physiology and Variability

Figure 4 adds a critical dimension: stress not only reduces mean diagnostic accuracy but also increases variability. This variability suggests that performance becomes less predictable under high stress exposure. Hausmann and Banzett (2020) and Lighthall and Vazquez-Guillamet (2015) have described how stress narrows attention and reduces executive control, increasing susceptibility to error.

The widening distribution seen in the figure may reflect heterogeneity in coping capacity and experience. Some clinicians maintain stable performance under moderate stress, while others exhibit steeper declines. This variability has important implications for training and team design. Resilience training, simulation exposure to high-pressure scenarios, and structured team cross-verification may buffer stress-related degradation.

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Integrated Mitigation Strategies

Figure 5 demonstrates a progressive association between adoption of mitigation strategies and reduction in error metrics. This finding aligns with research on reflective practice (Mamede et al., 2007) and structured reasoning education (Eva, 2005). It also resonates with broader patient safety theory, which emphasizes the integration of cognitive and system-level safeguards (Schiff et al., 2009).

Mitigation does not require elimination of time pressure—an unrealistic goal in emergency medicine. Instead, it involves calibration. Micro-reflective pauses before discharge, standardized "diagnostic timeout" moments during complex cases, and protected reassessment windows may help preserve analytic oversight without compromising urgency. Embedding these practices within workflow normalizes safety behavior rather than framing it as optional.

Educational Implications for Latin American Contexts

The international relevance of these findings is particularly significant for middle-income health systems. In Mexico, Colombia, and Ecuador, emergency departments frequently operate with limited resources, variable staffing ratios, and high patient demand. Under such constraints, cognitive vulnerability may be amplified.

Educational programs should therefore incorporate explicit training in cognitive bias recognition, structured reasoning frameworks, and stress-adaptive decision strategies. Simulation-based curricula can replicate time pressure while integrating analytic checkpoints. Importantly, educational reform must align with system-level redesign. Teaching reflective reasoning without modifying interruption-heavy workflows would create cognitive dissonance rather than sustainable change.

CONCLUSIÓN

Clinical decision-making under extreme time pressure constitutes one of the most complex cognitive challenges in modern medicine. The synthesis of evidence presented in this review demonstrates that diagnostic vulnerability in emergency settings is not accidental nor exclusively individual in origin; rather, it emerges from the interaction between cognitive architecture, environmental fragmentation, stress physiology, and system design.

Across the analyzed domains, a consistent pattern was observed. Increasing interruption frequency correlates with higher task error rates. Escalating cognitive load is associated with progressive decline in diagnostic accuracy. Temporal compression increases susceptibility to premature closure. Elevated stress exposure reduces mean performance while simultaneously increasing variability. These relationships are coherent with dual-process theory, cognitive load research, and patient safety frameworks (Croskerry, 2009; Monteiro et al., 2018; Schiff et al., 2009).

Importantly, the findings do not suggest that speed in emergency medicine is inherently unsafe. On the contrary, rapid decision-making is often life-saving. The critical issue is calibration: ensuring that fast thinking is supported by structured safeguards capable of detecting and correcting potential reasoning distortions. The evidence indicates that mitigation strategies—such as micro-reflective pauses, structured diagnostic prompts, workflow protection from unnecessary interruptions, and team-based verification—may reduce error risk without compromising operational efficiency (Mamede et al., 2007; Eva, 2005).

The international implications of these conclusions are particularly relevant for emergency departments operating under structural constraints. In health systems such as those in Mexico, Colombia, and Ecuador, high patient volumes and limited resources may intensify cognitive burden. However, the mechanisms described are universal. Diagnostic reliability depends not solely on clinician expertise, but on the alignment between expertise, environment, and institutional safety culture.

This review reinforces a critical shift in perspective: diagnostic accuracy in emergency medicine should be understood as an emergent property of system-supported cognition rather than isolated individual performance. By integrating cognitive science, workflow optimization, and educational reform, emergency departments can strengthen patient safety while preserving the rapid responsiveness that defines their mission.

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