This document is a best practices essay from the international, multidisciplinary collection of teaching and training techniques, “Critical thinking and Clinical Reasoning in the Health Sciences.” Each essay in this set provides an example of training reasoning skills and thinking mindset described by international experts in training clinical reasoning.

Teaching Critical Thinking in Medicine

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This chapter is an important orientation to the discovery of embedding critical thinking pedagogy into the content of a health sciences seminar session or bedside teaching opportunity. We expect that as you read this chapter, the critical thinking content in your own course offerings will become more and more transparent to you and to your students. The chapter follows a somewhat different format that the ones that follow. In his discussion, Dr. Jenicek offers us an opportunity to think about the historical influence of the critical thinking movement on the teaching of medicine. His wisdom as an international scholar is apparent as he traces progress to date on our scholarly understanding of human reasoning and judgment and offers interesting reflections for future endeavors. The reference list at the end of this
chapter will assist those who wish to aid the development of new science in this area. We particularly endorse his comment that the application of critical thinking to the procedures of clinical medicine, community health programs, bedside practice and health science researchers is the best way to attain relevant growth in clinical reasoning. He has also included the generous welcome that you to contact him at \texttt{jenicekm@mcmaster.ca}

Introduction

Is the teaching of critical thinking in medicine new? Yes and no, based on the author’s learning, academic and professional experiences. Today, most North American medical schools and faculties have among their objectives to educate and train new health professionals as critical thinkers. In view of this objective, we wish to reflect here upon:

1. How we did this in the past;
2. What we are doing now; and
3. What should we strive to achieve in the future? What are the challenges of teaching critical thinking in medicine and how can we best face them in the years to come?

In the following pages I offer some possible answers to these questions.

Elements of modern critical thinking were taught in medicine for several generations under different labels and only more recently has critical thinking and its teaching emerged as an entity under its own name. Critical thinking \textit{per se} has benefited from its contact with the basic sciences and almost all medical specialties and disciplines that support them like epidemiology, biostatistics and sociology on one side and philosophy on the other.

The past three or four generations of philosophers significantly enriched our understanding of informal logic, argument and argumentation as core elements in a wider spectrum of critical thinking in general. They advanced structured methodology and expanded uses and applications of critical thinking in an ever-growing number of domains of human life, biological sciences, social and other sciences and arts. The leap from ideas about critical thinking at the beginning of the past century$^{1,2}$ to contemporary informal logic$^3$, critical thinking$^4$ and its current vision$^5,6$ was enormous as can be seen from these very few examples and the illustrative references in this chapter. An even more considerable time span separates the classical forms of argumentation in ancient Greece$^7$ (the ubiquitous Aristotelian categorical syllogism, its \textit{premises and conclusions} as its expression) and India$^9$ (Nyaya school, its ‘\textit{demonstration} through a ‘\textit{proposition} – \textit{reason} – \textit{exemplification} – \textit{application} – \textit{conclusion}’ complex) from logic and modern argument modeling$^9$ (involving \textit{claim, grounds, backing, warrant, qualifier, rebuttals} as building blocks) and its applications$^{10}$. Critical thinking appears now as important in the practice of medicine and the health sciences, in health science research, and in philosophy in medicine itself as are already medical ethics and epistemology of research. In these rapidly evolving times, fundamental tools are now available and new challenges and distinctions are developing.

Today, critical thinking in medicine and its teaching are at the crossroads of epidemiology, biostatistics, evidence-based medicine (EBM), and clinical teaching methodology. Which path should we choose? In discussing such a question here and in trying to find at least a partial answer, the reader should be aware that this is a personal reflection of a health professional and academic based mainly on a recent individual experience and acquired knowledge. It is unsupported so far by structured research, evaluation, integration and synthesis of various experiences with teaching critical thinking across medical academic and professional institutions. This will come only later. Medicine is not an exact science, but a biological one, bearing the inherent attributes of probability and uncertainty. Let us now take a closer look!
1. Past experience and contributions to critical thinking in medicine

In the search for the best possible description and understanding of disease and other health phenomena occurrence, biostatisticians and physicians played and are playing a major role in the development of the methodology required for the measurement, counting, quantification and classification of what was seen at the bedside and in the community. Thus, biometrics and clinimetrics were born.

In the search for the best possible proof and explanation of causes of disease occurrence and course, epidemiologists and biostatisticians refined the methodology of observational analytical studies. Clinical trialists adopted and further elaborated these causal thinking roots in the experimental method (clinical trials) as part of the general scientific method used in medicine. As they relate to critical thinking, these initiatives have so far been classified (in the spirit of this chapter) into two basic categories: causal thinking and logic of medicine, often within the larger framework of the philosophy of medicine.

In ‘causal thinking,’ John Stuart Mill’s ideas about causes were developed and adapted to the biological and social characteristics of medicine by physicians, dentists, biostatisticians and sociologists including C Bernard, AB Hill, J Jerushalmy and CE Palmer, RS Ludley and LB Lusted, AR Feinstein, B MacMahon and TF Pugh, experts involved in smoking and health evaluation, M Susser, C Buck, AS Evans, DL Weed, JM Elwood, S Greenland’s and KJ Rothman’s groups of authorities, to name just a few in somewhat chronological order (and with apologies to all the unnamed). We have reviewed, summarized, referenced and updated these contributions elsewhere.

In conjunction with causal considerations, various aspects of reasoning and logic in the framework of philosophy in medicine as a more distinct entity were proposed by LS King, EA Murphy, ED Pellegrino and DC Thomasma, HR Wulff et al., CI Phillips’ group, and also in fuzzy logic in medicine as originally advanced by LA Zadeh and K Sadek-Zadeh. In 1995, our ‘Epidemiology. Logic of Modern Medicine’ bore a rather cheeky subtitle referring to the logic behind epidemiology. A more distinct introductory coverage of logical aspects of evidence-based medicine followed only in 2003. The relevance of argumentation in light of SE Toulmin’s philosophy was emphasized for medicine by R Horton and presented even more forcefully later on by DL Hitchcock. Fundamental notions of logic and critical thinking in medicine under this title appeared in 2005, followed by a collection of suggested teaching and learning tools in a self-learning guide in 2006.

2. General philosophy and strategies of teaching critical thinking in medicine today

To teach physicians critical thinking, we have to choose between two strategies: We can convey the message the way philosophers do for general studentship or we can apply critical thinking to the procedures followed by clinical medicine and community health programs practitioners at the bedside or in the community or to the procedures followed by health researchers in the performance of their scientific method and research protocols. The latter definitely appears more attractive and relevant for the action-oriented recipients of the message.

Reflecting on the second question of how we teach critical thinking in medicine today, I find it helpful to consider several distinct groups:

- Medical students and residents in various clinical specialties and in community and family medicine;
- Research oriented physicians;
- Clinical teachers and academic clinicians, ‘teachers to be taught.’
For all young physicians in training

From the currently available array of general critical thinking teaching methods\textsuperscript{39,40} (classroom assessment techniques, cooperative learning strategies, case studies/discussion, using questions, conference style learning, writing assignments, dialogues, creating ambiguities in the group and solving them instantly), clinical cases studies at hospital floors, rounds and consults, case studies and medical information appraisal are essential training for undergraduates and graduates in medicine.

In medicine, related to the above mentioned techniques and strategies of teaching methods, two types of clinical teaching methods are currently often in use: Pimping and Socratic discourse. ‘Pimping,’\textsuperscript{41,42} in the field of medicine, refers to clinical practice teaching where persons in power ask questions (often irrelevant to the problem solution and/or unanswerable) of their junior colleagues with objectives ranging from knowledge acquisition to embarrassment, humiliation, and/or establishment of pecking order within the pimping/pimped group. So far, I have not met anyone who did not experience pimping during their medical training. Sometimes, pimping is intentional, sometimes, pimpers believe that this is the right way to lead others to desirable knowledge, attitudes or skills. Most of these are ignoring what we know as good pedagogy for teaching critical thinking today.

The Socratic method\textsuperscript{43,44} which is a ‘more participatory, focused, structured, goal oriented, and polite form of pimping’ is also in use. Questions (directed uncertainty) are stated, answers to them are proposed, objectives and objections to the answer are explored, and answers are revised to stand up to all known relevant objections. Various Socratic – type questions\textsuperscript{45} are used according to their nature (clarification, probing assumptions - questions – reasons – evidence - implications and consequences, and revising viewpoints and perspectives) in a clear direction in the problem understanding and solving process. To be effective, they should be systematic, directional, purpose driven, categorized, and not raised in a haphazard way. The Socratic method is therefore a cornerstone of teaching at the level of clinical physician. The Socratic method potentially falls short if the clinician fails to look closely enough at the argumentation being offered. Adding the more detailed learning of argumentation, argument construction (research projects) and reconstruction (critical appraisal of evidence and how the evidence is used in argumentation)\textsuperscript{46-48} appears to be a necessary teaching and learning tool to be mastered and used by all academic physicians involved in classroom, laboratory or bedside teaching and research.

For more experienced physicians (research oriented, clinical teachers and academic clinicians):

In the spirit of the shortest definition of critical thinking\textsuperscript{4}, a “reasonable reflective thinking that is focused on deciding what to believe or do”, training oriented this way is perhaps optimal for medicine because it stresses two distinct entities that are inherent and vital to the profession: understanding a health problem (diagnosis, biological mechanisms, causes, history and prognosis) and decisions concerning how to solve it (exposure control, disease prevention and radical or conservative treatment, health promotion).

Health research applied to critical thinking and effective argumentations adds another necessary dimension to thinking critically in the health sciences. Scriven’s and Paul’s vision of critical thinking as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action\textsuperscript{49} is particularly attractive for any scientific method and research protocol practitioner given this definition’s particular and almost explicit link to the scientific method.

Both of these concepts and definitions accurately reflect medical reasoning in understanding and actions.
Examples of Teaching Critical Thinking in Medicine (TCTM)

Besides *ad hoc* seminars and TCTM applied in a scattered manner across the health research methodology and other opportunities in fundamental and clinical epidemiology, two of our recent experiences are worth sharing. In both instances, our goal was to introduce critical thinking, its objectives, relevance and illustrative applications to various health professionals, first in public health (*a*) and then in internal medicine (*b*). The Attachment at the end of this essay summarizes the statement of purpose, conceptual framework and content of those events.

### a. Critical thinking for public health professionals

In the framework of continuing education, as directed and initiated by Dr. Freddie Asinor from the APHA a one-day workshop (Institute CEI # 1003.0) entitled “Evidence-Based Practice. Logic and Critical Thinking” was given at the American Public Health Association’s *APHA 133rd Annual Conference* in Philadelphia, December 2005. Physicians, public health nurses and others participated. Dr. David L. Hitchcock was my co-presenter at this event.

Let me take a moment to talk about Dr. Hitchcock who has a lifelong experience in graduate and undergraduate teaching of critical thinking. David is Professor of Philosophy at the McMaster University, and the author of “*Critical Thinking: A Guide to Evaluating Information.*” He guided my writing of two chapters on logic and critical thinking in the book *Foundations of Evidence Based Medicine.* This remarkable partnership and exceptional mutual understanding lead to a wonderful friendship and a future collaboration in the monograph entitled *Evidence-Based Practice. Logic and Critical Thinking in Medicine.*

The purpose of the workshop was to offer participants an overview of the principles and methods of modern informal logic and critical thinking as used and required for effective formulation of public health programs and policies, priority setting, implementation, analysis and evaluation. The learning objectives were the following: In terms of attitudes, participants should come to realize that the production of the best evidence for effective public health decision making is not enough if it is not coupled and accompanied by the most rational and effective uses of the best evidence. In terms of knowledge, participants were lead to acquire a basic understanding of thinking critically about health problems and making decisions about them. In terms of skills, participants most importantly acquired the ability to apply the principles and techniques of logic and critical thinking to health problems under their jurisdiction, putting into practice the essential building blocks of modern argumentation and linking them in such a way to arrive at the best claims, proposals, and conclusions in the public health domain.

Teaching methods during the workshop included the identification of the participants’ own needs and interests and expectations, small group discussions, and an analysis of cases like the Katrina public health disaster (DL Hitchcock) and one public health program evaluation article (M. Jenicek). On this occasion I asked participants to evaluate the paper entitled, “Effectiveness of school programs in preventing childhood obesity.” by Veugelers and Fitzgerald. The participants were asked to analyze the case and the program evaluation to identify and criticize the arguments being made by each. Both were used as illustrations of how arguments may and should be constructed and reconstructed for the benefit of health professionals in their understanding and decision-making.

As part of the teaching materials, the American Public Health Association has provided our own textbook, *Evidence-Based Practice. Logic and Critical Thinking in Medicine (2005)* to each of the participants. In addition, we developed and distributed two new interactive exercises to each participant (with solutions provided only after the discussion and the analysis of both cases made first by small groups or couples of participants.) The solutions have been handed to participants in written (answers to questions related to Katrina disaster, as well as handwritten comments added into the original AJPH paper.

Prior to the workshop, we had invited participants to send us suggestions about which health problems would be of most interest to them in order to make the program even more relevant and tailored to their needs. Surprisingly, none
of the participants brought or sent in advance any health problems to be discussed in the workshop. Nonetheless the workshop appeared to offer participants effective learning opportunities. The evaluation of our workshop presentation was formative, based on the subjective assessment by each participant. On a scale from one to five (one being poor and five being excellent), we were evaluated above 4 points for objectives, content, and presentation style, endorsing the value of the session. Only a lack of enough time and the wish that our health problems could have been distributed in advance were voiced as suggestions for improvement. In our own evaluation of the session, we noted a persistent confusion between critical appraisals of evidence as already rooted in evidence-based public health and critical thinking about the health problem supported by already appraised best evidence. We clarified this point again later in a special review and position paper45.

b. Critical thinking for internists

On October 18th and 19th, 2006, the Department of Medicine of the University of Calgary, Alberta and the Alberta Medical Association (Physician and Family Support Program) organized and sponsored a series of seminars for residents, internists and academic staff in internal medicine to discuss with participants logic and critical thinking in clinical reasoning and decisions, reading, understanding and writing medical articles and theses, improving communication with colleagues and patients, and communicating and positively dealing with physician stress and health51. Drs. Dianne Maier (organizer and sponsor from the Alberta Medical Association), Ghazwan Altabbaa (from the University of Calgary and its Department of Medicine, moderator and initiator of the project), and Milos Jenicek (presenter) participated in their respective roles.

The objective of the encounters was coverage and knowledge of basic rules of informal logic and critical thinking in medical practice and research. In terms of attitudes, participants were led to see this field as a useful, structured and necessary way of understanding medical problems and making rational decisions about them. In terms of skills, participants learned how to critically analyze clinical situations and selected medical information pertaining to them, to apply the critical thinking methodology at least in part to problems of their choice and to evaluate for themselves the correctness and relevance of such an experience. Selected major fallacies in medical reasoning and decision-making were highlighted and corrections proposed.

A seminar form with group discussion on selected major fallacies in reasoning and decision-making were the major teaching methods. PowerPoint® presentations summarizing the message and short practical examples were distributed at each encounter to all. The PowerPoint® presentations were based in part on the spirit and style of vignettes and exercises proposed by us in A Physician’s Self-Paced Guide to Critical Thinking.38

The evaluation was formative. About one third of participants gave the program high marks, one third gave average marks and the rest gave low marks reflecting feelings about evidence-based medicine itself. It was felt that in the future, a workshop of at least one-day would be more appropriate for this topic and the mastery of its components.

Both of these experiences were in line with our expectations of what might be expected from these first initiatives devoted to critical thinking as their main topic (how modern critical thinking methodology in health sciences is structured, relevant, teachable and usable in research and practice) and led us to further review the strengths and some weaknesses in evidence-based medicine whose expanded interface with logic and critical thinking methodology appears increasingly more applicable43,45,52,53.

3. How do we foresee teaching critical thinking in medicine in the future in the light of past and present experiences?

Given the experiences past and present discussed above, we work within a solid framework with critical thinking5 on one side and its steadily improving teaching and evaluation6 on the other. Some conceptual and methodological
elements for medicine are now also available. Several major challenges are anticipated in the near future with regard to methodology and teaching interface.

**Overcoming terminology and methodology overload, overlaps, and discrepancies**

An increasing number of new terms are enriching those already in existence in medicine, epidemiology, biostatistics and EBM. Critical thinking and argumentation vocabulary, newer for all, do not simplify the situation. For example, in the field of evidence-based medicine, there are about thirteen definitions for evidence-based medicine itself, two for evidence-based clinical practice, five for evidence-based healthcare, one for evidence-based practice and at least three for evidence-based public health. Within epidemiology and biostatistics, at least five definitions for bias are quoted. Moreover, biases overlap in their meaning with what philosophers would call fallacies. In philosophy, numerous synonyms for a great number of fallacies complicate matters for beginners and classifications abound. As for critical thinking itself, more than twenty definitions were compiled. In the theory of the scientific method, scholars still disagree about the number and sequence of steps that constitute it, going from four to fifteen. Pragmatists who are accustomed to straightforward definitions of cancer, obstetrics, cardiology, iron deficiency or myocardial infarction often ignore various different types of definitions known to logicians. It will take some time and a proper clearinghouse for this often cacophonous tower of Babel to disappear.

**Improving the interface between knowledge, practice, experience and critical thinking as foundations of medical understanding and decision-making**

Teaching critical thinking and critical thinking itself should not be offered as a new graft to be accepted or rejected. Critical thinking is a discipline that must be taught and learnt as anything else. It cannot be acquired simply by osmosis from more experienced medical elders. It should be taught by all and learnt by all. However, some methodologically experienced ‘critical thinkers’ will appear to convey the fundamentals of critical thinking and argumentation by teaching the teachers. They will join the crowd of basic sciences and clinical specialists, epidemiologists, biostatisticians, sociologists and others as “teaching time mongers” in undergraduate programs.

Perhaps the greatest challenge is bedside instruction and floor clinical teaching where we have two choices: Either ‘pimping’ or teaching argumentation through the Socratic method. Again, both options should be known to all and training in the latter and its practice will not come by itself either. We cannot count solely on the knowledge of critical thinking acquired in our college years. Often, the only information overloaded physicians remember from their elementary logic classes is that ‘all humans are mortal – Socrates is human – Socrates is mortal’. Even if they are better equipped in logic and critical thinking, we cannot assume that they will automatically be able to translate and apply these critical thinking skills in the context of medicine. Hence, critical thinking should be taught in close relation and application to various steps of clinical and epidemiological reasoning and decision making or to the steps of the scientific method and research methodology from original ideas to final claims in the production of new evidence. This medical practice and research adapted methodology in argumentation and critical thinking in its own curriculum will necessarily deviate from a similar curriculum in critical thinking training at large.

So far, teaching of critical thinking in medicine with varying contents and through various teaching methods is already seen throughout the world and has proven to be progressively useful at the undergraduate level, in basic sciences, in teaching residents, in family medicine, and also in health care management, and health promotion.

What will appear, then, as teaching and learning proposals in the reader’s future? Here are some guidelines for developing effective classroom and bedside teaching sessions that embed critical thinking in the teaching of the health sciences:

- Try to define as clearly as possible the desirable and necessary attitudes, knowledge and skills needed for a clinical practice grounded in critical thinking.
• Develop common objectives, core content and suitable teaching methodology and evaluation of TCTM that would be usable not only in medicine, but also in other health sciences.
• Define the problem and question (differential diagnosis, toxic effect, treatment, effectiveness in an individual or group) in a manageable form for argumentation.
• Gather the best and unbiased evidence as a base from which critical thinking will be applied.
• Incorporate critically appraised evidence into the building blocks of the argument
• Use argument construction or reconstruction as a means leading to the solution of the problem, both carried out by a Socratic method.
• Do not forget that coupling the best evidence with clinical circumstances and patient preferences and values is also a matter of argumentation and that all three elements (evidence / circumstances / preferences) of clinical decision making are by definition building parts of an argument and argumentation.
• Anticipate, prevent, detect and correct fallacies at any step of the scientific method, patient care, health program, professional and non-professional communication.
• Teach critical thinking in medicine with a focus on understanding and solving health and disease problems.
• Evaluate both the beneficial and problematic effects of your teaching and how they improve the learner’s practice and research.

Teaching, learning, practicing and evaluating this type of critical thinking in medicine essentially lie ahead of us. Is there any greater award than our patients and communities benefiting in their health and disease from our will to “make sense” of our endeavors?

What we have seen in this chapter is a long journey already started and to be pursued. Its essence may be symbolically compared to the journey of artists-painters from pointillism (at the end of the 19th century) in which a picture was constructed from dots, blending at a distance into recognizable shapes and color tones, to today’s single bold strokes of the brush across the whole canvas conveying the essence of the artist’s message. Aren’t our present experiences in teaching critical thinking in medicine the “dots” that should lead us to some kind of unifying TCTM guidelines (“strokes”)?

Attachment

Combined Statements of Purpose and Abstracts of recent institutes

1. The APHA institute for public health professionals, a one-day workshop: Evidence-Based Practice: Logic and Critical Thinking in Public Health

The purpose of this workshop is to offer participants a basic overview of the principles and methods of modern informal logic and critical thinking as used and required for effective formulation of public health programs and policies, priority setting, implementation, analysis, and evaluation. Logic and critical thinking is becoming a necessary additional companion to epidemiology, biostatistics and other basic sciences, necessary tools for rational public health. It underlies the whole process of understanding of health problems in the community and making decisions about them. The program will show that any important claim in practice, research, administration or health policy making should be the outcome of use of the best evidence in cogent argumentation accompanied by critical appraisal. The presentation of the activities will be conducted throughout with reference to examples from the public health field. As much as possible, participants will be encouraged to bring their own topics to the program. Selected topics will be used for analysis and improvement by all.

2. Discussion with the academic staff in internal medicine (internists in a teaching position): Improving communication with colleagues and patients: it’s good for everyone’s health, including yours

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Few things are more frustrating and unproductive than not getting one’s message across. Arriving at a mutual understanding of the best evidence, its uses and ensuing recommendations and acceptance of diagnosis, treatment, patient risk assessment and prognosis require structured communication and argumentation. Modern rules of argumentation forwarded by logicians and critical thinking experts for general use also apply to medical practice and research as they already advantageously do in law, business and the military arts. Our discussion will show if and how this domain can be further developed through our experience. Isn’t this, after all, a ‘logical’ extension of Evidence-Based Medicine?

3. Discussion with hospital staff (attending physicians)

Enhancing the Meaning of our Work: Making the most of our communication with patients and peers at rounds, visits and consults

Competing alternatives, claims, theories and decisions are ubiquitous in our daily work, so how should we deal with the situation? Empowered with the best evidence, experience and knowledge of specific clinical settings, we need to reach a mutually clear and acceptable understanding of patient problems and our medical decisions, both in line with patient values and preferences. We also need to make good decisions in the end. Modern argumentation at the core of critical thinking as recently developed within informal logic and critical thinking in general is built on a half a dozen or so fundamental considerations. These building blocks must be based not only on valid evidence, but also on their applicable link to our decisions and recommendations to our colleagues and patients. Some frequent fallacies, even if well intentioned, will be pointed out to illustrate challenges in our everyday medical communication.

4. Half-day workshop for residents in internal medicine, Communicate and Positively Tackle Your Stress: Critical thinking methodology in clinical practice and research

Physician self awareness and continuing development of personal communication technique and style is important for individual physician health, collegial and professional relationships and generalizes to improved patient care. Effective clinical decision making in Evidence-Based Medicine requires not only critical appraisal of evidence, but also a mastery of structured ways of reasoning leading to the best possible choices for individual patient or group care (hospital and extramural community). In our seminar, we will outline the differences and complementarity of both concepts. We will see how our knowledge and experience can be used to make the best possible bedside decisions and to effectively share our views with peers.

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