Review article

# Critical quality evaluation of network meta-analyses in dental care

Dae-Woo Lee[a], In-Soo Shin[b],*

[a] *Department of Pediatric Dentistry and Institute of Oral Bioscience, School of Dentistry, Chonbuk National University, Jeonju, Republic of Korea*
[b] *Department of Education, College of Education, Jeonju University, Jeonju, Republic of Korea*

ABSTRACT

*Objective:* Network meta-analysis (NMA) is a new method to compare the effects of multiple treatments in dental care. We examined whether published NMA follow the key methodological reporting recommendations, the PRISMA Extension Statement.
*Design:* Collection of published systematic reviews with NMA in dental care
*Data sources:* MEDLINE, EMBASE, and Web of Science searched from inception to May 1, 2017.
*Study selection:* All NMA published in dental journals comparing the clinical efficacy of three or more interventions with and without closed loops.
*Data extraction and synthesis:* NMA reporting was assessed according to the PRISMA Extension checklist. We assessed the reporting of general components (27 items) and key NMA methodological components (5 new items, S 1–5) of the systematic review process of NMA in dental care.
*Results:* Among 85 identified articles, 21 NMA (16 used the Bayesian statistical approach, and 5 the frequentist approach) were included. Overall, among 21 articles, 15 (71%) reports of NMA in dental care did not describe in detail the network regarding S1-5 based on the PRISMA Extension. Problem areas include exploring the geometry of the network (S1), assessment of insistency (S2) <u>in the method section</u>, presentation of network structure (S3), summary of network geometry (S4), exploration for inconsistency (S5) <u>in the result section</u>, risk of bias across studies, protocol registrations, and additional analysis.
*Conclusions:* The quality of NMA reporting was low in the dental field. An NMA with inadequate reporting reduces the end-user's confidence on the quality of the reported results. The PRISMA Extension guideline is relatively new and should be used more extensively to improve reporting practices in the field of dental care.

## 1. Introduction

Evidence-based dentistry is defined as an attempt to apply standardized evidence obtained through scientific methods more uniformly to specific areas of dental care [1]. A systematic review and meta-analysis are helpful for the busy practitioner or policy decision-makers who need summarized results, because they systematically identify, evaluate, and synthesize high-quality literature to answer specific research questions [2]. However, a traditional meta-analysis has limitations, because it can only make direct comparisons [3].

In recent decades, a new statistical analysis method, namely the network meta-analysis (NMA), has become increasingly popular in dental area [4–11]. An NMA enables a quantitative synthesis of the network of trials comparing different sets of interventions *by combining the direct and indirect evidence of interventions based on a* route of *common comparators* [12,13]. Compared to pairwise meta-analyses, NMA consolidates all available evidence into a common statistical framework to visualize a larger volume of evidence and estimate the relative effectiveness and treatment ranking among all interventions (even if head-to-head comparisons are lacking) [14]. Our study objective is to check and evaluate the reporting quality of NMA such as reporting quality evaluation papers for other intervention meta-analysis in dental areas such as Moraschini V, Barboza Edos S. and Schiegnitz E, Kämmerer P, Al-Nawas B. [15,16]. Hutton et al. [39] offered a comprehensive overview regarding published assessments of the reporting quality of SRs with NMA. Petropoulou et al. [40] included a large collection of published SRs with NMA across all health fields, and focused mostly on the methodological quality of these publications but part of the results and conclusions are relevant to the reporting quality [17,18].

However, conducting an NMA has several challenges and limitations. Several methodological reviews previously evaluated how the indirect comparisons of NMA were conducted and reported in the medical literature [17–21]. Most of these reviews focused on checking the methodological quality of NMA, especially validity assumptions

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(based on heterogeneity, transitivity, and inconsistency), which are considered important. In recent years, NMA reviews have been gradually increasing in the field of dentistry, but there is no evaluation as to whether they are performed well. As far as we know, this is the first study that systematically evaluates the methodological quality of NMA articles in dental journals. Therefore, we performed a methodological systematic review of published NMA to examine whether the reports adequately followed the key reporting components of the systematic review process based on the PRISMA Extension guideline, which has been recently developed based on the consensus of NMA experts.

## 2. Materials and methods

### 2.1. Eligibility criteria

All NMAs published in dental journals that compared the clinical efficacy of three or more interventions based on randomized controlled trials (RCT) or non-RCTs were included as eligible studies [22]. We excluded methodological review, editorial style reviews or concise reviews, conventional meta-analysis reviews, articles not related to dental journals, and reviews not involving human participants. We did not include NMAs involving indirect comparisons with an open loop network of interventions Inconsistency is difference between direct and indirect comparisons. To check inconsistency, we need closed loop network of interventions rather than open loop.

### 2.2. Information sources and search strategy

#### 2.2.1. Electronic search
We systemically searched the following databases from the earliest available date to May 1, 2017: MEDLINE, EMBASE, and the Web of Science. The search strategy was a combination of MeSH (medical subject heading) terms and free text words including "network meta-analysis"[mesh], "network meta-analysis"[txt words], "review"[mesh], "systematic review"[txt words], "dentistry"[mesh], and "dental"[txt word]. The detailed search strategy employed in this study is shown in Appendix Table 1. Grey Literature was searched via OpenGrey (opengrey.eu).

#### 2.2.2. Hand search
Reference lists of the included systematic reviews and previously published systematic reviews with network meta-analysis related to the topic were screened to identify any additional studies.

### 2.3. Study selection

Each identified article was independently screened by title and abstract by the two authors to remove duplicate entries and studies that failed to meet the inclusion criteria. To avoid excluding potentially relevant articles, the full-text paper was searched and examined when the abstract provided unclear information. Any disagreement was resolved through discussion. Full-text articles that satisfied the inclusion criteria were assessed by two reviewers with clinical knowledge of dental care and methodological knowledge of NMA. References of the included articles were further checked manually.

### 2.4. Data collection process and data items

The two authors independently extracted the data from each included article into predesigned coding sheets: [1] study identification: first author's name, location of corresponding authors, year of publication, and journal name; [2] number and design of studies included in NMA; [3] population (participants); [4] interventions; [5] comparison between interventions; and [6] outcome measures. We included the detail information (item 1 to item 6) in the Appendix Table 2. Discrepancies were resolved through discussion.

### 2.5. Planned methods of analysis

#### 2.5.1. Reporting of epidemiological and descriptive characteristics
We assessed epidemiological and descriptive characteristics of the included NMA studies according to journal type, location of corresponding author, funding source, type of intervention, and type of reporting guideline.

#### 2.5.2. Reporting of general components and key methodological components of the systematic review process
This methodological systematic review was conducted under the recommendation of the PRISMA Extension guidelines for reporting NMA [23], which includes a 32-item checklist and flow diagram: 27 general items and 5 new NMA items. This extension adds 5 new items (S1-5) that authors should consider when reporting an NMA, and 11 modifications to previous PRISMA items [24] for the 27 general items. According to these guidelines, we assessed whether key methodological and general components were reported or not.

#### 2.5.3. Statistical analysis: descriptive statistics and frequency
Categorical data were summarized by numbers (percentages). The extracted information on the PRISMA items is summarized across the eligible SRs using absolute and relative frequencies

## 3. Results

### 3.1. Study selection

In total, 85 publications (Fig. 1) were found through the electronic database searches. After eliminating duplicates, 55 articles were selected, and of these, 25 were excluded after screening the title and abstract. In total, 30 articles were reviewed for eligibility by assessing the full text. The reasons for study exclusion during the final review were as follows: editorial style review (n = 3), systematic review and meta-analysis (n = 1), articles not related to NMA (n = 3), articles not involving human participants (n = 1), and commentary (n = 1). We included the remaining 21 articles to evaluate the quality of NMAs in dental care [4–11,25–37].

### 3.2. Study characteristics

#### 3.2.1. Epidemiological and descriptive characteristics
Reports of NMAs were published in 6 journals: 10 reports (48%) were published in the Journal of Clinical Periodontology, 4 (19%) in the Journal of Dentistry, 3 (14%) in the Journal of Dental Research, 2 (10%) in the American journal of dentofacial and orthodontics, 1 (5%) in the Journal of periodontology and 1 (5%) in the Clinical implant dentistry and related research (Table 1). The corresponding authors were located in Europe (71%) or Asia (29%). The types of interventions varied across the wide-ranging dental field. Many were related to treatment procedures (57%), followed by therapeutic strategies (33%). The reporting guidelines used for the systematic review process also varied: 9 (43%) articles used the PRISMA guideline (2009), and 4 (19%) used the PRISMA-Extension reporting guidelines (2015). However, 9 (35%) papers did not describe the reporting guidelines used. Regarding funding source, most studies received private and/or public support (80%), one study had no funding, and three studies did not clearly report the funding source.

#### 3.2.2. General characteristics of included studies
The main characteristics of all included studies are described in Appendix Table 2. Included studies were published recently, between 2010 and 2017. Regarding the authors, of 21 NMA papers, Tu, YK participated in 12 papers, and Schwendicke, F in 5. In addition, Faggion, CM, Buti, J, and Paris, S were involved in four studies respectively. Through these results, we were able to determine that most