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LETTER TO THE EDITOR

COVID-19 outbreak: succinct advice for dentists and oral healthcare professionals

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Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. The virus, identified as the causative agent for a cluster of pneumonia cases initially detected in Wuhan City, China, in late 2019, was isolated and its sequence made available on January 7 and 12, 2020, respectively [2]. Phylogenetic data implicate a zoonotic origin of the virus, which is closely related to two bat-derived severe acute respiratory syndrome (SARS)–like coronaviruses, but more distant from SARS-CoV and Middle East respiratory syndrome (MERS)-CoV [3]. The study of community transmission and family clusters of the disease, as well as the rapid spread of infection across the world, has soon provided key insights to support the existence of person-to-person transmission [4].

According to an early scoping review [5], reported symptoms of COVID-19 range from mild to severe, with some cases (1–3%) resulting in death, particularly in adult and elder individuals. The most commonly reported clinical manifestations are fever, cough, myalgia or fatigue, pneumonia, and complicated dyspnea. Current estimates of COVID-19's case fatality rate suggest that the novel coronavirus is less deadly than the pathogens behind other large-scale outbreaks, such as of SARS, MERS, and Ebola. However, the infection seems to spread much faster than SARS, MERS, and seasonal influenza [6]. The virus's basic reproduction number (R0)—the number of people on average one infected person will pass the virus to—is comparatively high, and WHO has published their estimation of R0 to be 2.0–2.5 using early information.

The Centers for Disease Control and Prevention (CDC) in the USA has indicated that certain healthcare workers, including dentists, are at a "very high" risk of exposure to SARS-CoV-2. In particular, it appears that working in high-risk departments, longer duty hours, and suboptimal hand hygiene after contacting with patients are linked to COVID-19 [7]. Dental professionals are not only at high risk for infection but also can become potential carriers of the disease. Hence, the aim of this review was to collect currently available evidence and resources to help dental professionals minimize the spread of SARS-CoV-2. While this information is current up to March 2020, it is likely that new information will emerge in the next weeks.

Transmission routes of SARS-CoV-2 and why it matters to dentists

The available epidemiologic data suggest strongly that transmission of SARS-CoV-2 occurs primarily via respiratory droplets from coughs and sneezes within a range of about 1–2 m and by direct contact [8]. Indirect contact via contaminated surfaces is another likely cause of infection [9]. Latest research also shows that airborne transmission is possible because the virus is stable for several hours to days in aerosols and on surfaces. Specifically, SARS-CoV-2 was detectable, albeit at progressively lower titers, in aerosols for up to 3 h, up to 4 h on copper, up to 24 h on cardboard, and up to 2 to 3 days on stainless steel and plastic, respectively [10]. The unique nature of dental interventions, which include aerosol generation, handling of sharps, and proximity of the provider to the patient's oropharyngeal region [11], exposes dentists and oral health professionals to contagion.

Importantly, studies have shown the presence of SARS-CoV-2 in both saliva and feces of the affected patients [12]. SARS-CoV-2 enters the cell in the same path as SARS coronavirus, that is, through spike S1 protein binding to the ACE2 cell receptor [13]. ACE2+ epithelial cells of salivary gland

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ducts were demonstrated to be early targets of SARS-CoV infection [14], and SARS-CoV-2 is likely to have the same tropism for the salivary epithelium; this may be a possible explanation for the presence of SARS-CoV-2 in secretory saliva. Viral carriage in salivary fluids is a key, additional risk factor for aerosol-generating procedures that routinely take place in dental practice.

In this document, I assumed that person-to-person transmission can occur via large particle droplets (> 5 μm), smaller airborne particles (< 5 μm) called "droplet nuclei" or "aerosols", direct physical contact with blood or body fluids, or indirect contact via contaminated surfaces or environments. The implications of SARS-CoV-2 transmission routes in the dental setting are summarized in Table 1.

Guidelines for dental and oral health practitioners

In general, in workplaces where workers have high or very high exposure risk, employers may follow the guidance for "Steps All Employers Can Take to Reduce Workers' Risk of Exposure to SARS-CoV-2" drafted by the US Department of Labor [15] or "COVID-19: Guidance for infection prevention and control in healthcare settings" by the UK Department of Health and Social Care [16]. However, these recommendations are not specific to dentistry and may not be practical or applicable to dental settings.

Table 1 SARS-CoV-2 transmission routes and suggested precautions in the dental setting

Transmission	Representative example	Suggested precautions
Droplets	Coughing, sneezing, or talking at short distance	Distancing measures (e.g., in waiting room), surgical masks for at-risk patients, PPE for staff
Airborne	Inhaling aerosols from rotary dental instruments and suspended in the air	Reduce aerosol-producing procedures, N95 respirator masks or FFP3 respirator, saliva ejectors, room ventilation
Direct contact	Unprotected touching, contact with oral fluids, secretions, or contact with body lesions	Wear standard PPE, including eyewear or face shields
Contaminated surfaces	Contaminated hands, contaminated needle or other sharp objects, instruments and surfaces not properly cleaned or disinfected	Frequent hand hygiene, thorough disinfection of all surfaces, sterilization of non-disposable instruments

To date, there has been no international consensus on the provision of dental services during the epidemic of COVID-19. In this document, I have analyzed and summarized practices that have been proposed by relevant healthcare organizations across the world (Fig. 1).

Preparedness plan and streamlining of dental procedures

Dental teams should hold routine response plan briefings to ensure that workers and workplaces are prepared to minimize the risk of infection. Dentists, oral healthcare professionals, technicians, and cleaners should all be trained on the standard and transmission-based precautions in addition to following local government guidance such as frequent hand washing and self-isolation for 2 weeks in case of mild cough or low-grade fever (37.3 °C or more) [17]. It is important to brief the team about the recommendations reported in the next paragraphs.

With some exceptions, there is overall a consistency in guidance that dental activity during pandemic should be limited to **emergencies** and **urgent dental care**. Most local governments and dental associations are not prescriptive as to what constitutes essential dental care and suggests that dentists use their professional judgment in determining a patient's need for urgent or emergency care. In China, all the 48 public tertiary dental hospitals suspended general non-emergency dental treatment while providing emergency dental services only [18]. According to the British Dental Association, "there should be a reduction in the amount of routine dental activity, particularly in respect of vulnerable groups and importantly that staff and patient exposure to potential infection should be reduced by avoiding all aerosol generating procedures wherever possible" [19]. The American Dental Association has provided a list of dental procedures that are to be considered urgent—these mainly refer to potentially serious conditions and dental/oral pain (Table 2).

By and large, it is recommended that dentists should avoid elective and non-urgent dental care and operations that can produce droplets and aerosols so far as local restrictive measures are in place.

Early recognition and prevention of transmission before dental treatment

Patient triage and consulting It is useful to use patient-reminder calls to identify patients reporting illness or suspicious symptoms, in which case dental treatment should be deferred. Whenever possible, patient triage should be performed by telephone before confirming the appointment. Accompanying persons should not be allowed in the premises and patients should be provided with surgical masks; efforts need to be made to limit the number of patients in the waiting room to 1 person and for a limited time. Once patients enter

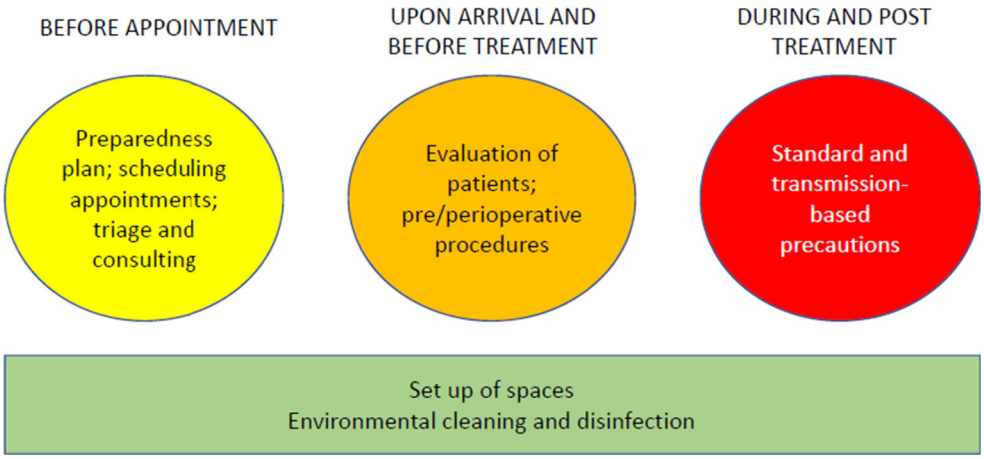

Fig. 1 Schematic plan of actions and recommendations in the dental setting during COVID-19 pandemic

the dental clinic, temperature measurement should be performed and, in addition to medical and dental history, patients contact history should be recorded [20], whereas travel history is perhaps less relevant at this stage due to the spread of the virus worldwide.

Patients not admitted for emergency treatment should be offered advice and instructions to temporarily manage their dental problems. For example, parents of children with orthodontic appliances may be asked to take pictures to document their clinical condition. Patients with mild symptoms from gingivitis should be given practical daily advice of oral hygiene, and pharmacologic management may be suggested if necessary [21]. In China, 69% of public tertiary dental hospitals offered free online professional consultations [18]. It is also important to prioritize the follow-up of these patients as soon as routine dental treatment resumes.

Set up of common spaces Visual alerts (e.g., posters) that promote respiratory hygiene and cough etiquette measures should be placed in waiting areas or at reception desks and are considered a component of standard precautions practiced routinely in dental settings. Key information to be provided to patients include covering the mouth and nose during coughing and sneezing, using tissues to contain respiratory secretions and promptly disposing of them, and performing hand hygiene after contact with respiratory secretions [22]. Furthermore, waiting areas should be set up to ensure that physical distancing measures can be maintained (e.g., 1–2 m between patients). It is also useful to provide alcohol-based hand rub (ABHR) with 60–95% alcohol, tissues, and no-touch receptacles for disposal in waiting areas.

Environmental cleaning and disinfection Dentists or dental managers should ensure that the dental clinic is a safe environment for patients and workers at all times. SARS-CoV-2 can survive on surfaces for up to 3 days; hence, door handles, light switches, and other potentially contaminated surfaces can be the vehicle of indirect contact between patients and

Table 2 List of procedures that may be considered dental emergencies and urgent dental care. Adapted from: American Dental Association "What Constitutes a Dental Emergency?"

Type	Procedures
Dental emergencies	Uncontrolled bleeding; cellulitis or diffuse soft tissue bacterial infection with intra-oral or extra-oral swelling that potentially compromise the patient's airway; trauma involving facial bones, potentially compromising the patient's airway
Urgent dental care to relieve severe pain	Severe dental pain from pulpal inflammation; pericoronitis or third-molar pain; abscess or localized bacterial infection resulting in localized pain and swelling; tooth fracture resulting in pain or causing soft tissue trauma; extensive dental caries or defective restorations causing pain; replacing temporary filling on endo access openings in patients experiencing pain
Other urgent dental care	Surgical post-operative osteitis, dry socket dressing changes; dental trauma with avulsion/luxation; dental treatment required prior to critical medical procedures; final crown/bridge cementation if the temporary restoration is lost, broken, or causing gingival irritation; suture removal; denture adjustment on radiation/oncology patients; denture adjustments or repairs when function impeded; snipping or adjustment of an orthodontic wire or appliances piercing or ulcerating the oral mucosa; biopsy of abnormal tissue

dental professionals and should be cleaned frequently (Table 3). Guidelines have been published and constantly updated by the WHO [23], as well as by local institutions across the world [15, 16, 24]. In general, routine cleaning and disinfection procedures are appropriate for SARS-CoV-2 in healthcare settings, including those patient care areas in which aerosol-generating procedures are performed. The CDC proposes the use of standard cleaners and water to pre-clean surfaces prior to applying an EPA-registered, hospital-grade disinfectant to frequently touched surfaces or objects. EPA-registered disinfectants that have qualified under EPA's emerging viral pathogens program for use against SARS-CoV-2 have been published [25] and include hydrogen peroxide, quaternary ammonium, sodium hypochlorite, and ethanol at various formulation types and contact times.

Pre- and peri-operative procedures

There are standard and specific procedures that can be implemented to reduce the likelihood of viral spread and of generating droplets and aerosols during dental treatment. These practices have not been tested or validated for SARS-CoV-2 and are mainly based on results obtained with oral bacteria or recommendations related to common viruses such as influenza.

When assigning a **treatment room**, at risk patients (elderly, people with underlying diseases and those with positive contact history but without symptoms) should be separated from others whenever possible and a treatment room with a closed door should be used [26].

A preoperational **antimicrobial mouthrinse** is believed to reduce the number of microorganisms that populate the oral cavity and disseminated by means of the aerosol generated via dental procedures. [27]. Preprocedural mouthrinse containing oxidative agents such as 1% hydrogen peroxide or 0.2% povidone is recommended for the purpose of reducing the salivary load of oral microbes, including potential SARS-CoV-2 carriage, whereas the most commonly used chlorhexidine mouthrinse may not be effective [13].

The use of **rubber dam** is thought to significantly minimize the production of saliva- and blood-contaminated aerosol or spatter [28]; however, there is no direct evidence of a reduction of viral loads. Early studies show that application of rubber dams during restorative procedures could significantly reduce airborne particles in ~ 3 feet diameter of the operational field by 70% [29]. The reduction of bacterial contamination of the atmosphere, perioperatively, is greatest at 1 m from the headrest; therefore, the use of rubber dam would minimize significantly the inhalation of infective aerosols by dental personnel. Conversely, more recent evidence suggests that use of rubber dam results in significantly higher aerosol levels on various areas of the dentist's head [30]. Although in this latter case the aerosol generated is likely to contain less viral particles, overall these data strongly suggest that dentists are required to cover their heads with suitable protective wear.

Anti-retraction handpiece can significantly reduce the backflow of oral bacteria and HBV into the tubes of the handpiece and dental unit as compared with the handpiece without anti-retraction function [31]. Therefore, the use of dental handpieces without anti-retraction function is not indicated during COVID-19 epidemic (in geographically and temporally defined areas of outbreak) and/or pandemic.

The use of saliva ejectors with low or high volume can reduce the production of droplets and aerosols, and the use of a complete four-hand operation is also desirable [20]. Procedures that are likely to induce coughing should be avoided (if possible) or performed cautiously [32].

Infection control precautions and practices for oral healthcare workers

Standard precautions Dentists follow a uniform infection control protocol to treat all patients, irrespective of their medical histories. Infection control precautions were introduced largely because of the human immunodeficiency virus (HIV) epidemic and were designed and updated to prevent transmission of HIV, hepatitis B virus (HBV), hepatitis C virus (HCV), and other bloodborne diseases [33]. These *standard precautions* are designed to protect healthcare personnel and patients from pathogens that can be spread by blood or any other body fluid, excretion or secretion [22]. Elements of standard precautions include (1) hand hygiene; (2) use of personal protective

Table 3 Suggestions for routine environmental cleaning of dental clinic premises. Adapted from: Australian Government, Department of Health: "Environmental cleaning and disinfection principles for COVID-19"

	Frequently touched	Minimally touched
Items	Door handles, tabletops, light switches, chairs	Floors, ceilings, walls, blinds
Procedure	Should be cleaned frequently—as much as possible during the day	Should be cleaned daily
	Detergent solution can be used	Detergent solution/wipes are adequate, damp mopping preferable to dry mopping
	Detergent-impregnated wipes may be used	Window curtains should be regularly changed in addition to being cleaned
		Sinks and basins should be cleaned frequently

equipment (PPE, e.g., gloves, masks, eyewear); (3) respiratory hygiene/cough etiquette; (4) sharps safety (engineering and work practice controls); (5) safe injection practices (i.e., aseptic technique for parenteral medications); (6) sterile instruments and devices; and (7) clean and disinfected environmental surfaces [22]. According to the US Occupational Safety and Health Administration (OHSA), standard precautions during patient care is determined by the task being performed and the type of exposure that is anticipated, not by the patient. For example, only gloves may be needed when obtaining dental radiographs, whereas protective eyewear and clothing, gloves, and masks are necessary when placing restorations [31]. Standard precautions that apply to most dental procedures, including oral examination, are the use of PPE such as surgical mask, goggles/eye protection or face shield, gown or protective clothing, gloves, and head cap. Oral healthcare professionals should perform hand hygiene before putting on and after removing PPE, including gloves. Any reusable PPE and equipment must be properly cleaned, decontaminated or sterilized, and maintained after and between uses [34]. Standard precautions are routine infection control practices and should be in place in dental clinics at all times.

Transmission-based precautions Unfortunately, due to the unique characteristics of dental procedures where a large number of droplets and aerosols could be generated, the standard protective measures in daily clinical work are not effective enough to protect from COVID-19—or from any other diseases that can spread through contact, droplet or airborne routes—especially when patients are in the incubation period, are unaware they are infected, or choose to conceal their infection [16]. Hence, a second level of precautions, referred to as *transmission-based precautions*, need to be implemented and are always used in addition to standard precautions. There are three categories of transmission-based precautions: airborne, droplet, and contact [35], and these also apply to other respiratory viruses (Table 4). Notable additions to standard precautions include the utilization of particulate respirators by dentists and chairside assistants (e.g., N-95 masks authenticated by the National Institute for Occupational Safety and Health or FFP2/3-standard masks set by the European Union) and use of high-volume evacuation (HVE) or systems that improve the general ventilation and effectively control the airflow patterns and filtration of the circulating air. In dental offices in which these airborne precautions cannot be implemented, having the patient wear a mask at any time when outside the operative room, placing the patient in a private room distant from other patients, ensuring a level of room ventilation (e.g., frequent natural ventilation via windows, for example, 5-min air change between each patient), and avoiding the presence of unnecessary individuals in the room [31] will reduce the likelihood of transmission.

Sadly, the lack of PPE supplies in response to the increased demand has been putting healthcare workers, including dentists, in a difficult position. This poses threats not only to workers but also to their patients due to the potential spread of SARS-CoV-2 [36]. The CDC has published contingency and crisis strategies to cope with PPE shortage which include, for example, prioritizing PPE use for selected care activities, utilizing reusable PPE that can be reprocessed, and/or using PPE beyond the manufacturer-designated shelf life [37]. Due to the varying incidence of infection with SARS-CoV-2, and considering the evolving challenges that are being faced, it is rational to adapt patient management strategies locally.

Concluding remarks

COVID-19 has been causing tens of thousands of deaths globally, and many of these fatalities are doctors and healthcare workers. Despite the tight restrictions imposed by local governments across the world, dentists are healthcare

Table 4 Viral respiratory conditions requiring transmission-based precautions

Disease	Contact precautions	Droplet precautions	Airborne precautions	Duration of precautions
Human Influenza (seasonal)	NA	X	NA	5 days
2009 H1N1 Influenza	X	X	X	7 days from symptom onset
Severe acute respiratory syndrome (SARS), MERS, and Ebola	X	X	X	10 days after resolution of fever, if respiratory symptoms absent or improving
Coronavirus disease 2019 (COVID-19)	X	X	X	Up to 2 weeks after resolution of symptoms
Tuberculosis (1)	NA	NA	X	Until the patient receiving effective therapy is improving clinically and laboratoristically
Chicken pox (2)	X	NA	X	Until lesions are dry and crusted

(1) Example of non-viral respiratory condition, for comparison

(2) Example of viral, non-respiratory condition, for comparison

NA, not applicable; *X*, precaution to be adopted

professionals who continue to have a duty of care, especially to patients in pain, and are at high risk of SARS-CoV-2 transmission during this pandemic. It is therefore of outmost importance that infection control and other recommended procedures are adhered to and implemented in the dental setting. Notwithstanding the paucity of data specifically related to SARS-CoV-2, here I attempted to provide succinct, yet evidence-based and practical guidelines for dentists and oral health workers. These mostly involve implementation of procedures and practices such as prioritizing dental appointments, patients' triage, transmission-based precautions, and environmental cleaning and disinfection.

Compliance with ethical standards

Conflict of interest The author declares that he has no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, formal consent was not required.

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