Predictive value: Will I need insulin?

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Case history

Jenny presented with a three week history of polyuria, polydipsia, weight loss and thrush. Her urine test showed 4+ glycosuria. You tell Jenny you think she has diabetes; she is now worried that she will need insulin.

Jenny is 37 years of age, has no family history of type 2 diabetes and did not have gestational diabetes with either of her two children. She is overweight, but not obese (height 158 cm, weight 65 kg*). She does not exercise regularly, but is 'always on the go' in her job as a receptionist. Her age and strong family history of autoimmune disease (two sisters have autoimmune thyroid disease – one hypo- and one hyper-thyroid) suggest she may have late onset autoimmune diabetes (LAD). You tell Jenny that if she does, her beta cells will be destroyed and she will need insulin to control her blood glucose. You explain that: 'only time will tell, and insulin treatment is much easier and simpler than it used to be'. Jenny is not reassured and asks if there is a test that will tell her if she needs insulin.

A proposed new antibody test detects about 90% of people who have LAD and is false-positive in about 10% of people who don't.

Question 1

What is the sensitivity of the test?

Question 2

What is its specificity?

Question 3

If Jenny is not very likely to have LAD (ie. about 1 in 20) and the test is positive, how likely is she to need insulin?

Question 4

If you think Jenny is fairly likely to have LAD (ie. about 1 in 2) and the test is negative, how likely is she not to need insulin?

Question 5

If it became available, would you order the new test on Jenny?

Feedback

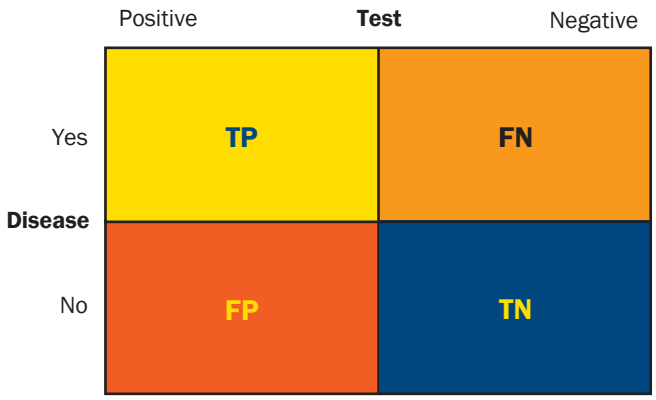
Answer 1

Sensitivity equals people with the disease who have a positive test divided by the total number of people with the disease (Figure 1).

Answer 2

Specificity equals the number of people without the disease with a negative test divided by the total number of people without the disease (Figure 1).

* Body mass index (BMI)=weight (kg)÷height^2(metre^2)=65 ÷1.58^2=26. Healthy BMI 20–25, overweight 25–30, obese >30 kg/m^2.



In patients with the disease the true positives (TP) have a positive test and the false negatives (FN) have a negative test. In patients without the disease, the false positives (FP) have a positive test and the true negatives (TN) have a negative test.

Sensitivity = true positives divided by all those with the disease, ie. TP/(TP+FN)

Specificity = all those without the disease minus false positives divided by all those without the disease, ie. 1 minus false positives divided by all those without the disease (1-FP/FP+TN).

Figure 1. Sensitivity/specificity model

Answer 3

The predictive value of a positive test equals the number of people with a positive test who have the disease divided by the total number of people who have a positive test.

If we assume that of 1000 people like Jenny, 50 (1 in 20) will have LAD. Of these 50, 90% will have a positive test (0.90x50=45). Of the 950 without the disease, 10% (95) will have a positive test. The positive predictive value equals 45 divided by 45 plus 95 equals 0.32 (32%). Given your 'guestimate' and the positive test, Jenny has about a 1 in 3 chance of needing insulin.

Answer 4

The negative predictive value of a negative test equals the number of people without the disease with a negative test divided by the total number of people with a negative test.

If we now assume that of 1000 people like Jenny, 500 will have the disease (1 in 2) and 500 won't. Of the 500 with the disease, 10% (50) will have a negative test (the test is only positive in 90% of those with disease). Of the 500 without the disease, 90% (450) will have a negative test (the test is only positive in 10% of those without the disease). The negative predictive value of the negative test equals 50 divided by 50 plus 450 equals 10%.

In this scenario, if Jenny's test were negative she would be 90% likely not to need insulin.

Answer 5

The decision to test or not test would depend on your 'guestimate' of Jenny's likelihood of having LAD and how she will respond to the implications of a positive or a negative test.

In the first case, you may tell her she is unlikely to develop LAD, therefore, she won't spend the next few weeks or months worrying. In the second case, you may suggest she has the test since a negative result will enable you to reassure her and a positive result will give you some confidence that she is likely to need insulin.

The predictive value of a positive test in this case equals those with the disease and a positive test divided by all those with a positive test, ie. (500 x 0.9) ÷ (500 x 0.9 + 500 x 0.1) = 450/500=90%.

Conflict of interest: none declared.

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