

Clinical reasoning education: helping medical students think like physicians

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Clinical reasoning is a fundamental activity of daily medical practice and reflects the mental processes of physicians during patient encounters, from which conclusions are drawn about the nature and possible causes of patients' complaints or abnormal conditions, about likely diagnoses, and about actions to be undertaken. Clinical reasoning is a complex skill that requires the acquisition of a judicious mix of medical knowledge and clinical experience.

Based on the dual-process theory of human cognition, clinical reasoning involves the use of two types of mental processes: rapid, spontaneous pattern recognition (called System-1 thinking) and deliberate, analytical reasoning (System-2 thinking) (1,2). Pattern recognition relies on the availability of "illness scripts" or similar past clinical experiences stored in the physician's long-term memory, against which patients' signs and symptoms are recognized, compared, and evaluated. If there is no rapid recognition, a more detailed, analytical process is activated to unravel the patient's problem. Illness scripts are general mental representations of illnesses, including details of typical signs and symptoms, causes, expected ancillary findings, natural course of the illness, prognosis, and management options (3). They are stored in physicians' long-term memory as discrete units, with unique labels, alongside with other specific instances of prior patients' experiences that encapsulate the features of a particular illness. Illness scripts and instances can be quickly retrieved from memory during a new clinical encounter to trigger comparisons among illnesses and prompt relevant diagnostic hypotheses (6), ideas for investigation, and management options. Efficient patient care requires physicians to have a rapid understanding of a patient's problems and make timely decisions about the need to order diagnostic tests or referral to other specialists, and initiate treatment. As physicians become more experienced, they rely more on rapid, time-efficient pattern recognition processes and only revert to more deliberate, time-consuming analytical processes for ill-defined problems or verification purposes.

How can a medical curriculum be constructed to support the acquisition of clinical reasoning skills from an early stage? Clinical teachers must focus both on diagnosing patients' medical problems and students' learning problems (4). Based on research on clinical reasoning, Bowen & ten Cate proposed a set of six recommendations to foster the development of clinical reasoning among medical students as prerequisites for applied clinical reasoning with patients in authentic clinical settings (5): (a) learning to build a clinical vocabulary through translation of patients' stories into medical terminology; the language of medicine is needed to capture complex concepts into single words or phrases that allow for efficient information exchange, (b) training to synthesize patients'

presenting concerns into problem representations, i.e. "the problem we are trying to solve", focusing on the core aspects of the chief complaint—onset (rapid versus gradual), site (generalized versus localized), severity (mild versus severe), chronology (discrete versus continuous, progressive), and the context in which these occur, to reformulate the patient's story into a concise, abstracted problem statement, using semantic qualifiers (6) ("This is an *acute, large* joint, *mono* arthritis that makes me think of a gout, possibly a septic arthritis"), (c) gradually but actively building an illness script mental repository, i.e. organized knowledge about the diagnostic hypotheses associated with multiple problem representations, (d) employing contrastive learning, that is, explicitly searching for similarities and differences between problems (7), (e) using these distinguishing features to employ hypothesis-driven inquiry in further history taking (H), physical examination (P), and testing strategies rather than a rote, exhaustive H&P; hypothesis driven inquiry supports active prioritization of diagnostic hypotheses anchored on information gathered, and (f) acquiring a habit of diagnostic verification before closing the reasoning process.

Education to prepare pre-clinical students for clinical encounters cannot utilize much actual patient experiences to build the capacity for System-1 thinking.

Case-Based Clinical Reasoning (CBCR) education (8) helps pre-clinical students to become acquainted with clinical thinking before being actively involved in patient care. Not all the above recommendations can be incorporated in CBCR, but many can. This education is based on longitudinal, small-group work using written patient cases, starting with simple cases that become progressively more complex with time. The cases are designed to shift the medical students' mental processes from organ-system thinking to patient-problem thinking, starting with the patient's chief complaint and related signs and symptoms. Each session begins with an initial presentation of a patient's problem and prompts the group to ask questions to explore the patient's condition, to propose broad causal explanations, and to suggest focused history questions and physical examination. Before moving on to next steps of inquiry, new patient information is presented, such as more history information, or physical examination findings, in order to move the group into further forward thinking. Two-dimensional tables are drawn on a board, with hypotheses on one axis and H&P and test findings on the other axis, to prompt the group to weigh all hypotheses against all findings (supportive, exclusionary, or non-discriminating) and refine their differential diagnosis, followed by the presentation of new clinical information. During each two-hour session, students can develop a first images of the illness as a script. This rudimentary script will be refined every time the student encounters somewhat

similar patient cases that may remind them about this CBCR case. With all CBCR cases, students have the opportunity to develop their analytical reasoning skills and build a repertoire of rudimentary illness scripts, continuously supplemented with more patient instances to foster rapid pattern recognition (9,10).

Learning and optimizing clinical reasoning is a process that extends from medical school through residency and throughout one's professional life as a physician. While

experience with patients is essential in this process, training can start during the pre-clinical phase of medical education, by using written cases that can stimulate junior medical students to start thinking as physicians and prepare them for clinical reasoning at the bedside.

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