

Using the Prioritized Differential Diagnosis to Interpret Diagnostic Tests

Working with uncertainty in medicine

- Clinicians will always have to proceed with uncertainty; we rarely achieve 100% confidence in our decisions.
- Each test you do to evaluate a patient's complaints, *including the H and P*, will change your level of certainty about the possible diagnosis.
- Effective diagnosticians need to understand how tests impact certainty in diagnosis.

Question on Rounds..

- What is a good test for us to choose for this patient in whom we are considering a particular diagnosis?



The Answer: It depends...

- Is it more important that we are certain the patient has the disease?
 - For example, we want to start a risky or expensive treatment.
- Is it more important that we are certain that the patient is free of disease?
 - We want to reassure them that they are healthy or turn our attention to a different disease.

Our Approach

- Work through some statistics and math to prove our points – DON'T PANIC!!!
- Then develop some general heuristics (rules of thumb) to guide decision making daily without the math
- Apply the heuristics to our existing knowledge base about clinical likelihood.

References for the Interested

- Today's work: Medow M, Lucey C. Evidence-Based Medicine December 2011 | volume 16 | number 6 | 163-167
- General Reference: Current Medical Diagnosis and Treatment: Chapter e3.

Performance of Tests: General Principles

- Tests can be described by the extent to which they differentiate between patients with disease and without disease.
- **Sensitivity**: the proportion of people with the disease who have an abnormal test result
- **Specificity**: the proportion of people free from disease who have a normal test result

Sensitivity and Specificity

- Are determined using ideal general populations.
- In general, they are independent of the pre-test probability or prevalence of disease.
- They are characteristics of the test, not of the patient who has taken the test.
- In general, they are reciprocal: a higher sensitivity generally means a lower specificity.

Sensitivity: 2 x 2 contingency table

Sensitivity: $A \div (A + C)$		Disease	
		Present	Absent
Test Results	Positive	A	B
	Negative	C	D

- The higher the **SENSITIVITY**, the more likely that a **NEGATIVE** result means that the disease is not present (because almost everyone with the disease tests positive for the disease).
- **SN-Neg:OUT**: Sensitive tests, when negative, rule OUT the disease

Test
Characteristics



Before the
test result
in our pt

Specificity: 2 x 2 contingency table

Specificity: $D \div (B + D)$

		Disease	
		Present	Absent
Test Results	Positive	A	B
	Negative	C	D

The higher the **SPECIFICITY**, the more likely that a POSITIVE results means that the disease is PRESENT (because almost everyone who is healthy has a negative test).

SP-Pos:IN: Specific Tests, when positive, rule in the disease

Test
Characteristics



Before the
test result
in our pt

Quiz 4.2: A sensitive test

1. Rules in disease when the test result is positive
2. Is positive in people with the disease more often than it is negative in people with the disease.
3. Is positive in people with the disease more than it is positive in people without the disease.

But what we really want to know is..

- What happens to our clinical pretest probability as a result of the test result:
 - If the test is positive, how much more confidence do we have in our clinical diagnosis?
 - If the test is negative, how much does that decrease our confidence in our clinical diagnosis?
- That requires we use the test characteristics and our Tiered pretest probability.

Positive Predictive Value

$$\text{PPV: } A \div (A + B)$$

		Disease		
		Present	Absent	
Test Results	Positive	A	B	All Pts who test +
	Negative	C	D	All Pts who test (-)
		E	F	All Pts who are tested

Test Performance!



After the test result is back

What proportion of patients with a **positive test result** actually **have the disease**?

Depends on the **Prevalence** of Disease [$E \div (E + F)$] and the test characteristics of sensitivity and specificity.

Another way of saying it

- Given a positive test result in my patient, how *certain* am I that the patient has the disease in question?
 - The answer is in the Positive Predictive Value calculation

Negative Predictive Value

PPV: $D \div (D + C)$

		Disease		
		Present	Absent	
Test Results	Positive	A	B	All Pts who test +
	Negative	C	D	All Pts who test (-)
		E	F	All pts who are tested

Test Performance!



After the test result is back

The proportion of people who test **negative** for the disease who truly **don't have the disease**.

Depends on the **Prevalence** of Disease [$E \div (E + F)$] and the test characteristics of sensitivity and specificity.

Another way of saying it...

- Given a negative test result in my patient, how *certain* am I that the patient is **free of** the disease in question?
 - The answer is in the Negative Predictive Value calculation.

What if....

I want to know about misdiagnosis?

- What proportion of people with a negative test result actually have the disease?
 - False negative rate or $(1-\text{NPV})$
- What proportion of people with a positive test result are actually healthy?
 - False positive rate or $(1-\text{PPV})$

Quiz 4.3

- Dr. Osler is somewhat concerned that his patient might have a terrible disease. He orders a test and the result is positive. The statistic that describes the proportion of people with a positive test that actually have the disease is:
 1. Sensitivity
 2. Specificity
 3. Positive Predictive Value
 4. Negative Predictive Value
 5. 1- Negative Predictive Value

Quiz 4.4:

- Dr. Halstead is somewhat concerned that his patient may have a terrible disease. He orders a test result and that test result is negative. The statistic that describes the proportion of people with a negative test who STILL have the disease is:
 1. Sensitivity
 2. Specificity
 3. Positive Predictive Value
 4. Negative Predictive Value
 5. $1 - \text{Negative Predictive Value}$