THE ART & SCIENCE OF EXPERT THINKING

A key to superior clinical reasoning and medical decision-making
Objectives

- Describe cognitive processes of expert thinking in clinical reasoning and decision-making
- Apply teaching methods that will assist learners in utilizing expert thinking in clinical settings
- Develop individual approaches to incorporate the concept of expert thinking into various settings
Dual-Process Model of Reasoning

- Unconscious
- Conscious
- Rapid
- Deliberate
- System 1: Non-analytical
- System 2: Analytical
- Intuition

Quirk, M 2006
Croskerry 2003
Cognitive Exercise:
An 18-month old with fever and swollen eyes
What is the Diagnosis?

6 month old with seizures
System 1

“Trust sense of familiarity”
System 1: Intuition

- Experience is translated into action without intervention of any reasoning process.
- Experts address, integrate and make sense of multiple complex pieces of data subconsciously.
- “Pattern recognition” & “Illness script”

“Thinking without thinking”
Early initial hypothesis

• Correct Dx hypothesis considered once during the encounter predicts Dx accuracy, \( OR \ 15, 95\% \ CI \ (1, 219) \)

• Correct Dx hypothesis within the first 10 questions predicts Dx accuracy, \( OR \ 24, 95\% CI \ (2.6, 222) \)

• Correct Dx considered within 5 min, 95% chance of reaching a correct Dx

Neufeld 2004
Nendaz 2006
Can you memorize this?

DRAHSISNRETTAPGNIYFITNEDI

IDENTIFYING PATTERNS IS HARD

Learning in ‘chunks’ help organize the knowledge
What Makes The Expert?

“…no amount of rules or facts can capture the knowledge an expert has when he has stored his experience of the actual outcomes of tens of thousands of cases.”

Experiential Learning

Dreyfus & Dreyfus, 1986
Mylopoulos et al. Academic Medicine 2012
Organized Knowledge = Expertise
Illness script: semantic qualifiers

“The Key to Expert Pattern Recognition”
Sort Out Illness Scripts

A man with knee pain
Create & Compile Illness Scripts = Organize knowledge
Patient Story

- A 72-year old white man presents with knee pain that woke him up from sleep; “the worst pain I’ve ever had.” The knee was normal before he went to bed; now it’s also swollen. He had similar problems 9 months and 2 years ago.
“Here’s an **older** man with an **acute, recurrent** attack of **severe** pain in a **single, large** joint, a **mono**-arthritis. This could be gout or septic arthritis.”
<table>
<thead>
<tr>
<th>Semantic qualifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt char.</td>
<td>Mr. S., 72</td>
</tr>
<tr>
<td>Site</td>
<td>R. knee</td>
</tr>
<tr>
<td>Course</td>
<td>Last year</td>
</tr>
<tr>
<td>Severity</td>
<td>Blankets</td>
</tr>
<tr>
<td>Context</td>
<td>Night</td>
</tr>
<tr>
<td>Onset</td>
<td>Last night</td>
</tr>
</tbody>
</table>
Access to ‘illness script’

Older man
Acute onset
Recurrent
Mono, large joint

Woman
Gradual onset
Chronic
Poly, small joint

Gout, Septic arthritis
Rheumatoid arthritis
1. Problem representation:
   Synthesize, Use Semantic qualifiers, Capture 3 components

2. Generate three DDx based on your problem representation

DDx:
1.
2.
3.
EXAMPLE-‘illness script’

Older man
Acute onset
Recurrent
Mono, large joint

Gout, Septic arthritis

Woman
Gradual onset
Chronic
Poly, small joint

Rheumatoid arthritis
## Compare & Contrast Scripts

<table>
<thead>
<tr>
<th>Acute onset</th>
<th>Subacute or Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever, Leukocytosis</td>
<td>Afebrile</td>
</tr>
<tr>
<td>Marked tenderness</td>
<td>Dull tenderness</td>
</tr>
<tr>
<td>Rapid progression</td>
<td>Gradual progression</td>
</tr>
<tr>
<td>Toxic appearing</td>
<td>Non-toxic</td>
</tr>
<tr>
<td>Unilateral &gt; bilateral</td>
<td>Symmetric, diffusely scattered pattern</td>
</tr>
<tr>
<td>Smooth, indistinct border</td>
<td>Cutaneous changes</td>
</tr>
<tr>
<td>Risks for infection</td>
<td>Risks for venous stasis</td>
</tr>
</tbody>
</table>

- **Cellulitis**
- **Venous stasis**
System 1: Irrational & Unexplainable

Efficient but Error-prone

"I think you should be more explicit here in step two."

Sydney Harris
Novice & Pattern Recognition

Mental availability

- Illness scripts
- Mental state
- Cognitive Biases

Actual probability
- Abscess
- Kawasaki’s
- Mononucleosis

Pharyngitis

Wrong diagnosis
System 2

“Think it through, then decide”
Systematic Analysis

- Organized and Logical
  - Start with
    - Acute vs. Chronic
    - Anatomy or Structure
    - Pathophysiology or Mechanism of Illness
    - Organ System
  - Then
    - Etiology
DDx via Etiology

V Vascular
I Infection and inflammatory (autoimmune)
N Neoplastic (paraneoplastic)
D Drugs
Iiatrogenic and idiopathic
C Congenital (developmental, genetic)
A Anatomic
T Trauma
E Environmental and endocrine (metabolic)
# Diagnostic Checklist

## Enter Clinical Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Adolescent (13-16yrs)</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
</tr>
</tbody>
</table>

**Refine search:**
- Travel history: North America

## Diagnoses

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme Disease</td>
<td>INFEC</td>
</tr>
<tr>
<td>Rubella Infection</td>
<td>INFEC</td>
</tr>
<tr>
<td>Inflammatory Bowel Disease</td>
<td>INFEC</td>
</tr>
<tr>
<td>Crohn's Disease</td>
<td>INFEC</td>
</tr>
<tr>
<td>Sarcoidosis</td>
<td>RESP</td>
</tr>
<tr>
<td>Neutrophilic Dermatoses</td>
<td>RHEUM</td>
</tr>
<tr>
<td>Erythema Nodosum</td>
<td>RHEUM</td>
</tr>
<tr>
<td>Pyoderma Gangrenosum</td>
<td>RHEUM</td>
</tr>
<tr>
<td>CNS T B &amp; T B Meningitis</td>
<td>INFEC</td>
</tr>
<tr>
<td>Staphylococcus aureus Infection</td>
<td>INFEC</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>INFEC</td>
</tr>
<tr>
<td>Sickle Cell Disease / Crisis</td>
<td>HEMAT</td>
</tr>
<tr>
<td>Lombero's Syndrome</td>
<td>INFEC</td>
</tr>
<tr>
<td>Wegener's Granulomatosis</td>
<td>RHEUM</td>
</tr>
<tr>
<td>Osteomyelitis and Septic Arthritis</td>
<td>INFEC</td>
</tr>
<tr>
<td>Hodgkin Disease</td>
<td>NEOPL</td>
</tr>
<tr>
<td>Influenza</td>
<td>INFEC</td>
</tr>
<tr>
<td>Group A Streptococcus</td>
<td>INFEC</td>
</tr>
<tr>
<td>Non-Hodgkin Lymphoma</td>
<td>NEOPL</td>
</tr>
</tbody>
</table>

*Click diagnosis for evidence-based content.*

## Feedback

**Feedback:**

[Submit]
The extent of diagnostic thinking is as good as you frame it.
A post-op teenager

- 15-yo, Hispanic male
- Admitted post op from pectus excavatum corrective surgery
- abdominal pain, fatigue
COGNITIVE AUTOPSY

What caused the misdiagnosis?

What went wrong with the Illness script(s)?
Cognitive Biases

• Predictable patterns of deviation in judgment that occur in particular situations and lead to cognitive errors:
  – perceptual distortion
  – illogical interpretation, or irrationality
  – inaccurate judgment

• Universal and may be preventable using the cognitive de-biasing process
Common Cognitive Biases

Availability
biased by ease of recall

Framing
biased by details surrounding the clinical data

Blind Obedience
biased by authority or technology

Anchoring
stuck on initial impression

Premature Closure
prematurely halting diagnostic workup
Cognition vs. Metacognition

“Thinking about one’s own thinking, and others’ thinking”

Adapted from Nelson 1990, Psych of Learning and Motivation
Making a **plan before** thinking episode

**Regulating** thought **during** episode

**Reflecting afterwards** to revise the decision, and plan future practices
Cognitive Debiasing

**COGNITIVE PAUSE!**

- Did I put enough effort toward this problem?
- Did I omit anything serious/life threatening?
- Am I about to repeat my past mistakes?
- Does it make clinical/logical sense?
- Let’s think outside the box!
Red Flag Prompt

- Objective: To determine if a “pause” and focus on isolating “red flags” strategy during diagnostic reasoning improves diagnostic performance.
- Red Flag definition:
  - a constellation of symptoms, signs, clinical data or circumstances that should lead to heightened suspicion for a serious condition and trigger additional evaluation.
- Methods: 71 Pediatric resident physicians from 2 university based children's hospitals.
  - Randomized controlled, scenario-based study which featured a 2 (Red flags: Yes/No) x 2 (Case Complexity: Complex/Simple) between-subjects measures design.
- Results/Conclusion:
  - Overall, the results show that alerting the participants to watch out for red flags significantly improves diagnostic accuracy, in general, and for complex cases in particular.

Impact of Red Flags and Case Complexity on Diagnostic Performance among Pediatric Residents: A Randomized Controlled Vignette Study. Chartan, C. Thammasitboon, S. Sur, M. Krishnamurthy, P. Singh, H.
GROUP EXERCISE
Slowing Down and Debiasing

GROUP WORK

- Discuss…
  - Identify opportunities in the case where the providers could have **slowed down** to avoid errors
  - Determine if **cognitive biases** led to the errors
GROUP WORK

- Consider the case from the perspective or “frame” of:
  - Resident
  - Nurse
  - Mother

- How could understanding the “frame” of each individual impact diagnostic process?
- How could this have changed their response to the situation?
Innovations:

- Reflective Practice
- MedU
- Deliberate Practice Module
System 1 vs. System 2
2-Step Expert Thinking

The Intellectually Disciplined Process

Evaluate information matching patterns with illness scripts

Evaluate one’s own thought to reduce biases
Take Home Points

- **System 1** thinking—fast, often accurate, prone to biases
  - Problem Representation with Semantic Qualifiers AND Illness Scripts are a good way to develop **System 1** thinking

- **System 2** thinking—deliberate, often accurate, prone to framing effects
  - Cognitive debiasing and Cognitive autopsy with reframing can help improve **System 2** thinking

- It is important to know when to use **System 1 vs. System 2**