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Diagnosis and management of clinical reasoning difficulties: Part I. Clinical reasoning supervision and educational diagnosis*

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ABSTRACT
There are many obstacles to the timely identification of clinical reasoning difficulties in health professions education. This guide aims to provide readers with a framework for supervising clinical reasoning and identifying the potential difficulties as they may occur at each step of the reasoning process.

Introduction
It is the responsibility of Faculties and Schools to ensure that the health professionals they educate are able to provide the best care for their patients. One of the key aspects of clinical competence is clinical reasoning.

The clinical setting, which allows learners to engage in authentic professional tasks and problem-solving, and confronts them with the complexity of patients and clinical care, provides the most fertile learning environment (Kolb 1984; Schön 1987; Rudaz et al. 2013).

The clinical setting, however, poses specific challenges for supervisors, rendering their task particularly difficult (Hoffman & Donaldson 2004). Clinical teachers play both a traditional role, ensuring that patients receive adequate care and an educational one. In their educational role, they must make the most of each clinical problem as a learning opportunity by assessing learners’ performance, identifying their strengths and weaknesses and providing constructive feedback (Prideaux et al. 2000; Irby 2014).

Learners’ poor performances should be swiftly addressed. Identifying and delineating concerns early may facilitate timely remediation of problems (Hauer et al. 2009; Cleland et al. 2013; Steinert 2013). Many studies indicate that delayed or poor identification and remediation of clinical reasoning difficulties can lead to clinician underperformance and can ultimately compromise patient care (Hicks et al. 2005; Frellsen et al. 2008; Hauer et al. 2009).

It may be difficult for teachers to endorse this educational role. Teachers may feel more comfortable addressing gaps in knowledge even if other difficulties are identified, or in focusing supervision almost exclusively on solving the patient’s problem (Laidley et al. 2000; Audétag et al. 2011a). Nonetheless, an exploratory study (Audétag et al. 2011b) found that clinical supervisors quickly sense that something is amiss in their learner’s clinical reasoning. Faculty development should therefore focus on building on supervisors’ intuition to allow them to more clearly delineate the nature of the problem and address it purposefully.

Clinical reasoning: how does it work? Reasoning processes and characteristics

Dual process theory
Research in cognitive psychology has shown that thinking relies on two major systems (Kahneman et al. 1982):

System 1: an immediate, intuitive and quick approach, and System 2, a more conscious, analytical and slower approach. For the sake of clarity, we will first describe each process, Systems 1 and 2, to help understand the concept of dual process described thereafter.

System 1: Nonanalytical process
This process is automatically triggered when individuals are faced with a problem to solve (Kahneman 2011). It consists
of a quick and spontaneous recognition of the nature of a problem. In clinical practice, this process refers to memo-
ized experiences and can lead to the generation of a work-
ing diagnostic hypothesis or immediate patient manage-
ment decisions (Norman et al. 2007).

**System 2: Analytical process (hypothetico-deductive reasoning)**

The spontaneous solutions emerging from System 1 may be
challenged by a slower, more analytical approach aimed at
confirming or refuting them. Furthermore, when the cli-
nician faces a less familiar clinical problem, or if the case is
more complex, System 2 process may be needed to gener-
ate hypotheses by the activation of stored knowledge. The
data at hand are interpreted to assess their fit with each
hypothesis, so that each hypothesis is verified and may be
rejected, maintained, or further tested with the acquisition
of additional clinical information (Elstein et al. 1978).

**Dual process**

Dual process theory posits that Systems 1 and 2 are at play
and may be present simultaneously. The mixed use of both
processes seems associated with better diagnostic competen-
tce in some circumstances (Ark et al. 2006), but how both systems are activated and used is still under study
and debate (Norman et al. 2013).

These processes cannot be disconnected from their underly-
ing knowledge base and are not per se guarantees of success-
ful diagnosis (Elstein et al. 1978; Norman et al.
2014).

**Problem representation**

Mental representation of the clinical problem is a key ele-
ment for the understanding of the clinical problem, whether at
the stage of its initial assessment or later in the process,
when additional information has been retrieved (Chang et al.
1998; Nendaz & Bordage 2002; Ericsson 2006). This represen-
tation may take several shapes, including semantic abstrac-
tion (Bordage 1994), that is, transforming the information
provided by the patient into more abstract, medical concepts.
This allows clinicians to link the information with their fund
of medical knowledge, generate relevant hypotheses, and col-
lect significant data (Chang et al. 1998; Nendaz et al. 2005).

**Networks of knowledge**

Health professionals rely on mental models to help them
make sense of unfolding situations. Among several models
of knowledge organization, illness scripts are specialized
knowledge structures that link clinically relevant informa-
tion about general disease categories, specific examples of
diseases and conditions that enable diseases. Scripts may
contain, not only attributes related to a diagnostic cat-
egory, but also triage components, or management deci-
sions (Charlin et al. 2000).

**Facilitating the development of clinical reasoning
and engaging in educational diagnosis**

In their AMEE Guide, Kilminster et al. highlighted the deter-
minants of effective supervision (Kilminster et al. 2007).

The findings of research on medical expertise have led to
general suggestions to foster the development of students’
clinical reasoning skills (Eva 2004; Norman 2005; Schmidt &
Rikers 2007). Students should, for instance, be exposed
early to a variety of examples that provide an accurate rep-
resentation of the range of ways in which diseases occur.
They should engage actively in problem solving, reflecting
and elaborating on patients’ problems to gradually build
up their knowledge base (Chamberland et al. 2011). A rich
and well-organized knowledge base is central to clinical
reasoning; it evolves through stages during medical train-
ing as illness scripts emerge as students are exposed to
patients (Norman 2005). Clinical experiences certainly accel-
erase changes in students’ knowledge structures, instigating
a more rapid shift from causal networks to illness scripts
(Schmidt et al. 1990; Schmidt & Rikers 2007).

Supervisors should not just focus on the results of
learners’ clinical reasoning, for example the diagnosis, but
also on the reasoning processes and the context at stake for
a particular case (Nendaz et al. 2011). This can be done by:

- asking the learners to articulate their own reasoning
  pathway (what hypotheses they raised and verified, what
data made them reject or retain a hypothesis, etc.).
- interpreting indirect signs related to their learners’ clinical reasoning (e.g. focused or unfocused history,
  identification of discriminating features, differential diagnosis).

Experts can also provide explicit role modeling by
unfolding their own reasoning to enable learners’ develop-
ment (Stalmeijer et al. 2009).

**The basic principles of educational diagnosis of
learners’ reasoning**

In the hope of helping supervisors transfer competencies
from their clinical role to their teaching role, several
authors have highlighted the similarities between a
health professional’s use of clinical reasoning and a
teacher’s use of educational reasoning. Both are aimed at
solving problem (Vaughn et al. 1998), using similar strat-
egies (Evans et al. 2010) based on specialized knowledge
organized in teaching scripts (Irby 1992; Côté & Bordage
2012; Irby 2014). These scripts, like illness scripts, are
developed and enriched when supervisors practice educa-
tional reasoning and encounter different types of difficul-
ties (Irby 2014).

During clinical supervision, supervisors have mainly
access to the outputs of their learners’ clinical reasoning,
such as the data collected by the learner, their differential
diagnosis and their management plan. These are similar to
the symptoms and signs of an illness. In order to evaluate
the learner’s reasoning processes, supervisors must first
make them visible and try to develop a clear initial mental
representation of the overall pattern. Just as in clinical rea-
soning, the supervisor should then endeavor to delineate,
characterize and translate the learner’s strengths and weak-
nesses in a more abstract way, which allows him/her to
label the observed difficulty. This characterization enables
the supervisor to generate educational hypotheses s/he will
then need to test during subsequent supervised patient
encounters.
Collecting educational data

Supervisors should generate educational hypotheses and collect data purposefully to confirm or eliminate competing hypotheses, through a proactive educational reasoning process (Kilminster & Jolly 2000). Various modes of clinical supervision may be used to collect those data about the learner’s reasoning skills, such as direct observation, case discussions, chart review, discussions with other supervisors, to name but a few. Supervisors can also use specific techniques such as SNAPPS, (Wolpaw et al. 2009), “The one minute preceptor” model (Neher et al. 1992; Ferenchick et al. 1997), the “Flipped supervision” (Mehlman 2003) or “The Aunt Minnie model” (Cunningham et al. 1999) designed to teach, but also to assess clinical reasoning. These methods enable supervisors to have a structured approach leading to a process of delineation of the difficulty and remediation (Kuhn 2002). Table S1, provided on-line as Supplementary material describes these specific techniques designed to teach and assess clinical reasoning.

Table S2, also found on-line as Supplementary materials, provides examples of questions that supervisors should consider in order to identify strengths and weaknesses in the learner’s clinical reasoning process as it unfolds.

Factors affecting the quality of clinical reasoning

Understanding the root causes of different clinical reasoning difficulties is important to guide remediation and the following section provides an overview of these causes. The quality of reasoning will first depend on the degree of clinical reasoning development of the learner. Clinical reasoning ability develops over the course of training. Boshuizen and Schmidt demonstrated that expert biomedical knowledge is gradually encapsulated and integrated into clinical knowledge, leading to illness scripts enabling more efficient reasoning (Boshuizen & Schmidt 1992).

Various difficulties in clinical reasoning

Between 5% and 15% of medical students suffer from academic difficulties, mostly due to cognitive factors and flaws in clinical reasoning (Hunt et al. 1989; Yates & James 2006; Audétat 2013a; Audétat et al. 2015). Unfortunately, these difficulties are often recognized late in the learners’ course of study and training, usually when problems arise in clinical rotations (Hauer et al. 2009; Audétat et al. 2012).

Studies on diagnostic errors and difficulties indicate that a majority of errors include a cognitive component (Bordage 1999; Graber et al. 2005; Norman et al. 2017). According to Graber, the majority of cognitive difficulties are not directly related to a pure lack of knowledge, but rather to a flaw in its application to data collection, data integration and data verification (Graber et al. 2005). Limiting a remediation process to the sole knowledge dimension may thus prove insufficient to address reasoning difficulties.

Other factors as potential sources of clinical reasoning difficulties

Several factors have been recognized as sources of reasoning and diagnostic difficulties (Graber et al. 2005; Higgs & Jones 2008; Norman & Eva 2010; Durning et al. 2011; Nendaz & Perrier 2012; Audétat et al. 2012). According to Durning’s ecological psychology and situated cognition perspective of clinical reasoning, the following three contextual factors should be explored when assessing reasoning difficulties of a learner in a given clinical situation (Durning et al. 2011): clinician factors, patient factors and setting factors.

Diagnosing clinical reasoning difficulties

Clinical reasoning difficulties are often a sign of mere delayed development, which should not lead to consider learners as “problem learners”. Developing a specific understanding of the difficulty at play is nevertheless important precisely so that measures can be taken to avoid minor difficulties becoming more serious.

A taxonomy of clinical reasoning difficulties

Reasoning difficulties may be classified according to the different steps of clinical reasoning, as difficulties may occur at each one of these steps (Bordage 1999; Norman & Eva 2010; Nendaz & Perrier 2012).

Several authors have developed typologies of clinical reasoning difficulties (Graber et al. 2005; Kassirer et al. 2009; Rencic 2011; Audétat et al. 2013a) or have attempted to classify difficulties post hoc, once errors have been committed (Kassirer 1989; Kempainen et al. 2003). In view of the educational perspective of the Guide, we have opted to use Audétat et al.’s taxonomy. This aims to identify the most common clinical reasoning difficulties as they present in learners’ patient encounters, case summaries, or chart reviews (Audétat et al. 2013b). The clinical reasoning process is divided in discrete steps, as it unfolds in the clinical setting. Table 1 presents the main difficulties identified.

Other types of difficulties

Other types of difficulties can coexist with clinical reasoning difficulties. Vaughn et al. for example, identified four classes of problems in learners (affective, cognitive, structural and interpersonal) (Vaughn et al. 1998). In her AMEE Guide on the topic, Steinert provides a useful framework for the overall management of academic difficulties (Steinert 2013). Clinical reasoning difficulties may represent a visible manifestation of other, deeper troubles, such as concentration problems due to personal issues, burn-out, depression, etc. Supervisors are encouraged to tactfully explore and address any such issues before attempting to implement specific clinical reasoning remediation.

Remediation strategies

Clinical supervision is a key process to help learners develop clinical reasoning. The strategies used by supervisors to uncover learners’ clinical reasoning can themselves be useful to foster its development. For more complex clinical reasoning difficulties, we will outline specific and targeted remediation strategies in Part II of this Guide.

Conclusions

Despite the challenges posed by the clinical setting, it is possible for supervisors to identify the strengths and
weaknesses of their learners’ clinical reasoning. The understanding of their own reasoning processes and their engagement in a process of educational diagnosis of their learners’ reasoning should help supervisors select appropriate supervision strategies to facilitate the development of their learners’ clinical reasoning.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

Notes on contributors

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Mathieu Nendaz, MD, MHP, is an internist at the Geneva University Hospitals and trained in health professions education at the University of Illinois at Chicago. He is presently Director of the Unit of Development and Research (UDREM) and Professor at the Faculty of Medicine, University of Geneva, Switzerland. His research interests include Internal Medicine and Medical Education. In this field, he is particularly interested in decision-making, clinical reasoning, clinical supervision, and interprofessional issues.

Table 1. Principal clinical reasoning steps and potential difficulties (M. Audétat et al. 2013b).

<table>
<thead>
<tr>
<th>Steps of clinical reasoning process</th>
<th>Main difficulties</th>
<th>Definition of the difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem representation</td>
<td>Poor representation of the nature of the clinical problem</td>
<td>The learner: (1) does not transform the information provided by the patient into abstract, medical concepts, or (2) fails to elaborate a mental representation of the presenting problem.</td>
</tr>
<tr>
<td>Hypotheses generation and direction of data gathering</td>
<td>Difficulties in generating hypotheses, identifying cues and directing data gathering</td>
<td>The learner: (1) fails to detect or appropriately select the key features or cues that should allow him/her to generate diagnostic hypotheses, or (2) fails to generate a certain number of diagnostic hypotheses to guide his/her reasoning</td>
</tr>
<tr>
<td>Refinement of hypotheses and hypotheses testing, Data interpretation</td>
<td>Premature closure</td>
<td>Difficulties in prioritizing</td>
</tr>
<tr>
<td>Final diagnosis or labeling of problem and development of a management plan</td>
<td>Difficulties in building an overall picture of the clinical situation</td>
<td>The learner fails to make connections between the different pieces of information, fails to integrate the patient’s perspective and contextual factors to build a picture of the clinical situation and adjust his/her investigation or management plan.</td>
</tr>
</tbody>
</table>

The integration and synthesis of the whole reasoning process is unsatisfactory leading to the proposal of inadequate management plans.

References


