Teaching and learning clinical reasoning: a teacher's toolbox to meet different learning needs

Abstract

Clinical reasoning is an essential part of medical practice and therefore should be an important part of clinical teaching. However, it has been and is still a challenge for clinical teachers to support learners in the development of their clinical reasoning skills. As learners progress in clerkship, so do their learning needs. As a result, teachers need multiple tools to foster the development of clinical reasoning and should know when and why to use them. This article presents tools gathered as part of a clinical teacher's toolbox aimed at coaching learners towards the next step in their clinical reasoning development as well as helping teachers diagnose clinical reasoning difficulties and meet the diverse learning needs of their learners. The article focuses on three tools that were developed by faculty at the University of Sherbrooke Faculty of Medicine and Health Sciences: the iSNAPPS-OMP Technique, the Anticipatory Supervision Technique and the Clinical Sudoku or table of discriminating clues. This article uses the term 'tools' as a generic expression to signify 'items in a toolbox'. It includes all kinds of resources (techniques, strategies, models) that were gathered to help clinical teachers with the teaching of clinical reasoning.

Key words: Anticipatory supervision; Clinical reasoning; Clinical supervision; Pedagogical diagnosis process; Teaching tools

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Introduction

It is widely accepted that the teaching and learning of clinical reasoning is not a simple task. As claimed by Gigante (2013), 'deliberate teaching of clinical reasoning can seem overwhelming and even impossible'. In the teaching process, the clinical teachers' expertise can be their own demise: by more or less consciously using checklists, shortcuts and scripts that have been acquired throughout the years, they effectively render their clinical reasoning process invisible for learners (Delaney and Golding, 2014). For Chamberland et al (2015), 'an expert model, which is largely automatized and works at a higher level of abstraction, may be difficult for students to follow'. Hence, novice learners cannot grasp those strategies and use them as a basis to develop their own clinical reasoning skills.

However, having teachers explicitly outline their clinical reasoning process is not sufficient for learners to acquire clinical reasoning skills. Learners also need to make clear their own clinical reasoning which, in turn, will enable teachers to identify knowledge gaps (Pascoe et al, 2015). This may not be as simple as it seems: although clinical teachers might feel that something is amiss in their learners' clinical reasoning, they still struggle to delineate the specific difficulty and help the learner take the next step to improve it (Audétat et al, 2017a).

For the last 10 years or so, clinical teachers associated with the Faculty of Medicine and Health Sciences of the University of Sherbrooke have been invited to participate in yearly workshops on teaching at the clerkship level (the last 1.5 years of the undergraduate medical programme). At the end of each workshop, as part of the evaluation process, participants are asked to identify their teaching needs and subjects they would like to see covered in forthcoming workshops. Year after year, the challenges posed by teaching clinical reasoning and helping learners overcome clinical reasoning difficulties have been a recurrent emerging theme, despite several faculty development opportunities on the subject. This has led to the development of a longitudinal 3-year programme on the teaching and assessment of clinical reasoning skills (to be discussed in a future article), which includes a 'clinical reasoning toolbox' to supply clinical teachers with resources for teaching clinical reasoning. This

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Table 1. Tools included in the clinical reasoning toolbox classified according to period of clinical training

Beginning of clerkship	Anticipatory Supervision Technique (D Clavet, G Girard, unpublished workshop material, 2011)
	Clinical Sudoku (B Martineau, unpublished material, 2014)
	Comparative reading and mind mapping (Audétat and Laurin, 2010)
	Expliciting or bringing learner to explicit clinical reasoning (Audétat and Laurin, 2010)
Mid-clerkship	Encouraging learners to present their case to a colleague (the main elements)
	Using 'what-ifs' (decontextualization)
	Weighting and prioritising data based on contexts
End of clerkship	Flipped supervision or 'Tell me the story backward' (Mehlman and Farmer, 2003)
	The integrated SNAPPS (Summarize, Narrow, Analyze, Probe, Plan, Select)–One-minute Preceptor (D Clavet, L Langlois, unpublished workshop material, 2014)

toolbox was put together by clinical teachers and pedagogical experts from the Faculty of Medicine and Health Sciences at the University of Sherbrooke.

This article shares some of the tools in the clinical reasoning toolbox, including both teacher- and learner-centred tools. Furthermore, it describes some of the tools developed by the faculty and pedagogical staff, as they are less likely to be known. The article also suggests a process through which clinical teachers can diagnose clinical reasoning difficulties which can, in turn, help them choose the best-suited tool or strategy to help learners overcome the challenges they face at different times in the development of their clinical reasoning skills.

Putting together a clinical reasoning toolbox

All around the world, multiple tools have been developed in an effort to help clinical teachers with the challenges of teaching clinical reasoning. While some, like the One-minute Preceptor model (Neher and Stevens, 2003) and the Anticipatory Supervision Technique (D Clavet, G Girard, unpublished workshop material, 2011), are teacher driven and oriented towards providing guidance to teachers to better help their learners develop clinical reasoning skills, others, like SNAPPS (a mnemonic acronym for Summarize, Narrow, Analyze, Probe, Plan, Select) (Wolpaw et al, 2003) and the Clinical Sudoku or table of discriminating clues (B Martineau, unpublished material, 2014), are learner driven and meant to be used proactively by learners. Each has its set of characteristics rendering it most effective within specific contexts, with different types of learners, and with different learning needs and challenges during clinical training.

Table 1 lists the tools included in the clinical reasoning toolbox classified according to the period of clinical training where they are most likely to be helpful for learners. This classification should be considered as general guidance only, since learning needs and rhythms may vary between learners and context. The Anticipatory Supervision Technique, for example, could well be used at the middle or end of clerkship in a discipline less familiar for the learner; likewise, flipped supervision could be used with a high performing mid-clerkship learner or with more guidance from the teacher.

From this toolbox, three tools which were developed by members of the Faculty of Medicine and Health Sciences of the University of Sherbrooke are described: the integrated SNAPPS–One-minute Preceptor (iSNAPPS-OMP) technique, the Anticipatory Supervision Technique and the Clinical Sudoku.

The integrated SNAPPS–OMP technique

The SNAPPS (Wolpaw et al, 2003) and One-minute Preceptor models (Neher and Stevens, 2003) are aimed at different users. While the SNAPPS model is learner-driven (Barangard et al, 2016; Seki et al, 2016), providing learners with guidelines so that they can take the

lead in case presentations, the One-minute Preceptor model is teacher-driven (Farrell et al, 2016; Seki et al, 2016; Swartz, 2016; Vandaba et al, 2018) and structured as a series of steps for teachers to follow. Both are well-known, widely used models that have been shown by multiple studies to be beneficial to learners in clinical settings.

In a review of both the SNAPPS and the One-minute Preceptor models, Pascoe et al (2015) identified the following benefits of using the One-minute Preceptor:

> **'improved ability to assess the learner and provide targeted teaching, improved integration of feedback, learner preference, and ease with which it is learned by faculty members.'**

As for the SNAPSS model, the following benefits have been identified:

1. Expression by learners of a larger number of differential diagnoses
2. Increased ability to justify their reasoning
3. The ability to formulate more questions and identify zones of uncertainty.

The SNAPPS model is also thought to help foster self-directed learning (Pascoe et al, 2015). The iSNAPPS-OMP technique, developed by Clavet and Langlois (unpublished workshop material, 2014), combines both models as indicated by its name. It is based on the premise that, when rightly integrated, the steps of each model complement one another (Table 2). Using this tool, both teacher and learner have a parallel structure to follow in a discussion that further stimulates dialogue between teacher and learner during the process

Table 2. The integrated SNAPPS and One-minute Preceptor (iSNAPPS-OMP) technique

The SNAPPS model (Wolpaw et al, 2003) To be used by learner		**The One-minute Preceptor model (Neher and Stevens, 2003) To be used by clinical teacher**
Summarize	Briefly the history and findings	
Narrow	The differential to two or three relevant possibilities	***1. Get a commitment*** Encourage learner to make a commitment to a diagnosis, work-up or therapeutic plan
Analyze	The differential by comparing the possibilities	***2. Probe for supporting evidence*** Ask learner what evidence supports this commitment or the rejection of other choices *Steps 1 and 2 should give access to clinical reasoning*
Probe	The preceptor by asking questions about uncertainties, difficulties, or alternative approaches	
		3. Teach general rules Teach the learner common 'take-home points' or general rules that can be used in future cases, aimed preferably at an area of weakness for the learner
Plan	Management for the patient's medical issues	
		4. Reinforce what was right Tell the learner what they did right (specific behaviour) and the positive impact it had
		5. Correct mistakes If learner is not aware of an error, tell them what was not right, the (potential) consequences, and how to improve for next time and help learner narrow issue for self-directed learning
Select	A case-related issue for self-directed learning	

From D Clavet, L Langlois, unpublished workshop material (2014)

of developing clinical reasoning skills in learners (D Clavet, L Langlois, unpublished workshop material, 2014).

As it combines two pre-existing models, the iSNAPPS-OMP technique can claim to carry the advantages of both, potentially allowing for compensation of flaws on the part of the teacher and/or learner. For instance, where SNAPPS is mainly to be used with advanced learners because of its emphasis on self-directed learning, the One-minute Preceptor framework brings the possibility of more guidance, which expands its range of use and sets the ground for scaffolding. The same can be said about feedback, which does not have a separate step in SNAPPS but is largely represented in the One-minute Preceptor (steps 4 and 5). However, the iSNAPPS-OMP technique does require that both teachers and learners be trained to use the technique and that it be implemented systematically to be used at its full potential.

The Anticipatory Supervision Technique

The Anticipatory Supervision Technique (D Clavet, G Girard, unpublished workshop material, 2011) is most appropriate with beginner learners or when a learner is new to a discipline or a health problem and does not have sufficient knowledge to make diagnostic hypotheses. It is mainly aimed at helping clinical learners develop their ability to elaborate a relevant interview plan, using what they know and the information they have access to (Table 3). Using this technique, the clinical teacher discusses the learner's plan before, or early in the interview with a patient, in order to make the learner share what they know, what hypothesis they would retain or reject and why. Even if a learner does not have sufficient knowledge to determine a diagnosis, with the teacher's help, they should be able to clarify what they can tell from the case and what they cannot tell because of a lack of knowledge or information.

The Anticipatory Supervision Technique can, in turn, help the teacher to steer the learner in the right direction and help them see the different possibilities (What if the patient says this? What if, instead, you find that? What would you do next? What question would be relevant?). Coming back from the interview, the learner would then summarise the interview and discuss with the teacher what adjustments were made during the interview and why. Also, the discussion should encompass what the anticipatory exercise of structuring the

Table 3. Synthesis of the Anticipatory Supervision Technique

Description	Discussion of the interview plan with the learner before meeting the patient or early during the interview when the learner is faced with a problem that he/she does not recognise
Objective	Develop the learner's ability to mentally elaborate a relevant and flexible plan that can be adjusted during the interview
When to use	When the learner shows signs of: ■ Difficulty structuring or orienting interview based on context ■ Difficulty generating multiple relevant hypotheses from a few symptoms ■ Difficulty applying theoretical knowledge to a specific health problem ■ Difficulty dealing with patients with whom interactions make it difficult to develop and manage a plan ■ Difficulty using content of the patient's previous notes to guide consultation

Precautions	For anticipatory supervision to be useful:
	■ Keep the learner active in the process
	■ Help the learner perceive the interview plan as a helpful tool as long as he/she and the plan remain flexible and adjustable
	■ After the interview take a moment for feedback on:
	  ■ Adjustments made during the interview and what caused him/her to make these
	  ■ The impacts of this anticipatory structuring (risk, benefits, limits)

From D Clavet, G Girard, unpublished workshop material (2011)

interview permitted that would have been more difficult to do without this process, what could be improved for the next time, and what are the limitations of the exercise.

As no studies have been conducted to assess the impact of this technique on the development of clinical reasoning, there are no data to support its use, other than what was unofficially heard from learners and teachers. As such, the benefits of this technique are:

1. Helping learners build a sense of self-efficacy by helping them to realise that they always have a knowledge base to work with and build upon
2. Teaching them a framework to better prepare for the encounter with a patient
3. Identifying learning needs and issues for self-directed learning.

For both the teacher and the learner, it is also a way to protect the patient, to make sure they have access to the best possible care.

The Clinical Sudoku

Another tool developed by one of the authors' colleagues is based on the findings of Nendaz et al (2005) and Bordage (1987), which suggest that one way of helping the learning process is to reactivate previous knowledge and bring the learner to organise what they know. For these authors, these basic principles of cognitive psychology can be transferred to medical education by teaching prototypes of illnesses belonging to general categories. For example, in the chest pain category, some prototypes would be angina, oesophageal spasm, costochondritis or musculoskeletal pain, and pulmonary embolism. Furthermore, they state that for the clinical reasoning process to start, the signs and symptoms observed in a patient must trigger some diagnosis or categories of diagnoses (Nendaz et al, 2005). Keeping that in mind, Martineau (unpublished material, 2014) developed a tool called 'the Clinical Sudoku', which is now widely used in the undergraduate medical programme at the University of Sherbrooke. Just as a mathematical Sudoku, this tool is organised as a table with multiple cells. In the table, the rows are attributed to prototypes in an illness category, while the columns present items that can help discriminate between prototypes, as well as different treatment options (Table 4). As the learners gain new knowledge, they fill up the empty cells until they are all full.

Table 4. Example of a completed Clinical Sudoku for chest pain

Hypothesis	Discriminating questions	Discriminating elements in physical exam	Investigations	Treatment
Angina	Triggered by effort Stops with rest Same effort reproduces the pain Radiation to the left arm and jaw Can be associated with dyspnoea, nausea and diaphoresis	Physical exam often normal Arrhythmia Pallor, dyspnoea, diaphoresis during pain	Electrocardiogram Stress test Myocardial perfusion imaging	Nitroglycerin Calcium-channel blocker Beta blocker Long-acting nitrate Aspirin
Oesophageal spasm	Often associated with gastro-oesophageal reflux disease and other gastrointestinal symptoms Helped by hot water Not triggered by effort	Physical exam often normal If gastritis or gastric ulcer, pain when palpating upper abdomen	Nil	Treat gastro-oesophageal reflux disease Change in lifestyle and dietary modification Antacids Proton pump inhibitors
Costochondritis or musculoskeletal pain	Pain triggered by movement or breathing	Pain reproduced by palpating thorax	Nil	Reassurance Acetaminophen Non-steroidal anti-inflammatory drugs Infiltration when necessary
Pulmonary embolism	Pain aggravated by deep breath Dyspnoea Immobilisation or recent trip Pain in calf	Tachypnoea Fast heart rate Pulmonary S2 increased	D-dimer Pulmonary angioscan	Heparin Direct oral anticoagulant

Although this tool is mainly used in its written form in preclinical teaching, it can be used in clinical settings as a structure to discuss a case with the learner. The teacher would ask questions like 'what are the main clinical entities to consider when a patient tells you he has chest pain?'; 'what would bring you to the conclusion that X is more probable than Y?'

Be it by using the written or oral form, the Clinical Sudoku can help learners classify diagnoses and discriminate between these by outlining their characteristics, their similarities and, most importantly, their differences, which direct the diagnosis toward a more specific illness. This exercise allows the learner to consider the relative weight of each symptom and use each clue to narrow the diagnostic possibilities and choose appropriate treatment options.

Identifying learning needs

Having tools to help learners develop their clinical reasoning is a step forward, but these are of little help if the user does not know when to use them or to what end. Therefore, the clinical teacher should be able to pinpoint what the learner is struggling with and choose the most suitable tool(s) to fit his/her learning need(s).

To help clinical teachers do this, the toolbox also provides a 'model' of the pedagogical diagnosis process. To make this easily accessible, the pedagogical diagnosis process is positioned as one similar to making a clinical diagnosis (Figure 1). Just as a clinician would look for clues (signs and symptoms) before generating hypotheses and further investigating these to arrive at a differential and then a final diagnosis, so must the clinical teacher look for clues, make hypotheses and investigate to be able to determine the most probable challenge the learner is facing. Similarly, just as a clinician must have at least some basic knowledge of possible illnesses to establish a clinical diagnosis, so too must the clinical teacher be aware of the main clinical reasoning learning challenges to be able to identify which ones are at play for a particular learner.

One of the tools frequently used to pinpoint clinical reasoning learning challenges is Audétat et al's (2017a, b) guide to clinical reasoning difficulties, which features five general categories of clinical reasoning difficulties (Table 5). For each category, the authors identify clues to recognise the difficulty while supervising or reading the learner's notes in the patient's medical records. They also provide questions that enable teachers to detect the difficulty by bringing learners to verbalise their clinical reasoning hypothesis, and some suggestions of remediation strategies (Audétat et al, 2017b). This makes for a very thorough, easy to use tool, helpful for all clinical teachers.

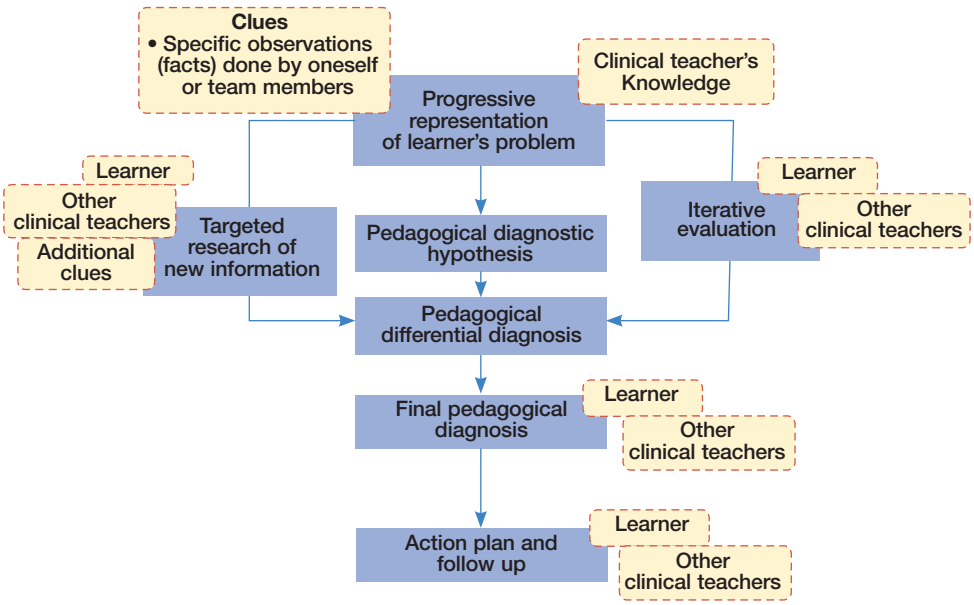

Figure 1. The process of making a pedagogical diagnosis.

Key points

- Clinical teachers need to be provided with tools to better foster quality teaching of clinical reasoning.
- The first step in helping learners develop their clinical reasoning is for teachers to get access to that reasoning.
- Diagnosis of clinical reasoning difficulties can be compared to posing a clinical diagnosis.
- Multiple tools are available to address the diversity of learning needs, including the integrated SNAPPS-One-minute Preceptor technique, the Anticipatory Supervision Technique and the Clinical Sudoku.

Table 5. Main difficulties in clinical reasoning

Hypothesis generation, perception of clues, targeted data collection	Most frequent at clerkship level
Premature closing (considering only one hypothesis)	
Prioritising (health problems or clues)	
Drawing a global picture of the clinical situation	
Elaboration of intervention plan	

From Audétat et al (2017a)

Conclusions

If we match the three tools presented with the most frequent clinical reasoning difficulties identified during clerkship (Table 5), it appears they cover the span of these difficulties, thereby providing ideal ways of helping learners overcome their challenges. In the reality of daily clinical teaching, teachers do not question the usefulness of these tools. They mostly recognise their need to have multiple tools at their disposal so that they can work with varied learner profiles. These also help reduce their feelings of helplessness or a perceived lack of personal resources when faced with a learner that 'does not quite get it'. As such, the faculty has achieved the goal of providing useful tools, as shown in a follow-up study assessing whether clinical teachers had effectively used the tools proposed and transferred their new knowledge into practice (Gagnon et al, 2016).

Nonetheless, the process by which the tools presented here are helping teachers diagnose learners' challenges has yet to be assessed. As most studies focus on the development of learners' clinical reasoning, there remains a need to better understand how clinical teachers assess their learners' needs and how to enable them to overcome their challenges. This would give precious insight on best practices in this regard.

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Conflicts of interest

The authors declare no conflicts of interest.

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