EBM Diagnosis

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Mission

Intro to diagnostic test characteristics
(naming what you didn’t know you already know!)

Validity criteria for a paper on a diagnostic test
(do I really want to read this? will I really use this?)

Showing EBM is seriously useful
(and it is seriously fun to understand what you are doing, and why)
### Approach to Diagnosis

**Pattern recognition vs probabilistic diagnostic reasoning**

<table>
<thead>
<tr>
<th>Pattern recognition</th>
<th>Probabilistic diagnostic reasoning</th>
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<tr>
<td>See it and recognize disorder</td>
<td>Clinical assessment generates pretest probability</td>
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<tr>
<td>Compare posttest probability with thresholds</td>
<td>New information generates posttest probability</td>
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<tr>
<td>(usually pattern recognition implies probability near 100% and so above threshold)</td>
<td>(May be iterative)</td>
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- Clinicians select a small list of diagnostic possibilities, the differential diagnosis
- Clinicians then estimate the pretest probabilities using clinical experience (which can be prone to bias and random error), using studies of the same presenting complaint with thorough work-up to yield estimates of frequency of the diagnoses, or using validated clinical decision rules

• Green card = less likely ACS
• Yellow card = more likely ACS
• Blue card = neutral
Case Scenario

- 47 year old, businessman, presents to the ER
- athlete
- with a 1 hour history of squeezing retro-sternal chest pain radiating to both arms
- diaphoretic
- nauseated
- BP 110/70 mmHg, HR 74/min
- S1, S2, no murmur,
- ECG 1 mm ST-segment depression leads V1-V4
Test and Treatment in the Diagnostic Process

Test Threshold

↑

Treatment Threshold

Probability between test and treatment threshold – further testing is required
Let’s Think About A Diagnostic Test Study:

In patients with concern for ACS how reliable is a new high sensitivity troponin compared to a standard troponin assay for early diagnosis of MI?
Approach to Diagnostic Test Articles

Diagnosis

Sensitive cardiac troponin assays were more accurate than a standard troponin assay for early diagnosis of AMI


Clinical impact ratings: ★★★★★★☆☆

15 December 2009 | ACP Journal Club | Volume 151 • Number 6

Are the results valid?

What are the results?

How can I apply the results to the patient care?
Critical appraisal

Are the results valid?

• Did participating patients present a diagnostic dilemma?

• Did investigators compare the test to an appropriate, independent reference standard? Gold Standard

• Were those interpreting the test and reference standard blind to the other results?

• Did investigators perform the same reference standard to all patients regardless of the results of the test under investigation?
Critical appraisal

What are the results?

• What likelihood ratios were associated with the range of possible test results?

(Ah ha, math .....☺️, we’ll come back to this)
Critical appraisal

How can I apply the results to the patient care?

• Will the reproducibility of the test results and the interpretation be satisfactory in my clinical setting?

• Are the study results applicable to the patients in my practice?

• Will the test results change my management strategy?

• Will the patients be better off as a result of the test?
Exam Tip…. Setting Up Your 2 x 2 Table

- Single biggest error is setting this up incorrectly.

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<tr>
<td><strong>Test Positive</strong></td>
<td>TRUE POSITIVE</td>
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### Sensitivity & Specificity

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**Sensitivity** = Likelihood of a positive test when disease is present

**Specificity** = Likelihood of a negative test when disease is absent
Where you are --- What you see --- What you think
# Sensitivity & Specificity

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Sensitivity = Likelihood of a positive test when disease is present

Specificity = Likelihood of a negative test when disease is absent
Thinking about LRs

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Diagnostic test: Looking for someone with red & white striped cap & shirt, blue bottoms
Likelihood Ratios

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\[
\text{LR}(+) = \frac{\text{Likelihood of a positive test in the presence of disease}}{\text{Likelihood of a positive test in the absence of disease}} = \frac{TP}{(TP+FN)} / \frac{FP}{(FP+TN)} = \frac{\text{sensitivity}}{1-\text{specificity}}
\]

\[
\text{LR}(-) = \frac{\text{Likelihood of a negative test in the presence of disease}}{\text{Likelihood of a negative test in the absence of disease}} = \frac{FN}{(TP+FN)} / \frac{TN}{(FP+TN)} = \frac{(1-\text{sensitivity})}{\text{specificity}}
\]
Likelihood Ratios

Impact on likelihood of disease

- **Increased impact**
  - LR = 100
  - LR = 10
  - LR = 5
- **No impact**
  - LR = 1
- **Increased impact**
  - LR = 0.2
  - LR = 0.1
  - LR = 0.01

LR = 0

LR = ∞
Back to our case

4 sensitive cardiac troponin assays vs a standard troponin assay for early diagnosis of acute myocardial infarction in the emergency department*

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<tr>
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<th>Sensitivity (95% CI)</th>
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*ROC = receiver-operating characteristic; diagnostic terms and CI defined in Glossary. LRs calculated from sensitivity and specificity in article. The gold standard was final clinical diagnosis at 60 days.
†At 99th percentile.
‡At 10% coefficient of variation.
Nomogram

Graphic example for Fagan Nomogram for Bayes theorem

Reference

Glasziou, P. Evid Based Med 2001;6:164-166
Some Fun Examples of LR from our cases……

• Diaphoresis:  
  LR = 2.0 (1.9-2.2)

• Chest pain radiation both arms:  
  LR = 9.7 (4.6-20)

• Nausea or vomiting:  
  LR = 1.9 (1.7-2.3)

• History of MI  
  LR = 1.5-3

• Chest pain sharp or stabbing:  
  LR = 0.3 (0.2-0.5)

• Pleuritic chest pain:  
  LR = 0.2 (0.2-0.3)

• Chest pain with palpation:  
  LR = 0.2-0.4

JAMA Rational Clinical Exam, Ch 35. Myocardial Infarction p.467, 2009
Bringing it back to the patient: 1 hour history of squeezing retro-sternal chest pain radiating to both arms

Patient with signs/symptoms of Acute Coronary Ischemia

Nomogram

Pre-test probability | Likelihood ratio | Post-test probability

Dr. Campbell-Scherer Department of Family Medicine
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Figure 3. Diagnostic Accuracy of Cardiac Troponin Assays at Presentation According to Time since Onset of Chest Pain.

The area under the receiver-operating-characteristic curve (AUC) is shown, according to the time since the onset of chest pain, for the four sensitive cardiac troponin assays and the standard assay performed on blood samples obtained at presentation for the diagnosis of acute myocardial infarction.
Critical appraisal

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