Clinical Reasoning

I. Key Concepts in Clinical Reasoning

II. Clinical Reasoning Exercises and Tools
   1. Highlighter Exercise
   2. Problem Representation with Semantic Qualifiers
   3. Coaching to Promote Co-selection
   4. Probability Poker
   5. Differential Diagnosis Formulation – Traditional vs. Alternative
   6. Illness Script Generation
   7. “Read About Your Patients” (Reading Horizontally)
   8. Textbook Teaching Cases
   9. Persuade the MD
   10. “Seeing the Forest for the Trees”

III. Selected References
I. KEY CONCEPTS IN CLINICAL REASONING

BACKGROUND
In pre-clinical years, students learn about medicine based on individual diagnoses/organ systems, often not in comparison. For some this approach may carry over into residency and beyond. These learners may read extensively and take thorough, detailed H&P’s, but are unable to access their stored knowledge and apply it to clinical cases. Advanced clinical reasoning involves mental comparison of diagnostic possibilities from chief complaint presentation to plan generation, with constant modification as new information is revealed. This transition from ‘novice’ to ‘proficient’ clinical reasoner is actually achieved naturally by most clinicians as they advance through training and practice. Promoting clinical reasoning focuses on deliberate attention to improving this process. Focus is usually on presentations (the observers’ window to learners’ thought processes) and uses frequent ‘stops’ and challenges to determine reasoning behind learners’ ideas and decisions, which can be accomplished on rounds, in small groups, and in individual, one-on-one sessions. Learner buy-in is crucial, and the learner must be willing to reflect on improvement areas and recognize weakness areas when pointed out by observers.

Key Elements of Clinical Reasoning

![Figure 1. Key Elements of the Clinical Diagnostic Reasoning Process.](image)


ELEMENTS OF CLINICAL REASONING Coaches should promote learners’ use of these learning strategies as they encounter cases:

1. Directed Data Acquisition
Learners elicit H&P information specific to the working differential (a directed history and physical exam) that was formulated from the chief complaint and that is constantly modified and reprioritized as new information is revealed.

2. Problem Representation
A problem representation is a 1-2 sentence summary of a case, usually generated at the start of the Assessment section. Failure to generate an appropriate problem representation can result in the random generation of hypotheses that are based on isolated findings in the case.
3. Semantic Qualifiers
Semantic qualifiers are opposing, often paired descriptors that can be used to compare and contrast diagnostic considerations. Learners with strong clinical reasoning skills, when generating a problem representation, use more semantic qualifiers than novices when discussing the discriminating features of a case. Examples of semantic qualifiers:
- **ONSET** Slowly or suddenly or rapidly/acute or subacute or chronic
- **SITE** Bilateral or unilateral
- **SITE** Central or peripheral
- **COURSE** Constant, intermittent, episodic, progressive
- **SEVERITY** Mild or moderate or severe
- **CONTEXT** At rest, with activity
- **PT CHARACTERISTIC** age, race, gender

4. Co-selection/Reading Horizontally/Compare and Contrast
Goal is to have learners read about patients focusing on the differential diagnosis (not the primary diagnosis) and learn about many diagnoses in relation to each other.

5. Illness script generation
Illness scripts are a way for learners to organize the features of classic disease presentations, promoting ease of comparison. Illness scripts have three components: the predisposing conditions, the pathophysiological insult, and the clinical consequences (see example below). Learners can use clinical encounters and/or reading to help define primary illness scripts, and with time compare multiple illness scripts mentally as they encounter future cases.

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**Sample Illness Script:**

**PYLORIC STENOSIS***

**PREDISPOSING CONDITIONS**
- Usually 1-3 months old
- 4:1 Male:Female
- First born son

**PATHOPHYSIOLOGY**
- Pyloric muscular hypertrophy
- Pyloric canal narrows
- Near-complete obstruction

**CLINICAL CONSEQUENCES**
- Non-bilious projectile vomiting
- No diarrhea
- Severe: weight loss
- Hypo-Cl, Hypo-K, metabolic alkalosis

*By Long, M, using ‘Bordage’ format*
II. CLINICAL REASONING EXERCISES

10 PRACTICAL EXERCISES/TOOLS
1. Highlighter Exercise
2. Problem Representation with Semantic Qualifiers
3. Coaching to Promote Co-selection
4. Probability Poker
5. Differential Diagnosis Formulation – Traditional vs. Alternative
6. Illness Script Generation
7. “Read About Your Patients” (Reading Horizontally)
8. Textbook Teaching Cases
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10. Seeing the Forest for the Trees

1. HIGHLIGHTER EXERCISE
EXPLANATION: This exercise can be done using any written/dictated H&P (minus the assessment and plan) and a highlighter pen.
THE STEPS
- Coach provides someone else's written/dictated H&P, minus assessment and plan
- Learner highlights key clinical features (the parts that seem most important to consider in establishing a diagnosis and plan of care)
- Learner summarizes case and discusses the highlighter choices and reasoning with coach
Expanded:
- Learner generates problem representation using semantic qualifiers
- Learner outlines DDX, prioritizes DDx, and explains rationale
EXAMPLES:
- Two examples follow (on next two pages)

2. PROBLEM REPRESENTATION WITH SEMANTIC QUALIFIERS
EXPLANATION: An extension of the Highlighter Exercise, this exercise emphasizes the importance of identifying the combination of key features in the patient’s presentation prior to finalizing the DDx.
THE STEPS:
- Have learner create a 1-2 sentence summary of the case, using semantic qualifiers.
EXAMPLE:
- This is a
  - school-aged child with an
  - acute onset of
  - severe exudative pharyngitis,
  - high fever,
  - tender cervical adenopathy
  - diffuse sandpaper rash...
  who also has headache, abdominal pain and no symptoms of viral upper respiratory tract infection.

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1 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
2 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
Using highlighter choices/problem representation/DDx/plan, assess student's clinical reasoning.

**MS IV CLINIC NOTE**

**CC:** Aaron is a 9 year-old boy with a chief complaint of sore throat.

**HPI:** Aaron was completely well until he developed a sore throat in the middle of last night. The throat pain woke him from sleep; mom thought he felt hot – checked his temperature and found he had a temp of 104. With Tylenol his temperature came down to 101. Today he says he can’t swallow solid foods, but he can drink. He has a headache (2/10) and a stomachache (all over, “just a little.’’) He vomited once after he woke up this morning.

Review of systems: Negative for weight loss, fatigue, cough, runny nose, difficulty breathing, palpitations, joint pain, weakness, or dizziness. Normal urine output. One episode of vomiting; no diarrhea. His whole family is sick with viral upper resp. tract infections.

Past medical history is unremarkable. Aaron was born at full term. No allergies, no medications accept Tylenol.

Social history: lives with mom dad, 3 y.o. sister, no pets/smokers.

Travel history: the family recently visited relatives in Connecticut

**Exam**

- **T 39.2      P 88        RR 15      BP 100/60   O2 SAT 99%**
- General: Well-developed, well-nourished, NAD
- HEENT: Normal fundi, PERRL, TMs clear.
- Pharynx – erythema with white patches, tonsils 3+ with symmetric enlargement, uvula midline. Tongue with prominent papillae. Petechiae on soft palate. MMM.
- Neck: supple, shotty cervical lymphadenopathy.
- Chest: clear no retractions, wheezes, crackles, or distress
- Heart: regular rate and rhythm – no M/R/G
- Abdomen: soft, non-tender, no masses, no HSM
- Neuro: Normal CN’s, DTR’s, sensation to touch, & coordination.
- Skin: diffuse rash - very fine, raised, with mild erythema - over the trunk and back, rough like sandpaper
- Ext: Warm, 2+ pulses, <2sec cap refill.

**SUMMARIZATION OF THE PROBLEM:** Aaron is a 9 year old male with throat pain, fever, vomiting, sick contacts, just back from Connecticut. He has a fever but no tachypnea, no tachycardia, neither hypertension nor hypotension, no hypoxia. He has a throat erythema with petechiae on his palate and prominent papillae and he has cervical lymphadenopathy. He also has a rash. Pain is so bad he can’t swallow.

**DIFFERENTIAL DIAGNOSIS:** He could have strep throat or a URI. He could also have mononucleosis—that can cause throat erythema and a rash. His whole family is sick so he could have caught a virus or Strep from them. Neisseria gonorrhea is a gram (+) diplococcus that can cause a bad sore throat with redness. Also on the differential of throat pain with erythema might be a peritonsilar abscess or a retropharyngeal abscess. It hurts to swallow so he could get dehydrated if he stops drinking and his throat pain gets worse. Lymphadenopathy can be infectious, maybe Hodgkin’s lymphoma. Consider conversion disorder, but very low on my differential.

**PLAN OF CARE:** Throat culture, CBC with differential, Chem panel with uric acid and LDH, Neck ultrasound or CT to rule-out abscess, EBV titers. Blood culture. Consider admission for IV fluid hydration.

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Using highlighter choices/problem representation/DDx/plan, assess student’s clinical reasoning.

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Skin: diffuse rash - very fine, raised, with mild erythema - over the trunk and back, rough like sandpaper  
Ext: Warm, 2+ pulses, <2sec cap refill.  

**SUMMARIZATION OF THE PROBLEM:** Aaron is a 9 year old male, otherwise healthy, with acute onset of severe throat pain and high fever, associated with mild abdominal pain, mild headache, and a single episode of vomiting. He has no URI symptoms, but sick contacts have URI’s. He is febrile in clinic with other VSS, and physical exam is remarkable for tonsilar erythema and palatal petechiae as well as a sandpaper rash; he has no hepatosplenomegaly and only shotty cervical lymphadenopathy.  

**DIFFERENTIAL DIAGNOSIS:** The acute onset of fever with throat findings, a sandpaper rash, and with no URI symptoms places strep pharyngitis at the top of my list. URI’s are common in this age group this time of year, his family is sick, so maybe he has a URI with the only major symptoms being fever and rash, but the quality of the rash seems more like strep. Mononucleosis can cause throat abnormalities and rash but would not likely have this acute an onset; he has no history of fatigue and no splenomegaly, plus his lymphadenopathy is mild at best—not classic infectious mononucleosis. A retropharyngeal abscess is common for toddlers but not children in this age group, and peritonsilar abscesses are more often apparent on physical exam. Reassuring is that he is overall well-appearing and not dehydrated.  

**PLAN OF CARE:** Rapid strep, throat culture if rapid strep (-). NSAID for throat pain. Empiric coverage for GABHS. Follow up in 1-2 days if not improved or worse to re-assess for evolution of symptoms and re-exam, or sooner if concerns.  

3. COACHING TO PROMOTE CO-SELECTION

EXPLANATION: This exercise can be used to highlight and emphasize many key components of clinical reasoning (directed history-taking and exams, generation of problem representation, use of semantic qualifiers, co-selection of diagnostic possibilities reflecting horizontal reading and illness script comparison).

TOOL: The Clinical Reasoning Recording Template (below) to help coach document learners’ thoughts

THE STEPS

• Provide chief complaint/problem – learner defines a working differential diagnosis and identifies key questions to ask, exam findings to look for
• Learner performs a directed H&P in steps – explicitly stating questions and exam maneuvers to elicit differentiating features and narrow the preliminary DDx
• Learner generates problem representation (summarize the case in 1-2 sentences) using semantic qualifiers
• Learner develops and defends dx, comparing this cases’ illness script with other probable diagnoses (co-selection/horizontal reading)

* Exercise stops if learner has insufficient knowledge at any point; resume exercise after reading*

<table>
<thead>
<tr>
<th>Learner Task</th>
<th>Intermediate Step</th>
<th>Coach’s Prompts</th>
<th>Stuck?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Review chief complaint</td>
<td>Initial DDx</td>
<td>What questions would you ask in the history?</td>
<td>If learner is stuck at any point, have learner read to gather more information about the chief complain and discriminating features</td>
</tr>
<tr>
<td>2. History</td>
<td>Revised DDx</td>
<td>What would you look for in exam?</td>
<td></td>
</tr>
<tr>
<td>3. Exam</td>
<td>Revised DDx</td>
<td>What labs/studies would you order?</td>
<td></td>
</tr>
<tr>
<td>4. Labs/Studies</td>
<td>Revised DDx</td>
<td>Problem representation</td>
<td></td>
</tr>
<tr>
<td>5. Assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Prioritized DDx</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Problem-based plan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
4. PROBABILITY POKER

EXPLANATION: This exercise can be used either individually or with a small group of learners to reveal clinical reasoning as elements of a case are revealed.
TOOLS: A grid for each learner (see template below); markers (poker chips or candy)

THE STEPS

• Pass out a grid and a pile of markers (~10) to each learner
• Present a brief clinical scenario; learners provide 3-5 preliminary diagnoses and record in grid
• Prompt learners to ask questions to obtain clinical information
• After 2-3 questions, ask each learner to mark on their grid the most likely diagnosis/diagnoses. The one that is the most probable should have the most chips. The students can add/subtract diagnoses throughout the exercise (up to 5 total diagnoses).
• Repeat above step with further questions about the patient’s history, PE, etc.
• At the end of the ‘game’, ask each learner to commit to the most likely diagnosis and justify the prioritization of this diagnosis.
• Learners should record pertinent “positives” and “negatives”, and compare and discuss these at the end (thus, you can avoid rewarding a correct diagnosis that is arrived at for the wrong reasons).

<table>
<thead>
<tr>
<th>Diagnosis 1</th>
<th>Diagnosis 2</th>
<th>Diagnosis 3</th>
<th>Diagnosis 4</th>
<th>Diagnosis 5</th>
</tr>
</thead>
</table>

| Discriminating Features (Pertinent +/-) | Discriminating Features (Pertinent +/-) | Discriminating Features (Pertinent +/-) | Discriminating Features (Pertinent +/-) | Discriminating Features (Pertinent +/-) |

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5a. Differential Diagnosis Formulation – Traditional
Explanation: Traditional differential diagnosis formulation can be used for learners who have difficulty expanding their differentials.

Tools: Any mnemonic that allows learner to expand the differential.

The Steps:
- Introduce learner to tools for expanding differentials.

Example:
- “Vindicate”
  - V Vascular
  - I Infectious, Inflammatory
  - N Neoplastic
  - D Degenerative
  - I Iatrogenic, Idiopathic
  - C Congenital
  - A Autoimmune, Allergic
  - T Toxin, Trauma
  - E Endocrine/Metabolic

5b. Differential Diagnosis Formulation – Alternative
Explanation: Alternative differential diagnosis formulation can be used for learners who have difficulty prioritizing their differentials.

The Steps:
- Have learner consider:
  - “Don’t miss” Diagnoses (urgent/emergent)
  - Treatable Diagnoses
  - Common Diagnoses

6. Illness Script Generation
Explanation: This exercise can be helpful for learners to determine when a patient’s course is deviating from what is expected, so they can further expand their differentials.

Tool:

![Diagram]

The Steps:
- Have learner organize classic features of disease presentations (including predisposing conditions, pathophysiology, and clinical consequences).

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7. “READ ABOUT YOUR PATIENTS”: READING HORIZONTALLY

EXPLANATION: In the first two years of medical school, traditionally students have been taught to read about each diagnosis separately. However, in real life, patients present with symptoms (not given diagnoses), and learners need to be able to compare multiple potential diagnoses.

TOOL:

<table>
<thead>
<tr>
<th>PRESENTING SYMPTOM</th>
<th>Diagnosis #1</th>
<th>Diagnosis #2</th>
<th>Diagnosis #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pathophysiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Features</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Features</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complications</td>
<td></td>
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</tr>
</tbody>
</table>

THE STEPS:
- Have learner compare and contrast multiple diagnoses (in terms of epidemiology, pathophysiology, typical exam features, lab features, treatment, and complications).

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8 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
8. TEXTBOOK TEACHING CASES

EXPLANATION: This exercise can be used to highlight and emphasize many key components of clinical reasoning (generation of problem representation, use of semantic qualifiers, discriminating features).

OPTION 1:
- Learner determines the diagnosis and management plan for provided scenarios
- Allows learner to compare and contrast differences in presentation of a given chief complaint (using discriminating features)

EXAMPLE 1:

<table>
<thead>
<tr>
<th>Abdominal Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 month-old</td>
</tr>
<tr>
<td>• 1 day</td>
</tr>
<tr>
<td>• Paroxysmal crying</td>
</tr>
<tr>
<td>• Emesis, no diarrhea</td>
</tr>
<tr>
<td>• Blood in stool in ER</td>
</tr>
<tr>
<td>8 year-old</td>
</tr>
<tr>
<td>• Mid-abdominal pain yesterday</td>
</tr>
<tr>
<td>• RLQ pain and limping today</td>
</tr>
<tr>
<td>• No appetite</td>
</tr>
<tr>
<td>3 year-old</td>
</tr>
<tr>
<td>• 3 weeks</td>
</tr>
<tr>
<td>• Periumbilical, LLQ pain</td>
</tr>
<tr>
<td>• Blood-streaked stool</td>
</tr>
<tr>
<td>12 year-old gymnast</td>
</tr>
<tr>
<td>• 2 months</td>
</tr>
<tr>
<td>• Cramping abdominal pain</td>
</tr>
<tr>
<td>• Loose stools</td>
</tr>
<tr>
<td>• Not growing</td>
</tr>
</tbody>
</table>

OPTION 2:
- Provide chief complaint/problem and different ages/underlying conditions/scenarios
- Learner fills in common diagnosis and key discriminating features

EXAMPLE 2:

<table>
<thead>
<tr>
<th>Abdominal Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 month-old male</td>
</tr>
<tr>
<td>• __________________</td>
</tr>
<tr>
<td>• __________________</td>
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<tr>
<td>• __________________</td>
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<tr>
<td>15 month-old</td>
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<td>• __________________</td>
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<td>• __________________</td>
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<td>• __________________</td>
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<td>3 year-old</td>
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<td>• __________________</td>
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<tr>
<td>12 year-old</td>
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<td>• __________________</td>
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<td>• __________________</td>
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</tbody>
</table>

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9 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
9. PERSUADE THE MD
EXPLANATION: The learner is placed in the role of a patient, having to describe how they would persuade a physician that he/she has a certain disease or needs a certain test performed. This exercise lets the learner verbalize common/classic disease presentations.

THE STEPS: Coach tells learner:
• You have [symptom] and are worried that you might have [diagnosis].
• You make an appointment with the [clinic, PMD, ED], hoping the doctor will send [test].
• What information will you give the busy doctor... to convince her within the first 2 minutes of the interview that you have [diagnosis] and/or need [test]?

EXAMPLE: Coach tells learner:
• You have a headache. You believe you might have a brain tumor. The doctor you are seeing has never met you before. You have 2 minutes to persuade the doctor that you need a head CT scan to rule out a brain tumor. What will you tell her about your signs and symptoms?

10. “SEEING THE FOREST FOR THE TREES”
EXPLANATION: This exercise can be used to help learners with micromanager tendencies who are now in manager roles to see the bigger picture. Pangaro (1999) described the developmental steps that learners in clinical medicine go through:

(G)RIME
• Gather data
• Report data
• Interpret data
• Manage
• Educate (teach & learn)

Some learners may have been successful at gathering and reporting data, but interpreting and managing might be more difficult because it requires being able to take a step back and “see the bigger picture.” For some detail-oriented learners, it might help to have a checklist to run through in creating the assessment and plan.

THE STEPS
• Have learner consider the following questions in formulating the assessment and plan:
  • What was the reason for admission?
  • What does the patient think is wrong? Nurses’ thoughts?
  • What are the goals of hospitalization?
  • What are the criteria for discharge?
  • What is the patient’s baseline/context?
  • Are we moving back to baseline or will there be a new baseline?
  • Progress toward goals, discharge, baseline

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11 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
12 Adapted from Stuart, AE. ‘Clinical Reasoning Skills’ Workshop; USC Innovations in Medical Education Conference 2009
III. SELECTED REFERENCES ON CLINICAL REASONING


Stuart, AE, Blankenburg R, Long M. Clinical Reasoning Skills Workshop, USC Innovations in Medical Education Conference, 2009