Likelihood Ratios for Microbiology

We noted with interest a recent letter (G. Giocoli, Letter, J. Clin. Microbiol. 38:3520–3521, 2000) exhorting microbiologists to report likelihood ratios (LRs) along with diagnostic test results. We wish to expand on the strengths and weaknesses of LRs for infectious disease diagnosis.

As Giocoli points out, sensitivity and specificity reflect the probability of a test result when disease status is known, whereas for individual patients we wish to know the probability of disease given the test result. With a physician’s estimate of the pretest probability, LRs allow estimation of disease probability given a test result—seemingly the ideal diagnostic parameter. LRs may be calculated from 2×2 tables or directly from the sensitivity (Se) and the specificity (Sp) (2): LR for positive result = (Se)/(1 − Sp); LR for negative result = (1 − Se)/(Sp).

LRs allow estimation of a test’s contribution to decision-making. A clinician estimates the pretest probability of disease, either from prevalence data alone or in combination with clinical risk factors. A positive diagnostic test increases the likelihood of the diagnosis, whereas a negative test makes it less likely. LRs quantitate how much the test result has altered the disease probability. The posttest probability should be high enough to confirm the diagnosis or low enough to rule out disease. If the posttest probability falls between these two thresholds, further testing is required. The clear advantage of LRs is to permit the calculation of posttest probabilities with the help of a convenient nomogram (Likelihood Ratios; Center for Evidence-Based Medicine [http://cebm.jr2.ox.ac.uk/docs/likerats.html]), unlike sensitivity and specificity, which require conversion to prevalence-corrected predictive values.

Furthermore, LRs can be applied to more than two outcomes of a test (2). For example, enzyme immunoassays often define a positive cutoff. LRs may be applied to different levels of cutoffs, such that a high optical density is associated with a higher LR (and hence is more likely to confirm a diagnosis) than with a low, but still positive, result.

However, clinicians rarely use LRs. They have difficulty estimating pretest probabilities, do not carry nomograms, and disagree on thresholds for ruling out, or ruling in, disease. In general, clinicians claim to prefer sensitivity and specificity, albeit with their own clinical experience, as the “gold standard” for assessing these parameters (1).

LRs are summary measures which enable microbiologists to better express diagnostic test performance and facilitate clinician estimation of posttest probabilities of disease. We believe that LRs are simpler and more intuitively used than sensitivity and specificity and will lead to improved test utilization and decision-making through an understanding of the clinical impact of a test result. Until there is more general acceptance and use of LRs as summary parameters, the reporting of LRs for positive and negative test results should complement, rather than supplant, sensitivity and specificity.

REFERENCES


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