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Discussion

Misdiagnosis and failure to diagnose in emergency care: Causes and empathy as a solution

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ABSTRACT

Diagnostic error is the most frequent cause of allegations of negligence in emergency care in the United States and is estimated to contribute to the death of hundreds of thousands of patients worldwide each year. In this special contribution, we elucidate the cognitive mechanisms that emergency physicians use to make decisions and identify how these mechanisms can become sources of diagnostic error. The discussion centers on the appraisal of proposed methods to reduce the risk of diagnostic error, including debiasing strategies and a brief discussion of the theoretical basis for interventions to improve clinician empathy.

1. Introduction

In a recent article, Makary and Daniel estimated that medical error is the third leading cause of death in the United States [1]. Among these errors, diagnostic errors are the most frequent. Physicians commit diagnostic error, manifested as a failure to detect disease, in five to 15 % of cases [2–4]. This includes both false negatives (failure to diagnose) and false positives, which can lead to unnecessary interventions secondary to over-diagnosis. Emergency medicine (EM) is considered one of the specialties in which the rate of diagnostic errors is highest [5–8]. In this article, we will identify the cognitive mechanisms that enable emergency physicians (EPs) to reach a diagnosis. We will then identify the factors that contribute to the occurrence of errors. Finally, we will discuss some strategies to reduce the risk of error.

2. How do emergency physicians reach a diagnosis?

2.1. Mechanisms to reach a diagnosis

Many models of clinical reasoning have been described in the literature. Hypothetico-deduction, first described in the late 1970s, is considered the most relevant to the general approach to reasoning, particularly diagnostic reasoning [9]. It stipulates that diagnostic hypotheses are generated quickly, then data collection is performed deductively to verify the generated hypotheses. However, this model does not explain the cognitive mechanisms that allow physicians to generate and test diagnostic hypotheses. The emergence of the dual-process theory has led to an understanding of how environmental information is processed and linked to the knowledge stored in long-term memory to enable physicians to diagnose [10,11]. In particular, this theory has made it possible to identify the brain's ability to combine disparate data collected in the environment to generate relevant hypotheses in each new patient. “Dyspnea - mature age - history of heart failure”; “Headache – photophobia - fever”; “Edema of limb – redness - prolonged immobilization”. The number of combinations of signs and symptoms which lead any EP to generate instantaneous diagnostic hypotheses is endless. In the previous examples, the word combinations immediately allow shortcuts in thinking, suggesting acute pulmonary edema (APE), meningitis and deep

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venous thrombosis, respectively. The cognitive mechanism that allows diagnostic hypotheses to be generated very quickly by combining some patient data is known as "intuition" [11].

EPs rely heavily upon intuition, which is considered a "default" mode of thinking [12]. It has thus been widely demonstrated that most of our behaviors are underpinned by intuitive processes [13]. Intuition is, in fact, an indispensable condition for the practice of medicine and, more generally, for human survival [14]. Indeed, human beings are cognitively incapable of exploring all possible hypotheses in the face of a problem due to innate limitations in working memory [14,15]. In the examples previously cited, there are dozens of hypotheses. The physician's intuition will generate the most probable hypothesis(s) by combining two to four clinical or contextual data points [16,17]. It has been shown that this strategy—sometimes referred to as "heuristics"—is in most cases effective in the field of medical practice [15,18].

The ability to intuitively generate diagnostic hypotheses requires experience. As these experiences are lived, the brain will compare them to extract typical data (data that it finds consistently from one experience to another) and eliminate parasitic data (data that it finds only in a few cases). This approach leads to the construction of prototypes, i.e. typical representations of a given disease [11,19]. If these prototypes are stored in the long-term memory of an EP, the hypothesis to which they are attached will emerge immediately and effortlessly. This mechanism, sometimes called "pattern recognition", comprises a major component of intuitive thought processing [19–21].

According to the dual-process theory, a more detailed and deliberate process of human cognition —known as the "analytical" system— adds to intuition to create diagnostic hypotheses [10,11,16]. The analytical system represents the conscious process of reflecting on data collected to generate more deliberate diagnostic hypotheses, as opposed to those that arise from intuition. When EPs are confronted with ambiguous clinical scenarios, the next step rests upon the analytical process: evaluating the available data, asking what is missing, and adding in rumination and reflection to induce the most plausible diagnosis. The dual-process theory of decision-making is illustrated in Fig. 1.

The next step to reach a diagnosis is hypothesis testing and verification, through the acquisition of additional data. Precise and accurate detection of useful data with simultaneous exclusion of extraneous data is a key element of diagnostic performance, called "signal to noise detection" [22]. In the case of APE, the physician could examine the lower limbs for edema, auscultate the lungs for crackles, or obtain a brain natriuretic peptide in anticipation of an increased value. This step is based on the activation of "diagnostic scripts," a succession of slots that the physician will have to fill in to reach a sufficient level of certainty to conclude the definitive diagnosis [19,23]. For example, the pulmonary auscultation and the brain natriuretic peptide assay would correspond to two different slots in the APE diagnostic script. If the slots fill with the expected values, the hypothesis is supported. If not, the physician will doubt his or her hypothesis, or even reject it, to explore new ones.

While it is accepted that the hypothetico-deductive approach involves both intuitive and analytical processes, the scientific literature is currently divided as to when each process occurs. Historically, intuition was linked to the hypothesis generation phase (typically less than one minute) and analytical processes to the verification phase (minutes to hours) [11]. Recent work in the field of EM shows, however, that while a large majority of hypotheses are generated by intuitive processes, their verification sometimes remains anchored in intuition [16]. It is therefore possible that the two processes operate simultaneously, rather than successively and independently.

2.2. The complexity of decision-making in emergency medicine

While cognitive processes are universal, context has a considerable influence upon clinical reasoning [24,25]. The

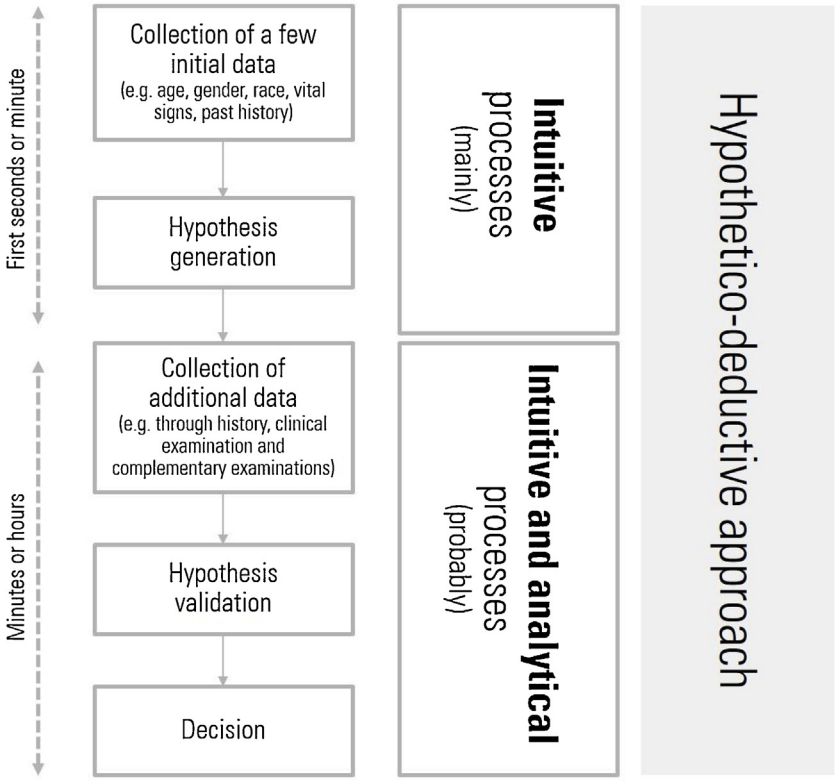

Fig. 1. A schematization of the clinical reasoning approach in emergency medicine, based upon the dual-process theory.

Table 1
Four main causes of cognitive error in emergency care.

Premature closure	Early interruption of the process of verifying working hypotheses
Anchoring bias	Focusing early on a salient element of the case and failing to get out of it when there is data that should have led to do so
Availability bias	Improperly basing decisions on events that can easily be extracted from long-term memory
Confirmation bias	Giving more importance to data that supports the working hypothesis than to data that should lead to its questioning

practice setting for EM is unique. It is described by some authors as "chaotic" [17,20,27,28]:

- EPs rarely have a prior relationship with the patient, which makes the decision-making process far more dependent upon initial data as opposed to a history of data.
- Frequently, scant information is available about the patient, including situations of impaired consciousness or travelers with emergent conditions. EPs must therefore reason despite limited data.
- EPs operate interdependently with nurses and other health professionals, such that the opinion of these professionals can frame or label the patient [28].
- The data processed by the physician often changes during the patient's management. For example, systolic blood pressure can decrease, pain can increase, or consciousness can deteriorate.
- EPs must have effective internal processes to manage ambiguity, especially in the first minutes of patient management. Uncertainty is thus a central marker of the practice of EM.
- Decisions often need to be made rapidly because of the acuity of the patient's condition or to maximize throughput in the emergency department. This time pressure is exacerbated by frequent task interruptions.
- The psycho-affective status of the physician may be marked by factors related to fatigue, stress or other emotions that are likely to interfere with the implementation of cognitive processes.

The emergency department's practice environment is unique and subjects the physician's diagnostic reasoning to significant constraints, rendering EPs vulnerable to error. In the next section, we will describe the primary mechanisms underlying these errors.

3. The mechanisms of diagnostic errors

Retrospective work by Kachalia and colleagues in 2007 showed that patient-related factors, lack of appropriate supervision, inadequate handoffs and excessive workload were involved in 34 %, 30 %, 24 % and 23 % of serious adverse events, respectively [8]. However, the most frequent reason for error, found in almost all of these events (96 %) and alone in a third of cases, is cognitive factors [8], including overconfidence, failure to use "second thought" analysis to critically appraise "first look" intuitive decisions, or misinterpreting non-verbal behaviors [2,29–31].

Reasoning errors are well recognized as inherent to the heuristic approach [32]. Physicians, despite their training and experience, are equally affected by these biases as any human being [15,33]. Cognitive biases cause most diagnostic errors [34]. In this section, we will describe the four biases that are considered to be most frequently involved in the occurrence of errors in clinical practice [15,33,35]. A summary is provided in Table 1.

3.1. Overconfidence

A physician sees a pale patient holding his back and limping when he arrives to the emergency room, and concludes that the patient has sciatica. He asks the nurse to set him up in the waiting room and administer an analgesic. He will see this patient when he can, with all the other patients already waiting. A few minutes later, the patient collapses into cardiac arrest, suffering an abdominal aortic aneurysm (AAA) rupture.

Intuitively generated assumptions should be second-tested as part of a hypothetico-deductive approach guided by diagnostic scripts. Skipping or shortening this step excessively leads to "premature closure," considered by some authors to be the leading cause of error in medical practice [4].

3.2. An impaired physician

A physician has worked seven-night shifts in a row. The triage nurse talks to the EP about a young patient who complains of vague chest pain for 15 days, apologizing and pointing out that "people come more and more to the emergency room for anything!" The physician fulminates and asks the triage nurse to advise the patient to go to see her primary care doctor in the morning. The patient will die of massive pulmonary embolism a few hours later.

Cognitive stress, whether from personal strife, substance use, or sleep deprivation, can impair cognitive processing. This may lead to impulsive thinking, leading to over-reliance on available clinical data, contextual data or another person and "anchoring bias"—sometimes called "fixing bias"—wherein the clinician remains anchored to information, ignoring elements that would detach him/herself from the presumed diagnosis [35].

3.3. A physician with a recent striking history—the gambler's fallacy

A physician hospitalizes patients who come to the emergency room much more often than her colleagues, without reason. She explains that recently, she discharged a patient in his sixties who complained only of malaise. He presented a few hours later to the emergency department in hypovolemic shock from a gastrointestinal bleed.

All physicians are influenced by recent events that they or their colleagues have experienced. When the memory of these events leads to inappropriate decision making, we speak of "availability bias." The illusion of future probability based upon prior events is known as the "gambler's fallacy."

3.4. A blind physician

A physician examines a patient with diarrhea and diffuse abdominal tenderness. "We are in the middle of a seasonal epidemic," the physician reasons without further thought. The pain is very localized in the right lower quadrant, but he only recognizes the script of gastroenteritis and fails to adequately consider the script of appendicitis. The patient will be operated on a few hours later for appendicitis.

Diagnostic scripts are useful to guide the physician in collecting data, telling him or her what to look for and what he or she may find. The problem is that patients can tell many scripts. Unfortunately, the physician may only acknowledge confirmatory data while ignoring or underestimating contradictory data. This is called "confirmation bias."

Biases may be more prevalent in EPs due to the "chaotic" environment described previously. Research conducted to date in this area has not definitively shown that contextual factors alter

the performance of EPs, although they may lead to different decisions and affect the quality of communication [36–39].

4. Implications for practice

4.1. Strategies to reduce error

Researchers who study heuristics and biases argue that error reduction requires the implementation of "debiasing strategies" [35,40,41]. These strategies promote the use of analytical cognitive processes to allow a "second chance" [41,42], asserting that most errors result from failed intuition. It is imperative that physicians acknowledge that their decisions may be biased or flawed. As Klein points out, "All doctors should [. . .] be aware of possible pitfalls in medical decision-making and take steps to avoid these unnecessary errors" [33]. Other, more specific strategies have been described [33,41,43–46]:

- Forcing oneself to generate several diagnostic hypotheses.
- Asking questions that are contrary rather than confirmatory in relation to the hypotheses generated.
- Taking more time to diagnose, so that physicians can better test the hypotheses generated.
- Using decision aid tools, including decision algorithms, as part of a Bayesian approach to reasoning.
- Employing a strategy to enhance empathic communication.
- Reflecting on one's reasoning as it unfolds, with the aim of identifying the situations in which it would lead on the wrong track.

Our understanding of bias is limited by poor methodological quality [34]. In almost all studies, the effects of interventions aimed at reducing the error rate are measured in the short-term and the definition of error and appropriate reasoning remain unclear [34]. Additionally, studies on biases are sometimes themselves subject to a bias. An example is "retrospective" or "hindsight bias," wherein people retrospectively perceive events as more predictable than they actually were.

Strategies to enhance empathy warrant mention as a potential method to reduce diagnostic error [45–47]. Empathy consists of both cognitive and affective empathy (Fig. 2). Cognitive empathy is the understanding of the facts from the patient's point of view, and affective empathy entails understanding the patient's emotions, fears and worries. Both contribute to successful data acquisition and diagnostic hypothesis generation, and to the explanation of symptoms to the patient in the absence of a particular diagnosis [48,49]. In the example cases, the physicians were disconnected from their patients, and failed to understand their perspectives, leading to diagnostic error. Empathy could have helped the first physician to connect with his patient and elucidate that the patient also had abdominal pain and was lightheaded, leading to the diagnosis of ruptured AAA, or for the physician in the second case to uncover the patient's strong family history of hypercoagulability, leading to the correct diagnosis of pulmonary embolism.

While both components of empathy have the potential to reduce error, cognitive empathy can help overcome the biases in Table 1, and therefore appears to have the most value at enhancing the ability to decode verbal and non-verbal cues [50,51]. More specifically, toward improving the accuracy of hypothesis generation, cognitive empathy provides a framework to overcome premature closure, a powerful and common confounder of decision-making in emergency care [26]. In the emergency care setting, speed to a decision represents one of the most prized metrics by which physicians are judged. Ironically, the administrative pursuit of a shorter length of stay, often viewed as a quality metric, rewards premature closure [52]. At the same time, the most common allegations of medical malpractice against trainees as well as certified practitioners in emergency care allege negligence in diagnosis, which to some extent, always involves premature closure, by failure to widen diagnostic testing [53]. Premature closure, or the over-reliance on intuition ("seizing and freezing"), appears to be independent of physician experience level [54]. When Krupat et al. presented medical students and experienced internists with complex medical vignettes, their diagnostic accuracy depended upon processes rather than experience [55]. Specifically, diagnostic accuracy was enhanced when participants engaged three processes: 1. When participants included more items in their diagnostic lists; 2. When they persisted, and less frequently quit before learning all available information; and 3. When they more often switched diagnoses during the course of the vignette [55]. In a nutshell, cognitive empathy happens when the provider says "tell me more," showing the provider's willingness to maintain a wider and more flexible differential diagnosis. Verbal openness also encourages the patient to disclose his or her perceptions which the physician can then use to differentiate physiological causes of symptoms–which warrant diagnostic testing–from emotions, fear, irrational thoughts or misperceptions about symptoms–which require cognitive and affective reassurance as opposed to low-value diagnostic testing. Whether or not this approach increases or decreases length of stay remains uncertain, but higher perception of self-empathy appears inversely correlated with self-perception of burnout [56].

Empathy has other benefits that suggest higher perceived quality of care, including higher patient satisfaction [57]. Moreover, patients who experience an adverse outcome from medical care may be less likely to sue physicians who display high empathy [43]. As one example, the physician who saw the patient with malaise and an occult gastrointestinal bleed could have asked one simple empathy-conveying question: "Is there anything else?" This powerful phrase can reveal new relevant data, such as "I have been too tired to do the work that I have always done" or "my stool looks like tar."

Several teaching methods have been developed to enhance empathy in medical care [58,59]. To help teach empathy specifically to EPs, Pettit et al. developed a concept-based, visual

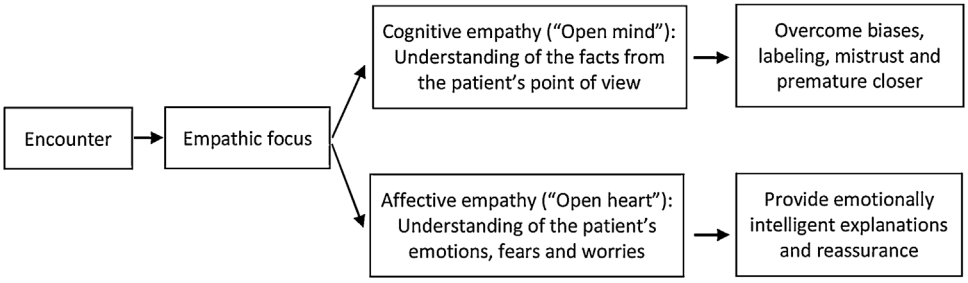

Fig. 2. The role of empathy in reducing diagnostic error.

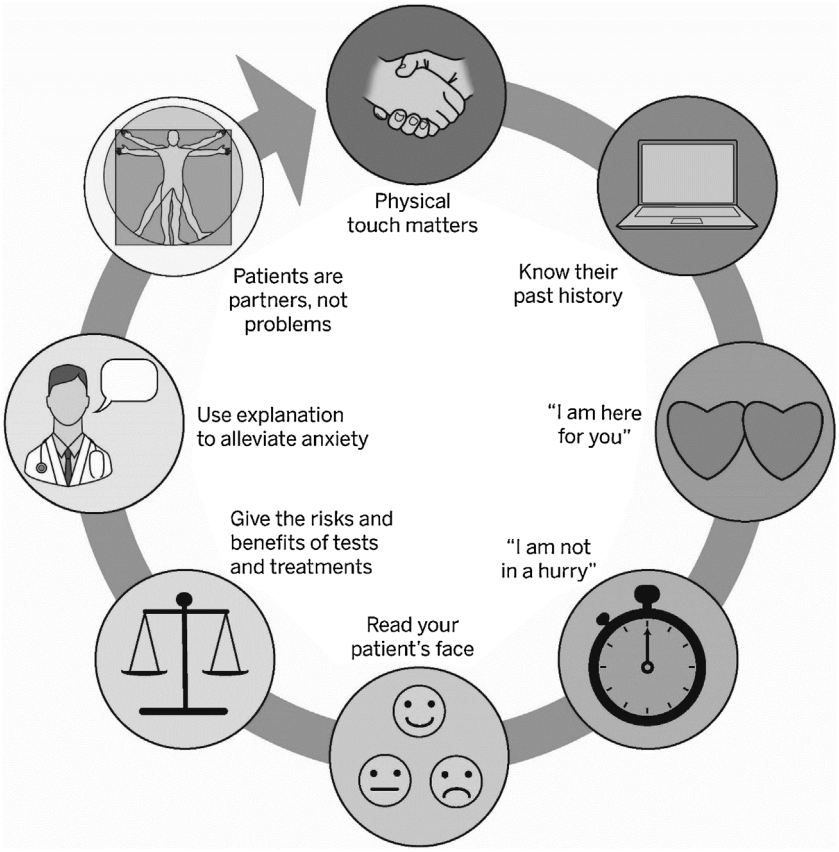

Fig. 3. Conceptual diagram to help reinforce key words and behaviors to cultivate empathy in emergency care. This stems from the hypothesis that improved empathy leads to better health communication and subsequent harm reduction (Used with Permission from Pettit K et al., Acad Emerg Med Educ Train, 2019).

teaching tool termed the "empathy circle" (Fig. 3) [60]. This cognitive map, supplemented by a didactic lecture, is the only educational tool we are aware of specifically designed to teach empathy to EPs. The purpose of the tool is to provide anchoring words and behaviors derived from patient interviews and surveys as tangible methods to improve perception of EP empathy.

4.2. Present and future reality

It must be emphasized that zero tolerance for errors is not feasible, and can lead to over-testing and squandered resources. Goals should be set toward harm reduction, not elimination of all error. Norman et al. write: "The assumption that a magic bullet will emerge to eliminate all errors is likely nothing more than wishful thinking" [61]. Eva et al highlight that "it is unrealistic and unreasonable to expect clinicians to think in a non-human manner" [15]. Most strategies deployed in clinical settings aim to reduce the consequence of errors and not their prevalence.

5. Conclusion

Human reasoning, coupled with experience, offers the extraordinary ability to efficiently solve problems faced by individuals quickly and with minimal cognitive effort. Intuition, in particular, ensures professional endurance in emergency care, whereas the "rational" approach of analytical processes allows adaptation and flexible thought [15]. Although the work done in the field of clinical reasoning has revealed part of the cognitive functioning of the physician, there are still many areas of shadows, particularly regarding diagnostic error in emergency care [34,61]. Uncertainty remains about the interactions between intuitive and analytical processes, and a lack of clarity about when and how to choose which process should dominate decision-making. Empathy is a potential tool for reducing error and improving performance. Lack of knowledge of clinical reasoning compels the need for research into effective strategies to reach the goal of error reduction in all stages of practice [62].

Author contributions

TP and JK defined together the content of the article. TP drafted a first version that was revised by AM and JK. All authors have approved the final version of the manuscript.

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Declaration competing interest

TP, AM and JK report no competing interests.

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