Therapeutic Reasoning Underlying Antibiotic Selection

Research Highlights
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Purpose: Clinical reasoning research has helped illuminate how clinicians make diagnoses but offers less insight into management of diagnoses. Some research suggests similarities between the reasoning processes that underlie diagnostic and therapeutic decisions. However, specific factors related to therapeutic reasoning remain largely undefined. The need to understand physician therapeutic choices is particularly salient within Infectious Diseases, where antibiotic prescribing has implications beyond the individual patient given increasing rates of antimicrobial resistance. Past researchers have made efforts to examine physicians decision of whether or not to prescribe antibiotics. Our study advances this work by exploring the factors and processes underlying physician choice of specific antibiotics.

Methods: We conducted individual interviews with a purposeful sample of physicians in Hospital Medicine (HM) and Infectious Diseases (ID) at two hospitals within a university system. Our semi-structured interview guide explored the reasoning underlying antibiotic choice through clinical vignettes and examples from participants clinical practice. Following the vignettes, participants used notecards to specify steps in their antibiotic reasoning process. We identified steps and factors after 12 interviews, then conducted 4 more to balance HM and ID participation and confirm and refine our initial set of steps and factors. We transcribed interview recordings then generated a codebook through an iterative, inductive analytic process. We used Dedoose to code the interviews and facilitate analysis.

Results: We identified five interrelated antibiotic reasoning steps: Naming the Syndrome, Delineating Pathogens, Host Features, Case Features, and Antibiotic Selection. Naming the Syndrome was an explicit step to succinctly define the clinical situation. Delineating Pathogens involved naming causative organisms, although how and where in the process this occurred varied among participants. Antibiotic Selection, the step during which participants considered characteristics of specific antibiotic options, typically occurred toward the end of the reasoning process. In determining both the likely pathogens and the therapeutic options, participants engaged in two additional steps. They considered Host Features, aspects of the patients history and status, as well as Case Features, characteristics of the specific clinical situation, to make these determinations. Within these later steps, participants mentioned many different factors relevant to the process overall. Based on these data, we developed a general antibiotic reasoning framework that incorporated each step. The relationship between steps was shaped in part by the antibiotic reasoning processes delineated through the notecard exercise.

Discussion: The antibiotic reasoning framework we generated provides a detailed view of cognitive processes underlying therapeutic reasoning while caring for patients with suspected infections. Although specific to this clinical context, multiple steps are likely relevant across medical specialties. The step Naming the Diagnosis links the process to diagnostic reasoning. This step also triggers specific therapeutic options, although in antibiotic reasoning pathogens arise as an intermediary between diagnosis and treatment. The subsequent process of exploring the fit between different therapeutic options and the specific clinical context including host and case features seems similar to the process of script selection within diagnostic reasoning, as hypothesized by other researchers. The specific factors we identify as important within different antibiotic reasoning steps build upon generalized therapeutic reasoning frameworks established by prior research, delineating the key factors in greater detail and specific to antibiotic choice.
**Significance:** Our study elucidates a detailed model of antibiotic reasoning and factors influencing the reasoning process. This model offers opportunities to transform teaching in Infectious Diseases away from rote memorization of organisms and antibiotics toward a clinical reasoning framework and provides a structure for potential interventions within antimicrobial stewardship. Finally, our framework contributes to the understanding of therapeutic reasoning more generally and could serve as the basis for future studies aimed at understanding treatment choice within other clinical contexts.
The definition(s) of clinical reasoning

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Purpose: Despite being a considered a core aspect of a health professionals practice, little consensus exists regarding what clinical reasoning is. An understanding of clinical reasoning is imperative to support teaching and assessment initiatives, particularly given its inclusion within competency frameworks and practice profiles across the health professions. The purpose of this research was to collect, analyze, and synthesize the explicit definitions of clinical reasoning present in the health professions education literature in order to better support the development of teaching and assessment strategies relevant to clinical reasoning.

Methods: Within the context of a Best Evidence Medical Education supported scoping review, we reviewed 625 papers across 18 health professions identified as relevant to a definitional review of clinical reasoning (full reporting of methods in Young et al [revisions under review]). Papers were identified through systematic searches of five databases, with screening and study selection occurring in teams of two. Data extraction focused on the identification of explicit definitions of clinical reasoning anywhere in the text of an included manuscript. Definitions were descriptively and inductively.

Results: Within the 625 papers included in the review, we identified 96 explicit definitions. Three main findings emerged from our analyses. 1) There were commonalities identified across definitions These commonalities included: a) that clinical reasoning is fundamental to successful clinical practice, b) that it is a type of thinking applied to health contexts, and c) it is used towards the more proximal goals of diagnosis, treatment, prescription, and the more removed goals of long terms disease management or improved patient care. 2) The details of clinical reasoning definitions varied. Specifically, definitions differed based on: a) what clinical reasoning is a function of (e.g. cue recognition), b) how it is executed (e.g. deliberation), and c) the nature of the end goal (e.g. generating and testing hypotheses). Finally, 3) Definitions differed base on the segmentation of the clinical reasoning process (e.g. cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation).

Discussion: The 96 definitions converged on the importance of clinical reasoning in clinical care, its applied nature to healthcare, and the ultimate goal of clinical reasoning as providing high quality patient care. However, they differed in meaningful ways within and across professions in terms of how clinical reasoning is executed, observed, and understood.

Significance: These findings suggest the presence of different understandings, or conceptualizations, of clinical reasoning within the health professions literature. We structure our
teaching and assessment practices according to how we understand the educational or assessment target, and in this case how we understand what clinical reasoning is, how it is enacted, and how we make it observable. These different understandings of what clinical reasoning is, is comprised of, and is enacted through, likely result in importantly different teaching and assessment approaches both within and across the health professions. For example, if one thinks of clinical reasoning according to heuristics and biases, you would create a very different teaching and assessment strategy than someone who considers clinical reasoning to be enacted through optimal coordination of patient goals and providers expertise. Therefore, it is critical for educators, scholars and researchers to be more explicit regarding their definition of key concepts in medical education, such as clinical reasoning, in order to ensure better communication and a shared understanding of educational and assessment goals.
Does the Opportunity to Reflect and Revisit during a Clinical Skills Exam Improve Students’ Clinical Reasoning?

Research Highlights
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Purpose: Though reflection is valued in clinical medicine, little empirical evidence exists to support its impact on performance.1 Clinical skills exams (CSEs) are opportune for exploring reflection outcomes.2 Typically, in CSEs students visit each standardized patient (SP) once. However, students' thinking may deepen if, after reflecting while writing their patient note (PN), they revisit their patients to further explore differentials. This study explored the effects of both live and virtual revisits on clinical reasoning. Aims:
1) examine the effect of a live revisit on students' diagnostic reasoning
2) compare the clinical reasoning effect of a live revisit with the more feasible virtual revisit
3) examine the effect of both on assessment psychometrics.

Methods: In spring 2017, 251 GW and Jefferson students and 179 UIC students conducted live and virtual revisits respectively during an end-of-third-year CSE. GW and Jefferson shared 6 cases; UIC used 3 of these cases plus 2 of their own. All students had 15 minutes for a focused history, physical and counseling and 10 minutes to write a USMLE-style PN. Live revisits added 5 minutes to revisit the patient and 5 minutes to complete a revisit questionnaire; virtual revisits added 5 minutes to complete the questionnaire. The questionnaire: List up to 3 additional history questions or physical examination maneuvers that (live: you asked) or (virtual: you would like to ask) to clarify your differential diagnosis. Explain how this information would help you. Trained faculty used the UIC PN rubric to score patient notes, and a Revisit Rubric to rate the diagnostic relevance and rationale of revisit items.

Results: Live revisit: students listed additional H&P items in 59% (302/513) of revisit opportunities. Of the 547 items requested across cases, 107 (20%) were key to the diagnosis of the case, 357 (65%) were relevant but not key, and 83 (15%) were irrelevant. 306 rationales were provided: 216 (71%) were correct or partially correct. If the items listed had been included in the PN, 45 (15%) would have resulted in an increased score, 3 (1%) in decreased scores and 254 (84%) in no change.

Virtual revisit: students listed additional H&P in 81% (373/463) of revisit opportunities. Of the 756 items requested across cases 148 (20%) were key, 454 (60%) were relevant but not key and 154 (20%) were irrelevant. 714 rationales were provided: 651 (91%) were correct or partially correct. If the items listed had been included in the PN, 98 (26%) would have resulted in an increased score, 17 (6%) in decreased scores and 258 (68%) in no change.

There were no significant correlations between revisit scores, H&P checklist scores, or PN scores. Including revisit scores increased the variance associated with Person-Case interaction (case specificity) and decreased the reliability (Generalizability) of the CSE scores: G-Coefficient .32 to .13 and phi-Coefficient .21 to .10 in live and virtual revisits, respectively.

Discussion: In both live and virtual revisits, reflection while writing the PN resulted in most
students identifying additional key/relevant H&P items, promoting diagnostic reasoning. Training students in more elaborate reflection methods (e.g., de-biasing schemes; fuzzy cognitive mapping)4,5 may further improve clinical reasoning. Reduced reliability when including revisit scores may result from giving students more time to think of additional items, decreasing inter-student score differences resulting in more homogeneity.

**Significance:** These studies suggest that the opportunity to reflect and revisit may be valuable to incorporate into curriculum to promote students’ diagnostic thinking. Virtual revisits require less time and may be more feasible for busy clinical skills centers. Implementation of reflect-revisit depends upon training objectives: to optimize clinical outcomes is it more important to train students to reason in situ or to further calibrate their reasoning through reflect-revisit?