



Mitigation of Aerosol Generating Procedures in Dentistry

Report on Recent Published Evidence

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Introduction

In September 2020, the Scottish Dental Clinical Effectiveness Programme (SDCEP), with the support of Cochrane Oral Health, published a Rapid Review of the evidence related to the generation and mitigation of aerosols in dental practice and the associated risk of transmission of SARS-CoV-2. The aim of the Review was to identify and appraise the evidence related to several pre-determined key questions about AGPs in dentistry (see Appendix 1) and to use a process of considered judgment of this evidence and other relevant factors to reach agreed positions that may be used to inform policy and clinical guidance.

A multidisciplinary Working Group comprising subject specialists from disciplines including particle physics, aerobiology and clinical virology, in addition to those performing multiple roles within dentistry, was convened and was supported by a methodology team that undertook the literature searches, evidence appraisals and summaries. The considered judgement process was modelled on the GRADE evidence-to-decision framework¹ and took into account the available evidence assessed in the context of risk, benefits and harms. The final document was made available on the SDCEP [website](#) and informed national infection prevention and control guidance.²

The agreed position statements presented in the Rapid Review were based on the evidence available at the time of publication. In view of the constantly evolving situation, SDCEP committed to supporting the Review as a living document and confirmed that the Working Group would continue to meet as necessary to assess new evidence to maintain currency of the document.

Ongoing Literature Review

The SDCEP Rapid Review was based on a comprehensive literature search of online databases conducted on 22 June 2020, with a similar supplementary search focussed on air cleaners carried out on 25 August 2020. A document which details the methodology used for the development of the Rapid Review, including details of the scope, evidence search strategy, evidence appraisal and the considered judgement process can be found on the SDCEP [website](#).

Since publication, this literature search has been updated at approximately six-weekly intervals, using the same search terms but with a modified range of literature databases, including addition of the medRxiv preprint server for health sciences. All searches were performed by the Cochrane Oral Health Information Specialist. Screening of results was performed in duplicate, with articles of interest selected by screening against pre-defined inclusion and exclusion criteria (see Appendix 1).

To date, five searches with 1017 articles have been screened, resulting in 50 articles of interest following de-duplication and removal of articles already cited in the published review (Table 1).

Table 1 Search results

Search	Date Range	No. of Articles retrieved	No. of Articles of interest
September 2020	22/06; 25/08 – 15/09/20	262	10
October 2020	15/09 – 28/10/20	272	20
December 2020	28/10 – 08/12/20	147	13
January 2021	08/12/20 – 25/01/21	185	15
March 2021	25/01 – 02/03/21	151	10
Total		1017	68
Following removal of duplicates and studies already cited in SDCEP Review			50

Articles of interest were categorised based on the Review question(s) they relate to (Table 2).

Table 2 Categorisation of articles of interest

Question	No. of Articles	Question	No. of Articles
Procedures	11	Other Procedural Mitigation	3
Suction	12	Ventilation/Fallow Time	2
Rubber Dam	2	Air Cleaners	4
Pre-procedural Mouthrinse	7	Miscellaneous	5
Antimicrobial Coolants	3	Excluded	5

After reading of the full text articles, several were judged to be not relevant to the Review questions and excluded as noted in the sections below. The remaining articles of interest were appraised and data extracted using standardised forms.

As in the published Review, preprint articles that met the inclusion criteria were appraised and are noted in the following sections.

Procedures

SDCEP Rapid Review question: *Which dental procedures produce aerosols and which present higher risk of SARS-CoV-2 transmission via aerosol?*

Of the 14 articles of interest that relate to this question, four are systematic reviews, with the majority of the remainder being experimental simulation studies using dental manikins.

Jackson et al.³ conducted a systematic review of the classification of aerosol or non-aerosol generating procedures across healthcare in official guidance documents and academic publications. Overall, dental and oral procedures are classified as AGPs if high speed devices, specified as “air turbines, air/water syringes, scopes, high-speed drills, or other power tools or high-speed handpieces; and the use of ultrasonic scalers” are used, with a high level of consensus (78%) among the included sources. There is less certainty about the AGP status of other dental procedures. Similarly, Viridi et al.⁴ conducted a rapid systematic review of ‘official’ guideline documents and other publications that attempt to define and categorise dental AGPs only. It concluded that in the 26 guidelines identified, there is a lack of consensus internationally about what constitutes a dental AGP and which procedures are AGPs. However, use of

high-speed handpieces, air-water syringes, and powered scalers are generally agreed to pose the highest risk of transmission. It proposes a stratified approach that incorporates some flexibility to take account of various local factors, which is consistent with the procedure categorisation (with an element of risk assessment) proposed in the SDCEP Rapid Review.

The systematic review by Gallagher et al.⁵ focused on oral surgery procedures and was based on the larger systematic review by Innes et al.⁶ which sought to catalogue what is known about bio-aerosol generation relevant to clinical dentistry. All 11 studies included in this review found the risk of blood and micro-biological contamination to patients, dental team and dental operatory present at some stage across all settings, procedures and distances during oral surgery procedures, including nonsurgical tooth extraction. None of the studies included the detection of viruses. Despite the low certainty of evidence, the findings of this review do support the correct use of full PPE and favour mitigation by using high-volume suction. It does not provide additional insight into the categorisation of procedures, use of rubber dam, use of preprocedural mouthwash or fallow time.

Al-Moraissi et al.⁷ (preprint) systematically reviewed whether dental and maxillofacial surgical procedures generate bioaerosols which can transmit COVID-19 and whether additional standard personal protective equipment is essential to prevent spread of COVID-19 during dental and maxillofacial AGPs. Their review presents evidence that high speed rotary instruments produce respirable aerosols. There is inconclusive evidence from the included studies to demonstrate that dental procedures using high speed instruments produce infectious aerosols during dental procedures. No studies evaluating the effectiveness of PPE for preventing transmission of COVID-19 were identified.

Three experimental studies used particle measurement to evaluate splatter and aerosol spread associated with dental AGPs.

Kun-Szabo et al.⁸ simulated AGPs (direct spray turbine, indirect spray turbine, ultrasonic scaler) with a dental manikin head using high volume evacuation or an extraoral aerosol exhaustor. Particle detection was only at one position via a spectrometer sampler placed 20 cm above the manikin. The results suggest that aerosol production is sensitive to the precise technique used. As an exploratory investigation with significant methodological limitations this study provides no additional evidence.

Hobson et al.⁹ (preprint) investigated particles created in simulated AGPs (use of 3-in-1 syringe, air rotor and ultrasonic scaler), and the time taken to dissipate, whilst using high volume suction with one volunteer in a primary care setting. The study provides limited evidence on particulate matter at 50 cm from the treatment area for 'mock' AGPs but provides no insight into levels of contamination with infectious particles as no analysis of bacterial/viral particles was performed.

Din et al.¹⁰ in a dental mannikin simulation investigated the particles produced during orthodontic procedures including duration, the range of particle sizes, and the effect of water on emitted aerosol during debonding. Particulate matter was released during orthodontic debonding with a slow speed handpiece. The adjunctive use of water or alternatives involving fast handpiece use were associated with more marked aerosol release. No increase in particulates was associated with prolonged use of a 3-in-1 air-water syringe. Particulate levels reduced to baseline levels over a short period (approximately five minutes with 6 air changes per hour [ACH]). Further research with patients is required.

Four experimental studies used fluorescent dye to evaluate splatter and aerosol spread associated with dental AGPs.

Han et al.,¹¹ using a phantom head simulation, described a method with fluorescein dye in irrigation water to visualise splatter and aerosol contamination by ultrasonic scaling, air-water spray, high-speed and low-speed handpieces. All procedures caused contamination distributed across at least 120 cm. The high-

speed handpiece generated the most splatter and aerosols while the slow-speed handpiece produced the least contamination.

Llandro et al.¹² used fluorescein dye introduced into the oral cavity of a dental manikin in a simulation to evaluate splatter and/or settled aerosol contamination during orthodontic debonding. This study suggests that orthodontic debonding is unlikely to produce widespread contamination compared to other AGPs such as crown preparation with a high-speed drill, but localised contamination is likely.

Kaufman et al.¹³ aimed to assess the distribution and deposition of aerosols with a dental manikin during simulated periodontal therapy with air polisher and ultrasonic scaler. However, the detection method employed (fluorescein dye detected on filter paper with no time delay) is more likely to give a measure of splatter than aerosol. The air polisher appeared to generate more contamination than the ultrasonic scaler in the set-up used.

Chanpong et al.¹⁴ used a fluorescent dye applied to teeth in a dental manikin to observe the extent of splatter on dental personnel that occurs with both simulated AGPs and coughing in a dental anaesthesia practice. The study found significant splatter on the body of the dentist and dental assistant associated with AGPs, even when HVE was used, and confirms the requirement for mitigation.

With regard to the Rapid Review question, collectively the evidence from these experimental simulation studies is judged to be of very low certainty due to the varied methods employed to measure splatter and aerosol contamination, surrogate outcome measures and the lack of direct evidence regarding respiratory virus transmission.

There were three other articles of interest identified from the screens that were subsequently excluded on reading of the full text. Shanmugaraj and Rao¹⁵ aimed to assess the microbial profile and index of microbial air contamination in dental clinics. However, the study provides insufficient detail on the dental procedures performed, level of ventilation and dental equipment to allow the findings to be applied to other settings. Abdelkarim-Elafifi et al.¹⁶ in a simulation investigated the use of lasers in preference to high speed turbines to reduce the amount of aerosol produced during restorative dental procedures. This very preliminary study measured splatter and aerosol and indicates further investigation of the intervention may be warranted. Bizzoca et al.¹⁷ described an AGP scoring system based on opinion rather than experimental data.

In the SDCEP Rapid Review three groups of dental procedures were proposed that are categorised according to the characteristics of the instruments used and assumptions regarding aerosol generation. The articles identified to date do not provide any higher certainty evidence regarding the risk of SARS-CoV-2 transmission associated with dental AGPs to inform the proposed approach.

Suction

SDCEP Rapid Review question: *Should high volume suction be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?*

Twelve articles related directly to this Review question. One article is a systematic review. One article reports on a retrospective cohort study. Two articles report experimental studies that involve human volunteers. The remaining eight articles are experimental studies using simulated patients (dental manikins or phantom heads).

Samaranayake et al.¹⁸ systematically reviewed the efficacy of bio-aerosol mitigation strategies used in dentistry, including high volume suction. The review, which includes some of the studies referenced in the Cochrane Review¹⁹ on the same topic, concludes that strategies such as 'high volume evacuation' are effective at mitigating bioaerosols in a dental clinic environment. However, the certainty of the evidence is

likely to be low due to the methodological shortcomings of the included studies, such as indirectness and imprecision.

A retrospective cohort study by Sarapultseva et al.²⁰ compared the prevalence of SARS-CoV-2 antibodies in dental healthcare workers in 3 separate clinics equipped with different types of aspirating systems. While the prevalence of SARS-CoV-2 infection was significantly higher at the clinic equipped with an aspirating vacuum pump without HEPA filter, due to methodological limitations it is not possible to draw firm conclusions from this study.

Yang et al.²¹ investigated the effect of three different suction devices on levels of aerosol in a study with a single human volunteer patient undergoing two dental procedures. However, the usefulness of this proof of concept study is limited by methodological shortcomings and the outcomes are unclear. Bates and Bates²² (preprint) aimed to evaluate aerosol generated during simulated dental procedures with two suction systems: saliva ejector and high-volume evacuator. This study appears to show that in a clinical setup with one patient, use of both high-volume evacuation and saliva ejector reduces the number of aerosol particles near the patients mouth and 1.5 m away, provided there is adequate ventilation.

Eight experimental studies (Balanta-Melo et al.,²³ Shadad et al.,²⁴ Matys et al.,²⁵ Nulty et al.,²⁶ Ehtezazi et al.,²⁷ Chavis et al.,²⁸ Comisi et al.,²⁹ Ravenel et al.³⁰) utilise a simulated clinical set-up to investigate the efficacy of several different suction arrangements. The suction devices investigated included both the intraoral high-volume suction commonly used in dentistry and additional stand-alone extraoral suction devices or scavengers. Most studies found that use of high-volume suction, whether intraoral or extraoral, results in a significant reduction in bioaerosol at distances close to the simulated oral cavity. However, the certainty of evidence is low given that these are studies using simulated dental procedures in dental manikins. Further studies with patients are required to confirm any clinical benefit from these interventions.

The current Agreed Position in the SDCEP Rapid Review is to recommend the use of high-volume suction to reduce the potential risk of SARS-CoV-2 transmission associated with dental aerosol generating procedures. The articles identified to date are consistent with the current Agreed Position but do not provide any higher certainty evidence to inform the use of high-volume suction to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Rubber Dam

SDCEP Rapid Review question: *Should rubber dam be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?*

Two articles relate directly to this Review question; one is a systematic review and one is an experimental study. Both also investigate the use of other mitigation strategies, such as high-volume suction.

Samaranayake et al.¹⁸ systematically review the efficacy of bio-aerosol mitigation strategies used in dentistry, including rubber dam. The review, which includes some of the studies referenced in the Cochrane Review on the same topic,¹⁹ concludes that strategies such as 'rubber dam' are effective at suppressing bio-aerosols in a dental clinic environment. However, the certainty of the evidence is likely to be low due to the methodological shortcomings of the included studies, such as indirectness and imprecision.

Balanta-Melo et al.²³ conducted an experimental study using a dental mannikin and simulated tooth preparation for a full crown. The use of rubber dam resulted in a reduction in ultrafine particles and in the overall concentration of particles as measured by laser diffraction at a distance of 11 cm from the simulated oral cavity. However, the certainty of evidence is low given the study design and levels of

contamination with infectious particles were not assessed. Further studies with patients are required to confirm any clinical benefit from this intervention.

The current Agreed Position in the SDCEP Rapid Review is to recommend the use of rubber dam to reduce the potential risk of SARS-CoV-2 transmission associated with dental aerosol generating procedures. The articles identified to date are consistent with the current Agreed Position but do not provide any higher certainty evidence to inform the use of rubber dam to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Pre-procedural Mouthrinse

SDCEP Rapid Review question: *Should pre-procedural mouth rinse be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?*

Seven articles related directly to this Review question. Three articles are systematic reviews, two articles are reports of randomised controlled trials and two articles describe experimental studies.

Ortega et al.³¹ performed a systematic review which aimed to determine if hydrogen peroxide mouthwashes have a virucidal effect. However, no studies met the inclusion criteria, which were quite broad, and the authors concluded that the lack of evidence should lead to a reassessment of the advice to use this particular mouthwash as a mitigation against SARS-CoV-2. Moosavi et al.³² investigated the possible benefit of antiviral mouthrinses against COVID-19. However, this review reports on *in vitro* studies only and extrapolates from indirect, low certainty, non-clinical data. The review by Samaranayake et al.¹⁸ investigates the efficacy of bio-aerosol mitigation strategies used in dentistry, including pre-procedural mouthrinse. The authors found evidence that pre-procedural mouthrinses can reduce levels of bacteria in bio-aerosols but no evidence about the antiviral effectiveness of this mitigation strategy.

Two reports of RCTs were found. Nayak et al.³³ investigated the efficacy of chlorhexidine (CHX) and herbal mouthwashes to reduce bacterial contamination of dental aerosols. This small study (n=30) suggests that CHX/herbal mouthwashes can reduce the bacterial contamination of dental aerosols generated during ultrasonic scaling. However, it is unclear whether this result can be generalised to reducing the viral contamination of dental aerosols. Seneviratne et al.³⁴ (preprint) investigated the effect of pre-procedural mouthrinses on the SARS-CoV-2 load in the saliva of COVID-19 positive patients. This small study (n=16) suggests a decrease in SARS-CoV-2 salivary load with use of cetylpyridinium chloride and povidone-iodine mouthwash that is sustained at 3h and 6h compared to the control group. The effectiveness of chlorhexidine mouthrinse was less clear. However, the limited number of participants and the use of a method to quantify virus that did not assess viability means that further studies involving patients in a dental setting are required to validate the result.

Two experimental studies investigate the *in vitro* efficacy of antimicrobial mouthwashes against SARS-CoV-2. Davies et al.³⁵ (preprint) demonstrated that essential oil-containing, povidone iodine and hypochlorous acid-containing mouthwashes effectively inactivate SARS-CoV-2 while hydrogen peroxide and chlorhexidine-containing mouthwashes were not effective. Hassandarvish et al.³⁶ found that povidone iodine mouthwash has antiviral activity against SARS-CoV-2, even when diluted 50% and with only 15 seconds contact time. However, *in vivo* data collected in a dental setting is required to confirm the findings from both these studies and to determine the substantivity of the anti-viral effect.

The current Agreed Position in the SDCEP Rapid Review is to not recommend the use of pre-procedural mouth rinses to reduce the potential risk of SARS-CoV-2 transmission associated with dental aerosol generating procedures. The articles identified to date do not provide any higher certainty evidence to inform the use of pre-procedural mouthrinses to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Antimicrobial Coolants

SDCEP Rapid Review question: *Should antimicrobial coolants be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?*

Four articles related directly to this Review question. Three of the identified articles are experimental studies while the fourth is a literature review. Plog et al.³⁷ propose that the addition of viscoelastic polymers will suppress irrigant aerosolization by dental scalers and drills; a proof of concept study with a simulated dental patient suggests the additive does reduce aerosol formation. Two experimental studies by Ionescu et al.^{38,39} investigated the efficacy of adding H₂O₂ to dental water lines to reduce the viral load of bio-aerosols created by dental AGPs. While the results suggest that the additive is effective, there are several limitations to the methodology used. Further investigations in a clinical setting are required to substantiate the findings of these three studies.

The final article of interest identified from the screen was subsequently excluded on reading of the full text. Bardellini et al.⁴⁰ performed a literature review and propose the use of ozonised water in waterlines to reduce the viral load of dental aerosols. However, there are no experimental data reported.

The current Agreed Position in the SDCEP Rapid Review is to not recommend the use of antimicrobial coolants to reduce the potential risk of SARS-CoV-2 transmission associated with dental aerosol generating procedures. The articles identified to date do not provide any higher certainty evidence to inform the use of antimicrobial coolants to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Other Procedural Mitigation

SDCEP Rapid Review question: *Should other procedural mitigations be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?*

Three articles relate directly to this question; all are reports of experimental studies. A fourth article which initially seemed relevant does not report any experimental data and was therefore excluded.

Three articles propose novel barrier devices to prevent aerosol dispersion. All devices are positioned over the patient's head and chest with access ports for the dentist and assistant. Two of the devices are composed of a plastic sheet on a simply constructed frame while the third is a rigid plastic chamber which is unlikely to be available commercially at this time. Teichert-Filho et al.⁴¹ and Montalli et al.⁴² show in two proof of concept studies that their proposed devices are effective at preventing contamination by bacterial solution and/or fluorescent dye from the dental waterline during simulated dental procedures. However, further studies are required to show clinical benefit and patient acceptability. Vikhe et al.⁴³ also propose a 'homemade' isolation tent that provides a barrier between patient and clinician, but no experimental tests have been performed to demonstrate its effectiveness.

Montalli et al.⁴⁴ performed a proof of concept study to investigate the effectiveness of a spray reduction device for ultrasonic scalers. While the results of the study suggest the device is effective, there are methodological limitations and the device should be investigated in a clinical setting to confirm the findings.

The articles identified to date do not provide evidence of sufficient certainty to inform the use of other procedural mitigation to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Ventilation/Fallow Time

SDCEP Rapid Review question: *What fallow time should be used to minimise the risk of SARS-COV-2 transmission to the dental team and other patients?*

Two articles related directly to this Review question.

Ehtehazi et al.²⁷ carried out a phantom head simulation measuring particle generation associated with multiple AGPs. With low volume suction alone, particles persisted beyond the time period monitored at all sites in the surgery tested, this was substantially reduced with several combinations of mitigations. The addition of intraoral high-volume suction (HVS) only or in combination with use of an air cleaner system (filterless high-voltage plasma air purifier) were most effective. While this simulation study has limitations, the findings are consistent with the agreed positions within the SDCEP Rapid Review, supporting the use of intraoral high-volume suction to mitigate the risk associated with dental aerosol generating procedures and to reduce fallow time. The proposal that even without ventilation and HVS, a fallow time of around 30 minutes is sufficient and that fallow time may be eliminated if HVS (intraoral) and the air cleaning system described in this study is used requires further investigation.

Shahdad et al.⁴⁵ (preprint) aimed to assess the generation of aerosol by particle measurement during a standard dental procedure in a dental manikin simulation with or without mechanical ventilation and with or without the use of extraoral suction. The number of variable factors complicates the interpretation, but the results suggest that mechanical ventilation (6 ACH) with high volume suction may be sufficient to enable a reduction in fallow time. Further research is required. This study supports the recommendation that AGPs should not be carried out in a room with no ventilation.

The current Agreed Position in the SDCEP Rapid Review is that a pragmatic fallow time is recommended to reduce the potential risk of SARS-CoV-2 transmission associated with treatment that involves a Group A dental procedure. The articles identified to date do not provide any higher certainty evidence to inform the approach proposed in the Rapid Review for implementing fallow time to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Air Cleaners

SDCEP Rapid Review question: *What air cleaning technologies can be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?*

Four articles address this Review question. All are reports of experimental studies.

Two articles investigate the use of air cleaners to remove potentially contaminated aerosol particles. While the study by Kahler et al.⁴⁶ appears to show that the device examined is effective at removing aerosol particles, it does not account for the presence of objects/people in the room and does not specifically look at the device in a dental context. It is also not clear whether the level of aerosol used in this study corresponds to levels of aerosol generated by a dental AGP. The findings from a study by Ren et al.⁴⁷ suggest that using a portable air cleaner, especially in rooms with low ACH, can both reduce the accumulation of aerosol particles and increase the rate of removal. However, further studies in a clinical setting (with patient undergoing an AGP) are required to give a more realistic idea of the impact of portable air cleaners on aerosol removal.

Botta et al.⁴⁸ report a modelling study to investigate the use of UVC lamps to inactivate SARS-CoV-2 on surfaces in a dental setting (i.e. not aerosol). The results suggest that this is possible but clinical studies in health care settings are required to evaluate the device.

Finally, Mirhoseini et al.⁴⁹ performed a quantitative and qualitative assessment of microbial aerosols in different indoor environments of a dental school clinic. This article is not COVID-specific and does not sample for virus but may provide useful information if experimental set-ups to monitor airborne virus are being considered.

The current Agreed Position in the SDCEP Rapid Review is to not recommend the use of air cleaners to reduce the potential risk of SARS-CoV-2 transmission associated with dental aerosol generating procedures. The articles identified to date do not provide any higher certainty evidence to inform the use of air cleaners to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs.

Miscellaneous

Five articles address miscellaneous issues related to the Review topic. One article is a clinical guideline and three articles are reviews of the literature. It has, to date, not been possible to access one of the articles of interest.

The CDC guidance for dental settings⁵⁰ covers aspects included in the SDCEP Rapid Review and gives recommendations on the use of suction, dental dam and pre-procedural mouthrinses that broadly align with the Agreed Positions of the Review. There is also advice on ventilation. However, no supporting evidence is cited and details of methodology or authorship are not included. Articles by Maia et al.,⁵¹ Mahdi et al.⁵² and Turkistani et al.⁵³ claim to be systematic reviews but on closer inspection appear to be reviews of the literature to identify others' COVID-19-related recommendations, including mitigation of AGPs. The mitigation strategies identified mirror most of the SDCEP Review's Agreed Positions with the exception of pre-procedural mouthrinses, which are recommended by many of the publications identified by the three reviews.

Conclusion

The articles identified to date do not provide any higher certainty evidence that would change the current Agreed Positions that relate to each of the Review questions.

Given the lack of higher certainty evidence identified to date, and the rapidly evolving dynamics of the COVID-19 pandemic, the strategy for maintaining the currency of the review will be reconsidered to determine whether to continue to periodically update the literature search and appraisal and, if so, how to achieve this in an efficient manner.

Appendix 1 Key Questions and Inclusion/Exclusion Criteria

Key Questions

The questions which informed the evidence search are:

- a) Which dental procedures produce bioaerosols? (PROCEDURES)
- b) Do different AGPs produce different levels of risk? (RISK)
- c) What current mitigation procedures, alone or in combination and in addition to PPE, are most effective for reducing the risk associated with dental AGPs? To include:
 - i) Mouthwashes (PREPROCEDURAL MOUTHRINSE)
 - ii) Rubber dam (RUBBER DAM)
 - iii) High volume suction (SUCTION)
 - iv) Any other factors identified (ANTIMICROBIAL COOLANTS; OTHER PROCEDURAL MITIGATION)
- d) Following dental treatment using an AGP for COVID-19 and non-COVID-19 patients, how long should the 'fallow period' be before environmental cleaning and seeing the next patient? (VENTILATION/FALLOW TIME)
- e) What environmental mitigation can reduce the 'fallow period' following an AGP? (AIR CLEANERS)

N.B. The word in brackets following each question refers to the relevant heading in the report.

Inclusion/exclusion criteria

The inclusion and exclusion criteria used for the post-publication screening process are a modified version of the criteria used for the initial Rapid Review, expanded to improve the specificity of the screening process.

Inclusion criteria:

- Article type:
 - systematic reviews (i.e. include a methods section, search of one or more databases and details of included studies);
 - guidelines (i.e. make *de novo* recommendations based on a systematic search of evidence and include a description of methodology used);
 - randomized controlled or controlled clinical trials relevant to dental settings;
 - observational studies;
 - experimental studies
- Topic specific: relevant to the questions above i.e. relate to aerosol generation in a dental setting, mitigating factors/interventions to reduce potential risk from contaminated aerosols (e.g. mouthwashes, rubber dam, high volume suction, air cleaners) or fallow period following AGPs

Exclusion criteria:

- Articles that are clearly a letter, opinion article or editorial
- Articles on non-dental AGPs
- Articles related to HIV/AIDS (there were a large number of such articles that were considered not relevant to the review questions)
- Articles on Personal Protective Equipment alone
- Articles not in English, unless COVID-19 specific, because of time constraints
- Surveys
- Case studies and case series (would not be considered sufficient to change agreed positions)
- Test of principle studies on new technologies that do not assess application in a clinical setting
- Articles reporting modelling or theoretical predictions, unless tested in a relevant setting

References

1. Alonso-Coello P, Schunemann HJ, Moberg J, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *BMJ*. 2016;353:i2016.
2. Public Health England. COVID-19: infection prevention and control dental appendix 2020; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/965686/Infection_prevention_and_control_guidance_Dental_appendix_.pdf. Accessed 31 March, 2021.
3. Jackson T, Deibert D, Wyatt G, et al. Classification of aerosol-generating procedures: a rapid systematic review. *BMJ Open Respiratory Research*. 2020;7(1).
4. Viridi MK, Durman K, Deacon S. The Debate: What Are Aerosol-Generating Procedures in Dentistry? A Rapid Review. *JDR Clinical and Translational Research*. 2021;2380084421989946.
5. Gallagher JE, K CS, Johnson IG, et al. A systematic review of contamination (aerosol, splatter and droplet generation) associated with oral surgery and its relevance to COVID-19. *BDJ Open*. 2020;6:25.
6. Innes N, Johnson IG, Al-Yaseen W, et al. A systematic review of droplet and aerosol generation in dentistry. *J Dent*. 2021;105:103556.
7. Al-Moraissi EA, Abood M, Alasseri N, Gunther F, Neff A. Is Standard Personal Protective Equipment Effective Enough To Prevent COVID-19 Transmission During Aerosol Generating Dental, Oral and Maxillofacial Procedures? A Systematic Review. *Medrxiv*. 2020.
8. Kun-Szabo F, Gheorghita D, Ajtai T, et al. Aerosol generation and control in the dental operator: an in vitro spectrometric study of typical clinical setups. *PLoS One*. 2021;16(2):e0246543.
9. Hobson Ross S, Pabary Shiv B, Amlani K, Badminton K. Aerosols created by dental procedures in a primary care setting. *Medrxiv*. 2020.
10. Din AR, Hindocha A, Patel T, et al. Quantitative analysis of particulate matter release during orthodontic procedures: a pilot study. *British Dental Journal*. 2020.
11. Han P, Li H, Walsh L, Saso I. Splatters and Aerosols Contamination in Dental Aerosol Generating Procedures. *Applied Sciences*. 2021;11(4):1914-1914.
12. Llandro H, Allison JR, Currie CC, et al. Evaluating splatter and settled aerosol during orthodontic debonding: implications for the COVID-19 pandemic. *British Dental Journal*. 2021;Online ahead of print.
13. Kaufmann M, Solderer A, Gubler A, Wegehaupt FJ, Attin T, Schmidlin PR. Quantitative measurements of aerosols from air-polishing and ultrasonic devices: (How) can we protect ourselves? *Plos ONE*. 2020;15(12):e0244020.
14. Chanpong B, Tang M, Rosenczweig A, Lok P, Tang R. Aerosol-Generating Procedures and Simulated Cough in Dental Anesthesia. *Anesthesia Progress*. 2020;67(3):127-134.
15. Shanmugaraj GB, Rao AK. A study to assess the microbial profile and index of microbial air contamination in dental operatories. *Indian Journal of Dental Research*. 2020;31(3):465-469.
16. Abdelkarim-Elafifi H, Arnabat-Artes C, Parada-Avendano I, Polonsky M, Arnabat-Dominguez J. Aerosols generation using Er,Cr: YSGG laser compared to rotary instruments in conservative dentistry: a preliminary study. *Journal of Clinical and Experimental Dentistry*. 2021;13(1):e30-e36.
17. Bizzoca ME, Campisi G, Lo Muzio L. An innovative risk-scoring system of dental procedures and safety protocols in the COVID-19 era. *BMC Oral Health*. 2020;20(1):301.
18. Samaranayake LP, Fakhruddin KS, Buranawat B, Panduwawala C. The efficacy of bio-aerosol reducing procedures used in dentistry: a systematic review. *Acta Odontologica Scandinavica*. 2021;79(1):69-80.

19. Nagraj SK, Eachempati P, Paisi M, Nasser M, Sivaramakrishnan G, Verbeek JH. Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases. *Cochrane Database of Systematic Reviews (Online)*. 2020;10:CD013686.
20. Sarapultseva M, Hu D, Sarapultsev A. SARS-CoV-2 Seropositivity among Dental Staff and the Role of Aspirating Systems. *JDR Clinical and Translational Research*. 2021:2380084421993099.
21. Yang M, Chaghtai A, Melendez M, et al. Mitigating saliva aerosol contamination in a dental school clinic. *BMC Oral Health*. 2021;21(1):52.
22. Bates D, Bates A. Analysing air particle quantity in a dental primary care setting. *medRxiv*. 2020.
23. Balanta-Melo J, Gutierrez A, Sinisterra G, et al. Rubber Dam Isolation and High-Volume Suction Reduce Ultrafine Dental Aerosol Particles: an Experiment in a Simulated Patient. *Applied Sciences*. 2020;10(18):6345-6345.
24. Shahdad S, Patel T, Hindocha A, et al. The efficacy of an extraoral scavenging device on reduction of splatter contamination during dental aerosol generating procedures: an exploratory study. *British Dental Journal*. 2020.
25. Matys J, Grzech-Lesniak K. Dental Aerosol as a Hazard Risk for Dental Workers. *Materials*. 2020;13(22).
26. Nulty A, Lefkaditis C, Zachrisson P, Van Tonder Q, Yar R. A clinical study measuring dental aerosols with and without a high-volume extraction device. *British Dental Journal*. 2020.
27. Ehtezazi T, Evans DG, Jenkinson ID, et al. SARS-CoV-2: characterisation and mitigation of risks associated with aerosol generating procedures in dental practices. *British Dental Journal*. 2021.
28. Chavis SE, Hines SE, Dyalram D, Wilken NC, Dalby RN. Can extraoral suction units minimize droplet spatter during a simulated dental procedure? *Journal of the American Dental Association*. 2021;152(2):157-165.
29. Comisi JC, Ravenel TD, Kelly A, Teich ST, Renne W. Aerosol and spatter mitigation in dentistry: analysis of the effectiveness of 13 setups. *Journal of Esthetic and Restorative Dentistry*. 2021.
30. Ravenel TD, Kessler R, Comisi JC, Kelly A, Renne WG, Teich ST. Evaluation of the spatter-reduction effectiveness and aerosol containment of eight dry-field isolation techniques. *Quintessence International*. 2020:2-12.
31. Ortega KL, Rech BO, El Haje GLC, Gallo CB, Perez-Sayans M, Braz-Silva PH. Do hydrogen peroxide mouthwashes have a virucidal effect? A systematic review. *Journal of Hospital Infection*. 2020;106(4):657-662.
32. Moosavi MS, Aminishakib P, Ansari M. Antiviral mouthwashes: possible benefit for COVID-19 with evidence-based approach. *Journal of Oral Microbiology*. 2020;12(1):1794363.
33. Nayak SU, Kumari A, Rajendran V, Singh VP, Hegde A, Pai KK. Comparative Evaluation of Efficacy of Chlorhexidine and Herbal Mouthwash as a Preprocedural Rinse in Reducing Dental Aerosols: a Microbiological Study. *International Journal of Dentistry*. 2020;2020(no pagination).
34. Seneviratne CJ, Balan P, Ko Kwan Ki K, et al. Efficacy of commercial mouth-rinses on SARS-CoV-2 viral load in saliva: randomized Control Trial in Singapore. *Medrxiv*. 2020.
35. Davies K, Buczkowski H, Welch SR, et al. Effective in-vitro inactivation of SARS-CoV-2 by commercially available mouthwashes. *Biorxiv*. 2020.
36. Hassandarvish P, Tiong V, Mohamed NA, et al. In vitro virucidal activity of povidone iodine gargle and mouthwash against SARS-CoV-2: implications for dental practice. *British Dental Journal*. 2020;Online ahead of print.
37. Plog J, Wu J, Dias YJ, Mashayek F, Cooper LF, Yarin AL. Reopening dentistry after COVID-19: complete suppression of aerosolization in dental procedures by viscoelastic Medusa Gorgo. *Physics of Fluids*. 2020;32(8):083111.

38. Ionescu AC, Brambilla E, Manzoli L, Orsini G, Gentili V, Rizzo R. Efficacy of personal protective equipment and H₂O₂-based spray against coronavirus in dental setting. *Oral Diseases*. 2020;Online ahead of print.
39. Ionescu AC, Brambilla E, Manzoli L, Orsini G, Gentili V, Rizzo R. Aerosols modification with H₂O₂ reduces airborne contamination by dental handpieces. *Journal of Oral Microbiology*. 2021;13(1):1881361.
40. Bardellini E, Amadori F, Veneri F, Conti G, Majorana A. Coronavirus Disease-2019 and dental practice: a project on the use of ozonized water in the water circuit of the dental armchair. *Stomatologija*. 2020;21(2):35-38.
41. Teichert-Filho R, Baldasso CN, Campos MM, Gomes MS. Protective device to reduce aerosol dispersion in dental care in times of COVID-19 pandemic. *International Endodontic Journal*. 2020;Online ahead of print.
42. Montalli VAM, Garcez AS, Montalli GAM, et al. Individual biosafety barrier in dentistry: an alternative in times of covid-19. Preliminary study. *RGO rev Gaucha odontol*. 2020;68(68):1-7.
43. Vikhe DM, Dhope SV, Mhaske PN, Shah SV, Palekar UG. "Pravara tent"- An innovative protective device to control aerosol in dental clinics during the COVID-19 pandemic. *Journal of Clinical and Diagnostic Research*. 2020;14(11):ZH01-ZH03.
44. Montalli VAM, Garcez AS, Oliveira LVCd, Sperandio M, Napimoga MH, Motta RHL. A novel dental biosafety device to control the spread of potentially contaminated dispersion particles from dental ultrasonic tips. *PloS One*. 2021;16(2):e0247029.
45. Shahdad S, Hindocha A, Patel T, et al. Fallow time determination in dentistry using aerosol measurement. *Medrxiv*. 2021.
46. Kahler Christian J, Fuchs T, Hain R. Quantification of a Viomed Klinik Akut V 500 disinfection device to reduce the indirect risk of SARS-CoV-2 infection by aerosol particles. *Medrxiv*. 2020.
47. Ren Y, Huang Q, Marzouk T, et al. Effects of mechanical ventilation and portable air cleaner on aerosol removal from dental treatment rooms. *Journal of Dentistry*. 2020;105:103576.
48. Botta SB, Teixeira FDS, Hanashiro FS, de Araujo WWR, Cassoni A, Salvadori MCBS. Ultraviolet-C decontamination of a dental clinic setting: required dose and time of UVC light. *Brazilian Dental Science*. 2020;23(2,supl):1-10.
49. Mirhoseini SH, Koolivand A, Bayani M, et al. Quantitative and qualitative assessment of microbial aerosols in different indoor environments of a dental school clinic. *Aerobiologia*. 2021:1-8.
50. Guidance for Dental Settings. *Centers for Disease Control and Prevention*. 2020.
51. Maia ABP, Reis VP, Bezerra AR, Conde DC. Recommendations for Management and Mitigation of Aerosol Generated by the Use of High-Speed Rotary Instruments During the COVID-19 Epidemic: an Integrative Review. *Rev Bras Odontol*. 2020;77(1):1-8.
52. Mahdi SS, Ahmed Z, Allana R, et al. Pivoting Dental Practice Management during the COVID-19 Pandemic-A Systematic Review. *Medicina*. 2020;56(12).
53. Turkistani K, Turkistani K. Dental risks and precautions during COVID-19 pandemic: a systematic review. *Journal of International Society of Preventive and Community Dentistry*. 2020;10(5):540-548.