Understanding diagnostic tests. Part 3.

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In the previous articles from this series[1,2] we discussed important characteristics used in order to evaluate diagnostic tests: sensitivity, specificity, positive predictive value, and negative predictive value. In this final part, we discuss positive likelihood ratio (LR+), negative likelihood ratio (LR−), and ROC curves.

LIKELIHOOD RATIOS

LRs combine sensitivity and specificity to quantify how helpful a new diagnostic test is in changing (increasing or decreasing) the probability of having a disease compared with the prevalence of that disease (pretest probability) in the population studied. The LR+ of a test is the probability of a positive result in patients with the disease divided by the probability of a positive result in patients without the disease, whereas LR− is the probability of a negative result in patients with the disease divided by the probability of a negative result in patients without the disease. LR+ ranges from 1 to infinity, and an LR+ of 1 indicates that the probability of a positive test result is the same for patients with and without the disease; therefore, the test is useless. An LR+ greater than 1 supports the presence of the disease, and the greater LR+ is, the more a positive test result increases the probability of the disease when compared with the pretest probability. LR− ranges from 1 to 0, and the closer the LR is to 0, the lower the probability of the disease is if the test result is negative.

ROC CURVES

We use ROC curves to make a global assessment of the value of a diagnostic test by calculating the area under the curve (AUC). The values of the AUC can vary from 0 to 1.0, and values over 0.8 indicate that the diagnostic test has very good accuracy. The ROC curve plots sensitivity (true positives) against "1 – specificity" (false negatives) for all the possible cut-off values of the new test (Figure 1). As we have previously discussed, there is always a trade-off between sensitivity and specificity when we define a cut-off value for quantitative test results. If a new test were perfect, there would be a complete separation of values between patients with and without the disease, the cut-off value would be the lowest value among patients with disease, and the AUC would be 1. However, since there are no perfect tests, there will always be some false positive or some false negative results. The more accurate a test is, the greater the AUC is, which is the probability that a random person with the disease has a higher value of the measurement than a random person without the disease.[3]

MAKING SENSE OF DIAGNOSTIC TEST PERFORMANCE CHARACTERISTICS

If you are wondering which of the parameters described is more useful to evaluate a diagnostic test—sensitivity, specificity, LRs, or ROC curve—the answer is: it depends! Each parameter describes a specific characteristic of the test, and depending on how you will use the test, one or another may be more useful. Now that you understand these concepts, interpreting a test result will be much more than just looking at the result.

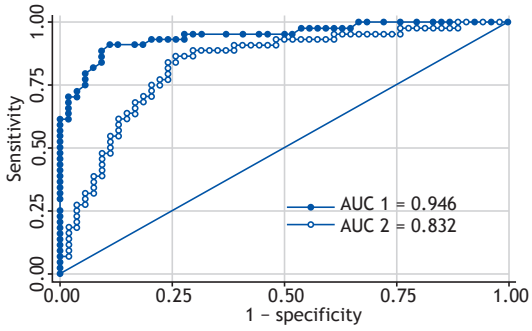

Figure 1. ROC curve plotting sensitivity vs. "1 – specificity" for two different tests. Both tests have good accuracy; however, test 1 (closed circles) has an area under the curve (AUC) of 0.946 and test 2 has an AUC of 0.832 (open circles), meaning that test 1 has overall better accuracy to discriminate between patients with and without the disease. This figure was created with fictitious data.

REFERENCES

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