Teaching Students to Think About Complexity and Subtlety

Occam's razor, Hickam’s Dictum, Cognitive Traps, and the Perils of Clinical Guidelines and Evidence B(i)ased Medicine
Objective

- To understand the title of this talk
How I came to this topic

- “Thinking about thinking”

- Geriatric Medicine
  - “Experts in complexity and subtlety”

- How do I teach this????
- How do we take novices and turn them into experts?
- How do we teach students to think?
- What mistakes do trainees make in thinking?
How Doctors Think

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Goals of Today’s Session

- Discuss some of the challenges of taking novice learners to the next step of expertise

- Understand how evidence based medicine teaching and clinical guidelines can be misused by novice learners

- Discuss common cognitive errors made by trainees

- Discuss some ways we might begin to teach trainees about thinking to avoid these errors and develop expertise
The Old Way of Becoming An Expert
Levels of Cognitive Behavior

- **Skills Based**
  - After learned, need only visual/motor input with minimal cognitive input
- **Rule Based**
  - Following a clinical guideline or protocol
- **Knowledge Based**
  - Clinical decision making
  - Management decisions
  - Diagnostic reasoning
## Mismatch between teaching and practice

**Taught**
- Step-by-step approaches
- Book knowledge
- EBM and Bayesian Analysis
- Hypothesis testing
- Thoroughness / Luxury of Time

**What they see**
- Quick, snap judgments
- “Wisdom” “Experience”
- “Fast and Frugal” or “Flesh and Blood” (real world)
- Pattern recognition and seemingly automatic retrieval from the subconscious
- Shortcuts
“Flesh and Blood Decision Making”

How Doctors think in real life:

- Pattern Recognition
- “Mind as Magnet”
- Non-linear
- Thinking and acting are connected
  - Not data collection followed by analysis
  - “Thought in action”
- Usually 2-3 diagnoses initially
- Heuristics (shortcuts)
Decisions Made in the Blink of an Eye

- “Fast and Frugal” decisions are often amazingly accurate in the right hands
- *Blink* by Malcolm Gladwell
- Trainees are busy looking at every piece of information; the expert goes to the data that will be most helpful or hones in on things are abnormal (don’t fit the expected pattern)
- Leaves trainees very confused and feeling inadequate
Evidenced Based Medicine

- Evidenced Based Medicine
  - Big advance in medical education
  - Moved medicine from the days of “apprenticeship” (following what an expert did and copying that behavior)
  - Gives trainees a way to evaluate the enormous amount of new information
- Often abused and a cause of much “lazy thinking”
  - Evidenced B(i)ased Medicine
Evidence B(i)ased Medicine

- “But the $p$ was less than 0.05”

- Statistically significant is not the same as clinically meaningful
Evidence B(i)ased Medicine

- Does the study apply to my patient?
  - Inclusion criteria
  - Exclusion criteria

- Spectacular examples of adverse effects to patients when this is not done
  - Example: Hyperkalemia after the RALES trial

- An alternative: the N of 1 randomized, clinical trial
Evidence B(i)ased Medicine

- Inability to place evidence in the proper context

- Not taking into account patient preferences
Evidence B(i)ased Medicine

- Manipulation of data and use of data for marketing by pharmaceutical industry and device marketers

- Example: Relative risk versus absolute risks
Clinical guidelines and cookbook medicine

- Great for the simple, straightforward, typical patient
- Help reduce variability in clinical practice
- Speed rate that new knowledge is applied

Why trainees love them:
- Clear answer of “what to do next”
- Clear targets / goals of treatment
- Simplify things / “take away the uncertainty”
Teaching trainees to think
Early Trainees

- Spent years taking tests, sitting in classrooms
- Used to multiple choice questions and “one right answer”
- Uncomfortable with uncertainty
- “There must be a right answer”
- In the end, this leads to a search for THE diagnosis
Occam’s Razor

- A principle attributed to the 14th-century English logician and Franciscan friar William of Ockham.
- *Numquam ponenda est pluralitas sine necessitate*
  - Plurality ought never be posited without necessity
- Diagnostic Parsimony (unifying diagnosis)
- Take all the patient’s symptoms and try to find a single underlying cause
- Emphasized in Sir William Osler’s teachings and writings
Hickam’s Dictum

- Former chairman of Medicine at Indiana University
- “Patients can have as many diseases as they damn well please”
- Statistically more likely that a patient has several common diseases, rather than having a single rarer disease which explains multiple symptoms.
Saint’s Triad

- South African Physician
- Hiatal hernia
- Gallbladder disease
- Diverticulosis

No patho-physiological basis for the coexistence of these three diseases; but are often found in the same patient
Thinking errors

- I discovered there were many other errors other than “the search for the unifying diagnosis”

- Cognitive Psychology and research into “How Doctors Think”

- Cognitive Errors
How do cognitive errors occur?

- Not in isolation typically
- Cascade of sequential cognitive mistakes
- They are common
  - Up to 10% of autopsies reveal a diagnosis that was clinically relevant that was missed
  - Misdiagnosis occurs 15-20% of the time and about 80% of these are due to cognitive errors
- Technology is not a solution
  - Increased technology can increase mis
Types of Cognitive Errors

- Over 30-40 types of cognitive errors have been described in the literature
- A few very common:
  - Anchoring
  - Availability
  - Attribution
  - Premature Closure
  - Confirmation Bias
Anchoring

- Snap judgment
- Locking onto salient features in the initial presentation
- Get “anchored” to this initial hypothesis and then hard to detach from this diagnosis
Confirmation Bias

- “Pertinent Negatives” (or positives) which all make one less likely to consider alternate diagnoses
- Mind’s tendency to “cherry pick” data that fits with our assumptions and rationalize away contradictory data
- Can often compounds an anchoring error
Premature Closure or “Freezing”

- Once you have something that “fits” you stop thinking
- Also has been called “satisficing error”
  - Satisfy + suffice
- “The fracture most commonly missed is the second”
Framing or Diagnosis Momentum

Once several doctors/specialists agree on a diagnosis it is easier to perpetuate it rather than take the time to question its accuracy.
Availability Errors

- Choosing the most likely or most memorable diagnosis
- Over-estimation of frequency vivid or easily recalled events
- Under-estimation of frequency of ordinary or hard to recall events
- The “New England Journal Effect” at morning report
The Zebra Retreat

- “When you hear hoofbeats, think horses”

- But... if you never think of Zebras you will never diagnose one

- Not considering a disease because of its unfamiliarity or rareness
Representativeness

- Deleting a disease from the differential diagnosis list because it does not match the standard variant/usual presentation
- A large problem in diagnosis of patients in whom “atypical presentations” are quite common
Attribution Errors

- Stereotyping
- Judgemental
- Gender Bias
- Racial Bias
Commission Bias

- The urge to act rather than do nothing even when nothing is preferable.
- Rooted in beneficence/active intervention

Omission Bias

- The tendency towards inaction
- Events that are attributed to the natural events of a disease better than those related to a physician’s intervention
- Rooted in non-malificence
Outcome Bias

- Opting for diagnostic decisions that will lead to good outcomes rather than bad ones
- Stronger likelihood in decision making towards what one hopes will happen than for what one really believe might happen
- Results in minimization of potential serious diagnoses
Aggregate Bias / Aggregate Fallacy

- Belief that aggregated data / practice guidelines do not apply to your patient— that your patient is exceptional, atypical, or special

- For example, prescribing antibiotics when not indicated for sinusitis
Playing the Odds

- Opt for the more common or more benign diagnosis because it is more likely

Rule out the Worst-Case Scenario

- Also called “Base-rate neglect”
- Often used in Emergency Room Medicine
- Often used to avoid litigation
Gambler’s Fallacy

- Belief that if a coin is tossed 5 times and is heads each time, then surely the 6th toss has a greater chance of being tails
- (Adjusting the pre-test probability based on outcomes of preceding independent events)
Some other cognitive errors:

- Ying-Yang-Out
- Psych-out Error
- Sutton’s Slip
- Sunk Costs
- Triage Cuing
How do we teach avoidance of these cognitive errors?

- Make thinking explicit – think out loud!
- Feedback
  - Challenges with fragmented system and hand-offs of care
  - Decreased use of autopsies
  - M&M conferences
- Reflective Practice
- Become comfortable with uncertainty
- Acknowledgement that we get it wrong up at least 10% and up to 20% of the time
Thinking about Thinking

- Metacognition: “Cognitive Pills for Cognitive Ills”
- Features of Metacognition
  - Awareness of the requirements of the learning process
  - Recognition of limitations of memory
    - Willing to “look it up”
  - Appreciation of perspective (de-anchoring)
    - Willing to step back and look at the big picture
  - Capacity for self-critique
  - Ability to select and switch between different strategies to deal with each situation
Cognitive Debiasing Strategies

- Develop insight/awareness
- Consider alternatives
- Metacongition / Reflective approach
- Decrease reliance on memory
- Simulations
- Cognitive Forcing Strategies
- Make tasks easier
- Minimize time pressures
- Establish accountability
- Feedback
Summary

- It is possible to get our students to “think”
- We must teach trainees to avoid the simple route of blindly following clinical guidelines and practicing cookbook medicine
- Development of better thinking strategies is what separates a novice from an expert
- We must start with thinking about thinking ourselves and make our thinking explicit to our trainees
- We must teach trainees to think about thinking
- Why? Various cognitive errors are very common and lead to misdiagnosis, and this has significant implications for patient safety
References