Tolerating Uncertainty

The Next Medical Revolution

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Education is at the heart of patient care.
Uncertainty

“As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.”
---Albert Einstein

“All understanding is provisional and subject to continual adjustment.”
---Atul Gawande
Case 1

Janice is a 35 year-old woman who comes to you demanding a mammogram now and annually thereafter. She has no family history of breast cancer and her genetic testing is negative, but wants to be certain she will be safe because a friend of hers died from breast cancer. Her exam is normal. You respond.....
They’re just words…or are they?

- Likely...
- Maybe...
- Probability...
- 10% chance of dying vs. 90% chance of surviving – are they perceived the same by the patient?
Objectives for Today

• Examine uncertainty in clinical reasoning by describing a framework that incorporates inductive thinking, cognitive bias, and probabilistic approaches to clinical problems
• Examine uncertainty in the context of patient values and high value care
• Describe strategies for discussing uncertainty with patients
An Experiment

Take out a piece of paper....
Who is this?
WRITE DOWN YOUR ANSWER
Who is this?
WRITE DOWN YOUR ANSWER

How certain are you?
The Limits of Patterns
What is the diagnosis?
Neural Activation of Pattern Recognition

How we think...Dual Processing

• Conscious thought
• Unconscious thought
  – Cognitive Biases
Judgment Under Uncertainty
*Tversky and Kahneman, Science, 1974*

“...people rely on a limited number of heuristic principles which reduce the number of complex tasks of assessing probabilities...to simpler judgmental operations” which can “lead to severe and systemic errors.”
Dual Process Model for Thinking

**SYSTEM 1 AND SYSTEM 2 PROCESSING**

**“FIRST REACTIONS”**
- System 1 = fast, automatic, impulsive, associative, *emotional*, and unconscious processing = limbic.

**“THINKING”**
- System 2 = slower, conscious, reflective, deliberative, analytical, rational, logical processing = neocortex.
What is critical thinking?
Thinking Approaches

Modified from Pottier et al. Med Ed 2010

Inductive Reasoning

Deductive Reasoning
Clinical Reasoning and Critical Thinking

Overlapping Concepts

- Inductive Thinking
- Hypothetico-deductive Reasoning
- Clinical Epidemiology
- EBM
Diagnosis vs. Hypothesis

- **Diagnosis**: “the act of identifying a disease from its signs and symptoms”
- **Hypothesis**: “a tentative assumption made in order to draw out and test its logical or empirical consequences”

Merriam-Webster dictionary

Implications?
Asking Questions (of others and yourself!)

- Why?
- How?
- Tell me how you think about this problem?
- What do you know about X?
- “You know more than you think!”
Knowledge and Cognitive Biases

• **Cognitive bias and cognitive dispositions to respond**

• **Metacognition:** think about how you are thinking

• **Availability bias** - probability assigned based on ease of recall of specific examples

• **Confirmation bias** - selectively accepting or ignoring data

• **Anchoring bias** - defend your position
Diagnostic Calibration

• Relationship between diagnostic accuracy and physician confidence of accuracy
  – Low level of confidence $\rightarrow$ likely to over-test
  – High level of confidence $\rightarrow$ likely to under-test

• Affected by:
  – Individual tolerance for uncertainty
  – Environmental: fatigue, time available to think
  – Patient tolerance for uncertainty

A. Cifu, JAMA 2017
The Importance of Questions

If I had an hour to solve a problem and my life depended on it, I would use the first 55 minutes determining the proper questions to ask.

Albert Einstein
Case 2

- Ms. D (age 60) began smoking at age 13. She has averaged 1 pack per day since (47 pack years)
- She stopped smoking 2 months ago when threatened with loss of a leg due to an arterial occlusion
- Periodic COPD exacerbations
- Hx of hypertension and diabetes mellitus
- Wants to be screened for lung cancer
BACKGROUND

• Lung cancer is the leading cause of cancer death in the U.S.; overall 5-year survival 18%

• 85% of cases are diagnosed at a late stage with regional LN or distant metastases

• Third leading cause of death

• Studies of screening with plain CXR have not shown reduced lung CA mortality
Biological Rationale for CT Screening

• Time from first malignant cell to radiologically apparent tumor (plain CXR) -- 9 years
• Resection of stage IA non-small cell tumors (tumor size less than 2 cm, negative nodes; no metastases) associated with 5-year survival of 50-90%
• Aggressive tumors likely to have spread by time they become apparent (hence, no survival benefit from CXR screening)
NATIONAL LUNG SCREENING TRIAL (NLST)

- N=53,453
- **Aged 55-70**
- **30 pack years, smoked within 15 years**
- Random assignment to:
  - Low dose CT annually x 3 years
  - Or single plain CXR
- Outcome all cause and lung cancer specific mortality
- Median f/u 6.5 years

NEJM 2011;365:395
### NLST Results: Absolute vs Relative Risk

<table>
<thead>
<tr>
<th></th>
<th>Single CXR</th>
<th>Annual LDCT x3</th>
<th>RRR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of positive test</td>
<td>6.9%</td>
<td>24.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of positive tests that were false positive</td>
<td>94.5%</td>
<td>96.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung cancer incidence/100,000</td>
<td>572</td>
<td>645</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung cancer death /100,000</td>
<td>309</td>
<td>247</td>
<td>20.0%</td>
<td>6.8-26.7%</td>
</tr>
<tr>
<td>Death any cause /100,000</td>
<td>1303</td>
<td>1389</td>
<td>6.7%</td>
<td>1.2-13.6%</td>
</tr>
</tbody>
</table>
Screening and the Individual

• What is good for a single person?
• Relative risk tells only part of the story. What is the absolute risk for this patient given her particular story?
• Absolute risk of dying from lung cancer in NLST only 1.7%. Screening reduced risk to 1.4%.
NLST – Generalizable?

- Patients – younger, healthier, more educated, less likely to be current smokers
- Most subjects enrolled in tertiary centers – less likely to do interventions on nodules; lower surgical mortality than national data (note: for every 10 deaths from lung cancer averted, 3 died from complications of invasive testing and surgical treatment)
NLST – Other considerations

- **Radiation exposure**: estimates of 1 radiation-associated cancer death per 2500 people screened; particular concern for younger people

- **Psychological distress**: false positives in cancer screening associated with depression and perception of poorer overall health

- **Overdiagnosis**: detection of cancer that would not otherwise become clinically significant (broncho-alveolar carcinoma)
When lung cancer screening discussed with the patient, she states: “if they find a spot on my lungs, I want it taken out; I don’t want to wait for more CT scans.”

What do you tell her?
Screening and the Population Perspective

• What is good for 300 million people?
• Small changes in relative risk may lead to significant lives saved for a population
Value Added Care

- How does the intervention add value to the life of the patient? Not just cost issues.
- Consider:
  - Quality of life, what is important to the patient?
  - False positives?
- Complications from evaluation (biopsies; surgery)?
- Emotional burden: How well can she deal with uncertainty?
Back to Case 1

Janice is a 35 year-old woman who comes to you demanding a mammogram now and annually thereafter. She has no family history of breast cancer and her genetic testing is negative, but wants to be certain she will be safe because a friend of hers died from breast cancer. Her exam is normal. You respond.....
Conversations about Uncertainty with Patients: Shared Decision-Making

- Tell me what you understand about your condition and the options.
- What do you value? What brings you joy? What scares you?
- This is what we know and what we don’t know...
- How do you understand probabilities?
- Tests and procedures can have complications
- The concepts of the false positive and negative
The hardest thing for doctors...

“I think the hardest transition from residency, where we essentially trained in inpatient medicine, to my practice as a primary-care physician was feeling comfortable with waiting.”

Rose in “Tell me where it hurts”
Atul Gawande, The New Yorker, January 23, 2017
Summary

• Uncertainty is commonplace in medicine
• We must admit our own uncertainty; talk about hypotheses rather than diagnoses
• When reading the literature, beware of “overselling” by the authors/editors
• High value care is not always about achieving certainty
• Discussions with patients take time and patience