How to Avoid Guessing about Risk

Most of us are vulnerable to the dangerous illusion called the false positive. To demonstrate, please allow me to make you sick.

You have been feeling tired for a long while and your skin is becoming painfully dry. Your doctor suspects you have Finding's Pneumonia (named for Sir Basil Finding; called FindingPneumo for short). She orders a test. It can only be given once. You test positive.

Your doctor informs you that without treatment, FindingPneumo will shortly cause your skin to turn bright orange and scaly for about three years.

There is a cure. She recommends you take it. It has side effects, however: severe flulike symptoms for two months. It costs $28,000 and is not covered by your insurance.

You are uncertain. Should you buy the cure? What is your risk? You ask for more facts. Your doctor gives you these:

1. Three percent of the population has FindingPneumo, whether or not they have symptoms yet. She unnecessarily points out—you are not an idiot—that 97 percent of the population does *not* have FindingPneumo.

2. The test for FindingPneumo is not perfectly accurate. There is a 10 percent chance of a false positive. That is to say, one out of ten people who do *not* have FindingPneumo will nonetheless get a test result that says they do.

3. There is also a 67 percent chance that a person who actually *has* FindingPneumo will test positive for it. That leaves a 33 percent chance of a false negative.

You seek a second opinion. That doctor tells you exactly the same thing, as does Wikipedia.

Now you must decide. Should you spend $28,000 and feel horrible for sixty days to ensure that you do not look like a clown fish for three years?

Yes, you did test positive, but what is the chance it was a false positive? Do you really have Finding-Pneumo? The test is only 67 percent accurate, after all.

So you have a 67 percent chance of having the disease, right? Wrong.

An estimate of 57 percent, however, neatly subtracts the 10 percent false positive number from 67 percent. Also wrong.

Channel your inner Gene Kranz. Be a good flight director. Don't guess. Know. Assess your risk with

statistics. Just how strong a piece of evidence is the fact that you tested positive for FindingPneumo?

Imagine that Flight Director Kranz gives you this big hint: "Base rates." Imagine you ask him to elaborate and he says: "Ninety-seven percent of the population is a lot of people."

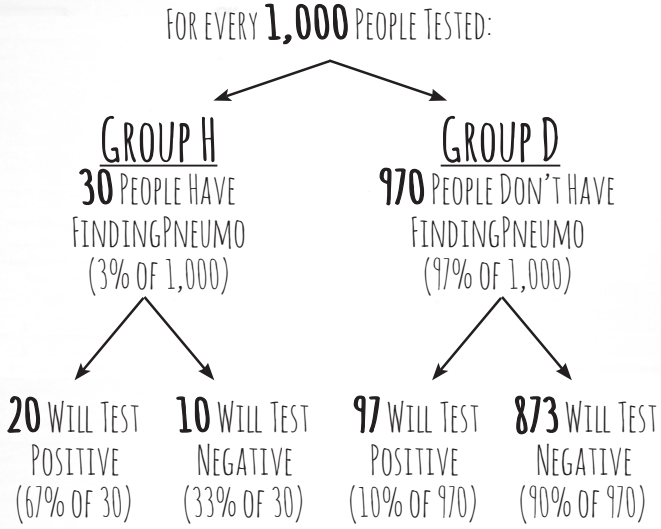
The thought then occurs to you that a large number of people must get false positives. Indeed the 10 percent false positive rate multiplied by the 97 percent of the population who don't have FindingPneumo means that 9.7 percent of the population will get a false positive if tested.

You see that the false positive group would be more than three times larger than the 3 percent of all people who actually *have* FindingPneumo. Feeling a bit better, you proceed to turn your uncertainty into risk. You get out pen and paper and proceed to draw the diagram opposite this page.

Now you know your risk. You have a less than one in five chance of becoming bright orange and scaly. Maybe you will keep your $28,000 and skip the side effects of the medicine. Maybe you won't. You certainly won't be guessing.

Regardless of your choice—or the result—you have done what needs to be done by someone who tests positive for FindingPneumo. That's excellent.

Does a Positive Test Mean I Have FindingPneumo?



Since I tested positive, I need to know the probability of **anyone** testing positive actually having the disease. To start, I will add the number of people who test positive from both groups:

20 from Group H + 97 from Group D = 117 total people who tested positive

I will turn uncertainty into risk by seeing what percentage of that 117 people who tested positive are the 20 people who test positive and actually do <u>have</u> the disease:

20 ÷ 117 = 0.17

Because I tested positive, my probability of having FindingPneumo is **17%.**