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Survey revealed a lack of clarity about recommended methods for meta-analysis of diagnostic accuracy data

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Abstract

Objectives: To collect reasons for selecting the methods for meta-analysis of diagnostic accuracy from authors of systematic reviews and improve guidance on recommended methods.

Study Design and Setting: Online survey in authors of recently published meta-analyses of diagnostic accuracy.

Results: We identified 100 eligible reviews, of which 40 had used more advanced methods of meta-analysis (hierarchical random-effects approach), 52 more traditional methods (summary receiver operating characteristic curve based on linear regression or a univariate approach), and 8 combined both. Fifty-nine authors responded to the survey; 29 (49%) authors had used advanced methods, 25 (42%) authors traditional methods, and 5 (9%) authors combined traditional and advanced methods. Most authors who had used advanced methods reported to do so because they believed that these methods are currently recommended ($n = 27$; 93%). Most authors who had used traditional methods also reported to do so because they believed that these methods are currently recommended ($n = 18$; 75%) or easy to understand ($n = 18$; 75%).

Conclusion: Although more advanced methods for meta-analysis are recommended by The Cochrane Collaboration, both authors using these methods and those using more traditional methods responded that the methods they used were currently recommended. Clearer and more widespread dissemination of guidelines on recommended methods for meta-analysis of test accuracy data is needed.

Keywords: Test accuracy; Diagnostic accuracy reviews; Systematic reviews; Meta-analysis; Meta-analytical methods; Diagnostic tests

1. Introduction

The last few years have witnessed a large increase in the need to make evidence-based decisions about the use and interpretation of medical tests [1,2]. One way of making valid statements about the accuracy of tests is by systematically analyzing results in previously published and unpublished primary studies. Accuracy is defined as the ability of a test to discriminate between patients with and without the disease of interest. Within a systematic review, the accuracy results of prior studies can be included to generate a single and more precise summary estimate and analyze sources of heterogeneity, a process referred to as meta-analysis. Meta-analyses, if rigorously prepared, can objectively summarize the results of prior studies, help identify the risk of bias in primary studies, and improve the reliability and accuracy of conclusions and recommendations [3−5].

The challenge in diagnostic accuracy studies is that there are usually two outcome measures of interest: sensitivity and specificity, for example, or positive and negative predictive values. These two measures of accuracy can be negatively correlated, in particular when studies applied different thresholds to define a positive test result [4−6]. Additionally, primary diagnostic studies tend to have small sample sizes, are carried out in diverse settings, and, as a consequence, can display substantial variability in study results [4−9].

Different methods for meta-analyzing diagnostic accuracy data have been proposed in the past 20 years [10]. The earlier introduced and more traditional methods include independent pooling of sensitivity and specificity

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What is new?

Key findings

- Although more advanced methods for meta-analysis are recommended by The Cochrane Collaboration, authors using traditional methods indicated that they believed that these methods are currently recommended.
- Most authors who used advanced methods did so because they believed that these methods are currently recommended. However, they were unclear if these methods were easy to understand.
- Authors who did not consider using hierarchical methods of meta-analysis (advanced methods) responded that they did not know enough about those methods or had never heard of them. Many were unsure if the methods were time consuming, if they understood them, or if they thought that the methods would significantly change their results.

What this adds to what was known?

- More than half of articles in our survey relied on more traditional methods for meta-analysis of accuracy studies.

What is the implication and what should change now?

- To generate clearer guidance, we propose publications of simple and practical tutorials in medical journals, provision of simple to use online tutorials or training with sample data sets, and more research showing the benefits of the advanced methods of meta-analysis to a clinical audience.

[11], pooling of diagnostic odds ratios [11], pooling of likelihood ratios [11,12], and generating a summary receiving operating characteristic (SROC) curve based on linear regression [13,14]. More advanced methods proposed in the last decade are hierarchical methods, such as the hierarchical SROC (HSROC) model [15] and the bivariate random-effects models [16], and trivariate analysis of sensitivity, specificity, and prevalence [17].

Univariate or independent pooling of accuracy measures does not account for correlations between sensitivity and specificity. Ignoring this correlation can underestimate accuracy and may provide misleading results [4,6,18]. Generating an SROC curve based on linear regression (Moses−Littenberg model) fully accounts for neither imprecision of study estimates nor between-study heterogeneity [4,6]. The advanced methods have been shown to be more statistically sound and flexible than the traditional methods [4,6,19]. Unlike traditional methods, advanced methods typically take into account both within- and between-study variability and estimate the correlation between sensitivity and specificity.

The Cochrane Collaboration is an international organization that helps people make well-informed decisions about health care by promoting the preparation and use of systematic reviews [20]. A few years ago, the collaboration also started including systematic reviews of test accuracy studies in the Cochrane library. The Cochrane Methods group currently recommends the use of two hierarchical methods of meta-analysis: the HSROC model and the bivariate random-effects models [6].

Despite advanced methods being available and recommended, previous reports have shown that the uptake of these methods of meta-analysis is slow. Most authors still use more traditional methods of meta-analysis [2,21]. To understand why and to improve guidance on the recommended methods to use, we asked authors of diagnostic accuracy reviews about selecting the type of methods for meta-analyzing the data in their publication.

2. Methods

Because diffusion of novel methods takes time and dissemination typically progresses slowly, we wanted to focus on recently published reviews. To collect a sample of recently published quantitative diagnostic accuracy reviews, we searched MEDLINE for articles published between September 2011 and January 2012. This search was done in February 2012 by one author (E.A.O.) using the following search strategy: (systematic[sb] AND ((‘‘diagnostic test accuracy’’ OR DTA[tiab] OR ‘‘SENSITIVITY AND SPECIFICITY’’[MH] OR SPECIFICIT*[TW] OR ‘‘FALSE NEGATIVE’’[TW] OR ACCURACY[TW]))).

To be eligible for this study, articles should be reviews of published diagnostic accuracy studies, published in English, with a meta-analysis. We excluded meta-analyses of individual patient data as the methodology of such studies differs from that of meta-analysis of published data [22].

Two authors (E.A.O. and M.M.G.L.) extracted the method of meta-analysis used in the eligible articles by reading the full text of the articles for the methods used and also by examining the references cited. Disagreements were resolved through discussion and consensus. We then classified the method of meta-analysis used into three groups: the traditional methods group, the advanced methods group, and the combined traditional and advanced methods group (for those who used both methods). The traditional methods of meta-analysis included independent pooling of sensitivity and specificity, the SROC method based on linear regression (Moses−Littenberg model), pooling of diagnostic odds ratios, and independent pooling of likelihood ratios. The advanced methods are the hierarchical models: bivariate logit-normal random-effects