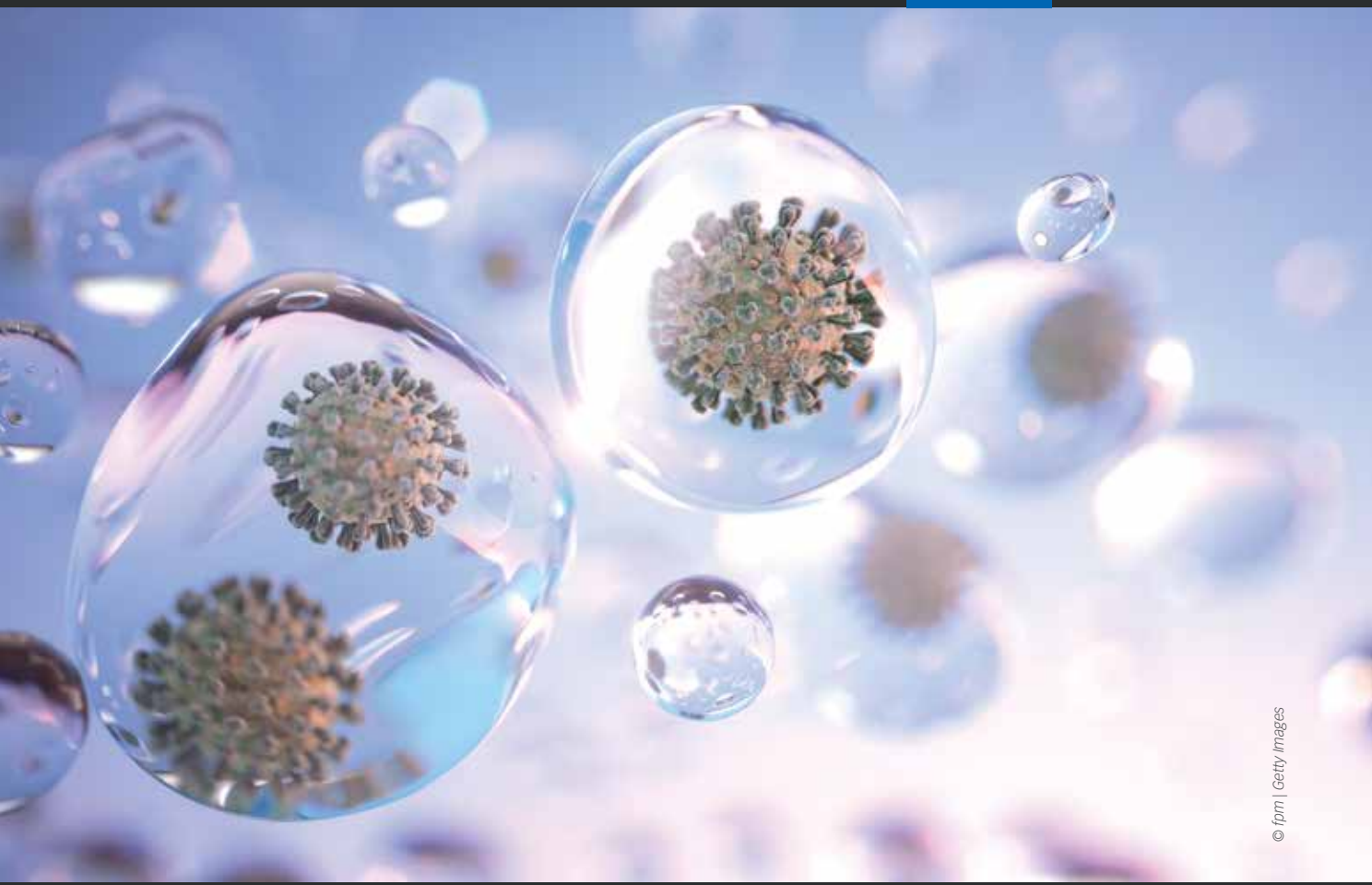
ACE
Dental Academy of Continuing Education ™

EARN
3 CE
CREDITS

This course was written for dentists, dental hygienists, and dental assistants.



© fpm | Getty Images

# Oral hygiene: Office and home care during the COVID-19 pandemic

A peer-reviewed article written by Gregori M. Kurtzman, DDS, MAGD

*Commercial support provided by CloSYS Oral Care*

| | |
|---|---|
| PUBLICATION DATE: | MARCH 2021 |
| EXPIRATION DATE: | FEBRUARY 2024 |

ENDEAVOR BUSINESS MEDIA

SUPPLEMENT TO ENDEAVOR PUBLICATIONS

EARN
**3 CE CREDITS**


## ABSTRACT

COVID-19 (SARS-CoV-2) emerged globally in the latter part of 2019 and has spread to every country, leading to a pandemic with increasing infections and deaths related to the virus. COVID-19 has an aerosol transmission that causes infection primarily through the mouth, nose, and eyes and is transmitted primarily by the mouth (breathing, coughing) and nose (sneezing). Use of masks when out in public has been recommended, and in some geographic areas, mandated to limit potential contact with aerosol containing the virus in an attempt to stem infection spread. Recent studies have indicated that a large percentage of those infected with COVID-19 are asymptomatic carriers able to transmit the virus to others through normal activities that produce aerosol, such as talking, exhaling, sneezing, and coughing. Viral load related to COVID-19 has been reported to be consistently high in the saliva and relatively higher than found in the oropharynx during the early stages of infection. Patients need to remove their masks during dental treatment, and if the virus is present in the mouth, they may spread it into the room air via aerosol when talking or breathing prior to treatment initiation. High-volume evacuation aids in elimination of aerosol created during treatment but may not completely eliminate virus particle spread into the operatory air and hence throughout the office. Pretreatment rinsing with specific mouth rinses has been advocated to inactivate any SARS-CoV-2 virus present in the patient's mouth and eliminate aerosolization of those active particles. This course will review the various mouth rinses available, and their effectiveness on SARS-CoV-2 for use as pretreatment rinses, and improved home care to limit potential spread of the virus with asymptomatic carriers.


## EDUCATIONAL OBJECTIVES

Upon completion of this course, the dental professional should be able to:

1. Incorporate basic practices to limit or prevent COVID-19 spread in the dental practice
2. Minimize the potential of asymptomatic carriers to spread the virus in the dental practice
3. Describe available mouth rinses and their effectiveness against COVID-19
4 Limit potential spread of the virus to those one may encounter when unable to wear a mask, such as fellow home residents, and aid in improving periodontal health in general through incorporation of antiviral oral rinses in home care

DACE
Dental Academy of Continuing Education ™

Go online to take this course.
DentalAcademyofCE.com
QUICK ACCESS CODE 21009

This continuing education (CE) activity was developed by Endeavor Business Media with no commercial support.

This course was written for dentists, dental hygienists, and dental assistants, from novice to skilled.

**Educational methods:** This course is a self-instructional journal and web activity.

**Provider disclosure:** Endeavor Business Media neither has a leadership position nor a commercial interest in any products or services discussed or shared in this educational activity. No manufacturer or third party had any input in the development of the course content.

**Requirements for successful completion:** To obtain three (3) CE credits for this educational activity, you must pay the required fee, review the material, complete the course evaluation, and obtain an exam score of 70% or higher.

**CE planner disclosure:** Laura Winfield, Endeavor Business Media dental group CE coordinator, neither has a leadership nor commercial interest with the products or services discussed in this educational activity. Ms. Winfield can be reached at lwinfield@endeavorb2b.com.

**Educational disclaimer:** Completing a single continuing education course does not provide enough information to result in the participant being an expert in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

**Image authenticity statement:** The images in this educational activity have not been altered.

**Scientific integrity statement:** Information shared in this CE course is developed from clinical research and represents the most current information available from evidence-based dentistry.

**Known benefits and limitations of the data:** The information presented in this educational activity is derived from the data and information contained in the reference section.

**Registration:** The cost of this CE course is $59 for three (3) CE credits.

**Cancellation and refund policy:** Any participant who is not 100% satisfied with this course can request a full refund by contacting Endeavor Business Media in writing.

**Provider information:**

**Dental Board of California:** Provider RP5933. Course registration number CA code: 03-5933-21009. Expires 7/31/2022. "This course meets the Dental Board of California's requirements for three (3) units of continuing education."

PACE ACADEMY OF GENERAL DENTISTRY PROGRAM APPROVAL FOR CONTINUING EDUCATION

Endeavor Business Media is a nationally approved PACE program provider for FAGD/MAGD credit. Approval does not imply acceptance by any regulatory authority or AGD endorsement. 11/1/2019 to 10/31/2022. Provider ID# 320452 AGD code: 010

Endeavor Business Media is designated as an approved Provider by the American Academy of Dental Hygiene, Inc. #AADHPNW (January 1, 2021-December 31, 2022). Approval does not imply acceptance by a state or provincial Board of Dentistry. Licensee should maintain this document in the event of an audit.

ADA CERP® | Continuing Education Recognition Program

Endeavor Business Media is an ADA CERP–recognized provider.

ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of dental continuing education. ADA CERP does not approve or endorse individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry.

Concerns or complaints about a CE provider may be directed to the provider or to ADA CERP at ada.org/goto/cerp.

ENDEAVOR BUSINESS MEDIA

## INTRODUCTION

COVID-19 is the disease caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It emerged in late 2019 and spread across the globe, leading to a pandemic with infections and deaths increasing daily. With this, changes have occurred across society to stem the potential spread of the virus and the health issues resulting from exposure.

COVID-19 travels as an aerosol, causes infection primarily through the mouth, nose, and eyes, and is transmitted primarily by the mouth (breathing, coughing) and nose (sneezing). Use of masks when in public is recommended, and in some geographic areas, mandated to limit potential contact with aerosols containing the virus in an attempt to reduce the spread of infection. Recent studies indicate that a large percentage of those infected with COVID-19 are asymptomatic carriers. Those individuals present with no symptoms of the infection but are actively infected, being able to transmit the virus to others through normal activities that produce aerosols, such as talking, exhaling, sneezing, and coughing. Evidence indicates that the percentage of asymptomatic carriers is between 30% and 50% of those who are infected.[1-6] With the potential of asymptomatic transmission, individuals may be infected and not aware of that state due to a lack of symptoms. Masks are worn to prevent potential spread of the virus. Yet, there are individuals who resent having to wear masks and simply refuse to do so. This has made transmission prevention challenging, and the refusal to wear masks when in public has added to the increase in infection rates being reported.[7] While we eagerly await widespread antiviral vaccine inoculation, we have an opportunity to reduce the risk of transmission and infection through enhanced oral care practices in the dental office and in the home.

## IMPROVING SAFETY IN THE PRACTICE AND LIMITING POTENTIAL SPREAD OF COVID-19 DURING TREATMENT

Dental offices have by and large followed the recommendations of the Centers for Disease Control and Prevention (CDC), American Dental Association (ADA), and state health departments requiring mask-wearing by all staff while in the office as well as patients when they present for appointments. This, combined with limiting how many individuals are in the waiting room, has helped limit potential spread in the dental practice. But patients during treatment have to remove the mask to allow planned care while in the operatory chair. Prior to initiating treatment on the patient in the chair, once the mask is removed, aerosols are produced as they breathe and talk. Unmasked mouths and noses can spread potentially infected aerosols throughout the operatory and flow to other parts of the dental office, invisibly contacting others. This contact can be with clothing and other items that, in turn, can be touched and potentially transferred by the fingers to the face, by rubbing the eyes, or by brushing hair. Although it has been recommended that staff wear disposable gowns, patients or their escorts typically are not wearing these, and that aerosol can settle on their clothes. Additionally, the majority of treatment we render to patients produces aerosols that can further increase the potential spread of the virus through the office. Extraoral evacuation (high-volume suction) aids in control of aerosol spread when a high-speed handpiece or ultrasonic/piezo with its water spray is being utilized. But can we reduce the virus that may be in the saliva prior to treatment to decrease potential aerosolization?

Viral load related to COVID-19 has been reported to be consistently high in the saliva and relatively higher than found in the oropharynx during the early stages of infection.[8,9] Unfortunately, the patient cannot wear a mask during most dental treatments, so the potential to spread any virus intraorally is present.[9] This can be generated through normal exhalation and speaking.[10,11] Utilization of high-volume evacuation helps following the patient's removal of the mask or during actual treatment, so any aerosol generated is removed and not allowed to become suspended in the operatory's air.

## DECREASING IN-OFFICE VIRAL SPREAD IN THE OPERATORY

Recommendations regarding treatment room preparation for patient care have changed considering COVID-19 and its potential for aerosol transmission. Those recommendations have included the following:[12-15]

- *Disposable single-use plastic chair cover*—Aids in room cleanup following patient treatment as surfaces that may have had contact with aerosol generated during treatment is removed. Areas may be missed if the chair is simply wiped down after patients.
- *Full-coverage disposable gown by treatment personnel*—Prevents contaminated aerosol produced during treatment from contacting underlying clothing and transfer of potentially contaminated clothing outside the dental office.
- *Disposable bouffant head cover*—Prevents aerosol contact with the head and hair of the treatment personnel and limits prospect of transfer out of the dental office at the end of the day.
- *Disposable shoe covers*—Prevents aerosol contact with clinicians' shoes and potential transfer out of the dental office.
- *UV virus air filtration*—Potentially removes and inactivates any virus in the room's air, decreasing potential for infected aerosol spread. With all precautions, there is still some potential for aerosols generated during treatment to be in the operatory's air, circulating throughout the office.
- *Face mask*—Prevents inhalation of potentially infected aerosols and is to be worn by anyone in the dental office as per ADA and CDC guidelines.
- *Face shield*—Covers areas of the face that a mask or eye/safety glasses does not cover to protect from aerosol exposure.
- *High-volume evacuation*—Used during all treatment to evacuate aerosol produced during treatment and minimize spread of potentially infected aerosol throughout the room.[16]
- *Social distancing in the waiting area*—Patients contact the office prior to entering for their appointment (phone, text, or email). They are instructed when to enter the dental office only when the operatory is ready for them so they are not sitting in the waiting area, potentially spreading virus through contact with furniture or sitting within six feet from other patients.

- *Treating ultrasonic reservoirs and dental unit waterlines*—Used continuously, antimicrobial cleaners can reduce the amount of microbial transmission of aerosols generated by dental procedures and equipment.[17,18]
- *Hand-washing stations*—Placement of antiseptic gel at the front desk and in the waiting area for patients to use when entering the office and following treatment when they return to the front desk to check out.
- *Temperature check*—Verifies upon entering the office that patients or staff are not showing the symptom of a fever.[19]

Wearing masks, face shields, disposable uniforms, and coverings, along with high-volume evacuation, treating waterlines and ultrasonic reservoirs, washing hands, and social distancing in the waiting area all help to some degree in preventing transmission and infection in the dental environment, but no one action alone is sufficient to stop the spread of the disease. All the listed recommendations working together help reduce the risk of potential aerosol spread in the dental office. However, addition of an oral hygiene regimen, with patient oral rinsing prior to dental treatment, may further reduce but not necessarily eliminate the risk of infection and transmission. But managing viruses intraorally prior to the initiation of treatment should be considered to minimize or eliminate the infection potential of the aerosol produced. Human saliva may play a pivotal role in transmission of SARS-CoV-2.[20,21] Disinfecting the oral cavity and saliva may have a significant role in reducing transmission of the disease.

## ORAL PRETREATMENT RINSING

Recent evidence suggests a role of the oral cavity in the transmission and pathogenicity of SARS-CoV-2. Antiseptic mouth rinses may help in reducing the viral load in the oral cavity, thereby probably reducing risk of transmission through aerosol production during talking, breathing, and other actions.[22] SARS-CoV-2 spreads by coughing, sneezing, droplet inhalation, and contact with surfaces contaminated by aerosol. As outlined, sufficient evidence has been reported regarding the presence of SARS-CoV-2 in human saliva, making it a potential transmission route for COVID-19. Those in a dental practice—doctor, staff, and patients—have a risk of SARS-CoV-2 infection due to close contact with potential exposure to saliva-contaminated droplets and aerosols generated during dental procedures. In addition, saliva-contaminated surfaces could lead to potential cross-infection. Hence, the control of saliva-related transmission in the dental office is critical, especially during the pandemic period of COVID-19.[23] Community transmission of SARS-CoV-2 often occurs before symptom onset, and with the reported high percentage of asymptomatic carriers, potential for inadvertent aerosolization in the dental setting should be considered. In the absence of a system of contact tracing, it is not possible to know when someone becomes infected and by whom in the dental office or in social settings generally. In human infections, SARS-CoV-2 viral load rises slowly over multiple days and remains near the limit of detection of rapid, low-sensitivity tests.[24] It is therefore prudent to assume that each patient seen in the dental office may be potentially infected and asymptomatic and treat them accordingly.

Oral rinses are widely used solutions for microbial reduction, especially before oral and periodontal surgery and any aerosol-producing procedure.[25-27] Both the American Dental Association[28] and the Centers for Disease Control and Prevention[29] have recommended the use of preprocedural oral rinses prior to dental procedures. Utilization of a pretreatment antimicrobial oral rinse is generally believed to reduce the number of oral microbes, including viruses, present. A pretreatment oral rinse is recommended even when a rubber dam will be utilized, as there will be periods prior to dam placement and removal when the patient's breathing without a mask could potentially spread saliva containing the virus. Various oral rinses have been advocated for use as a pretreatment rinse. Yet, not all oral rinses are equally effective as antimicrobials, and some present additional issues with their use.

Dental personnel and patients may benefit from the routine use of preprocedural mouth rinses.[30] SARS-CoV-2 has shown that it is vulnerable to oxidation, so a pretreatment oral rinse containing oxidative agents such as 1% hydrogen peroxide or 0.2% povidone has been recommended for the purpose of reducing the salivary load of oral microbes, including potential SARS-CoV-2. It has been reported that some oral rinses, including those containing cetylpyridinium chloride, chlorine dioxide, and povidone-iodine, were able to decrease salivary load of the virus for up to six hours following use.[31] Yet, not all oral rinses have demonstrated to be effective antiviral agents, and some present with negatives that limit use in the office as a pretreatment rinse or by the patient in daily home care.

Furthermore, some reports confuse the human coronavirus (associated with the common cold) with its more infectious and deadly cousins. The reported evidence of the antiviral activity of products against human coronavirus (HCoV) 229E, severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome-related coronavirus (MERS-CoV), or other viruses may not be generalized to the antiviral activity against SARS-CoV-2.[32] Therefore, it is important to test a product against SARS-CoV-2 specifically. To date, such testing has been confined to biocontainment infectious disease laboratories, but clinical studies with infected humans are underway at several research universities.

## CETYLPYRIDINIUM CHLORIDE (CPC)

Cetylpyridinium chloride (CPC), a quaternary ammonium compound, is reported safe for use in humans.[33,34] Oral rinses with concentrations of 0.05% have been used to reduce dental plaque and gingivitis.[35,36] It has also been reported as an alternative rinse in those patients who develop mucosal irritation and stains related to chlorhexidine (CHX) for bacterial reduction.[37] The antiviral effects of cetylpyridinium chloride have been demonstrated to be effective in influenza patients, significantly reducing the severity and duration of related cough and sore throat.[38] Therefore, it has been hypothesized that it may be effective against SARS-CoV-2 based on its lysosomotropic action and its ability to destroy viral capsids.[39] These findings indicate that CPC could be effective

against other enveloped viruses such as coronaviruses.[39] Currently, the published literature has not reported any evidence confirming cetylpyridinium chloride has any effect on SARS-CoV-2, so its application as a pretreatment rinse prior to dental care may not have any effect on potential spread of the virus with aerosol production when the patient is unmasked during treatment.

## POVIDONE-IODINE

Studies have demonstrated that povidone-iodine has a higher virucidal activity than other commonly used antiseptic agents, including CHX and benzalkonium chloride.[40,41] There has been a reported prevalence of 0.4% allergy cases. Its effectiveness has been well demonstrated through many in vitro studies against multiple viruses, including SARS-CoV, MERS-CoV, and influenza virus A (H1N1).[40,42] Nasal and oral use with concentrations of 1%–5% are reported as effective at inactivating SARS-CoV-2 after 60-second exposure times.[43] Virucidal activity was present at concentrations as low as 0.5% with a contact time of 15 seconds.[44] Several negatives present with use of povidone-iodine as an oral rinse. There is potential for an allergic reaction in some patients who are sensitive to iodine. Additionally, the taste of povidone-iodine oral rinses, even at low concentrations, is objectionable to most patients and has the potential to stain composite resins being placed during the appointment.

## HYDROGEN PEROXIDE

Hydrogen peroxide found in a number of commercial oral rinses at concentrations of 1.5% and 3.0% is an odorless liquid. Lack of an adverse soft-tissue effect was found in many studies of 1%–1.5% concentrations used as a daily rinse over two years' follow-up.[45] Studies have reported that 3% concentration effectively inactivated adenovirus types 3 and 6, adeno-associated virus type 4, rhinoviruses 1A, 1B, and type 7, myxoviruses, influenza A and B, respiratory syncytial virus, strain long, and coronavirus strain 229E within 1–30 minutes, discovering that coronaviruses and influenza viruses were the most sensitive.[46] Since SARS-CoV-2 is vulnerable to oxidation, preprocedural mouth rinses containing oxidative agents such as 1% $H_2O_2$ have been suggested to reduce the salivary viral load.[28] Unfortunately, this recommendation does not appear to be supported in recent literature, as it was found to be minimally effective as a virucidal agent for SARS-CoV-2 after contact times as long as 30 seconds.[47-49]

## CHLORHEXIDINE (CHX)

Chlorhexidine is a broad-spectrum antiseptic that acts against gram-positive and gram-negative bacteria, aerobes, facultative anaerobes, and fungi by increasing bacterial cell wall permeability, causing lysis.[50] It has been used in dentistry to reduce dental plaque and treat periodontal disease.[51] Chlorhexidine has been shown to break up oral biofilm, allowing access to deeper bacteria being protected by the biofilm's structure.[52] Evidence indicates chlorhexidine has an in vitro effect against lipid-enveloped viruses such as influenza A, parainfluenza, herpes virus 1, cytomegalovirus, and hepatitis B.[53,54] However, chlorhexidine may not be effective for killing SARS-CoV-2.[21] Studies have shown that chlorhexidine is ineffective for inactivating some coronavirus subtypes, suggesting that it is also ineffective against SARS-CoV-2.[55] Although SARS-CoV-2 is an enveloped virus, chlorhexidine has been reported to have little or no effect against coronaviruses when compared with other mouth rinses.[56]

## CHLORINE DIOXIDE ($CLO_2$)

Chlorine dioxide (ClO2) acts as an oxidizing agent, reacting with several cellular constituents including the cell membrane of microbes. Oxidation of proteins and lipids in the cell membrane leads to the death of the organism. Stabilized chlorine dioxide (Cloralstan) has been reported in the literature to reduce both plaque and gingival indices and bacterial counts in the oral cavity similar to other routinely used oral rinses.[57] The solution has shown a high safety and efficacy with concentrations of up to 40 ppm in drinking water reported to not show any toxicity in subchronic oral toxicity tests.[58] A lack of cytotoxicity to human cells and selective toxicity to bacteria appears to be related to the cell membrane structure. Microbial cells are killed extremely fast, with kill times for bacteria in the order of seconds of contact time with chlorine dioxide. Thus, contact time is sufficient to kill all bacteria, but short enough to keep chlorine dioxide from penetrating into the living tissues of the patient, minimizing cytotoxic effects when applying it as an antiseptic such as an oral rinse. Most importantly, bacteria are not able to develop resistance against chlorine dioxide.[59] Stabilized chlorine dioxide oral rinse (ClōSYS Oral Rinse, Rowpar Pharmaceuticals Inc., Scottsdale, AZ) demonstrated 100% kill activity against periodontal pathogens and, in some cases, achieved a high kill at the one-minute mark.[60] ***Enterococcus faecalis***, a common oral inhabitant that is difficult to kill, has been linked with endodontic reinfection of previously treated canals, and has been reported to be inactivated with chlorine dioxide.[61] Another common bacterium associated with infection, both oral and systemic, is ***Escherichia coli***. Chlorine dioxide has been reported to kill this bacterium in wastewater as well as prior strains of SAR-CoV.[62] Chlorine dioxide is active against cytomegalovirus, polio virus, herpes I and II, HTLV-III, ***Candida albicans***, and Pseudomonas.[63] Variation in receptor binding may determine infectivity of a particular virus. Thus, what is effective against one type of virus, even other human coronaviruses, may not extrapolate to SARS-CoV-2. So, chlorine dioxide as an oral rinse has a broad range of microorganism cytotoxicity. With regard to SARS-CoV-2, chlorine dioxide as an oxidizing agent reacts to the virus capsid proteins, leading to destruction of the virus. Recently concluded studies reported that chlorine dioxide had a high effectiveness against SARS-CoV-2 when used as an oral rinse and can be effectively utilized prior to dental treatment to reduce or eliminate virus present in the saliva and oral cavity that may become aerosolized when the patient removes their mask to initiate treatment or during treatment. An in vitro study on a specific brand of chlorine dioxide-containing oral rinse reported that ClōSYS Ultra Sensitive rinse reduced SARS-CoV-2 by 98.4% in 30 seconds.[64] Similarly, in vitro study on mint-flavored

ClōSYS Sensitive rinse demonstrated reduction of 98.44% in 30 seconds.[65] An added benefit of chlorine dioxide in an oral rinse compared to other rinses that have been shown to be effective against SARS-CoV-2 is that it has no discernable flavor, so patient objections to its use as a pretreatment rinse or recommended daily rinse are overcome.

## HOME CARE WITH AN ANTIVIRAL DIRECTION

Saliva, as previously discussed, is a harbor for SARS-CoV-2. Evidence suggests a role of the oral cavity in the transmission and pathogenicity of SARS-CoV-2, and day-to-day consideration of this may play an important role in preventing casual spread of the virus. Routine daily use of antiseptic mouth rinses may help in decreasing the severity of COVID-19 and in reducing the risk of transmission through aerosol production during talking, breathing, and other actions via the oral cavity.[22] Additionally, most patients infected with COVID-19 had a viral shedding period of 30 days or less. As such, noninfectious viral nucleic acid may have accumulated in the uncleaned oral cavities and can continue to be detected. Thus, removal of such viral nucleic acid through toothbrushing and gargling may improve the accuracy of PCR testing.[66]

Patients with poor oral hygiene may be more susceptible to SARS-CoV-2 than patients performing good oral home care by harboring the virus in accumulated plaque (biofilm).[31] Those patients in turn may shed and transmit the virus longer, following recovery from the disease. In the case of asymptomatic carriers, they also have greater potential to spread the virus to those living with them or when encountering others outside the home if a mask is not worn. Therefore, use of an antiviral oral rinse—both in-office and at home—during the pandemic decreases potential aerosolization of the virus, and oral biofilm management has nonperiodontal implications with multiple systemic connections originating in the oral cavity.

A study reported examining the antibacterial properties of various oral rinses including sodium hypochlorite (NaOCl), chlorhexidine, Listerine, and chlorine dioxide on selected common oral pathogens and on oral biofilm. The results demonstrated that chlorine dioxide was more effective than other currently used oral rinses used as disinfectants with regard to aerobic bacteria and Candida yeast. Regarding anaerobes, chlorine dioxide's efficacy was found to be similar to chlorhexidine. The biofilm-dissolving effect of chlorine dioxide is significantly greater when compared to chlorhexidine and Listerine. It was concluded that chlorine dioxide is a potent disinfectant with high efficacy on oral pathogenic microorganisms and a powerful biofilm-dissolving effect compared to the current antiseptic oral rinses.[67] As discussed, not all oral rinses recommended for routine use to manage oral biofilm and microbes that cause or contribute to periodontal disease have an effect on SARS-CoV-2. Cetylpyridinium chloride, hydrogen peroxide, and chlorhexidine have not demonstrated in the literature any effect on SARS-CoV-2 and are negligible as an antivirus oral rinse during the pandemic. Povidone-iodine is effective against SARS-CoV-2, but its strong taste is objectionable to most patients, and compliance as a daily rinse would be very low, making it procedurally ineffective.

Chlorine dioxide has an effective antiplaque action as well as oral bacterial load reduction that have been found to be comparable to chlorhexidine.[68] No significant difference has been reported between chlorine dioxide and chlorhexidine with respect to mean reduction in plaque and gingival scores.[69]

Chlorhexidine has been reported to affect gingival fibroblasts, periodontal ligament cells, and osteoblast cells.[70] Patient daily use may have a negative effect on healing following nonsurgical and surgical periodontal treatment. On the other hand, chlorine dioxide has no reported effect on those cells, and no negative effects have been reported with its use as an oral rinse or daily home use.[71] Additionally, chlorine dioxide has the added benefit of having been proven to be effective against SARS-CoV-2 as well as an oxidizing agent against other commonly found microbes in the oral environment. Its anti-SARS-CoV-2 activity is reported to be over a 97.4% virus kill rate while being able to break down oral biofilm. This has shown promise in treating exposed threads on titanium implants comparable with povidone-iodine but with added SARS-CoV-2 action.[72]

Malodor (bad breath) is a frequent patient complaint, leading them to ask for advice from the hygienist or dentist. Chlorine dioxide-containing unflavored mouthwash, as an adjunct to brushing with toothpaste, demonstrates a clinically relevant reduction in oral malodor after three weeks of twice-daily use.[73] Use of a chlorine dioxide-containing mouthrinse significantly decreases mouth odor, and it reduces volatile sulfur compound concentrations in exhaled air for at least eight hours after use.[74] Chlorhexidine was found to have no reduction of malodor. Additionally, a frequent patient complaint with chlorhexidine daily rinsing has been staining of plaque not removed with toothbrushing, and there is potential for staining of less-than-ideal restoration margins.[75]

The key to patients' daily use and compliance of any recommended oral rinse is taste. Chlorine dioxide has no taste and is available as a flavor-free oral rinse or mint flavored, which will overcome patient objections to taste that they may have experienced with other oral rinses. To maximize effectiveness with chlorine dioxide as a daily oral rinse for home care, the patient should use it twice daily immediately following toothbrushing. Swishing for 30 seconds or longer and gargling are recommended for distribution of the oral rinse throughout the oral cavity. The author recommends that prior to spitting out the rinse, the patient use a toothbrush to brush the rinse over all the teeth. This will distribute the chlorine dioxide into areas (between the teeth, into the gingival sulcus, over the tongue, and into the throat) that rinsing alone may not effectively reach.[76] Removable appliances such as partial or complete dentures as well as clear aligners and mouthguards can accumulate oral biofilm that may possibly contain SARS-CoV-2 virus from the oral cavity. Immersing the appliance in chlorine dioxide when not in the mouth will aid in dissolution of the attached biofilm and inactivate any viruses as well as bacteria that may be present. This will aid in eliminating respiratory issues that may occur with aspiration of biofilm

when the appliance is worn.

Utilization of a chlorine dioxide oral spray may be a good preventive during the day when oral rinsing is not practical, and it is easy for the patient to accomplish. A recent in vitro study reported a 99.90% reduction in SARS-CoV-2 in 30 seconds of contact with ClōSYS Oral Spray.[64]

## CONCLUSION

The COVID-19 pandemic has changed life due to the spread of SARS-CoV-2 through aerosols, with a high rate of infection and mortality. Using masks outside the home may limit potential spread due to asymptomatic carriers and inhalation of aerosols containing the virus. But dental treatments require patients to remove their masks to allow clinicians access to the oral cavity, and patients' breathing and talking without a mask can spread the virus from infected saliva to the operatory's air, and then throughout the office. High-volume evacuation helps with aerosols produced when the dental handpiece or ultrasonic/piezo is utilized, but it may not be completely effective; nor may the use of dental unit waterline cleaners and ultrasonic reservoir treatments. Use of a pretreatment rinse with an agent that has proven effective against SARS-CoV-2 as soon as the patient removes their mask supplements other methods implemented in the office to eliminate potentially infected aerosol. Chlorine dioxide has been shown in the literature to be effective against SARS-CoV-2 as well as other microbes, while dissolving oral biofilm without the negatives associated with other oral rinses. Its benefits with daily use include improved periodontal health without hampering tissue cells and their regenerative qualities as reported with chlorhexidine use. The absence of taste in unflavored chlorine dioxide rinses overcomes patient objections to taste, thus improving patient compliance for daily home care. The COVID-19 pandemic has generated a new world of practices in the office and at home that may improve the health and safety of patients and professionals alike.

## REFERENCES


1. 30 percent of people with COVID-19 show no symptoms: Here's where they carry it. Hartford HealthCare. November 23, 2020. https://hartfordhealthcare.org/about-us/news-press/news-detail?articleid=29806&publicId=395#:~:text=He%20said%20roughly%2040%20percent,testing%20positive%20for%20the%20virus
2. Fernandez J. COVID-19 roundup: New estimate of asymptomatic carriers; use of face coverings varies; and update on lingering symptoms. Baptist Health South Florida. July 17, 2020. https://baptisthealth.net/baptist-health-news/covid-19-roundup-new-estimate-of-asymptomatic-carriers-use-of-face-coverings-varies-and-update-on-lingering-symptoms/
3. Hu P, Jansen JO, Uhlich R, et al. Early comprehensive testing for COVID-19 is essential to protect trauma centers. *J Trauma Acute Care Surg.* 2020 Oct;89(4):698-702. doi:10.1097/TA.0000000000002870
4. McCrimmon KK. The truth about COVID-19 and asymptomatic spread: It's common, so wear a mask and avoid large gatherings. UCHealth Today. November 5, 2020. https://www.uchealth.org/today/the-truth-about-asymptomatic-spread-of-covid-19/#:~:text=Studies%20show%20that%20at%20least,fall%20spikes%20of%20COVID%2D19.&text=A%20recent%20study%20found%20that,for%20COVID%2D19%20were%20asymptomatic
5. Han D, Li R, Han Y, et al. COVID-19: Insight into the asymptomatic SARS-CoV-2 infection and transmission. *Int J Biol Sci.* 2020 Aug 27;16(15):2803-2811. doi:10.7150/ijbs.48991.
6. Teherán AA, Camero Ramos G, Prado de la Guardia R, et al. Epidemiological characterisation of asymptomatic carriers of COVID-19 in Colombia: a cross-sectional study. *BMJ Open.* 2020 Dec 7;10(12):e042122. doi:10.1136/bmjopen-2020-042122
7. Gao X, Chen W, Guo L, et al. [Asymptomatic infection of COVID-19 and its challenge to epidemic prevention and control]. *Zhonghua Liu Xing Bing Xue Za Zhi.* 2020 Dec 10;41(12):1985-1988. Chinese. doi:10.3760/cma.j.cn112338-20200427-00659
8. Yoon JG, Yoon J, Song JY, et al. Clinical significance of a high SARS-CoV-2 viral load in the saliva. *J Korean Med Sci.* 2020 May 25;35(20):e195. doi:10.3346/jkms.2020.35.e195
9. Hamedani S, Farshidfar N, Ziaei A, Pakravan H. The dilemma of COVID-19 in dental practice concerning the role of saliva in transmission: A brief review of current evidence. *Eur Oral Res.* 2020 May 1;54(2):92-100. doi:10.26650/eor.20200050
10. Lu CW, Liu XF, Jia ZF. 2019-nCoV transmission through the ocular surface must not be ignored. *Lancet.* 2020 Feb 22;395(10224):e39. doi:10.1016/S0140-6736(20)30313-5
11. Tang J, Li Y, Lu Q, et al. Risk factors and prevention strategies for the occupational exposure of medical staff during the coronavirus disease-19 pandemic (Review). *Exp Ther Med.* 2021 Feb;21(2):176. doi:10.3892/etm.2020.9607
12. Turkistani KA, Turkistani KA. Dental risks and precautions during COVID-19 pandemic: A systematic review. *J Int Soc Prev Community Dent.* 2020 Aug 21;10(5):540-548. doi:10.4103/jispcd.JISPCD_295_20
13. Bizzoca ME, Campisi G, Muzio LL. Covid-19 pandemic: What changes for dentists and oral medicine experts? A narrative review and novel approaches to infection containment. *Int J Environ Res Public Health.* 2020 May 27;17(11):3793. doi:10.3390/ijerph17113793
14. Amato A, Caggiano M, Amato M, et al. Infection control in dental practice during the COVID-19 pandemic. *Int J Environ Res Public Health.* 2020 Jul 2;17(13):4769. doi:10.3390/ijerph17134769.
15. Villani FA, Aiuto R, Paglia L, Re D. COVID-19 and dentistry: Prevention in dental practice, a literature review. *Int J Environ Res Public Health.* 2020 Jun 26;17(12):4609. doi:10.3390/ijerph17124609
16. Sabino-Silva R, Jardim ACG, Siqueira WL. Coronavirus COVID-19 impacts to dentistry and potential salivary diagnosis. *Clin Oral Investig.* 2020 Apr;24(4):1619-1621. doi:10.1007/s00784-020-03248-x
17. Wirthlin MR, Marshall GW. Evaluation of ultrasonic scaling unit waterline contamination after use of chlorine dioxide mouthrinse lavage. *J Perio.* 2001 Mar 72(3);401-410. https://doi.org/10.1902/jop.2001.72.3.401
18. Saini R. Efficacy of preprocedural mouth rinse containing chlorine dioxide in reduction of viable bacterial count in dental aerosols during ultrasonic scaling: A double-blind, placebo-controlled clinical trial. Dental Hypotheses. 2015;6(2):65–71. doi:10.4103/2155-8213.15847
19. Mahdi SS, Ahmed Z, Allana R, et al. Pivoting dental practice management during the COVID-19 pandemic–A systematic review. *Medicina (Kaunas).* 2020 Nov 25;56(12):644. doi:10.3390/medicina56120644

20. Xu J, Li Y, Gan F, et al. Salivary glands: Potential reservoirs for COVID-19 asymptomatic infection. *J Dent Res.* 2020 Jul;99(8):989. doi:10.1177/0022034520918518
21. Peng X, Xu X, Li Y, et al. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci.* 2020 Mar 3;12(1):9. doi:10.1038/s41368-020-0075-9
22. Herrera D, Serrano J, Roldán S, Sanz M. Is the oral cavity relevant in SARS-CoV-2 pandemic? *Clin Oral Investig.* 2020 Aug;24(8):2925-2930. doi:10.1007/s00784-020-03413-2
23. Li Y, Ren B, Peng X, et al. Saliva is a non-negligible factor in the spread of COVID-19. *Mol Oral Microbiol.* 2020 Aug;35(4):141-145. doi:10.1111/omi.12289
24. Winnett A, Cooper MM, Shelby N, et al. SARS-CoV-2 viral load in saliva rises gradually and to moderate levels in some humans. medRxiv [Preprint]. 2020 Dec 11:2020.12.09.20239467. doi:10.1101/2020.12.09.20239467
25. Kosutic D, Uglesic V, Perkovic D, et al. Preoperative antiseptics in clean/contaminated maxillofacial and oral surgery: Prospective randomized study. *Int J Oral Maxillofac Surg.* 2009 Feb;38(2):160-5. doi:10.1016/j.ijom.2008.11.023
26. Dominiak M, Shuleva S, Silvestros S, Alcoforado G. A prospective observational study on perioperative use of antibacterial agents in implant surgery. *Adv Clin Exp Med.* 2020 Mar;29(3):355-363. doi:10.17219/acem/115087
27. Marui VC, Souto MLS, Rovai ES, et al. Efficacy of preprocedural mouth rinses in the reduction of microorganisms in aerosol: A systematic review. *J Am Dent Assoc.* 2019 Dec;150(12):1015-1026.e1. doi:10.1016/j.adaj.2019.06.024
28. ADA interim guidance for minimizing risk of COVID-19 transmission. Kavo Dental Excellence. May 1, 2020. https://www.kavo.com/en-us/resource-center/ada-interim-guidance-minimizing-risk-covid-19-transmission
29. Guidance for dental settings. Centers for Disease Control and Prevention. Updated December 4, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html
30. Reis INR, do Amaral GCLS, Mendoza AAH, et al. Can preprocedural mouth rinses reduce SARS-CoV-2 load in dental aerosols? *Med Hypotheses.* 2021 Jan;146:110436. doi:10.1016/j.mehy.2020.110436.
31. Seneviratne CJ, Balan P, Ko KKK, et al. Efficacy of commercial mouth-rinses on SARS-CoV-2 viral load in saliva: Randomized control trial in Singapore. *Infection.* 2020 Dec 14:1–7. doi:10.1007/s15010-020-01563-9
32. Shewale JG, Ratcliff JL. Overinterpretation of the antiviral results for human coronavirus strain 229E (HCoV-229E) relative to severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). *J Med Virol.* 2021;1-3. https://onlinelibrary.wiley.com/doi/epdf/10.1002/jmv.26722
33. Mukherjee PK, Esper F, Buchheit K, et al. Randomized, double-blind, placebo-controlled clinical trial to assess the safety and effectiveness of a novel dual-action oral topical formulation against upper respiratory infections. *BMC Infect Dis.* 2017 Jan 14;17(1):74. doi:10.1186/s12879-016-2177-8
34. Gerba CP. Quaternary ammonium biocides: Efficacy in application. *Appl Environ Microbiol.* 2015 Jan;81(2):464-9. doi:10.1128/AEM.02633-14
35. Latimer J, Munday JL, Buzza KM, et al. Antibacterial and anti-biofilm activity of mouth rinses containing cetylpyridinium chloride and sodium fluoride. *BMC Microbiol.* 2015 Aug 21;15:169. doi:10.1186/s12866-015-0501-x
36. Langa GPJ, Muniz FWMG, Costa RDSA, et al. The effect of cetylpyridinium chloride mouthrinse as adjunct to toothbrushing compared to placebo on interproximal plaque and gingival inflammation–A systematic review with meta-analyses. *Clin Oral Investig.* 2021 Feb;25(2):745-757. doi:10.1007/s00784-020-03661-2
37. Feres M, Figueiredo LC, Faveri M, et al. The effectiveness of a preprocedural mouthrinse containing cetylpyridinium chloride in reducing bacteria in the dental office. *J Am Dent Assoc.* 2010 Apr;141(4):415-22. doi:10.14219/jada.archive.2010.0193
38. Popkin DL, Zilka S, Dimaano M, et al. Cetylpyridinium chloride (CPC) exhibits potent, rapid activity against influenza viruses *in vitro* and *in vivo*. *Pathog Immun.* 2017;2(2):252-269. doi:10.20411/pai.v2i2.200
39. Baker N, Williams AJ, Tropsha A, Ekins S. Repurposing quaternary ammonium compounds as potential treatments for COVID-19. *Pharm Res.* 2020 May 25;37(6):104. doi:10.1007/s11095-020-02842-8
40. Kariwa H, Fujii N, Takashima I. Inactivation of SARS coronavirus by means of povidone-iodine, physical conditions and chemical reagents. *Dermatology.* 2006;212 Suppl 1(Suppl 1):119-23. doi:10.1159/000089211
41. Lachapelle JM. Allergic contact dermatitis from povidone-iodine: A re-evaluation study. *Contact Dermatitis.* 2005 Jan;52(1):9-10. doi:10.1111/j.0105-1873.2005.00479.x
42. Parhar HS, Tasche K, Brody RM, et al. Topical preparations to reduce SARS-CoV-2 aerosolization in head and neck mucosal surgery. *Head Neck.* 2020 Jun;42(6):1268-1272. doi:10.1002/hed.26200
43. Pelletier JS, Tessema B, Frank S, et al. Efficacy of povidone-iodine nasal and oral antiseptic preparations against severe acute respiratory syndrome–coronavirus 2 (SARS-CoV-2). *Ear Nose Throat J.* 2020 Sep 21:145561320957237. doi:10.1177/0145561320957237. Erratum in: *Ear Nose Throat J.* 2020 Dec 8;145561320977784
44. Bidra AS, Pelletier JS, Westover JB, et al. Rapid in-vitro inactivation of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using povidone-iodine oral antiseptic rinse. *J Prosthodont.* 2020 Jul;29(6):529-533. doi:10.1111/jopr.13209
45. Muniz FWMG, Cavagni J, Langa GPJ, et al. A systematic review of the effect of oral rinsing with $H_2O_2$ on clinical and microbiological parameters related to plaque, gingivitis, and microbes. *Int J Dent.* 2020 Oct 31;2020:8841722. doi:10.1155/2020/8841722
46. Mentel' R, Shirrmakher R, Kevich A, et al. Inaktivatsiia virusov perekis'iu vodoroda [Virus inactivation by hydrogen peroxide]. *Vopr Virusol.* 1977 Nov-Dec;(6):731-3. Russian
47. Bidra AS, Pelletier JS, Westover JB, et al. Comparison of in vitro inactivation of SARS CoV-2 with hydrogen peroxide and povidone-iodine oral antiseptic rinses. *J Prosthodont.* 2020 Aug;29(7):599-603. doi:10.1111/jopr.13220
48. Gottsauner MJ, Michaelides I, Schmidt B, et al. A prospective clinical pilot study on the effects of a hydrogen peroxide mouthrinse on the intraoral viral load of SARS-CoV-2. *Clin Oral Investig.* 2020 Oct;24(10):3707-3713. doi:10.1007/s00784-020-03549-1
49. Davies K, Buczkowski H, Welch SR, et al. Effective *in-vitro* inactivation of SARS-CoV-2 by commercially available mouthwashes. 2020 BioRxiv. https://doi.org/10.1101/2020.12.02.408047
50. Milstone AM, Passaretti CL, Perl TM. Chlorhexidine: Expanding the armamentarium for infection control and prevention. *Clin Infect Dis.* 2008 Jan 15;46(2):274-81. doi:10.1086/524736
51. da Costa LFNP, Amaral CDSF, Barbirato DDS, et al. Chlorhexidine

mouthwash as an adjunct to mechanical therapy in chronic periodontitis: A meta-analysis. *J Am Dent Assoc.* 2017 May;148(5):308-318. doi:10.1016/j.adaj.2017.01.021

52. Vitkov L, Hermann A, Krautgartner WD, et al. Chlorhexidine-induced ultrastructural alterations in oral biofilm. *Microsc Res Tech.* 2005 Oct;68(2):85-9. doi:10.1002/jemt.20238
53. Brookes ZLS, Bescos R, Belfield LA, et al. Current uses of chlorhexidine for management of oral disease: A narrative review. *J Dent.* 2020 Dec;103:103497. doi:10.1016/j.jdent.2020.103497
54. Bernstein D, Schiff G, Echler G, et al. In vitro virucidal effectiveness of a 0.12%-chlorhexidine gluconate mouthrinse. *J Dent Res.* 1990 Mar;69(3):874-6. doi:10.1177/00220345900690030901
55. Assis MS, Araújo RAAM, Lopes AMM. Safety alert for hospital environments and health professional: Chlorhexidine is ineffective for coronavirus. *Rev Assoc Med Bras (1992).* 2020 Sep 21;66Suppl 2(Suppl 2):124-129. doi:10.1590/1806-9282.66.S2.124
56. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J Hosp Infect.* 2020 Mar;104(3):246-251. doi:10.1016/j.jhin.2020.01.022. Erratum in: *J Hosp Infect.* 2020 Jun 17.
57. Kerémi B, Márta K, Farkas K, et al. Effects of chlorine dioxide on oral hygiene–A systematic review and meta-analysis. *Curr Pharm Des.* 2020;26(25):3015-3025. doi:10.2174/1381612826666200515134450
58. Ma JW, Huang BS, Hsu CW, et al. Efficacy and safety evaluation of a chlorine dioxide solution. *Int J Environ Res Public Health.* 2017 Mar 22;14(3):329. doi:10.3390/ijerph14030329
59. Noszticzius Z, Wittmann M, Kály-Kullai K, et al. Chlorine dioxide is a size-selective antimicrobial agent. *PLoS One.* 2013 Nov 5;8(11):e79157. doi:10.1371/journal.pone.0079157
60. Drake D, Villhauer AL. An in vitro comparative study determining bactericidal activity of stabilized chlorine dioxide and other oral rinses. *J Clin Dent.* 2011;22(1):1-5.
61. Herczegh A, Ghidan A, Friedreich D, et al. Effectiveness of a high purity chlorine dioxide solution in eliminating intracanal Enterococcus faecalis biofilm. *Acta Microbiol Immunol Hung.* 2013 Mar;60(1):63-75. doi:10.1556/AMicr.60.2013.1.7
62. Wang XW, Li JS, Jin M, et al. Study on the resistance of severe acute respiratory syndrome-associated coronavirus. *J Virol Methods.* 2005 Jun;126(1-2):171-7. doi:10.1016/j.jviromet.2005.02.005
63. Young RO. Chlorine dioxide ($CLO_2$) as a non-toxic antimicrobial agent for virus, bacteria and yeast (Candida Albicans). *Int J Vaccines Vaccin.* 2016;2(6):00052
64. Shewale J. Assessment of mouthrinse against SARS-CoV-2. November 3, 2020. MRIGlobal. https://cdn.shopify.com/s/files/1/0239/7795/1296/files/CloSYS_COVID-19_Final_Report_2020_MRIGlobal.pdf?v=1598652807
65. Shewale J. Assessment of ClōSYS Sensitive rinse (ClōSYS GentleMint flavored rinse) against SARS-CoV-2. MRIGlobal. https://cdn.shopify.com/s/files/1/0239/7795/1296/files/CloSYS-Sensitive-COVID-Final-Report-MRIGlobal.pdf?v=1605035093
66. Warabi Y, Tobisawa S, Kawazoe T, et al. Effects of oral care on prolonged viral shedding in coronavirus disease 2019 (COVID-19). *Spec Care Dentist.* 2020 Sep;40(5):470-474. doi:10.1111/scd.12498
67. Herczegh A, Gyurkovics M, Agababyan H, et al. Comparing the efficacy of hyper-pure chlorine-dioxide with other oral antiseptics on oral pathogen microorganisms and biofilm in vitro. *Acta Microbiol Immunol Hung.* 2013 Sep;60(3):359-73. doi:10.1556/AMicr.60.2013.3.10
68. Yadav SR, Kini VV, Padhye A. Inhibition of tongue coat and dental plaque formation by stabilized chlorine dioxide vs chlorhexidine mouthrinse: A randomized, triple blinded study. *J Clin Diagn Res.* 2015 Sep;9(9):ZC69-74. doi:10.7860/JCDR/2015/14587.6510
69. Yeturu SK, Acharya S, Urala AS, Pentapati KC. Effect of aloe vera, chlorine dioxide, and chlorhexidine mouth rinses on plaque and gingivitis: A randomized controlled trial. *J Oral Biol Craniofac Res.* 2016 Jan-Apr;6(1):54-8. doi:10.1016/j.jobcr.2015.08.008
70. Wirthlin MR, Ahn BJ, Enriquez B, Hussain MZ. Effects of stabilized chlorine dioxide and chlorhexidine mouth rinses in vitro on cells involved in periodontal healing. *J West Soc Periodontol Periodontal Abstr.* 2006;54(3):67-71.
71. Coelho AS, Laranjo M, Gonçalves AC, et al. Cytotoxic effects of a chlorhexidine mouthwash and of an enzymatic mouthwash on human gingival fibroblasts. *Odontology.* 2020 Apr;108(2):260-270. doi:10.1007/s10266-019-00465-z
72. Venkei A, Eördegh G, Turzó K, et al. A simplified in vitro model for investigation of the antimicrobial efficacy of various antiseptic agents to prevent peri-implantitis. *Acta Microbiol Immunol Hung.* 2020 Mar 9;67(2):127-132. doi:10.1556/030.2020.01080
73. Lee SS, Suprono MS, Stephens J, et al. Efficacy of stabilized chlorine dioxide-based unflavored mouthwash in reducing oral malodor: An 8-week randomized controlled study. *Am J Dent.* 2018 Dec;31(6):309-312.
74. Frascella J, Gilbert RD, Fernandez P, Hendler J. Efficacy of a chlorine dioxide-containing mouthrinse in oral malodor. *Compend Contin Educ Dent.* 2000 Mar;21(3):241-4, 246, 248 passim; quiz 256.
75. Tartaglia GM, Tadakamadla SK, Connelly ST, et al. Adverse events associated with home use of mouth rinses: A systematic review. *Ther Adv Drug Saf.* 2019 Sep 23;10:2042098619854881. doi:10.1177/2042098619854881
76. Tsai CL, Wu PC. Possible beneficial role of throat gargling in the coronavirus disease. *Public Health*. 2020 Aug 185:45-46. doi:10.1016/j.puhe.2020.05.055.

**GREGORI M. KURTZMAN, DDS, MAGD, FACD, FPFA, DADIA, DICOI, DIDIA,** is in private general dental practice in Silver Spring, Maryland, and is a former assistant clinical professor at University of Maryland in the departments of restorative dentistry and endodontics. He is a former American Academy of Implant Dentistry (AAID) Implant Maxi-Course assistant program director at Howard University College of Dentistry. Dr. Kurtzman has lectured internationally on the topics of restorative dentistry, endodontics and implant surgery and prosthetics, removable and fixed prosthetics, and periodontics. He has more than 750 published articles as well as several e-books and textbook chapters. He has earned fellowship in the Academy of General Dentistry (AGD), American College of Dentists (ACD), International Congress of Oral Implantology (ICOI), Pierre Fauchard Academy, Academy of Dentistry International (ADI); mastership in the AGD and ICOI; and diplomate status in the ICOI, American Dental Implant Association (ADIA), and International Dental Implant Association (IDIA). He is also a consultant and evaluator for multiple dental companies. Dr. Kurtzman has been included in the "Top Leaders in Continuing Education" by *Dentistry Today* annually since 2006 and was featured on their June 2012 cover. He can be reached at dr_kurtzman@maryland-implants.com.

QUICK ACCESS CODE 21009

## ONLINE COMPLETION

Take this test online for immediate credit. Visit **dentalacademyofce.com** and sign in. If you have not previously purchased the course, select it from the "Online Courses" listings and complete your purchase. The exam will then be added to your "Archives" page, where a "Take Exam" link will be provided. Click on this link, complete all questions, and submit your answers. An immediate grade report will be generated. If you receive a score of 70% or higher, your verification form will be provided immediately for viewing and printing. View and print forms at any time by visiting the site and returning to your "Archives."

## QUESTIONS

**1. SARS-CoV-2 is primarily spread through:**
A. Breathing
B. Touching
C. Coughing
D. A and C

**2. Aerosol transmission of the virus causes infection primarily through:**
A. Mouth
B. Nose
C. Eyes
D. All of the above

**3. Evidence indicates that the percentage of asymptomatic carriers is between:**
A. 40 and 60%
B. 30 and 50%
C. 20 and 40%
D. 10 and 30%

**4. The potential for asymptomatic transmission is decreased by:**
A. Wearing a mask in public
B. Covering your mouth with your hand when talking
C. Covering your mouth with your hand when coughing
D. Covering your mouth with your hand when sneezing

**5. Increases in infection observed are due to:**
A. Refusal to wear masks in public
B. Not social distancing
C. Ignoring CDC and other authorities' pandemic guidelines
D. All of he above

**6. Once the patient's mask is removed prior to initiating treatment:**
A. Aerosol is produced as they breathe and talk
B. Aerosol is not a concern until treatment is initiated
C. The patient should be asked to cover their mouth when talking
D. The patient should be asked not to talk until the mask is replaced following treatment

**7. Extraoral evacuation is recommended for all of the following except:**
A. Aerosol produced by a high-speed handpiece
B. Aerosol produced by ultrasonics/piezo with its water spray
C. Aerosol that may be produced during surgical procedures
D. When talking to the patient prior to treatment initiation

**8. Viral load related to COVID-19 has been reported during the early stages of infection to be consistently higher in the:**
A. Nose
B. Saliva
C. Oropharynx
D. Skin

**9. Disposable chair covers:**
A. Aid in room cleaning
B. Have no effect on aerosol in the operatory
C. Limit contact of aerosol to hard-to-clean areas that can spread the virus to subsequent patients
D. A and C

**10. Full coverage disposable gowns:**
A. Limit contact of aerosol with underlying clothing
B. Are equal to surgical scrubs regarding virus contact spread to the wearer
C. Have not been found adequate with regard to SARS-CoV-2
D. Can be wiped down between patients if contact with blood occurs

**11. Improvement in operatory air quality can be achieved with:**
A. Spraying disinfectant in the air prior to seating the patient
B. Wiping down all surfaces between patients with a disinfectant
C. Use of masks by the dental personal in the operatory
D. UV air filtration unit in the operatory

**12. Antiseptic mouth rinses may help in:**
A. Decreasing infected aerosol production
B. Improving the patient's malodor
C. Masking taste from the dental materials to be used
D. Making the patient feel more comfortable

**13. Infected aerosol from SARS-CoV-2 may cause spread by:**
A. Coughing
B. Talking
C. Contact with infected aerosol on surfaces
D. All of the above

**14. Community transmission of SARS-CoV-2 often occurs:**
A. Before symptom onset
B. Following onset of symptoms
C. Only after a positive COVID test
D. Is unavoidable

**15. Patients infected with COVID-19 have a viral shedding period of:**
A. 7 days
B. 14 days
C. 30 days
D. 45 days

QUICK ACCESS CODE 21009

## ONLINE COMPLETION

Take this test online for immediate credit. Visit **dentalacademyofce.com** and sign in. If you have not previously purchased the course, select it from the "Online Courses" listings and complete your purchase. The exam will then be added to your "Archives" page, where a "Take Exam" link will be provided. Click on this link, complete all questions, and submit your answers. An immediate grade report will be generated. If you receive a score of 70% or higher, your verification form will be provided immediately for viewing and printing. View and print forms at any time by visiting the site and returning to your "Archives."

## QUESTIONS

**16. Oral rinses are widely used solutions before oral and periodontal surgery for the purpose of:**

A. Microbial reduction
B. Oral biofilm reduction
C. Lowering aerosol infection potential
D. All of the above

**17. Cetylpyridinium chloride has been advocated as an alternative to:**

A. Chlorhexidine for bacterial reduction
B. Listerine for malodor reduction
C. Hydrogen peroxide for whitening
D. Povidone-iodine for SARS-CoV-2 reduction

**18. The antiviral effects of cetylpyridinium chloride have been demonstrated to be effective against all except:**

A. Influenza
B. Virus associated with the common cold
C. Virus associated with sore throats
D. SARS-CoV-2

**19. Povidone-iodine virucidal ability is:**

A. Equal to chlorhexidine
B. Less than chlorhexidine
C. Greater than chlorhexidine
D. Equal to benzalkonium chloride

**20. Povidone-iodine has been shown to be effective against which of the following viruses?**

A. MERS-CoV
B. Influenza virus A (H1N1)
C. SARS-CoV
D. All of the above

**21. The negatives to the use of povidone-iodine as a rinse include all except:**

A. Taste
B. Discoloration of composites being placed
C. Potential allergic reactions
D. Ineffective against SARS-CoV-2

**22. Hydrogen peroxide as an oral rinse is not effective against which of the following viruses?**

A. Rhinoviruses
B. Influenza viruses
C. Coronavirus strain 229E
D. SARS-CoV-2

**23. Chlorhexidine is recommended as an oral rinse for all the following benefits except:**

A. Broad spectrum antibacterial
B. SARS-CoV-2 killer
C. Fungicide
D. Plaque reduction

**24. Chlorhexidine has been reported to affect all of the following except:**

A. Gingival fibroblasts
B. Periodontal ligament cells
C. Osteoclast cells
D. Osteoblast cells

**25. Chlorine dioxide is:**

A. An oxidizing agent
B. A reduction agent
C. A cell coating agent
D. A binding agent

**26. Which of the following statements is false? As an alternative to chlorhexidine, chlorine dioxide:**

A. Is equal to chlorhexidine in plaque reduction
B. Is less effective against SARS-CoV-2 killing
C. Has no effects on tissue cells such as fibroblasts
D. Is equal in gingival scores

**27. Which is not true of chlorine dioxide?**

A. Reduces malodor
B. Potent antimicrobial
C. Has no taste
D. May cause tissue irritation

**28. Utilization of a chlorine dioxide nasal spray has been shown to:**

A. Increase virus kill during the day between oral rinsing
B. Be an effective alternative to pretreatment oral rinsing
C. Eliminate the need for use of masks
D. Replace the need for oral home care rinsing

**29. Use of chlorine dioxide oral rinse as part of daily home care has shown to decrease SARS-CoV-2 presence in the saliva by more than:**

A. 92%
B. 94%
C. 96%
D. 98%

**30. Which of the following has been effective against SARS-CoV-2 as an oral rinse as demonstrated in the literature?**

A. Cetylpyridinium chloride
B. Hydrogen peroxide
C. Chlorhexidine
D. Chlorine dioxide

| | |
|---|---|
| PUBLICATION DATE: | MARCH 2021 |
| EXPIRATION DATE: | FEBRUARY 2024 |

ANSWER SHEET

# Oral hygiene:
# Office and home care during the COVID-19 pandemic

Name: Title: Specialty:

Address: Email: AGD member ID (if applies):

City: State: ZIP: Country:

Telephone: Primary ( ) Office ( )

**Requirements for obtaining CE credits by mail/fax:** 1) Read entire course. 2) Complete info above. 3) Complete test by marking one answer per question. 4) Complete course evaluation. 5) Complete credit card info or write check payable to Endeavor Business Media. 6) Mail/fax this page to DACE. A score of 70% is required for CE credit. **For questions, call (800) 633-1681. Course may also be completed at dentalacademyofce.com.**

## EDUCATIONAL OBJECTIVES

1. Incorporate basic practices to limit or prevent COVID-19 spread in the dental practice
2. Minimize the potential of asymptomatic carriers to spread the virus in the dental practice
3. Describe available mouth rinses and their effectiveness against COVID-19
4. Limit potential spread of the virus to those one may encounter when unable to wear a mask, such as fellow home residents, and aid in improving periodontal health in general through incorporation of antiviral oral rinses in home care

## COURSE EVALUATION

1. Were the individual course objectives met?

Objective #1: Yes No Objective #2: Yes No

Objective #3: Yes No Objective #4: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

| | | | | | | |
|---|---|---|---|---|---|---|
| 2. To what extent were the course objectives accomplished overall? | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Please rate your personal mastery of the course objectives. | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. How would you rate the objectives and educational methods? | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. How do you rate the author's grasp of the topic? | 5 | 4 | 3 | 2 | 1 | 0 |
| 6. Please rate the instructor's effectiveness. | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Was the overall administration of the course effective? | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Please rate the usefulness and clinical applicability of this course. | 5 | 4 | 3 | 2 | 1 | 0 |
| 9. Please rate the usefulness of the supplemental webliography. | 5 | 4 | 3 | 2 | 1 | 0 |

10. Do you feel that the references were adequate? Yes No

11. Would you participate in a similar program on a different topic? Yes No

12. If any of the continuing education questions were unclear or ambiguous, please list them.

_____

13. Was there any subject matter you found confusing? Please describe.

_____

14. How long did it take you to complete this course?

_____

15. What additional continuing dental education topics would you like to see?

_____

Mail/fax completed answer sheet to:

**Endeavor Business Media**
Attn: Dental division
7666 E. 61st St. Suite 230, Tulsa, OK 74133
Fax: (918) 831-9804

☐ Payment of $59 is enclosed.
**Make check payable to Endeavor Business Media**

If paying by credit card, please complete the following: ☐MC ☐Visa ☐AmEx ☐Discover

Acct. number: _____

Exp. date: _____ CVC #: _____

Billing address: _____

_____

**Charges on your statement will show up as PennWell / Endeavor.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 16. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 2. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 17. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 3. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 18. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 4. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 19. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 5. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 20. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 6. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 21. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 7. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 22. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 8. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 23. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 9. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 24. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 10. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 25. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 11. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 26. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 12. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 27. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 13. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 28. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 14. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 29. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 15. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | 30. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |

**PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.**

### INSTRUCTIONS

All questions have only one answer. If mailed or faxed, grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a Verification of Participation form. The form will be mailed within two weeks after receipt of an examination.

### COURSE EVALUATION AND FEEDBACK

We encourage participant feedback. Complete the evaluation above and e-mail additional feedback to Aileen Gunter (agunter@endeavorb2b.com) and Laura Winfield (lwinfield@endeavorb2b.com).

### COURSE CREDITS AND COST

All participants scoring 70% or higher on the examination will receive a verification form for three (3) continuing education (CE) credits. Participants are urged to contact their state dental boards for CE requirements. The cost for courses ranges from $20 to $110.

### PROVIDER INFORMATION

Endeavor Business Media is an ADA CERP–recognized provider. ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education. ADA CERP neither approves nor endorses individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry. Concerns about a CE provider may be directed to the provider or to ADA CERP at ada.org/gotocerp.

Endeavor Business Media is designated as an approved PACE program provider by the Academy of General Dentistry. The formal continuing dental education programs of this program provider are accepted by the AGD for fellowship, mastership, and membership maintenance credit. Approval does not imply acceptance by a state or provincial board of dentistry or AGD endorsement. The current term of approval extends from 11/1/2019 to 10/31/2022. Provider ID# 320452. AGD code: 010.

Dental Board of California: Provider RP5933. Course registration number CA code: 03-5933-21009. Expires 7/31/2022. "This course meets the Dental Board of California's requirements for three (3) units of continuing education."

Endeavor Business Media is designated as an approved provider by the American Academy of Dental Hygiene Inc. #AADHPNW (January 1, 2019–December 31, 2020). Approval does not imply acceptance by a state or provincial board of dentistry. Licensee should maintain this document in the event of an audit.

### RECORD KEEPING

Endeavor Business Media maintains records of your successful completion of any exam for a minimum of six years. Please contact our offices for a copy of your CE credits report. This report, which will list all credits earned to date, will be generated and mailed to you within five business days of receipt.

### CANCELLATION AND REFUND POLICY

Participants who are not 100% satisfied can request a refund by contacting Endeavor Business Media in writing.

### IMAGE AUTHENTICITY

The images in this educational activity have not been altered..