TEST STATISTICS

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- If we have a gold standard of evidence we can then construct a confusion matrix
- The test sensitivity and specificity can be calculated
- The prevalence *could* also be calculated or can come from an independent source
- Bayes' rule can be used to calculate the PPV

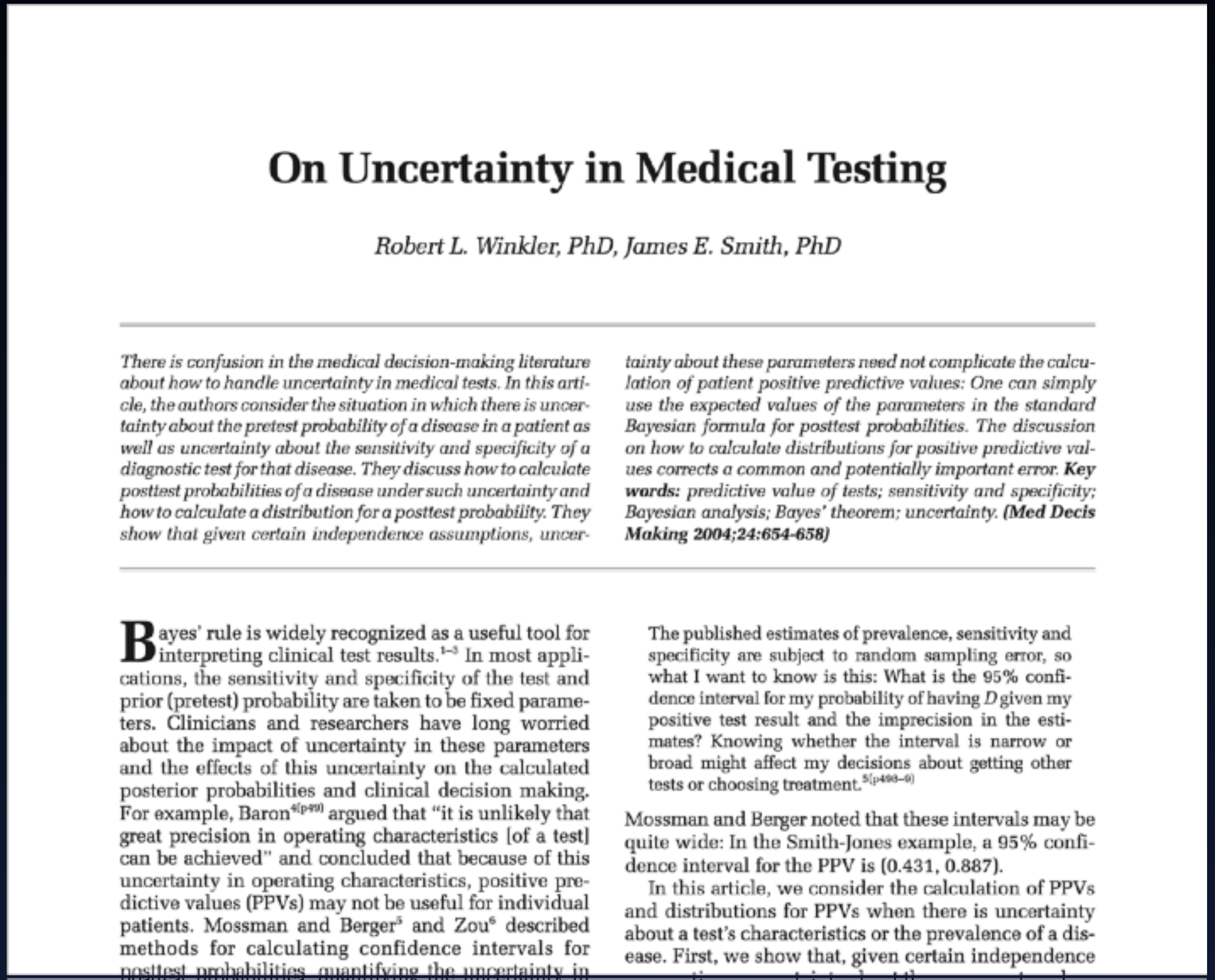
	Gold Positive	Gold Negative
Test Positive	*A*	B
Test Negative	C	D

$$s = \frac{A}{A+C} \qquad t = \frac{D}{B+D}$$

$$p = \frac{A+C}{A+B+C+D}$$

$$PPV = \frac{ps}{ps + (1-p)(1-t)}$$

WINKLER AND SMITH



On Uncertainty in Medical Testing

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There is confusion in the medical decision-making literature about how to handle uncertainty in medical tests. In this article, the authors consider the situation in which there is uncertainty about the pretest probability of a disease in a patient as well as uncertainty about the sensitivity and specificity of a diagnostic test for that disease. They discuss how to calculate posttest probabilities of a disease under such uncertainty and how to calculate a distribution for a posttest probability. They show that given certain independence assumptions, uncertainty about these parameters need not complicate the calculation of patient positive predictive values: One can simply use the expected values of the parameters in the standard Bayesian formula for posttest probabilities. The discussion on how to calculate distributions for positive predictive values corrects a common and potentially important error. **Key words:** *predictive value of tests; sensitivity and specificity; Bayesian analysis; Bayes' theorem; uncertainty.* ***(Med Decis Making 2004;24:654-658)***

Bayes' rule is widely recognized as a useful tool for interpreting clinical test results.[1–3] In most applications, the sensitivity and specificity of the test and prior (pretest) probability are taken to be fixed parameters. Clinicians and researchers have long worried about the impact of uncertainty in these parameters and the effects of this uncertainty on the calculated posterior probabilities and clinical decision making. For example, Baron[4(p49)] argued that "it is unlikely that great precision in operating characteristics [of a test] can be achieved" and concluded that because of this uncertainty in operating characteristics, positive predictive values (PPVs) may not be useful for individual patients. Mossman and Berger[5] and Zou[6] described methods for calculating confidence intervals for posttest probabilities quantifying the uncertainty in

> The published estimates of prevalence, sensitivity and specificity are subject to random sampling error, so what I want to know is this: What is the 95% confidence interval for my probability of having *D* given my positive test result and the imprecision in the estimates? Knowing whether the interval is narrow or broad might affect my decisions about getting other tests or choosing treatment.[5(p498–9)]

Mossman and Berger noted that these intervals may be quite wide: In the Smith-Jones example, a 95% confidence interval for the PPV is (0.431, 0.887).

In this article, we consider the calculation of PPVs and distributions for PPVs when there is uncertainty about a test's characteristics or the prevalence of a disease. First, we show that, given certain independence

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