



Scottish Dental  
**Clinical Effectiveness Programme**

# **Rapid Review Methodology**

## **Mitigation of Aerosol Generating Procedures in Dentistry**

Version 1.1

7 December 2020

## Version history

Version	Date	Summary of changes
V1.0	25/09/2020	First published
V1.1	07/12/2020	Considered Judgement tables for Version 1.0 of the Rapid Review (published 25 September 2020) added in Appendix 3

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## 1. Methodology Overview

*Mitigation of Aerosol Generating Procedures in Dentistry* is 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 this rapid review was to identify and appraise the evidence related to several pre-determined key questions about aerosol generating procedures (AGPs) in dentistry and to use a process of considered judgment of this evidence and other relevant factors to reach agreed position statements that may be used to inform policy and clinical guidance. It is important to stress that this rapid review does not have the status of guidance. However, many aspects of SDCEP's standard guidance development process ([www.sdcep.org.uk/how-we-work/sdcep-guidance-development-process/](http://www.sdcep.org.uk/how-we-work/sdcep-guidance-development-process/)) have informed the methodology of this rapid review. Key stages included:

- Drafting of the scope;
- Convening a multidisciplinary Working Group;
- Agreement on the scope and review questions;
- Systematic literature search and screening;
- Evidence appraisal, synthesis and summary;
- Considered judgements to reach agreed position statements;
- Preparation of the draft review based on considered judgements;
- Developmental editing of the review report;
- Dissemination of the review report.

Specific details of the methodology used for the development of the *Mitigation of Aerosol Generating Procedures in Dentistry* rapid review are presented either in the review report ([www.sdcep.org.uk](http://www.sdcep.org.uk)) or in the following sections of this methodology document.

## 2. Working Group

The Working Group included subject specialists from disciplines including particle physics, aerobiology and clinical virology, as well as individuals from a range of relevant branches of the dental profession, and a patient.

Jeremy Bagg (Chair)	Professor of Clinical Microbiology, University of Glasgow; Head of Glasgow Dental School; Chair of SDCEP Steering Group
Jan Clarkson (Director of SDCEP)	Associate Postgraduate Dental Dean, NHS Education for Scotland; Professor of Clinical Effectiveness, University of Dundee; Joint Co-ordinating Editor, Cochrane Oral Health, University of Manchester
Mick Armstrong	General Dental Practitioner; Chair, British Dental Association
Allan Bennett	Biosafety Specialist, National Infection Service, Public Health England
Pauline Carruthers	Practice Manager, Selkirk Dental Practice, NHS Borders
Paul Coulthard	Dean and Institute Director, Institute of Dentistry, Queen Mary University of London (QMUL); President, British Association of Oral Surgeons
Julie Deverick	President of the British Society of Dental Hygiene and Therapy
Andy Duncan	Account Manager, National Physical Laboratory (NPL)
Fiona Ellwood	Dental Nurse; Executive Director & Patron of the Society of British Dental Nurses; Subject Expert, Bangor University
Mike Escudier	Professor of Oral Medicine and Education, King's College London; Former Dean, Faculty of Dental Surgery, Royal College of Surgeons of England
Anne-Marie Glenny	Head of Division of Dentistry, School of Medical Sciences, University of Manchester; Joint Co-ordinating Editor of Cochrane Oral Health, University of Manchester
Ilona Johnson	Reader and Honorary Consultant in Dental Public Health, Cardiff University School of Dentistry
Steven Johnston	Senior Dental Officer, NHS Orkney
Kathy Li	Clinical Research Fellow MRC, University of Glasgow Centre for Virus Research; Honorary Clinical Virologist, NHS Greater Glasgow and Clyde
Tina McGuff	Patient
Gavin McLellan	Deputy Chief Dental Officer, CDO & Dentistry Division, Scottish Government; General Dental Practitioner
Ian Mills	Dean of Faculty of General Dental Practice (UK), Royal College of Surgeons of England; General Dental Practitioner

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Gillian Nevin	General Dental Practitioner; Assistant Postgraduate Dental Dean (CPD), NHS Education for Scotland
Joe Noar	Consultant Orthodontist/Hon Senior Lecturer, Eastman Dental Hospital/Institute, London; Director for Clinical Governance, British Orthodontic Society
William Priestley	Dental Adviser, Health and Social Care Board, Northern Ireland
Paul Quincey	Principal Research Scientist, National Physical Laboratory (NPL)
Liz Roebuck	Consultant in Paediatric Dentistry, NHS Lothian
Brian Stevenson	Consultant/Hon Senior Lecturer in Restorative Dentistry; Acting Clinical Director, Dundee Dental Hospital
Sandra White	National Lead for Dental Public Health, Public Health England
Gavin Wilson	Specialty Trainee in Oral Surgery, Leeds Dental Institute/University of Leeds; Chief Dental Officer's Clinical Fellow, NHS England/Care Quality Commission

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N.B. The individuals listed do not necessarily represent the views of the organisations with which they are affiliated.

### 3. Methodology Team

SDCEP operates within NHS Education for Scotland. For this publication, members of Cochrane Oral Health assisted with the methodology.

Douglas Stirling	Programme Lead (Guidance), SDCEP, NHS Education for Scotland
Derek Richards	Specialist Advisor to SDCEP; Director, Centre for Evidence-based Dentistry; Senior Lecturer, University of Dundee
Samantha Rutherford	Specialist Lead, SDCEP, NHS Education for Scotland
Michele West	Specialist Lead, SDCEP, NHS Education for Scotland
Margaret Mooney	Business Support, SDCEP, NHS Education for Scotland
Laura Beaton	Research Fellow, TRiADS, NHS Education for Scotland
Linda Young	Programme Lead (Implementation), TRiADS, NHS Education for Scotland
Anne Littlewood	Trials Search Coordinator, Cochrane Oral Health, University of Manchester
Laura McDonald	Managing Editor, Cochrane Oral Health, University of Manchester
Philip Riley	Lecturer in Oral Health, University of Manchester; Editor, Cochrane Oral Health
Tanya Walsh	Professor of Healthcare Evaluation, University of Manchester; Editor, Cochrane Oral Health
Helen Worthington	Professor of Evidence Based Healthcare, University of Manchester

Thanks also to Lorna Barnsley, Anne Coats, Tracy Frail, Elizabeth Payne and Colin Yau for additional business support throughout this work.

## 4. Scope

A draft of the scope of the rapid review was developed by the Methodology Team and the Working Group chair based on recent experience of developing other resources relevant to the topic, research conducted to inform these resources and feedback received. The scope was refined and agreed by the Working Group and the final version was published on the SDCEP website on 1 July 2020. The scope is provided in Appendix 1.

The scope included several questions to be addressed by the review:

- a) Which dental procedures produce bioaerosols?
- b) Do different AGPs produce different levels of 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
  - ii) Rubber dam
  - iii) High volume suction
  - iv) Any other factors identified
- 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?
- e) What environmental mitigation can reduce the 'fallow period' following an AGP?

## 5. Literature Search

A comprehensive literature search of online databases Medline, Embase, Cochrane Database of Systematic Reviews, Epistemonikos, Cochrane COVID-19 Study Register, Database of Abstracts of Reviews of Effects and WHO COVID-19 Global Literature Database was conducted on 22 June 2020 by the Trials Search Co-ordinator of Cochrane Oral Health. No date limits were applied. A similar supplementary search focussing on air cleaners and restricted to articles published between 2010-2020 was carried out on 25 August 2020. See Appendix 2 for details of searches. These two searches retrieved 4,058 and 375 articles respectively.

After a preliminary examination of a subset of retrieved articles, the following criteria were agreed by the Methodology Team to identify relevant articles.

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. include recommendations); randomized controlled or controlled clinical trials carried out in a dental setting; 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.

Records were screened in duplicate by reviewers against the inclusion and exclusion criteria to identify systematic reviews, guidelines and primary studies relevant to the rapid review questions. Additional manual searching and follow up of citations from relevant articles identified through the systematic search also took place. Other sources of evidence, including unpublished work, identified by Working Group members during the process were also considered, taking relevance and methodological quality into account.

As with the development of SDCEP guidance, the strategy adopted for this rapid review was to focus on existing systematic reviews, guidelines, policy documents, legislation or other recommendations if these were identified in the search, before considering primary studies. These documents were appraised for their quality of development, evidence base and applicability to the review questions. Only in the absence of these documents or when supplementary information was required, were other published research and reports, and unpublished work considered.

## 6. Evidence Appraisal and Synthesis

For the rapid review of evidence relating to dental AGPs, recent systematic reviews were identified for each of the questions specified in the scope. This included additional relevant pre-publication systematic reviews shared with the Working Group, which were included in this instance due to the urgency imposed by COVID-19 pandemic and a lack of published synthesised evidence.

Systematic reviews were appraised and the data relevant to the review question was extracted, in duplicate, using a standard SDCEP evidence appraisal form. A GRADE (Grading of Recommendations, Assessment, Development and Evaluation; [www.gradeworkinggroup.org](http://www.gradeworkinggroup.org)) rating for evidence certainty was assigned where possible.

## 7. Focus Groups

During the process of conducting this rapid review, three focus groups were conducted by SDCEP's partner programme TRiADS (Translation Research in a Dental Setting) to better understand the current opinions of professionals and patients regarding AGPs. Two focus groups with dental health professionals sought to gain insight into their views towards different approaches to fallow time. Similarly, in another focus group the views of members of the public regarding their experiences of primary care dentistry during the COVID-19 pandemic were explored. The outcomes of these focus groups were made available to the Working Group and contributed to the considered judgement process (in particular, informing the assessment of values and preferences, acceptability and feasibility). Reports on these focus groups are available on the TRiADS website ([www.triads.org.uk/in-development/covid-19/](http://www.triads.org.uk/in-development/covid-19/)).

## 8. Considered Judgements and Agreed Position Statements

Meetings of the Working Group were held remotely with papers provided in advance. Anonymous polling was conducted to facilitate the decision-making process when working with a large group online and to

ensure that each group member had an equal opportunity to contribute to the outcome. It was agreed at the outset that only Working Group members could vote and that 75% would be accepted as a consensus majority for binary votes. In some instances, not all Group members were in agreement and the relevant agreed positions were informed by the consensus majority. Some Working Group members may not support every outcome within the rapid review report.

Evidence summaries, which also identified areas where evidence was lacking, were shared with the Working Group to inform and facilitate the considered judgement process, leading to an agreed position for each question. Following a process modelled on the GRADE evidence-to-decision framework for developing guidance recommendations,<sup>1</sup> the Working Group considered the available evidence in the context of the balance of benefits and harms, values and preferences, acceptability and feasibility of the interventions. The Working Group's consideration of the criteria and the resulting agreed position statements and other outcomes for each review question were recorded in SDCEP's standard Considered Judgement Forms. See Appendix 3 for the Considered Judgement Form relevant to each review question.

Several of the agreed positions reached are 'to not recommend' an intervention. These are conditional statements because although these interventions are not recommended for universal adoption in practice, some practitioners might choose to use them after careful consideration of all relevant factors.

## 9. Rapid Review Report and Dissemination

The agreed position statements, context and associated narrative were drafted within a report document by the Methodology Team, with further developmental editing carried out following several rounds of discussion and feedback from the Working Group. Implementation points and proposals for categorisation of dental procedures and determination of fallow time were developed to address practicalities identified through the considered judgement process. A final pre-publication draft was circulated to members of the Working Group and key stakeholders were notified.

The review was first published on the SDCEP website (<https://www.sdcep.org.uk/published-guidance/covid-19-practice-recovery/rapid-review-of-agps/>) on 25 September 2020 and announced widely to stakeholders by email and social media.

## 10. Updating the Rapid Review

This rapid review was conducted to inform policy and guidance for dental services adapting in response to the evolving COVID-19 pandemic. The agreed position statements presented in this document are based on the evidence available at the time of publication. In view of the constantly evolving and urgent situation, this is a living document and the Working Group will continue to meet to assess new evidence to maintain currency of the document in the coming months. Although there has been no formal consultation or peer review due to time constraints, future updating will encompass consideration of any feedback received post-publication.

## 11. Conflicts of Interest

All contributors to SDCEP work are required to declare their financial, intellectual and other relevant interests by completing a Declaration of Interests form. At each Working Group meeting, participants were asked to confirm whether there were any changes to these. Any declared interests that could constitute a

conflict of interest were considered by the Working Group chair and the Methodology Team. For this rapid review, there were no declared interests that were considered to constitute a conflict that would require further action. All declarations of interest are available on request.

## **12. Acknowledgements**

The Working Group would like to thank the dental professionals and members of the public who participated in focus groups and responded to surveys. We are also grateful to: Rebecca Harris, Mark Robertson, Sukriti KC, Waraf Al-Yaseen, Nicola Innes, Richard Holliday, James Allison, Owen Addison, Sumanth Kumbargere Nagraj and their colleagues for sharing unpublished research data to support this rapid review; David Conway at Public Health Scotland and Jennifer Rodgers at the Scottish Emergency Dental Service for supplying unpublished data.

## Appendix 1 – Scope

### Aerosol Generating Procedures in Dental Practice Rapid Review Scope and terms of reference of the working group

Version 2: 26 June 2020

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.

#### Why this review is needed

Dental services have been severely curtailed during the COVID-19 pandemic. Safe remobilisation of dental services relies on addressing the great uncertainty that exists about the use of aerosol generating procedures and the associated risk of transmission of SARS-CoV-2.

#### What the review aims to do

The aims of this review are:

- to determine which dental procedures constitute aerosol generating procedures (AGPs)\*;
- to determine what measures are likely to mitigate the risk of transmission of SARS-CoV-2 via dental AGPs;
- to inform procedures for environmental cleaning between patients following a dental AGP.

\* Dental aerosol generating procedures (AGPs) are defined as any dental procedure that results in the production of airborne particles (aerosols).

Aerosols contain two types of particle defined by their size:

- Droplets are larger and heavier particles (greater than 5µm). Droplets can travel up to 1 metre from the source and contaminate surfaces within that range.
- Droplet nuclei are smaller (1-5µm) and can stay airborne for long periods of time before landing and contaminating surfaces.

#### Questions the review will address

- a) Which dental procedures produce bioaerosols?
- b) Do different AGPs produce different levels of 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
  - ii) Rubber dam
  - iii) High volume suction
  - iv) Any other factors identified
- 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?
- e) What environmental mitigation can reduce the 'fallow period' following an AGP?

### Questions the review will not address

- Levels of personal protective equipment, which are determined by Public Health England/Health Protection Scotland for various healthcare settings and circumstances.
- The timing of reintroduction of AGPs in dental practice.
- The financial aspects of supporting practices throughout the period of reintroducing AGPs in dental practice.

### Target groups

Patients who require dental care that might involve an aerosol generating procedure, including:

- A) those who are not currently suspected to be a possible or confirmed COVID-19 case (no symptoms, not living in a household with a symptomatic person, no positive swab test, not waiting for a test or test results). This includes patients who are at higher risk, though not necessarily shielding, or extremely high risk (shielding) of developing severe illness with coronavirus.
- B) those who have COVID-19 symptoms or who have swab-tested positive for COVID-19 or who have close contact with a COVID-19 case (i.e. in their household) and therefore should be self-isolating.

Members of the dental team involved in the provision of dental care that might involve an aerosol generating procedure.

### Target users

The review will be of interest to everyone working in general dental practice, the public/community dental service, the hospital dental service, dental professionals in training and patients. The review will be particularly relevant to policy makers and those involved in dental education.

### Method of working

- The project will be coordinated by SDCEP staff who will be responsible for establishing a working group, developmental editing, consultation and publication. Further information about SDCEP is provided at [www.sdcep.org.uk](http://www.sdcep.org.uk).
- Literature searches, based on the questions to be addressed, will be conducted by Cochrane Oral Health (COH).
- Members of SDCEP and COH will constitute a methodology team that will screen, appraise and summarise available evidence for consideration by the working group.
- The working group will comprise topic experts from across the UK (including medical virology and aerobiology), representatives of the general, public and hospital dental services and patients. The group will be chaired by Prof. Jeremy Bagg.
- Requirements of working group members will include:
  - applying professional experience and expertise;
  - representing the views of a wider group;
  - drawing on personal experience (e.g. a patient with a relevant condition, a carer);
  - sharing research experience and knowledge of the subject (e.g. caring for patients with a relevant condition, involvement in other relevant projects);
  - maintaining confidentiality throughout the review process and until the review is published.

- The working group will:
  - refine the scope including the key questions provided by the methodology team;
  - receive and consider summarised evidence provided by the methodology team;
  - make considered judgements that may inform recommendations;
  - read and comment on drafts of the review and comments and suggestions received prior to publication;
  - approve the final version of the review for publication;
- A draft of the review will be circulated to a wider group of stakeholders, including specialist dental societies, for comment.
- Having considered the comments received from stakeholders, the review will be refined for publication.
- All contributors will be required to declare interests and any competing interests will be managed according to SDCEP's standard process (see [www.sdcep.org.uk/about/get-involved-2/](http://www.sdcep.org.uk/about/get-involved-2/)).

### **Format and usage**

The review will be published and made freely available for use by other organisations to inform guidance on the use of aerosol generating procedures in dental practice.

## Appendix 2 – Evidence Searches

Scottish Dental Clinical Effectiveness Programme: Aerosol generating procedures			
Summary of Searches			
Database	Version/issue	Date of search	Records retrieved
MEDLINE Ovid (ePub ahead of print, in-process and other non-indexed citations)	1946 to 22 June 2020	22.06.20	2,720
Embase Ovid (search limit: exclude MEDLINE indexed journals)	1980 to 22 June 2020	22.06.20	1,786
Cochrane Database of Systematic Reviews, Ovid	Whole database	22.06.20	23
Epistemonikos	Whole database	22.06.20	12
Cochrane COVID-19 Study Register	Whole database	22.06.20	31
Database of Abstracts of Reviews of Effects, Ovid	2005 to 22 June 2020	22.06.20	0
WHO COVID-19 Global Literature Database	Whole database	22.06.20	33
4,058 records after deduplication			

### MEDLINE Ovid search strategy

1. exp dentistry/
2. exp dental facilities/
3. infection control, dental/
4. exp dentists/
5. dental staff/
6. exp dental auxiliaries/
7. (dental or dentist\$ or hygienist\$).mp.
8. Dental high speed equipment/
9. ("high speed air rotor\$" or "low speed handpiece\$" or "low speed hand piece\$" or micromotor\$ or "turbine handpiece\$" or "electrosurgery unit" or "air polisher\$" or "prophy angle\$" or "air-water syringe\$" or "high speed hand piece\$" or "high speed handpiece\$" or "three-way air syringe\$" or "threeway air syringe\$" or "ultrasonic scaler\$" or "hard-tissue laser\$" or "dental drill\$" or "piezo unit\$" or "piezo hand piece\$" or "piezo handpiece\$" or "rotary instrument\$" or "air abrasion" or "water spray\$").mp.
10. or/1-9
11. Air microbiology/
12. Air pollution, indoor/
13. Aerosols/
14. Inhalation exposure/
15. (aerosol\$ or bioaerosol\$).mp.

16. ((air\$ or inhal\$ or expos\$ or risk\$) adj5 (droplet\$ or splatter\$ or spatter\$ or microbe\$ or bacillus or germ\$ or microorganism\$ or virus\$ or viral or coronavirus\$ or COVID\$ or "middle east? respiratory syndrome\$" or MERS or MERS-CoV or "camel flu" or SARS or "sudden acute respiratory syndrome\$" or "Wuhan virus\$" or 2019-nCoV or SARS-CoV-2 or SARS-CoV or SARS-CoV-1 or SARS-1)).ti,ab.
17. (air adj5 (pollut\$ or quality or impur\$)).mp.
18. Decontamination/
19. or/11-18
20. 10 and 19

### **Embase Ovid search strategy (includes a search limit to exclude MEDLINE indexed journals)**

1. exp dentistry/
2. dental facility/
3. exp dental personnel/
4. (dental or dentist\$ or hygienist\$).mp.
5. ("high speed air rotor\$" or "low speed handpiece\$" or "low speed hand piece\$" or micromotor\$ or "turbine handpiece\$" or "electrosurgery unit" or "air polisher\$" or "prophy angle\$" or "air-water syringe\$" or "high speed hand piece\$" or "high speed handpiece\$" or "three-way air syringe\$" or "threeway air syringe\$" or "ultrasonic scaler\$" or "hard-tissue laser\$" or "dental drill\$" or "piezo unit\$" or "piezo hand piece\$" or "piezo handpiece\$" or "rotary instrument\$" or "air abrasion" or "water spray\$").mp.
6. or/1-5
7. exp Air pollution/
8. Aerosol/
9. Environmental exposure/
10. (aerosol\$ or bioaerosol\$).mp.
11. (air adj5 (pollut\$ or quality or impur\$)).mp.
12. Decontamination/
13. ((air\$ or inhal\$ or expos\$ or risk\$) adj5 (droplet\$ or splatter\$ or spatter\$ or microbe\$ or bacillus or germ\$ or microorganism\$ or virus\$ or viral or coronavirus\$ or COVID\$ or "middle east? respiratory syndrome\$" or MERS or MERS-CoV or "camel flu" or SARS or "sudden acute respiratory syndrome\$" or "Wuhan virus\$" or 2019-nCoV or SARS-CoV-2 or SARS-CoV or SARS-CoV-1 or SARS-1)).ti,ab.
14. or/7-13
15. 6 and 14

### **Epistemonikos search strategy**

(title:(title:(dental OR dentist OR hygienist\* OR "high speed air rotor\*" OR "low speed handpiece\*" OR "low speed hand piece\*" OR micromotor\* OR "turbine handpiece\*" OR "electrosurgery unit" OR "air polisher\*" OR "prophy angle\*" OR "air-water syringe\*" OR "high speed hand piece\*" OR "high speed handpiece\*" OR "three-way air syringe\*" OR "threeway air syringe\*" OR "ultrasonic scaler\*" OR "hard-tissue laser\*" OR "dental drill\*" OR "piezo unit\*" OR "piezo hand piece\*" OR "piezo handpiece\*" OR "rotary instrument\*" OR "air abrasion" OR "water spray\*"))) OR abstract:(dental OR dentist OR hygienist\* OR "high speed air rotor\*" OR "low speed handpiece\*" OR "low speed hand piece\*" OR micromotor\* OR "turbine handpiece\*" OR "electrosurgery unit" OR "air polisher\*" OR "prophy angle\*" OR "air-water syringe\*" OR "high speed hand piece\*" OR "high speed handpiece\*" OR "three-way air syringe\*" OR "threeway air syringe\*" OR "ultrasonic scaler\*" OR "hard-tissue laser\*" OR "dental drill\*" OR "piezo unit\*" OR "piezo hand piece\*" OR "piezo handpiece\*" OR "rotary instrument\*" OR "air abrasion" OR "water spray\*")) AND (title:(aerosol OR bioaerosol OR droplet\* OR splatter\* OR spatter\*) OR abstract:(aerosol OR bioaerosol OR droplet\* OR splatter\* OR spatter\*)) OR abstract:(title:(dental OR dentist OR hygienist\* OR "high speed air rotor\*" OR "low speed handpiece\*" OR "low speed hand piece\*" OR micromotor\* OR

"turbine handpiece\*" OR "electrosurgery unit" OR "air polisher\*" OR "prophy angle\*" OR "air-water syringe\*" OR "high speed hand piece\*" OR "high speed handpiece\*" OR "three-way air syringe\*" OR "threeway air syringe\*" OR "ultrasonic scaler\*" OR "hard-tissue laser\*" OR "dental drill\*" OR "piezo unit\*" OR "piezo hand piece\*" OR "piezo handpiece\*" OR "rotary instrument\*" OR "air abrasion" OR "water spray\*")) OR abstract:((dental OR dentist OR hygienist\* OR "high speed air rotor\*" OR "low speed handpiece\*" OR "low speed hand piece\*" OR micromotor\* OR "turbine handpiece\*" OR "electrosurgery unit" OR "air polisher\*" OR "prophy angle\*" OR "air-water syringe\*" OR "high speed hand piece\*" OR "high speed handpiece\*" OR "three-way air syringe\*" OR "threeway air syringe\*" OR "ultrasonic scaler\*" OR "hard-tissue laser\*" OR "dental drill\*" OR "piezo unit\*" OR "piezo hand piece\*" OR "piezo handpiece\*" OR "rotary instrument\*" OR "air abrasion" OR "water spray\*")) AND (title:((aerosol OR bioaerosol OR droplet\* OR splatter\* OR spatter\*))) OR abstract:((aerosol OR bioaerosol OR droplet\* OR splatter\* OR spatter\*))))

### Cochrane Database of Systematic Reviews Ovid search strategy

1. (dental or dentist\$ or hygienist\$).mp.
2. ("high speed air rotor\$" or "low speed handpiece\$" or "low speed hand piece\$" or micromotor\$ or "turbine handpiece\$" or "electrosurgery unit" or "air polisher\$" or "prophy angle\$" or "air-water syringe\$" or "high speed hand piece\$" or "high speed handpiece\$" or "three-way air syringe\$" or "threeway air syringe\$" or "ultrasonic scaler\$" or "hard-tissue laser\$" or "dental drill\$" or "piezo unit\$" or "piezo hand piece\$" or "piezo handpiece\$" or "rotary instrument\$" or "air abrasion" or "water spray\$").mp.
3. 1 or 2
4. (aerosol\$ or bioaerosol\$).mp.
5. ((air\$ or inhal\$ or expos\$ or risk\$)
6. 4 or 5
7. 3 and 6

### Cochrane COVID-19 Study Register search strategy

1. (dental or dentist\* or hygienist\*) AND INREGISTER 94
2. ("high speed air rotor\*" or "low speed handpiece\*" or "low speed hand piece\*" or micromotor\* or "turbine handpiece\*" or "electrosurgery unit" or "air polisher\*" or "prophy angle\*" or "air-water syringe\*" or "high speed hand piece\*" or "high speed handpiece\*" or "three-way air syringe\*" or "threeway air syringe\*" or "ultrasonic scaler\*" or "hard-tissue laser\*" or "dental drill\*" or "piezo unit\*" or "piezo hand piece\*" or "piezo handpiece\*" or "rotary instrument\*" or "air abrasion" or "water spray\*") AND INREGISTER 0
3. #1 OR #2 94
4. (aerosol\* or bioaerosol\*) AND INREGISTER 89
5. (air\* or inhal\* or expos\* or risk\*) AND INREGISTER 2701
6. #4 or #5 2723
7. #6 AND #1 31

### Database of Abstracts of Reviews of Effects, Ovid search strategy

1. (dental or dentist\$ or hygienist\$).mp.
2. ("high speed air rotor\$" or "low speed handpiece\$" or "low speed hand piece\$" or micromotor\$ or "turbine handpiece\$" or "electrosurgery unit" or "air polisher\$" or "prophy angle\$" or "air-water syringe\$" or "high speed hand piece\$" or "high speed handpiece\$" or "three-way air syringe\$" or "threeway air syringe\$" or "ultrasonic scaler\$" or "hard-tissue laser\$" or "dental drill\$" or "piezo unit\$" or "piezo hand piece\$" or "piezo handpiece\$" or "rotary instrument\$" or "air abrasion" or "water spray\$").mp.
3. 1 or 2
4. (aerosol\$ or bioaerosol\$).mp.
5. ((air\$ or inhal\$ or expos\$ or risk\$)

6. 4 or 5
7. 3 and 6

### WHO COVID-19 Literature Database

(dental OR dentist OR hygienist\* OR "high speed air rotor\*" OR "low speed handpiece\*" OR "low speed hand piece\*" OR micromotor\* OR "turbine handpiece\*" OR "electrosurgery unit" OR "air polisher\*" OR "prophy angle\*" OR "air-water syringe\*" OR "high speed hand piece\*" OR "high speed handpiece\*" OR "three-way air syringe\*" OR "threeway air syringe\*" OR "ultrasonic scaler\*" OR "hard-tissue laser\*" OR "dental drill\*" OR "piezo unit\*" OR "piezo hand piece\*" OR "piezo handpiece\*" OR "rotary instrument\*" OR "air abrasion" OR "water spray\*")

AND

(aerosol OR bioaerosol OR droplet\* OR splatter\* OR spatter\*)

Scottish Dental Clinical Effectiveness Programme: Aerosol generating procedures - air cleaners additional search			
<b>Summary of Searches</b>			
<b>Database</b>	<b>Version/issue</b>	<b>Date of search</b>	<b>Records retrieved</b>
MEDLINE Ovid (ePub ahead of print, in-process and other non-indexed citations)	1 January 2010 to 25 August 2020	25.08.20	251
Embase Ovid (search limit: exclude MEDLINE indexed journals)	1 January 2010 to 25 August 2020	25.08.20	68
Cochrane Database of Systematic Reviews, Ovid	Whole database	25.08.20	8
Epistemonikos	Whole database	25.08.20	13
Cochrane COVID-19 Study Register	Whole database	25.08.20	34
Database of Abstracts of Reviews of Effects, Ovid	2005 to 25 August 2020	25.08.20	0
WHO COVID-19 Global Literature Database	Whole database	25.08.20	44
375 records after deduplication			

### MEDLINE Ovid search strategy

1. exp viruses/
2. (droplet\$ or splatter\$ or spatter\$ or virus\$ or viral or coronavirus\$ or COVID\$ or "middle east? respiratory syndrome\$" or MERS or MERS-CoV or "camel flu" or SARS or "sudden acute respiratory syndrome\$" or 2019-nCoV or SARS-CoV-2 or SARS-CoV or SARS-CoV-1 or SARS-1).mp.
3. 1 or 2
4. Inhalation exposure/
5. Aerosols/
6. (aerosol\$ or bioaerosol\$).mp.

7. 4 or 5 or 6
8. Air filters/
9. (air adj5 (filter\$ or filtration or purif\$ or clean\$ or scrub\$)).mp.
10. ((HEPA or "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance") adj5 filter\$).mp.
11. Air ionization/
12. (ionis\$ or ioniz\$).mp.
13. Ozone/
14. (ozonis\$ or ozoniz\$).mp.
15. Ultraviolet rays/
16. (ultraviolet or UV or ultra-violet or actinic).mp.
17. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
18. 3 and 7 and 17

### **Embase Ovid search strategy (includes a search limit to exclude MEDLINE indexed journals)**

1. exp virus/
2. (droplet\$ or splatter\$ or spatter\$ or virus\$ or viral or coronavirus\$ or COVID\$ or "middle east? respiratory syndrome\$" or MERS or MERS-CoV or "camel flu" or SARS or "sudden acute respiratory syndrome\$" or 2019-nCoV or SARS-CoV-2 or SARS-CoV or SARS-CoV-1 or SARS-1).mp.
3. 1 or 2
4. environmental exposure/
5. aerosol/
6. (aerosol\$ or bioaerosol\$).mp.
7. 4 or 5 or 6
8. Air filter/
9. (air adj5 (filter\$ or filtration or purif\$ or clean\$ or scrub\$)).mp.
10. ((HEPA or "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance") adj5 filter\$).mp.
11. ionization/
12. (ionis\$ or ioniz\$).mp.
13. Ozone/
14. (ozonis\$ or ozoniz\$).mp.
15. Ultraviolet radiation/
16. (ultraviolet or UV or ultra-violet or actinic).mp.
17. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
18. 3 and 7 and 17
19. limit 18 to exclude medline journals

### **Epistemonikos search strategy**

(title:((droplet\* OR splatter\* OR spatter\* OR virus\* OR viral OR coronavirus\* OR COVID\* OR "middle eastern respiratory syndrome\*" OR "middle east respiratory syndrome" OR MERS OR MERS-CoV OR "camel flu" OR SARS OR "sudden acute respiratory syndrome\*" OR 2019-nCoV OR SARS-CoV-2 OR SARS-CoV OR SARS-CoV-1 OR SARS-1)) OR abstract:((droplet\* OR splatter\* OR spatter\* OR virus\* OR viral OR coronavirus\* OR COVID\* OR "middle eastern respiratory syndrome\*" OR "middle east respiratory syndrome" OR MERS OR MERS-CoV OR "camel flu" OR SARS OR "sudden acute respiratory syndrome\*" OR 2019-nCoV OR SARS-CoV-2 OR SARS-CoV OR SARS-CoV-1 OR SARS-1))) AND (title:((aerosol\* OR bioaerosol\*)) OR abstract:((aerosol\* OR bioaerosol\*))) AND (title:((air AND (filter\* OR filtration OR purif\* OR clean\* OR scrub\* OR HEPA OR "High Efficiency Particulate Air" OR "High Efficiency Particulate Arrestance" OR ionis\* OR ioniz\* OR ozonis\* OR ozoniz\* OR ultraviolet OR UV OR ultra-violet OR actinic))) OR abstract:((air AND (filter\* OR filtration OR purif\* OR clean\* OR scrub\* OR HEPA OR "High Efficiency Particulate Air" OR "High

Efficiency Particulate Arrestance" OR ionis\* OR ioniz\* OR ozonis\* OR ozoniz\* OR ultraviolet OR UV OR ultra-violet OR actinic))))))

### **Cochrane Database of Systematic Reviews Ovid search strategy**

1. exp viruses/
2. (droplet\$ or splatter\$ or spatter\$ or virus\$ or viral or coronavirus\$ or COVID\$ or "middle east? respiratory syndrome\$" or MERS or MERS-CoV or "camel flu" or SARS or "sudden acute respiratory syndrome\$" or 2019-nCoV or SARS-CoV-2 or SARS-CoV or SARS-CoV-1 or SARS-1).mp.
3. 1 or 2
4. Inhalation exposure/
5. Aerosols/
6. (aerosol\$ or bioaerosol\$).mp.
7. 4 or 5 or 6
8. Air filters/
9. (air adj5 (filter\$ or filtration or purif\$ or clean\$ or scrub\$)).mp.
10. ((HEPA or "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance") adj5 filter\$).mp.
11. Air ionization/
12. (ionis\$ or ioniz\$).mp.
13. Ozone/
14. (ozonis\$ or ozoniz\$).mp.
15. Ultraviolet rays/
16. (ultraviolet or UV or ultra-violet or actinic).mp.
17. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
18. 3 and 7 and 17

### **Cochrane COVID-19 Study Register search strategy**

1. (aerosol\* or bioaerosol\*) AND INREGISTER
2. (air\* or inhal\* or expos\* or risk\*) AND INREGISTER
3. #1 or #2
4. (air near5 (filter\* or filtration or purif\* or clean\*)) AND INREGISTER
5. ((HEPA or "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance") near5 filter\*) AND INREGISTER
6. (ionis\* or ioniz\*) AND INREGISTER
7. (ozonis\* or ozoniz\*) AND INREGISTER
8. (ultraviolet or UV or ultra-violet or actinic) AND INREGISTER
9. ((aerosol\* or bioaerosol\* or droplet\* or spatter or splatter) near2 reduc\*) AND INREGISTER
10. #4 OR #5 OR #6 OR #7 OR #8 OR #9
11. #10 AND #3

### **Database of Abstracts of Reviews of Effects, Ovid search strategy**

1. (droplet\$ or splatter\$ or spatter\$ or virus\$ or viral or coronavirus\$ or COVID\$ or "middle east? respiratory syndrome\$" or MERS or MERS-CoV or "camel flu" or SARS or "sudden acute respiratory syndrome\$" or 2019-nCoV or SARS-CoV-2 or SARS-CoV or SARS-CoV-1 or SARS-1).mp.
2. (aerosol\$ or bioaerosol\$).mp.
3. (air adj5 (filter\$ or filtration or purif\$ or clean\$ or scrub\$)).mp.
4. ((HEPA or "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance") adj5 filter\$).mp.
5. (ionis\$ or ioniz\$).mp.
6. (ozonis\$ or ozoniz\$).mp.
7. (ultraviolet or UV or ultra-violet or actinic).mp.

8. 3 or 4 or 5 or 6 or 7
9. 1 and 2 and 8

**WHO COVID-19 Literature Database**

(tw:(aerosol or bioaerosol)) AND (tw:((filter\* or filtration or purif\* or clean\* or scrub\* or HEPA or "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance" or ionis\* or ioniz\* or ozonis\* or ozoniz\* or ultraviolet or UV or ultra-violet or actinic))) AND (tw:(air))

## Appendix 3 – Considered Judgements

### Categorisation of Aerosol Generating Procedures

Rapid Review Question
<p>Scope question:</p> <ul style="list-style-type: none"> <li>c) Which dental procedures produce bio-aerosols?</li> <li>d) Do different AGPs produce different levels of risk?</li> </ul> <p>Based on this, the following question was used to facilitate the review process:</p> <p><b>Which dental procedures produce aerosols and which present higher risk of SARS-CoV-2 transmission via aerosol?</b></p>
1. Summary of evidence
<p><i>Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.</i></p> <p>A scoping review by Zemouri et al. (2017),<sup>2</sup> which focussed on identifying the microbial composition of bioaerosols rather than describing the spread, reported that the sources of bio-aerosols in dental clinics were ultrasonic scalers (USS), high speed hand pieces (HSAR), air turbines, three-in-one syringes, and air water syringes. It did not attempt to quantify the spread of bioaerosol by different dental procedures.</p> <p>In March 2020, the Norwegian Institute of Public Health (NIPH) reported a rapid summary of the available research on aerosol generating procedures in health care, and the associated risk of COVID-19 infection for health care workers.<sup>3</sup> This identified the Zemouri et al. (2017) scoping review and three additional primary studies that identify ‘high rotation pens’ and ultrasonic scalers as sources of bioaerosols in dental procedures.</p> <p>In a May 2020 evidence assessment of medical procedures with higher risk of causing respiratory infections,<sup>4</sup> Health Protection Scotland reported weak evidence for an increase associated with dental procedures using high speed devices such as ultrasonic scalers and drills, but no evidence for dental procedures that do not involve high speed devices (e.g. scaling by hand).</p> <p>A pre-publication systematic review by Innes et al. (2020)<sup>5</sup> sought to identify what is known about bio-aerosol generation relevant to clinical dentistry, including which activities generate bio-aerosols, the associated spread and settle and evidence of association with exposure, infection and transmission of pathogens. No studies showed a direct association between dental procedures and exposure, infection and transmission of pathogenic micro-organisms. The authors devised a bespoke method for assessing study quality/risk of bias for seven domains, which varied considerably for each of the seven domains. The majority of studies scored high quality for controls, moderate for four domains (study funding, conflict of interest, procedure description and outcome reporting) and “low” for two domains (equipment use and sample size). The 83 included studies investigated eight different procedures and there was evidence of contamination of surfaces around the surgery environment/personnel or contamination in air from all procedures evaluated and at the furthest points studied: USS (n=44 studies); HSAR (n=31); oral surgery (n=11), slow-speed handpiece (n=4); air-water (triple) syringe (n=4), air polishing (n=4) hand scaling (n=2), prophylaxis with cup and pumice (n=2). There was also evidence that contamination varied by procedure type. The operator’s body and arm and the patient’s body were especially affected. Although none of the studies involved respiratory viruses, those on bacteria, blood splatter and aerosol in dentistry show that activities using powered devices produce the greatest contamination. Methodology and outcome measure heterogeneity meant that between study comparisons could not be made.</p> <p>Based on within-study comparisons of data from 13 studies,<sup>5</sup> the authors of the Innes et al. systematic review proposed a categorisation of higher, moderate and lower risk procedures:</p> <ul style="list-style-type: none"> <li><u>higher risk</u>: USS, HSAR, air-water syringe [air only or air/water together], air polishing, extractions using motorized handpieces;</li> <li><u>moderate</u>: slow-speed handpieces, prophylaxis with pumice, extractions and</li> <li><u>lower</u>: air-water syringe [water only] and hand scaling.</li> </ul> <p>The available evidence is of poor quality and there are significant gaps that limit drawing firm conclusions around contamination from different procedures. Further research using standardized methodologies and outcomes to facilitate synthesis and synergize research across the community is required that would allow the proposed hierarchy of</p>

contamination from procedures to be modified or verification. The findings of this systematic review are to be interpreted with caution as study limitations were not assessed using a published, validated tool, pooling was not possible due to clinical and methodological variation and there is concern regarding the applicability of the outcome measures assessed. Most studies used microbial surrogate measures (mainly oral flora) and blood or coloured water for detecting contamination following these procedures. None looked at respiratory viruses. Also, the procedures evaluated are likely to be used with mitigation and personal protection. Finally, this is a pre-peer review draft and therefore some inconsistencies are likely to be resolved through peer review and refinement before publication.

The World Health Organization (WHO) defines AGPs as any medical, dental or patient care procedure that results in the production of airborne particles <5 µm in size (aerosols), which can remain suspended in the air, travel over a distance and may cause infection if they are inhaled.<sup>6</sup> It is these smaller particles, that are of most concern. High energy instruments are most likely to produce smaller particle size aerosols.<sup>7</sup> The limited available evidence indicates that it is dental procedures that involve the use of high energy instruments, such as high-speed air turbines and ultrasonic scalers, that contaminate the air around the dental chair through the production of bioaerosol.<sup>5,8</sup> This is reflected in recent UK national reports.<sup>4,9</sup>

### Handpiece drill speed

Despite several reports that conclude that it is high speed dental handpieces that are most associated with contamination via bioaerosol generation, none provides a clear indication of what is meant by 'high speed'. Consequently, additional unpublished research was identified that is relevant to this point.

A recent study, carried out in a simulated dental setting, measured aerosol generation by dental instruments operated under different conditions.<sup>10</sup> Atomisation of coolant was visualised using high speed imaging and broadband or monochromatic laser light-sheet illumination. The study found that aerosol production from dental handpieces is extremely complex and dependent on multiple factors including speed of rotation, mixing of air and water, delivery method of coolant, type of bur used and position of the high volume suction tip. Although complex, a generalisable observation was that the use of instruments at speeds less than 80,000 to 100,000 rpm appears to reduce the risk of atomisation significantly and less than 60,000 rpm leads to minimal aerosol production. Removal of air within coolant spray also significantly reduces aerosolization.

### 3-in-1 syringe

Aerosol generation by the use of the 3-in-1 syringe is widely debated. Five studies were identified (4 of which were included in the systematic review of Innes et al.) that investigated the relative levels of contamination resulting from use of the 3-in-1 syringe compared to the use of other dental instruments.<sup>11-15</sup> The evidence from these studies is likely to be of low certainty overall, due to study design and limitations, imprecision due to small sample sizes reported in single studies and indirectness in relation to measures of aerosol contamination. However, the studies consistently suggest that the air water spray from a 3-in-1 syringe can, under the conditions tested, produce contaminated splatter and bioaerosol at rates in similar ranges to a high speed handpiece. In the studies where these comparisons were made, the rates were considerably lower when using the 3-in-1 syringe with either air or water only, with water only being the lowest.

Notably, in most of the studies, the levels of contamination produced by each instrument were compared as rates or measured over equivalent time periods. This does not take into account the length of time that the different instruments would typically be used for in dental practice. Therefore, actual levels of contaminated aerosol generated by brief use of a 3-in-1 syringe could be considerably less than from the longer use of a high speed drill. Furthermore, in practice, these instruments are likely to be used with high volume suction which will significantly reduce the levels of contaminated aerosol.

Overall, the certainty of evidence to inform which dental procedures produce aerosols and which present higher risk was judged to be very low due to the diverse methods used to assess aerosol production (which precluded between study comparisons), surrogate outcomes measure of aerosol spread and absence of direct evidence regarding respiratory virus transmission.

## 8. Considered judgment

*Summarise the group's agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.*

For this review question, consideration of balance of effects, sub-groups, values and preferences, acceptability and feasibility are not appropriate.

Having considered the available evidence, the Working Group agreed that many dental procedures have the potential to generate aerosols but acknowledged that the amount of aerosol generated is likely to vary between procedures and instrumentation. Via a series of votes, the Working Group agreed that categorizing procedures would be helpful and, if this was possible, they would be supportive of extrapolating this to be indicative of risk of SARS-CoV-2 transmission. However, there was a lack of consensus on the reliability of categorizing dental procedures based on amount of contamination.

After consideration of a number of variants, the Working Group agreed unanimously (n=23) to propose a pragmatic categorisation of dental procedures into three groups based on the type of instrument used and assumptions about the likelihood of generating aerosols with smaller particles.

**Group A** procedures use powered, high velocity instruments that emit or require water or irrigants for cooling. These procedures will produce aerosol particles <5 µm and require airborne transmission-based precautions, procedural mitigation and fallow time.

**Group B** procedures use powered, low velocity instruments. These procedures may produce aerosol particles <5 µm, with the amount depending on instrument use, and require procedural mitigation and standard infection prevention and control precautions as routinely used in dentistry.

**Group C** procedures do not use powered instruments. These procedures may produce splatter but are unlikely to produce aerosol particles <5 µm and require standard infection prevention and control precautions as routinely used in dentistry.

High speed air or electric rotors operating at speeds greater than 60,000 rpm were categorised in Group A procedures, and procedures using handpieces operating at speeds less than 60,000 rpm categorised in Group B. A cut-off of 60,000 rpm between the categories was considered to be a suitable precaution that allows for variation in instruments, handpiece use, type of bur etc. and the complexity of factors affecting aerosol generation.

3-in-1 syringe with air and water used together were categorised in Group A procedures, unless established through a risk assessment that it will only be used very briefly, in which case the same precautions as for Group B procedures can be followed. Use of a 3-in-1 syringe with air alone or water alone were categorised in Group B, reflecting the available evidence.

These three groups are illustrated in Table 3.1 in the rapid review report. This table also includes precautions required during periods of community transmission, including the PPE recommended in UK national guidance.<sup>16</sup> Examples of instruments/procedures that fall into each group are also given. These lists are not exhaustive, but the category definitions can be used to assess in which group a given unlisted instrument/procedure should be placed. As the individual circumstances of instrument use for some Group B procedures can vary significantly, further risk assessment by the clinician may be necessary to determine whether additional precautions are required.

As overall the evidence is rated as of very low certainty, further research is very likely to add to our understanding of aerosol generation by dental procedures and therefore may inform a change in the categorisation of dental procedures proposed by the Working Group.

## 9. Additional information

*Include any further information that is relevant to the agreed position*

To supplement information derived from systematic reviews, individual studies concerned with aerosol generation from the 3-in-1 syringe are summarized below.

Belting et al. (1964)<sup>12</sup> reported on environmental contamination from dental procedures carried out on 5 patients with active tuberculosis. The small number of participants and variable results make it difficult to draw conclusions about relative levels of contamination from the air turbine versus the air water syringe.

Micik et al. (1969)<sup>13</sup> compared bacterial concentrations in dental aerosols generated under controlled conditions using a test chamber with air sampling onto bacterial culture plates during procedures. The air water spray from a 3-in-1 syringe and an air turbine handpiece with water coolant both produced rates of bacterial aerosols in the highest level grouping of procedures and activities tested (median cfu/min of 37,000 and 1,000, respectively) that could be reduced by >99% with high velocity suction. According to this study, the use of air only, or water only, produced bacterial aerosols at much lower rates (median cfu/min of 72 and 10 cfu/min, respectively).

Miller et al. (1971)<sup>15</sup> measured bacterial contamination from splatter generated by dental procedures, using bacterial settle plates near the patient's head for very short periods in a simulated dental surgery clean room. The use of an air

water spray or an air turbine handpiece (with water coolant) produced bacterial contamination in the highest level grouping ( $>10,000$  cfu/ft<sup>2</sup>), while air alone only produced moderate levels of bacterial contamination (1,000-10,000 cfu/ft<sup>2</sup>) and water alone, only low levels (10-100 cfu/ft<sup>2</sup>). All procedures were carried out for the same length of time.

Miller (1995)<sup>14</sup> reported on the aerosolization of blood by dental procedures in a study that used blood samples injected into an artificial gingival sulcus within a stirred settling aerosol chamber. Dental procedures were carried out for a fixed length of time (1 minute) and aerosol samples collected through ports for particle analysis. The air water spray from the 3-in-1 syringe aerosolized blood at a higher rate (mean of 1.7  $\mu$ L/min) than the air turbine handpiece (mean of 0.4  $\mu$ L/min). Reported mean rates for air only and water only were 0.7  $\mu$ L/min and 0.02  $\mu$ L/min, respectively.

Allison et al. (2020 pre-print)<sup>11</sup> using fluorescein as a tracer to measure aerosol and splatter, also reported that high speed air turbine, ultrasonic scaler and 3-in-1 syringe produced contamination in the area around the source. The high speed air turbine (used for 10 min) produced the highest levels of contamination in total across the distances measured (up to 4 metres) while the 3-in-1 spray (used for 30 seconds) produced high levels at 0.5 metres but little beyond 1 metre. In this simulation study the tracer originated from the water line rather than from a patient's mouth.

## Procedural Mitigation – High Volume Suction

Rapid Review Question
<p>Scope question:</p> <p>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:</p> <p>i) Mouthwashes ii) Rubber dam iii) High volume suction iv) Any other factors identified</p> <p>Based on this, the following question for mitigation by use of high volume suction was used to facilitate the review process:</p> <p><b>Should high volume suction be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?</b></p>
1. Summary of evidence
<p><i>Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.</i></p> <p>A yet to be published<sup>‡</sup> Cochrane Review<sup>17</sup> investigates interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases. This review includes information on the use of high volume suction/evacuation to mitigate microbial contamination of dental aerosols. It should be noted that as the review is still in the pre-publication stage, it is likely that changes will be made prior to publication (see Additional Information below).</p> <p>The review includes 16 low-powered studies (RCTs or NRCTs), six of which considered the efficacy of high volume suction/evacuation to reduce microbial contamination from aerosol generated by dental procedures. Five studies examined the use of high volume evacuation (HVE) versus no HVE; one study compared HVE to conventional dental suction.</p> <p><b>High volume evacuation (HVE) versus no HVE</b></p> <p>The results of the five studies which investigated this intervention were combined where appropriate. All investigated the contamination of aerosols using bacterial culture plates, with these placed at different distances from the patient/operator.</p> <ul style="list-style-type: none"> <li>• Five studies tested the reduction in contamination of aerosols at a distance of less than 12 inches from the patient’s oral cavity. There was a significant reduction in aerosol contamination in the HVE group compared to the control group.</li> <li>• It should be noted that at this distance, the culture plates are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.</li> <li>• Two studies investigated the contamination from aerosols on operator’s face shield/ mask.</li> <li>• There was a reduction in contamination of aerosols in the HVE group but the result is not statistically significant as there are wide confidence intervals that cross the line of no effect.</li> <li>• Again, it should be noted that plates located on the operator’s face shield/mask are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.</li> <li>• Two studies investigated the contamination from aerosols at more than one-foot distance (0.5 and 0.9 metres; results combined) from oral cavity of the patient. There was a reduction in contamination of aerosols in the HVE group but the result is not statistically significant as there are wide confidence intervals that cross the line of no effect.</li> </ul> <p>The GRADE certainty of evidence for this intervention was assigned as <b>very low</b> by the reviewers due to issues with risk of bias, inconsistency (high and unexplainable heterogeneity) and imprecision (wide confidence intervals, small sample size). The reviewers also report that there was considerable heterogeneity in all three subgroups which could not be explained clinically. This suggests that further research is likely to change the results obtained here.</p>

<sup>‡</sup>The Cochrane systematic review *Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases* was published on 13 October 2020. The final analysis for the comparisons reported in this Summary of Evidence section are reported in Section 9 of this table.

### High volume evacuation (HVE) versus conventional dental suction

One study investigated the use of high volume evacuation to reduce contamination of aerosols compared to conventional dental suction. The outcome was evaluated at 40cm and 150cm distance from patient's oral cavity. Reduction in contamination of aerosols in the HVE group was observed for both distances but the result is not statistically significant as there are wide confidence intervals that cross the line of no effect.

The GRADE certainty of evidence for this intervention was assigned as **very low** by the reviewers due to risk of bias (unclear risk of selection bias, performance bias, detection bias and reporting bias) and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

Note that the six studies above investigate different 'high volume' suction or evacuation devices, and level of detail about the device used in each study varies. It is unclear whether the different devices used in each of these studies contribute to the unexplained heterogeneity observed in the first comparison described above (HVE vs no HVE). Also, the studies included in the review used bacterial colony plates placed at different distances from the patient's oral cavity and it is unclear whether those plates placed close to the patient are collecting bacterial fallout that is purely aerosol-derived or whether droplets and spatter are also being captured.

Overall, from the data presented in the review, it is unclear whether high volume suction/evacuation reduces contaminated aerosols compared with not using this intervention. However, the evidence presented in the review is very low certainty due to heterogeneity, risk of bias and small sample sizes and wide confidence intervals. The majority of the included trials reported only one outcome, i.e., reduction in bacterial contamination of aerosols measured using CFUs. This is a surrogate outcome and it is not clear how these results can be interpreted when considering their usefulness in reducing the risk of SARS-CoV-2 due to aerosol generating procedures. There is also no indication of what would be considered a clinically important reduction in contaminated aerosol.

It should be noted that the review authors acknowledge that there may be unpublished data not identified by their search and that other study designs, such as in-vitro experimental studies, observational studies, case series and case reports, which were not included could have influenced the results of the review.

### International Guidelines and Specialist Societies

The rapid review carried out by the CoDER working group<sup>18</sup> found that while the use of high-volume suction is often a routine practice during dental treatment, only 73% of international guideline documents recommend use of high-volume suction for non-COVID patients. Only 10% of the documents (China, France, Italy, Malaysia, the Philippines and South Africa) provide evidence to support the recommendation

Overall, the certainty of evidence was judged to be very low, due to risk of bias, imprecision and inconsistency.

### 2. Balance of effects

*Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.*

The Working Group considered the evidence above on the potential benefit of high volume suction in reducing bioaerosol from dental procedures. No adverse events were reported in the Cochrane review and the review authors did not perform a separate search for adverse effects.

It was noted that the benefit of using high volume suction in this context will be for the dental professionals and possibly other patients attending the surgery, rather than directly for the patient undergoing the AGP. However, high volume suction does have other direct patient benefits such as removal of saliva and debris, thereby reducing the risk of choking and improving visibility in the oral cavity.

The Group did not identify any adverse effects of using high volume suction.

The Group's judgement was that the benefits of using high volume suction outweigh the harms. 100% of Group members voted that the balance of effects *probably favours* or *favours* using high volume suction.

### 3. Subgroup considerations

*Comment here on any subgroup considerations e.g. vulnerable groups; COVID-19 status; care setting*

The group did not highlight any specific groups for whom high volume suction/evacuation would not be suitable. However, it was noted that for some individuals, suction may itself induce a gag reflex.

<p><b>4. Values and preferences</b> <i>Summarise any evidence or information on values and preferences.</i></p>
<p>The group did not raise any points about values and preferences associated with high volume suction.</p>
<p><b>5. Acceptability</b> <i>Is the intervention acceptable to patients, dental team and other stakeholders?</i></p>
<p>While none of the studies included in the systematic review evaluated the acceptability of the intervention to patients and dental professionals, the Working Group noted that it is standard practice for dental practitioners to use high volume suction.</p> <p>The Group therefore judged that using high volume suction is <i>acceptable</i> (90%) or <i>probably acceptable</i> (10%).</p>
<p><b>6. Feasibility</b> <i>Comment on cost, resource implications and implementation considerations, if applicable.</i></p>
<p>While none of the studies included in the systematic review evaluated the costs for the intervention or its feasibility, the following points were noted by the Working Group:</p> <ul style="list-style-type: none"> <li>• High volume suction has a number of variables and is both equipment and operator sensitive.</li> <li>• Although suction is already available in all dental practices, there may be practices where the ‘high volume suction’ available does not meet the required standard and significant costs may be involved in upgrading facilities to meet these.</li> <li>• There are costs involved in getting the level of suction assessed and calibrated – if the flow rate is too low, then new equipment may be required which will also have an associated cost</li> <li>• Level of suction can vary on a day-to-day basis depending on quality of equipment, quality/frequency of filter cleaning etc.</li> <li>• An assistant is required to use suction effectively and additional costs may be incurred to facilitate this.</li> </ul> <p>The Group were unanimous (100%) in their judgement that using high volume suction is <i>feasible</i> to implement.</p>
<p><b>7. Other factors</b> <i>Indicate any other factors taken into account.</i></p>
<p>It was noted that community transmission levels will not impact on the recommendation as AGPs will be required regardless, although the setting may vary depending on the UK COVID level.</p>
<p><b>8. Considered judgment</b> <i>Summarise the group’s agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.</i></p>
<p>Taking all of the above into account, Working Group members (n=20) voted as indicated on the following two options:</p> <p><i>A: The panel’s agreed position is that high volume suction/evacuation is recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (100%)</i></p> <p><i>B: The panel’s agreed position is that high volume suction/evacuation is not recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (0%)</i></p> <p>After subsequent discussions, the wording of the final agreed position was:</p> <p><b>The Working Group’s agreed position is that high volume suction is recommended to reduce the potential risk of SARS-CoV-2 transmission associated with dental AGPs.</b></p> <p>High volume suction should be used where available and where appropriate but may not be suitable for those with a strong gag reflex.</p> <p>This agreed position is based on very low certainty, indirect evidence in favour of high volume suction, insignificant risk of harm, and as a standard current practice, high volume suction is known to be acceptable and feasible.</p>

## 9. Additional information

*Include any further information that is relevant to the agreed position*

The Cochrane systematic review *Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases*<sup>17</sup> was published on 13 October 2020. The final analysis for the two comparisons reported in the Summary of Evidence section of this document are reported below.

### High volume evacuation (HVE) versus no HVE

All studies investigated the contamination of aerosols using bacterial culture plates, with these placed at different distances from the patient/operator.

- Three studies tested the reduction in contamination of aerosols at a distance of less than 12 inches from the patient's oral cavity. There was a significant reduction in aerosol contamination in the HVE group compared to the control group.  
**MD = -47.41**; 95% CI -92.76 to -2.06; participants = 122; studies = 3;  $I^2 = 95\%$   
There was significant unexplained heterogeneity  
This data analysis gave a mean difference value which differs from that considered by the Group but the difference is not significant and does not change the conclusions of the review.
- Two studies investigated the contamination from aerosols on operator's face shield/ mask.  
There was a reduction in contamination of aerosols in the HVE group but the result is not statistically significant as there are wide confidence intervals that cross the line of no effect.  
**MD = -15.71**; 95% CI -46.37 to -14.95; participants = 42; studies = 2;  $I^2 = 95\%$   
There was significant unexplained heterogeneity.  
The result of this data analysis was unchanged from that considered by the Group.
- One study investigated the contamination from aerosols at more than one-foot distance from oral cavity of the patient. There was a reduction in contamination of aerosols in the HVE group but the result is not statistically significant as there are wide confidence intervals that cross the line of no effect.  
**MD -1.00**; 95% CI -2.56 to 0.56; participants = 80; studies = 1  
This data analysis gave a mean difference value for the first comparison which is different to that considered by the Group but the difference does not change the conclusions of the review.

### High volume evacuation (HVE) versus conventional dental suction

A reduction in contamination of aerosols in the HVE group was observed for both distances but the result is not statistically significant as there are wide confidence intervals that cross the line of no effect.

40 cm: **MD -2.30**; 95% CI -5.32 to 0.72; participants = 12; studies = 1

150 cm: **MD -2.20**; 95% CI -14.01 to 9.61; participants = 12; studies = 1

The results of this comparison were unchanged from those considered by the Group.

The certainty of the evidence for both comparisons, which was originally assigned as very low, is unchanged in the published version of the review.

While some of the final figures for estimate of effect in the published review differ from those considered by the Working Group to reach an agreed position, they are consistent with what was reported originally and do not change the conclusion of the review. Therefore, the agreed position of the Group remains unchanged.

## Procedural Mitigation – Rubber Dam

Rapid Review Question
<p>Scope question:</p> <p>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:</p> <p>i) Mouthwashes ii) Rubber dam iii) High volume suction iv) Any other factors identified</p> <p>Based on this, the following question for mitigation by use of rubber dam was used to facilitate the review process:</p> <p><b>Should rubber dam be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?</b></p>
<p><b>1. Summary of evidence</b></p> <p><i>Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.</i></p>
<p>A yet to be published<sup>‡</sup> Cochrane Review<sup>17</sup> investigates interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases. This review includes information on the use of rubber dam to mitigate microbial contamination of dental aerosols. It should be noted that as the review is still in the pre-publication stage, it is likely that changes will be made prior to publication (see Additional Information below).</p> <p>The review includes 16 low-powered studies (RCTs or NRCTs), five of which considered the efficacy of rubber dam to reduce microbial contamination from aerosol generated by dental procedures. Three studies examined the use of rubber dam compared to no rubber dam; one study compared the use of high volume evacuation (HVE) with and without rubber dam; one study compared the use of rubber dam plus HVE to the use of the Isolite device.</p> <p><b>Rubber dam vs. no rubber dam</b></p> <p>The results of the three studies which investigated this intervention could not be combined due to methodological or clinical heterogeneity.</p> <ul style="list-style-type: none"> <li>• Two studies tested the effectiveness of rubber dam to reduce colonisation of culture plates placed at one and two metres from the participant's mouth; the rubber dam group in both studies showed statistically significant reduction in the level of contamination of aerosols at all distances.</li> <li>• A third study compared the effectiveness of rubber dam versus no rubber dam on contamination of operator (samples collected from forehead, left ear, submental region and occipital region of the operators' head scarves). In this comparison, there was insufficient evidence of a difference in the level of contamination of aerosols with the use of rubber dam compared to no rubber dam.</li> </ul> <p>It should be noted that the areas from which samples were collected in this study are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.</p> <p>The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to possible risk of bias (unclear risk of selection bias, performance bias, detection bias and reporting bias in all three studies plus a high risk of attrition bias in one study), imprecision (small sample size reported in a single study) and study design. This suggests that further research is likely to change the results obtained here.</p> <p><b>Rubber dam + HVE versus only HVE</b></p> <p>One study investigated the use of rubber dam in combination with high volume evacuation (HVE) compared to HVE alone. Rubber dam + HVE significantly reduced the level of contamination on the patient's chest area and the dental unit light compared to HVE only. It should be noted that contamination at these areas could be due to droplet/splatter as well as any aerosol generated by the procedure.</p>

<sup>‡</sup>The Cochrane systematic review *Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases* was published on 13 October 2020. The final analysis for the comparisons reported in this Summary of Evidence section are reported in Section 9 of this table.

The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias; detection bias; reporting bias) and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

### **Rubber dam + HVE vs Isolite**

One study investigated the use of the Isolite suction device compared to rubber dam plus HVE. The Isolite suction device significantly reduced level of contamination in aerosols compared with rubber dam + HVE. It should be noted that three of the collection plates were located close to the patient's mouth, while two were placed further away on countertops but data is not reported at an individual plate/position level. Also, the plates located close to the patient's mouth could be contaminated by droplet/spatter as well as any aerosol generated by the procedure

The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias) and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

Overall, the data presented in the review suggests that aerosol reducing methods such as rubber dam may reduce contaminated aerosols when compared with not using rubber dam. However, the results are to be interpreted with caution as the evidence is very low certainty due to heterogeneity, risk of bias and small sample sizes and wide confidence intervals. The included trials reported only one outcome, i.e., reduction in bacterial contamination of aerosols measured using CFUs. This is a surrogate outcome and it is not clear how these results can be interpreted when considering their usefulness in reducing the risk of COVID-19 due to aerosol generating procedures. There is also no indication of what would be considered a clinically important reduction in contaminated aerosol.

It should be noted that the review authors acknowledge that there may be unpublished data not identified by their search and that other study designs, such as in-vitro experimental studies, observational studies, case series and case reports, which were not included could have influenced the results of the review.

### **International Guidelines**

The rapid review carried out by the CoDER working group<sup>18</sup> found that 73% of international dental guidance documents recommend the use of rubber dam for non-COVID patients. Only 10% of the documents (China, France, Italy, Malaysia, the Philippines and South Africa) provide evidence to support the recommendation.

Overall, the certainty of evidence was judged to be very low due to risk of bias and imprecision.

While all of the studies assessed reduction in bacterial contamination of aerosols, and provide some evidence that rubber dam is effective, this evidence is indirect. However, as the intervention is a barrier technique, it is judged that the evidence is likely to be generalisable to reduction of SARS-CoV-2 in aerosols from dental procedures.

## **2. Balance of effects**

*Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.*

The Working Group considered the evidence above on the potential benefit of rubber dam in reducing bioaerosol from dental procedures. Adverse effects of rubber dam were not reported by any of the studies that address this question and the review authors did not perform a separate search for adverse effects.

It was noted that the benefit of rubber dam in this context will be for the dental professionals and possibly other patients attending the surgery, rather than directly for the patient undergoing the AGP. However, rubber dam does have other direct patient benefits such as protection of the airway and soft tissues and ensuring a dry field which may improve restoration longevity.

Possible adverse effects could include irritation or allergic reactions to the material used. It was noted that some patients cannot tolerate rubber dam and that it can cause some patients to cough. Removal of rubber dam from an infected patient may be an additional risk i.e. saliva/secretions on reverse side may cause a bioaerosol if dam not removed carefully. Similarly, poorly placed rubber dam may allow saliva leakage.

The Group's judgement was that the benefits of using rubber dam outweigh the harms. 95% of Group members voted that the balance of effects *probably favours* or *favours* using rubber dam.

<p><b>3. Subgroup considerations</b> <i>Comment here on any subgroup considerations e.g. vulnerable groups; COVID-19 status; care setting</i></p>
<p>The Working Group identified some patient groups for whom rubber dam may not be suitable. This includes those with a history of latex allergy and those who cannot tolerate rubber dam (e.g. some patients with learning disabilities or those with claustrophobia). It was also noted that it is not possible to use rubber dam for some dental treatments (e.g. surgical extractions, periodontal treatment).</p>
<p><b>4. Values and preferences</b> <i>Summarise any evidence or information on values and preferences.</i></p>
<p>It was noted that:</p> <ul style="list-style-type: none"> <li>• Patient preference for the use of rubber dam is likely to vary. Some patients find rubber dam reassuring, but others do not like it (BDA research indicates that about 10% of patients do not like rubber dam).</li> <li>• Individual practitioner values and preferences will depend on their experience of using rubber dam and their attitude to the technique. There may be a skills or attitude barrier/gap to overcome (i.e. training/ encouragement may be required).</li> <li>• If using rubber dam reduces fallow times, this may be an incentive for rubber dam use.</li> </ul>
<p><b>5. Acceptability</b> <i>Is the intervention acceptable to patients, dental team and other stakeholders?</i></p>
<p>While none of the studies included in the systematic review evaluated the acceptability of the intervention to patients and dental professionals, the following points were noted by the Working Group:</p> <ul style="list-style-type: none"> <li>• Use of rubber dam is considered best practice in restorative dentistry.</li> <li>• The attitude of practice owner to rubber dam could potentially influence its use (e.g. whether the practice owner makes the necessary equipment/supplies available in the practice)</li> <li>• New or experienced practitioners may become deskilled in the use of rubber dam if it is not used frequently and this may affect the acceptability.</li> <li>• A Cochrane review<sup>19</sup> (4 studies, very low certainty evidence) suggests that use of rubber dam reduces failure rate of restorations, and may also shorten the time required for treatment – both of these outcomes may increase acceptability of rubber dam for dental professionals and patients.</li> </ul> <p>A majority of the Group judged that using rubber dam is acceptable but there was a range of views. In a vote, 61% of the Group felt that using rubber dam would be <i>acceptable</i> or <i>probably acceptable</i>, with 29% judging that acceptability would vary. 10% of the Group felt that using rubber dam would be <i>probably not acceptable</i>.</p>
<p><b>6. Feasibility</b> <i>Comment on cost, resource implications and implementation considerations, if applicable.</i></p>
<p>While none of the studies included in the systematic review evaluated the costs for the intervention or its feasibility, the following points were noted by the Working Group:</p> <ul style="list-style-type: none"> <li>• Some practitioners are likely to require training on rubber dam placement.</li> <li>• The placement of rubber dam is potentially within the scope of practice of all DCP groups, with appropriate training.</li> <li>• Concerns about sustainability and increased use of plastic were raised.</li> <li>• There are some procedures where rubber dam cannot be used e.g. surgical extractions, periodontal treatment, orthodontic treatment.</li> <li>• Patient tolerance may be linked to how well the operator places rubber dam.</li> </ul> <p>A majority of the Group (85%) judged that using rubber dam is <i>feasible</i> or <i>probably feasible</i> to implement.</p>
<p><b>7. Other factors</b> <i>Indicate any other factors taken into account.</i></p>
<p>It was noted that community transmission levels will not impact on the recommendation as AGPs will be required regardless, although the setting may vary depending on the UK COVID level.</p>

## 8. Considered judgment

*Summarise the group's agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.*

Taking all of the above into account, Working Group members (n=18) voted as indicated on the following two options:

*The panel's agreed position is that rubber dam is recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (83%)*

*The panel's agreed position is that rubber dam is not recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (17%)*

After subsequent discussions, the wording of the final agreed position was:

**The Working Group's agreed position is that rubber dam is recommended to reduce the potential risk of SARS-CoV-2 transmission associated with dental AGPs.**

Rubber dam may not be appropriate for all patients or procedures but should be used when applicable and where it can be used effectively.

This agreed position is based on very low certainty, indirect evidence in favour of rubber dam, with benefits outweighing harms. Use of rubber dam is likely to be acceptable for most patients and feasible with sufficient training and experience.

## 9. Additional information

*Include any further information that is relevant to the agreed position or that become available subsequent to the considered judgement of the Group.*

The Cochrane systematic review *Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases*<sup>27</sup> was published on 13 October 2020. The final analysis for the three comparisons reported in the Summary of Evidence section of this document are reported below.

### Rubber dam vs. no rubber dam

The results of the three studies which investigated this intervention could not be combined due to methodological or clinical heterogeneity.

- Two studies tested the effectiveness of rubber dam to reduce colonisation of culture plates placed at one and two metres from the participant's mouth; the rubber dam group in both studies showed statistically significant reduction in the level of contamination of aerosols at all distances.
- 1 metre (RCT): **MD -16.20** [95% CI -19.36 to -13.04]; CCT: **MD -10.10** [95% CI -19.72 to -0.48]
- 2 metres RCT: **MD -11.70** [95% CI -15.82 to -7.58]; CCT: **MD -2.80** [95% CI -4.65 to -0.95]
- The result of this data analysis was unchanged from that considered by the Group.
- A third study compared the effectiveness of rubber dam versus no rubber dam on contamination of operator (samples collected from forehead, left ear, submental region and occipital region of the operators' head scarves). In this comparison, there was insufficient evidence of a difference in the level of contamination of aerosols with the use of rubber dam compared to no rubber dam.  
Forehead MD **0.98** [95% CI -0.73 to 2.70]; Left ear MD **0.96** [95% CI -0.08 to 2.00];  
Submental region MD **0.52** [95% CI -0.11 to 1.16]; Occipital region MD **0.77** [95% CI -0.46 to 2.00]  
The result of this data analysis was unchanged from that considered by the Group.

### Rubber dam + HVE versus only cotton roll + HVE

One study investigated the use of rubber dam in combination with high volume evacuation (HVE) compared to cotton roll plus HVE. Rubber dam + HVE significantly reduced the level of contamination on the patient's chest area and the dental unit light compared to HVE only.

Chest: MD **-251.00** [95% CI -267.95 to -234.05]; Dental light MD **-12.70** [95% CI -12.85 to -12.55].

The result of this data analysis was unchanged from that considered by the Group (N.B. the name of the comparison was amended to include 'cotton roll').

### Rubber dam + HVE vs combination system

One study investigated the use of a combination system compared to rubber dam plus HVE. The combination system significantly reduced level of contamination in aerosols compared with rubber dam + HVE

MD **-125.20** [95% CI -174.02 to -76.38].

The result of this data analysis was unchanged from that considered by the Group (N.B. the name of the comparison was amended to replace 'Isolite' with 'combination system').

The certainty of the evidence for all comparisons, which was originally assigned as very low, did not change in the published version of the review.

As the estimates of effect in the published review are the same as those considered by the Working Group to reach an agreed position, the conclusions of the Group remain unchanged.

## Procedural Mitigation – Pre-procedural Mouth Rinses

Rapid Review Question
<p>Scope question:</p> <p>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:</p> <p>i) Mouthwashes ii) Rubber dam iii) High volume suction iv) Any other factors identified</p> <p>Based on this, the following question for mitigation by use of mouthwash was used to facilitate the review process:</p> <p><b>Should pre-procedural mouth rinse be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?</b></p>
1. Summary of evidence
<p><i>Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.</i></p> <p>Two recent systematic reviews report on the efficacy of pre-procedural mouth rinse to reduce microbial contamination from aerosol generated by dental procedures.</p> <p>In an analysis of 12 RCTs, Marui et al. (2019)<sup>20</sup> found that overall, a preprocedural mouth rinse significantly reduced the number of bacterial colony forming units measured after dental procedures including ultrasonic scaling, air polishing or the use of a low speed or turbine handpiece (mean reduction, 64.8%; 95% CI, 50.4% to 79.3%; <math>I^2 = 37\%</math>). Although one of the included studies (12 participants out of 397 across all studies) reported an increase in the numbers and diversity of airborne bacteria, this was not consistent with the overall body of evidence. The systematic review found that chlorhexidine (CHX) mouth rinse was more effective than those containing cetylpyridinium chloride (CPC) or essential oil (CHX: mean reduction, 78.9%; 95% confidence interval [CI], 59.9% to 98.04%; <math>I^2 = 0\%</math>; CPC: mean reduction, 61.2%; 95% CI, 20.2% to 102.27%; <math>I^2 = 0</math>; essential oil: mean reduction, 61.3%; 95% CI, 29.9% to 92.7%; <math>I^2 = 76\%</math>). The evidence certainty for the included studies was rated as moderate due to risk of bias.</p> <p>Koletsis et al (2020)<sup>21</sup> carried out a systematic review of 21 RCTs and 8 non-RCTs including most of the studies assessed by Marui and colleagues. Eleven of the RCTs contributed to a network meta-analysis comparing various interventions used in dental practice to reduce microbial load in aerosols. The interventions included chlorhexidine (CHX), chlorine dioxide (ClO<sub>2</sub>), cetylpyridinium chloride, herbal substance related treatment, high volume evacuator (HVE), ozone and povidone iodine. Tempered 0.2% CHX mouth rinse (47°C) was ranked as the most effective of the interventions in achieving reduced bacterial load after the use of ultrasonic scaling in dental practice, followed by conventional CHX 0.2%, ClO<sub>2</sub> and ozone. HVE was ranked the least effective of those included in the comparisons. The review authors assigned the level of confidence as moderate for comparisons related to tempered CHX 0.2%, conventional CHX 0.2%, and ClO<sub>2</sub> all compared with control.</p> <p>These systematic reviews provide moderate certainty evidence that preprocedural mouth rinse can reduce the bacterial load in aerosols from dental procedures. However, none of the included studies measured viral contamination or transmission. Also of note is that virus in saliva is likely to be rapidly replenished. Consequently, with regard to the effect of preprocedural mouth rinse on SARS-CoV-2 in dental aerosols, this evidence is indirect and can only be considered to be of very low certainty.</p> <p>Two Cochrane Reviews<sup>22,23</sup> investigated the use of antimicrobial mouthwashes and nasal sprays by patients to protect healthcare workers from COVID-19. The evidence searches for these did not find any studies reporting on the effect of mouthwash on COVID-19 transmission or levels of SARS-CoV-2 in saliva or aerosols. We are aware of one very small, uncontrolled pilot study published in July 2020 that assessed the effect of mouth rinse on SARS-CoV-2 virus in COVID-19 patients.<sup>24</sup> This study reported that for 2 of the 4 participants included, a 1% povidone iodine mouth rinse resulted in a significant drop in viral levels in the patients' saliva. Controlled clinical trials are required to confirm this preliminary report.</p> <p>Povidone iodine and hydrogen peroxide have both been suggested as potential antiviral mouthwashes because of their oxidative properties. Recent in vitro studies report that povidone iodine mouthwash solution (0.5-1.5% povidone iodine for 15-30 secs) has effective antiviral activity against SARS-CoV-2 virus<sup>25,26</sup> while hydrogen peroxide (1.5-3%) is only</p>

minimally effective.<sup>27</sup> However, these studies were funded by pharmaceutical companies producing povidone iodine mouthwash, so may be at risk of bias.

A recent literature review highlighted by a working group member considered the known mechanisms of viral lipid membrane disruption by widely available dental mouthwash components.<sup>28</sup> While several have the potential to disrupt the SARS-CoV-2 lipid envelope, there is a need for clinical evaluation of their effectiveness in reducing transmission of SARS-CoV-2. Overall, there is a lack of direct evidence on the clinical effectiveness or substantivity of mouthwash for the reduction of SARS-CoV-2 viral levels in patient saliva or dental aerosols.

### International Guidelines:

The rapid review<sup>18</sup> carried out by the CoDER working group found that 82% of international dental guidance documents recommend the use of a pre-procedural mouthwash. The two most commonly recommended mouthwashes are hydrogen peroxide (38 documents) and povidone iodine (30 documents) with many documents recommending the use of either of these two mouthwashes. Three documents recommend cetyl pyridinium and 3 recommend mouthwash without stipulating the type. However, only 10 of the 63 documents cite sources in support of the recommendation, while two of the documents recommend a mouth rinse despite indicating there was no evidence of effectiveness.

Overall, the certainty of evidence was judged to be very low.

## 2. Balance of effects

*Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.*

The Working Group considered the evidence supporting the use of pre-procedural mouth rinse as summarized above. It was noted that the potential benefit of mouth rinse in reducing bioaerosol from dental procedures will be for the dental professionals and possibly other patients attending the surgery, rather than directly for the patient using the mouth rinse.

Adverse effects of mouth rinse were not reported in the systematic reviews and studies considered. Possible adverse effects include irritation or allergic/anaphylactic reactions to components of the mouth rinse. Another concern is the potential for disruption of the normal oral microbiota. Certain mouth rinses may carry specific risks such as the risk of excess iodine ingestion from iodine-containing solutions or staining of teeth with chlorhexidine. Some concern has been expressed that there may be a health risk associated with use of mouthwashes that contain alcohol.

The Group's judgement was that the possible harms of using a pre-procedural mouth rinse outweigh the uncertain benefit. 71% of Group members voted that the balance of effects *does not favour* or *probably does not favour* pre-procedural mouth rinse.

## 3. Subgroup considerations

*Comment here on any subgroup considerations e.g. vulnerable groups; COVID-19 status; care setting*

Povidone iodine solutions are not recommended during pregnancy or for patients with active thyroid disease, allergy or undergoing radioactive iodine therapy. Some patients are allergic to iodine.

Some patients with certain mucosal conditions (e.g. erosive lichen planus) do not tolerate mouthwashes well. Some patients with learning difficulties will be unable to use mouthwashes.

It has been suggested that povidone iodine could be used as a nasal spray, but no studies have been found in the ongoing Cochrane systematic review and therefore our focus is on use of these agents as mouthwashes.

It was noted that there are some patients who can have a severe reaction to components in mouthwash and for whom mouthwash is contraindicated.

## 4. Values and preferences

*Summarise any evidence or information on values and preferences.*

Since the benefit is not for the patient but for others, particular care is required around consent for use of a pre-procedural mouth rinse. Some patients might perceive a benefit. Therefore, unless there is significant harm, its use cannot necessarily be precluded.

A patient view was expressed that they would be happy for an intervention to be used if there is evidence that it is beneficial to themselves or others.

<p>Data from a survey on dental team members' perceptions of mouthwash suggest that a minority think it is of benefit.</p> <p>Group members agreed that patients often appreciate when additional measures are taken to reduce risk. Consequently, some professionals will think that using mouth rinse is worthwhile even when there is a lack of evidence.</p>
<p><b>5. Acceptability</b> <i>Is the intervention acceptable to patients, dental team and other stakeholders?</i></p>
<p>A patient view was that mouthwash would be acceptable to patients if it is of direct clinical benefit to them or others.</p> <p>Concern was expressed about the effect of using mouthwashes on making the consent process more complicated and lengthy.</p> <p>Some mitigations might be acceptable to implement, if they are not harmful, even before there is evidence to support their effectiveness, as this helps to promote confidence of both patients and professionals.</p> <p>The Group had a range of views about the acceptability of using pre-procedural mouth rinse. 48% voted that use of pre-procedural mouth rinse would be <i>acceptable</i> or <i>probably acceptable</i>, with 28% voting that it would be <i>not acceptable</i> or <i>probably not acceptable</i>. The remaining group members were unsure or felt that acceptability would vary.</p>
<p><b>6. Feasibility</b> <i>Comment on cost, resource implications and implementation considerations, if applicable.</i></p>
<p>The following points were noted regarding feasibility:</p> <ul style="list-style-type: none"> <li>• There are material costs and also indirect costs in explaining use of mouthwash when obtaining consent and in dealing with potential adverse reactions.</li> <li>• Availability of stocks of mouthwash could be a concern.</li> <li>• It is unclear how often a mouthwash would need to be used to remain effective.</li> <li>• There are environmental consequences.</li> <li>• Ejection of the mouthwash from the mouth could be a concern.</li> <li>• Some patients might object to the bad taste of some mouthwashes.</li> </ul> <p>Taking all the issues mentioned into consideration, the Group member's opinions on the feasibility of implementing pre-procedural mouth rinse varied. 52% voted that use of pre-procedural mouth rinse would be <i>not feasible</i> or <i>probably not feasible</i>, with 33% voting that it would be <i>feasible</i> or <i>probably feasible</i>. The remaining group members were unsure or felt that feasibility would vary.</p>
<p><b>7. Other factors</b> <i>Indicate any other factors taken into account.</i></p>
<p>Any effect of the mouth rinse is likely to be short lived, will be of no benefit to the patient and might not be of benefit to others. There is a need for education of professionals and patients.</p> <p>Some practitioners may choose to continue using mouth rinses even in the absence of evidence.</p>
<p><b>8. Considered judgment</b> <i>Summarise the group's agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.</i></p>
<p>Taking all of the above into account, Working Group members (n=18) voted as indicated on the following two options:</p> <p><i>The panel's agreed position is that pre-procedural mouth rinse is recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (0%)</i></p> <p><i>The panel's agreed position is that pre-procedural mouth rinse is not recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (100%)</i></p> <p>After subsequent discussions, the wording of the final agreed position was:</p> <p><b>The Working Group's agreed position 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.</b></p>

This is a conditional agreed position meaning that using a pre-procedural mouth rinse is unlikely to benefit most patients, but some might prefer to use a mouth rinse. It must be noted that there are groups for whom certain mouthwashes are absolutely contraindicated.

**9. Additional information**

*Include any further information that is relevant to the agreed position*

## Procedural Mitigation – Antimicrobial Coolants

Rapid Review Question
<p>Scope question:</p> <p>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:</p> <p>i) Mouthwashes ii) Rubber dam iii) High volume suction iv) Any other factors identified</p> <p>One additional factor identified was the use of antimicrobial coolants in dental unit waterlines.</p> <p>Based on this, the following question for mitigation by use of antimicrobial coolants was used to facilitate the review process:</p> <p><b>Should antimicrobial coolants be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?</b></p>
1. Summary of evidence
<p><i>Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.</i></p> <p>A yet to be published<sup>‡</sup> Cochrane Review<sup>17</sup> investigates interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases. This review includes information on the use of antimicrobial coolants to mitigate microbial contamination of dental aerosols. It should be noted that as the review is still in the pre-publication stage, it is likely that changes will be made prior to publication.</p> <p>The review includes 16 low-powered studies (RCTs or NRCTs), two of which investigated using anti-microbial agents (e.g. chlorhexidine gluconate, povidone iodine) as ultrasonic coolants to reduce microbial contamination from aerosol generated by dental procedures. Two studies compare chlorhexidine to distilled water, while there were single comparisons of povidone iodine vs distilled water, cinnamon extract vs distilled water, chlorhexidine vs cinnamon extract and chlorhexidine vs povidone iodine.</p> <p>The antimicrobial agents are used in solution form and at lower concentrations than would be used in preprocedural rinses or local irrigation. They are intended to reduce bacterial contamination of the waterlines and to also penetrate into the periodontal pocket to act on the local microbia and prevent the contamination of any aerosols produced during dental treatment.</p> <p><b>Chlorhexidine versus distilled water</b></p> <p>Two studies tested the efficacy of using chlorhexidine coolant and distilled water coolant to reduce contamination of aerosols during ultrasonic scaling. In one study, three blood agar plates (one positioned 40 cm to the left of the patient’s head, another to the right of the patient’s head and one placed 2 m behind the patient) were left uncovered for 20 min following the dental procedure; high vacuum suction was also used. In the other study, six plates were placed at a distance of 1 foot from the patient’s head, 2 on the left, two on the right and two on the patient’s chest and sample collected during a 20 min dental procedure; saliva ejector was also used. The results of the two studies were combined and less CFUs were observed the chlorhexidine group compared to the distilled water group. However, the result is not statistically significant as there are wide confidence intervals crossing the line of no effect. It should be noted that due to the position of the collection plates (apart from the plate placed 2m behind the patient), these are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.</p> <p>The review authors note that there was considerable heterogeneity; they attributed this to combined mean values of CFUs in one study and downgraded the certainty of the evidence. However, it may not have been appropriate to combine the results as one study collected samples during the dental procedure and consequently had much higher CFU counts than those reported in the other study, which collected samples for a 20 minute period after the procedure.</p> <p>The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias; detection bias; attrition bias; reporting bias), inconsistency due to high and</p>

<sup>‡</sup>The Cochrane systematic review *Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases* was published on 13 October 2020. The final analysis for the comparisons reported in this Summary of Evidence section are reported in Section 9 of this table.

unexplainable heterogeneity and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

#### **Povidone iodine versus distilled water**

One study tested the efficacy of using povidone iodine coolant and distilled water coolant to reduce contamination of aerosols during ultrasonic scaling. The study protocol was the same as described previously. Less CFUs were observed in the povidone iodine group compared to distilled water group. It should be noted that due to the position of the collection plates (apart from the plate placed 2m behind the patient), these are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.

The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias; attrition bias; reporting bias) and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

#### **Cinnamon extract versus distilled water**

One study investigated the effectiveness of using cinnamon extract coolant and distilled water coolant to reduce contamination of aerosols during ultrasonic scaling at three different sites. The study protocol was the same as described previously. Less CFUs were observed in the cinnamon extract group compared to distilled water group at all three culture sites. It should be noted that due to the position of the collection plates, these are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.

The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias; detection bias; attrition bias; reporting bias), and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

#### **Chlorhexidine versus cinnamon extract**

One study investigated the effectiveness of using chlorhexidine and cinnamon extract coolant to reduce contamination of aerosols during ultrasonic scaling at three different sites. The study protocol was the same as described previously. Less CFUs were observed in the chlorhexidine group compared to the cinnamon group at chest area and patient's left side. However, less CFUs were observed in cinnamon group compared to chlorhexidine group on patient's right side, with wide confidence intervals crossing the line of no effect. It should be noted that due to the position of the collection plates, these are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.

The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias; detection bias; attrition bias; reporting bias), and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

#### **Chlorhexidine versus povidone iodine**

One study tested the efficacy of using chlorhexidine coolant and povidone iodine coolant to reduce contamination of aerosols during ultrasonic scaling. The study protocol was the same as described previously. Less CFUs were observed in the chlorhexidine group compared to povidone iodine group. It should be noted that due to the position of the collection plates (apart from the plate placed 2m behind the patient), these are likely to be contaminated with droplet/splatter as well as any aerosol generated by the procedure.

The GRADE certainty of evidence for this intervention was assigned as very low by the reviewers due to risk of bias (selection bias; performance bias; attrition bias; reporting bias) and imprecision (small sample size reported in a single study). This suggests that further research is likely to change the results obtained here.

Overall, from the data presented in the systematic review, suggests that antimicrobial coolants may reduce aerosol contamination compared to using water as a coolant. However, the evidence presented here is very low certainty due to heterogeneity, risk of bias and small sample sizes and wide confidence intervals. Both of the trials reported only one outcome, i.e., reduction in bacterial contamination of aerosols measured using CFUs. This is a surrogate outcome and it is not clear how these results can be interpreted when considering their usefulness in reducing the risk of SARS-CoV-2 due to aerosol generating procedures. There are also questions around whether the plates are in fact measuring the contamination in aerosol, with regards to the distance from the subject's oral cavity, the amount of time the plates are left exposed during/following the AGP procedures and whether the bacterial 'settle' observed actually originates from aerosol. There is also no indication of what would be considered a clinically important reduction in contaminated aerosol.

<p>It should be noted that the review authors acknowledge that there may be unpublished data not identified by their search and that other study designs, such as in-vitro experimental studies, observational studies, case series and case reports, which were not included could have influenced the results of the review.</p>
<p><b>2. Balance of effects</b> <i>Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.</i></p>
<p>The Working Group considered the evidence above on the potential benefit of using antimicrobial coolants to reduce bioaerosol from dental procedures. No adverse events were reported in the Cochrane review. One study stated that patients in each group were asked about any discomfort noticed, such as alteration in taste or burning sensation during debridement procedure and patients were also asked to report if any adverse effects were experienced post-treatment. No adverse effects were reported during or after 1-month follow-up. Another study notes that some subjects might complain of unpleasant taste.</p> <p>It was noted that this benefit of antimicrobial coolants in this context will be for the dental professionals and possibly other patients attending the surgery, rather than directly for the patient undergoing the AGP. It was also noted that dental practices already use biocides in waterlines and if biocides with proven antiviral activity could be identified, this would be useful. However, although <i>in vitro</i> studies show some of the additives [when used as a mouthwash] have viricidal action against SARS-CoV-2, there are no studies which show an antiviral effect if coolants are placed in the waterlines.</p> <p>Possible adverse effects of using antimicrobial coolants include irritation or allergic reactions to components of the coolant. Another concern is the potential for disruption of the normal oral microbiota. Certain antimicrobial coolants may carry specific risks such as the risk of excess iodine ingestion from iodine-containing solutions or staining of teeth with chlorhexidine. However, it should be noted that the antimicrobial coolants are used at lower concentrations than would be used in preprocedural rinses or local irrigation. The Group also expressed concerns that antimicrobial coolants could damage dental units/chairs.</p> <p>A majority of the Group judged that the benefits of using antimicrobial coolants do not outweigh the possible harms but there was a range of views. In a vote, 76% of the Group felt that the balance of effects <i>favours or probably favours</i> not using antimicrobial coolants, with 18% judging that the balance of effects <i>does not favour either using or not using</i> antimicrobial coolants and 6% judging that it <i>probably favours</i> the intervention.</p>
<p><b>3. Subgroup considerations</b> <i>Comment here on any subgroup considerations e.g. vulnerable groups; COVID-19 status; care setting</i></p>
<p>Povidone iodine solutions are not recommended during pregnancy or for patients with active thyroid disease, anaphylactic allergy or undergoing radioactive iodine therapy. Reports of allergy/anaphylaxis are linked to use of chlorhexidine. The Working Group identified some other patient groups for whom antimicrobial coolants may not be suitable. In particular, there was concern about the possibility of allergic reactions to antimicrobial coolants e.g. those with a seafood allergy are often allergic to iodine, which would contraindicate povidone iodine coolants. It was noted that risk of allergy is often unpredictable and that it can be difficult to screen patients and document the process. There was also acknowledgement that if a patient with a known allergy to the coolant attends, there would need to be a robust process to ensure that coolants are sufficiently flushed from waterlines.</p>
<p><b>4. Values and preferences</b> <i>Summarise any evidence or information on values and preferences.</i></p>
<p>The Group did not raise any points specifically related to values and preferences. However, some of the points noted below under acceptability relate to values and preferences.</p>
<p><b>5. Acceptability</b> <i>Is the intervention acceptable to patients, dental team and other stakeholders?</i></p>
<p>While none of the studies included in the systematic review evaluated the acceptability of the intervention to patients and dental professionals, the following points were noted by the Working Group:</p> <ul style="list-style-type: none"> <li>• There is a risk of allergy, as highlighted above.</li> </ul>

- There may be cost and/or time implications as practitioners will have to explain why antimicrobial coolants are being used in order to obtain informed consent (although it was noted that consent not required for biocides currently used in waterlines).
- There may also be legal and ethical issues related to such universal use of an intervention

A range of views were expressed in a vote on acceptability. 22% of group members felt that the use of antimicrobial coolants would be *not acceptable*, 33% felt it would be *probably not acceptable*, 11% felt that it would be *probably acceptable*, 11% felt that it would be *acceptable*, 17% felt that acceptability *varies* and 6% of the Group voted *don't know*.

## 6. Feasibility

*Comment on cost, resource implications and implementation considerations, if applicable.*

While none of the studies included in the systematic review evaluated the costs for the intervention or its feasibility, the following points were noted by the Working Group:

- Where practices currently use water as a coolant, there may be additional costs to move to antimicrobial coolants.
- If there is a cost related to using antimicrobial coolants, but there is no evidence of a benefit, it is unlikely that practices will chose to implement the intervention.

A majority of the Group judged that using antimicrobial coolants would not be feasible to implement but there was a range of views. 29% of group members felt that the use of antimicrobial coolants would be *not feasible*, 47% felt it would be *probably not feasible*, 6% felt that it would be *probably feasible*, 6% felt that feasibility varies and 12% of the Group voted *don't know*.

## 7. Other factors

*Indicate any other factors taken into account.*

It was noted that community transmission levels will not impact on the recommendation as AGPs will be required regardless, although the setting may vary depending on the UK COVID level.

## 8. Considered judgment

*Summarise the group's agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.*

Taking all of the above into account, Working Group members (n=17) voted as indicated on the following two options:

*The panel's agreed position is that use of an antimicrobial coolant is recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (0%)*

*The panel's agreed position is that use of an antimicrobial coolant is not recommended to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs. (100%)*

After subsequent discussions, the wording of the final agreed position was:

**The Working Group's agreed position 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.**

Although there is very low certainty, indirect evidence of effect, the possible harms of antimicrobial coolants outweigh the potential benefits and the Working Group had concerns about the acceptability and feasibility of using antimicrobial coolants. Consequently, the agreed position is to not recommend antimicrobial coolants for the purpose of reducing the potential risk of SARS-CoV-2 transmission.

## 9. Additional information

*Include any further information that is relevant to the agreed position or that become available subsequent to the considered judgement of the Group.*

The Cochrane systematic review *Interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases*<sup>17</sup> was published on 13 October 2020. The final analysis for the five comparisons reported in the Summary of Evidence section of this document are reported below.

### **Chlorhexidine versus distilled water**

- In the unpublished version of the review, the results of two studies were combined for this comparison. Less CFUs were observed in the chlorhexidine group but the result was not statistically significant as there were wide confidence intervals crossing the line of no effect. It was noted in the pre-publication analysis above that it may not have been appropriate to combine the results as one study collected samples during the dental procedure and consequently had much higher CFU counts than those reported in the other study, which collected samples for a 20 minute period after the procedure.
- The published version of the review only includes the results from the study that collected samples for a 20 minute period following the procedure, which now gives a statistically significant result in favour of the chlorhexidine coolant (**MD -124**; 95% CI -135.78 to -112.22; participants = 20).
- Although the result of this data analysis is different from that considered by the Group when reaching their agreed position, the removal of one of the studies from the data analysis increases the imprecision of the estimate of effect (small sample size reported in a single study). Therefore, this re-analysis of the data does not substantially change the conclusion of the review and is unlikely to have changed the agreed position of the Group.

#### **Povidone iodine versus distilled water**

- In the unpublished version of the review, one study was included for this comparison and less CFUs were observed in the povidone iodine group compared to distilled water group.
- The published version of the review includes the same study but an updated data analysis gives a mean difference value (**MD -656.45**; 95% CI -672.74 to -640.16; participants = 40) which is different to that considered by the Group. However, the difference does not change the conclusions of the review and is unlikely to have changed the agreed position of the Group.

#### **Cinnamon extract versus distilled water**

- In the unpublished version of the review, one study investigated the effectiveness of cinnamon extract coolant during ultrasonic scaling at three different sites, with a MD reported for each site. Fewer CFUs were observed in the cinnamon extract group compared to distilled water group at all three culture sites.
- The published version of the review reports only one MD value (**MD -644.55**; 95% CI -668.70 to -620.40; participants = 40) which is different to any of the previous values considered by the Group. However, the difference does not change the conclusions of the review and is unlikely to have changed the agreed position of the Group.

#### **Chlorhexidine versus cinnamon extract**

- In the unpublished version of the review, one study compared the effectiveness of chlorhexidine coolant to that of cinnamon extract coolant during ultrasonic scaling at three different sites, with a MD reported for each site. Fewer CFUs were observed in the cinnamon extract group compared to chlorhexidine at the patient's chest area and left side but the opposite was observed at the patient's right side.
- The published version of the review reports only the MD value for the patient's right side in favour of the cinnamon extract coolant (**MD 11.9**; 95% CI -12.08 to 35.88; participants = 40) which is unchanged in the published version of the review. However, the difference does not change the conclusions of the review and is unlikely to have changed the agreed position of the Group.

#### **Chlorhexidine versus povidone iodine**

- In the unpublished version of the review, one study compared the efficacy of chlorhexidine coolant to that of povidone iodine coolant during ultrasonic scaling. Fewer CFUs were observed in the chlorhexidine group compared to povidone iodine group.
- The published version of the review includes the same study but an updated data analysis gives a mean difference value (**MD -59.30**; 95% CI -64.16 to -54.44; participants = 20) which is different to that considered by the Group. However, the difference does not change the conclusions of the review and is unlikely to have changed the agreed position of the Group.

The certainty of the evidence for all comparisons, which was originally assigned as very low, did not change in the published version of the review.

While the estimates of effect in the published review differ from those considered by the Working Group to reach an agreed position, the outcome of the review is unchanged. Therefore, the conclusions of the Group remain unchanged.

## Environmental Mitigation – Fallow Time

### Rapid Review Question

Scope question:

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?

Based on this, the following was used to facilitate the review process:

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

### 1. Summary of evidence

*Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.*

A recent systematic review<sup>29</sup> evaluated evidence on the environmental persistence of SARS-CoV-2. Three experimental studies were included, only one of which reported on persistence of viable SARS-CoV-2 in aerosols.<sup>30</sup> This study found that SARS-CoV-2 remained viable in aerosols throughout the duration of the experiment (3 hours), with a reduction in infectious titer from 103.5 to 102.7 TCID50 per liter of air over this time. The experiment was carried out using high concentrations of virus introduced into a sealed chamber and provides an indication of virus stability in a suspended aerosol but no information on the mitigating effect of ventilation or other interventions on virus persistence. A more recent, similar experimental study<sup>31</sup> reported retained infectivity and virion integrity of SARS-CoV-2 for up to 16 hours in respirable-sized aerosols.

These studies were carried out under entirely experimental conditions rather than in a clinical environment and provide no information about virus transmission via aerosol.

### NSS technical report (SBAR), including literature review

A technical report<sup>9</sup> recently published by a short-life working group convened by National Services Scotland aimed to review and produce recommendations with respect to ventilation (and associated aspects) within dental practices and treatment rooms in relation to COVID-19 based on the best available evidence and consensus expert opinion.

The technical report included a literature review of dental aerosols – risk and mitigation measures, which aimed to address the following questions:

1. What distances from (and times following) aerosol generating procedures have been associated with transmission of influenza, SARS, MERS or COVID-19?
2. What are the effects of dental dam, suctioning and other interventions on dental aerosol generation, content and/or dissemination?
3. What distances are reached by infectious viral aerosols during dental treatment?
4. What aerosol infection control measures have other countries employed to aid in re-establishment of dental services during the COVID-19 pandemic and is there evidence of their efficacy?
5. How long does it take for dental infectious viral aerosols to disperse/fallout following dental aerosol generating procedures and how does ventilation/air change rate affect this process?
6. What particle sizes are produced during dental aerosol generating procedures?

The literature review was conducted by one person with a search of just two databases (Medline and Embase) and a high-level search strategy that may not have identified all relevant documents. No formal assessment of the quality of the evidence was undertaken. The results were presented as a narrative description of individual studies.

More extensive recent systematic reviews of AGPs (Innes et al 2020),<sup>5</sup> rubber dam and high-volume suctioning<sup>17</sup> and mouth rinsing<sup>20,21</sup> have been carried out using standard systematic review methodology for most of the questions addressed by this rapid review and are considered here as part of other considered judgements. The conclusions of the NSS literature review are in line with the findings from the systematic reviews. Regarding fallow time, the NSS literature review concluded:

*The evidence base cannot currently support a defined and appropriate fallow time for dental AGPs in the context of the COVID-19 pandemic. Very weak evidence currently suggests that peaks in bacterial dissemination during dental procedures may take approximately 30 minutes to dissipate but further research is needed.*

### **Fallow time calculation and mitigations**

The basic model used for calculating decreasing concentration in the aerosol over time may be a reasonable approach if it is assumed that the concentration of any airborne contaminant decreases exponentially over time, with no new contaminant being produced, and the only removal mechanism is dilution characterised by the air changes per hour (ACH).

Formulae are presented for the rate of contamination of the air by infectious virus, peak concentration of infectious virus, concentration following 99% removal at 6 air changes per hour following a 10 minute AGP with no mitigations, and time to achieve the equivalent concentration with mitigations. Assumed reductions in aerosol generations incorporated into fallow time calculations (70% for rubber dam, 80% for high volume suction and 94% for both) are based on information presented in the NSS literature review.

The baseline (no mitigation) table estimates the fallow time at different air change rates based on calculations for a target of 99% reduction in aerosol at 6 air changes per hour (ACH).

However, there are several assumptions relating to the modelling:

- All procedures are assumed to generate the same rate of viruses per hour, and more generally all procedures are assumed to generate the same rate of airborne particles/droplets, which behave in the same way. This is unlikely to be true and is not seen in the NPL data (see below).
- Since the generation rate from different procedures is likely to vary significantly, the standard 99% target reduction assumed may in some circumstances be unnecessarily stringent.
- Air exchange takes place by simple dilution only.
- Airborne particle/droplet removal mechanisms other than simple dilution via air exchange may well be important. For example, larger droplets (above around 10  $\mu\text{m}$ ) can be expected to settle under gravity within about 10 minutes. Smaller droplets are likely to stick to surfaces when they come into contact with them, even if they are taken there by draughts rather than by gravity. Smaller droplets can coalesce to form larger ones that will settle out more quickly. Actual removal rates are therefore likely to be higher than those modelled and are best estimated by experiment.

Other guideline documents that provide this level of detail reference Appendix B of the CDC Guidelines for Environmental Infection Control in Health-Care Facilities (2003)

<https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html#tableb1>. The NSS technical report does tally with the CDC document for 99% reduction at 6 ACH (no mitigation) but differs for other ACHs.

The report states: “*Furthermore, we have not attempted risk assessments at an individual or population level based on estimates of the COVID-19 epidemiology in the UK population, as this is expected to vary. We have therefore, taken a precautionary approach based on modelling scenarios balanced with expert opinion.*” Consequently, the proposed fallow times are based on the assumption that after any aerosol generating procedure on any patient, there is SARS-CoV-2 virus present that needs to be removed, which unless treating confirmed COVID-19 patients is very unlikely to be the case.

The NSS technical report indicates that a minimum of 10 minutes fallow time is necessary to allow droplets (>5-10 $\mu\text{m}$  in diameter) to settle. It also states that, ‘*The potential hazard for infection from droplets and splatter will be reduced by adherence to standard infection control precautions that are well rehearsed in dental practice.*’

The NSS technical report recommends that

- AGPs should not be undertaken in surgeries that:
  - have no mechanical or natural ventilation;
  - have mechanical ventilation and no immediate access to room data on ACHs.
- For surgeries that have access to natural ventilation only and no immediate access to room data on ACHs, a risk assessment should be carried out to assess suitability of area for carrying out AGPs.

### **Recirculating Air Cleaners (“air scrubbers”)**

The NSS technical report provides information on the potential additional benefit of these devices but provides no formal evidence to support their use.

### National Physical Laboratory (NPL) observations

NPL scientists have conducted a preliminary investigation within a typical dental surgery setting using optical particle counting to monitor airborne particles and the effect of AGPs. This found that that peaks in aerosol particle concentrations within the surgery (which may or may not have been directly associated with a dental procedure) typically return to baseline within approximately 15 minutes.<sup>32</sup>

### International guidelines

The rapid review<sup>18</sup> of international guidelines carried out by the CoDER working group found that:

- 48% (30/63) of the guidelines refer to a fallow period after providing AGP treatment for non-COVID patients
- The amount of time recommended varied (2-180 mins) between guidelines and also within guidelines, depending on environmental mitigation.
- None of the fallow period recommendations referenced any scientific evidence.

Only the Canadian guideline provides specific details on air changes per hour, including a detailed table of the impact of different numbers of air changes (based on the CDC guideline and applicable for patients who have screened or tested positive for COVID-19).

Overall, the certainty of evidence was judged to be very low. Studies that measure bacterial contamination or airborne particles provide indirect evidence to inform determination of fallow time. However, if aerosols do contain infective virus particles, precautions to reduce aerosols based on measurements of other agents should be generalisable to reduction of SARS-CoV-2 in aerosols from dental procedures. Theoretical modelling of aerosol generation and reduction by procedural and environmental mitigation necessitates assumptions. Experimental measurement would be preferable.

## 2. Balance of effects

*Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.*

As the NSS literature review concluded that there is little evidence to inform how long any fallow period should be but in principle a fallow period allows time for droplets to settle and for aerosols to disperse and that if the aerosol is carrying viable virus this will reduce the risk of exposure to virus and transmission. In theory, a longer fallow period allows more aerosol dispersal and greater potential risk reduction, which would be beneficial to both patients and dental team members.

The greater the fallow time between patients, the fewer number of patients can be seen in a surgery each session. This reduced capacity will increase waiting times for appointments and could lead to an increase in urgent or emergency cases and reduction in provision of preventive care and increased potential for harm. In a focus group of dental professionals convened to inform this review, 82% of participants thought the implementation of fallow time would be challenging. Reduced patient turnover was identified as a contributory factor.

According to the Scottish Emergency Dental Service, NHS24 in Scotland has seen a significant increase in dental calls since general dental services have had to limit their capacity due to COVID-19 restrictions. It was noted by a member of the Working Group that the National Poisons and Information Service has also reported an increase in reported analgesic overdoses. (Also see additional information below)

Dental practices rely on a certain throughput of patients to remain viable and therefore incorporation of a fallow period after appointments involving AGPs will impact on this. Several members of the Working Group expressed the view that dental practices might remain viable with a short fallow time but some would not survive with a post-AGP fallow time of one hour.

The views of the group on the balance of effects (benefits versus harms) were widely spread for a relatively long fallow time (60 minutes) but clearly in favour of having a fallow time if that time is relatively short, with 72% of Group members voting that the balance of effects *probably favours* or *favours* using a fallow time when this is 15 minutes.

## 3. Subgroup considerations

*Comment here on any subgroup considerations e.g. vulnerable groups; COVID-19 status; care setting*

The Working Group considered whether fallow time should differ for “non-COVID-19” and confirmed COVID-19 patients and concluded that if a patient has or is likely to have COVID-19 (i.e. patients within UK IPC High Risk COVID-19 Pathway<sup>16</sup>), treatment should be delayed if possible and therefore no distinction is required regarding fallow time.

<p>It would be advisable to schedule carefully the appointments of patients who are on the vulnerable list to minimise any risk and to provide reassurance.</p> <p>Special care patients might not tolerate various forms of procedural mitigation and therefore a longer fallow time might be necessary.</p> <p>Multi-chair surgeries present a more complicated situation that will need careful assessment of ventilation and air flow to inform fallow time requirements.</p> <p>Fallow time should not be influenced by the presence of dental team members in vulnerable groups, as these should undergo a separate workplace assessment.</p>
<p><b>4. Values and preferences</b> <i>Summarise any evidence or information on values and preferences.</i></p>
<p>It was noted that:</p> <ul style="list-style-type: none"> <li>• Patients and the dental team are likely to value any measure that is likely to increase their safety in the dental surgery if there is evidence that it is of overall benefit.</li> <li>• Surveys of professionals (to date unpublished) indicate highly varying attitudes towards the risk of SARS-CoV-2 infection.</li> </ul>
<p><b>5. Acceptability</b> <i>Is the intervention acceptable to patients, dental team and other stakeholders?</i></p>
<p>No studies directly evaluated acceptability of fallow time for patients or professionals. The Working Group noted:</p> <ul style="list-style-type: none"> <li>• It might not be acceptable to differ from other medical guidance on fallow time.</li> <li>• In a medical settings, other forms of mitigation might not be carried out and these settings are likely to be secondary care and therefore with different priorities than most dental settings.</li> </ul> <p>The view of the Group was that for non-COVID patients a relatively long fallow time (60 minutes) would not be acceptable, but all members of the group judged that a relatively short fallow time (15 minutes) would be <i>acceptable</i> or <i>probably acceptable</i> to the profession and patients.</p>
<p><b>6. Feasibility</b> <i>Comment on cost, resource implications and implementation considerations, if applicable.</i></p>
<p>No studies directly evaluated acceptability of fallow time for patients or professionals. The Working Group noted:</p> <ul style="list-style-type: none"> <li>• Improving ventilation to reduce fallow time is likely to involve investment in additional equipment. There may be other costs, implications for access to dental care and might influence oral health inequality.</li> <li>• Determining a bespoke fallow time will depend on knowledge of air changes per hour and will require periodic monitoring.</li> <li>• Measuring air change rates accurately is likely to require specialist input and may not be reliable. In any workspace with natural ventilation, air changes will be affected by atmospheric conditions and in all dental surgeries, layout and working practices are likely to lead to periodic variations in ventilation.</li> </ul> <p>The view of the Group was that a relatively long fallow time (60 minutes) would not be feasible but 95% of the group judged that of a relatively short fallow time (15 minutes) is <i>feasible</i> or <i>probably feasible</i>.</p>
<p><b>7. Other factors</b> <i>Indicate any other factors taken into account.</i></p>
<p>The prevalence of SARS-CoV-2 in population (as of 10 September 2020, approximately 1 in 900) and the proportion of asymptomatic cases (estimated to be 20%<sup>33</sup>) means that the likelihood of treating an asymptomatic infected patient at this time is low to very low.</p> <p>There is a lack of evidence about the amount and viability of the virus in saliva, virus viability in dental aerosols and the minimum infectious dose of SARS-CoV-2. While dental aerosols pose a theoretical risk for SARS-CoV-2 transmission, this risk has yet to be confirmed from observational studies.</p>

There are certain dental procedures that will generate aerosols with significant amounts of <math><5\ \mu\text{m}</math> particles about which there is most concern.

## 8. Considered judgment

*Summarise the group's agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.*

Taking all of the above factors into account, Working Group members (n= 20) voted as indicated that in principle (irrespective of duration):

*The panel's agreed position is that a fallow time is recommended to reduce the risk of SARS-CoV-2 transmission associated after treatment that involves the use of high speed drill or ultrasonic scaler. (85%)*

*The panel's agreed position is that a fallow time is not recommended to reduce the risk of SARS-CoV-2 transmission associated after treatment that involves the use of high speed drill or ultrasonic scaler. (15%)*

It was noted that based on balance of effects, and in order to be acceptable and feasible to implement, the length of the fallow time would need to be relatively short. The working group considered several options for determining the fallow time: 1) a single fixed fallow time; 2) discrete (i.e. pre-specified) fallow times that may take into account the use of procedural mitigation and ventilation; 3) variable fallow times calculated from modelling that incorporate adjustment for procedural mitigation and ventilation.

A consensus majority (76% n=17) voted against option 1, which was regarded as overly simplistic. A consensus majority (94% n=19) voted for option 2 in preference to option 3, which was regarded as based on worst case-scenario modelling, requires accurate determination of ventilation rate, which might not be available or possible, and, if applied rigorously, the majority of fallow times proposed would be excessive and impractical.

A majority of the group [56% (n=18) when there were five choices; 63% (n=19) when there was a choice of 30 or 60 minutes] favoured a maximum discrete fallow time (i.e. when ventilation is poor or unknown and with no other mitigation) of 30 minutes and that this could be reduced with i) high volume suction (95% consensus, n=16) ii) rubber dam (89% consensus, n=18) and iii) ventilation demonstrated to be  $\geq 6$  ACH (100% consensus n=18). A majority, which did not reach consensus, was in favour of reducing fallow time with shorter AGPs (71%, n=17).

It was agreed that irrespective of ventilation and the procedural mitigation used, after any procedure at higher risk of generating an aerosol the minimum fallow time is 10 minutes to allow droplets to settle before environmental cleaning. It was also confirmed that aerosol generating procedures should not be performed in a room with no natural or mechanical ventilation.

The group agreed that the fallow time could commence at the end of aerosol production rather than at the end of the patient appointment. However, it was acknowledged that this could be unpredictable and therefore difficult to implement and record. Consequently, some practitioners might choose to add the discrete fallow time to the end of the appointment to facilitate scheduling. Scheduling appointments likely to involve aerosol production at the end of a session might also reduce the impact of fallow time.

Based on these discussions, the wording of the final agreed position was:

**The Working Group's agreed position 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.**

This agreed position is based on limited observational evidence that aerosols generated from dental procedures disperse within relatively short periods, a lack of evidence about the presence, viability and infectivity of SARS-CoV-2 within a dental aerosol and prevalence of COVID-19 at a level that presents a low risk of seeing an asymptomatic COVID-19 patient. Certain dental procedures will generate aerosols with significant amounts of <math><5\ \mu\text{m}</math> particles (Group A in Table 3.1 of the published review). Consequently, applying a fallow time during periods of sustained community transmission should only be necessary as a precaution following Group A dental procedures.

Based on this considered judgement, a scheme for the application of pragmatic fallow times was proposed and illustrated in the form of flowchart (Figure 5.1 in the published review). After discussion and refinement, the features of this scheme were:

- an assumption that high volume suction is standard practice for most Group A procedures;
- a benchmark fallow time, dictated by ventilation rate, of 15-30 minutes;
- a modest reduction in fallow time (e.g. by 5 minutes) with use of high-volume suction, rubber dam and short aerosol generation;

- a minimum fallow time of 10 minutes (the time required to allow larger droplets to settle before environmental cleaning).

In a vote, 83% of working group members (n=23) voted in favour of the flowchart representation of this scheme. In a subsequent refinement, a note was added that when ventilation is poor and suction is not used, the benchmark fallow time is longer (up to 60 minutes).

The Working Group thought it important

- to acknowledge that this approach to fallow time differs significantly from current UK guidance, but that this is an evidence-informed, pragmatic proposal that aims to enable implementation of a precautionary fallow time in a manner that is likely to allow dental services to function both safely and at reasonable capacity;
- to stress the importance of investigating the air change rate within each surgery as a matter of urgency and the need for modifications to dental surgery ventilation to meet the requirements of current UK healthcare guidance and legislation, which might require specialist technical support and financial investment;
- to include that if a patient
  - a. has no symptoms, had a negative SARS-CoV-2 (COVID-19) test within the last 72 hours and has self-isolated prior to treatment (i.e. patients within UK IPC Low Risk COVID-19 Pathway<sup>16</sup>), no fallow time is required following a Group A dental procedure.
  - b. is likely to have COVID-19 (i.e. patients within UK IPC High Risk COVID-19 Pathway<sup>16</sup>), treatment using Group A dental procedures should be delayed if possible.

## 9. Additional information

*Include any further information that is relevant to the agreed position*

### Dental patient care during the COVID-19 pandemic

According to data Public Health Scotland's Management Information and Dental Accounting System (MIDAS), there was a 97% decrease in the number of patient contacts per month in April 2020, the first full month of the UK COVID-19 lockdown, the average in the 12 months prior to March 2020 (461,525). By July 2020, patient contacts had increased substantially. However, this was still only 34% of the monthly average pre-lockdown. A similar pattern in individual treatments is observed pre- and post-lockdown. However, by July 2020 the number of teeth extracted had risen to 52% of the pre-lockdown monthly average while the number of teeth filled had only reached 17% of the pre-lockdown monthly average.

This pattern of change from before to during the pandemic is likely to be similar across the UK.

The average claims for a prescription fee, which can only be made if no other treatment is provided, decreased by 33% in April 2020 from the previous 12 monthly average and decreased further in May 2020. As with other treatments, there was a rise between June and July 2020, with claims for a prescription fee increasing to approximately 300% of the pre-lockdown monthly average. Data extracted from the Prescribing Information System for Scotland (PRISMS) shows that in the 12 months prior to March 2020, an average of 23,419 antibiotic items were prescribed by NHS primary care dentists and dispensed in community pharmacy in Scotland. The majority were for amoxicillin (68%) or metronidazole (29%). Unlike the number of treatments provided, these prescriptions steadily increased from March 2020, reaching 33,800 in June 2020, a 44% increase from the pre-lockdown monthly average (Figure 2.2b).

While direct patient contacts have fallen significantly, in Scotland there has been a 50% increase in calls to NHS24. Data from the Scottish Emergency Dental Services (SEDS) at NHS24 demonstrated an overall increase in call volumes during April and May, which represents an increase of 21% and 57% respectively compared with the same time period in 2019. Calls have remained at a high level since May 2020, with 82% (range 79-87%) of calls being classified as 'urgent', 7.5% (range 3.8 – 9.6%) being classified as 'routine' and less than 1% classified as 'emergency'.

## Environmental Mitigation – Air Cleaners

<b>Rapid Review Question</b>
<p>Scope question:</p> <p>What environmental mitigation can reduce the 'fallow period' following an AGP?</p> <p>Air cleaning technologies additional to conventional natural and mechanical ventilation were considered.</p> <p>Based on this, the following question was used to facilitate the review process:</p> <p><b>What air cleaning technologies can be used to reduce the risk of SARS-CoV-2 transmission associated with dental AGPs?</b></p>
<b>1. Summary of evidence</b>
<p><i>Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.</i></p>
<p><b>Background on air cleaning technologies</b></p> <p>Various technologies and approaches exist that aim to reduce contamination in aerosols. The primary method is likely to be dilution through mixing with fresh air via an efficient ventilation system. Alternative or additional approaches include fumigation, fogging, germicidal UV (GUV) light, high efficiency particulate air (HEPA) filtration and ionisation, some of which can be used in combination.</p> <p>Fumigation and fogging decontaminate the air through the use of disinfection chemicals such as hydrogen peroxide, ozone, chlorine dioxide, hypochlorous acid or formaldehyde, dispensed throughout the room as gases or mists. Due to the health risks from exposure to the chemicals used, fumigation and fogging are unsuitable for occupied rooms and, since they also require a period of time for clearing after disinfection, are unlikely to be a useful environmental mitigation for dental AGPs. In relation to COVID-19, the WHO does not recommend routine application of disinfectants to environmental surfaces via spraying or fogging in indoor spaces.<sup>34</sup></p> <p>Germicidal UV light is known to be effective against a range of bacterial and viral pathogens and is a widely used antimicrobial technology. Under laboratory conditions, SARS-CoV-1, MERS-CoV and MHV coronavirus can be inactivated by GUV.<sup>35,36</sup> To avoid harmful exposure of occupants in a room, UV lamps can only be operated within enclosed or shielded devices or when the room is unoccupied.</p> <p>Ionising (or electrostatic) air cleaners generate positive or negative ions which in turn charge airborne particles making them more likely to attach to surfaces, within the device or elsewhere in the room, thus reducing their concentration in an aerosol.</p> <p>Air cleaning devices utilising HEPA filtration, GUV, ionisation or combinations of these are likely to be the most relevant for dental settings. In principle, if contaminating particles are removed effectively, in-room air cleaners with an air flow mechanism can contribute equivalent air changes per hour (eACH) to the existing ventilation, at levels determined by their efficiency and air flow rate.</p> <p>This evidence summary only considers evidence relating to the effectiveness of in-room air cleaners in dental or other healthcare settings and does not include fumigation, fogging or the use of GUV devices without airflow.</p> <p><b>Cochrane Systematic Review</b></p> <p>A Cochrane Review<sup>17</sup> investigated interventions to reduce contaminated aerosols produced during dental procedures for preventing infectious diseases. The review included 2 studies relating to environmental mitigation in dental settings.</p> <p>The first study considered the efficacy of a local standalone air filtration system (including HEPA pre-filters, gas filter cartridges and an electrostatically charged post-filter) in reducing bacterial contamination from various dental procedures.<sup>37</sup> Based on this study there may be a reduction in contamination of aerosols while using the air cleaning system (ACS) compared to no ACS during cavity preparation (MD in CFU -66.70, 95% CI -120.15 to -13.25 per m<sup>3</sup>; 2 participants) or during ultrasonic scaling (MD -32.4, 95% CI -51.55 to -13.25; 2 participants). All sampling was performed with the clinic windows closed and no air conditioning systems or fans on. The results of this study were rated as being of very low certainty, due to unclear risk of bias, study design and imprecision due to small sample size reported in a single study.</p>

The second included study evaluated the reduction in volume of contaminated aerosol and in level of contamination using laminar air flow with HEPA filtration during ultrasonic scaling.<sup>38</sup> This controlled clinical trial found a reduction in the level of contamination in aerosols (less CFUs) during the use of laminar air flow with HEPA filters compared to no laminar air flow or filter, sampled at 1.5m from the floor (MD -483.56, 95% CI -550.02 to -417.10; 50 participants) and 20 to 30cms from patients mouth (MD -319.14, 95% CI -385.6 to -252.68; 50 participants). Meta-analysis of the results for volume of contaminated aerosol could not be carried out due to missing data. The results of this study were also rated as being of very low certainty, due to unclear risk of bias, study design and imprecision due to small sample size reported in a single study.

The Cochrane Review did not find any studies on other methods such as ionisation, use of ventilation, ozonisation, UV light or fogging that met the inclusion criteria.

### **Supplementary evidence search**

Three additional studies assessing air cleaners were identified from a further search carried out for SDCEP by Cochrane Oral Health.

Hubar et al. (2009)<sup>39</sup> assessed two commercial ionic air purifiers in a dental office and reported that the unit with a germicidal UV light was more effective in killing bacteria retrieved from the device after operation than the unit without UV, but did not measure the extent of reduction of airborne bacterial contamination.

Chen et al. (2010)<sup>40</sup> carried out computational fluid dynamics modelling of airflow and particle removal for different scenarios in a dental surgery with a recirculating filtration air cleaner placed in different locations. The modelling was based on measurements taken in a dental clinic and while the study did not measure the effectiveness of the air cleaner during patient treatments it concluded that the positioning of the air cleaner is a particularly important consideration for controlling particle dispersion.

Verhougstraete and Reynolds (2016)<sup>41</sup> assessed the use of a portable air device which combined HEPA filtration with biocidal UV light in 2 intensive care hospital rooms. This study measured levels of aerosolised coliphage, artificially introduced into the rooms as a virus surrogate, and reported no statistically significant difference in concentrations with or without the air cleaner. In both study rooms, the air cleaner was tested with the existing ventilation in place (12.4 and 37 air changes per hour). Based on this and despite the lack of effect of the air cleaner under the conditions tested, the authors proposed that environments with reduced air exchange rates may benefit most from combining portable air filtration devices with natural HVAC conditions.

### **National Services Scotland (NSS) technical report (SBAR) and rapid review**

The NSS SBAR *Ventilation, water and environmental cleaning in dental surgeries relating to COVID-19*<sup>9</sup> provides information on the potential additional benefit of recirculating air cleaners and cites the study by Hallier et al.<sup>37</sup> (described above) as very weak evidence to support their use.

*Addition of recirculating air cleaning devices could enhance the effective air change rate (but will not provide additional fresh air). The impact of such devices will depend on the specific device air flow rate and the size of the room. Devices should be correctly sized and the impacts on the room air flows considered. Recirculating air cleaning devices based on HEPA filter systems or UV-C are likely to be effective. Other technologies should be approached with caution as there is little evidence for effectiveness in practice.*

The report also notes that when selecting an air cleaning device, consideration should be given to:

- Whether the device filters the appropriate size of aerosol or particulate.
- The efficiency with which any UV system inactivates viruses similar to SARS-CoV-2.
- The maximum air flow rate which is compatible with the acceptable noise level.
- Positioning in the room and impact on efficacy.
- Maintenance for consistent performance.

The SBAR does not provide advice on local extract ventilation (LEV) systems stating that further research is necessary to establish their feasibility.

### **Scientific Advisory Group for Emergencies (SAGE)**

A recent paper prepared by the Environmental and Modelling group (EMG) for the Scientific Advisory Group for Emergencies (SAGE): *Application of UV disinfection, visible light, local air filtration and fumigation technologies to microbial control*<sup>42</sup> includes summaries of evidence from 6 primary studies and 5 reviews, guidance documents or speculative articles relating to air cleaners. These are presented as a representation of available studies but were not

identified through an exhaustive literature search and therefore are unlikely to include all relevant evidence. The paper was not peer-reviewed. Two of the studies investigate air cleaners in healthcare settings although neither were dental.

Rao et al. (2020)<sup>43</sup> assessed the use of a portable air filtration device with photo-electrochemical oxidation technology in hospital paediatric treatment areas. The study reported clinical outcomes including reductions in mean length of ICU stay, patient ventilation, nebuliser use and intubation but did not present evidence on the effect on aerosol contamination levels that might inform the use of air cleaners in dental settings. The other included study from a healthcare setting<sup>41</sup> is already discussed above (Cochrane supplementary evidence search).

A health technology policy assessment included in the EMG report also assessed air cleaning technologies in healthcare settings.<sup>44</sup> The assessment reported that the effectiveness of in-room air cleaners varies widely, ranging from 12 to 99% depending on the technology used and conditions under which evaluation was carried out. A systematic review of evidence was carried out as part of the assessment to specifically address the question of whether air cleaners that combine HEPA filtration and UV germicidal irradiation are more effective than those using HEPA filters alone. One small experimental study was identified that assessed a combined HEPA-UV unit in a simulated hospital room for removal of bacterial contamination. The rate of air cleaning by the HEPA-UV in-room air cleaner was statistically significantly greater when the UV lights were on compared with when the UV lights were removed. However, there is uncertainty as to whether the effect was attributable to the UV irradiation or not.

The other studies on air cleaners included in the EMG report considered effects on cigarette smoke, allergens and other particles in domestic settings and in general suggest that in-room air cleaners may have some benefit. Some of the studies found that HEPA filtration units were the most efficient type and one study concluded that ionic electrostatic appliances provide little or no benefit compared with filtration devices.

The evidence included in the EMG paper comes from a variety of small studies carried out under different conditions and therefore it is not possible to combine the data. Any effects are likely to be of very low certainty.

With regard to air cleaners, the EMG paper concludes:

*Local air cleaning devices, including filter devices and UV-C devices – which may be found in combination - are unlikely to have significant benefit unless the airflow rate through the device is sufficient. There may be some poorly ventilated spaces where these may be useful.*

#### **International Guidelines:**

Of the 63 international dental guidance documents assessed in the rapid review<sup>18</sup> carried out by the CoDER working group, 24% refer to air cleaning devices or technologies. The most commonly mentioned were HEPA filtration and UV. None of the documents cited evidence to support air cleaning approaches; two acknowledged a lack of evidence in relation to effectiveness in relation to COVID-19.

In summary, the evidence on the effectiveness of air cleaners for reducing aerosol contamination comes from several small studies carried out under different conditions in different settings, which overall are judged to be of low quality. Although several documents acknowledge that recirculating in-room air cleaning devices with HEPA filtration and/or GUV are likely to be the most effective, there is insufficient evidence from their use in healthcare settings to establish the size of effect or on which to base direct comparisons between different types of device. The effectiveness of in-room recirculating air cleaning devices is likely to be variable and will depend on the type of device, efficiency of contaminant removal or inactivation, airflow rate, size of the room, positioning of the device and existing levels of ventilation. None of the studies directly assess the effect of air cleaners on SARS-CoV-2.

Overall, the certainty of evidence was judged to be very low.

## **2. Balance of effects**

*Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.*

In terms of benefits, there is limited evidence on the effectiveness of air cleaners for reducing levels of contaminated aerosols in dental settings and no evidence relating to effectiveness for SARS-CoV-2. The size of the effect of air cleaners is likely to vary depending on the type, efficiency of particle removal or inactivation, air flow rate, level of existing ventilation, size of room and positioning.

Potential adverse effects or harms identified include:

- Accidental exposure to UV light could cause eye and skin damage.

<ul style="list-style-type: none"> <li>• Inappropriate positioning of a recirculating air cleaner might affect room airflow and therefore exposure of dental professional to droplets/aerosol particles.<sup>40</sup></li> <li>• Certain air purifiers can produce ozone during operation, as a by-product of air ionisation.<sup>45</sup></li> <li>• Noise levels and the potential to be a trip hazard.</li> </ul> <p>The Group's judgement on the balance of effects was divided. 41% of group members voted that the balance of effects <i>probably favours</i> using air cleaners, and 14% voted that it <i>probably does not favour</i> using air cleaners. 41% voted that balance of effects is neither for or against the use of air cleaners. This indicates that the potential benefits and possible harms might be fairly closely balanced.</p>
<p><b>3. Subgroup considerations</b> <i>Comment here on any subgroup considerations e.g. vulnerable groups; COVID-19 status; care setting</i></p>
<p>Air cleaning devices might be more beneficial for facilities with lower air change rates who are unable to improve ventilation by other means in the short term.</p>
<p><b>4. Values and preferences</b> <i>Summarise any evidence or information on values and preferences.</i></p>
<p>In-room air cleaning devices might provide some reassurance to patients and dental professionals.</p>
<p><b>5. Acceptability</b> <i>Is the intervention acceptable to patients, dental team and other stakeholders?</i></p>
<p>If the device provides a high flow rate and effective filtration it might be able to boost existing ventilation and potentially reduce fallow time.</p> <p>Recirculating air cleaners will produce some level of noise which be might unacceptable for some people.</p> <p>Free standing devices placed near the treatment area could be an obstruction.</p> <p>A majority of the Group judged that using an air cleaner would be acceptable. 73% of the Group members voted that using an air cleaner would be <i>acceptable</i> or <i>probably acceptable</i>, with 23% judging that acceptability would vary.</p>
<p><b>6. Feasibility</b> <i>Comment on cost, resource implications and implementation considerations, if applicable.</i></p>
<p>There will be costs associated with purchase, installation, usage and ongoing maintenance (e.g. performance testing, replacement of filters, cleaning or replacement of UV lights).</p> <p>Estimated costs for purchase of an air cleaner range from ~£1000 to £10,000 depending on the device.</p> <p>The impact of the costs associated with an air cleaner might vary depending on whether a practice is NHS, private or mixed.</p> <p>Likely to need specialist advice to maximise efficiency and assess impact on room air flow.</p> <p>The ease and speed of implementation might affect feasibility.</p> <p>A majority of the Group judged that using an air cleaner would be feasible, although it was acknowledged that the impact of costs might vary. 77% of the Group members voted that using an air cleaner would be <i>feasible</i> or <i>probably feasible</i>.</p>
<p><b>7. Other factors</b> <i>Indicate any other factors taken into account.</i></p>
<p>Whether or not to use an air cleaner might have to be a balanced decision, taking into account what other mitigating factors are in use.</p> <p>There was concern that if air cleaners were recommended, unless there is validation testing, some dental facilities may purchase and use unsuitable or inefficient devices.</p> <p>The peak efficiency of any air cleaning device is likely to fall over time. Maintenance and periodic validation/performance testing will be required to ensure devices are operating effectively.</p>

## 8. Considered judgment

*Summarise the group's agreed position on the question including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable.*

Taking all of the above factors into account, the working group voted (n=22) on the agreed position. It was agreed, following the considered judgement discussions, that voting for the second option (not recommended) would mean that air cleaners are not recommended for routine use, rather than that air cleaners should not be used. The voting was:

*The panel's agreed position is that using air cleaners is recommended to reduce the potential risk of SARS-CoV-2 transmission associated with dental AGPs. (18%)*

*The panel's agreed position is that using air cleaners is not recommended to reduce the potential risk of SARS-CoV-2 transmission associated with dental AGPs. (82%)*

After subsequent discussions, the wording of the final agreed position was:

**The Working Group's agreed position 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 Group considered that there is currently insufficient evidence to recommend using air cleaners as a universal mitigation for use in all dental facilities. This agreed position is conditional as the group acknowledged that air cleaners might be beneficial and could be an option, particularly for premises with lower air flow rates, but that effectiveness for reducing aerosol contamination levels will be variable and that there may be significant costs. The importance of technical advice, validation and maintenance should be emphasised.

## 9. Additional information

*Include any further information that is relevant to the agreed position*

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