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A scoping review of physicians' clinical reasoning in emergency departments

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SL contributed to the design of the study and to data analysis (data extraction) and interpretation. He reviewed manuscript drafts.

NT contributed to the design of the study (search strategy) and to data collection (producing the initial database). She reviewed manuscript drafts.

AT contributed to the design of the study and to data interpretation. She reviewed manuscript drafts.

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VD contributed significantly to the design of the study and to data analysis (screening and reviewing papers for inclusion, analyzing the data charts, quantitative analyses) and data interpretation. She reviewed manuscript drafts.

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ABSTRACT

Clinical reasoning is considered a core competency of physicians. Yet there is a paucity of research on clinical reasoning specifically in emergency medicine, as highlighted in the literature. We conducted a scoping review to examine the state of research on clinical reasoning in this specialty. Our team, comprised of content and methodological experts, identified 3763 articles in the literature, 95 of which were included. Most studies were published after 2000. Few studies focused on the cognitive processes involved in decision-making, i.e. clinical reasoning. Of these, many confirmed findings from the general literature on clinical reasoning, specifically the role of both intuitive and analytical processes. We categorized factors that influence decision-making into: contextual factors, patient factors, and physician factors. Many studies focused on decisions regarding investigations and admission. Test-ordering is influenced by physicians' experience, fear of litigation, and concerns about malpractice. Fear of litigation and malpractice also increase physicians' propensity to admit patients. Context influences reasoning but findings pertaining to specific factors, such as patient flow and workload, were inconsistent. Many studies used designs such as descriptive or correlational methods, limiting the strength of findings. Many gray areas persist, where studies are either scarce or yield conflicting results. The findings of this scoping review should encourage us to intensify research in the field of emergency physicians' clinical reasoning, particularly on the cognitive processes at play and the factors influencing them, using appropriate theoretical frameworks and more robust methods.

INTRODUCTION

Emergency physicians make potentially life-saving decisions every day. The way physicians make decisions has fascinated researchers for nearly half a century. Research in this field can broadly be divided into two schools of thought.[1] On the one hand, the heuristics and biases approach takes a critical stance towards human reasoning, often focusing on the fallibility, vulnerability and inconsistency of cognitive processes, especially intuitive ones. On the other hand, the naturalistic decision-making approach focuses on expert reasoning, trying to demystify it by examining the strategies and data used by the human brain to make decisions quickly and effectively in complex natural environments. Within these frameworks a reasoning model has emerged describing human decisions as the result of intuitive and analytical processes, depending on the task to be solved and the time available,[2] and stressing that experts rely heavily on their intuition.[3]

In the field of medicine, the cognitive processes that underpin decisions are generically referred to as "clinical reasoning".[4] The ability to make decisions is an essential and core competency in medicine.[5–8] These decisions range from attributing a diagnosis (or, at least, reaching a sufficient understanding of a clinical problem to direct management) to ordering investigations, and determining optimal management (defined by Cook et al. as “choices about treatment, follow-up visits, further testing, and allocation of limited resources” which would include resuscitation, admission, and discharge in the emergency setting[9]).[7,10] In the literature, many terms are used to describe clinical reasoning, including "critical thinking", "problem solving", "diagnostic reasoning", and even "decision making".[11,12] Many authors use them interchangeably, whereas others do not.[6] For example, “decision making” sometimes refers specifically to a research paradigm that focuses on medical diagnosis under ideal

conditions using a probabilistic approach based on Bayesian models, and other times more broadly to the diagnostic, investigative, and treatment choices physicians make in the messy clinical setting.[13] In this manuscript, we will distinguish clinical reasoning (cognitive processes involved in clinical work) from decisionmaking (decisions resulting from clinical reasoning).

Dual-process theory is currently seen as a "universal" model of reasoning, used both in the general literature and in the clinical reasoning literature.[5] Its relevance has been demonstrated in several areas of medical practice, including family medicine, anesthesiology and emergency medicine.[8,14,15] Dual-process theory proposes that clinical reasoning involves two types of processes:[4,5]

- Intuitive processes, sometimes referred to as "system 1", which rely on mental shortcuts (sometimes called "heuristics") that enable individuals to make decisions quickly and with minimal conscious effort. Intuitive processes involve the rapid recognition of patterns from a limited amount of data, based on knowledge developed through experience and stored in long-term memory.
- Analytical processes, sometimes referred to as "system 2" or "normative/rational reasoning", which consist of deliberate and rule-governed reasoning. Analytical processes involve the active collection and interpretation of data.

According to dual-process theory, many factors can exert an influence on the clinical reasoning process, including on the relative likelihood of relying on intuitive or analytical processes:[4,5,16]

- Contextual factors linked to the working environment (e.g. organization of the health system, location and practice environment, time of the day, interruptions, available

resources, patient flow [i.e. the ratio between patients entering and patients leaving emergency departments] and workload).

- Patient factors (e.g. age, personal characteristics, language).
- Physician factors (e.g. age, education and training, experience, personality traits, intellectual abilities).

In the past decade, a consensus has emerged regarding the significant role of context (including physicians' work environment) on clinical reasoning.[16,17] Emergency medicine in particular, has specific characteristics that may have an impact on physicians' reasoning: physicians must make decisions quickly, based on incomplete information, and team-manage multiple patients at the same time, with interruptions and a high level of uncertainty.[8] Despite these contextual specificities, there appears to be little work on clinical reasoning in this particular context of practice.[18] This finding led Sandhu *et al*., in 2006, to launch a call for further research in order to better understand the cognitive strategies used by emergency physicians to make their decisions.[19] A decade after this call, we aimed to examine the state of research on clinical reasoning in emergency medicine by conducting a review of relevant literature. Our research question was: What is known about physicians' clinical reasoning in the context of emergency medicine?

METHODS

We present a summary of our methods below and invite interested readers to consult appendix 1 for further details.

To answer our research question, we decided to conduct a scoping review, a type of knowledge synthesis used for the purposes of "summarizing and disseminating research findings", and "examining the extent, range and nature of research activity".[20]

Clinical reasoning is a complex topic, so we assembled a multidisciplinary team of researchers. The team included six clinical reasoning experts (TP, MCA, MN, SL, MY and VD), one of whom is an emergency physician (TP), one pediatric emergency physician (LP), and two methodological experts (NT, AT). We followed the five steps recommended in Arksey and O'Malley,[20] and by Levac *et al.*,[21] methodological frameworks which were recently discussed by Thomas *et al*. in the context of health professions education.[22] We summarize these five steps and how we performed them in the following paragraphs.

1. Step 1: Identifying the research question

   In order to identify the research question, TP and VD proposed an initial question which was discussed and refined with the rest of the team.

2. Step 2: Identifying relevant studies

   Our search was designed to capture the literature about (1) clinical reasoning, (2) by practicing physicians, and (3) in the emergency department. Our librarian team member (NT) worked with two content experts (TP and VD) to select appropriate search terms (see appendix 2). A series of pilot searches was conducted in Medline to ensure that the final search would retrieve 10 key papers we had collectively identified. The final search was performed in June 2016 in Medline (Ovid SP), EMBASE (Ovid SP), ERIC (EBSCOhost) and PsychINFO (Ovid SP), with no date or language limits. The search was updated in June 2017.

3. Step 3: Selecting the studies to be included in the review

We used an iterative process to define our inclusion and exclusion criteria.

Our inclusion criteria were:

- Article reports primary research
- Article focuses on clinical reasoning processes including diagnosis, investigations and management, synonyms representing intuitive or analytical reasoning OR on physician/patient/contextual factors influencing clinical reasoning
- Study refers to practice in the emergency department
- Sample includes – at least some - practicing physicians

Our exclusion criteria were (additional criteria in bold)

- Article reports on non-primary research (case reports, commentaries, editorials, literature reviews)
- Study refers only to practice outside the emergency department (during transfer, disaster sites, other ambulatory settings, critical care unit)
- Sample does not include practicing physicians (only patients, residents, nurses, paramedics)
- Study does not focus on clinical reasoning processes or influencing factors, e.g., focuses on:
    - clinical reasoning accuracy only (with no analysis of influencing factors)
    - perception
    - decision making about career choice
    - performance of technical skills
    - performance in communication, collaboration, professionalism
    - attitudes towards decision making tools or guidelines

- Study focuses on educational interventions

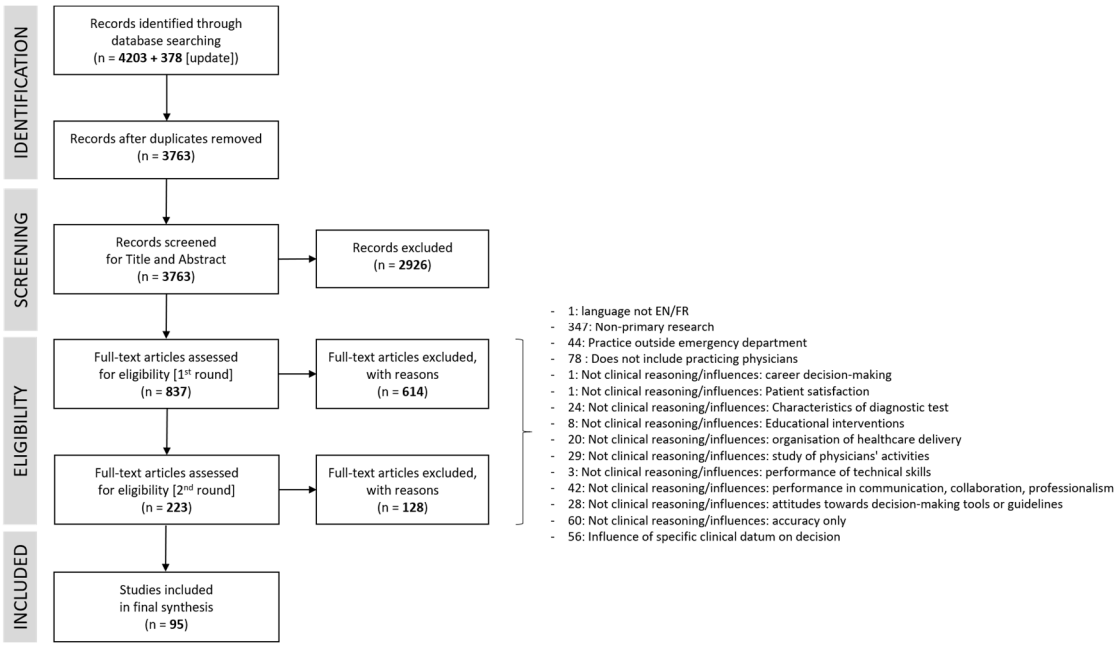
The selection process occurred in 3 steps using a dedicated online software (Covidence®, Veritas Health Innovation Ltd, Melbourne, Australia). First, two researchers (TP and VD) looked at the title and abstract of the articles and decided whether to include each study. They independently reviewed subsets of 50 studies until they reached agreement in at least 90% of cases (this threshold being considered as a rule of good practice in scoping reviews).[22] This level of agreement was reached after reviewing 200 abstracts. They then divided the remaining abstracts for review.

The second step consisted in reading the full texts. TP and VD independently read full texts in subsets of 25 papers until they reached an agreement level of 90%, which they did after reviewing 75 articles. The remainder of the articles were split between them.

In a third step, TP and VD involved the research team (excluding our methodological experts) to refine inclusion and exclusion criteria. Based on the revised inclusion and exclusion criteria, TP and VD reviewed the proposed full texts for inclusion independently. Remaining disagreements were discussed with the whole team (excluding the methodological experts) and resolved by consensus.

We retrieved 4203 articles from the four databases in our initial search and our second search to update the database (Figure 1). After removing duplicates, we reviewed 3763 abstracts, and 837 full-text papers, of which we included 95 (see appendix 3).

Figure 1: Prisma flow diagram showing the different steps of study selection



4. Step 4: Charting the data

   TP and VD created the first version of the extraction form, relying on the theoretical framework, dual-process theory, described in the introduction (see appendix 4). In order to refine the form, we asked the whole team (excluding the methodological experts) to independently extract data from six randomly chosen articles. We formed two teams of extractors (LHP-SL and MN-MCA) and randomly assigned half of the articles to each team for independent extraction.

5. Step 5: Collating, summarizing, and reporting the results

   For extraction of descriptive data such as country, methods or methodology used, population group, type of cognitive process mentioned, and step of decision making (i.e. diagnosis, investigations and/or management), VD identified disagreements between the two extractors, and computed the percentage of agreement for each question and for each pair of extractors (see appendix 5). Disagreements were resolved by a third author (TP or

VD). For open-ended extraction questions regarding the findings of each paper, we kept responses from both extractors for analysis.

Descriptive analysis

To characterize the database, VD conducted descriptive analyses of the questions using IBM SPSS Statistics for Windows v23 (IBM Corp., Armonk, N.Y., USA). TP and VD independently analyzed the extracted data for open-ended questions, successively for cognitive processes, contextual factors, patient factors and physicians' factors.

Thematic analysis

For each of the topics listed above, TP and VD produced a narrative summary of themes following a deductive approach based on our theoretical framework (e.g. searching in the "patient factors" topic results and summarizing findings based on age, gender, language, culture/ethnicity, insurance status, past medical history, signs and symptoms, patient expectations). They then discussed their respective narratives, returning to the extraction file and in some cases the original articles as needed, to reach consensus. The whole team discussed the findings in a team meeting and over email, to select the most salient findings and discuss potential implications.

RESULTS

Characteristics of Included Studies

Of the 95 papers included in this review, most were published after 2000, with an upward trend in the number of publications across time (Figure 2). Characteristics of included papers are summarized in Table 1. Two thirds of studies were conducted in North America. Based on Punch and Oancea's classification,[23] we determined that the majority of studies used a non-

experimental quantitative approach (59%), with few experimental (9%) studies. Non-experimental studies (n=56) typically used surveys (n=37), and most analyses were purely descriptive (n=39). The proportion of qualitative studies –which included 16 interview studies, 1 focus group study, and 3 studies combining several qualitative methods- increased from 0 prior to 2000, to 17% in the 2000s and 27% since 2010.

Twelve studies (13%) included only pediatric patients. A majority of studies (57%) were limited to examining reasoning for a specific disease (or group of diseases), symptom, test, or treatment.

The focus of studies was mainly on management (43%) or on multiple steps in the clinical reasoning process (27%), with few studies focused on diagnosis alone (16%; Table 1). Forty-nine percent (49%) of studies presented findings relating to contextual factors that might influence clinical reasoning, from the macrolevel (e.g. healthcare system, urban versus rural) to the mesolevel (e.g. section of the emergency department/triage category, workload), and the microlevel (e.g. physical space, interruptions, noise). Forty-five percent of studies included patient factors that might influence clinical reasoning (age, gender, language, culture/ethnicity, insurance status, past medical history, signs and symptoms, patient expectations). Fifty-four percent of studies included physician factors that might influence clinical reasoning (age, gender, training, experience, beliefs, fear of litigation/risk aversion/tolerance of uncertainty).

Figure 2: Number of publications per year, and proportion of quantitative, qualitative, and mixed methods studies

Table 1: Characteristics of included papers

			N 95	Percent
Country	North America		62	65
	Europe		14	15
	Asia		12	13
	Oceania		5	5
	Africa		1	1
	More than one location		1	1
Research approach (based on Punch and Oancea[23])	Quantitative		69	73
		Non-experimental	*56*	*59*
		Quasi experimental	*4*	*4*
		Experimental	*9*	*10*
	Qualitative		20	21
	Mixed methods		6	6
Focus of studies (step of decision making)	Diagnosis		15	16
	Investigations		7	7
	Management		41	43
	Multiple (more than one)		26	27
	Other		3	3
	Not extracted		3	3
Specificity	Disease/symptom/test/treatment-specific		54	57
	General		41	43
Patient population	Pediatric only		12	13

We present the thematic results according to the theoretical framework as described in the introduction. We will therefore first describe the findings from the review that discuss the elements relating to the clinical reasoning processes that underlie decision making, then findings relating to contextual factors, patient factors and physician factors that influence clinical reasoning.

Main Results

Clinical reasoning

Few of the included papers specifically examined the cognitive processes underpinning decision-making, i.e. clinical reasoning *per se* (n=21, 22%, of which 4 publications were from the same research project).[8,24–44] Although some of these papers did not use the terminology of "dual-process theory", 19 described both analytical and intuitive types of reasoning processes, 1 paper described only intuitive[32] and 1 only analytical processes.[39] Although clinicians self-report that they are more analytical than intuitive,[34] studies found that experts (defined variably based on attending status, experience -e.g. more than 5 or 10 years experience-, or peer recognition) tended to use more intuitive processes than novices (typically defined as residents and/or fellows, but sometimes less experienced attending staff).[24,34,36,40] Intuitive processes allowed them to generate diagnostic hypotheses very quickly, even before seeing the patient,[25] and to form a first impression of the patient (specifically in terms of "well/unwell"), which influenced subsequent reasoning and decisions.[25] First impressions were based on very little information,[25] including non-verbal cues (e.g. child is crying versus smiling).[36] Three experimental studies found inconsistent results in terms of the role of intuitive processes on diagnostic errors. Cruz and colleagues' study using clinical vignettes found that ECG interpretation could be biased by adding information from the patient history.[45] Mohan et al, in a serious game (a computer game designed for purposes beyond entertainment, in this case for research) engaging participants in a simulated emergency department, found that increasing participants' cognitive load led to undertriage of patients who were less representative of trauma patients requiring transfer,

suggesting that increasing cognitive load triggered the use of a representativeness heuristic.[31] However, Monteiro et al. found that interruptions, which should lead to increased use of heuristics, did not lead to an increase in diagnostic errors on clinical vignettes.[44] In addition to intuitive reasoning, experts also used analytical reasoning, specifically in atypical[26] or life-threatening situations[38], using algorithms in the latter.[29] Reasoning in the emergency department was underpinned by knowledge largely constructed through clinical experience.[24,30,39,42]

Contextual factors

Within our database of included studies, forty-eight papers (51%) reported on contextual factors that might influence clinical reasoning. [25,26,29,31–35,38,39,44,46–82]

Patient flow, work/cognitive load and bed availability

Admission rates were influenced by factors such as time of day,[46] with conflicting results regarding the influence of patient flow and workload.[47,60] An experimental study found that high cognitive load increased reliance on intuitive reasoning.[31] One study found that bed availability influenced patients' length of stay in an observation unit.[80]

Interruptions and noise

Three studies examined the impact of interruptions.[44,49,74] Two studies found that interruptions led to physicians engaging in a prioritization of current task versus the task related to the interruption.[49,74] This additional decision required mental processing which increased the overall cognitive load on physicians.[49] One found that interruptions increased the time taken to reach a decision but did not impact quality of decisions.[44] Finally, loud intermittent sounds were found in an experimental study to increase stress, distraction, and speed of decision making, with no impact on quality of decisions.[50]

Available resources

Physicians believed that test ordering was excessive.[82] Investigations were used to rule diagnostic hypotheses in or out,[8] even when they were very unlikely,[82] but also at times to provide reassurance to the patient and to the physicians themselves.[83] Multiple factors influenced test-ordering decisions, including fear of litigation,[82,84,85] concerns about the cost to patients,[83] and the scientific evidence (although one study suggested emergency physicians were less likely to base their test-ordering decisions on the evidence than other specialists.[75])

Patient factors

Forty-three publications (45%) included patient factors.[25,26,32–34,36–38,45,46,48,52,56–58,61–73,78,81–83,86–96]

Age

Several studies found that physicians (and in one study residents more so than attending staff)[68] cited age as a factor they considered when deciding to withhold or stop resuscitation,[63,67,78] although in one study, physicians cited physiological age as opposed to actual age as an important factor[26] and in another, physicians felt that age would not be a major factor in their decision to admit a patient brought to the emergency department in cardiac arrest.[48] In one vignette study[58] and in a study of actual cases,[90] age was indeed a factor in withholding or stopping resuscitation. Mutrie et al.[66] found that physicians considered age in the decisions to admit and Ben Assuli et al.[56] found that age increased the likelihood of being admitted. Finally, age was considered a complicating factor in communication, with physicians tending to order more tests because they were unsure of the accuracy of the history when the patient's cognitive state was uncertain, or when they found it difficult to communicate with patients suffering from hearing deficits.[37,86]

Communication

Communication barriers such as language and cultural differences complicated history-taking, reduced physicians' confidence in the accuracy of the data from the history and increased physicians' diagnostic uncertainty.[37,86] Physicians described ordering more tests when faced with communication barriers.[37,86]

Gender

Gender was not consistently related to decision making in our database and the evidence of gender bias was therefore weak. Men were more likely to be admitted[56] and overtriaged for minor injuries,[32] but they received similar analgesic prescriptions for pain management to females (except for severe pain, where females were more likely to be prescribed analgesics).[70]

Ethnicity

Two studies examined the potential for ethnicity to bias clinical reasoning and found inconsistent results. Thea et al. found that ethnicity influenced the types of questions physicians asked patients presenting with chest pain. Non-Caucasian patients were more likely to be asked about smoking and alcohol or cocaine use, suggesting that stereotypes about patient lifestyle may be at play.[89] On the other hand, Tamayo et al. in an experimental vignette study, found that ethnicity did not influence opioid prescription.[95]

Physician characteristics

Fifty-two studies (55%) included physician factors.[26,27,32–40,44–46,48,51–55,57,58,61–63,65–68,70,72,73,75,79,81,82,85,87,88,91–94,96–104]

Specialized training

Two studies in our database examined the impact of specialized training on admission rates. Specialized training was variably defined as completing residency which included emergency medicine training, or as completing a complementary specialty such as pediatric emergency

medicine, or as having obtained a postgraduate emergency medicine-related certification. One study on pediatrics emergencies found that general pediatricians' patient admission rates were higher than those of pediatric emergency physicians,[46] but Mutrie et al.[66] found no differences in general admission rates based on specialized training. Specialized training was, however, seen as making difficult decisions easier in trauma or end-of-life cases,[26,51] although experience was seen as a more significant factor.[51] Specialized training was also associated with physicians being even more favorable to analytical thinking than other emergency physicians were.[34] Neither board certification nor experience influenced self-reported use or endorsement of shared decision making.[52,81]

Experience

Experienced physicians were more accurate in their diagnoses, especially in complex cases,[33,39,44,45] and had lower patient mortality rates, especially in the most severe cases.[53,96] They were not, however, any better at predicting survival in cases of acute congestive heart failure than more junior colleagues.[92] Experience was generally associated with fewer investigations,[51,86,87,96] although one study found no difference for number of lab test requests.[96] Findings were inconsistent in terms of admission rates. Li et al.[96] found lower admission rates for experienced physicians and Gaucher et al.[46] found lowest admission rates for physicians with 5-10 years of experience, followed by the most senior physicians, whereas Wu et al.[88] found higher rates of admission for more experienced physicians. Studies were also inconsistent in regards to speed, with two studies suggesting experienced physicians were faster,[44,87] and one study finding they were slower than junior colleagues.[96] According to one study, experts had a broader sense of the clinical situation, could extract relevant cues from a wealth of information, and although they came to a working diagnosis faster, they were more likely to keep an open mind, whereas novices (in this study, first-year residents) struggled to identify relevant cues, relied more on objective and flagged abnormalities from investigations,

thought more linearly and tended to commit sooner to a diagnosis, making it harder for them to reconsider their diagnosis if disconfirming information became available.[40] The fact that experts kept an open mind longer was consistent with a finding from an experimental study in which experts not only generated more and better diagnostic hypotheses than did residents,[39] but they also generated their final diagnosis later.[39] There were no differences in favoring analytical reasoning versus intuitive reasoning based on experience.[34]

Gender

In our database, gender had no influence on admission rates of pediatric patients,[46] on over-undertriage of patients with injuries,[32] on accuracy of survival judgments,[92] on unscheduled revisits, or on attitudes to risk.[101] However, one study found that women were more favorable than men regarding intuitive reasoning (although both men and women reported using analytical reasoning more than intuitive reasoning)[34] and were less likely than men to report using bleeding risk scores.[100] One study found that women had similar attitudes towards shared decision making than men[52] but another found that they had higher levels of self-reported use than men did.[81]

Fear of litigation

Patients managed by physicians with a high level of risk aversion or concerns about malpractice were more likely to be admitted, particularly in intensive care units, and underwent more testing,[54,85,97–99,104] although two studies found that fear of malpractice and stress from uncertainty did not influence decisions.[54,104]

LIMITATIONS

One of the challenges in reviewing the literature on clinical reasoning is a lack of consensus surrounding terminology, resulting at least in part from the diversity of theoretical

frameworks used in the study of clinical reasoning and decision making.[105] For example, the MeSH terms "decision making" or "clinical decision making" do not capture all relevant articles. In order to increase the sensitivity of the search, we included as many relevant key terms as possible, and ensured that these terms identified the ten key papers collectively identified by our team. However, we did not attempt to further validate the search by measuring the sensitivity and the precision of the search. Therefore, despite our inclusive search strategy and our broad inclusion criteria, we cannot rule out the possibility of having missed relevant articles. In particular, we are aware of several studies on the impact of context on the practice of emergency medicine, such as interruptions and noise, which were not retrieved.[106–108] We hypothesize that these studies were not identified by our literature search because they did not specifically address the impact of these contextual factors on clinical reasoning. However, the purpose of a scoping review is not to be exhaustive, but to depict the breadth and depth of a body of knowledge.

In seeking breadth, we included articles that focused on specific diseases, symptoms or syndromes. The findings from such studies point to factors of interest but cannot be assumed to generalize to emergency medicine practice as a whole. Furthermore, in seeking to describe the scope of the literature as opposed to proposing a synthesis of the best evidence as in a systematic review, we did not evaluate the quality of studies.

Another issue in interpreting results was that the definition of expertise is ambiguous, with some authors using experience as the only marker for expertise.

Finally, we did not extract information about the use – or lack thereof – of a theoretical framework. Although few studies used an explicit theoretical framework, more detailed information could have been interesting.

DISCUSSION

Most of the studies included in this scoping review were published after 2000, reflecting a growing field of research in clinical reasoning in emergency medicine, in line with the 2006 *Annals of Emergency Medicine* call.[19]

A Focus on Management

In contrast to the general literature on clinical reasoning, which focuses mainly on the diagnostic step of clinical reasoning,[11,109] most of the work included in this scoping review focused on the patient management step (including disposition, treatment, and follow-up plan). This result could be explained by the fact that management in emergency medicine (e.g. decision to resuscitate or decision to admit) must often proceed in the absence of a clear diagnosis. Considering management as a key output of clinical reasoning places the emergency medicine literature ahead of the broader clinical reasoning literature, where explicit discussion of the reasoning underpinning management,[9] including for patients with multiple chronic conditions is currently under-studied.

The Role of Intuition

In our scoping review, few studies specifically focused on the clinical reasoning processes underpinning decision making, i.e. clinical reasoning *per se*. Those that did generally described both analytical and intuitive types of reasoning, which supports the relevance of dual-process theory –a theoretical framework commonly used in the broader clinical reasoning literature.[4] We also found that physicians relied on knowledge based on their clinical experience when making decisions. In fact, experience –and presumably the experiential knowledge that it encompasses– had a stronger influence on decision making

than did specialized training. In the broader literature on clinical reasoning, intuitive reasoning processes are seen as developing through experience, which is consistent with some of the studies suggesting that experts rely on intuition more than novices.[110–114]

The Weight of Context

The influence of context on reasoning has been recognized since the 1990s, and many studies have confirmed this influence in the field of medicine.[16,17] Context is even considered by some authors as the most significant factor affecting clinical reasoning.[16] Half of the studies included in our database examined at least one contextual factor. However, most of the studies only looked at the impact of contextual variables on decisions per se rather than on the underlying cognitive processes. We suggest further research examine in more depth the impact of context on clinical reasoning itself and believe that cognitive load theory may be a useful theoretical lens to examine the impact of contextual features of emergency medicine such as interruptions and noise.[44] One feature of emergency medicine that was rarely mentioned in our database but is an emerging concept in the broader clinical reasoning literature is team-based reasoning.[115–118] How the reasoning of a first agent (for example, the triage nurse or a paramedic) might influence the reasoning of a second agent (for example, the emergency physician) is an area of research associated with potentially important implications for emergency medicine, where team-based care is commonplace. For instance, how can experts develop an effective "know-who" and judiciously make use of their colleagues' reasoning, without falling prey to anchoring bias?[28] Studies aimed specifically at collaborative or team-based reasoning may improve our understanding of actual reasoning in the emergency department, which could contribute to increased quality of reasoning and hence decisions.[115–118]

Physician Factors: The Practice of Defensive Medicine

Changing one's practice in relation to the threat of malpractice has been referred to as "defensive medicine".[119] It is associated with behaviors such as prescribing more unnecessary investigations and/or treatments, avoiding risky yet necessary procedures, excessively admitting patients or referring them to other specialists, or, in some specialties, refusing to treat high-risk patients.[119] One would expect it to be prevalent in emergency medicine, which, despite average rates of malpractice claims,[120] is typically perceived as a "risky" specialty.[119]

In our database, most studies examining constructs related to risk aversion and fear of litigation showed that physicians who were more concerned about risk and/or litigation prescribed more investigations and admitted more patients. While this issue may be more prevalent in North America, where litigation issues may be more prominent, and where many of the studies in our database were conducted, the role of attitudes related to risk-taking merits further investigation.

One of the challenges in interpreting this body of literature is that different articles use different terms to study similar and related constructs, and different instruments to measure them. Future work in this area would benefit from semantic and conceptual clarity, and should provide more data regarding the validation of measurement instruments.

A Risk of Ageism?

Several studies found that physicians considered patients' age, particularly in admission decisions or when deciding whether to initiate or withdraw resuscitation. Whether or not they did so appropriately, i.e. to accurately determine diagnosis or estimate prognosis, is beyond the scope of this paper. The studies we examined were not designed to distinguish appropriate

clinical management from ageism. Further research is warranted in this area, particularly in light of the increase in elderly patients in emergency departments.

The Relationship between Communication and Clinical Reasoning

Another factor impacting clinical reasoning in our database was communication. Whether it be language issues, patient hearing deficits, or concerns about patient reliability, emergency physicians rely heavily on the clinical history and resort to more investigations when they are unsure of its reliability.[27,37,86] Further studies should examine cultural communication barriers in more depth as these are likely to also influence clinical reasoning.

We would like to conclude this article in two parts: first by summarizing the answer to our research question, and then by opening up additional research perspectives, particularly in terms of methodology. Considering our aim to examine the state of knowledge on how emergency physicians make decisions, our review revealed that cognitive processes are mobilized in a similar way to other specialties, with both analytical and intuitive processes at play. However, the context of emergency medicine practice and several physician factors (including fear of litigation and experience) and patient-related factors (including age and language) play a determining role in the decisions that are made. In identifying factors that influence decisions, our review suggests that further research is needed to understand how these factors play a specific role in successful decision making as well as in errors. Such research could help design interventions to improve patient safety.[121,122] The field of research on clinical reasoning in emergency medicine has been growing since the early 2000's. However, further research is needed. In our review, most studies used a quantitative descriptive approach. Experimental studies were rare. We suggest they should be used more often, specifically to examine biases linked to patient factors, and to study the impact of

specific contextual factors such as interruptions and noise. Qualitative research, particularly suitable for studying reasoning,[10] represented only 21% of included studies although the proportion has been increasing since the 2000s. Recent qualitative research in the field of emergency physicians' reasoning has contributed significantly to the understanding of complex decision-making mechanisms. Qualitative methods are especially useful to study clinical reasoning in complex natural environments and should be used to examine the interactions between clinicians, patients, and the emergency department environment.[5] Finally, in line with quality criteria for research in medical education in general, we recommend that future studies be grounded in appropriate theoretical frameworks.[123,124]

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