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Aerosol generation in dental clinics and its control/ prevention: Systematic and meta-analysis

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ADMINISTRATIVE INFORMATION

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 April 2024 and was last updated on 25 April 2024.

INTRODUCTION

Review question / Objective 1. Synthesizing existing evidence regarding aerosol generation in dental settings. 2. Evaluating the effectiveness of various control measures.

Rationale Aerosol generation in dental practice presents a significant concern for infection control, particularly in the context of bacterial and viral diseases such as COVID-19. This systematic review and meta-analysis aim to investigate strategies for controlling and preventing aerosol generated microbes during dental procedures.

Condition being studied Oral health care is classified as a very high-risk occupation category involved with aerosol production because the oral cavity is a habitat for micro-organisms that can cause infection and cross-contamination. Among oral health, dentistry is considered one of the most aerosol generated fields during dental procedures, for instance, ultrasonic or rotatory instruments, which are expected to produce significant amounts of aerosols. In addition, air abrasion, opening teeth for drainage, polishing teeth, placement of dental implants, cementation of fixed prosthesis, and tooth extraction are also considered high aerosol-generating procedures. Moreover, many routine dental procedures produce a visible large amount of aerosols, and due to the close proximity of dental staff with the patients are more likely to be exposed and infected rapidly with those aerosols. In addition to large droplets, there are also a production of very small droplets which remain in the air for a quite longer time before infecting the healthcare professional.
Likewise, aerosols containing pathogenic micro-organisms can be considered as a risk for infection transmission in dental settings. The dental aerosol dispersion poses a risk of contaminating not only the mucous membranes of dentists' or oral health care professionals' mouths, respiratory airways and eyes as well as materials used in dentistry and surfaces in the surrounding environment. The microflora mainly gram-positive organisms (Micrococcus spp. and Staphylococcus

epidermidis), gram-positive rod-shaped bacteria as well as endospores and non-porous bacteria and mold fungi (Penicillium and Cladosporium). Most importantly, viruses, including COVID-19 which can be transmitted by direct contact or aerosols generated through dental procedures.

Aerosol generation in dental clinics is a significant concern due to its potential to spread infectious agents, including bacteria and viruses, posing risks to both oral health-care professionals and patients. Aerosols generated during dental procedures can contaminate the air and surfaces within the clinical environment, increasing the risk of cross-infection. Therefore, implementing effective control and prevention measures is essential to mitigate these risks. By analyzing a comprehensive body of research, this study can provide valuable insights into the factors contributing to aerosol generation, such as the type of dental procedure, equipment used, and environmental conditions. Furthermore, they can assess the efficacy of interventions aimed at reducing aerosol generation, such as pre-procedural mouth rinses, high-volume evacuation systems, air purification devices, and personal protective equipment. Through evidence-based recommendations derived from systematic reviews and meta-analyses, dental practitioners can implement targeted strategies to minimize aerosol generation and transmission, thereby enhancing the safety of dental care delivery for both providers and patients. Therefore, this systematic review and meta-analyses aimed in synthesizing existing evidence regarding aerosol generation in dental settings and evaluating the effectiveness of various control measures.

METHODS

Search strategy A systematic search was performed until April 2024. Five electronic databases, such as PubMed, ScienceDirect, The Cochrane Library, Google Scholar, and Scopus, were searched for the most relevant studies. Different keywords such as “aerosol generation” OR “aerosol generation procedure” OR “aerosol generating procedures” OR “AGPs” OR “splatter” OR “droplets” OR “bioaerosols” AND “dental procedures” OR “dental clinics” OR “dental setting” OR “dental practice” OR “ultrasonic dental scaling” OR “tooth scaling” OR “tooth extraction” OR “tooth restoration” AND “prevention” OR “control” OR “control measures” OR “interventions” were used.

Participant or population Patients were treated for dental issues, Intervention: any strategies for the prevention and control of aerosol contaminationLaboratories using Air purification filters.

Intervention Any strategies for the prevention and control of aerosol contamination.

Comparator Any alternative control method utilized, for instance, saline or water.

Study designs to be included This study was designed according to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Eligibility criteria Studies published in English.

Information sources Initially, 594 research articles were retrieved from different searched databases, including PubMed, ScienceDirect, The Cochrane Library, Google Scholar, and Scopus. After retrieval, research papers were screened for any duplication, and 154 were found to be duplicated and removed before the titles and abstracts screening process was started. Afterwards, 440 research papers were screened and evaluated for their eligibility set for the present study, and inclusion and exclusion criteria were strictly followed. After a thorough screening, 417 research papers were found not to be according to study’s inclusion criteria and thus excluded. After such screening, only 23 research papers were found eligible for full-text assessment. A total of 4 research papers were excluded due to different reasons listed in Figure 1. At the end, 19 research papers were included in the present study.

Only randomized controlled trials (RCTs) published in English were included.

Main outcome(s) Any outcome regarding microbial load measurement in aerosols after the dental procedure.

Additional outcome(s) This study underscores the importance of a multifaceted approach integrating anti-septic mouthwash and suction devices to minimize the risk of cross-contamination and infection transmission during aerosol-generated dental procedures, thus safeguarding the health and safety of both patients and dental healthcare workers.

Data management Data was extracted on the selected studies matching the inclusion requirements in a predesigned data recording Excel sheet. Two reviewers independently record each study’s characteristics (author ID, country, sample size), participant’s characteristics (age, gender, dental procedure type), intervention and

control characteristics, and outcomes (microbes load, key findings, conclusion, limitations).

Quality assessment / Risk of bias analysis The Cochrane Collaboration tool was utilized for the quality assessment of RCTs using the web-based app Robvis [18]. Assessment was done in the domain of randomization, deviation from intended intervention, measurement of data, missing outcomes, and reporting.
The collected data was subjectively assessed for the included papers in the systematic review, and the PRISMA checklist was also used. Meanwhile, RevMan 5.4 was used for meta-analysis to assess the pooled efficacy of interventions on microbial load of aerosol generated during the dental procedure and identify any potential sources of heterogeneity [19]. The random effects model was utilized, with a significance level of 0.01.

Strategy of data synthesis The collected data was subjectively assessed for the included papers in the systematic review, and the PRISMA checklist was also used. Meanwhile, RevMan 5.4 was used for meta-analysis to assess the pooled efficacy of interventions on microbial load of aerosol generated during the dental procedure and identify any potential sources of heterogeneity [19]. The random effects model was utilized, with a significance level of 0.01.

Subgroup analysis The data was compiled from a variety of articles:
• Author(s), year of publication, country, study design.
• Total number of patients/datasets.
• Training/validation datasets
• Test datasets
• Aim of the study.

Sensitivity analysis Not applicable.

Language restriction Only articles in English.

Country(ies) involved Saudi Arabia.

Keywords Aerosol generated procedures, AGPs, microbes, pathologies, management, mouthwash, suction devices.

Dissemination plans All the data will be shared upon request and after publication of the article.

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