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Hi, this tutorial covers false positives and false negatives. So let's just start with a situation. So suppose you need to bring your dog to the vet for a Lyme disease test. If you're not familiar with Lyme disease, Lyme disease is a common tick-borne disease. So if you spend a lot of time outside with your dog, it's often good to check for ticks. So the test, then, for the disease has two outcomes, either a positive test or a negative test. So after the vet performs the test, he's either going to read the test as being positive or negative.

A positive test would indicate that Lyme disease is present in the dog. A negative test would indicate that Lyme disease is not present in the dog. Most tests of this type are not 100% accurate. So sometimes you will get incorrect or false tests.

OK, so let's just take a look at, basically, the four different outcomes that can happen with the dog and the test. All right, so I have it broken down into basically two categories-- either a positive test, a negative test, and then whether the disease was present or the disease was not present in the dog. OK, so let's think about which of these outcomes would be good outcomes, which would be bad outcomes.

OK, so if we take a look at this first one, a positive test, when the disease is present. That outcome is good. If the dog actually has the disease, it's good if they test positive so then they can actually get the treatment that the dog needs.

OK, now if we look at this one, a positive test if the disease is not present. This is bad. So we'd be committing an error here. So there'd be a flaw in the test. And since this is a positive test that is incorrect, what we do is we call this a false positive. So that's a false positive test.

OK, now if we take a look now at the next one, a negative test when the disease is present. OK, that's also a bad outcome. You don't want the dog to test negative if they actually have the disease. In that case, the disease might spread, the side effects may continue, so this is also a bad outcome. And since this is a negative test that was incorrect, we call this a false negative. And then, finally, a negative test, when the disease is not present, that's also a good outcome.

OK, so kind of to formally define false positive and false negative, a false positive is when a test indicates that a condition is present when it actually does not exist, and a false negative is when a test indicates that a condition is not present when it actually does exist. And both of these two things have different repercussions. Again, if you get a false positive, it's going to test-- the dog is going to

test for Lyme disease when it doesn't actually have it.

So what's going to happen here, as a consequence, is the owner is probably going to end up having to pay for medication, which the dog doesn't need, spend more time treating the dog, and then a false negative, probably in this situation is a little bit worse. The dog won't get treatment for the disease, and it might spread.

OK, so let's investigate the false positives and false negatives a little bit more here. So suppose it's known that 90% of Lyme disease tests are positive when the dog has the disease, and 90% of tests are negative when dogs don't have the disease. Also suppose that 10% of dogs tested actually have the disease. OK, so let's kind of put those numbers into context a little bit here.

OK, so we know that 10% of dogs have the disease. So the disease is present. And 90% of dogs, the disease is not present. Now if the disease is present, there's a 90% chance of a positive test, a 10% chance of a negative test. OK, so now to actually figure out what percent of dogs will fit in this category, what we can do is take the 10%, so the 0.1 probability that the disease is present and multiply it by 0.9, which is the probability of a positive test if the disease is present. So if we multiply those two, we end up with 0.09. So that means 9% of all of the dogs that come into the clinic will fit into this category, OK?

Now then having a negative test if the disease is present, we take that 10%, there's a 0.1 probability that the disease is present in the dog and multiply it by 0.1 again because 0.1 is the probability of getting a negative test if the disease is present. So if we multiply those two together, we get 0.01. So 1% of dogs that come to the clinic will fit into this category.

OK, so now for the next two, again there's a 90% chance that the disease is not present. So we're going to take that 0.9 and we're going to multiply this by the probability of a positive test if the disease is not present. And that's 10%. So if we multiply those two together, that's 0.09. OK and then for a negative test, so now there's a 90% chance of a negative test if the disease is not present, so then we're going to multiply that by 0.9, and that ends up being 0.81.

OK, so now, let's kind of interpret these numbers. So 9% of dogs will be in this category, 9% in this category, 1% in this category, 81% in this category. Now, the thing that kind of strikes me is that these two numbers are the same. So basically, if the dog receives a positive test, there's an equal number of dogs in each of these two categories. So really, that means that if there's a positive test, 50% of dogs will actually have the disease. 50% will not have the disease. So that's a problem. So this

positive test doesn't give us a real clear indication on whether or not the disease is actually present.

So due to the presence of false positives and false negatives, it is important to carefully interpret the results of any test. So that has been the tutorial on false positives and false negatives. Thanks for watching.