Clinical Reasoning
DISCLAIMER
Agenda

Clinical Reasoning Presentation

Introduction
- Definition
- Med 313 observation
- POM benchmarking
- Clinical Reasoning Components

Traditional
- Encyclopedic Facts
- Expert review
- Hypothetico-deductive
- Pattern recognition

Bowen Example
- Trainees' dilemma
- Diff Dx - Illness scripts

Demo 1
- Structure
- Debriefing

Demo 2
- DTI
- Sample Questions
- Illness Scripts
- Abstracting
- Compare & contrast
- Brief clinical case

Demo 3
- Practice
- Colvin

Flexibility & Structure
- Concepts
- DTI
- Implications

Application Strategies
- Instructional Methods
- Remaining challenges

Summary & Conclusions

Wednesday, November 18, 2009
Introduction

Clinical Reasoning
- Process by which clinicians collect, process, and interpret patient information to develop an action plan
- Creating a story from Hx, PE, test results, serial observations, etc.

- Ambulatory Medicine Clerkship
  - Similar preparation → Uneven performance

- Practice of Medicine course
  - Predigested cases for practice-based learning
  - Interns’ Struggles
Clinical Reasoning Process?

Diagram showing the clinical reasoning process with nodes such as Common conditions & patterns, Similar cases, Uncommon manifestations of common conditions, Observing from first view, History, Physical exam, Test results, Others' opinions, Generating hypotheses, Supporting/Refuting hypotheses, Integrating new data, Revise hypotheses, and others forming a network.
Quest: How Do the Experts Do It

- Encyclopedic Mastery of the Facts?

- Experts’ Self Description
  - Limited self-insights
  - Some pattern recognition
    - “It just looks like...”
    - “I don’t know but the answer comes to me...”

- Hypothetico-Deductive Model
Hypothetico-Deductive Strategy

Used by most experienced clinicians, most times

Process
- Formulation from the earliest clues of a short list of potential diagnoses or actions
- Performance of the clinical and paraclinical maneuvers to reduce the length of the list

Videotaped clinicians with standardized patients
- Diagnoses: pericarditis, duodenal ulcer, peripheral neuropathy, multiple sclerosis
- First hypothesis generation:
  - average = 28 seconds after chief complaint (range 11-55 seconds)
- Hypotheses generated/case: average = 5.5
- Correct hypothesis generation:
  - average = 6 minutes into the 30 minute evaluation
Trainees’ Dilemma

Infectious
Neoplastic
Endocrine/metabolic
Neuropsychiatric
Special Organ:
  - heart, lung, kidney, gastrointestinal
Connective tissue and auto-immune
Hematologic
Genetic
Traumatic
Nutritional
Iatrogenic and drug-induced
Trainees’ Dilemma

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V - Vascular
I - Infection/Inflammatory/Auto-Immune
N - Neoplasm (Primary or Metastatic)
D - Drugs
I - Iatrogenic
C - Congenital/Developmental/Inherited
A - Anatomic
T - Trauma
E - Environmental Exposure/Endocrine/Metabolic
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Wednesday, November 18, 2009
Opportunity

Review Article

Educational Strategies to Promote Clinical Diagnostic Reasoning

Judith L. Bowen, M.D.
General Internal Medicine
Oregon Health Science Center

N Engl J Med
Volume 355 (21):2217-2225
November 23, 2006
Clinical Case: R1 vs. R3

<table>
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<tr>
<th>The Case as Seen by a Novice Resident and an Expert Resident.</th>
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The Case as Seen by a Novice Resident and an Expert Resident.

**Patient’s story:** My knee hurt me so much last night, I woke up from sleep. It was fine when I went to bed. Now it’s swollen. It’s the worst pain I’ve ever had. I’ve had problems like this before in the same knee, once 9 months ago and once 2 years ago. It doesn’t bother me between times.

**Novice resident’s presentation:** My next patient is a 54-year-old white man with knee pain. It started last night. He does not report any trauma. On examination, his vital signs are normal. His knee is swollen, red, and tender to touch. It hurts him a lot when I test his range of motion. He’s had this problem twice before.

**Teacher’s inquiry:** What do you think is causing this pain?

**Novice resident’s response:** It could be an infection. It could be a new onset of rheumatoid arthritis. It could be Lyme disease. Since he doesn’t recall falling, I doubt it’s an injury. I don’t know whether osteoarthritis ever presents like this, but he does have a history of knee pain.
Clinical Case: R1 vs. R3

The Case as Seen by a Novice Resident and an Expert Resident.

**Patient’s story:** My knee hurt me so much last night, I woke up from sleep. It was fine when I went to bed. Now it’s swollen. It’s the worst pain I’ve ever had. I’ve had problems like this before in the same knee, once 9 months ago and once 2 years ago. It doesn’t bother me between times.

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**Expert resident’s presentation:** My next patient is a 54-year-old white man with a sudden onset of pain in his right knee that awakened him from sleep. He does not report any trauma and was essentially asymptomatic when he went to bed. His history is remarkable for two episodes of similar, severe pain 9 months and 2 years ago. He is pain-free between episodes. He is afebrile today. His knee is swollen, tender to touch, and erythematous.

**Teacher’s inquiry:** What do you think is causing this patient’s knee pain?

**Novice resident’s response:** It could be an infection. It could be a new onset of rheumatoid arthritis. It could be Lyme disease. Since he doesn’t recall falling, I doubt it’s an injury. I don’t know whether osteoarthritis ever presents like this, but he does have a history of knee pain.

**Expert resident’s response:** The patient has acute gout. He has had multiple discrete episodes with abrupt onset of extremely severe pain involving a single joint with evidence of inflammation on examination. Before all his episodes, he is asymptomatic. I would have expected gout to affect the first metatarsophalangeal joint, but it can present in the knee. Nothing suggests any ongoing, chronic problem in the knee. I don’t see any portal of entry to suggest acute infectious arthritis and he looks quite well for that. His other joints are normal on examination. I doubt that he has a flare-up of osteoarthritis with pseudogout or a systemic, inflammatory arthritis such as rheumatoid arthritis.
Clinical Diagnostic Reasoning Process

Illness Script for Gout


Predisposing conditions
Age ≥40 yr
Male sex
Alcohol use
Use of diuretics

Pathophysiological insult
Abnormal uric acid metabolism
Precipitation of crystals in joint
Inflammation of the joint

Clinical consequences
Acute pain
Single joint, usually the first metatarsophalangeal joint
Recurrent
Exercise 1

Clinical Scenario Exercise 1

1. **Pair up** with partner

2. Select **one** of the three option conditions

3. **Independently**, write a few words or phrases in each category for the selected condition

4. When both are finished, **compare** your written notes

5. Be prepared to **summarize** your observations
Exercise 1 Debriefing
Exercise 1 Debriefing

- Show similar terms despite diverse training
- Demonstrate dominance of abstracting terms
- Allow rapid retrieval
- Facilitate comparison of illness scripts
Competing Models of Medical Diagnosis

- **Hypothetico-Deductive**
  - Data acquisition
  - Hypothesis generation
  - Data interpretation
  - Hypothesis evaluation

- **Knowledge-Based**
  - Organization of medical knowledge
    - Recognition of meaningful information
    - “Forceful feature”
  - Availability of medical knowledge
    - Ready access to knowledge structured in memory

- Goals: empiric support for theory & assessment tool development
- Inventory of diagnostic thinking (56 --> 41 items; 17 ± 4 min)

**Measures**

- (a) degree of **thinking “flexibility”**
- (b) **knowledge structure in memory** (how one actually makes diagnoses)

**Comparisons** among

- 30 subjects from nine groups (n=270)
- 1st year students, 3rd year students, house staff, junior and senior faculty, and general practitioners (UK study; all general internal medicine except last)
### Diagnostic Thinking Inventory

<table>
<thead>
<tr>
<th></th>
<th>1</th>
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DTI Exercise 2


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DTI Data


### Table 2. Mean scores and standard deviations (in ascending order) for the nine subject groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total score ((k = 41))</th>
<th>Thinking ((k = 21))</th>
<th>Structure ((k = 20))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) First-year medical students</td>
<td>153.9 (18.2)</td>
<td>79.2 (10.0)</td>
<td>74.7 (10.4)</td>
</tr>
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<td>(2) Third-year medical students</td>
<td>158.3 (18.5)</td>
<td>81.6 (11.2)</td>
<td>76.7 (9.1)</td>
</tr>
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<td>(3) Senior house officers</td>
<td>168.4 (15.5)</td>
<td>85.6 (9.3)</td>
<td>82.8 (7.8)</td>
</tr>
<tr>
<td>(4) House officers</td>
<td>170.1 (15.5)</td>
<td>87.4 (7.7)</td>
<td>82.7 (9.8)</td>
</tr>
<tr>
<td>(5) General practice trainees</td>
<td>172.2 (15.3)</td>
<td>88.1 (8.1)</td>
<td>84.1 (9.1)</td>
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<td>(6) General practitioners</td>
<td>172.3 (16.2)</td>
<td>91.6 (9.3)</td>
<td>80.1 (8.3)</td>
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<td>(7) Consultants</td>
<td>177.5 (14.5)</td>
<td>92.0 (9.2)</td>
<td>85.6 (8.5)</td>
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<td>(8) Senior registrars</td>
<td>178.7 (16.1)</td>
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<td>(9) Registrars</td>
<td>180.2 (14.0)</td>
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Knowledge-Based Model at Work

More astute clinicians
- Build global representation of case
- Rich network of knowledge bound by abstractions
- Categorize by similar and opposing bits
  - young - old; acute - chronic; gradual - sudden
  - “2 day duration in a 26 year-old” becomes “acute process in a young adult”
  - “3 times in past 2 days” becomes “acute and intermittent”

Weaker diagnosticians
- Use lexicon model of medical knowledge
- Lists of signs and symptoms
- Include or exclude disorders as the signs and symptoms come and go
- Proceed “feature-by-feature”

-Lemieux & Bordage, 1986
-Bordage & Lemieux 1986, 1987
Glossary:

<table>
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<th>forceful features</th>
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<td>abstracting terms</td>
<td>semantic qualifiers</td>
</tr>
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<td>case formulation</td>
<td>problem representation</td>
</tr>
<tr>
<td>typical presentation</td>
<td>illness script</td>
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</table>

Problem Representation

- Translating the story into abstractions (problem representation) fosters retrieval of relevant “illness scripts”
- Abstractions (“semantic qualifiers”) serve like Google search terms
- Examples: acute vs. chronic; insidious vs. abrupt onset; progressive vs. relapsing; symmetrical vs. asymmetrical; proximal vs. distal; mono- vs. poly-, etc.
Clinical Reasoning Process

Data-Gathering

Forceful Features

Problem Representation

Illness Scripts

Compare & Contrast

Pattern Recognition

Hypothetico-deductive
Translating the patient’s story...

I have pain “under my right rib” “after I eat” “on and off for the last 2 days” “really hurts”

Subacute recurrent severe post-prandial RUQ pain.
Illness Scripts

**Characteristics**

- Learned cognitive summaries of particular conditions
- Include risk factors, key findings (Hx, PE, tests), pathophysiology, treatment, illness course, memorable cases, recent reading, areas of ambiguity, pearls
- Remarkably similar from experienced clinician to clinician in the same specialty despite separate training

**Trainees learn common patterns AND how to distinguish among patterns**

- The illness script for PNEUMONIA differs from that for CONGESTIVE HEART FAILURE in the constellation of features, despite some overlap.
- The trainee learns features common to both AND which features favor one condition over another
Compare & Contrast

Pneumonia

Congestive Failure
Patient’s particulars

- 69 yo
- 15 lb weight loss
- fever to 101°
- travel to Thailand

Problem representation

ABSTRACTION PROCESS

Specific details of THIS patient to general pattern of similar patients

Illness script #1
Illness script #2
Illness script #3

Pattern Recognition
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Wednesday, November 18, 2009
Trainee’s Tasks

- **Data collection**
- **Problem representation**
  - Key features
  - Abstraction (semantic qualifiers)
- **Illness script**
  - **Knowledge**
    - Build knowledge stores retrieved by clinical presentations
    - Use typical cases to build prototypes
    - Read & practice comparing and contrasting ≥ 2 hypotheses
  - **Selection**
    - Compare & contrast between two or more plausible ones
    - “Considering a typical case of TB. How does Mr. Jones compare?”
    - Prioritize among the competing options
    - Verify/reject by additional observations, tests, expert opinions, etc.
### Example

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<th>Key Features</th>
<th>Problem Representation</th>
<th>Differential Diagnosis</th>
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- **67 yo woman**
- **s/p hysterectomy 4 hrs ago**
- **DM; HTN**
- **HR 105, BP 92/50**
- **Hgb 13.9->9.4**
- **Elevated LFTs**
- **Normal ECG**
- **I/O +3 liters**
- **Afebrile**
- **Incision OK**
- **Abd distention**

- Postop (hours)
  - hysterectomy with abd distention, tachycardia, hypotension, 4 gm Hgb decrease
- Post-op bleeding
- Fluid overload with hemodilution

- ≥ 2 processes
  - Decompensated liver disease
  - Hemolysis

- ETC.
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Wednesday, November 18, 2009
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Curricular Items

- learn semantic qualifiers
- drill selecting forceful terms
- learn typical cases
- compare & contrast illness scripts
- develop multiple-choice objective questionnaire
- develop drill exercises, based on typical cases

Wednesday, November 18, 2009
Diagnosing the Learner’s Skills and Problems in Clinical Reasoning

MODEL 1 COMPETING HYPOTHESIS
ELICIT PLAUSIBLE PROBLEM REPRESENTATION
MODEL CREATION OF ILLNESS SCRIPT
COMPARE & CONTRAST AT LEAST 2 CONDITIONS AS DRILL
ASK LEARNER TO DEFEND 1° & 2° DIAGNOSES FROM KEY CASE FEATURES
HAVE LEARNER GIVE TYPICAL PRESENTATION FOR THIS DIAGNOSIS

Diagnosing Learner’s Skills

Data acquisition and reporting
- Lacks important data
- No selection of important data
- Both

Problem representation
- Disorganized presentation
- Disorganized discussion
- Poor summary statement
- Both

Hypothesis generation: Search for and selection of illness script
- Multiple diagnoses in random order
- Unprioritized lists
- No problem representation or illness scripts
- Differential dx not linked to case findings

MODEL BEHAVIORS
SEEK APPRAISAL
THINK ALOUD FOR LINKS
COMPARE & CONTRAST LEARNER’S STATEMENT
LIST ALL IMPORTANT FINDINGS
MODEL PROBLEM REPRESENTATION, PRIORITY SETTING, & COMPARE/CONTRAST
ASK LEARNER TO SUPPORT DIAGNOSTIC CHOICES FROM CASE FINDINGS


Wednesday, November 18, 2009
Limitations of artificial intelligence
- Pattern recognition, intuition, and reflection as critical to develop professional skills
- Not discrete steps but increments along a continuum


Dreyfus & Dreyfus Model


Novice
- Rule-driven
- Analytic reasoning
- Filter or prioritize

Advanced Beginner
- Sort through data & rules from experience
- Solve problems by analysis & pattern recognition

Competent
- Emotional buy-in
- Feels appropriate responsibility
- More pattern recognition for common problems
- Sees big picture
- Abstract to general

Proficient
- Relies on pattern recognition
- Problem-solving seems intuitive
- Analytic reasoning for management
- Extrapolates to unknown
- Lives with ambiguity

Expert
- Intuitive problem recognition & mgmt
- Discriminates features of non-recognizable pattern
- Clever
- Notices the unexpected

Master
- Practical wisdom
- Sees bigger picture of culture & context
- Deep commitment
- Concern for right/wrong decisions
- Ongoing improvement
- Reflects in, on, for action
To make an expert: 10 years or 10,000 hours (chess, medicine, etc.)

- Acquire extensive stable of examples that guide Dx & Mgt
- Pattern recognition is seemingly unconscious, effortless, all at once
- Basic science principles are used selectively, especially for difficult problems, employing pathophysiology (Neph, Hemat, Anesth)

Systematic, hypothesis-free search < combined pattern recognition + analytical search [performance: accuracy ± speed]

- Clinicians at all levels are vulnerable to suggested diagnoses, influencing interpretation of features
- Examples aid experts to interpret ambiguous features
- Trainees’ deliberate practice with multiple examples provides foundation and assistance for new cases
Deliberate Practice

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World class performance needs “deliberate practice” in any field: a multiplier effect
- Designed, purposeful, focused, demanding
- Cumulative benefit => start young
- Supportive environment
- Ongoing instruction after mastery
- Passion: Dedication to performance
- Can happen at any age but needs ≥ 10 yrs
- Constantly deepen knowledge & skills
- Practice will give instinctive benefit
- Examples: Tiger Woods, Mozart
Deliberate Practice

- Designed to improve performance
- Can and must be repeated extensively
- Provides continuous feedback on results
- Highly demanding: physically and mentally
- Remains a pursuit of passion
Application Strategies for Trainees

- Select meaningful information
- Discriminate relevant vs. irrelevant
- Form links between details & conditions
- Distinguish typical vs. atypical features
- Encourage pattern recognition as well as analytic reasoning to make diagnoses
- Emphasize reasoning (WHY) over facts (WHAT)
- Stress “big picture” reading first; later return for more detailed reading
- Emphasize common causes first rather than memorizing huge differential
- Read about
  - Most likely diagnosis
  - #1 competing diagnosis
Challenges Beyond POM

- Applying and expanding clinical knowledge in transition to wards after POM quarter 6
- Differences among clinical services in methods, disease array, and expectations for learner performance in clinical reasoning
- Remediation for those learners not functioning at par
- Building a “sufficient library” of typical cases for early clinical trainees
- Integrating a supplemental library of more atypical but relevant cases for more advanced clinical trainees (including residents)
- Aligning expectations among preceptors and attending physicians for optimal trainees’ behaviors (both in learning and in clinical performance)
Summary & Conclusions

- Training in clinical reasoning includes knowledge and skills in abstraction (semantic qualifiers and forceful terms), problem representation, and differential diagnosis among illness scripts.

- Experienced clinicians meld pattern recognition with analytic reasoning, enhanced by a expanded library of similar cases over years.

- Key learning steps include developing skills in problem representation and in comparing and contrasting among competing hypotheses.

- Moderate but important changes in the POM and subsequent clerkship training are required to enhance students’ knowledge and skills in this critical area.
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Similar challenges exist among residents as well.
Questions? ~ Comments?