January 2004. Thinking about, SPIN and SNOUT.

Thinking about,
SPIN and SNOUT
In cases where
Disease is rare.
Don't use SPIN,
But keep SNOUT in.

Introduction

In the March 2003 Rule of the Month we discussed the concepts of SPIN and SNOUT as promulgated by Sackett et al (1991). These very useful mnemonics are used to indicate that high specificity is needed to rule in disease, and high sensitivity is needed to rule out disease. Here we consider more carefully these rules when the disease is rare: occurrence is less than 1/100.

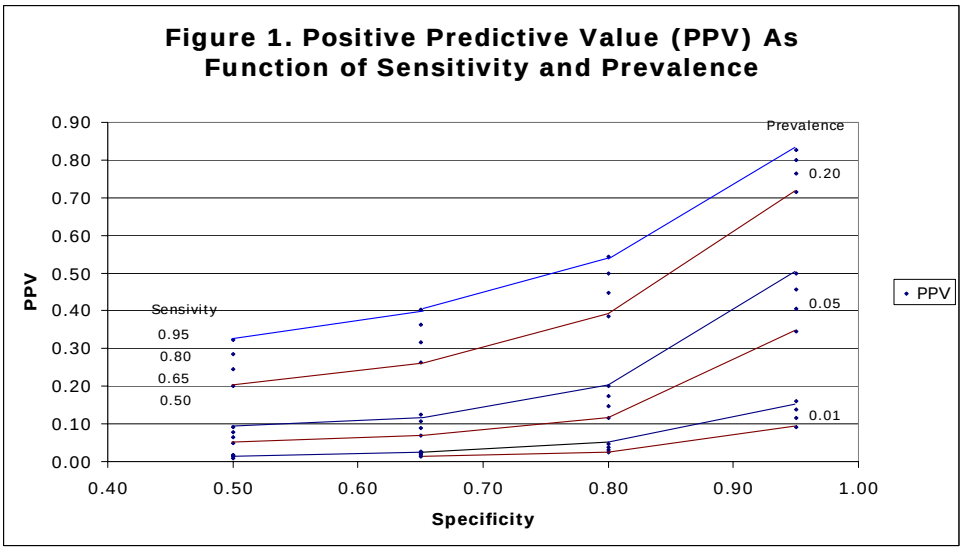
Rule of Thumb

When the disease is rare the specificity of a test is rarely high enough to give adequate positive predictive value. Only the sensitivity is useful in the rare disease case.

Illustration and Basis for the Rule

The prevalence, sensitivity, and specificity determine the positive predictive value (PPV) and negative predictive value (NPV) of a test. The PPV is the probability that the subject has the disease given that the test is positive—hence the link to SPIN. The NPV is the probability that the subject does not have the disease given that the test is negative—hence the link to SNOUT. But the relationship is asymmetric in terms of the dependence on the prevalence.

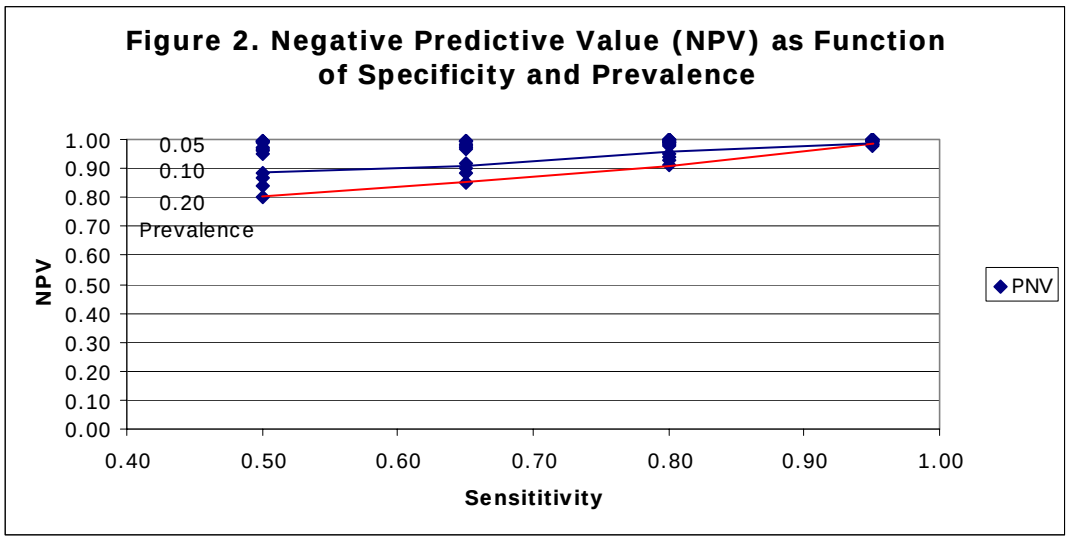
Figure 1. Positive Predictive Value (PPV) As Function of Sensitivity and Prevalence



Figures 1 shows how SPIN is related to prevalence, and Figure 2 shows how SNOUT is related to prevalence. The prevalence, sensitivity, and specificity determine the positive predictive value (PPV) and negative predictive value (NPV) of a test. The PPV is the probability that the subject has the disease given that the test is positive—hence the link to SPIN. The NPV is the probability that the subject does not have the disease given that the test is negative—hence the link to SNOUT. But the relationship is asymmetric in terms of the dependence on the prevalence. Figures 1 shows how SPIN is related to prevalence, and Figure 2 shows how SNOUT is related to prevalence.

Figure 1 shows that with rare diseases it is very unlikely that the specificity can be increased sufficiently high to get a reasonable PPV. "Reasonable" could mean more likely than not. That is, the PPV=0.50 or greater. The figure shows that this is very difficult to obtain with low prevalence. The figure also indicates that increasing the sensitivity has only a modest effect on the PPV. For rare diseases the sensitivity is make relatively little difference.

Figure 2 shows that with rare diseases the negative predictive value of a test is very high. In fact, the rarer the disease the greater the NPV! And this is true regardless of the specificity of the test.



Discussion

The two figures illustrate the asymmetry of the two concepts. A positive test basically does not mean much unless the specificity is very high. One example of where this is the case is HIV testing. Another is the plasma cotinine test for tobacco smoke with a reported specificity of 100% (Koepsell and Weiss, 2003, citing Jarvis et al, 1987). It often only possible to achieve such high values unless extreme, expensive care is taken in carrying out the test. Most of the routine medical tests used appear to have sensitivities and specificities below 95%. In these instances the rule stands.

Reference

Jarvis, M.J., Tunstall-Pedoe, H., Feyerabend, C., Vesey, C. and Saloojee, Y. (1987). Comparison of tests used to distinguish smokers from nonsmokers. *American Journal of Public Health*, **77:** 1435-1438.

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Sacket, D.L., Hayes, R.B., Gyatt, G.H. and Tugwell, P. (1991). *Clinical Epidemiology: A Basic Science for Clinical Medicine.* Second Edition. Little, Brown and Company, Boston, MA. (page 77).