How we diagnose and the limits of systems tools and human cognition

S012 – Diagnostic Mistakes: Understanding How we Misdiagnose
Saturday, July 30, 2016
2:00 PM - 5:00 PM

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Dept. of Dermatology and Cutaneous Biology
Thomas Jefferson University
DISCLOSURE OF RELATIONSHIPS WITH INDUSTRY

S012 – Diagnostic Mistakes: Understanding How we Misdiagnose
Saturday, July 30, 2016
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DISCLOSURES
I do not have any relevant relationships with industry.
Objectives

1. Identify the cognitive processes involved in decision-making

2. Recognize misleading heuristics and cognitive biases that contribute to errors in diagnosis

3. Evaluate strategies to avoid the shortcomings of cognitive processes involved in decision-making
The Birth of Patient Safety Movement

- 98,000 hospital deaths/yr
- Preventable medical errors
- Faulty systems and processes
  - adverse drug events
  - wrong-site surgery
  - mistaken patient identities

Medical error—the third leading cause of death in the US

Martin A Makary professor, Michael Daniel research fellow

Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, MD 21287, USA

- 98,000 hospital deaths/yr
- 251,454 hospital deaths/yr

Makary MA, Daniel M. Medical error—the third leading cause of death in the US. BMJ. 2016;353.
Medical Errors

Most of the research and emphasis have focused on reducing *system-based* errors by improving:

- communication (e.g. handoffs)
- coordination of care
- work flows, pathways, and processes
3 most common errors

1. biopsy pathway
   • inadequate specimen, no specimen in the bottle, incorrect site, etc.

2. medication management

3. wrong-site surgery
Diagnostic Errors

• 10-20% of medical errors may be attributable to diagnostic errors, but varies depending on specialty

• 40,000 to 80,000 estimated US hospital deaths annually

Sources of Diagnostic Error

<table>
<thead>
<tr>
<th></th>
<th>Sources</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No-fault error</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Knowledge deficit</td>
<td>25%</td>
</tr>
<tr>
<td>3</td>
<td>Affective influence</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cognitive Error</td>
<td>75%</td>
</tr>
</tbody>
</table>
Sources of Diagnostic Error

1. No-fault error
   • Correct diagnosis is not expected:
     • extremely rare atypical presentation
     • deceptive patient

2. Knowledge deficit

3. Affective influence

4. Cognitive Bias
Sources of Diagnostic Error

1. No-fault error
2. Knowledge deficit
   • novice clinician > experienced clinician
   • minimal contribution to diagnostic error
3. Affective influence
4. Cognitive Error
Sources of Diagnostic Error

1. No-fault error
2. Knowledge deficit
3. Affective influence
4. Cognitive Error
<table>
<thead>
<tr>
<th>Transitory Affective States</th>
<th>Endogenous Disorders</th>
<th>Situational Induced</th>
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<tbody>
<tr>
<td>• Sleep deprivation</td>
<td>• Mood variation</td>
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# Affective influences

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Affective influences

Situational Induced

- Countertransference error
  - disagreeable feelings toward certain type of patients or disease
Affective influences

Situational Induced

• Resolve countertransference error by:
  ✔ compensate by learning more about the disease
  ✔ referring the patient to a specialist who will take the time to listen, exam, and assess the patient
Sources of Diagnostic Error

1. No-fault error 25%
2. Knowledge deficit 75%
3. Affective influence
4. Cognitive Error
Sources of Cognitive Errors

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<th>Heuristics &amp; Cognitive Biases</th>
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<td>• Confirmation bias</td>
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<tr>
<td>• Diagnostic momentum</td>
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<td>• Search satisficing</td>
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Daniel Kahneman
Professor of Psychology and Public Affairs Emeritus at the Woodrow Wilson School, Princeton University

• Nobel Prize in Economic Sciences (2002)

• psychology of judgment and decision making
“Laziness is built deep into our nature”

## Dual Process Model of Reasoning

<table>
<thead>
<tr>
<th>System I</th>
<th>System II</th>
</tr>
</thead>
<tbody>
<tr>
<td>salt &amp; _______</td>
<td>demand &amp; _______</td>
</tr>
<tr>
<td>2x2</td>
<td>2x27</td>
</tr>
<tr>
<td>drive on an empty road</td>
<td>drive in NY city</td>
</tr>
<tr>
<td>recognize your phone number</td>
<td>tell someone your phone number</td>
</tr>
<tr>
<td>reading a billboard</td>
<td>reading critically</td>
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</table>
System I

- unconscious
- fast thinking (“mental shotgun”)
- automatic function of associative memory that cannot be turned off
- responsible for the daily routine decisions
System I

Gut feeling

Impressions

Instinct

Impulses

Intuition

Pattern recognition

Experience
System II

- conscious deliberate reasoning (hypothetical-deductive reasoning)
- slow thinking
- provides the checks and balances for System I
- responsible for self-control
ABC or A13C?  
121314 or 12B14?

System 1 suppresses ambiguity and doubt

# Dual Process Model of Reasoning

<table>
<thead>
<tr>
<th>System I (Fast)</th>
<th>System II (Slow)</th>
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<tbody>
<tr>
<td>Pattern recognition</td>
<td>Linear analysis</td>
</tr>
<tr>
<td>Differential recognition</td>
<td>Hypothetical-deductive</td>
</tr>
<tr>
<td>Stereotyping</td>
<td></td>
</tr>
<tr>
<td>Intuition</td>
<td></td>
</tr>
<tr>
<td>Heuristics</td>
<td></td>
</tr>
<tr>
<td>Acquired through clinical experience</td>
<td>Generate differential diagnosis</td>
</tr>
<tr>
<td></td>
<td>Gather information to validate</td>
</tr>
<tr>
<td>Unconscious &amp; rapid</td>
<td>Conscious &amp; slow</td>
</tr>
<tr>
<td>Low cognitive load</td>
<td>High cognitive load</td>
</tr>
<tr>
<td>Reliance by expert clinician</td>
<td>Reliance by novice clinician</td>
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Heuristics

- Describes the underlying mechanism by which System 1 cognitive phenomena are achieved
- Mental shortcuts to quick decisions ("eureka")
- It an \textit{adaptive} mental strategy to deal with uncertain and ambiguous environment
- \textit{Experience} serve as the foundation
System II

- System II is a careful linear analytical process
  - Taking History
  - Prioritize the key clinical findings
  - Generate a list of differential diagnosis
- Building of library of *illness scripts* takes place in System 2
Preference of Clinicians

Patient

System I
Illness scripts
Pattern recognition

System II
Analytical
Hypothetical-deductive

No match

Match

Expert

Diagnosis
System I

It is vulnerable to ERRORS

- suppresses ambiguity and doubt
- tendency to ignore logic and statistics
- COST of quick decisions is some degree of ACCURACY

- Susceptible to cognitive biases
- “Quick thinking” or heuristics can MISLEAD
## Sources of Cognitive Errors

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Heuristics and Cognitive Biases

- Efficient mental strategies to deal with an uncertain and ambiguous world
- They are accurate and work most of the time
- Operate at subconscious or unconscious level
- “Discourages” circumspection
## Sources of Cognitive Errors

### Heuristics and Cognitive Biases

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Data Gathering

- **Diagnostic momentum**: biased by diagnosis or diagnostic suggestions by other physicians
- **Confirmation bias**: searches and interprets information and data to suit the initial impression
- **Search satisficing**: stopping the search once an abnormality is found
- **Premature closure**: diagnosis rendered before all information are obtained
Confirmation Bias

• Confirmation bias: searches and interprets information and data to suit the initial impression

• We selectively look for information that fits with our preexisting expectations...at the same time we ignore or dismiss information that contradict these expectations
# Sources of Cognitive Errors

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Data Interpretation

- **Representativeness heuristic**: choosing diagnosis based on how well the case matches previously encountered diseases (illness scripts)

- **Anchoring**: anchors the diagnosis on initial information too early in the diagnostic process, failing to adjust this impression in light of later information

- **Overconfidence**: overestimate how much we know and how reliably we know it
Overconfidence

- General human trait
- Overconfidence is endemic in medicine
- System I promotes overconfidence
- Discourages circumspection
- Contributes to premature closure bias
## Sources of Cognitive Errors

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Diagnostic assessment

• **Availability heuristics**: bias toward diagnosis that are easily retrievable ("what is fresh or familiar in your mind")

• **Illusory correlation**: two events believed to be related, when, in reality, they are not—"true & true" but unrelated

• **Hindsight bias**: judgment bias based on knowledge of the outcome

• **Sunk-cost effect**: pursuance of an earlier diagnosis despite later information not supporting it because there was much investment in the initial diagnosis
Availability heuristics: bias toward diagnosis that are easily retrievable ("what is fresh or familiar in your mind")

- Subspecialists tend to over diagnose into the particular organ system or specialty in which they specialize
# Sources of Cognitive Errors

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Representativeness Heuristic

- **Base-rate neglect** is a common trap
- One needs to be grounded in accurate base-rate or prevalence of diseases

Availability Heuristic

- **Alternative diagnoses** are not considered
- For experts, "zebras" are not considered
- For novices, "horses" are not considered
Can we prevent diagnostic errors caused by misleading heuristics and cognitive biases?
## How to minimize diagnostic errors

<table>
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<th>System-level</th>
<th>Individual level</th>
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<tr>
<td>Optimize patient volume</td>
<td>Minimize stress, fatigue, and sleep deprivation</td>
</tr>
<tr>
<td>Use computer assisted diagnostic systems-e.g. Uptodate</td>
<td>Increase knowledge</td>
</tr>
<tr>
<td></td>
<td>Seek feedback and recalibrate</td>
</tr>
<tr>
<td></td>
<td>“Debias” yourself</td>
</tr>
<tr>
<td></td>
<td>Practice reflectively (metacognition)</td>
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Clinical Decision Support System

• Studies show their potential usefulness
  • prevention reminders
  • drug dosing and prescribing
  • disease management
  • diagnosis

• Improved patient outcome data are sparse

Clinical Decision Support System

- Low rate of adoption
- Often not well-integrated into the clinical workflow
- Adds more time
- Adds more cost
- Limited data on their usefulness

Seek feedback and recalibrate

- There are more opportunities to receive feedback and recalibrate in dermatology.
- There needs to be a conscious effort to obtain and receive feedback.
- The feedback should be for **BOTH** correct and incorrect diagnoses.
Debiasing Strategies

...That is to say, invoke System II mode of cognition more often
Debiasing Strategies
Practice more reflectively (metacognition)

1. Have an open attitude for introspection and reflection
2. Be aware of base rates or prevalence of diseases
3. Stay objective
4. Test hypothesis against data generated
5. Take a diagnostic time out: Consider alternative diagnosis
6. Be alert to the pitfalls of heuristics & cognitive biases
Do the strategies work?

• Given that cognitive biases usually occurs without any awareness (ie System I), can we consciously control thought processes that is sub or unconscious?

• Currently, no data exists on effectiveness of cognitive forcing strategies

Experts believe that it is possible to train yourself to be vigilant for these errors and to improve decision-making as a result, avoiding some of the predictable errors
Conclusions

1. Dual Process Model of Reasoning:
   - *Fast*-System I  
   - *Slow*-System II

2. System I prone to error:
   misleading heuristics and cognitive biases

3. Experience is the best defense against these errors

4. Awareness of the cognitive traps has the potential to decrease some of the diagnostic errors
The End