Raygun
Unpaid Advertisement

IOWA:
WAVE THE NEXT TIME YOU FLY OVER

IOWA CITY:
ALL OUR CREATIVITY WENT INTO THE NAME.

ACTUALLY, WE'RE JUST OUTSIDE THE MIDDLE OF NOWHERE.
Disclosures

• I have no financial or non-financial conflicts of interest

• However, I do sport a southwestern drawl honed in West Texas …

• And my passion over past 25+yrs is to create learning opportunities for resident/fellow physicians so they can be better than their faculty
Please Label Your Card Now

Yellow Card

- Side #1 = ‘Handout’ (for insights & tactics)
Mr. Cox – 80y/o

- Exasperated daughter brought to ED because “he hurts all over and can’t hardly move”
- Doctors & PT not helping with his C3-4 spinal stenosis (mod to severe) or known bilat rotator cuff disease
  - Hgb 11; Na 126; LFTs nl except Alb 2.2
  - ESR = 120
  - RF = 774 IU/ml
  - ED also got Anti-CCP = 300U/ml (nl <3)
Mr. Cox – 80y/o

- New Rheum Fellow called by ED …
  “Sounds like he’s got RA; we’ll see him in consult”

- Admitting Dx Overnite: RA, deconditioning, needs NHP

- At 7:30am: Diffuse aches, especially in shoulders and some hips; Fell on ice in March & broke left humerus; managed with immobilization; Ever since declining, especially past 2months

- Retired machinist for John Deere; Lives alone; HTN; DM; No h/o periodic joint swelling
Mr. Cox – 80y/o

• 40# wt loss over winter; daughter wonders if “cause he can’t barely feed himself”

• Looks pitiful, thin with temporal wasting
• Difficulty raising hands out of lap; hurts to gently shake hands; some thenar wasting; Dupuytren contracture

• Moderate tenderness across shoulder muscles; but NT with gentle passive ROM; no effusions or warmth
• No other joint warmth, swelling, or chronic changes of RA; DTRs 2+

• We started therapeutic trial 15mg pred/d; CXR; & requested outside cervical MRI
Mr. Cox – 80y/o

How are you feeling about his care?

• Rheum team evaluated: feels all from spinal stenosis, rotator cuff dz, fracture, immobility. Agrees no synovitis, but “worried about the high Anti-CCP so consider starting hydroxychloroquine”. “Get hand films to find erosions, do PT, and NHP. Doubt PMR.”
Today’s Road Map Objectives

• Review & Consider Facets of Diagnosis
• Practice Manipulating Numbers
• Practice Manipulating English
• Practice *Avoiding* Formulas
• Enjoy *Fun* Interaction
Key Take Home Messages

1. Ddx should be a verb
2. Orient 2x2 box; Know Doc’s perspective
3. For Sen/Spec/PPV/NPV … name denominator first
4. LRs are the Doctor’s friend
5. LR are just a ratio of likelihoods
Framing Differential Diagnosis & the Process of Diagnosis
What have your experiences been like with differential diagnosis?

Is ‘Differential Diagnosis’ used as

a) A Noun?

or

b) A Verb?
We’ve Seen That …

The Best Way to Understand Just About Anything in Medicine is to Reflect on a Patient . . .
Additionally,

We Can Learn A Lot from Other Real Life Dilemmas
My Car Won’t Start

WHY???
I Call Mechanic #1

“Oh boy, it could be a lot of things”

• No gas / Too much gas / Bad gas / Blocked gas
• Blocked air intake
• Dead battery / Disconnected battery
• Shorted ignition system / Failed spark plugs
• Ungrounded starter / Cellanoid / Other electrical short

“I’ll send over a tow truck, and we’ll run a bunch of tests to figure it out”
I Call Mechanic #2

#2: “When you turn the key, does it crank or not make any noise?”

Me: “Why do you ask?”

#2: “If it cranks, it’s a fuel or air problem, and if it doesn’t it’s an electrical problem”
I Call Mechanic #3

#3: “Did you run out of gas again?”

Me: “Uhh … I didn’t look at the gas gauge; let me go check …”

“Yep, it’s on empty”

#3: “I’ll be right over with a gallon of gas”

Me: “Please don’t tell my wife”
Why Such Different Responses?

- Mechanic #1 (just starting out)
- Mechanic #2 (mid-career & smart)
- Mechanic #3 (old, crusty, & savvy)
Primary Modes of Diagnostic Problem Solving

1. Strategy of Exhaustion
   (Diagnosis by Possibility – Mechanic #1)

2. Hypothetico-Deductive Strategy
   (Diagnosis by Probability – Mechanic #2)

3. Heuristics / Cognitive Shortcuts
   (Diagnosis by Pattern Recognition – Mechanic #3)
Intersection of Diagnosis & Therapy
So, Ddx can be an ACTIVE VERB

Instead of aiming to simply memorize lists of possibilities ...

Regard the Possibilities by:

- probabilistic implications
- prognostic implications
- pragmatic implications
Clinical Action Thresholds
(Critical to Clinicians)

- - - Treatment Threshold

Working Diagnosis &
Few Active Alternatives

- - - Testing Threshold

Other Diagnoses &
Those Ruled Out
Cross a Threshold?

Diagnostic tests most useful when results push disease probability across one of the thresholds, leading to a specific action: wait… test further… or treat.
Where Does Pretest Probability Come From?

Clinical Experience
Population Prevalence
Local Practice Databases

Planned Research
• of $P(Dz)$ for $Ddx$
• of Diagnostic Tests
• Clinical Prediction Rules
The 2 x 2 Table

**TRUTH**

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dx Test

From what perspective do Docs get to gaze into this box?
**The 2x2 Table**

<table>
<thead>
<tr>
<th>Depression</th>
<th>Present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAD Level</td>
<td>&gt;150</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>≤150</td>
<td>40</td>
</tr>
</tbody>
</table>

Neurohormone SAD levels in 200 dazed Cleveland Cavalier fans this morning

What will reassure us that we can trust the results?
Neurohormone SAD levels in 200 dazed Cleveland Cavalier fans this morning

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<td>50</td>
<td>5</td>
</tr>
<tr>
<td>≤150</td>
<td>40</td>
<td>105</td>
</tr>
</tbody>
</table>

Sen = 50/90 = 56%
Spec = 105/110 = 95%

PPV = 50/55 = 91%
NPV =
Neurohormone SAD levels in 200 dazed Cleveland Cavalier fans this morning.

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<tr>
<td>&gt;150</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>100-150</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>&lt;100</td>
<td>15</td>
<td>85</td>
</tr>
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</table>
We Need a 2nd Generation Diagnostic Test Performance Measure ... 

The Noble Likelihood Ratio
# Chief Resident Cohorts

**APDIM EBM Workshops**

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2007</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample Size</strong></td>
<td>119</td>
<td>174</td>
<td>107</td>
</tr>
<tr>
<td><strong>4th Yr Chief</strong></td>
<td>87%</td>
<td>85%</td>
<td>89%</td>
</tr>
<tr>
<td><strong>Univ-Based</strong></td>
<td>56%</td>
<td>56%</td>
<td>56%</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>50%</td>
<td>47%</td>
<td>43%</td>
</tr>
<tr>
<td><strong>Subspecialty Plans</strong></td>
<td>67%</td>
<td>75%</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>2003 (n=119)</td>
<td>2007 (n=174)</td>
<td>2015 (n=107)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>23%</td>
<td>23%</td>
<td>34%</td>
</tr>
<tr>
<td>Relative Risk Reduction</td>
<td>30%</td>
<td>35%</td>
<td>47%</td>
</tr>
<tr>
<td>Absolute Risk Reduction</td>
<td>33%</td>
<td>36%</td>
<td>50%</td>
</tr>
<tr>
<td>Confidence Interval</td>
<td>41%</td>
<td>49%</td>
<td>68%</td>
</tr>
<tr>
<td>Pretest Probability</td>
<td>46%</td>
<td>46%</td>
<td>63%</td>
</tr>
<tr>
<td>Number Needed to Treat</td>
<td>49%</td>
<td>51%</td>
<td>58%</td>
</tr>
</tbody>
</table>
2nd Generation Measure … LR

(No Formulas; just these 2 tenets)

1. LRs are the Doctor’s Friend

2. LRs are just a Ratio of Likelihoods
You’re Cranking Out Notes on the Wards ...
A Tired Lady:

- 71F, ↑fatigue, ↓exercise tolerance
- Pale conjunctivae
- Cough, sput, fever
- RLL crackles
- Hgb 8.7 g/dL
- Does she have iron deficiency anemia?
Neurohormone SAD levels in 200 dazed Cleveland Cavalier fans this morning.

### The 2 X 3 Table

#### Depression

<table>
<thead>
<tr>
<th>SAD Level</th>
<th>Present</th>
<th>Absent</th>
<th>LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;150</td>
<td>50</td>
<td>5</td>
<td>LR = 11</td>
</tr>
<tr>
<td>100-150</td>
<td>25</td>
<td>20</td>
<td>LR = 1.5</td>
</tr>
<tr>
<td>&lt;100</td>
<td>15</td>
<td>85</td>
<td>LR = 0.2</td>
</tr>
</tbody>
</table>
Likelihood Ratio Nomogram

- On left side, select pretest probability
- Straight line through center at LR
- Continue to right side, to posttest probability
Pre-test probability 45%

Post-test probability ~12%

Post-test probability ~90%
Mr. Cox – 80y/o

How are you feeling about his care?

- **Rheum team evaluated**: feels all from spinal stenosis, rotator cuff, fracture, immobility. Agrees no synovitis, but “worried about the high Anti-CCP so consider starting hydroxychloroquine”. “Get hand films to find erosions, do PT, & NHP. Doubt PMR.”

- **Next morning**: Best night of sleep in long time. Helped feed self. Able to participate with PT evaluation

- **Following morning**: bright affect and feeds self; can raise hands to shoulders without pain
Mr. Cox – 80y/o

• Following days – while awaiting Rehab placement – eating like horse; takes laps in hallways with walker

• Daughter tearfully exclaims that it’s a miracle

• Altho no boney erosions, rheum remains very concerned that he’s at very high risk for RA (“ACCP is very specific for RA”) and needs hydroxychloroquine. Suggest rapid prednisone taper down to 6mg and then they’d see him in 3months (we countered)

Think Out Loud: **WHY** is it so hard for our rheum colleagues to let go of RA?
Mr. Cox – 80y/o

- Anti-CCP has a sensitivity of 58% and specificity of 96%
- LR(+) = 14.5
- LR > 10 ... Result in large changes in post-test probability

Systematic Review: Accuracy of Anti-CCP for Diagnosing RA
Ann Int Med 2010; 152:456-464
Pre-test probability 1%

Pre-test probability 40%

Post-test probability >90%

Post-test probability ~10%
Key Take Home Messages

1. Ddx should be a verb
2. For 2x2 box, orient ‘Truth’ from on high
3. For Sen/Spec/PPV/NPV ... name denominator first
4. LRs are the Doc’s friend
5. LR are just a ratio of likelihoods
Savor Your EBM Learning & Teaching in Tasty Slices