
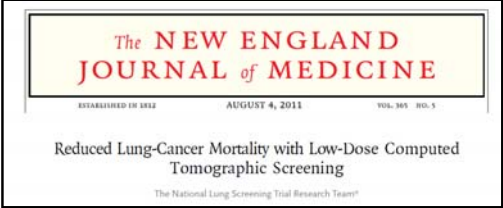


Tanner J. Caverly, MD  
 Instructor of Medicine  
 Primary Care Research Fellow  
 University of Colorado School of Medicine



## CLINICAL NUMERACY


Getting the gist of health risks



### STORY OF TWO CLINICAL ENCOUNTERS


○ **Dr. Innumerate**

*"You need to show up...the courage to undergo colonoscopy or Pap smear or mammogram or chest x-ray. It's not easy, but it could save your life."*



○ **Dr. Numerate**

*"You should know the number of patients needed to screen to avoid one lung-cancer death...the potential for overdiagnosis and other harms."*



1. Oz, Dr Mehmet. "Health Special: Cancer - TIME." *Time*, June 2, 2011.  
 2. Sox, Harold C. "Better Evidence About Screening for Lung Cancer." *New England Journal of Medicine* 365, no. 5 (August 4, 2011): 455-457.

### OVERVIEW

1. Clinical numeracy
  - getting the gist of a risk (1)
2. Pilot Data
3. Innumeracy
  - other things that influence gist (2)
4. Measuring clinical numeracy via the risk gist

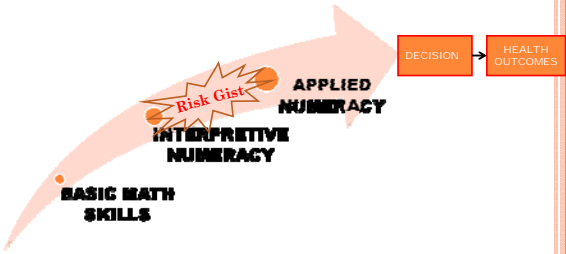
1. Reyna, V. F. "A Theory of Medical Decision Making and Health: Fuzzy Trace Theory." *Medical Decision Making* 28, no. 6 (November 17, 2008): 850-865.  
 2. Kahneman, Daniel. *Thinking, Fast and Slow*. 1st ed. Farrar, Straus and Giroux, 2011.

### CLINICAL NUMERACY

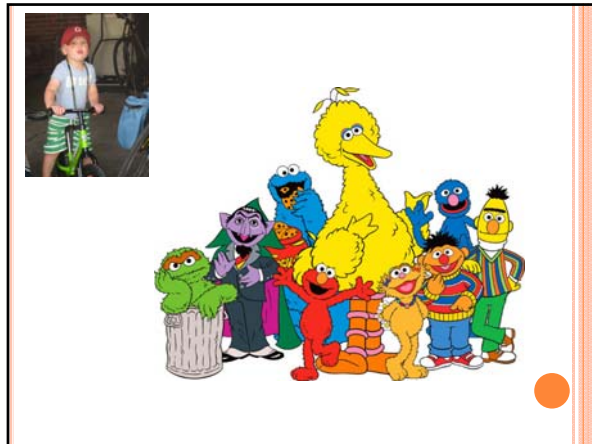
*"the ability to use numbers and numeric concepts in the context of taking care of patients."*

Schapira, Marilyn M., et. al. "A Framework for Health Numeracy: How Patients Use Quantitative Skills in Health Care." *Journal of Health Communication* 13, no. 5 (July 23, 2008): 501-517.

### Model of how numeracy might affect decisions and health outcomes



1. Schapira, Marilyn M., et. al. "A Framework for Health Numeracy: How Patients Use Quantitative Skills in Health Care." *Journal of Health Communication* 13, no. 5 (July 23, 2008): 501-517.  
 2. Reyna, V. F. "A Theory of Medical Decision Making and Health: Fuzzy Traces Theory." *Medical Decision Making* 28, no. 6 (November 17, 2008): 850-865.



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The next question deals with a new study where people either took pill X or placebo (a sugar pill). 3% of people taking placebo died; 1% of people taking pill X died.

Which statement is correct about how pill X changes the chance of death?

- A) 2 more deaths per 100 people
- B) 1 more death per 100 people
- C) 1 fewer death per 100 people
- D) 2 fewer deaths per 100 people

Schwartz, Lisa M., Steven Woloshin, and H. Gilbert Welch. "Can Patients Interpret Health Information? An Assessment of the Medical Data Interpretation Test." *Medical Decision Making* 25, no. 3 (May): 290–300.

3% of people taking placebo died; 1% of people taking pill X died.

Which statement is correct?

- A) 2 more deaths /100 people
- B) 1 more death / 100 people
- C) 1 fewer death /100 people
- D) 2 fewer deaths/100 people

**D: 91% correct**

A prominent health official comments: “We know that regular exposure to second-hand smoke increases the chances of developing heart disease by around 25%. This means that, for every four non-smokers who work in a smoky environment like a pub, one of them will suffer disability and premature death from a heart condition because of second-hand smoke.”

How strongly do you agree or disagree with the official’s statement?

- A) Strongly agree
- B) Somewhat agree
- C) Somewhat disagree
- D) Strongly disagree

Joel Best, *Stat-Spotting: A Field Guide to Identifying Dubious Data*, 1st ed. (University of California Press, 2008)

A prominent health official comments: “This means that, for every four non-smokers who work in a smoky environment like a pub, one of them will suffer disability and premature death from a heart condition because of second-hand smoke.”

How strongly do you agree or disagree with the official’s statement?

- A) Strongly agree
- B) Somewhat agree
- C) Somewhat disagree
- D) Strongly disagree

**D: 68% correct**

### Mammography May Be Beneficial, Regardless of Age

In women who are eighty years old or older, the five-year survival for women diagnosed with breast cancer was 82 per cent among those who did not get screening mammography and 94 per cent among those who did.

These results are based on a randomized controlled trial of screening mammography.

### Mammography May Be Beneficial, Regardless of Age

In women who are eighty years old or older, the five-year survival for women diagnosed with breast cancer was 82 per cent among those who did not get screening mammography and 94 per cent among those who did.

**No: 68% correct**

Enthusiasm for cancer screening

Schwartz, Lisa M, Steven Woloshin, Floyd J Fowler, and H. Gilbert Welch. "Enthusiasm for Cancer Screening in the United States." *JAMA: The Journal of the American Medical Association* 291, no. 1 (January 7, 2004): 71-78.

**(r=0.26, p=0.01)**

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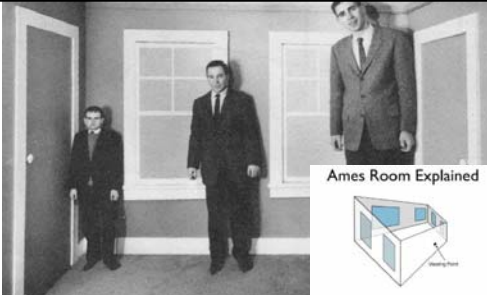
### IRRATIONAL INFLUENCES ON GIST

1. System 1
2. Cognitive Illusions
3. WYSIATI

### TWO SYSTEMS OF THINKING

<p><b>System 1</b></p> <ul style="list-style-type: none"> <li>○ Automatic, quick</li> <li>○ Little or no effort</li> <li>○ No sense of voluntary control</li> </ul> <ul style="list-style-type: none"> <li>• Orient to the source of a sudden sound</li> <li>• Drive a car on an empty road</li> <li>• Find a strong move in chess (if you are a chess master).</li> </ul>	<p><b>System 2</b></p> <ul style="list-style-type: none"> <li>○ Allocates attention to effortful mental activities</li> </ul> <ul style="list-style-type: none"> <li>• Focus on the voice of a particular person in a crowded, noisy room</li> <li>• Maintain a faster walking speed than is natural</li> <li>• Check the validity of a complex logical argument</li> </ul>
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### SYSTEM 1 AND LUNG CANCER

Ames Room Explained

1. CT screening cuts your risk of dying from lung cancer by 20% over 10 years
2. CT screening cuts your risk of dying from lung cancer 0.5% over 10 years

### Cognitive Illusion – exaggerated risk




<b>RELATIVE RISK REDUCTION</b>	<b>ABSOLUTE RISK REDUCTION</b> <small>(per year)</small>
<ul style="list-style-type: none"> <li>• Cut risk of dying from lung cancer by 20% over 10 years.</li> </ul>	<ul style="list-style-type: none"> <li>• Starting risk is 0.3%</li> <li>• Modified risk is 0.25% over 10 years.</li> <li>• Cut risk of dying from lung cancer by 0.05% over 1 year</li> <li>• 0.5% over 10 years</li> </ul>

“A MACHINE FOR JUMPING TO CONCLUSIONS”

## WYSIATI

*“What you see is all there is”*

### WYSIATI



- “220,000 people will be diagnosed with lung cancer every year”
- “160,000 will die from lung cancer every year in the US.”

**0.05%**

- “CT screening cuts your risk of dying from lung cancer by 20% over 10 years”

**0.5%**

### MAJOR PREMISE

Humans have biases → Doctors and statisticians are human → Doctors and statisticians have biases

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### CRITICAL RISK INTERPRETATION TEST (CRIT)

- Evaluate for a numerate risk gist
  1. Gist immune to framing effects
  2. Gist appropriately modified based on the type of risk
  3. Gist is Bayesian

### NEXT STEPS

- Highlight importance of clinical numeracy:
  1. Teaching trainees
  2. Patient care

Framework – Critical Risk Interpretation Test (CRIT)	
Test Category	Ideal response to test item
<b>1. Definition:</b>	
<i>Risk of what? Or Reduced risk of what?</i>	<ul style="list-style-type: none"> <li>• Give more importance to the risk of dying from a disease than the risk of getting disease</li> <li>• Select a larger risk estimate for deaths from all causes than death from a specific disease</li> <li>• Give more weight to a reduction in mortality from any cause than disease-specific mortality</li> <li>• Give more weight to a reduction in population-related mortality than a targeted or non-related test point</li> </ul>
<i>Risk out of how many?</i>	<ul style="list-style-type: none"> <li>• Give equal weight to an absolute number in the US population than to a proportion when they are the same.</li> </ul>
<i>Risk over what time frame?</i>	<ul style="list-style-type: none"> <li>• Give more weight to risk over the next 10 years than to risk over a lifetime when they are equivalent values</li> <li>• Select a larger risk estimate for a 20-year than 10-year risk</li> </ul>
<b>2. Framing:</b>	
<i>How is the risk framed?</i>	<ul style="list-style-type: none"> <li>• Give equal weight to an absolute risk reduction, a number needed to treat, and a relative risk reduction when they are equivalent</li> <li>• Give equal weight to positively framed risk and negatively framed risk when they are the same</li> </ul>
<b>3. Testing:</b>	
<i>How does testing modify the risk?</i>	<ul style="list-style-type: none"> <li>• Understand that disease detection is not the same as disease prevention</li> <li>• For a screening test give more weight to mortality reduction than improvement in 1-year survival rates or increased detection rates</li> <li>• Understand that prevalence affects the predictive value of a test</li> <li>• Understand that changing a test cutoff affects the number of false-positives and false negatives</li> </ul>
Tanner.Caverly@ucdenver.edu	