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Making Sense of Biostatistics: Predictive Values

By Kathleen Mathieson

Sensitivity and specificity are frequently used to assess the value of a diagnostic test. These values flow from the "true" disease status to the diagnostic test result. Sensitivity is the probability of a positive test, given the presence of the disease. Specificity is the probability of a negative test, given the absence of the disease.[1,2] In Table 1 below, among the 45 patients who are known to have the disease, 39 (87%) had a positive test result (sensitivity=.87). Among the 492 patients who are known to not have the disease, 325 (66%) had a negative test (specificity=.66). We can thus estimate that nine of 10 patients with the disease will have a positive test, while two of three patients without the disease will have a negative test.

Table 1. Sensitivity, Specificity and Predictive Values

	Disease Status			
Test Result	(+)	(-)	Total	
(+)	39	167	206	PPV*=39/206=.19
(-)	6	325	331	NPV=325/331=.98
Total	45	492	537	Prevalence=45/537=.08
	Sens=39/45=.87	Spec=325/492=.66		

*PPV=Positive predictive value; NPV=negative predictive value; Sens=sensitivity; Spec=specificity.

In clinical practice, however, the true disease status is unknown. Indeed, the aim of diagnostic testing is to use the test result to determine the probability of disease and the need for subsequent testing and/or treatment. For this reason, predictive values can be a more intuitive way than sensitivity and specificity to assess the clinical value of a diagnostic test because they flow in the reverse direction: from the test result toward the disease status.[3,4]

Positive predictive value (PPV) tells us the proportion of patients with a positive test result who have the disease. Negative predictive value (NPV) tells us the proportion of patients with a negative test result who do not have the disease. In Table 1, the PPV of the test is 39/206=.19 and the NPV is 325/331=.98. Based on these data, we can estimate that about 19 of 100 of patients with a positive test have the disease and 98 of 100 patients with a negative result do not have the disease. From this perspective, in this particular scenario, the diagnostic test has thus been demonstrated to be useful in ruling out the disease when the test is negative.

The disadvantage of predictive values is that, unlike sensitivity and specificity, they are substantially affected by the overall prevalence of the disease in the population being tested. In Table 1, the prevalence of the disease is 8%. In a population with a prevalence of 25%, the PPV would increase to 46% and the NPV would decrease to 94%, but the sensitivity and specificity results would remain the same.

Therefore, it is crucial to consider the prevalence of the disease in the patient population. Further, a specific patient may have greater or lesser probability of disease than the larger patient population, based on his or her personal risk factors. This "pre-test" probability should be taken into consideration when making clinical decisions.

References

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Author

Kathleen Mathieson, PhD, CIP, is an Associate Professor in the Doctor of Health Sciences Program at A.T. Still University (ATSU) in Mesa, Arizona. She is also a Vice-Chair of the ATSU-Arizona Institutional Review Board and a Still Research Institute Scientist. Contact her at 1.602.573.6547 or kmathieson@atsu.edu.