CORD Clerkship Directors in Emergency Medicine

Clinical Reasoning in Medical Students:

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Clinical Reasoning in Medical Students

Clinical reasoning is a complex topic involving multiple variables, perspectives, principles, and consequences. Both problem solving and decision-making approaches are fundamental to the understanding of clinical decision. Broadly defined clinical reasoning is a context-dependent way of thinking and decision making in professional practice to guide practice actions. (Higgs, 2010) Several key concepts are at the center of clinical reasoning. Multiple conceptual frameworks have emerged from these key concepts to help clarify our understanding of this complex topic.

The overarching goal of the session will be to provide medical educators with the fundamental skills needed to develop educational activities for their medical students that will improve their clinical reasoning skills with particular emphasis on different instructional tools that can be used in different contexts from the classroom to the bedside to the web.

Throughout the seminar, participants should be also be mindful of the implications of these models on instruction and assessment of clinical reasoning and the challenges they pose, namely that:

a. An adequate and ever growing fund of knowledge is critical
b. Clinical reasoning is a skill that improves with practice.
c. It’s highly individualized and idiosyncratic
d. It’s case and context specific
e. It’s not readily transferable from context to context, depending on noise and one’s resilience to it.
Key Elements of the Clinical Reasoning Process

1. **Data Acquisition** - Learners elicit the patient’s story through their history taking and physical examination skills ideally focusing upon the working differential formulated initially from the chief complaint and constantly modified as new information is obtained.

2. **Problem Representation and Semantic Qualifiers** - Problem representation is a summary of a clinical case that captures the key elements of the history and physical in abstract terms and forms that basis for a working differential diagnosis. Semantic qualifiers are discriminating descriptors that are useful for comparing and contrasting diagnostic considerations in distinguishing various diagnoses from each other.

3. **Generation of Differential Diagnosis Hypothesis** - The goal for this step is for learners to compare and contrast the possible differential diagnoses in relation to each other by highlighting the discriminating features of each diagnosis.

4. **Illness Script Generation** - Illness scripts represent “the story” that a disease or syndrome tells through the patient’s clinical presentation. Predisposing conditions, the pathophysiological insult, and clinical consequences are the anchor points that serve as the storyline for the illness.

5. **Diagnosis Selection through Dual Processing** - One framework for understanding clinical reasoning is dual process theory represented by analytic reasoning and intuitive reasoning. Analytical reasoning, exemplified by hypothetical deductive reasoning is slow, deliberate, and conscious. Intuitive reasoning relies on pattern recognition and is fast automatic, and subconscious.
Conceptual Frameworks for Understanding Clinical Reasoning

Dual processing theory of non-analytic vs. analytic reasoning

Eva’s model of combined non-analytic with analytic reasoning

- Both are used to formulate DDx
Gruppen and Frohna synthesize these two models to create an Integrative Model of Clinical Reasoning. In essence, the Eva combined model (green looped arrows) is integrated with a continuous goodness of fit testing (blue looped arrows) until judgment deems the risk vs. benefit of committing to a working diagnosis and taking an action to be favorable. These loops integrate in patient situations and environmental contexts (lightning bolts). As clinical reasoning is a high cognitive resource activity, the degree of extraneous noise that risks overwhelming cognitive load capacity comes into play.

Based on the Gruppen model and Cognitive Load Theory, review of the various clinical reasoning instructional tools. Does the tool, method or strategy address 1) Knowledge building, 2) Connection construction, 3) Building of pattern library, 4) Judgment development, and 5) ‘Noise’ reduction.
Approach to Teaching Clinical Reasoning

Figure. Approach to Teaching Clinical Reasoning (Higgs, 2010)

1) Learn the language and theory of diagnostic clinical reasoning
   *Instructional Strategy:* Overview of Clinical Reasoning and Conceptual Frameworks and Implications of Cognitive Load (i.e. Dual-Process Theory, Analytical Thinking and Intuitive Thinking in Emergency Medicine)
   *Assessment Tools:* Multiple Choice Questions on dual process theory, Clinical Cases illustrating illness scripts and analytical thinking.

2) Understand the process of reasoning as a prelude to workplace experience
   *Instructional Strategy:* Problem Based Learning Sessions with cases highlighting clinical reasoning. Simulation experiences and standardized patients highlighting diagnostic reasoning skills during history taking and physical exams. Emphasize oral presentation skills highlighting clinical reasoning (i.e. SNAPPS)
   *Assessment Tools:* Checklists and global performance assessments of simulation and standardized patient encounters and learner directed feedback and self-reflection. Script Concordance Testing, Key Features Examinations, Diagnostic Thinking Inventory.

3) Experience and gain understanding of clinical reasoning in action through workplace practice and feedback
   *Instructional Strategy:* Highlighter, Priming, Reverse Presentation, Differential Diagnosis Reframe Exercises, Taxonomy of Cognitive Errors, Bedside Thinking Aloud Exercises
   *Assessment Tools:* Direct Observation, Bedside Thinking Out Loud Exercises, Global Clinical Performance Evaluations, Learner Thinking Behavior Score Assessments.

4) Reflect upon one’s reasoning during and after practice to further understand, critique and develop their reasoning abilities
   *Assessment Tools:* Portfolio of Exemplary Review Cases, Quality Assurance Project, and Clinical Cases Facilitator Evaluations.
Educational Toolbox

Differential Diagnosis Reframe
(Worst-First Differential Diagnosis)

Rationale:
By suggesting a reframing of approaches to a learner’s approach to differential diagnosis an emphasis can be placed on clinical reasoning. By providing a simple analytical approach to clinical reasoning, students are asked to prioritize their assessments of patient presentations around “the worst diagnoses” – serious, life, or limb threatening diagnosis – first in the differential diagnosis of patients that they see. This analytical approach is a common clinical reasoning strategy in the emergency department.

Description:
Use as a deliberate practice strategy for developing practical, realistically prioritized differential diagnosis. Differential diagnosis reframing can take many different forms including Worst-First Differential Diagnosis. This reframing is particularly important for students who understand pathophysiology of disease but have a tough time recognizing disease in the clinical setting.

Examples:

- Worst-First Differential Diagnosis: Serious, Life-Threatening, Limb-Threatening possibilities are listed first in the assessment section of the oral presentation.

- Vindicate Differential Diagnosis: Vascular, Infectious/Inflammatory, Neoplastic, Degenerative, Iatrogenic/Idiopathic, Congenital, Autoimmune/Allergic, Toxin/Trauma, Endocrine/Metabolic

- System Based Differential Diagnosis: Neuro, Cardiac, Pulmonary, GI, Renal, Metabolic, ID, Prophylactic

References:
2. Becky Blankenburg and others, Revisiting How We Think, PAS Presentation, May 2011.
Thinking Aloud Exercises

*Rationale:*

Historically, thinking aloud exercises have been used in the clinical reasoning literature to assess how experts think. Currently, thinking aloud has been touted as a way to teach and assess clinical reasoning at the bedside.

*Description:*

This can be used as a deliberate practice strategy for differential diagnosis in real time while caring for the patient. Learners express out loud what they are thinking as they gather information or present information about a patient. Learners can also announce aloud the diagnoses that they are considering while listening to an oral presentation of a case. Similar exercises can be done in front of learners to demonstrate an expert in action at the bedside openly announcing what their impression of the clinical case is as they are obtain information from the patient.

*Examples:*

- Thinking out loud exercises can be done by teachers in front of learners to demonstrate an expert in action at the bedside openly announcing what their impression of the clinical case is as they are obtain information from the patient.

- As an alternative, thinking out loud exercises can serve as assessment tools for learners. Learners can announce as they are working through a case during their history and physical what diagnoses that they are considering. Additionally, a learner can announce or write down the diagnoses that they are considering while listening to the presentation of a second learner presenting a clinical case for the first time.

*References:*

SNAPPS Oral Presentations

**Rationale:**

SNAPPS is a learner-centered oral presentation technique where the learner rather than the teacher drives the conversation highlighting their clinical reasoning skills and self-perceived deficiencies. Students using this model demonstrate increased clinical reasoning through their presentation compared to more traditional presentation styles (Wolpaw, 2009).

**Description:**

- **S**ummarize briefly the history and physical
- **N**arrow the differential to 2-3 relevant possibilities
- **A**nalize the differential by comparing and contrasting the possibilities
- **P**robe the preceptor by asking questions about uncertainties, difficulties, or alternative approaches
- **P**lan management for the patient’s medical issues
- **S**elect a case-related issue for self-directed learning

**References:**

2. Wolpaw T, Papp KK and Bordage G. Using SNAPPS to facilitate the expression of clinical reasoning and uncertainties: a randomized comparison group trial. *Academic Medicine 2009;84(4):517-24.*
Highlighter Exercise

Rationale:

This exercise allows students to practice identifying the key/defining features in the history and physical exam of a patient that led to a particular diagnosis or management plan. This process can help in the development of illness scripts for different diagnoses.

Description:

Students are provided with a note and asked to use a highlighter to highlight key features in the history and physical exam that led to the diagnosis. This can also be done verbally at the end of a presentation by asking the student to verbally identify the key features that led to the diagnosis or ruled out a competing diagnosis.

Examples:

- Can use a note that the student wrote or an existing note from the EMR.
- Students can be asked to highlight key aspects of history and physical that support the ultimate diagnosis and/or those that ruled out a competing diagnosis.
- Might also encourage students to create a one-sentence summary of the key features of the case using semantic qualifiers to further develop their problem representation.

References

1. Becky Blankenburg and others, Revisiting How We Think, PAS Presentation, May 2011.
One-Minute Preceptor

Rationale:

This learner-centered approach to precepting emphasizes determining the learner’s understanding and representation of the patient’s problem and then teaching to the gap in their understanding. It has been found to make the student’s knowledge and reasoning more explicit for the preceptor and allows for higher order teaching than the general teaching points that often accompany traditional precepting (Irby, 2004).

Description:

5 Microskills for clinical precepting
1. Get a commitment
2. Probe for supporting evidence
3. Teach general rules
4. Reinforce what was done right
5. Correct mistakes and discuss next steps

References:

Reverse Presentation

Rationale:

By reversing the order of the standard presentation and placing the assessment first, the learner must immediately commit to a diagnosis or treatment plan. Putting the assessment first allows the preceptor to then pay attention to the key features in the rest of the presentation that either support or refute the student’s decision. This also forces the student to select the details to present that are relevant to the chosen diagnosis.

Description:

Ask students to present in an “ASOAP” format where they briefly summarize their assessment first and then present the rest of the data.

Examples:

A: This is a 9 yo boy with fever and pharyngitis. I think he is very likely to have Group A strep pharyngitis and I think we should get a throat culture.
S/O: Preceptor listens closely to presentation with end diagnosis in mind and student presents information that they think are relevant to the final diagnosis.
A/P: Assessment and plan presented in more depth but with more description of how the student came to this decision.

This can also be done in a format of “Persuade the MD” in which the student is given a limited amount of time to persuade their preceptor that their assessment is correct for this patient. This can also be done as an exercise with common complaints/diagnoses/symptoms i.e. “you have 20 seconds to persuade the MD that the patient you are seeing has Group A strep pharyngitis and needs a throat culture.”

References:

1. Becky Blankenburg and others, Revisiting How We Think, PAS Presentation, May 2011.
Learner Thinking Behavior Scale

Rationale:

Just like clinical reasoning needs to be explicitly taught, it should also be explicitly assessed. The Learner Thinking Behavior Scale was developed to assess the demonstration of thinking and reasoning of students in the context of a case presentation. A companion Preceptor Thinking-promotion scale was also developed to assess a preceptor’s ability to promote thinking.

Description:

**Learner Thinking Behavior Scale:**
(Modified by Todd Guth from Connell et al)

0 – The student has presents the case in a disorganized fashion. The student is unable to consistently maintain organization of the presentation into history of present illness, past history, physical exam, assessment, and plan. **RIME – Observer Stage**

1 – The student focuses on giving the facts of the case or on answering the preceptor’s questions about the case or about his or her knowledge. **RIME – Reporter Stage**

2 – The student explains his or her assessment of decisions usually in response to a preceptor probe but sometimes self-initiated in the context of the case discussion; the learner may seek information or advice from the preceptor. **RIME – Novice Interpreter**

3 – The student explores uncertainties or difficulties about the case with the preceptor; the focus is on “thinking out loud” about problems, sorting them out. The learner may ask for information to help clarify his or her thinking or raise questions about ideas or issues that arise during the encounter; he or she may also rethink an earlier position as the discussion of the preceptor goes along. **RIME – Advanced Interpreter**

Examples:

- Can be used after an individual case presentation as a formative assessment for the student.
- Could also be used in a more summative fashion with an OSCE or other clinical exam.
- It is important to consider what role the preceptor has in determining the student’s score on this scale. If the preceptor is not eliciting any of the student’s thinking in the discussion of the case, they more score lower.

References:

Diagnostic Thinking Inventory

Rationale:

This written exam exists to provide a tool to assess learners' diagnostic thinking ability outside of the clinical context and distinguish between weaker and stronger diagnosticians.

Description:

A 56-item diagnostic thinking inventory was developed to measure two aspects of diagnostic thinking: the degree of flexibility in thinking and the degree of knowledge structure in memory. The inventory has been used to assess an individual student's and clinician's diagnostic thinking and to plan ways of improving their diagnostic thinking.

Examples: (Taken from Diagnostic Thinking Inventory)

In considering each diagnosis,

| I try to evaluate their relative importance | | | I try to give them equal importance or weighting |

In thinking of diagnostic possibilities,

| I think of diagnostic possibilities early on in the case | | | First I collect the clinical information and then I think about it |

When I am interviewing a patient,

| I often seem to get one idea stuck in my mind about what might be wrong | | | I usually find it easy to explore various possible diagnoses |

References

Key Features Examination

Rationale:

A key feature examination is used to assess students' clinical decision-making skills by asking a series of actions from the learners of a clinical case. Content specificity is addressed by testing only those "key features" of the case that are critical to its resolution. By reducing the length of each problem, numerous clinical problems can be sampled in a single examination.

Description and Example:
(From Adapting the Key Features Examination for a Clinical Clerkship.)

Life-threatening asthma test item: key features and clinical problem

1. Key features
   For a young adult, with past history of asthma who presents in respiratory distress, the physician should:
   a. identify common precipitants
   b. interpret arterial blood gases, recognizing the danger of normal gases
   c. select appropriate initial management including bronchodilators and steroids

2. Clinical problem and question stem
   Mr F, a 25-year-old-male with asthma since childhood, is referred to you by the emergency room physician with acute shortness of breath. Over the past 48 h Mr F has developed a dry cough and has needed to use 2 puffs of salbutamol every 2 h for his shortness of breath, with little relief. On examination today he looks distressed and is only able to speak 2 words per breath.

   T 37.9 °C; HR 130, regular; BP 110/70 with 50 mmHg pulsus paradoxus; RR 40. He is using his accessory muscles of respiration. Trachea is midline. Chest examination reveals equal but diminished breath sounds bilaterally with no audible wheeze. Arterial blood gases on 35% oxygen indicate pH 7.40, pCO2 32 kPa, pO2 98 kPa, bicarbonate 24 mmol/L, oxygen saturation of 92%.

   1 What are the most important abnormalities (history, physical or lab values) that indicate this patient is in severe respiratory distress? List up to 3.
   2 What medications will you order immediately? List up to 5.
   3 What are the possible triggers for Mr F's asthma exacerbation? List up to 6.

3 Minimal acceptable responses
   1 Normal pCO2
   2 steroids, salbutamol, ipratropium
   3 infection, allergen, noncompliance

   *Each question was scored using a dichotomous scoring system, with `1' for listing the minimally acceptable correct responses, and `0' for not meeting this minimally acceptable level.

References:

Hypothesis Driven Physical Diagnosis

**Rationale:**

Teaching physical examination by rote memorization of maneuvers without the clinical context of a patient complaint or history encourages decontextualization of the educational experience for the student. By embedding physical examination maneuvers within diagnostic reasoning tasks and providing a situated learning approach, students are better able to learn both diagnostic reasoning and physical examination skills.

**Description:**

Instead of teaching learner physical examination skills in isolation, educational experiences can be created that embed the performance of physical examination maneuvers within a patient encounter that involves “a controlled history” and "limited diagnostic challenge."

**Examples:**

- The original study describes the use of OSCE stations as the venue to introduce the concept of teaching basic physical examination skills within the context of an actual patient encounter.

- Priming is a similar exercise where learners are asked to thinking about their differential diagnosis prior to seeing the patient and considering key questions to ask and key physical exam maneuvers to perform prior to seeing the patient. Priming is described as a separate tool in the toolbox.

**References:**

Priming

Rationale:

Similar to the hypothesis driven physical exam, priming provides a deliberate means of helping students think about focusing their data gathering and understanding that thinking about differential diagnosis and clinical reasoning occurs even before stepping in the room with the patient.

Description:

As opposed to waiting until after the patient visit to discuss the student’s reasoning, the preceptor initiates a teaching encounter prior to the visit and primes the student by helping them to think about what the initial differential diagnosis is and what the key aspects of the history and physical examination are.

Examples:

- Prior to a patient visit, consider asking the student the following questions:
  1. Based only on the limited information available to you before you see the patient, outline an initial differential diagnosis.
  2. List the top 5 details that you want to elicit on the history of present illness in order to narrow your differential and make a diagnosis.
  3. List 3-5 physical findings that will be essential to narrowing the differential and making a diagnosis.
  4. List 3-5 findings (on history or physical exam) that will be essential in determining the severity or urgency of the illness.
- If the chief complaint is complex or the preceptor anticipates that the student will have difficulty focusing on the key aspects of the history and physical exam, the preceptor might model or describe how they think about the chief complaint and the information they would focus on eliciting.
- Direct observation can also be tied in with priming such the preceptor observes how the student uses the information discussed to focus the history and physical exam.
- This can also be used with paper cases in which the preceptor guides the student through each step of the visit asking for a revised differential after each step (CC, HPI, PE, etc).

References:

1. Becky Blankenburg and others, Revisiting How We Think, PAS Presentation, May 2011
Script-Concordance Test

Description:

The conventional SCT is a well-researched paper-and-pencil assessment of student clinical reasoning and specifically, data interpretation. It consists of a large collection of short clinical scenarios followed by 3-part ‘if..., then you find.... the hypothesis becomes....’ type of questions. It is unique for its complex scoring system as responses by a panel of faculty experts are used as reference and as several options may be acceptable answers.

Rationale:

An efficient method of assessing student ability to interpret data and the effect of new data on diagnostic hypothesis generation. Conventionally administered as a paper-and-pencil assessment, a large number of domain specific questions can be sampled. SCT discriminately assesses clinical reasoning from medical knowledge, although the process of hypothesis generation is neither probed nor exposed.

Examples:

See handout created by Anne Minenko and Jerry Stapleton.

References:

Longitudinal Performance Exam (LPE)

Description:

The LPE is a large item volume paper- and- pencil assessment of student analytical and non-analytical reasoning, unique for its blending of two types of items (Diagnostic Pattern Recognition - Case et al., and Clinical Data Interpretation – Charlin et al.). CDI is in essence the Script Concordance Test format but unlike the SCT, each item has only one correct answer.

Rationale:

While the format of the LPE is not all that novel, the intended use is. Through repeated administration over a period of training, the LPE is being considered to longitudinally track student performance over time; therefore it is a formative ‘progress test’. Results published in the 2011 Academic Medicine article suggesting a DPR ceiling effect and failure to accelerate clinical reasoning in 3\textsuperscript{rd} year are based on a cross-sectional investigation. An ongoing longitudinal sensitivity- to -change study of a multi-school cohort of students may shed light on whether student progress differs depending on the type of medical school curriculum.

Examples:

See handout created by Anne Minenko and Jerry Stapleton.

References:

Concept Mapping

Description:

Concept mapping is an example of desirable discovery learning (student discovers content rather than is presented with content) and of meaningful learning (student assimilates new information with prior knowledge and experiences). A low resource, highly reliable, active clinical reasoning developmental strategy for the clinical or classroom years, using self-constructed diagrams and linking words and lines, students visibly expose their assimilation of new concepts into preexisting knowledge and how they relate to each other.

Rationale:

By exposing gaps, faculty can deliver targeted feedback; students of lower cognitive level benefit most from such diagnostic concept maps. Through serial administration, effectiveness of an intervention on individuals' clinical reasoning can be determined and expected personalized evolution of reasoning from linear to holistic and from simple to complex/ cross-linked can be documented with growing experience and sophisticated thinking. Quantitative and compound qualitative scoring methodologies exist. Online version is available at http://cmap.ihmc.us/conceptmap.html

Examples:

References:
Diagnostic Verification
“When U RACE, tie your LACES”

Rationale:
Diagnostic verification is an important component of clinical reasoning that should be pursued before a final diagnosis is accepted. Taking a diagnostic time-out during the decision making process in order to obtain verification has been proposed as a cognitive strategy to counteract diagnostic failure. The “When U RACE, tie your LACES” mnemonic offers a guide for what questions to ask during a time-out and potential high-yield times during emergency care to take the time-out. It can be employed in different venues including clinical shifts, self-reflective reviews of prior patient encounters, and case-based classroom teaching.

Description:
The “LACES” component of the construct comprises questions to ask for diagnostic verification. It begins with making sure life-threats have been considered as well as making sure overall that a complete differential has been generated rather a single diagnosis being prematurely accepted. Important diagnostic validity criteria include coherency (i.e., is there a pathophysiologic fit between the proposed diagnosis and clinical findings?) and adequacy (i.e., have all findings been explained?). Finally, asking whether a second problem is present can help guard against missing an additional injury or concurrent medical problem because the search stopped when one was initially found.

When and how often a diagnostic time-out should be performed during emergency care remains an open area of research. Some opportune situations, however, can be proposed based on logic and known high-risk times in emergency medicine. The “U RACE” component encompasses these situations. These include when a patient remains with an unexplained complaint (e.g., fever and back pain with a negative urinalysis) and/or when a patient returns to the ED with the same acute complaint. Some patients can be classified as high risk for diagnostic error owing to inadequate history (e.g., dementia or intoxication), an unreliable physical exam (e.g., abdominal pain in the setting of immunosuppression), or potentially negative feelings of the clinician towards the patient (e.g., borderline personality disorder). Critical conditions refers to both when a high-risk diagnosis is being entertained (e.g., has pulmonary embolism been effectively ruled out?) or when a high-risk intervention is being considered (e.g., thrombolysis for stroke). Lastly, end of shift presents a high-risk situation in terms of both cognitive fatigue and informational shortcomings associated with transfer of care.

References: