Teaching Diagnostic Reasoning

Paul Roman Chelminski, MD, MPH, FACP
"Che non men che saper dubbiar m'aggrada."

Epistemology, Heuristics & Polyarthritis

Paul Roman Chelminski, MD, MPH, FACP
• Did you receive specific instruction in diagnostic reasoning?

• What is your approach to diagnostic reasoning?

• What do you want to learn?
The Pursuit of Excellence

A fulfilling profession

• Autonomy

• Complexity

• Close linkage between effort & reward
The Engines of Excellence

Cognitive Prowess

Physical Stamina

Psychological Stamina
The Engines of Excellence

- Cognitive Prowess
- Psychological Stamina
The Engines of Excellence

Cognitive Prowess
Reasoning in a Partial Vacuum

“And thus do we of wisdom and of reach,
With windlasses and with assays of bias,
By indirections find directions out.”

--Hamlet, Act II, Sc. 1
Reasoning in a Partial Vacuum

“And thus do we of wisdom and of reach, With windlasses and with assays of bias, By indirections find directions out.”

--Hamlet, Act II, Sc. 1
How Do We Problems Solve, Anyway?
Dual Processing Model

**System 1**  
Non-Analytic (Fast)  
- Pattern recognition  
- Heuristics  
- Reflexive, **intuitive**, "gut"  
- Matching illness script

**System 2**  
Analytic (Slow)  
- Worst case scenario medicine  
- Hypothesis and deductive  
- Causal reasoning  
- Bayesian  
- EBM
Dual Processing Model

System 1
Non-Analytic (Fast)
• Pattern recognition
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Susceptible to Biases
Dual Processing Model

**System 1**
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- Pattern recognition
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**System 2**
Analytic (Slow)
- Worst case scenario medicine
- Hypothesis and deductive causal reasoning
- Bayesian
- EBM

Susceptible to Biases
Esoteric, Inefficient
Dual Process Model

Approaches to Decision Making

- Modular responsivity
- Gestalt effect
- Inductive reasoning
- Deliberation without attention
- Recognition primed
- Thin slicing
- Heuristics and biases
- Exhaustion Strategy
- Hypothetico-deductive reasoning
- Robust Decision Making
- Normative reasoning
- Bounded rationality
- Bayesian reasoning

Intuitive

Analytical
Heuristics

Formal Definition:
Experienced-based approach to problem

Chelminski Definition:
Comfort Food For The Brain
Rapid Reasoning
Rapid Reasoning

Mnemonics/Heuristics/
Pattern Recognition

Berger’s B’s for Acute Monoarthritis

- Bugs
- Blood
- Birefringence
Rapid Reasoning

Mnemonics/Heuristics/Pattern Recognition

Berger’s B’s for Acute Monoarthritis

- Bugs
- Blood
- Birefringence

- Fever
- RLQ Abd pain
- Elevated WBCs

Dx: Appendicitis
The Chelminski Model: Competing with Yourself

Tame Complexity (anxiolysis)

• Chief complaint

• Age

• Gender

(Early familiarization with social history)

• Create rapport

• Builds context
The Chelminski Model: Competing with Yourself

Tame Complexity (anxiolysis)

- Chief complaint
- Age
- Gender

(Early familiarization with social history)

- Create rapport
- Builds context
Clinical Priorities

- Most likely
- Most lethal
- (Most modifiable)
Diagnostic Reasoning

Figure 1. Key Elements of the Clinical Diagnostic Reasoning Process.
Diagnostic Reasoning

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MED 355;21  WWW.NEJM.ORG  NOVEMBER 23, 2006
Diagnostic Reasoning

Figure 1. Key Elements of the Clinical Diagnostic Reasoning Process.

Medical Students

Resident
Figure 1. Key Elements of the Clinical Diagnostic Reasoning Process.
### Diagnostic Probabilities, Comfort & Lifelong Learning

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**Convenience Vector**

**Diagnostic Probability**

**Cognitive Ease**

*Monday, May 20, 13*
## Diagnostic Probabilities, Comfort & Lifelong Learning

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- **Didactic/Testable**
- **Experiential/Assessable**
- **Cognitive Ease**
- **Diagnostic Probability**
- **Convenience Vector**

**Monday, May 20, 13**
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### Domains

- **Didactic/Testable**
- **Experiential/Assessable**
- **Mastery Vector**
- **Convenience Vector**
- **Diagnostic Probability**

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Monday, May 20, 13
Who Is Linda?*

“Linda is thirty-one years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice. She participated in gay rights demonstrations. She opposes hydraulic fracturing ("fracking").

Who Is Linda?

- Linda is a teacher in elementary school.
- Linda works in a bookstore and takes yoga classes.
- Linda is active in Habitat for Humanity.
- Linda is a psychiatric social worker.
- Linda is a member of the Sierra Club.
- Linda is a bank teller.
- Linda is an insurance salesperson.
- Linda is a bank teller and is active in Habitat for Humanity.
Probability vs. Plausibility

Bank Tellers

Bank Tellers Active In Habitat for Humanity
Who Is Linda?
Signal vs. Noise
Are getting unadulterated information?
Melinda is a 51 year old female with pain in many joints. She drinks heavily. She stopped working at a convenience store two years ago. She did not complete high school. She watches reality television shows all day. She lives in a single-wide trailer in rural Chatham county. Two of her three children are incarcerated. She has an abusive live-in boyfriend.

*Case courtesy of Tanvir Haque, MD
Who Is Melinda?

1. Melinda uses food stamps.
2. Melinda has gout and drinks moonshine.
3. Melinda has Medicaid and owns a car.
4. Melinda was a pharmacy tech in Siler City.
5. Melinda has a history of DUIs.
6. Melinda has gout.
7. Melinda rides a moped.
Why Plausibility Matters

Alcoholics With Gout

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Why Plausibility Matters

Alcoholics With Gout

Alcoholics with Saturnine Gout

Alcoholics With Gout
"After the Battle, Everyone is General*

*European Proverb
"Good judgement comes from experience, and experience comes from bad judgment"*

*Mullah Nasruddin*
Beware of Biases

• CC: Right thigh pain

• 52 yo female with DM, HTN, obesity, recurrent DVT

• Meds: chronic disease cocktail, warfarin

• Severe right thigh pain, with sensation of mass, recent elevated INR

• Tenderness of thigh with ? induration

Dx: Meralgia Paresthetica
Dr. Chelminski Guilty of "Basal Rate Neglect"

Monday, May 20, 13
Beware of Biases

- CC: Right thigh pain
- 52 yo female with DM, HTN, obesity, recurrent DVT
- Meds: chronic disease cocktail, warfarin

CBC, CK, CT, Dopplers, MRI all normal. What next?

Dx: Meralgia Paresthetica
Dr. Chelminski Guilty of "Basal Rate Neglect"
Cognitive Biases (Traps) & Heuristics: Environmental

- **Availability heuristic**: judging likelihood of by what comes easily to mind.

- **Basal rate neglect**: "Zebra hunting"

- **Anchoring and confirmation bias**: "Anchor" on a diagnosis; cherry picking information to "confirm" a pre-conceived and convenient notion. Shortcut slays hypothesis testing and ignores conflicting evidence.
Cognitive Biases (Traps) & Heuristics: Environmental

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Available Anchor/Confirm
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Available ➔ Anchor/Confirm
Cognitive Bias (Traps): 

**Patient**

- **Representativeness Error**: Thinking guided by stereotype or prototypical presentation and failure to consider atypical variants (e.g. only obese get OSA, ).

**Physician Emotional Bias**

- **Attribution Error**: Influence of negative stereotypes (e.g. lung abscess=alcoholism)
- **Affective Error**: Identifying with patient for a happy ending (and dropping one's guard)
The Epidemiology of Diagnostic Error

• 10 to 15% case rate

• ~75% diagnostic errors are cognitive

• "Cost of expertise"--specialists run afoul of availability heuristic
  
  • More likely to assign diagnoses in their specialty for cases ostensibly outside it

  • Assign higher probability to cases within their specialty
Genesis of Error

- No Fault Error
  - Masked/unusual presentation
  - Patient related
- System Related Error
- Cognitive Error

- No Fault Factor 7%
- System Related 19%
- System & Cognitive 46%
- Cognitive Error 28%
Cognitive Errors in 100 Cases

- Premature Closure: 39
- Faulty Context Generation: 26
- Salience Misperception: 25
- Missed Finding: 25
- Incomplete Workup: 24
- Failed Heuristic: 23
- Knowledge(4)/Skill(7) Deficits: 11

Monday, May 20, 13
Objectives:

1. Types of diseases missed

2. Diagnostic missteps

• Analyzed 190 instances of diagnostic error

• Two sites: Urban VA and "Private Integrated" health system. Both with residents.
<table>
<thead>
<tr>
<th>Source of Error</th>
<th>N</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Related</td>
<td>190</td>
<td>31 (16.3)</td>
</tr>
<tr>
<td>Patient-Provider</td>
<td></td>
<td>150 (78.9)</td>
</tr>
<tr>
<td>Diagnostic Tests</td>
<td></td>
<td>26 (13.7)</td>
</tr>
<tr>
<td>Follow-up</td>
<td></td>
<td>28 (14.7)</td>
</tr>
<tr>
<td>Referrals</td>
<td></td>
<td>37 (19.5)</td>
</tr>
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Patient-Practitioner Missteps  
N=190

<table>
<thead>
<tr>
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<th>No. (%)</th>
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<tbody>
<tr>
<td>Problems Ordering Tests</td>
<td>109 (57.4)</td>
</tr>
<tr>
<td>History Error</td>
<td>107 (56.3)</td>
</tr>
<tr>
<td>Exam Error</td>
<td>90 (47.4)</td>
</tr>
<tr>
<td>Failed Documentation Review</td>
<td>29 (15.3)</td>
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Table 5. Potential Severity of Injury Associated With Delayed or Missed Diagnoses

<table>
<thead>
<tr>
<th>Severity Rating</th>
<th>No. (%) of Diagnoses (N = 190)</th>
</tr>
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<tbody>
<tr>
<td>No harm</td>
<td>3 (1.6)</td>
</tr>
<tr>
<td>Inconvenience</td>
<td>0</td>
</tr>
<tr>
<td>Very minor harm or little or no remediation</td>
<td>2 (1.0)</td>
</tr>
<tr>
<td>Minor harm or remediation or treatment</td>
<td>20 (10.0)</td>
</tr>
<tr>
<td>Considerable harm or remediation or treatment</td>
<td>72 (37.9)</td>
</tr>
<tr>
<td>Very serious harm or danger or permanent damage</td>
<td>30 (15.8)</td>
</tr>
<tr>
<td>Serious permanent damage</td>
<td>36 (19.0)</td>
</tr>
<tr>
<td>Immediate or inevitable death</td>
<td>27 (14.2)</td>
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Most missed diagnoses were common conditions.
Pitfalls:
Generalists & Specialists

**Generalists**
- Diffusionism
- Epidemiological "anchoring" and "availability"
- Settle for the common
- "Denominator thinking"

**Specialists**
- "Partialism"
- Specialty "anchoring" and "availability"
- Zebra hunting
- "Numerator thinking"
Pitfalls: Generalists & Specialists

**Generalists**
- Diffusionism
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Both Are At Risk of Premature Closure & Bias
Refining Your Systems

**Individual**

- Use System 1 and System 2
- Take your own history (build a script). TEST YOUR OWN HYPOTHESES AND AVOID AVAILABILITY, ANCHORING CONFIRMATION BIASES
- Take cognitive risks.
- Read NEJM CPC's, Clinical Problem Solving.

**Community**

- Participate in Morning Report.
- Go to M&M (develop an M&M).
- Say "Yes" to evaluating unsolved cases.
Pitfalls

• Premature closure
Epistemology

- The science of knowing
- Heuristic = mental tools for knowing and learning (rules of thumb, "shortcuts in reasoning")
- Mnemonic = simplified heuristic
- Oversimplification inimical to complexity (reductionism) leads to false inferences (and error)
- Reductionism vs. Inference
Cognitive Biases

- **Anchoring**: relying on first impressions; cherry picking information to achieve a pre-conceived and usually convenient notion. A shortcut that ignores heterogeneity and conflicting evidence.

- **Availability heuristic**: judging likelihood of event by what comes easily to mind.
Clinical Reasoning

- Diagnostic:
  - Doctor's intellectual exercise

- Non-Diagnostic
  - Management
  - Taming complexity
## Diagnostic-Management Priorities

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<th>Effective Intervention</th>
<th>Likely</th>
<th>Rare but Plausible</th>
<th>Unlikely But Acute</th>
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<tr>
<td>CML</td>
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<td>Pott's Disease</td>
<td>Atypical PE RMSF</td>
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<tr>
<td>Pancreatic CA</td>
<td></td>
<td>Bulbar Palsies</td>
<td>Rabies</td>
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## Diagnostic-Management Priorities

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• Singh H, JAMA 2013, Error

• Problem representing: one sentence summary of problem.

• Illness: Inventory of illnesses

• Match problem with script.