

What happens if:

- The test characteristic has a higher sensitivity:
- SnNOUT: Sen- N eg-rule OUT the disease

New Case: A Likely Diagnosis (80%)

Specificity 80%

Sensitivity 95%



		Disease		
		Present	Absent	Post Test Probability
Test Results	Positive	A = 760	B = 20	Of disease: $A \div (A + B)$ PPV=97%
	Negative	C = 40	D = 180	Of Health: $D \div (D + C)$ NPV= 81%
		E = 800	F = 200	E + F = 1000

(+) Test

PRETEST

The false negative rate is now 20%

(-) Test

Very likely

Likely

Uncertain

Unlikely

Very unlikely

Pre test probability of 80%

Summarizing in Words

- When a disease is **likely**, a positive result from a very sensitive test can slightly increase certainty that the disease is present
- When a disease is likely, a negative result from a very sensitive test makes you much less certain that the disease is present.

New Case: Uncertain Diagnosis (50%)

Specificity 80% Sensitivity 95%		Disease		Post Test Probability
		Present	Absent	
Test Results	Positive	A = 475	B = 100	Of disease: $A \div (A + B)$ PPV=82%
	Negative	C = 25	D = 400	Of Health: $D \div (D + C)$ NPV= 94%
		E = 500	F = 500	E + F = 1000

Pre test probability of 50%

(+) Test 

PRETEST 

The false negative rate is now 6%

(-) Test 

Very likely

Likely

Uncertain

Unlikely

Very unlikely

Bayes Theorem, summarized

- Tests move the probability of disease up or down.
- If the pre test probability of disease is very high, a NEGATIVE test is more likely a false negative than a true negative.
- If the pre test probability of disease is very low, a POSITIVE test is more likely a false positive than a true positive.
- Tests have the highest impact when the diagnosis is in the uncertain range.

Do we have to do the math?

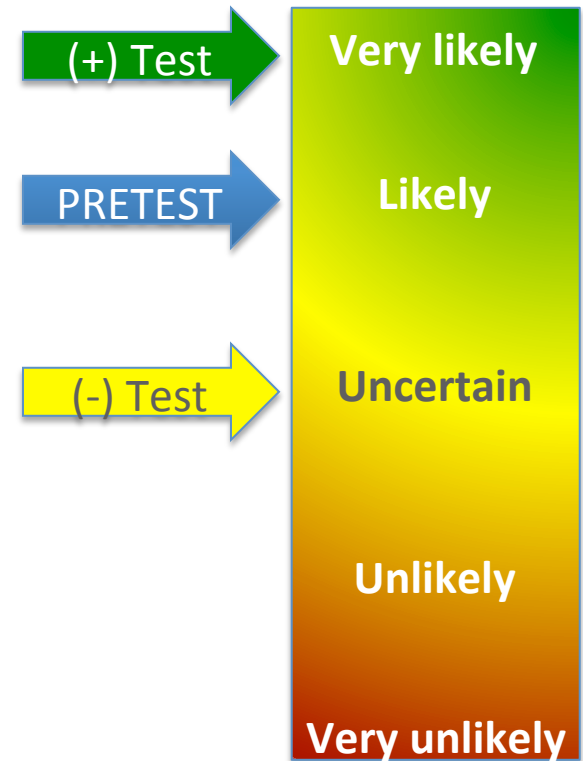
- Several options exist to make the correct interpretation of diagnostic tests easier.
- Both require you to assess the pretest probability of disease.

A Heuristic

- In general, good tests are able to move likelihood of diseases up or down one category (i.e. from uncertain to likely or from uncertain to unlikely)
- Special Cases:
 - If you need to rule out a disease, find a test with a sensitivity $> 99\%$
 - If you need to rule in a disease, find a test with a specificity of $> 99\%$
- Tests are generally not necessary for very likely or very unlikely possibilities. If tests are indicated for very unlikely or very likely conditions (for example, high risk treatment or high risk diagnosis), you may need more than one test.

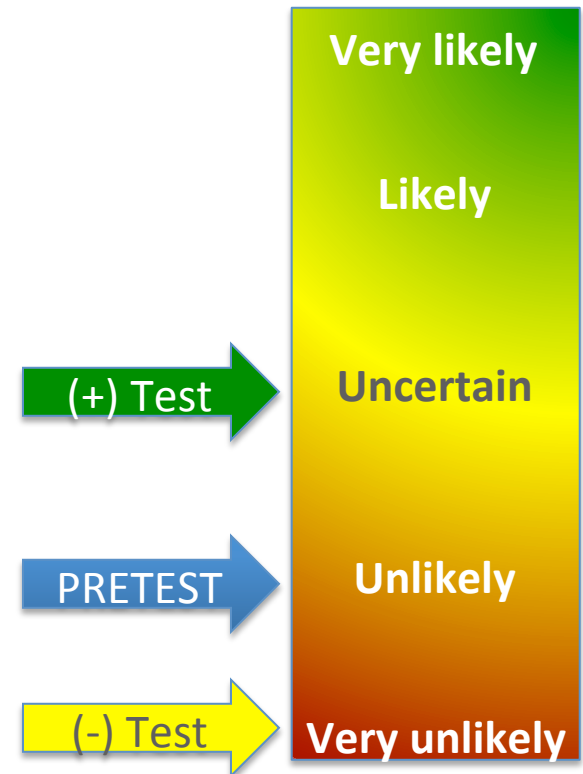
Ex: Is this chest pain due to CAD?

- Published data: middle aged man with anginal chest pain has a pre-test probability of Coronary Artery Disease of 70%.
- If the stress test is POSITIVE?
- If the stress test is NEGATIVE?
 - Be careful! It doesn't rule it out



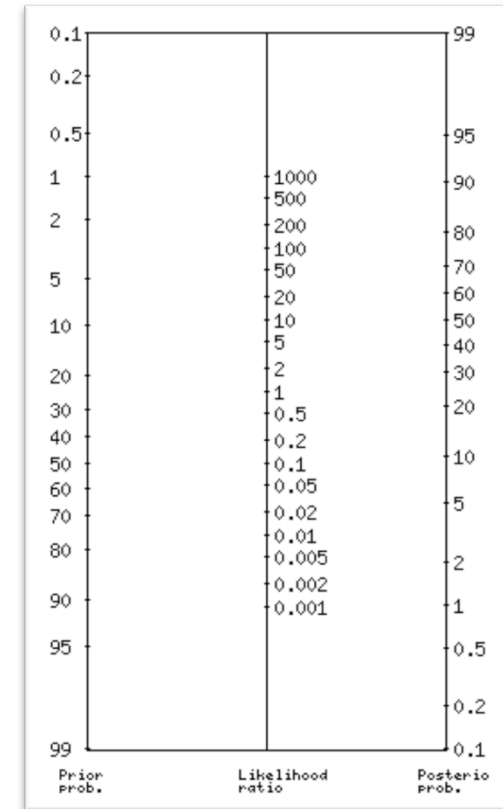
Ex: Is this chest pain due to CAD?

- Published data: middle aged woman with anginal chest pain has a pre-test probability of Coronary Artery Disease of 30%
- If the stress test is POSITIVE?
 - Be careful!
- If the stress test is NEGATIVE?



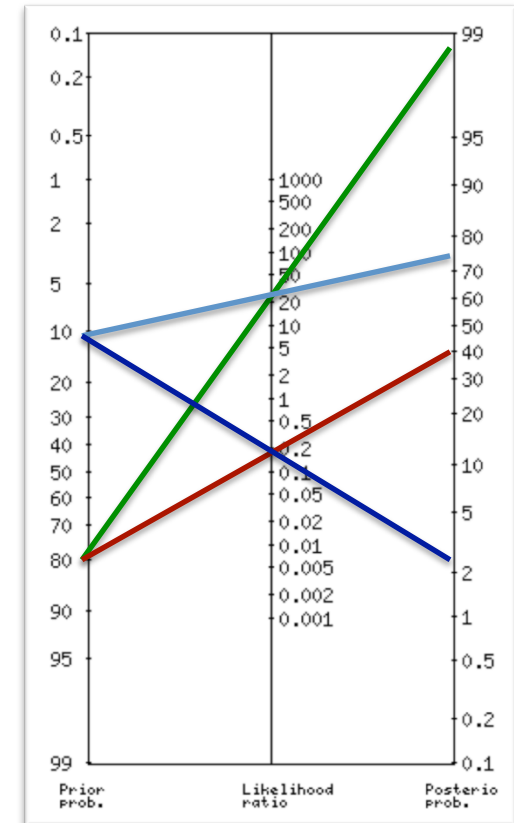
Bayesian (Fagan) Nomogram

- On line calculators:
 - <http://araw.mede.uic.edu/cgi-bin/testcalc.pl>
- Requires the use of likelihood ratios:
- LRs: the likelihood that a test comes from someone with a disease rather than someone without the disease:
- $LR + \text{test} = \text{sensitivity} / (1 - \text{specificity})$
- $LR - \text{test} = (1 - \text{sensitivity}) / \text{Specificity}$



Example: V/Q Nomogram

- Sensitivity 77%
- Specificity 97%
- $LR + = 25$, $LR - = .24$
- If Pretest probab is 80%?
 - Test Pos? Test Neg?
- If pretest probab is 10%?



Key Issues in Module 4

- Chosen carefully and used correctly, diagnostic tests can help decrease your uncertainty about the diagnoses you are considering.
- A common mistake is to consider a diagnostic test result as 100% accurate, rather than an aid to decrease uncertainty.
- Correct usage of tests requires that you know the pretest probability of the disease you are considering: Use your Tiers!
- With your pretest probability, employ 2x2 tables, heuristics or nomograms to anticipate how you will use the test results—positive or negative, *before* the results are back!

Quiz 4.8

- Diagnostic tests are most helpful:
 1. To rule in a disease that is Tier I
 2. To rule out a disease that is Tier I
 3. To rule in a disease that is Tier III
 4. To rule out a disease that is Tier II

End of Module 4