Any diagnostic test can come back positive or negative. And because no test is perfect, the result can also be true or false, regardless of whether it's positive or negative. Every diagnostic test generates true positives, false positives, true negatives, and false negatives. Here's a two-way table to summarize the possibilities.

Health Status of Person Tested	Test Results		
	Positive	Negative	Total
Sick	Correct Result True Positive	Type II Error False Negative	Total number of sick people
Healthy	Type I Error False Positive	Correct Result True Negative	Total number of healthy people
Total	Total number of positive tests	Total number of negative tests	Total number of people tested

The probability that a person is sick is the prevalence of the condition. So the prevalence times the total number of people tested is the total number of sick people. The rest of them are healthy.

total number of sick people = prevalence × test population
total number of healthy people = test population – total number of sick people

A *true positive* result means the test *correctly* identified a *sick* person. The number of true positives is the total number of sick people (prevalence × population) times the probability of a positive test, given that the person is sick (sensitivity).

true positives = total sick × sensitivity

A *false negative* result means the test *mistakenly* failed to identify a *sick* person. That's a type II error. The number of false negatives is the total number of sick people (prevalence × population) times the probability of a negative test, given that the person is sick (complement of sensitivity).

false negatives = total sick × (1 – sensitivity)

A *true negative* result means the test *correctly* identified a *healthy* person. The number of true negatives is the total number of healthy people (population – sick people) times the probability of a negative test, given that the person is healthy (selectivity).

true negatives = total healthy × selectivity

A *false positive* result means the test *mistakenly* failed to identify a *healthy* person. In other words, the test mistakenly identified a healthy person as being sick. That's a type I error. The number of false positives the total number of healthy people (population – sick people) times the probability of a positive test, given that the person is healthy (complement of selectivity).

false positives = total healthy × (1 – selectivity)

When a medical professional delivers a test result, there's no way to know whether it's true or false, the test only reports "positive" or "negative." The question in a patient's mind is, "Does a positive test result mean I'm really for sure sick?" or "Does a negative test mean I'm really for sure healthy?" The answers to both questions are technically no, but answering with a probability is much more informative. The probabilities that really matter to the patient are not prevalence, sensitivity, or selectivity, but

> the probability that the person is truly sick, given that the test result is positive, or
> the probability that the person is truly healthy given that the test result is negative,

This first probability is known as the *positive predictive value* (PPV) of the diagnostic test, and the second is called the *negative predictive value* (NPV). By thinking about what they mean as conditional probabilities, you can figure out how to compute them.

PPV = P(person is sick | test is positive)
= P(person is sick AND test is positive) ÷ P(test is positive)
= true positives ÷ all positives

NPV = P(person is healthy | test is negative)
= P(person is healthy AND test is negative) ÷ P(test is negative)
= true negatives ÷ all negatives

Does your doctor understand PPV and NPV? It's taught in medical school. (Probably no more than one class period). Sure hope they didn't skip that day...
