

## Protocol

# Oral irrigation devices: a scoping review protocol

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### ABSTRACT

**Background:** Effective daily removal of dental biofilm is essential for oral health. Although toothbrushing can effectively remove dental biofilm, it has little effect on subgingival biofilm and biofilm on contact surfaces of teeth and prostheses. Unlike toothbrushes, oral irrigation devices can deliver a pressurised stream of water below the gingival margin and on the proximal surfaces of teeth and prostheses. To our knowledge, no systematic, rigorous, scoping review on oral irrigation devices has been conducted to date. The purpose of this scoping review is to map key concepts and types of evidence available for oral irrigation devices, as well as to identify knowledge gaps to inform future research.

**Methods:** The protocol for this scoping review has been designed in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) and the Joanna Briggs Institute (JBI) guidelines. Four databases (Dentistry and Oral Sciences Source, CINAHL, MEDLINE, and Scopus) and eight sources of unpublished literature (Cochrane Library, Cochrane Oral Health's Trials Register, Google, Google Scholar, ISRCTN registry, Open Grey, Proquest Dissertations and Theses Global, and the WHO Clinical Trials Registry Platform) will be searched. Data will be extracted using a data extraction table designed by the reviewers. Extracted data will be summarised and presented in diagrammatic and tabular form, accompanied by a narrative explanation.

**Conclusions:** By identifying key concepts, types of evidence and knowledge gaps, this scoping review will guide future research in the field.

**Keywords:** Interdental cleaning devices, Oral hygiene, Oral irrigators, Scoping review, Water flosser, Water jet

### INTRODUCTION

Dental caries and periodontal diseases are among the world's most prevalent chronic, non-communicable diseases.<sup>1-3</sup> Untreated dental caries in permanent teeth is the most prevalent disease worldwide, while severe periodontitis is the sixth most common.<sup>1</sup> Not only can these conditions cause pain and tooth loss, but they can also place a significant economic burden on families and health care systems worldwide.<sup>4</sup> In 2015, global productivity losses due to untreated dental caries, severe periodontitis, and tooth loss were calculated to reach USD 187.61 billion, while expenditures on outpatient dental care reached USD 356.77 billion.<sup>5</sup>

Dental biofilm is one of the main factors contributing to the development of dental caries and periodontal diseases.<sup>6-8</sup> Likewise, biofilm on the surfaces of dental implants can trigger the development of peri-implant mucositis and peri-implantitis.<sup>9</sup> Therefore, regular and effective biofilm removal is fundamental for the long-term success of dental implants, the prevention of dental caries and periodontal disease, and overall oral and general health.<sup>10-13</sup>

Toothbrushing is the standard method of dental biofilm removal in the developed world.<sup>14</sup> However, it has a negligible effect on biofilm located on contact surfaces of

teeth, dental prostheses, and subgingival and submucosal biofilm.<sup>14,15</sup>

In contrast, oral irrigation devices, which work by aiming a pressurised stream of water onto tooth surfaces, may be able to remove the dental biofilm above and below the gingival margin.<sup>16,17</sup> They have also been shown to be able to deliver antimicrobial agents into periodontal pockets and under prostheses.<sup>18</sup> Furthermore, in contrast to toothbrushes and most interdental cleaning aids, a water stream created by an oral irrigator can penetrate deep below the gingival margin.<sup>15,19</sup> It has been shown that, when subgingival tips are used, oral irrigation devices can deliver solutions to as far as 90% of the depth of moderate pockets (6 mm or less).<sup>20</sup> As for supragingival tips, they allow penetration of solution to 71% of the depth of shallow pockets (0-3 mm), 44% of moderate pockets (4-7 mm), and 68% of deep pockets (over 7 mm).<sup>21</sup>

A number of studies have been conducted on oral irrigation devices since they became available in the 1960s. However, to our knowledge, no systematic, rigorous scoping review has been carried out to date. The authors believe that a broad overview of existing literature is required to determine gaps in the existing research and provide guidance for future studies in this field. A scoping review has been chosen as the most appropriate methodology for this study as it is suitable for providing a broad overview of existing literature and determining research gaps.<sup>22</sup>

## METHODS

This scoping review will be conducted following the JBI and PRISMA-ScR guidelines.<sup>23,24</sup> Preliminary searches of the Cochrane Database of Systematic Reviews, the Open Science Framework Database, PROSPERO, the JBI Systematic Review Register, the JBI Evidence Synthesis Journal, the Dentistry and Oral Sciences Source, CINAHL, MEDLINE, and the Scopus databases were conducted to check for existing and ongoing scoping and systematic reviews on oral irrigation devices.

Most of the reviews conducted to date predominantly provide an overview or compare the effectiveness of different interdental cleaning aids in removing dental biofilm and preventing periodontal disease and dental caries.<sup>14,25-30</sup> Concerning papers that specifically review studies on oral irrigation devices, only one (published in 2010) aimed to provide a broad overview of the topic.<sup>31</sup> The author searched one database (MEDLINE) but did not consider unpublished literature. Another paper (published in 2015) aimed to evaluate the safety of water irrigators.<sup>32</sup> The authors report that they searched published literature only but did not provide further details on their methodology. Another review, published in 2019, specifically examined the efficacy of water flossers in reducing dental biofilm and bleeding in adults with gingivitis.<sup>33</sup> Finally, a study conducted by Husseini,

Slot and Van der Weijden in 2008, overviewed the literature on the effects of oral irrigation on the clinical parameters of periodontal inflammation.<sup>34</sup>

### *Review question*

The authors aim to answer a broad, overarching question: ‘What is known from existing literature about oral irrigation devices?’ In addition, we will also address the following sub-questions: What methodologies have been used in research in relation to oral irrigation devices? And what research gaps exist in relation to oral irrigation devices, and what aspects require for the further investigation?

### *Eligibility criteria*

The population/ concept/ context (PCC) framework recommended by JBI was used to determine the eligibility criteria for this scoping review.<sup>23</sup>

### *Participants*

This element of the PCC framework is not relevant for this scoping review, as the authors aim to provide a broad overview of existing literature in relation to oral irrigation devices.

### *Concept*

This review will consider any research on oral irrigation devices.

### *Context*

In order to provide a broad overview of the existing literature, studies from any geographical location and setting will be eligible for inclusion.

### *Types of sources*

Published and unpublished primary and secondary studies will be included. Letters, narratives, opinion papers, commentaries, guidelines, and historic reviews will not be considered for inclusion. Only studies in English will be included. However, the authors intend to acknowledge potentially relevant studies in other languages where abstracts in English are available.

### *Search strategy*

A three-step search strategy proposed by JBI has been utilised for this scoping review.<sup>23</sup>

An initial, limited search of the Dentistry and Oral Sciences Source, CINAHL, MEDLINE, and Scopus databases was conducted, followed by an analysis of relevant articles for text words as well as the index terms. This helped in the development of the entire search strategy.

With the assistance of an experienced health sciences librarian, a complete search strategy was developed and later adapted for each of the databases we intend to search. The databases to be searched include the Dentistry and Oral Sciences Source, CINAHL, MEDLINE, and Scopus. There will be no limitations on geographic location or setting, and both published and unpublished literature will be searched.

The first searches will be carried out in 2022. Then, a follow-up update search will be carried out later to identify all newly published sources. No search limiters will be applied.

A complete search strategy for MEDLINE can be found in Table 1.

**Table 1: Search strategy for MEDLINE.**

S. no.	Search strategy
1.	“Water irrig*” OR “Water floss*” OR (“therapeutic irrig*” AND water) OR “oral irrigat*” OR monojet OR “subgingival irrigat*” OR “subgingival tip” OR “dental irrigat*” OR “interdental device*” OR “gingiv* therapeutic irrigation” OR “interdental cleaning device*” OR (“interdental cleaning” AND water) OR (“interdental cleaning” AND irrigat*) OR (“inter-dental cleaning” AND water) OR (“inter-dental cleaning” AND irrigat*) OR “irrigation device*” OR “supragingival irrigat*” OR “pulsated jet” OR “microdroplet device*” OR “micro droplet device*” OR “Water pik” OR waterpik OR waterpick OR “water pick” OR “water jet” OR waterjet OR “perio pik” OR “pick pocket” OR pickpocket OR “pik pocket” OR pikpocket
2.	“Oral health” OR dental OR dentistry OR caries OR periodont* OR gingiv* OR “oral hygiene”
3.	1 AND 2

The authors will also search the following sources of unpublished literature: Cochrane Library, Cochrane Oral Health’s Trials Register, Google, Google Scholar, the ISRCTN registry, Open Grey, ProQuest Dissertations and Theses Global, and the WHO Clinical Trials Registry Platform.

The first 100 items on Google, and the first 100 articles on Google Scholar, will be screened for eligible studies.

The authors will also conduct a ‘cited reference search’ and a ‘related documents search’ for relevant articles in Scopus to source additional studies.

### Selection of studies

All identified sources will be exported and uploaded into EndNote VX9, and duplicates will be removed.<sup>35</sup> The

references will then be exported to RAYYAN, a web-based systematic review tool, and the duplicates search will be repeated.<sup>36</sup> After the removal of duplicates, pilot testing will be conducted. First, both reviewers will independently screen 50 titles and abstracts using the inclusion criteria, after which they will discuss any discrepancies. Then, source selection will start once seventy-five per cent agreement has been achieved.

Identified sources will be screened independently by two reviewers in two stages. In stage one, the titles and abstracts of the retrieved sources will be screened by one reviewer to identify potentially relevant documents. The second reviewer will then independently check the decisions of the first reviewer by assessing both included and excluded sources. In stage two, full texts of potentially relevant sources will be retrieved and assessed in detail against the eligibility criteria by one reviewer. The second reviewer will then independently check the decisions of the first reviewer by assessing both included and excluded sources. Any disagreements that arise between the reviewers at any stage of the selection process will be resolved through discussion.

A PRISMA-ScR flowchart with the numbers of identified, screened, and excluded sources will be utilised.<sup>24</sup> This will be accompanied by a narrative description of the selection process. The reasons for sources being excluded at each stage of the selection process will also be reported.

### Data extraction

Data will be extracted from all sources included in the scoping review using a data extraction table developed by the reviewers. The two reviewers will pilot test the data extraction table of three sources. The results will be discussed, and, if required, modifications will be introduced to the table.

The data extraction table shown in the Table 2 may be further refined during the extraction process if the reviewers decide that additional data may be useful and should be extracted. An assessment of the risk of bias will not be performed, as the authors aim to provide a broad overview of existing literature, regardless of its risk of bias or methodological quality. Any changes to the data extraction table will be recorded and reported in the scoping review. One reviewer will extract data, and the second will verify the data for accuracy. Any disagreements that arise between the reviewers at any stage of the data extraction process will be resolved through discussion.

Authors of the studies included in the review will not be contacted for additional information, as the aim is to map only publicly available literature.

**Table 2: Data extraction table.**

First author, year	Type of source	Category	Product, if applicable	Design features	Key findings	Suggestion for future research, if applicable
-	-	-	-	-	-	-
-	-	-	-	-	-	-

### Data analysis and presentation

The results of the included sources will be descriptively mapped. In addition, an overview of concepts, types of evidence, research methods, and populations included in the studies will be provided. An evidence gap map may also be created to represent studies by year visually and the questions they aim to answer.

Primary studies will be categorised by study objectives and study population. The results may be presented as a bubble plot.

A mind map may be used to demonstrate the number of studies on different topics and subtopics. A narrative description will accompany all tables and diagrams. The study results will map existing literature on oral irrigation devices. The authors believe this can guide future research in the field.

### DISCUSSION

Oral irrigation devices have been present on the market for over 60 years.<sup>37</sup> A number of studies have been conducted in these years. However, to our knowledge, the existing literature on these devices has not been systematically analysed through a scoping review. This scoping review will map existing literature and identify any research gaps to guide future research. One limitation of the study is the exclusion of literature published in languages other than English. This can potentially lead to the omission of some relevant evidence.

### CONCLUSION

This systematic review will provide a broad overview of the existing literature on oral irrigation devices and identify research gaps. This will guide future research in the field with the potential for technology improvement and the improvement of oral health outcomes.

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