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Novel presentational approaches were developed for reporting network meta-analysis

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Abstract

Objectives: To present graphical tools for reporting network meta-analysis (NMA) results aiming to increase the accessibility, transparency, interpretability, and acceptability of NMA analyses.

Study Design and Settings: The key components of NMA results were identified based on recommendations by agencies such as the National Institute for Health and Care Excellence (United Kingdom). Three novel graphs were designed to amalgamate the identified components using familiar graphical tools such as the bar, line, or pie charts and adhering to good graphical design principles.

Results: Three key components for presentation of NMA results were identified, namely relative effects and their uncertainty, probability of an intervention being best, and between-study heterogeneity. Two of the three graphs developed present results (for each pairwise comparison of interventions in the network) obtained from both NMA and standard pairwise meta-analysis for easy comparison. They also include options to display the probability best, ranking statistics, heterogeneity, and prediction intervals. The third graph presents rankings of interventions in terms of their effectiveness to enable clinicians to easily identify ''top-ranking'' interventions.

Conclusions: The graphical tools presented can display results tailored to the research question of interest, and targeted at a whole spectrum of users from the technical analyst to the nontechnical clinician.

Keywords: Network meta-analysis; Graphical displays, presentational tools, summary forest plot, ranking, probability best

1. Introduction

Until recently, systematic reviews and health technology assessments (HTAs) have been limited to pairwise comparisons of interventions where direct evidence exists. However, often there is an array of candidate interventions relevant to the clinical question of interest, thus an analysis comparing all the relevant interventions may be more appropriate and useful to decision makers. Methodology to address this issue, which has increasingly been applied, is network meta-analysis (NMA; also known as mixed [or multiple] treatment comparisons) [1−4]. Despite the increase in the use of NMA, there is no established graphical presentational standard for reporting the results of NMA analogous to the forest plot [5] for standard pairwise meta-analysis (PWMA) [6,7].

Herein, we propose three novel graphical tools that aim to present NMA results in a clear and concise manner that combine both graphs and numerical estimates for optimal interpretation of NMA results and with built-in alternative display options to satisfy the needs of different audiences. General principles of graphical excellence for presenting data [8−10], in a manner that highlight and organize the data effectively, were used. This included reducing non-data ink; enhancing data ink; and grouping, prioritizing, and sequencing the data.

2. What is NMA?

The NMA is a recent development in evidence synthesis that extends the functionality of standard PWMA to allow for a simultaneous and coherent comparison of multiple interventions using an evidence base of trials that individually may

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What is new?

- Network meta-analyses generate large amounts of outputs that make reporting of key results challenging, leading to variable reporting styles and often suboptimal reporting of the results.
- Three graphical tools are proposed: two reporting the key results of NMA (alongside pairwise meta-analysis results), whereas the third summarizes the overall ranking of the interventions in terms of effectiveness.
- These graphical tools are designed to be tailored to display results relevant to the research question of interest, and the different formats are aimed to target both analysts and clinicians.
- Standardizing graphical tools for presenting NMA results would increase the acceptability, accessibility, transparency, and interpretability of NMA analyses.
- Software for the implementation of the graphical tools are freely available.

not compare all the treatment options of interest. Advantages of NMA include: (1) preservation of within-trial randomization when combining randomized controlled trials (RCTs) evidence (ie, NMA is performed using the relative effectiveness results of randomized arms of interventions from each trial included in the network—hence there is no breaking of randomization when synthesizing the results), (2) transparency of the framework (ie, no need for ''back of the envelope'' indirect comparisons based on a series of PWMAs), and (3) potential reduction of uncertainty owing to the inclusion of more data.

Owing to the inherent feature of NMA to compare multiple interventions simultaneously, there has been rapid growth in the number of published clinical articles that use NMA for the synthesis of evidence from clinical trials, as well as, tutorial articles that focus on educating clinicians and methodologists alike on the fundamentals of NMA and how to interpret NMA results presented in journal articles. For example, Salanti [11] summarizes what the principles of NMA are, and its benefits and concerns as a next generation evidence synthesis tool. Articles by Dias et al. [12,13] provided technical guidance on the conduct of NMA through the use of tutorial examples, which included useful program codes to facilitate the analysis and enhance the understanding. Other tutorial articles with greater relevance to clinicians on understanding the core concepts of NMA, interpreting results from published NMA, and hence applying it to real-life clinical situation were published recently in medical journals, for example, by Mills et al. [14,15] and Cipriani et al. [16].

Given the many advantages and the increased accessibility by the publication of the tutorials, the popularity and use of NMA have increased. However, the NMAs generate large numbers of results compared with PWMA; for example, an NMA including five different treatment regimens generates 10 pairwise comparisons; and this increases to 45 pairwise comparisons when 10 different treatment regimens are included. Presenting such large numbers of results can be challenging, especially when NMA is used to evaluate a number of different outcome measures within the area of interest. Two recent reviews on the reporting of NMA results highlighted the variability in reporting styles [7,17] in terms of both the content (eg, relative effect estimates, the probability that a treatment is most effective compared with all other treatments included in the network analysis [referred to subsequently as probability best], and so on) and presentational form (eg, table, text, and graph), and called for additional guidance and presentational tools for reporting NMA results to aid ease of interpretability.

3. Which NMA results are important?

A recent review by Tan et al. [7] on the reporting of NMA results in UK National Institute for Health Research HTA reports found that the most often reported NMA results included relative effects of comparative pairs of interventions, absolute effects of interventions, and probability best, all of which are recommended in the published NMA methods guidance documents by agencies such as the National Institute for Health and Care Excellence (NICE) [18] or International Society For Pharmacoeconomics and Outcomes Research [19,20]. Another statistic used in the reporting of NMAs, although not reported in the HTA reports reviewed, is the order of preference of an intervention among a number of interventions (ie, the ranking of an intervention, where the probability that an intervention is rank 1 is the probability best statistic). The ranks may be presented as summary statistics (eg, mean/median rank and surface under the cumulative ranking curve [SUCRA] [21]) or graphical representations of the distribution of ranks (eg, rankograms/barplots) indicating the probability that a given intervention is first, second, third best, and so on when compared with all other interventions in the network. In addition to the above, PWMA results are reported in the HTA reports, sometimes alongside NMA results to allow informal consistency checks to be made. Prediction intervals (the interval indicating the likely location for the underlying effect in a new study), although not routinely reported, have recently been advocated [22] for the reporting of the impact of heterogeneity in evidence synthesis.

4. Data set

As an illustrative example to present the graphical tools developed, we selected a recently published study that used