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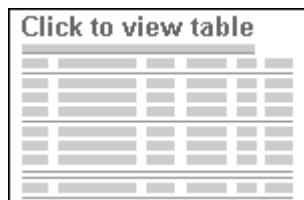Alert me when this article is cited: Email | RSS
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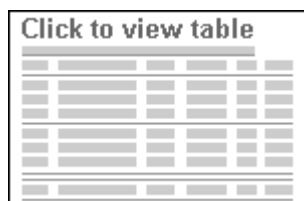**Published article online:**
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Original Article

Diagnostic errors and reflective practice in medicine

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Abstract

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Background Adverse effects of medical errors have received increasing attention. Diagnostic errors account for a substantial fraction of all medical errors, and strategies for their prevention have been explored. A crucial requirement for that is better understanding of origins of medical errors. Research on medical expertise may contribute to that as far as it explains reasoning processes involved in clinical judgements. The literature has indicated the capability of critically reflecting upon one's own practice as a key requirement for developing and maintaining medical expertise throughout life.

Objectives This article explores potential relationships between reflective practice and diagnostic errors.

Methods A survey of the medical expertise literature was conducted. Origins of medical errors frequently reported in the literature were explored. The potential relationship between diagnostic errors and the several dimensions of reflective practice in medicine, brought to light by recent research, were theoretically explored.

Results and Dissussion Uncertainty and fallibility inherent to clinical judgements are discussed. Stages in the diagnostic reasoning process where errors could occur and their potential sources are highlighted, including the role of medical heuristics and biases. The authors discuss the nature of reflective practice in medicine, and explore whether and how the several behaviours and reasoning processes that constitute reflective practice could minimize diagnostic errors. Future directions for further research are discussed. They involve empirical research on the role of reflective practice in improving clinical reasoning and the development of educational strategies to enhancing reflective practice.

Diagnostic errors and reflective practice in medicine

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Recent reports have stressed the impact of medical errors in health care. Adverse effects of doctors' mistakes have been pointed out as important causes of morbidity and mortality [1]. The Institute of Medicine report 'To Err is Human', published in 1999, estimates that, in the USA, between 44 000 and 98 000 patients die every year, as a result of clinical errors. If the lower estimate is considered, deaths owing to adverse events exceed the deaths attributable to motor vehicle accidents, breast cancer, or AIDS [2]. Studies have showed high health care expenditure owing to medical failures in many countries. Within the professional field, frequency and effects of clinical errors have been increasingly recognized, while the public perceives them as unacceptable and avoidable. A patients' safety movement aimed at minimizing preventable medical errors has rapidly grown [1]. Proceeding towards this goal requires understanding the reasons underlying medical mistakes. One of the sources of error is poor clinical judgement. Research into medical expertise has brought light to the reasoning processes involved in clinical judgement, and may thereby contribute to this endeavour. The capability of critically reflecting upon one's professional practice has been pointed out as a key requirement for developing and maintaining medical expertise. Through engaging in reflecting on one's own reasoning and decisions when faced with complex cases, doctors are expected to improve their performance [3]. Recent studies on failures of expert doctors have reinforced the potential role of reflective practice in reducing errors [4]. The nature of reflective practice in medicine has been explored, and, recently, empirical research brought to light its multidimensional structure [5].

This article intends to discuss relationships between poor reflective practice and diagnostic errors. Our purpose is to explore, on a theoretical basis, whether and how reasoning processes and behaviours that constitute reflective practice in medicine relate to failures in clinical judgements. Empirical evidence in support of approaches to reduce medical errors is still scarce. Our statement,

however, is that reflective practice provides doctors with a systematic framework, built upon an underlying theory, to understand and minimize diagnostic mistakes. Aimed at explaining our reasons, we start by discussing the origins of diagnostic errors and the nature of reflective practice in medicine. Subsequently, relationships between gaps in reflective practice and diagnostic errors are explored, and, finally, we highlight directions for further developments.

Origins of diagnostic errors

Understanding the nature of doctors' mistakes is considered a crucial condition for their prevention. The literature has therefore explored types and origins of medical errors. Attention has been directed particularly to diagnostic mistakes, which correspond to a significant proportion of all medical errors. Diagnostic errors are usually costly, potentially preventable, and have a high impact both for doctors and patients [6]. Kassirer & Kopelman [7] propose a classification of diagnostic errors that parallels the components of the diagnostic process. Errors could occur in the generation of hypotheses, in hypotheses refinement through data gathering and interpretation, and in diagnosis verification. Building upon this idea, Graber *et al*. [6] designed a comprehensive framework for understanding diagnostic errors. According to them, diagnostic errors can be classified in three major categories. '*No-fault* errors' occur when the right diagnosis could hardly be expected, owing to , for example, a silent illness or to a disease with atypical presentation. The second category, entitled 'system-related errors', refers to flaws in the health system that affect doctors' performance. Finally, 'cognitive errors' are those that can be attributed directly to the individual doctor. Cognitive errors result from 'inadequate knowledge or faulty data gathering, inaccurate clinical reasoning or faulty verification' [6]. Their article emphasizes the relevance of approaches to minimize cognitive errors. However, they are not extensively examined. In fact, the literature has discussed origins and types of diagnostic mistakes, but structured approaches, based on an underlying theory, to address cognitive errors remain unexplored. Cognitive diagnostic errors are the focus of our attention in this article. Briefly exploring the nature of medical practice is our starting point to better understand the origins of cognitive errors and challenges involved in their prevention.

Medical decisions are usually presented as a conscious application to a patient's problem of precise rules derived from a scientific knowledge base. Rational use of objective, well-established knowledge for guiding clinical judgements is highly valued by the public and within the professional fields [8]. Evidence-based Medicine has grown as an attempt to reduce gaps between research and practice, and thereby enhance use of scientific approaches in clinical judgements [9]. Uncertainty, however, is inherent to clinical decision making, owing to characteristics intrinsic to medical knowledge and practice. First, there is the incompleteness of medical knowledge and a fallibility inherent to science. The medical knowledge base changes continuously as a result of new discoveries [8]. Second, in spite of the growth of medical knowledge, it will always be insufficient to entirely preview prognosis or results of interventions. Clinical judgement is a complex process that always encompasses interpretation of findings within a particular situation. Relevant differences between individuals hardly made explicit and quantified, and the need to integrate patient preferences in decision making turn it improbable that any amount of empirical

findings can ever tell doctors what is to be done in a particular situation [9]. Doctors have to interpret the scientific literature in light of each patient's unique configuration of disease, characteristics, and needs for care [10,11]. Third, traditional views of the doctor as a neutral subject who objectively observes and interprets a patient's problem to make decisions have been increasingly questioned [12]. Contemporary theories understand knowledge as a construction influenced by the knower's position and perspectives. Clinical observations and interpretations do not escape from this constructivist view of knowledge. A doctor always brings to each clinical encounter a body of medical knowledge, including theoretical knowledge from several disciplines, and knowledge acquired through experience. This body of knowledge provides the basis for the interaction with each unique patient. From this interaction clinical knowledge required to solve the particular problem is produced. Doctors' experience, beliefs, and perspectives influence their perception and interpretation of features encountered in a case. Signs reinforcing a certain perspective may be highlighted, while another line of thought may not receive appropriate attention [12]. Research has shown that sociological and psychological factors embedded in doctors' reasoning play a role in the diagnostic process [12,13]. Clinical decision making therefore cannot be seen as an objective, rational application of scientific knowledge and rules. Indeed, it is a complex process, in which multiple dimensions interact, characterized by uncertainty and ambiguity. Fallibility is therefore inherent to medical decisions.

In spite of navigating large seas of uncertainty, however, doctors clearly make decisions in busy practices, and they usually do so with ease and confidence. Not surprisingly, therefore, clinical reasoning has attracted the attention of researchers over the last 30 years [14]. Generally two perspectives have been explored. The first is the decision-making approach. It suggests the analysis of the probability that a disease is present as the basis for reaching a diagnosis. The decision-making approach, however, apparently refers more to how doctors should reason than to how they actually do this in practice [15]. The second approach concentrates on understanding how medical knowledge is acquired, organized in memory, and retrieved later to solve clinical cases. The so-called problem solving studies have brought light to the actual process of diagnostic reasoning [14]. Research has shown that doctors' knowledge structures and their use change as they gain clinical experience [16]. When expert clinicians encounter patients with familiar clinical presentations, their reasoning is highly automatic. Diagnostic hypotheses usually arise early in the clinical encounter. Generation of hypotheses is based on pattern recognition through a process of matching the current case to instances of previously seen patients. In fact, illness scripts and instances of patients already seen were showed to have a crucial role not only in hypotheses generation. They also organize search for additional data and interpretation of evidence, thereby acting on hypotheses refinement and diagnoses verification [17]. Several knowledge structures apparently remain as layers in memory, and may be used to deal with problems [15,16,18]. Automatic reasoning typically encountered in common problems may be replaced by analytic reasoning approaches when doctors are faced with complex, unfamiliar cases [5,15]. Indeed, expert clinicians' reasoning seems to be characterized by complexity and flexibility, and, apparently, different mental strategies are adopted in response to different

problems' demands [9,15].

In spite of the usually high efficacy of expert doctors' reasoning strategies, they are not error proof. Within the problem-solving research perspective, the study of medical errors points to possible failures to generate the correct hypothesis, misperceptions and misinterpretations of evidence [15]. A review of experienced doctors' failures suggested that they could be related to difficulties that experts have to reframe the problem and restructure their initial hypotheses, when necessary to reorient initial reasoning as data are obtained [4]. Special attention has been given to the potential biases arising from the use of heuristics. Medical heuristics are 'mental shortcuts or maxims that are invoked, largely unconsciously, by clinicians to expedite clinical decision making' [11]. Heuristics derive from professional experience, tradition, personal theories and assumptions, and are not necessarily based on evidence or scientific rationale. Handled by experienced doctors, heuristics can be a powerful tool, allowing them to face clinical uncertainty and provide timely and efficient care [11,19]. On the other side, heuristics can distort clinical reasoning throughout the diagnostic process, thereby leading to cognitive errors. Illustrative examples were recently presented by Croskerry [20] in an extensive review of failed heuristics that describes not less than 30 biases frequently involved in cognitive errors. Some of them, also indicated by other authors [11,21], are particularly relevant in the position taken in this article. *Availability* is a common bias distorting hypotheses generation. It involves judging the probability of an event on the basis of readily recalled similar events. Recent or frequent experience with a disease tends therefore to increase the likelihood that it is considered as a diagnostic hypothesis. *Representativeness* leads to looking for prototypical manifestations of a disease. Evidence that strongly resembles a class of events is overemphasized and atypical variants may be missed. *Confirmation bias* leads a doctor to gather and interpret evidence that confirms an initial diagnosis rather than searching and considering evidence that refutes it, even when the latter is more definitive [21]. This type of bias commonly comes together with *anchoring* that occurs when the doctor remains fixed on first impression of the case, and fails in adjusting hypotheses in light of new data. *Premature closure*, accounted for a high proportion of missed diagnoses, occurs when a diagnosis is accepted before it is fully verified [20]. Usually doctors generate hypotheses early in the encounter with the patient. Acceptance of these initial hypotheses without ensuring that all data are considered and other alternatives are verified, may lead to wrong diagnosis [7].

'Value biases' occur when doctors' decisions are affected by psychological factors. Doctors, as other people, may have an undue perception of their own capabilities and personal control over the situation [10]. *Overconfidence* may lead to decisions based on incomplete information or hunches. The doctor may tend to replace a systematic and careful gathering of evidence by opinion [20]. *Outcome bias* is the tendency to opt for a diagnosis that will lead to good outcomes rather than those associated with bad outcomes. Unconsciously the doctor tries to avoid disappointment and chagrin associated with the latter. *Regret,* however, may distort doctor's reasoning in an opposite direction. The practitioner may overestimate the likelihood of a diagnosis with severe possible outcomes because of anticipated regret if a diagnosis were missed [21]. Sociocultural biases

have also been shown to affect clinical decision making. Patients' characteristics such as social class, ethnicity and gender apparently influence doctors' reasoning [10]. Doctors' training and age also affect their decisions [13].

These and other biases may distort reasoning throughout the whole diagnostic process. Some of them, like availability, affect predominantly generation of diagnostic hypotheses. Others tend to have effects particularly in hypotheses refinement and diagnosis verification. Confirmation bias, anchoring and premature closure exemplify the latter category. Psychological aspects underlie some biases, while others refer more directly to faulty information processing. It seems clear that multiple mechanisms are involved in diagnostic errors. Moreover, the risk of failures is embedded in the process of diagnostic reasoning, even for experienced doctors. Analysing how reflective practice could counteract this risk requires a prior step: understanding its nature and structure.

The nature of reflective practice in medicine

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Reflective practice may be defined as the capability of doctors to critically reflect upon their own reasoning and decisions while in professional activities [5]. In modern times, the grounds of the construct of reflective practice may be found in Dewey [22]'s work. According to Dewey, an expected event in one's life provokes a state of doubt, perplexity, or uncertainty that leads the individual to a process of 'reflective thought.' Through this process, the individual searches for possible explanations or solutions for the problem, explores their implications and validity, and tests hypotheses. The results would be new, enriched understandings of a problem [22]. Affective dimensions involved in critically examining one's own reasoning have been highlighted by other authors [23]. More recently, Schön's [24] studies of professional work brought to light the concept of reflective practice. According to Schön, professional practice is largely based on tacit knowledge, the so-called 'knowing-in-action'. A 'reflective practitioner', however, realizes when a phenomenon at hand does not fit his knowledge-in-action, and engages in a process of reflection, therefore reframing the problem and exploring more complex representations and alternative solutions. As a result, the practitioner's knowledge structures and practice would be enriched through learning from this experience.

Critically reflecting upon one's own practice has long been valued as a requirement for professional competence in medicine. Through embedding 'mindfulness' in their practice, Epstein [3] suggests, doctors gain the capability to observe the patient while observing themselves during the clinical encounter. Doctors also apply to their decisions a large body of personal knowledge, beliefs, values and experiences that are not entirely known to them. Perception and interpretation of features encountered in a patient's problem are influenced by this tacit knowledge. Mindfulness would allow doctors to become aware of their own reasoning processes, thereby questioning judgements. Although recognizing the subjective basis of his construct of 'mindful practice', Epstein lists its characteristics. They include general attributes such as an open mind, the willingness to examine aside categories and prejudices, the tolerance to one's areas of incompetence, the 'active observation of oneself, the patient and the

problem', critical curiosity, and peripheral vision.

Reflection on one's own reasoning has been specially valued by the perspective that views clinical knowledge as constructed, within the context of each encounter, through interaction between the doctor and the unique patient at hand. 'Reflexitivity' has been appointed as a requirement for appraisal and validation of knowledge constructed through this interaction. It involves doctors' reflection upon their own positions as 'knowers' during a clinical encounter. 'Metapositions', where a person moves out of his or her own way and gives a closer look at the situation, are needed for that [12]. By asking critical questions and reflecting on their own reasoning, practitioners could become self-conscious of the influence of their systems of beliefs and perspectives in their reasoning. The concept of meta-cognition, suggested by some authors, also emphasizes reflection on one's own thinking processes as a crucial condition for appropriate decision making in clinical cases. Meta-cognition encompasses the ability to explore a broader range of possibilities than those initially apparent, the capacity to exam and critique one's own decisions, and to select strategies to deal with decision-making demands [6,25].

Recent research has provided empirical evidence of the nature of reflective practice in medicine. Starting from a theoretical model constructed on the basis of the literature, Mamede & Schmidt [5] explored behaviours and reasoning processes of primary health care doctors when dealing with complex, unusual cases. A multidimensional structure of reflective practice arose from the studies. Reflective practice comprises at least five sets of behaviours, attitudes and reasoning processes in response to complex problems encountered in professional practice:

1 A tendency to search for alternative explanations, besides the initial ones that come to mind, in response to difficult or unexpected problems. This tendency was named *Deliberate Induction.*

2 A tendency to explore consequences of these alternative explanations. Through logical deduction, reflective doctors would, for instance, explore signs and symptoms that might be present if any one of these hypotheses were true. This tendency, called *Deliberate Deduction*, leads to predictions that might be tested against new data.

3 A willingness to *Test* these predictions extensively against the data encountered in the case at hand, and *Synthesize* new understandings about the problem.

4 An attitude of *Openness towards Reflection* as a means of solving patient problems. Doctors who show this attitude tend to engage in reflective, thoughtful reasoning in response to a challenging problem, instead of just discard it. In doing so, they better tolerate uncertainty and ambiguity that characterize the period of reflection.

5 The capability to reflect about one's own thinking processes, and to critically review one's own conclusions, assumptions and beliefs about a problem, called *Meta-reasoning.*

Doctors' behaviours or reasoning processes associated to the dimensions of reflective practice are presented in Table 1. Some of them showed to be positively related to the dimension to which they refer, whereas others were found to have negative relationships.

Adopting these behaviours in difficult cases may be seen as an indication of engagement in reflective practice.

The five components of reflective practice do not correspond to a strategy to be followed step-by-step, by doctors. In fact, they represent several dimensions that may overlap and occur in the moment of the action as well as after the event as part of a reflective doctor's reasoning. Doctors do differ in the extent to which they engage in reflective practice. Reflective approaches are adopted quite often by some doctors when dealing with complex or unexpected problems. Others rarely or never showed to use them [5]. What could be the consequences of these differences in engagement in reflective practice for clinical judgements?

Exploring relationships between reflective practice and diagnostic errors

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Automatic reasoning may be seen as the hallmark of expertise. Experienced doctors unavoidably tend to use a non-analytical approach to generate diagnostic hypotheses when faced with a usual problem. Pattern recognition through activation of instances of previously seen patients is the primary mechanism encountered in making diagnosis in familiar cases. Although usually very effective, the typical expert's diagnostic reasoning has its side effects. As practice becomes stable, doctors miss opportunities to think about what they are doing. They tend to be less attentive to phenomena that elude categories of their knowing-in-action, and hence may have difficulties in recognizing the unique parameters of a problem at hand. Complex or unfamiliar problems may be framed without sufficient attention to their particular features, distorting hypotheses generation. Negative effects of this non-reflective approach may occur throughout the diagnostic reasoning process, thereby leading to errors. Could reflective practice counteract these effects? Our following statements in response to this question are not based on empirical evidence, presently absent. They derive from what is known about the structure of reflective practice in medicine. Although built upon a theoretical basis, they remain therefore as conjectures to be further investigated.

A reflective practitioner tends to spend more time and efforts in the stage of framing and reframing the problem when dealing with unfamiliar cases. Investing in problem-setting prevents quick isolation of surface findings as an attempt to define a case in such a way that it may fit soon into available patterns. Reflective practice comprises a tendency to consider a broad range of factors potentially intervening in a problem and actions to manage it. Social and psychological dimensions tend to be considered by reflective doctors in searching possible explanations for the problem. Solutions proposed may go beyond the boundaries of the present situation, such as those set up by practice routines and traditional arrangements. Reflective doctors have an inclination to examine the problem in a more complex, comprehensive way. Another element of reflective practice is openness to recognize and accept difficulties in managing a case. A doctor who is open to reflection tends to remain thinking about an unsolved case, without insupportable feelings of distress. Uncertainty, inherent to the period of further exploration of the problem, is not viewed as a threat and a sign of weakness. These attitudes and

behaviours would allow a doctor to wait, whenever possible, until additional evidence is gathered. Other elements to better understand the problem could therefore become available. Hypotheses generation and refinement are expected to benefit from this tendency to invest efforts in understanding the problem, from this capability to recognize and deal with difficulties in managing a case. These attributes favour generation of a broader set of hypotheses, and to avoid fixing to the first solution that comes to mind. Errors owing to biases such as availability, representativeness and overconfidence, for instance, are likely to be minimized.

Disposition to extensive exploration of alternatives and solutions for complex problems was shown to be an attribute of reflective doctors. Instead of feelings of disappointment when an initial hypothesis is refuted by findings of investigation, a reflective practitioner may visualize discrepancies as positive. Inconsistencies encountered, for instance, when signs or symptoms expected from a certain hypothesis are not present tend to be seen as a trigger to other ways of thinking. Instead of searching for a quick solution, a reflective doctor would suspend conclusion regarding a diagnosis and maintain several alternatives until further evidence is available. Besides a positive attitude towards discrepancies and uncertainty, reflective doctors also show a tendency to set up and follow systematic plans for addressing differential diagnoses. Their behaviours include searching insights and additional information useful to visualize alternative diagnoses or making decisions between hypotheses, when dealing with a complex case. As a means for that, reflective doctors use to exam previous experience with similar patients, discuss with colleagues and review technical literature. These behaviours favour perception of unexplored aspects of a patient's history and reorientation to alternative lines of thought previously not considered. They lead to extensive search for grounds, exploration of alternatives, checking evidence of competing explanations for patients' problem. These attributes may play a role in minimizing missed diagnoses in complex cases. Errors may be favoured by a tendency to search harder and overemphasize information that reaffirms initial hypothesis, whereas evidence that refutes it is neglected. This would lead to failure in adjusting initial impression in the light of evidence gathered throughout the diagnostic process [10]. By being more attentive to discrepancies and seeing them in a positive way, reflective practitioners would be more likely to recognize and value disconfirmatory information. They could therefore modify initial impression according to them, which make them less prone to biases such as anchoring and confirmation. By tending to thoroughly explore and verify hypotheses and solutions considered for a problem, reflective doctors probably have reduced risks of reaching conclusions and closing a case without sufficient evidence. Premature closure, one of the major sources of diagnostic errors, could therefore been minimized. Meta-reasoning is a key component of reflective practice that acts throughout the whole process of clinical reasoning. A reflective doctor recognizes limits of objectivity in his or her own judgements. Reflective practitioners are open and attentive to questioning one's own assumptions about a case, and to check whether and how they influence exploration of a problem. Meta-reasoning makes it possible for a doctor, for example, to realize that his or her interpretation of symptoms was influenced by his preconceptions about the patient's behaviours or by his or her own fears and expectations about evolution of a case, instead of by

evidence from the problem. In this sense, meta-reasoning can contribute to prevent distortions in reasoning originated from socio-cultural and psychological factors, such as values biases. Critically thinking on one's own reasoning contributes for appropriate generation of hypotheses from first impressions, but it also favours thoroughly exploration of alternatives and verification of grounds of explanations.

In fact, the capability to critically think about one's own reasoning is considered a requirement for accurate diagnoses, as is an extensive knowledge base. The concept of meta-cognition, proposed by some authors, refers to reflective approaches through which doctors examine their own thinking processes [6,20]. Meta-cognition is a key element of 'Cognitive Forcing Strategies', suggested to reduce errors originated from failures in perception, failed heuristics and biases [25]. They aim at enhancing doctors' ability to critically thinking on their own reasoning, that is, meta-reasoning. Attention is also given to development of other attributes that are constituents of reflective practice, such as behaviours associated to deliberate induction and deliberate deduction. Epstein [3] suggests that experienced doctors could take advantage from mindfulness to avoid undesirable effects of automatic reasoning that come with expertise. Through maintaining an open mind, critical curiosity, and welcoming uncertainty, experienced practitioners can explore possibilities and consider alternative explanations for a problem, which is critical in complex cases.

Interesting to notice are attributes associated to meta-reasoning in studies on reflective practice that are apparently related to learning from experience. Meta-reasoning was showed to be associated to a disposition to reflect about complex cases after their completion. It is also related to a willingness to review one's own approach in cases referred to specialists, as an attempt to visualize what could be improved. These may be seen as indications of a tendency to reflect upon one's own decisions after the event has passed, which Schön conceptualized as 'reflection-on-action' [24]. This is a strong mechanism to learn from experience, including from one's own mistakes. It is reasonable to expect, therefore, that reflective practice could have a positive influence also in minimizing repetition of errors, thereby improving clinical performance throughout life.

Table 2 presents a schematic representation of the stages of the diagnostic process, the biases frequently leading to diagnostic errors in each one of them, and the indication of expected influence of the five dimensions of reflective practice.

Future directions

As far as we know, empirical evidence of the relationship between reflective practice and diagnostic errors is not available. There are, however, theoretical bases to reasonably expect that reflective practice can reduce likelihood of failures in clinical reasoning for solving complex cases. Many biases underlying errors in diagnoses can be partially explained as gaps in the dimensions of reflective practice. It is still to be explored by future research, however, whether and how far strengthening reflective practice really would have an effect in minimizing diagnostic errors. Non-analytical reasoning that comes together with professional experience uses to be

very effective to make clinical judgements, usually accurate, in routine situations. It may be especially valuable in contexts of time and resources constraints. As previously discussed, however, potential biases inherent to automatic reasoning make it prone to errors, particularly when doctors are faced with complex, unfamiliar cases. In these situations, reflective practice probably leads to minimizing mistakes. A question that may be posed refers to doctors' capacity to realize that there is an unusual problem, which would lead them to adopt a reflective approach. The nature of reflective practice entails, as one of its attributes, the capability to recognize when a problem at hand does not fit usual categories. Indeed, research showed that reflective doctors are more likely to recognize when they are faced with a complex problem. Another dilemma that could be pointed out refers to trade-offs. Further exploration of possibilities, more careful search and interpretation of data, critical review of one's own reasoning, would obviously lead to increase certainty in diagnoses. Undoubtedly, however, this may have a price. It would take more time, which could lead to delayed diagnoses, and require more testing. Risks for the patient and costs could therefore increase. The most careful diagnostic reasoning will reach a moment when a decision has to be taken usually under a certain degree of uncertainty. Again, theoretically, reflective doctors tend to better explore reasons underlying initiatives, to weight benefits and disadvantages of further exploring hypotheses. They would be better prepared to set the moment when exploration should stop and decisions taken. Apparently, therefore, higher performance in diagnosing complex cases can be expected from reflective practice. Despite its theoretical grounds, this statement, however, still requires empirical bases.

Limits and feasibility of reflective approaches in real life of medical practice is also an issue to be addressed. In the 'real world' of medical care, careful exploration of alternatives and critical examination of one's own thinking may be a hard, sometimes unrealistic task. Clinical judgements may have to be done under stress and time constraints. This may be particularly true in certain settings, such as in emergency departments. In other areas, ill-defined problems may be the rule, as it occurs in internal and family medicine specialties or in primary health care settings [26]. These conditions tend to increase the degree of uncertainty inherent to medical decisions. It is not a surprise, therefore, that delayed or missed diagnoses have been reported more frequently in these specialties [20]. However, there may be a potential for improving reflective approaches, and thereby medical diagnosis, that remains highly unexplored. Attention has been called to the substantial potential to minimize cognitive diagnostic errors through improving clinical reasoning, which was not thoroughly investigated until now [6,20]. Enhancement of reflective practice certainly is a promising area of research. From this, another question arises: is it possible to promote reflective practice? Again, there are certainly promising avenues for exploration here. Reflective practice entails a set of affective and cognitive skills. As skills, they could be expected to be taught and learned [27]. Undergraduate and vocational training could incorporate concerns with reflective approaches in clinical reasoning. Training for enhancing meta-cognition has been pointed as a strategy to reduce cognitive errors [25]. Approaches for improving cognition and therefore diagnostic reasoning, have been explored, and reports of successful initiatives already exist [6]. Further exploration of educational strategies to

enhance reflective approaches in clinical reasoning is certainly a requirement, and may offer promising perspectives in facing cognitive diagnostic errors.

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