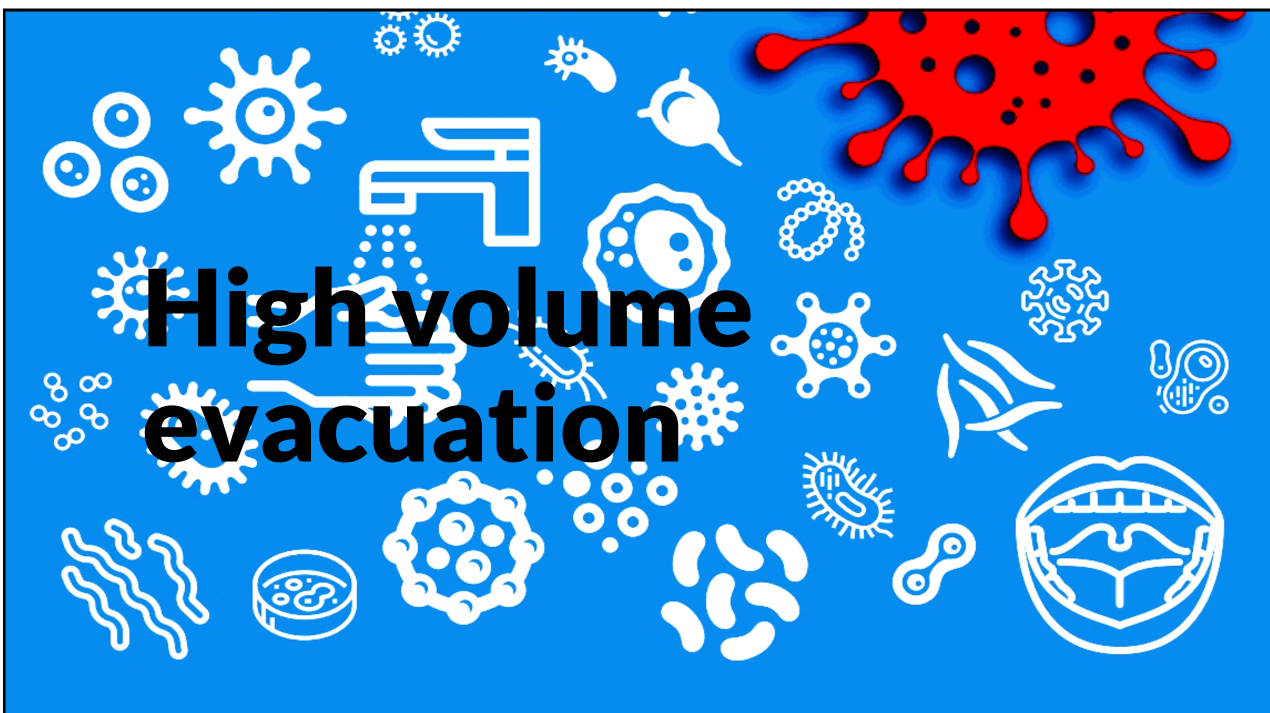
Contemporary Infection Control

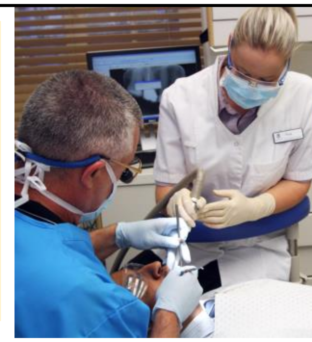
2022

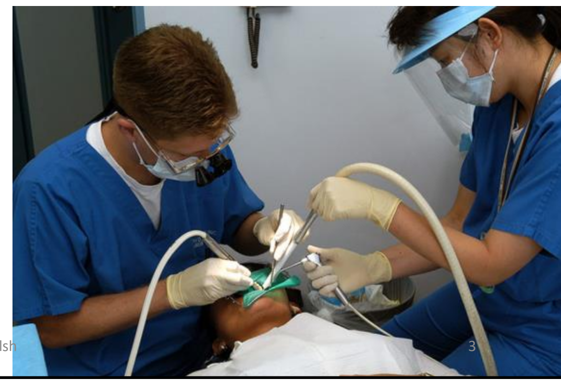
Emeritus Professor Laurence J. Walsh AO

BDSc(Hons), PhD, DDSc, GCEd, FRACDS, FFOP(RCPA), FFDT RCS Edin

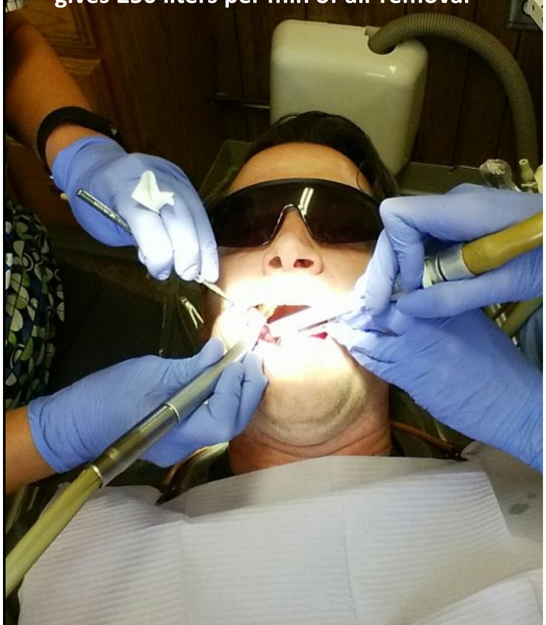


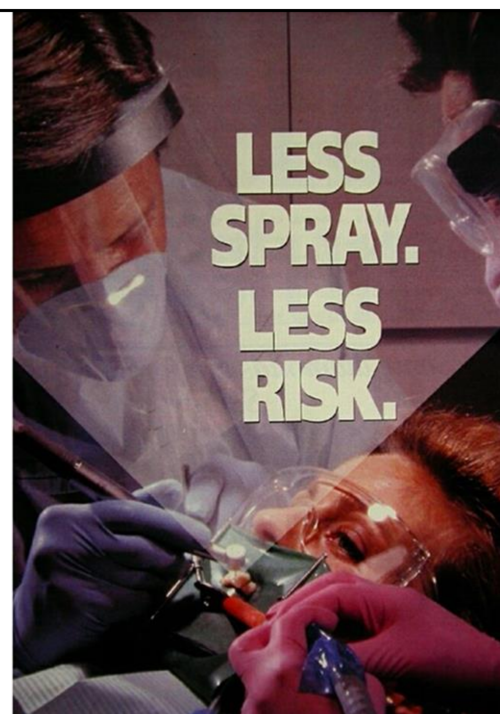
~95% plus reduction from **each** of **pre-procedural rinse, HVE, and dental dam.** These reductions are multiplicative, achieving around 10E5 to 10E6 reductions in bacterial counts in aerosols.





HVE with a large bore 8 or 10 mm tip gives 250 liters per min of air removal






sirona


Lunos

Effective suction for reducing aerosols

Effective high volume evacuation is recognised as a key component of strategies that mitigate the risk of infection to dental staff, including from aerosol-generating procedures performed on dental patients with upper respiratory tract infections. High-volume evacuation (HVE) using wide bore intraoral suction tips has been shown to be highly effective in reducing salivary contamination of the surrounding environment.

There is an extensive literature that supports the view that with correct placement of HVE, aerosols and spatter should be reduced by 90% or more.[1-14] This makes maintaining the suction system a critical component of safe working practices in everyday dental practice.

1. Micik RE, Miller RL, Mazzarella MA, Ryge G. Studies on dental aerobiology, I: bacterial aerosols generated during dental procedures. J Dent Res. 1969; 48: 49-56.
2. Bentley CD et al. Evaluating spatter and aerosol contamination during dental procedures. J Am Dent. Assoc. 1994; 125: 579-584.
3. Bennett AM et al. Microbial aerosols in general dental practice. Br Dent J. 2000; 189: 664-667.
4. Leggat PA, Kedjarune U. Bacterial aerosols in the dental clinic: a review. Int Dent J. 2001; 51: 39-44
5. Jacks ME. A laboratory comparison of evacuation devices on aerosol reduction. J Dent Hyg. 2002; 76: 202-206.
6. Harrel SK, Molinari J. Aerosols and splatter in dentistry: A brief review of the literature and infection control implications. J Am Dent Assoc. 2004; 135, 429-437.
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9. Dahlke WO et al. Evaluation of the spatter-reduction effectiveness of two dry-field isolation techniques. JADA. 2012; 143: 1199-1204.
10. Zemouri C et al. A scoping review on bio-aerosols in healthcare and the dental environment. PLoS ONE 2017; 12(5), e0178007.
11. Kobza J et al. Do exposures to aerosols pose a risk to dental professionals? Occup Med. 2018; 68:454-458.
12. Liu MH et al. Removal efficiency of central vacuum system and protective masks to suspended particles from dental treatment. PLoS ONE 2019; 14: e0225644.
13. Meethill AP et al. Sources of SARS-CoV-2 and other microorganisms in dental aerosols. J Dent Res 2021; 1-7. DOI: 10.1177/00220345211015948
14. Allison JR et al. Evaluating aerosol and splatter following dental procedures: addressing new challenges for oral health care and rehabilitation. J Oral Rehabil. 2021; 48:61-72.

Greater awareness of high volume suction

The COVID-19 pandemic has focused attention on the important protective role of high volume suction to remove aerosols generated by the normal breathing and speaking of patients (i.e. aerosol generating behaviours, or AGBs) as well as from dental procedures that use the triplex syringe or powered devices that generate aerosols (i.e. AGPs). Use of a large diameter (8 or 10 mm) suction tip provides the most effective removal of air from the patients oral cavity and the surrounding region.[25-28]

25. Meethill AP et al. Sources of SARS-CoV-2 and other microorganisms in dental aerosols. J Dent Res. 2021; 1-7. DOI: 10.1177/00220345211015948.
26. Allison JR et al. Evaluating aerosol and splatter following dental procedures: addressing new challenges for oral health care and rehabilitation. J Oral Rehabil. 2021; 48:61-72.
27. Holliday R et al. Evaluating contaminated dental aerosol and splatter in an open plan clinic environment: Implications for the COVID-19 pandemic. J Dent. 2021; 105: 103565.
28. Balanta-Melo J et al. Rubber dam isolation and high-volume suction reduce ultrafine dental aerosol particles: an experiment in a simulated patient. Appl Sci. 2020; 10: 6345.
29. Shahdad S et al. Fallow time determination in dentistry using aerosol measurement in mechanically and non-mechanically ventilated environments. Brit Dent J. 19 July 2021 DOI: 10.1038/s41415-021-3369-1.

Pre-procedural rinses

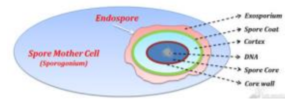
2013

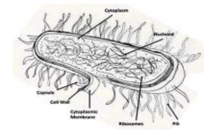
Antiviral and antibacterial effects of preprocedural mouthrinses

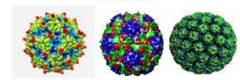
By Professor Laurence J. Walsh

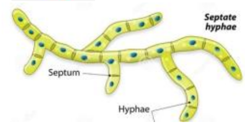
Descending order of resistance

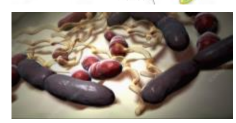
Bacterial Spores
Bacillus subtilis, Clostridium sporogenes
▼
Mycobacteria
Mycobacterium tuberculosis var. *bovis*, Nontuberculous mycobacteria
▼
Nonlipid or Small Viruses
Poliovirus, Coxsackievirus, Rhinovirus
▼
Fungi
Trichophyton spp., *Cryptococcus* spp., *Candida* spp.
▼
Vegetative Bacteria
Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella choleraesuis, Enterococci
▼
Lipid or Medium-size Viruses
Herpes simplex virus, CMV, Respiratory syncytial virus, HBV, HCV, HIV, Hantavirus, Ebola virus

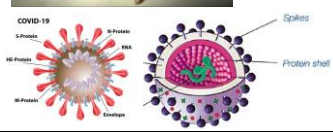












Mouth rinses and their antiviral actions

Professor Laurence J. Walsh AO

2020

In the context of the COVID-19 pandemic, the discussion on the question of mouth rinse and their antiviral actions begins by acknowledging that very few test products will have direct laboratory data for activity against the SARS-CoV-2 virus. The prohibition of virucidal claims by the TGA would prevent any antimicrobial antiseptic or mouthwash product from making such claims, at least in the Australian context. There seems to be confusion by some, who consider that the lack of claims against SARS-CoV-2 somehow implies that products do not work against it and lack efficacy. That assumption is incorrect.

A number of key principles can be drawn from what is known about the actions of various products upon enveloped viruses. Such viruses include the SARS-CoV-2 virus and human viral influenza. Such viruses are released by budding from human cells, or in the case of SARS-CoV-2, by exocytosis. Non-enveloped viruses (e.g. Adenoviruses) are more difficult to inactivate than enveloped viruses. For reasons of practicability and safety, much of the laboratory testing for antiviral activity relies on various surrogate targets and this is certainly the case for testing antiviral activity against SARS-CoV-2.

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Feature article

Mouthrinses

new perspectives for 2021

It is important that dental professionals understand the basics of antimicrobial mouthrinses and where they fit into the overall scheme of dental products for at-home use. This article provides a summary of the latest evidence on common antimicrobial mouthrinses, with particular reference to the unique period of the COVID-19 pandemic.

by **Emeritus Professor Laurence J. Walsh** AO

The strength of evidence—from strongest to weakest

The use of antimicrobial mouthrinses as part of at-home self-performed oral health care as an adjunct to mechanical methods for controlling dental plaque biofilms is well established, with chlorhexidine (CHX) used post-surgically for the short term and essential oils (EO) (Listerine™) used at home over the long term both having a large base of evidence, including from recent systematic reviews.[1-6] There is also evidence for a moderate but lesser effect of cetylpyridinium chloride (CPC) on dental plaque and gingival inflammation.

Virucidal Efficacy of Different Oral Rinses Against Severe Acute Respiratory Syndrome Coronavirus 2

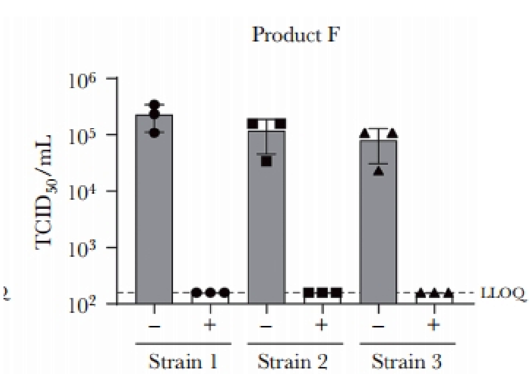
Toni Luise Meister,[1] Yannick Brüggemann,[1] Daniel Todt,[1,2] Carina Conzelmann,[3] Janis A. Müller,[3] Rüdiger Groß,[3] Jan Münch,[3] Adalbert Krawczyk,[4,5] Jörg Steinmann,[6,7] Jochen Steinmann,[8] Stephanie Pfaender,[1,a] and Eike Steinmann[1,a]

The Journal of Infectious Diseases

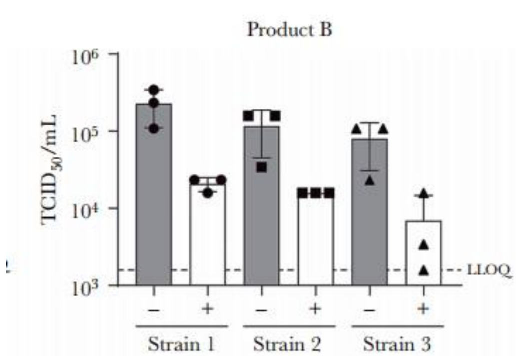
BRIEF REPORT

3 different SARS-CoV-2 clinical isolates mixed with an interfering substance mimicking a respiratory secretion. Time = 30 secs.

Listerine



Chlorhexidine



Original Contributions

Systematic Review

Efficacy of preprocedural mouthrinses in the reduction of microorganisms in aerosol

A systematic review

Vanessa Costa Marui, DDS; Maria Luisa Silveira Souto, DDS; Emanuel Silva Rovai, DDS; Giuseppe Alexandre Romito, PhD, MSc, DDS; Leandro Chambrone, PhD, MSc, DDS; Claudio Mendes Pannuti, PhD, MSc, DDS

Which rinse?

- Prepared onsite
  - Ozonated water (least taste and no additives)
- Commercial
  - Essential oils (Listerine) including alcohol-free versions
  - Hydrogen peroxide (diluted stock);
    - commercial with surfactants: Swirlprep, Colgate Peroxyl, Listerine Whitening
  - Quat (CPC, Cepacol, Oral B etc)
  - Povidone iodine (stains, possible irritancy)
  - CHX alcohol free (e.g. Swirl Hex, PDS, Curasept) – less effective against coronaviruses
  - CHX with alcohol (e.g. Savacol) – least well tolerated

Journal of Dental Research
1–7

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Sources of SARS-CoV-2 and Other Microorganisms in Dental Aerosols

A.P. Meethil[1], S. Saraswat[1], P.P. Chaudhary[2], S.M. Dabdoub[1], and P.S. Kumar[1,3]

Abstract

On March 16, 2020, 198,000 dentists in the United States closed their doors to patients, fueled by concerns that aerosols generated during dental procedures are potential vehicles for transmission of respiratory pathogens through saliva. Our knowledge of these aerosol constituents is sparse and gleaned from case reports and poorly controlled studies. Therefore, we tracked the origins of microbiota in aerosols generated during ultrasonic scaling, implant osteotomy, and restorative procedures by combining reverse transcriptase quantitative polymerase chain reaction (to identify and quantify SARS-CoV-2) and 16S sequencing (to characterize the entire microbiome) with fine-scale enumeration and source tracking. Linear discriminant analysis of Bray-Curtis dissimilarity distances revealed significant class separation between the salivary microbiome and aerosol microbiota deposited on the operator, patient, assistant, or the environment ($P < 0.01$, analysis of similarities). We also discovered that 78% of the microbiota in condensate could be traced to the dental irrigant, while saliva contributed to a median of 0% of aerosol microbiota. We also identified low copy numbers of SARS-CoV-2 virus in the saliva of several asymptomatic patients but none in aerosols generated from these patients. Together, the bacterial and viral data encourage us to conclude that when infection control measures are used, such as preoperative mouth rinses and intraoral high-volume evacuation, dental treatment is not a factor in increasing the risk for transmission of SARS-CoV-2 in asymptomatic patients and that standard infection control practices are sufficiently capable of protecting personnel and patients from exposure to potential pathogens. This information is of immediate urgency, not only for safe resumption of dental treatment during the ongoing COVID-19 pandemic, but also to inform evidence-based selection of personal protection equipment and infection control practices at a time when resources are stretched and personal protection equipment needs to be prioritized.

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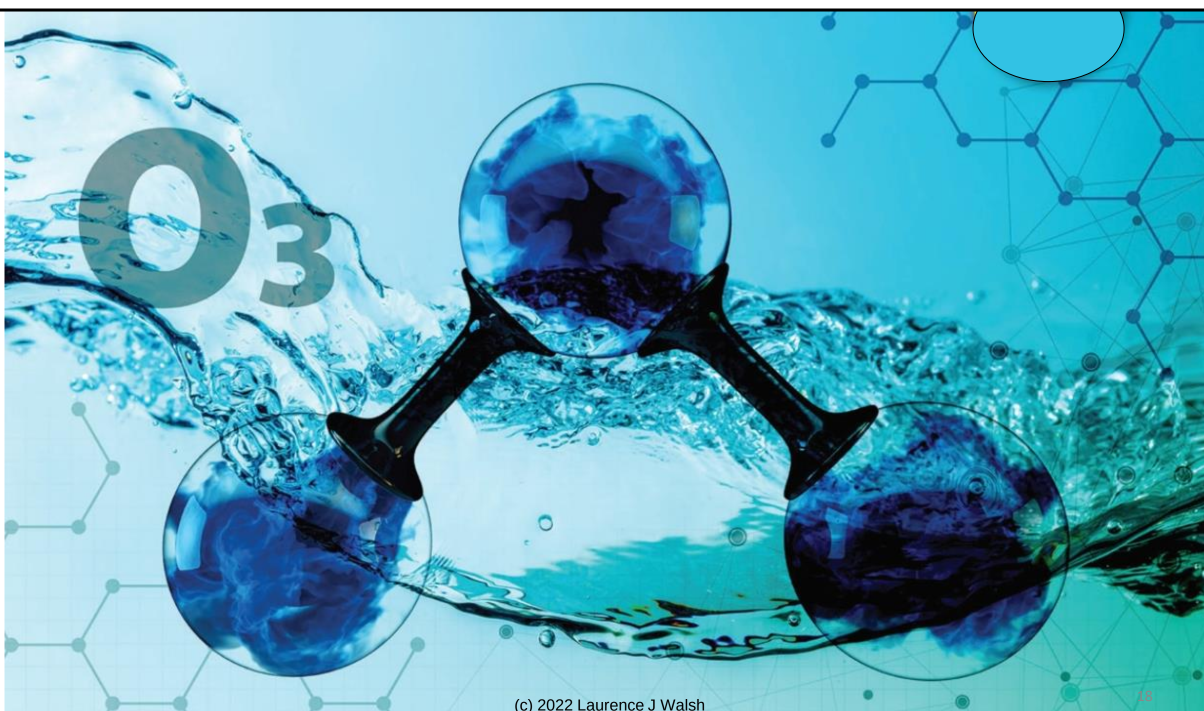

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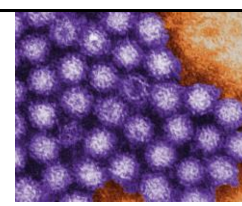
Oxidation: effects on viruses

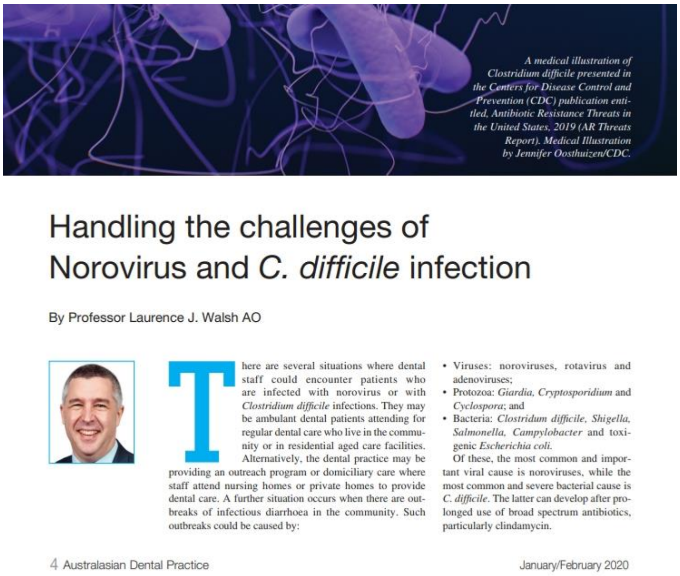
- **Enveloped** viruses: destroys the capsid by oxidation, then attacks viral nucleic acids.
- **Non-enveloped** viruses (**hard to kill**): Diffuses through the protein coat into the nucleic acid core, resulting in damage to viral nucleic acid.
- By oxidation, ozone causes a conformation (shape) change of outer proteins. This prevents the binding of the virus to receptors on host cells.
- Breidablik HJ. et al. Journal of Hospital Infection 2019; 102: 419-424

Tough targets: Noroviruses



- **The problem**
  - Thornton AC et al. Noroviruses: agents in outbreaks of acute gastroenteritis. Disaster Manag Response. 2004;2(1):4-9
  - Robilotti E et al. Norovirus. Clin Microbiol Rev. 2015;28(1):134-64.
- **The solution**
  - Wang H et al. Differential removal of human pathogenic viruses from sewage by conventional and ozone treatments. Int J Hyg Environ Hlth 2018;221:479-488.
  - Lim MY. Characterization of ozone disinfection of murine norovirus. Appl Env Microbiol. 2010;76(4):1120-1124

Tough targets: Literature review 2020



A medical illustration of Clostridium difficile presented in the Centers for Disease Control and Prevention (CDC) publication entitled, Antibiotic Resistance Threats in the United States, 2019 (AR Threats Report). Medical Illustration by Jennifer Oosthuizen/CDC.

Handling the challenges of Norovirus and *C. difficile* infection

By Professor Laurence J. Walsh AO

There are several situations where dental staff could encounter patients who are infected with norovirus or with *Clostridium difficile* infections. They may be ambulant dental patients attending for regular dental care who live in the community or in residential aged care facilities. Alternatively, the dental practice may be providing an outreach program or domiciliary care where staff attend nursing homes or private homes to provide dental care. A further situation occurs when there are outbreaks of infectious diarrhoea in the community. Such outbreaks could be caused by:

- Viruses: noroviruses, rotavirus and adenoviruses;
- Protozoa: *Giardia, Cryptosporidium* and *Cyclospora*; and
- Bacteria: *Clostridum difficile, Shigella, Salmonella, Campylobacter* and toxigenic *Escherichia coli.*

Of these, the most common and important viral cause is noroviruses, while the most common and severe bacterial cause is *C. difficile*. The latter can develop after prolonged use of broad spectrum antibiotics, particularly clindamycin.

4 Australasian Dental Practice January/February 2020

More than 99% of NoV can be inactivated by ozone at 1 mg/litre (1 ppm) within 2 minutes – both for cold tap water (5°C) and water at room temperature (20°C).

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SARS-CoV-2: Aqueous ozone

- Aqueous ozone achieves highly efficient inactivation of SARS-CoV-2.
- Even **aerial spraying of ozonated water** is effective on clinical isolates of SARS-CoV-2
- 100% inactivation with 0.75 ppm within 5 min
- 82–91.5% inactivation with 0.375 ppm at 5 mins.

- Albert S et al. Assessing the potential of unmanned aerial vehicle spraying of aqueous ozone as an outdoor disinfectant for SARS-CoV-2. Environmental Research **May 2021**; 196:110944.

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S. Albert et al. Environmental Research 196 (2021) 110944

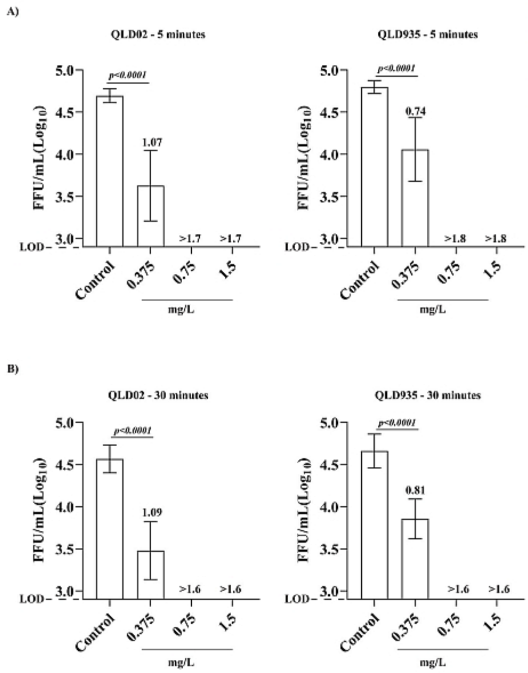

Fig. 4. SARS-CoV-2 inactivation by aqueous ozone. Viral titres (log_{10}FFU/mL) for QLD02 and QLD935 SARS-CoV-2 isolates remaining after 5 min (A) or 30 min (B) incubation at room temperature with different concentrations of aqueous ozone. Degassed ozone solution was used as a control. Average values from 14 to 24 individual wells for each treatment from two independent experiments are shown. The numbers above the bars show average log_{10} reductions in viral titres for each ozone concentration. P values were calculated using a nonparametric and Mann-Whitney test. The limit of detection (LOD) was 400 FFU/mL (2.9 log_{10}/mL). No virus was detected in any of the wells for 0.75 m/L and 1.5 mg/L of aqueous ozone. The percentage of reduction (P) for 0.375 mg/L ozone concentrations based on the mean log_{10} reduction (L) was calculated using the formula: $P = (1-10^{-L}) \times 100$.

Assessing the potential of unmanned aerial vehicle spraying of aqueous ozone as an outdoor disinfectant for SARS-CoV-2

Simon Albert[a,*], Alberto A. Amarilla[b], Ben Trollope[c], Julian D.J. Sng[b], Yin Xiang Setoh[b,1], Nathaniel Deering[a], Naphak Modhiran[b], Sung-Hsia Weng[d], Maria C. Melo[d], Nicholas Hutley[a], Avik Nandy[e], Michael J. Furlong[d], Paul R. Young[b], Daniel Watterson[b], Alistair R. Grinham[a], Alexander A. Khromykh[b,**]

[a] School of Civil Engineering, The University of Queensland, St. Lucia, QLD, 4072, Australia
[b] Australian Infectious Diseases Research Centre, School of Chemistry and Molecular Biosciences, The University of Queensland, St. Lucia, QLD, 4072, Australia
[c] The Ripper Group Pty Ltd, Level 5/50 York Street, Sydney, NSW, 2000, Australia
[d] School of Biological Sciences, The University of Queensland, St. Lucia, QLD, 4072, Australia
[e] Remote Sensing Research Centre, School of Earth and Environmental Sciences, The University of Queensland, St. Lucia, QLD, 4072, Australia

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Environmental Research 196 (2021) 110944

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Other viruses (typical papers)

- Kim CK et al. Mechanism of ozone inactivation of bacteriophage f2. Appl Environ Microbiol. 1980;39:210-218.
- Vaughn JM et al. Inactivation of human and simian rotaviruses by ozone. Appl Environ Microbiol. 1987;53: 2218-2221.
- Hall RM and Sobsey MD. Inactivation of hepatitis A virus and MS2 by ozone and ozone-hydrogen peroxide in buffered water. Water Sci Technol. 1993;27:371-378.
- Shin GA, Sobsey MD. Reduction of Norwalk virus, poliovirus 1, and bacteriophage MS2 by ozone disinfection of water. Appl Env Microbiol. 2003;69(7):3975-3978.

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Implementation

- Reticulated water connection (***Watermark***)
- ***Sensor tap (KIC tap) – handwash sink or scrub sink***
- Under-bench unit for high volume delivery
- Spray bottle system
- Self contained bottle system