

WEB PAPER

Clinical reasoning difficulties: A taxonomy for clinical teachers

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Abstract

Background: Clinical reasoning is the cornerstone of medical practice. To date, there is no established framework regarding clinical reasoning difficulties, how to identify them, and how to remediate them.

Aim: To identify the most common clinical reasoning difficulties as they present in residents' patient encounters, case summaries, or medical notes.

To develop a guide to support medical educators' process of educational diagnosis and management in this area.

Methods: We used a participatory action research method. We carried out eight iterative reflective cycles with a group of clinical teachers. The repeated phases of experimentation and observation were conducted by participants in their own clinical teaching setting. Our findings were tested and validated on both an individual and collective basis.

Results: We found five categories of clinical reasoning difficulties as they present in the clinical teaching settings. We identified indicators for each. Indicators may be different depending on the type of supervision. These findings were assembled and organized to construct a guide for clinical teachers.

Conclusions: The guide should assist clinical teachers in detecting clinical reasoning difficulties during clinical teaching and in providing remediation that is tailored to the specific difficulty identified. Its development furthers our understanding of clinical reasoning difficulties and provides a useful tool.

Introduction

The thought and decision-making processes associated with clinical reasoning are at the very heart of medical practice. They are complex processes involving multiple interacting dimensions and some degree of ambiguity and uncertainty. Most errors of clinical reasoning are not linked to gross incompetence or the lack of knowledge but rather to the vulnerability of clinicians' thinking in the real-world of clinical practice characterized by complexity, time pressures, and various other contextual constraints (Graber 2005; Scott 2009). Medical decisions are in effect inherently fallible (Mamede et al. 2007). There is surprisingly little evidence to guide "best practices" of remediation in medical education at all levels; nevertheless, the small number of available studies and the literature in the learning sciences do all point to a model that includes multiple assessment tools for identifying deficiencies, individualized instruction, deliberate practice followed by feedback and reflection, and reassessment (Hauer et al. 2009).

A complex body of literature

The abundance of the literature on clinical reasoning and the diversity of approaches used make it a difficult topic to comprehend and fully grasp. To date, the scientific community appears to converge on an understanding of clinical reasoning based on "dual process theory", a mixed cognitive model of

Practice points

- Proposes a taxonomy of the most common clinical reasoning difficulties encountered in clinical supervision during residency.
- Proposes a concrete tool to assist clinical teachers in identifying the most common clinical reasoning difficulties.
- Facilitates the design of tailored remediation strategies.

clinical reasoning involving both analytical (hypothetico-deductive) and non-analytical (pattern recognition) processes (Kulatunga-Moruzi et al. 2001; Eva 2004), but no single theory or empirical model has as yet gained unanimous acceptance (Higgs & Jones 2008).

It is unsurprising in view of this lack of consensus that no established conceptual framework or structured approach regarding clinical reasoning difficulties and their identification and remediation has emerged. Many authors have attempted to classify difficulties *post-hoc* once errors have been committed (Kassirer 1989; Chimowitz et al. 1990; Bordage 1999; Kempainen et al. 2003). But these approaches fail to explain *why* errors have occurred. This is a critical question from an educational perspective: it is crucial to understand why a difficulty arises in order to provide appropriate and targeted

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remediation. Clinical reasoning difficulties have a variety of root causes which need to be differentiated if tailored remediation strategies are to be designed (Norman & Eva 2010).

We have chosen to use problem-solving as our conceptual framework because it is *descriptive* and aims to reveal the processes that clinicians use naturally. Research based on this approach focuses on *identifying* the strategies that experts use in order to help learners (novices) to acquire them (Elstein et al. 1978; Bordage & Lemieux 1991).

Issues linked to the clinical teaching setting

The clinical teaching setting does not make the identification of difficulties easy: clinical educators must juggle supervision of clinical care and teaching. They are often engaged in a dual process of problem-solving: clinical reasoning to care for patients and educational reasoning to teach residents (Irby 1994; Bowen 2006). Furthermore, teaching conditions are for the most part dependent on factors that are beyond clinical educators' control such as clinical flow, diversity of clinical problems, and time constraints (Hoffman & Donaldson 2004; Chamberland & Hivon 2005).

These specificities might explain why learners are rarely observed over the course of their training (Ludmerer 2000; Howley & Wilson 2004; Hauer et al. 2008) and why so much time passes before problems are identified and addressed (Hicks et al. 2005; Frelsen et al. 2008). When clinical teachers see their residents at work, they can sense almost immediately when they experience difficulties, but this perception often remains global and intuitive (Audétat et al. 2011).

Study aims

Our study aimed to identify the most common clinical reasoning difficulties as they present in residents' patient encounters, case summaries, or medical notes. We also sought to develop a Guide to support medical teachers' process of educational diagnosis and elaboration of a remediation plan, which specifically addresses the clinical reasoning difficulties.

Methods

Our initiative rests on a certain number of assumptions:

Clinical reasoning results from the interpretation of data by a specific clinician faced with a specific situation (a specific patient within a specific context presenting with a specific constellation of signs and symptoms). The clinician brings to each encounter his/her own knowledge, skills, beliefs, and perspectives which influence his/her perception and interpretation of data (Mamede et al. 2007).

The result of clinical reasoning is not necessarily a precise diagnosis. In family medicine for instance, a substantial number of clinical encounters are motivated by physical symptoms that medicine cannot fully explain. Clinicians are often faced with managing chronic diseases or undifferentiated complaints which require coping with uncertainty. Clinical

reasoning will allow them to delineate the problem even in cases where they will not be able to formulate a specific diagnosis. Furthermore, in emergency medicine, the process often aims at ascertaining whether a life-threatening or serious condition is present or not.

Organization of knowledge is the key in the construction of clinical expertise. The script concept explains many features of medical diagnosis and provides a theoretical foundation on which clinical education can be based (Charlin et al. 2000; Charlin et al. 2007).

The process of clinical reasoning does not end once a diagnosis has been reached. Although there is little in the literature about the processes leading to decisions regarding investigation and management, we firmly believe that clinical reasoning processes are involved: clinicians must for instance consider patients' opinions and values, availability of tests, potential for medical interactions. They must choose from an array of available means and reason in a context of uncertainty in terms of prognosis and response to treatment (Reid et al. 2001; Van der Weijden et al. 2003; Heneghan et al. 2009).

Effective clinical reasoning processes by different clinicians share common characteristics, i.e., formulating key questions early based on the early generation of diagnostic hypotheses, data gathering focused on relevant diagnostic hypotheses, repeated clarification of patients' complaints, frequently summarizing and synthesizing data (Nendaz et al. 2005b). Effective clinicians generate better hypotheses, are able to gather key data, and are better at interpreting data to test their hypotheses (Nendaz et al. 2005a).

The mental representation of clinical problems evolves over the course of the patient encounter. Lemieux and Bordage showed that clinicians analyze the spontaneous language of patients to extract its significance and assign medical meaning to it. This semantic transformation allows clinicians to construct a meaningful mental representation of the problem, activate relevant knowledge, and compare and contrast diagnostic hypotheses to progress towards a solution to the clinical problem (Lemieux & Bordage 1992). This overall representation of the problem as a whole can change over subsequent encounters with the patient. The initial problem representation is modified and enriched by new information and the history of the illness, leading to a more comprehensive representation at the end of the clinical assessment.

Supervision is crucial to the development of clinical reasoning and to the identification of difficulties. It is widely accepted that clinical reasoning is not an innate ability but rather a professional skill to be developed (Chamberland & Hivon 2005). Kilminster defined supervision in medicine as "the provision of monitoring, guidance and feedback on matters of personal, professional and educational development in the context of the doctor's care of patients" (Kilminster et al. 2007). Clinical supervision is, without a doubt, a key process to help residents learn, more likely to be effective when regular and constructive feedback is given (Johnson 2004; Kilminster et al. 2007).

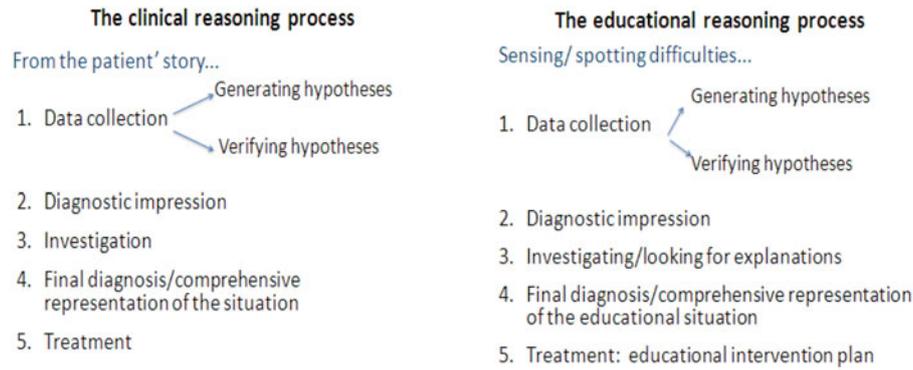


Figure 1. The parallel between the processes of clinical and educational reasoning.

Conceptual framework

A parallel between the processes of clinical reasoning and educational reasoning. As clinical educators are engaged in a dual process of clinical and educational reasoning, we believe that emphasizing the parallel between the two would be enlightening. Indeed, recognizing the similarities between the two processes can facilitate the transfer of competencies from a role that clinicians are very familiar with to the other, promoting a sense of mastery in their teaching tasks.

In educational reasoning, clinical teachers seek to understand what their residents' problems might be (Figure 1). As in clinical reasoning, they identify cues and formulate explanatory hypotheses, which they test to arrive at an educational diagnosis.

It therefore appears relevant to understand *how* difficulties manifest themselves, what cues can lead to their detection, how they can be differentiated, and what their root causes are.

A co-construction process. Our research is situated in a socioconstructivist paradigm where the processes and then, the Guide, were co-constructed with clinical teachers involved at every step. We chose qualitative methodology, specifically participatory action research as defined by Kemmis and McTaggart. For these authors, participatory action research is a process of development carried out collaboratively by a group of people interested in changing practice in their setting (Kemmis & Mc Taggart 2005).

Setting

We chose family medicine residency as our setting because, as outlined by Croskerry, family medicine is one of three specialties (the others being internal medicine and emergency medicine) in which diagnostic uncertainty and the likelihood of missing or delaying diagnosis are most evident (Croskerry 2003). Residency appeared most appropriate because residents manage patients on their own and they are supervised over several months by the same team of clinical teachers.

Participants

We trained a group of four family doctors involved in clinical education at the Department of Family Medicine and

Emergency Medicine of Université de Montréal. Participants were selected on the basis of:

- (1) Expertise: over 15 years of clinical and educational experience.
- (2) Academic involvement in committees or activities in relation to residents with clinical reasoning difficulties.
- (3) Academic involvement in committees or activities in relation to faculty development.
- (4) Involvement as a clinical educator in the process of identification and remediation of clinical reasoning difficulties in residents.

Data collection – analysis and development of the guide

The process of participatory action research is often described as a spiral constituted by several reflective cycles (Planning – acting and observing – reflecting – replanning, etc.). Each step is carried out collaboratively with participants.

Eight three-hour sessions were held between April and August 2009, each representing a reflective and iterative cycle (reflection and elaboration – experimentation and observation in the clinical setting – data analysis, reflection and modification – experimentation and observation, etc.) until data saturation was reached. The successive phases of experimentation and observation were conducted by participants in their own clinical teaching setting. Our findings were tested and validated on an individual (during supervision with a resident) and collective (during group discussions with clinical teachers) basis. This iterative model not only between researcher and data but also between researcher and participants allowed the participants to be involved in the analysis and to provide inter-judge validation. Findings were further validated in a faculty development workshop: 17 clinical teachers from various departments at Université de Montréal (five from family medicine, two from surgery; three from nutrition, and seven from physiotherapy or occupational therapy) tested our findings using examples of clinical reasoning difficulties encountered in their respective domains.

Results

As proposed by Kuhn (2002), we divided the clinical reasoning process in discrete steps to facilitate the identification of difficulties:

- (1) Hypotheses generation and direction of data gathering.
- (2) Refinement of hypotheses and hypotheses testing.
- (3) Final diagnosis or characterization of problem and development of a management plan.

We uncovered five main categories of clinical reasoning difficulties (Table 1). To do so, we were especially mindful to elements that made sense in the clinical teaching setting.

For each difficulty we identified:

Cues or indicators of these difficulties as they present in clinical supervision. We found that these indicators could differ depending on the type of supervision provided, i.e. direct observation, case discussions, or review of medical records.

Examples of questions aimed at eliciting learners' clinical reasoning and testing specifically for the presence of the difficulty.

Explanatory hypotheses as to the root causes of the difficulty which once tested can help target remediation.

Suggestions for remediation strategies tailored to each specific difficulty. The proposed concrete remediation strategies are based on principles of cognitive psychology and reflective practice.

These findings were assembled and organized to construct a guide for clinical educators.

We sought to design simple and effective strategies for use in clinical supervision, allowing clinical educators to reach a precise educational diagnosis and provide tailored remediation. (The guide is included as additional material.)

Discussion

The reflective and iterative process between the phases of data analysis, elaboration and experimentation, and observation in the clinical setting allowed us to identify five common categories of clinical reasoning difficulties as they present in clinical supervision of residents. This is a real challenge to integrate teaching moments into the day-to-day routine. Fortunately, techniques and methods like the One-Minute Preceptor (Neher et al. 1992; Irby 1997) or the SNAPPS technique (Wolpaw et al. 2009) have been developed to structure the supervision process. We believe that our results should enhance these techniques and greatly facilitate the identification of clinical reasoning difficulties, even in an office setting with multiple competing demands on physician time and thinking.

The guide we subsequently developed should promote and support the educational reasoning process (data gathering, explanatory hypotheses and testing of these hypotheses, educational diagnosis, development of a remediation plan, use of educational methods, and assessment of results) that clinical educators engage in when they address their learners' clinical reasoning difficulties.

Its relevance was confirmed for use on a one-on-one basis with residents and within educational teams. Its use encourages educators to go beyond their global impressions to

Table 1. Principal clinical reasoning steps and their potential difficulties.

Step of clinical reasoning	Prototypical difficulties	Definitions
Hypotheses generation and direction of data gathering	Difficulties in generating hypotheses, identifying cues and directing data gathering	<p>Learner:</p> <ul style="list-style-type: none"> ● Fails to detect or appropriately select the key features or cues that should allow him/her to generate diagnostic hypotheses ● Fails to generate a certain number of diagnostic hypotheses to guide his/her reasoning ● Fails to direct and focus his/her data gathering.
Refinement of hypotheses and hypotheses testing	Premature closure	<p>Learner:</p> <ul style="list-style-type: none"> ● Quickly focuses on a single diagnostic hypothesis and conducts the interview superficially or directs it exclusively according to that hypothesis. ● Limits him/herself passively by failing to generate alternative hypotheses, or actively when he/she swiftly fixates on a single feature of the case.
	Difficulties in prioritizing	<p>Learner:</p> <ul style="list-style-type: none"> ● Prioritizes the patient's problems inadequately, e.g. when there are several complaints and fails to focus the interview on the case's most important aspects. ● Has difficulty in appropriately choosing when to ascribe significance to cues or data obtained in the course of the encounter.
Final diagnosis or labeling of problem and development of a management plan	Difficulties in painting an overall picture of the clinical situation	<p>Learner:</p> <ul style="list-style-type: none"> ● Fails to make connections between the different pieces of information ● Fails to integrate the patient's perspective and contextual factors
	Difficulties elaborating a management plan	<p>Learner:</p> <ul style="list-style-type: none"> ● Displays an unsatisfactory process of integration and synthesis of the whole reasoning process is unsatisfactory leading to the proposal of inadequate management plans.

recognize and label common difficulties. This should facilitate early intervention with more targeted and therefore more effective remediation.

Its repeated use should contribute for establishing educators' credibility in the eyes of their learners and increasing their confidence in their ability as educators. According to Stone et al. (2002), this may in fact be a crucial factor in fostering a sense of identity and of commitment to their role as educators.

We hypothesize that this guide will also prove useful to learners by clarifying the nature of their difficulties. This is especially important as learners who present such difficulties are frequently unaware of their problems.

This guide follows in the steps of Kassirer and Barrows who proposed specific methods of supervision targeted at clinical reasoning (Kassirer 1983, Barrows & Pickell 1991). These strategies consist mainly in encouraging learners to uncover the thoughts underpinning each question they ask patients, and to justify and prioritize each diagnostic hypothesis they consider. These methods encourage reflection on and in action which contributes to the development of clinical expertise (Schön 1983).

The guide was designed for use in various contexts of clinical teaching, such as direct supervision (observation), case discussions, or supervision through review of records. In so doing, we believe it takes into account the constraints of clinical teaching. We would nevertheless like to stress the potency of direct observation. Many authors deplore the lack of direct supervision provided to learners over the course of their medical training and emphasize its importance, especially in the development of clinical reasoning where errors and difficulties are so common (Bordage 1995; Schuwirth 2002; Bowen 2006; Hauer et al. 2010). We have personally experienced, in line with findings from Cydulka et al. (1996), that direct observation of residents allows supervisors to identify problems that were not apparent in case discussions. We, like Hauer et al. (2010), would like to contribute to the development of an educational culture which promotes direct observation. We believe that our guide may assist by describing how clinical reasoning difficulties manifest themselves in direct supervision, the cues that can be used to identify them and by proposing concrete remediation strategies for use during supervision.

Finally, the success of such a tool rests on careful implementation (Hauer et al. 2010): it requires processes of faculty development and support to help clinical educators make the tool their own by understanding the conceptual framework and the educational methods it is based on.

Strengths and limitations

The five categories of clinical reasoning difficulties outlined here represent common difficulties encountered in family medicine. They are not mutually exclusive and can overlap to some extent, reflecting the complexity of clinical reasoning itself. Nevertheless, we believe they constitute a significant first step towards a taxonomy of clinical reasoning difficulties.

Although clinical educators in other health domains successfully used our guide, further research is warranted to confirm the transferability of our findings.

Conclusions

We believe that the construction of this guide contributes to a deeper understanding of the difficulties that occur during the development of clinical reasoning. We hope to facilitate the provision of remediation by assisting clinical educators in detecting and identifying these difficulties during clinical supervision.

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