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ARTICLES

Teaching clinical thinking to first-year medical students

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Abstract

Background: The ability to think clearly and critically is necessary to normal human conduct. Particular forms of reasoning characteristic of practitioners of medicine have been studied, but a principled pedagogical framework that also reflects clinical practice has not been delineated.

Aims: The goals are: identify the principles that underlie the clinical thinking of physicians, develop a pedagogical framework, and design and implement curricular modules for medical students in the first year of their studies.

Methods: The authors reviewed prior work on clinical thinking of physicians and medical students as well as reflective pieces by seasoned clinicians. They also examined modalities of logic and inference used by physicians and others. The designed modules were implemented at the Faculty of Medicine at McGill University and linked to training in attentive listening and clinical observation.

Results: Five core features of a pedagogic framework on clinical thinking were developed and used to design and implement a series of teaching modules for first-year medical students.

Conclusions: The core features, and the modules based upon them, can serve for further empirical work on clinical reasoning and lead to modules for advanced students as they progress in their acquisition of expertize.

Hypothesis substitutes, for a complicated tangle of predicates attached to one subject, a single conception

Charles Sanders Peirce (1878)

Introduction

The curriculum for entering medical students at the Faculty of Medicine, McGill University, includes modules on clinical thinking that are parts of a continuum with preceding units on attentive listening (Boudreau et al. 2009) and clinical observation (Boudreau et al. 2008). These, together, form the core of the *Clinical Method*, which is in turn a central theme of our curriculum on 'Physicianship' (Boudreau et al. 2007). We aim to impress upon students at the outset of their training, that hearing, seeing and thinking in the clinical context are special exemplars of their quotidian counterparts and are skills that must be learned explicitly and practiced continually. In other words, a clinician develops, with training and exercise, special ways of interacting with patients and their worlds. The skills of the clinical method – applied repeatedly in the crucible of the clinical context, enriched by the experiences of numerous patients, shaped by the ethical exigencies of providing medical care, and infused with the personal values that these engender – are transformed into practical wisdom. We have chosen to call this *clinical phronesis*, following a suggestion made previously by Pellegrino in his work in biomedical ethics (Davis 1997). This basket of pragmatic skills, together with knowledge and skills in therapy and clinical management taught later in the curriculum, form the armature upon which the patient–physician relationship is anchored, and the explanatory core of the medical curriculum, and of medicine. The ethos and guidelines termed professionalism (Steinert et al. 2007), when enacted through the clinical method, enable the process of healing that is the goal of the clinical relationship.

Practice points

- The modes of clinical thinking implicit in the teaching of medical students do not reflect actual practice by physicians.
- Clinicians quickly acquire cues from patients and develop several hypotheses that serve as explanatory stories of the illness.
- Abduction is the form of inference used by clinicians in generating these hypotheses.
- Such hypotheses are evaluated by further inquiry and an informal application of Bayesian reasoning.
- Clinical judgment, in the context of an introductory course, refers to the process of choosing amongst hypotheses whilst accommodating the particularities of the individual patient.
- Videotape clips of an experienced clinician interviewing simulated patients are useful in teaching clinical thinking to medical students in 'think-aloud' exercises.

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Why teach clinical thinking?

Clinical skills were traditionally imparted in piecemeal fashion. The medical interview and physical examination were taught at the outset of the student's clinical experience on the presumption that the prerequisite skills of observation, listening and reasoning were absorbed by witnessing role models, generally in the hospital setting. It is clear that this is no longer feasible, nor desirable. Clinicians are increasingly busy and have less time dedicated to instruction of students during the course of clinical care; hence specific attention to acquisition of these skills is necessary. In addition, the skills of the interview and communicating with patients were taught separately from those of observation and thinking, forcing students to independently forge links amongst these related aptitudes. By contrast, we endeavour to demonstrate their connectedness by grouping these training units under the rubric of physicianship, a longitudinal component that extends throughout the entire medical school curriculum.

A more cogent pedagogical rationale for teaching clinical thinking in the early phase of a medical curriculum is to promote encapsulation (Schmidt & Rikers 2007), a process by which biomedical knowledge becomes linked to and understood as explicating the causal chains of illnesses and diseases taught in courses in pathology and medicine and later observed in the clinic. Clinical reasoning thus serves as a cognitive link by providing a process in which biomedical knowledge is utilized, a bridge for transition into the clinic, and a framework whose interstices are then filled with clinical content. Teaching clinical reasoning provides a means of transforming for the students and encapsulating the basic notions of biomedicine with the higher-order content of the illnesses of patients. We propose that teaching the clinical method early in the curriculum may help to eliminate the gap between basic and clinical knowledge that continues to plague the Flexnerian curriculum (Boudreau et al. 2007). As Elstein (Elstein et al. 1978) and others (Bowen 2006) have noted, clinical thinking cannot be taught simply as a process of logic or heuristics alone – it must be imparted with content that makes it, literally, 'memorable'.

One important motivation for our strategy is the recognition that the traditional approach to teaching case histories, physical examination and diagnostic analysis does not reflect how physicians actually work and think (Barrows & Tamblyn 1980). Clinical educators insist that students carry out a history and a review of systems by following a prescribed path suspending until the end of all formulations of the illness in question. Teachers pretend that such an agnostic mode is actually possible and that a list of putative diagnoses will emerge naturally if the job is done right. No clinician would actually testify that such is his method of work. To quote Elstein et al. (1978) who have actually investigated how physicians think, '. . . the teacher is frequently unaware of the real system he uses to make his expert judgments. He may even believe that he operates in a very different fashion from the way in which he actually does operate. Imagine the frustration of students who must learn to ignore what he says they should do, and instead must themselves infer the model of his judgments' (Elstein et al. 1978, p. 40). In the same vein, Barrows and Tamblyn note the 'myth' (Barrows & Tamblyn 1980, p. 22) of the review of systems being taught in courses on the medical interview. In fact, Elstein et al. (1978, pp. 66, 168) have demonstrated that clinicians, as well as medical students in training, begin to generate hypotheses regarding the putative illness very quickly after gathering cues and information from the patient. Within minutes, several such hypotheses are formulated and these then guide the actual inquiry. In fact, they note that this approach is a means of coping with the open-ended problem presented by a patient. They state, 'The function of early hypotheses, therefore, is to limit the size of the space that must be searched for solutions to the problem. Some way of progressively constraining the size of the search space must be found or else a clinical workup could never end in the time that is actually available' (Elstein et al. 1978, p. 65). In other words, hypotheses transform an open problem into one with several hypothetical solutions and the goal of the interview and physical examination is to carry out a comparative evaluation of these competing 'diagnoses'. Thus, we detriment our students in the traditional training approach by teaching a scheme that is more difficult to apply to complex problems, and, in any event, is not actually the one we expect them to utilize a scant year or two later.

Our initial evaluations have indicated that students enjoy the experiences of problem-solving that clinical thinking presents and the opportunity to develop their nascent skills. As noted in the companion manuscripts on teaching listening (Boudreau et al. 2009) and observation (Boudreau et al. 2008), we consider that the explicit teaching of how a doctor thinks aids in their identity formation as physicians and as scientific healers. To cite Barrows and Tamblyn, 'The physician's experiment is his inquiry strategy, utilizing clinical skills' (Barrows & Tamblyn 1980, p. 43). Finally, such learning is a source of motivation and enjoyment for our students who, after all, applied to medical school to become skilled in the arts of 'doctoring'.

What do we teach?

We have constructed our modules around the following five main features:

(1) The elements of clinical thinking: Inquiry and judgement.
(2) The goal of the clinical encounter: Therapy and management.
(3) The process of clinical thinking: Hypothesis generation and evaluation.
(4) The clinician's mode of logic: Abduction.
(5) The clinician's mode of evaluation: Probability, natural frequencies and Bayesian reasoning.

(1) The elements of clinical thinking: Inquiry and judgement

Clinical thinking has also been termed clinical reasoning, clinical problem-solving and clinical judgement. We have found the following distinctions useful in teaching first-year medical students. Clinical thinking is a portmanteau term that

refers to the cognitive processes of a clinician in the course of his work. It includes, *inter alia*, clinical inquiry – the acquisition from the patient and other sources, of information relevant to the care of the patient; clinical reasoning – the generation of hypotheses, analysis of the information acquired and the evaluation of the hypotheses by means of the analysed information; and clinical judgment – the choice of hypotheses, diagnoses and modalities of treatment and management made in the light of the particularities of a given patient. These are based in part on the psychological model proposed by Elstein et al. (1978, p. 66) of 'cue acquisition, hypothesis generation, cue interpretation and hypothesis evaluation'. Hypothesis is 'a supposition or conjecture put forth to account for known facts; . . . a provisional supposition from which to draw conclusions that shall be in accordance with known facts, and which serves as a starting-point for further investigation by which it may be proved or disproved and the true theory arrived at'. (Oxford English Dictionary. Available at: http://www.oed.com; accessed 14 July 2008.).

(2) The goal of the clinical encounter: Therapy and management

Diagnosis is neither the goal, nor the end point, of the clinical encounter. Despite this fact, the patient is often described as a problem to be solved with the diagnosis as the solution. The actual goal of the patient in seeking help or advice is the resolution of a symptom or symptoms, whether by explication or treatment, and the recovery of the patient's ability to meet his purposes and goals and return to a sense of well-being. It is therefore helpful to frame the work of the doctor–patient interaction as the shared construction of an explanatory narrative that accounts for the facts at hand and whose elaboration can itself be helpful to the patient and may lead to interventions that relieve suffering and promote healing. We thus shift the focus somewhat from simple problem-solving, since that implies that once a plausible solution is available, the task is completed. In fact, many medical problems are complex and, even if soluble, cannot be captured by a single diagnostic label. The hegemony of the diagnosis in medical thinking is underscored by the popular portrayal as the doctor as detective in a 'whodunnit' who must identify the culprit, or disease, in question. The taxonomic needs of epidemiologists and health care administrators for distinct categories, the organization of textbooks of medical knowledge by disease, and the celebration of the model physician as the astute diagnostician, rather than outstanding caregiver or healer, have all contributed to the current state of affairs. By contrast, we aim in our teaching to stress the particularity of each patient, the uniqueness of his story and its instrumentality, not simply its (diagnostic) title. Finally, we demonstrate that the narrative jointly constructed by patient and physician can serve as a casual explanatory drain for the doctor and mediate meaning for the person who is ill.

(3) The process of clinical thinking: Hypothesis generation and evaluation

The students are taught by model scenarios that presume that even as first-year medical students, they have accumulated sufficient information about illnesses and physiology to proffer hypotheses about medical problems. They are then encouraged to consider evidence and develop several explanatory hypotheses that explain the symptoms in the context presented. This teaches that: (a) hypotheses are generated early in the clinical encounter; (b) they are based on cues acquired from the patient by observation and attentive listening, whether from his demeanour, physiognomy, words or paralanguage; (c) hypotheses must not be generated too early, that is, before the patient provides suggestive and useful cues and (d) more than one hypotheses is almost always needed, as the best evaluation of an hypothesis is by a comparison with alternatives.

The students are then asked what additional clinical features would be entailed by each hypothesis, and are encouraged to generate questions whose answers will be useful in the evaluation of the hypothesis, i.e. make it more or less likely as an explanation. We have devised an acronym QUEST: answers to *qu*estions, observations from physical *e*xamination, patient's description of *s*ymptoms, results of laboratory *t*ests. All these represent useful sources of information (or cues, in Elstein's configuration) that help evaluate hypotheses. This underscores the notion that although the concepts of sensitivity and specificity are generally applied to quantitative data from laboratory tests, they are equally applicable to the results of interrogation or examination of patients. We then demonstrate how some hypotheses are strengthened whilst others are weakened by applying to their evaluation the results of the clinical inquiry. Some hypotheses are then discarded and others modified. We then proceed to further iterations and demonstrate how a likely hypothesis can evolve with a series of judiciously chosen questions to the patient and due and careful attention to the answers and 'clues'.

(4) The clinician's mode of logic: Abduction

In order to present a model familiar to the students, we use the fictional detective Sherlock Holmes whose method of 'ratiocination' mirrors the medical model we are demonstrating. In addition to having been modelled by Conan Doyle on his professor at Edinburgh, the physician Joseph Bell (Wagner 2006), Holmes is also an exemplar of the astute observer who appreciates the need for cogent facts and cautions against premature conclusions. The method described in these fictional accounts is similar to that dramatized by Edgar Allan Poe in the stories of his own fictional detective, Auguste Dupin (Poe 1938), and termed abduction (Peirce 1998, Vol. 2, p. 106) by scholars of logic. As noted by Holmes in the Study in Scarlet, 'There are few people, however, who, if you told them a result, would be able to evolve from their own inner consciousness what the steps were which led up to that result. This power is what I mean when I talk of reasoning backward or analytically' (Doyle 2003). We have found the Holmesian genre to be a useful introduction to the formal explication of the modes of logic used by clinicians (Kempster 2006).

Charles Sanders Peirce, the American pragmatic philosopher, described the form of inference he termed retro-duction or abduction (Peirce 1998, Vol. 2, p. 441). Unlike deduction,

which applies a known and proven rule to a particular case to arrive at an inexorable result, and induction, which collects the results of many cases to define a probabilistic rule, abduction, faced with a result, proposes a previously known rule (or hypothesis) under which the case in question could be subsumed. The contrasts amongst these three forms of logic are summarized in Table 1.

Abduction characterizes the mode of thought of the detective, the clinician, and the scientist in the creative phase of his work. 'In abduction, the consideration of the facts suggests the hypothesis' (Peirce 1998, CS Vol. 2, p. 106). Just as the hypotheses of the scientist lead to experiments designed to ascertain their strength (or in a Popperian model, to experiments designed to eliminate one or more hypotheses), so does the clinician test his proposed explanatory hypotheses of the illness by further inquiry, physical examination or laboratory tests. By contrast, induction is the common mode of work of the epidemiologist, and deduction that of the mathematician and philosopher. This underscores the probabilistic nature of medical reasoning and its conclusions and also leads readily to the next section, the teaching of probability and Bayesian reasoning. This framework provides a contrast between medicine, the art of individualizing, and natural science, the art of generalizing.

(5) The clinician's mode of evaluation: Probability, natural frequencies and Bayesian reasoning

To move to the next steps of the physician's reasoning process, namely, evaluation of hypotheses, we introduce the concepts of chance, odds, probability, sensitivity, specificity, likelihood ratios and positive and negative predictive values. Although these ideas are traditionally used in describing laboratory tests, the same concepts are applicable to any clinical inquiry. It is also useful to note the contrast between what the evaluator of a test wishes to know, namely, sensitivity and specificity and what a patient and physician must understand, namely, the interpretation of a test result. In order to do so, we introduce the concept of base rates and the epidemiologic context within which the patient lives. We have found the natural frequency method and diagrammatic approach propounded by Gigerenzer and colleagues a simple and approachable means to demonstrate the impact of base rates on the contextualization of a test outcome (Sedlmeier & Gigerenzer 2001) (Figure 1). This means of display avoids the well described base rate fallacy to which clinicians and others have been shown to be prone (Eddy 1982). It is also an intuitive and arithmetically simple means of calculating a posterior probability in the light of new information. Hence, it is a means of teaching a Bayesian approach to hypothesis evaluation but avoiding the theorem and formula that neophytes, and even seasoned clinicians, find intimidating and confusing.

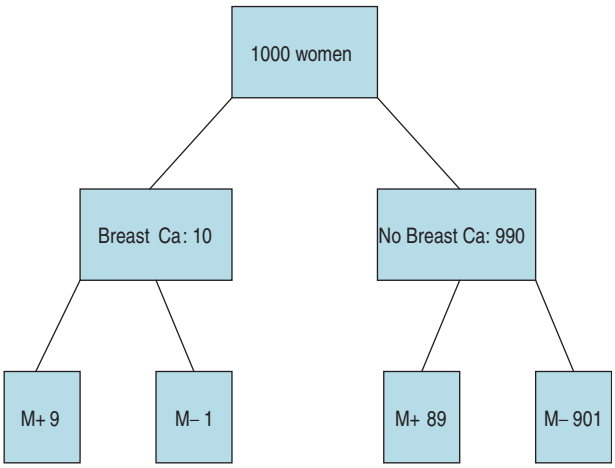

Figure 1. Natural frequency method of demonstrating probabilities.
Note: The figure demonstrates the natural frequency method of determining the answer to the following question posed to the students: A woman, aged 40, is told that her screening mammogram is 'positive'. What is the probability that she has breast cancer, given that the population prevalence of breast cancer in women aged 40 is 1% and screening mammography has a sensitivity of 90% and a specificity of 91%. Legend: Breast Ca: number of women with breast cancer; No Breast Ca: number of women without breast cancer; M+: number of women with positive screening mammogram; M−: number of women with negative screening mammogram. PPV^{+}: Predictive value of a positive test (based on Sedlmeier & Gigerenzer 2001).

Table 1. Different forms of inference.

	Inference		
Logical type	Deduction	Induction	Abduction
1st statement	All the beans from this bag are white	These beans are from this bag	These beans are white
2nd statement	These beans are from this bag	These beans are white	All the beans from this bag are white
Conclusion	These beans are white	All the beans from this bag are white	These beans are from this bag
Clinical Inference			
Induction: What epidemiologists do		Abduction: what physicians do	
Child 1 with measles has a rash		This child has a rash	
Child 2 with measles has a rash…		Children with measles have a rash	
Children with measles have a rash		It is a plausible hypothesis that measles explains the rash in this child	

Once students are comfortable with the natural frequency approach, we demonstrate the use of likelihood ratios in converting prior to posterior probabilities as such ratios are now available not only for validated laboratory tests but also clinical findings that flow from clinical inquiry (McGee 2007). This then fully deploys the concepts promulgated by the Bayesian approach, namely, the evolution of the probability of a given hypothesis, as more data are brought to bear on the question. A recent article by Gill et al. (2005) underscores this mode of thinking by physicians deciphering a clinical problem and notes that 'Bayesian reasoning is a natural part of clinical decision making'.

Our overall approach to clinical thinking is hypothesis generation by abduction, followed by iterative cycles of Bayesian reasoning. We find this to be a more precise description than the term 'hypothetico-deductive' often cited in the medical literature (Kassirer 1983; Lawson 2000). Abduction is a more precise term and permits comparison between clinical reasoning and other modalities of inference. The term has a distinguished history in Peircean philosophy and has been applied to the detective fiction of Poe and Doyle by the semioticians Umberto Eco and Thomas Sebeok (Eco & Sebeok 1983). The hypotheses generated by abduction stem from the experience of the clinician and what Eco called, the 'reductio ad unum' of the observations (Eco & Sebeok 1983, p. 205). As Peirce noted, 'Upon finding himself confronted with a phenomenon unlike what he would have expected under the circumstances he looks over its features and notices some remarkable character or relation among them, which he at once recognizes as being characteristic of some conception with which his mind is already stored, so that a theory is suggested which would explain (that is, render necessary) that which is surprising in the phenomenon' (Peirce quotation cited in Eco & Sebeok 1983, p. 181). In brief, the educated guess, clinical acumen or physician's experience. This model is congruent with the findings by Elstein that medical diagnostic work is driven by content rather than process (Elstein et al. 1978, p. 276) and teaches the students that nothing can substitute for knowledge acquisition and clinical experience.

How do we teach?

We use a combination of interactive lectures and small group learning sessions that, together with an examination session, provide 8 h of direct contact instruction. The topics addressed in each session are noted in Table 2. The small group teaching format is the mainstay of the pedagogical strategy for the initial 18 months of the medical curriculum at McGill University. Groups of 15 students work collaboratively with a facilitator to explore in depth various issues introduced in the whole class lectures. We start the module (Table 2) with a small group workshop in which students are presented with a simulated and simple clinical story of a college student with a 3 day history of nausea and vomiting. The students analyse the material and learn that they can use their own life experiences, burgeoning knowledge of pathophysiology and shared intuitions to arrive at an explanatory story. A script concordance (Charlin et al. 2000) exercise demonstrates how a hypothesis changes in likelihood in the face of new information and anticipates, in a rudimentary fashion, the Bayesian calculations that follow. We address the concepts of hypothesis, diagnosis and explanatory story of illness, clinical inference and abduction and the use of likelihood ratios in updating probabilities. The significance of base rates, and the base rate fallacy are then reviewed, followed by an exposition of Bayesian reasoning.

By using videoclips of physicians interviewing simulated patients, we encourage students to 'think aloud' about the mindset and rationale of the clinician as evidenced in the video. These exercises permit the students to practice the clinical skills previously taught and illustrate the application to the

Table 2. Overview of teaching sessions on clinical thinking.

Session objectives	Session format and content
Discover and explain that clinical reasoning revolves around inquiry, hypothesis generation and hypothesis evaluation.	Small group – using a simulated case history and script concordance exercises (Charlin et al. 2000) with vignettes derived from every-day life experiences.
Describe hypotheses as explanatory narratives of illness. Define and contrast different modes of inference, emphasizing abduction as the mode of clinical practice. Define odds, probability and chance. Discuss the QUEST model in solving clinical vignettes. Define sensitivity, specificity, likelihood ratios and base rate. Define decision-making. Calculate predictive values, likelihood ratios. Demonstrate the use of likelihood ratios and a simplified version of Bayes theorem to determine posterior probabilities. Apply the QUEST model. Understand and discuss the goals of the clinical encounter.	Interactive lecture – the model of the detective as someone who uses 'backward reasoning'; mathematical exercises requiring the calculation of odds from probabilities and vice versa (Simel 1985). Interactive lecture – using diagrammatic approaches (Loong 2003), visual aids (Paling 2003) and natural frequency methods (Sedlmeier & Gigerenzer 2001). Small group – using exercises that can be solved with abductive–Bayesian iterative cycles and a technique to approximate probability (McGee 2007). Small group – using guided questioning and 'think-aloud' exercises (Elstein et al. 1978) based on the viewing of video recordings of physician interviews of simulated patients.
Integrate attentive listening, clinical observation with principles of clinical thinking.	Interactive lecture – using targeted questioning and 'think-aloud' exercises of pre-recorded clinical scenarios.
In a whole class setting: • review the five main principles of clinical thinking. • practice with a formative performance examination – using multiple choice questions, short answer questions and a student response system i.e. 'clickers' (Premkumar & Coupal 2008).	

clinical setting of what may have seemed like 'dry' theories of inference.

In the teaching of clinical reasoning, we introduce the method of near peer learning by recruiting senior medical students as group facilitators. Both learners and facilitators are pleased with this choice. First-year students feel that senior students are better able than members of the faculty to understand their needs as learners and conversely, senior students appreciate a formal review of the methods of clinical thinking that they employ every day in the clinic. The senior students often request more workshops sessions to practice Bayesian approaches to reasoning for their own clinical learning, especially in evidence-based medicine.

What do we not teach?

There are a great number of issues relevant to clinical thinking that we do not teach in the first year and explicitly defer to future years when students are better equipped to deal with more complex issues. These include the following:

(1) Rapid clinical assessments: These are particularly relevant to medicine in the emergency room or other settings of acute care. The ability to rapidly ascertain if a patient is critically ill (and requiring immediate intervention), must be developed and is best taught when students are comfortable in the clinical setting and have sufficient experience with patients to begin to recognize those that are acutely ill. Similarly, the recognition of other important clinical *gestalts* can be learnt later in the medical school experience, for example, patients with chronic wasting illness, or those with renal, hepatic, pulmonary or cardiac failure. Indeed, the experienced clinician's course of inquiry is dependent on and flows from his 'specification' of the case, in other words, his earliest impressions of the patient. These reflect the values and prior conceptions of both actors in this interaction and considerable clinical skill is needed to generate valid early choices. In that sense, clinical judgment plays a role in all phases of the encounter. These are topics for more advanced training as the students accumulate their own clinical experience.

(2) Building relationships: The clinical encounter accomplishes a great deal more than understanding the nature of the illness. The relationship between patient and physician is crafted in that context and the communication of genuine concern is necessary to the trust that is at the core of healing. We specifically do not engage in these issues in this initial module so that the students can focus their attention on the issues of clinical thinking that are the pedagogical objectives at that point. In fact, it may be rather advantageous to teach clinical thinking without engaging real patients at the outset since the emotional issues that students face in their initial clinical encounters may overshadow the simpler goals of learning clinical inquiry.

(3) Memory and content: In teaching the clinical method, our focus is on development of skills and we minimize the importance of content at this stage. Nonetheless, the literature notes that the quality of hypothesis formation and evaluation depend greatly on the learned and experiential databases of the physician. In other words, material that is present and organized in memory.

(4) Heuristics and their biases: Psychologists have described the weaknesses of various heuristic devices in reasoning such as the availability, representativeness, framing, anchoring and confirmation biases. Such pitfalls in diagnostic thinking have been described pithily in a recent book by Jerome Groopman (2007) who warns patients about the biases that may afflict their doctors. We believe these issues are best introduced at later stages in the development of medical students' reasoning capabilities.

Conclusions

Teaching clinical thinking in first year is for us an innovation. Heretofore, such material was taught just prior to the students' first clinical experiences in the hospital setting. This early introduction enables us to link this module to our continuing series on physicianship and the clinical method and establish the connections amongst these. The videoclip modules are specifically chosen to permit integration of listening, observation and clinical thinking. We also underscore the use of language, paralanguage and behavioural cues evident in the videotaped interviews. Teaching these modules while the students are deeply embedded in learning the scientific basis of medicine should enhance the process of encapsulation by demonstrating how hypothesis formulation can be anchored in the students' newfound knowledge of anatomy, physiology and biochemistry. A natural bridge is thus created to pathophysiology and clinical medicine taught later in the curriculum.

The students are eager for material that appears to them clinically relevant and these modules afford an early experience with 'doctoring' and a prelude to interacting with actual patients. In fact, teaching how doctors think also illustrates what doctors do – thus, the students, we anticipate, will be more at ease when encountering patients for whose welfare they are in part responsible. Teaching clinical inference in the classroom and small group setting permits students to learn this specific subject with the appropriate level of attention and intensity. If the material is first introduced when actual patients are encountered, the students' attention is naturally drawn to dealing with the anxieties of their first clinical opportunity and the demands of the interpersonal interaction. Thus, we believe students should come to these milestone learning events with at least a theoretical knowledge and certain level of practice at clinical thinking with models and simulated patients.

Another link that is forged is between the epidemiologist's attention to populations, and the focus of clinical medicine on the individual patient. Clinical epidemiology and evidence-based medicine thus become scientific sources of the likelihood ratios, odds and distributions useful to the understanding of the individual with an illness. We propose in future modules to grapple with the relation and tension between seeing the 'point' of the individual and the 'curve' of the population of which that person is a putative member. Finally, this module

introduces, albeit only briefly, the concept of uncertainty that is a feature of the lives of physicians and patients alike. In many ways, clinical medicine is the art of dealing with the unknown, and how it is managed is a certain reflection on the skill of the physician.

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ABRAHAM FUKS erstwhile Dean of the Faculty of Medicine, McGill University, has a research interest in the use of language in medicine and is currently involved in numerous projects that include the intersection of clinical hermeneutics and narratology.

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