Defining and Practicing Therapeutic Reasoning: Can Technology Help?

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Outline
• Introduction (5 minutes)
• Exercise 1: Therapeutic reasoning exercise (5 minutes)
• Clinical Reasoning: Theories and Evidence (20 minutes)
• Exercise 2: Diagnosing and correcting reasoning errors (15 minutes)
• Leveraging digital tools to help learners practice therapeutic reasoning (25 minutes)
• Exercise 3: Group discussion: characteristics of a digital reasoning tool (15 minutes)
• Wrap-up (5 minutes)

Objectives
• By the end of this workshop, participants will be able to:
  • Discuss the current evidence on how clinicians and learners make decisions about therapeutics.
  • Employ methods to diagnose and correct errors in learners’ therapeutic reasoning processing.
  • Describe how scaffolding and intrinsic feedback can be used to assist learners in developing their therapeutic reasoning skills.
What Do Clinicians Think About When They Think About Therapeutics?

We don’t really know!

Management Reasoning Beyond the Diagnosis

Clinical reasoning—the integration of clinical information, medical knowledge, and contextual (situational) factors to make decisions about patient care—is fundamental to medical practice. Poor reasoning is an important cause of medical error; for example, diagnostic errors are thought to contribute to approximately 10% of patient deaths and hospital adverse events. Most research in clinical reasoning has focused on decisions related to diagnosis, i.e., diagnostic reasoning.

By contrast, management reasoning—which we define as the process of making decisions about patient management, including choices about treatment, follow-up visits, further testing, and allocation of limited resources—remains less well understood. Paradoxically, the processes involved in management reasoning are usually better understood than those in diagnostic reasoning.
Studying Clinical Reasoning Empirically

- Concurrent thinkaloud
- Interviewing participants
- Evaluation of interview products
- Cued retrospective recall
- Qualitative analysis
- Comparison to standard
Exercise 1

• Pair up with the person next to you: introduce yourself! (Briefly)
• Person with first name closest to start of (English) alphabet gets case A, other gets case B
• 1 minute: silently read your assigned case
• 2 minutes: turn to your partner and “think aloud” your clinical reasoning and recommendation
• 2 minutes: switch roles and repeat
Exercise 1 Demo
Go!

- Pair introductions – 30 seconds total
- Read cases silently – 1 minute
- Case A Thinkaloud – 2 minutes
- Case B Thinkaloud – 2 minutes
- Reactions:
  - What was hard about that? What was easy?
  - Were your thinkalouds similar or different?
Clinical Reasoning: Theories and Evidence
Dual-Systems Model of Cognition

**System 1**
- Fast
- Unconscious
- Automatic
- Everyday Decisions
- Error prone

**System 2**
- Slow
- Conscious
- Effortful
- Complex Decisions
- Reliable

Kahneman & Tversky
Expertise Development in Diagnostic Reasoning

Hypothetico-deductive

- Sudden increase in creatinine
  - R.P.G.N.
  - A.I.N.
  - Multiple Myeloma
  - Septic shock
  - Bilateral Pap. necrosis
  - Rhabdomyolysis
  - Nephrotoxins
  - Radiographic Dye

Consciously Incompetent
- Learn
- Practice

Consciously Competent

Assess

Experience

Lapse

Unconsciously Incompetent
System 1

Unconsciously Competent
System 2

Pattern recognition

Schema-driven

- True A.R.F?
  - Post-renal
  - Renal
  - Tubular
  - Obstr./interstitial
  - Urethral stricture
  - Rhabdomyolysis
  - Septic Shock
  - Pre-renal
  - Cardiac
  - Volume

Diagnostic Decision-making Models

Figure 2. Schematic model for diagnostic decision making

Croskerry P. Acad Med 2009;84:1022-1028
Therapeutic Reasoning Model

Diagnosis → Problem Representation

Evoked Set
- Option A
- Option B
- Option C
- Option D
- Option E

Patient-specific Selection Process
- Analytical
- Non-analytical

Pattern-matched Option

Prescription

Key Therapeutic Reasoning Findings

• Accuracy of diagnostic and therapeutic plans not correlated in MDs

• “Evoked set” of drug options:
  • Varied by disease (1.7 - 5.0)
  • Did not vary by experience
  • Choice within this set poorly predicted by stated preferences

• Therapeutic schemas of senior MDs richer than juniors

• Senior MDs more likely to incorporate patient context into management decisions

1McBee E, et al. BMC Med Ed 2017;17:211
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Med Hx=Conditions, Abx=Antibiotics, DDIs=Drug-Drug-Interactions, Dx=Diagnosis, Pref=Preferences, F/U=Follow-up, Tx=Treatment

Blue: Naming the Syndrome; Orange: Delineating Pathogens; Green: Case Features; Yellow: Host Features; Purple: Selecting Abx; Pink: Other Factors

Gruenberg, Abdoler, & MacDougall. In preparation
Clinical Reasoning Errors Potentially Applicable to Therapeutic Reasoning

- Lack of knowledge
- Search satisficing
- Problem representation failure
- Evoked Set
  - Option A
  - Option B
  - Option C
  - Option D
  - Option E
- Patient-specific Selection Process
  - Analytical
  - Non-analytical
- Pattern-matched Option
- Base-rate neglect
- Clinical inertia
- Multiple alternative bias
- Prescription bias
- Commission bias
- Contextual error
Exercise 2

• Work in same pair
• 2 handouts:
  • Student reasoning narrative for either case A and B
  • Clinical reasoning problems sheet
• 5 minutes: individually read and “mark up” student narrative for case, using reference sheet (when applicable)
• 5 minutes: turn to your partner and compare markups, discuss similarities and differences
Exercise 2 Demo

• SW is a 35 yo male being treated in the Emergency Department for an episode of asthma that occurred after exercise. His regular medications albuterol inhaler 2 puffs prn wheeze, fexofenadine 180mg daily po prn allergies, and ibuprofen 200mg po prn muscle soreness/pain. His oxygenation is 94% on 2L nasal cannula, BP 140/70, HR 100. In the ED he is receiving albuterol via nebulizer for his asthma and propranolol 10mg po BID for tachycardia.

• The medical resident in the ED asks your pharmacy student to assess and counsel SW on his inhaler technique. You student comes to you and says:

  • “The team asked me to see this patient about their inhaler technique. Looks like he had an asthma exacerbation. I was going to see if he used a spacer and encourage him to do so. I also would recommend switching to extended-release propranolol for convenience after he’s discharged.”

  Problem representation failure

  Commission bias
Go!

• Individually read and mark up case – 3-5 minutes
• Share markup experience with partner – 3-5 minutes
• Reactions:
  • Was this easy or hard? How well did you agree on your markups?
  • What aspects of the students’ reasoning process did not seem to be captured by the typology of reasoning errors?
Leveraging Digital Tools to Help Learners Practice Therapeutic Reasoning
**Case Delivery**

- **Internship**
  - Upper layer: real patients (e.g., internship)

- **OSCEs**
  - Intermediate layer: computer-simulated patients and/or simulated patients role-played by peers

- **EHR Simulator/My Dispense**
  - Back side: making diagnoses autonomously
  - Front side: fully and/or partially worked examples of making diagnoses

**Case Content**

- **Low element interactivity**
  - Lower layer: textual descriptions of diagnoses (e.g., literature)

- **High element interactivity**
  - Right side: many information elements to be taken into account when making a diagnosis

**Support**

**Complexity**

**Fidelity**

**Scaffolding, Feedback, Metacognition**

**Scaffolding vs Feedback vs Metacognition**

### Novices
- More effective:
  - Worked examples
  - Completion tasks
- Less effective:
  - Practice problems

### Experts
- More effective:
  - Worked examples
- Less effective:
  - Completion tasks

**Worked examples**

\[
\frac{2 + 4}{2} + x = 9
\]

\[
6/2 + x = 9
\]

\[
3 + x = 9
\]

\[
x = 9 - 3 = 6
\]

**Completion tasks**

\[
\frac{2 + 4}{2} + x = 9
\]

\[
6/2 + x = 9
\]

**Practice problems**

\[
\frac{2 + 4}{2} + x = 9
\]
Scaffolding Example

- **Design**: RCT
- **Population**: medical students practicing diagnosis in computerized learning environment
- **Intervention**: prompt for create problem representation (“summarize the patient in 1-2 sentences”)
- **Outcome**: “diagnostic efficiency”: cases accurately diagnosed/time spent
- **Results**: greater ”diagnostic efficiency” in intervention group (similar accuracy/less time)

Scaffolding vs *Feedback* vs Metacognition

Concurrent

Intrinsic

Extrinsic

Delayed
Feedback Example

• **Design**: RCT
• **Population**: medical students practicing diagnosis in computerized learning environment
• **Intervention**: immediate vs no feedback on cases
• **Outcome**: “diagnostic efficiency”: cases accurately diagnosed/time spent
• **Results**: greater ”diagnostic efficiency” in intervention group (greater accuracy/slightly more time)

Scaffolding vs Feedback vs **Metacognition**

Cognition

“The patient has a new fever...the team’s worried about infection”

“Fever came after three days in the hospital.”

“I’m worried about hospital-acquired organisms.”

“Vancomycin and piperacillin/tazobactam is an option, I remember.”

“My knowledge of hospital-acquired organisms isn’t great. I need to review those.”

“Where should I look for better evidence for this?”

“We used that in the last patient like this. But is this patient really that similar?”

Metacognition
Metacognition Example

• **Design**: Qualitative study
• **Population**: medical students and experienced physicians
• **Intervention**: implementation of metacognitive checklist vs common diagnostic reasoning errors
• **Outcome**: perceived utility
• **Results**: early steps perceived as useful by trainees, later steps by practitioners

• **Threat**
  • Worst-case scenario

• **What else?**
  • Problem representation, satisficing, clinical inertia, confirmation bias

• **Evidence**
  • Base-case, satisficing, confirmation bias

• **Dispositional influences**
  • Availability, commission bias

Exercise 3

• Work individually
• Use student worksheet you just marked up
• 5 minutes to consider:
  - What scaffolding/feedback/megacognitive prompting could be automated to a digital platform? How might this happen? Would anything be lost?
• 10 minutes: group discussion (prepare to be called on!)
Exercise 3 Demo

• “The team asked me to see this patient about their inhaler technique. Looks like he had an asthma exacerbation. I was going to see if he used a spacer and encourage him to do so. I also would recommend switching to extended-release propranolol for convenience after he’s discharged.”

Problem representation failure
-Scaffolding: require structured problem statements before proceeding in case

Commission bias
-Metacognitive prompting include prompts to consider “what’s the worst likely outcome if this patient is not treated or undertreated for this problem?”
Go!

• Review marked-up case and consider feedback/scaffolding/metacognition – 5 minutes

• Reactions:
  - What scaffolding/feedback/megacognitive prompting could be automated to a digital platform? How might this happen? Would anything be lost?
null
Other Technology Platforms

• Diagnosis
  • ISABEL  
    https://www.isabelhealthcare.com/products
  • DecisionSim  
    https://www.kynectiv.com/platform
  • FullCode  
    https://full-code.com/
  • Human Diagnosis Project  
    https://www.humandx.org/

• Therapeutics
  • MyDispense  
    https://info.mydispense.monash.edu/
  • SimPharm  
    https://www.simpharm.com/
Summary:

• Therapeutic (vs diagnostic) reasoning poorly studied
• Some diagnostic reasoning errors likely to overlap with TR errors
• Identifying reasoning errors (vs lack of knowledge) may help trainees
• Scaffolding, feedback, metacognition tools to improve TR
• Some aspects may be amenable to digital automation for trainee practice
• Further study/application/discussion needed!
Questions/Discussion