Teaching Clinical Reasoning
On Doctoring Faculty Development

Dartmouth Geisel School of Medicine
Objectives

• Work through a Clinical Problem Solving case

• Overview of Learning theory and vocabulary

• Strategies for practice with learners

• Outline for Year 1 and Year 2 On Doctoring Clinical Reasoning sessions
Lecture: Retention < 10%
Active Learning ➜ Better Results

Source: National Training Laboratories, Bethel, Maine
How do doctors think?

The exhaustive method, encouraged for use by medical students and residents

- Gather every bit of data possible, don’t miss a thing! Then try to come up with a diagnosis.

Hypothesis generation, preferred by seasoned clinicians, incorporating Bayesian reasoning

- Propose an explanatory hypothesis- see if it “fits” the story. Revise as you go along.

Pattern recognition, employed by experienced clinicians

- You’ll know it when you see it- you’ve seen it before

The reality—a combination of these methods
Metacognition

Awareness or analysis of one's own learning or thinking processes

Understanding the cognitive processes involved in clinical reasoning is helpful in building reasoning skills
Case

27 yo unemployed man admitted to the ED with shaking chills and fever x 4 days accompanied by sweats. He had some shortness of breath on exertion and a mild HA x 3 days. Appetite is poor, but no other GI sx. Able to keep hydrated and make urine.
Case

The patient said that he had been bitten by a friend’s cat a week prior. ROS is positive for a h/o transient vision loss right eye which lasted 45 seconds one day prior.

SH: Lives with his parents. Not in a relationship

Habits: Smoker 10 pack years. Drinks 4-5 beers/week
Case

PE: Toxic looking young man, rigor
T: 103, P 124, BP 110/40
Puncture wounds rt forearm, no cellulitis or abscess
HEENT: Flame shaped hemorrhage left fundus
2/6 early diastolic murmur in the aortic area. Lungs clear. No spleen.
3 min Case Discussion

• Partner up and discuss the case.

What do you think is going on?

Pay attention to HOW you think about the case?
Diagnostic Reasoning

Patient with a complaint or problem

$\Downarrow$

DDx for this problem

$\Downarrow$

DDx for this patient

$\Downarrow$

Working DDx

$\Downarrow$

Final Dx
Diagnostic Reasoning

• When we teach:
  – We take a history
  – Then do the physical exam
  – And then and only then have students figure out how things fit together
Diagnostic Reasoning (Iterative Process)

• In practice, the patient’s age and chief complaint get clinicians thinking immediately
  – thinking about the general DDx for the CC in that patient
  – this guides their questions
  – answers lead to revision of the working DDx
  – This prompts more questions (in a search for defining and discriminating features) and further refines the DDx

• This is “co-selection” – an iterative process of simultaneous data-gathering and searching for “illness scripts”. 
Diagnostic Reasoning
(an unconscious iterative process)

Patient’s story
Data acquisition
Summary statement
Hypothesis generation
Search for illness script
Diagnosis

Reasoning process

From Bowen 2006

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Iterative Reasoning Process

- **Chief Complaint**
- **Gather data**
- **Search for illness script match**
- **Refine hypotheses**
- **Refine Summary Statement**
Case Dissection
Key Steps

• Organizing/activating knowledge

• Accurate summary statement: helps sort through mental “illness data match” (illness scripts)

• Awareness of heuristics and medical errors
Think out aloud

- Activate the student’s prior knowledge
- Help them make connections
Case: Key Findings History

• Young male
• Unemployed
• Febrile, sweating, ill
• Cat bite
• Transient vision loss
Activating Prior Knowledge: History

- 27 yo male → ? Risk factor
- Unemployed → ? Substance abuse
- Febrile, sweating, ill → Infection
- Cat bite → Infection
- Transient vision loss → Neuro/Vasc

Hypotheses vs Objective data

- Osteo, Endo, HIV, Hepatitis
- P. Mult
- Strep
- S. Aur
- Cat scratch
Case: Key findings PE

- BP 110/40
- Flame shaped hemorrhage
- 2/6 early diastolic murmur in the aortic area
Activating Prior Knowledge: PE

• What does a high pulse pressure mean? What causes this?

• What are the causes of flame shaped hemorrhages?

• What are the causes of diastolic murmurs?
Stimulate Self Questioning

• Explain why...
• Explain how...
• What is the main idea of...?
• What is another example of...?
• What would happen if...?

• What is the diff. between...and...?
• How does...affect...?
• What are the strengths and weaknesses of...?
Key Steps

• Organizing/activating knowledge

• Accurate summary statement (leads to accurate choice of illness script)

• Awareness of heuristics and medical errors
Case: Summary Statement
Case: Summary statement

• 27 year old with a h/o cat bite who comes in with fever, rigors, transient vision loss and found to have hypotension, flame shaped hemorrhage and a new diastolic murmur.
Summary Statement

• An accurate Summary Statement triggers and guides the hypothesis generation (next step in framework).

• Requires deliberate practice
Diagnostic Reasoning

- Patient’s story
- Data acquisition
- Summary Statement
- Hypothesis generation
- Search for illness script
- Diagnosis

Reasoning Process

From Bowen 2006
Illness Scripts: A way to Organize

• Instead of storing clinical information discretely, experienced clinicians store and recall knowledge as diseases, conditions or syndromes – also called “illness scripts” (Bowen 2006)
Illness Scripts

General format:

• Risk factors/epidemiology
• Pathophysiology
• Clinical features
Illness Script

• Mental representation of a diagnosis/disease entity.
  – Built by starting with textbook or classic case
  – then refined based on experience and further learning.
Illness Script: Pneumonia

**EPIDEMIOLOGY**
The very young or old
Immunosuppressed
Smoking

**PATHOPHYSIOLOGY**
Infection of the lung parenchyma
airway inflammation

**CLINICAL FEATURES**
Fever, Cough, Pleuritic chest
Pain, Tachypnea
Illness Script for gout

• Epidemiology: age > 40, male, alcohol use, diuretics

• Pathophysiology: altered uric acid metabolism, joint crystal deposition, inflammation

• Clinical features: acute pain, monoarticular – first MT, recurrent
Illness Script

• Mental memory of a clinical condition or set of features of an illness—
  – Build blocks of information for each disease
  – As you build these blocks of information, they form crosslinks/references—so that as soon as you think about an illness—you automatically begin to think about another related one.

• How information is stored helps determine how effectively it is retrieved

• Experience helps “fill the cabinet”, organize, reorganize, cross-link & refine the scripts for each illness
Semantic Qualifiers

- Febrile ↔ Afebrile
- Acute ↔ Chronic
- Young ↔ Old
- Recurrent ↔ Single episode
- Surgical ↔ Non-surgical
Defining, Discriminating Features

- Defining Features
  - Gout
  - JRA

- Discriminating Features
  - Septic Arthritis
Defining, Discriminating Features

From Bowen 2006
Practice summary statement using semantic qualifiers

• 65 yo man with severe left knee pain. This has happened a couple of times before although in other joints. Often it occurs after he’s had several glasses of red wine.

• Older gentleman with recurrent monoarticular arthritis often associated with alcohol use.
Heuristics (Rules of thumb)

• Heuristics are useful but can often lead to systematic errors

• The accurate intuition of experts can be explained by the effects of prolonged practice rather than reliance of heuristics alone
Examples of Cognitive Errors

- Anchoring/Premature closure
- Availability/Last case bias
- Attribution/Stereotype

Croskerry 2003 The Importance of Cognitive Errors in Diagnosis and Strategies to Minimize Them
Bordage 1999, Why did I miss the diagnosis? Some cognitive explanations and educational implications
Bias Prevention: 3 Questions

• Ask: What else can it be?

• Does anything NOT fit in this story?

• Could 2 things be going on?
Strategies for Practice with Students

Presentations—what can go right or wrong?
Presentations

- Why so much attention to presentations?
- Presentations = window into thinking
- Process of presenting helps solidify reasoning skills
- Presentations take an abstract process and make it explicit
Strategies

• Useful for diagnosing the problem as well as reframing for practice.

• Overlap...not cut and dry which are best for what problem
Strategies

• Compare/Contrast DDx
  – Horizontal Reading

• Identify Defining/Discriminating Features
  – Highlighter Exercise
  – Reverse Presentation

• Concise Summary Statements
  – Summary Statement Listing Semantic Qualifiers

• Practicing your DDx
  – Reasoning through the Assessment
  – DDx shortcuts—Acronyms, Strategies
“Read About Your Patients”: Vertically
(This gives you knowledge)

Patient 1: ITP
- Epidemiology
- Pathophysiology
- Clinical features
  - DDx
    - HSP
    - Leukemia
    - Meningococcemia...
- Treatment
- Complications

Patient 2: ABO Incompatibility
- Epidemiology
- Pathophysiology
- Clinical features
  - DDx
    - Breast feeding jaundice
    - G6PD deficiency
    - Prematurity
    - E. coli sepsis...
- Treatment
- Complications
Horizontal Reading

• Read about similar/overlapping diagnoses at the same time.
• Lays down the cross-referencing as you file the scripts.

<table>
<thead>
<tr>
<th>PURPURA</th>
<th>HSP</th>
<th>ITP</th>
<th>Leukemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time course</td>
<td>Often after viral illness</td>
<td>Often after viral illness</td>
<td></td>
</tr>
<tr>
<td>Exam features</td>
<td>Afebrile, no HSM</td>
<td>Afebrile, no HSM</td>
<td>May have fever, HSM</td>
</tr>
<tr>
<td>Lab features</td>
<td>Normal platelets</td>
<td>Low platelets</td>
<td>Normal or Low</td>
</tr>
</tbody>
</table>
Strategies

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  – Horizontal Reading

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Case of “data dump”

• 16 yo male presents w/abdominal pain x 24 hrs

• Pain began yesterday in the RLQ.
  – Started at 10AM. Got better at 10:30, but worse again by 11AM.
  – Gradually worsened and got better just before bedtime but then worse again after waking up this morning.

• Decreased PO intake
  – Had a normal breakfast—toast with butter, glass of orange juice. Though some days he skips breakfast.
  – Lunch was decreased. Bought a bagel with cream cheese but only ate half. Saved the other half for dinner.
  – Dinner—he forgot about the bagel, but instead had spaghetti which his mother made for him.
Faulty Clinical Reasoning: “Symptoms”

- Problems with presentation of data
  - Unfiltered data dump
  - Disorganized
  - Missing important information
Underlying Problem?

• Insufficient knowledge

• Organization of knowledge

• Recognition of defining, discriminating features
Identifying Defining and Discriminating Features

• Highlighter—literally practice highlighting

• Take MS note, yellow pen...
  – Practice highlighting defining and discriminating features
    • For the purpose of make a diagnosis
    • For purpose of highlighting pertinent findings for deciding on a treatment plan
  – Can highlight in another color details that are redundant or not pertinent
Identifying Discriminating Features: Reverse Presentation

- S
- O
- A
- P

- A
- S
- O
- A
- P

This is a way to prime a preceptor to give feedback on the order, organization, selection of details presented:

“Joey is a 19yo with CC of fever and cough who likely has Pneumonia. Here’s why:” then presents S-O-A-P
Strategies

• Compare/Contrast DDx
  – Horizontal Reading

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  – Reverse Presentation

• Accurate and Concise Summary Statements
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Identifying Discriminating Features: Persuade Me

- You have had a headache on and off for the past month. You are afraid you have a brain tumor.
- The doctor you are seeing has never met you and seems to be in a rush.
- You have 20 seconds to persuade me that you need a head CT to rule out a mass.
- What will you say?

forces identification of essential features
Strategies

1. Metacognitive overview
2. Horizontal reading
3. Coaching to promote co-selection
4. Highlighter Exercise
5. Persuade the MD
6. Reverse Presentation
7. Problem Representation
8. Assessment
9. Disease Likelihoods
10. Differential Diagnosis
Coaching to promote Iterative thinking

Chief Complaint

Prime:
  • Initial DDx?
  • What information?

Gather data

Search for an illness script

Refine Summary Statement

Refine Hypotheses

Learners can be coached to do this deliberately
Presentations:
Symptoms of Faulty Clinical Reasoning

• **Inaccurate assessment**
  – This is a movie star dressed up as a dog for Halloween.

• **Missing assessment**
  – **SOP:**
    • This is a hairy animal with fluffy tail, in a top hat and tuxedo, my plan is to give it a cane.
  – **SOSOP**
    • This is a hairy animal with fluffy tail, in a top hat and tuxedo. So, for assessment, this is a hairy animal with fluffy tail, in a top hat and tuxedo. Plan is to give it cane.
Underlying problem

- Inadequate summarization
Write a 1-2 sentence summary of Joey’s key findings, using semantic qualifiers
This is a

- **Young adult male** with
- **acute** onset of
- **productive cough,**
- **high** fever,
- **tachypnea,** and a
- **pleuritic** chest pain
Strategies

• Compare/Contrast DDx
  – Horizontal Reading

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Problems with the DDx

- **Disembodied DDx:**
  - A generic differential for the initial complaint rather than a differential specific to the patient

- **Silo DDx:**
  - A separate DDx for each symptom or key finding, rather than a differential for the constellation of findings taken together

- **Frozen DDx:**
  - Continues to include items on the DDx that have been ruled out by new information – or continues to present a multi-item differential after a final diagnosis has been confirmed

- **Unprioritized/inappropriately prioritized DDx:**
  - Assigns inappropriate weight/probability to items on the DDx

- **Zebra DDx:**
  - DDx includes one or more rare, esoteric, highly unlikely diagnoses
Problems with DDX

- **Disembodied DDx**
  - This is an animal, so ddx includes cat, cow...
  - Incomplete illness script
- **Silo DDx**
  - Creates the ddx for the dog’s ear, nose, or tail
- **Frozen DDx**
  - Even though you recognize it runs and barks, unable to adjust ddx
  - Failure to seek a new script
- **Zebras and unicorns**
  - We can’t discount this may be a were-wolf
Components of a Well-Reasoned Assessment

• Summary Statement
• Differential with commitment to the most likely diagnosis
• Explanation of reasoning in choosing the most likely diagnosis
• Alternative diagnoses and explanation for why they are less likely

Student thinks out loud about summary statement and differential diagnosis

Baker, 2010
Clinical findings:
- Runs
- Barks
- Furry Tail
- Tongue sticking out

“Disease” Likelihoods
## “Disease” Likelihoods

<table>
<thead>
<tr>
<th></th>
<th>Runs</th>
<th>Barks</th>
<th>Furry Tail</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>7</td>
</tr>
<tr>
<td>Horse</td>
<td>+++</td>
<td>-</td>
<td>++</td>
<td>4</td>
</tr>
<tr>
<td>Cat</td>
<td>+</td>
<td>-</td>
<td>++</td>
<td>2</td>
</tr>
<tr>
<td>Tree</td>
<td>-</td>
<td>++</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>
## Disease Likelihoods

<table>
<thead>
<tr>
<th></th>
<th>Fever</th>
<th>Tachypnea</th>
<th>Cough</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>8</td>
</tr>
<tr>
<td>URI</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>4</td>
</tr>
<tr>
<td>Foreign Body</td>
<td>-</td>
<td>+</td>
<td>+++</td>
<td>3</td>
</tr>
<tr>
<td>UTI</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>
Differential Diagnosis Strategies

Traditional – use to expand DDx

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

Alternative – use to prioritize DDx

- Common
  - Atypical presentation
  - Rare diagnosis

- Severe
Cases
For each case

• What are the symptoms of faulty reasoning?
• What might be the underlying problems?
• What coaching strategies might be helpful?
Cases: Guidelines

• Assume that data presented in each case represent exactly what the student has gathered
• Algorithm
• Problems and strategies overlap
• Include ideas from your own experience
Parting Ideas

• Start with a metacognitive frame
  – Let the learner know you’ll be teaching them about thinking
• Target specific steps in the reasoning process for deliberate practice
• Experiment with different strategies to find a good fit
Discussion of course strategy for Year 1 and Year 2 On Doctoring
Year 1

• Introduce concept of clinical reasoning in broad terms from early case discussions and write ups.

• Session on formal intro to CR winter/spring term using a simple case
Year 2

• Sept 20: Introduction to CR with a Pneumonia case (small group)
• Oct 18: Chronic illness: Diabetic with cellulitis case (small group)
• Nov 1: Pericarditis case (small group)
• 2 additional sessions winter/spring: Pediatrics and surgical cases
References

Stuart E, Blankenburg B, Butani L, Johnstone N, Long M, Marsico N. COMSEP Workshop: Thinking about Thinking: Coaching to Promote Effective Clinical Reasoning