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## Review Article

## Precautions in dentistry against the outbreak of corona virus disease 2019

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## ABSTRACT

The outbreak of Coronavirus Disease 2019 (COVID-19) has become a severe global acute respiratory pandemic around the world in just a few months with an increasing number of infections and deaths. COVID-19 is a highly contagious and fatal disease. Almost everyone in the population is susceptible, and the incubation period is 1–14 days, mostly 3–7 days. The clinical symptoms of the COVID-19 are fever, dry cough and fatigue. Some patients are accompanied by symptoms such as nasal congestion, runny nose, sore throat, myalgia and diarrhea. Severe patients could even develop acute respiratory distress syndrome, septic shocks, metabolic acidosis and multifunctional organ failure, etc. Due to the relatively closed environment of dental clinics and the unique nature of dental procedures, both dental personnel and patients are easy to get infection through currently known respiratory droplet transmission, aerosol transmission, close contact transmission and other ways, inducing mutual cross-infection. Dental practitioners are facing unprecedented challenges due to the high risk of exposure to droplets and aerosols from saliva and other body fluids during dental procedures. Based on our experience and relevant research, this article introduces the basic knowledge about COVID-19 and the corresponding protective measures for dental practitioners, includes the risk of infection during dental procedures, the precautions related to the patients, infection control measures during dental treatment in clinics, protection measures at different levels for dental practitioners, and emergency dental treatment for confirmed COVID-19. It is the responsibility of every dental practitioner to fully understand the characteristics of the new coronavirus and strictly implement the most appropriate protective measures to reduce and control the risk of cross infection in dental procedures.

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## Introduction

The outbreak of Coronavirus Disease 2019 (COVID-19) has become a severe global acute respiratory pandemic around the world in just a few months with an increasing number of infections and deaths. The pathogen that caused the new coronavirus disease is a new type of coronavirus, which belongs to the beta-type coronavirus with a cell membrane. It is round or oval and has a diameter of 60–140 nm [1–3]. At present, it has been confirmed that it has more than 85% homology with bat SARS-like coronavirus (bat-slcovz45). The World Health Organization (WHO) announced the outbreak of new coronavirus COVID-19 as a public health emergency of international concern (PHEIC) on January 30, 2020, and raised the global risk assessment to the highest level on February 28, 2020 [4,5]. On March 11, 2020, the WHO declared the COVID-19 outbreak a global pandemic [4]. At present, there are more than 118,000 confirmed cases and 4291 deaths in 114 countries and regions around the world [6]. Meanwhile, about 30–40 countries are still at high risk of new coronavirus transmission [7–9]. Due to the characteristics of COVID-19, and the characteristics of dental procedures, dental practitioners are facing unprecedented challenges. The high risk of exposure to droplets and aerosols from saliva and other body fluids during the procedures may lead to cross infection between dental practitioners and patients. It is the responsibility of every dental practitioner to fully understand the characteristics of COVID-19 and strictly implement the most appropriate protective measures to reduce and control the risk of cross infection in dental procedures. The infection prevention and control practices during dental treatment are urgently needed. This review introduces the basic knowledge about COVID-19 and corresponding protective measures for dental practitioners based on our experience and related research.

## Epidemiological characteristics of COVID-19

Corona virus disease 2019 (COVID-19) is a new type severe respiratory disease. Its transmission mode and characteristics are still being studied. Sources of COVID-19 infection confirmed by current research are mainly patients with coronavirus infection, including those with asymptomatic infection. Almost everyone in the population is susceptible, and the incubation period is 1–14 days, mostly 3–7 days. COVID-19 could spread via respiratory droplets made when infected people sneeze, talk or cough. The droplets and the exhaled gas from the infected could be inhaled by the people at close distance, resulting in the infection [10,11]. Furthermore, novel coronavirus can survive in aerosol for several hours and even for several days [10,11]. Thus possibly the virus could transmit through aerosol. The diameter of biological aerosols generated in dental operations is generally 5 µm, which is easy to enter the respiratory system [12]. People could easily get infected when exposed to high concentration aerosol for a long time in a relatively closed environment such as dental clinic. Besides, people could get infected when they touch their mouth, nose or eyes after touching a contaminated surface or shaking hands with the infected patients. The WHO-China Joint Mission on Coronavirus Disease 2019 notes “viral shedding” has also occurred in human wastes including feces and

urine, which may lead to environmental pollution and cause aerosol or contact transmission [13,14].

## Clinical symptoms of COVID-19

Besides how COVID-19 is spread, dental practitioners need to be familiar with clinical symptoms. This can help them identify the suspected patients and decide what to do next include taking appropriate protective measures, advising patients to go to fever clinics, taking emergency dental treatment in a negative pressure clinic and so on. The clinical symptoms of the COVID-19 are fever, dry cough and fatigue. Some patients are accompanied by symptoms such as nasal congestion, runny nose, sore throat, myalgia and diarrhea. Mild patients only show low fever, mild fatigue, without signs of pneumonia. Severe patients often have dyspnea or hypoxemia one week after the onset of the symptoms, and even develop acute respiratory distress syndrome, septic shocks, metabolic acidosis and multifunctional organ failure, etc. Chest computed tomography (CT) images show ground-glass opacity. The most severe patients are the elderly and those with chronic underlying diseases [10,11,15]. However, some of those infected are asymptomatic, it's hard to identify those cases by clinical symptoms. The colored health code which could report address, health status, contact history, and residence history may be helpful.

## Challenges in dental clinic

Although no experimental or model data are currently available to accurately assess novel coronavirus transmission risk during dental procedures, due to the relatively closed environment of dental clinics and the unique nature of dental procedures, both dental personnel and patients are easy to get infection through currently known respiratory droplet transmission, aerosol transmission, close contact transmission and other ways, inducing mutual cross-infection [10,16]. Aerosols and droplets can be produced from saliva and blood during many dental procedures such as ultrasonic teeth cleaning by ultrasonic scaler, root canal ultrasonic oscillating irrigation, the removal of decayed dental hard tissue by high-speed handpiece and air–water syringe and when infected people in clinics cough, sneeze, talk or exhale. These droplets can land on the skin or mucous membranes of people who are nearby, can possibly be inhaled into the lungs, can deposit on the surface of dental instruments or tables and chairs. People could get infected when they touch their mucous membranes with their hands after touching the contaminated surfaces [17]. Aerosols and droplets could even contaminate the pipeline water and result in a serious infection (Fig. 1).

Furthermore, the shortage of PPEs is a major challenge for dental clinics. More efforts are needed to ensure the supplies. First, strictly control the use of PPEs. Different levels of PPEs need to be used according to the graded protection standards to achieve the maximum benefit of PPEs (Table 2). Panic hoarding and misuse should be avoided. Set up a full-time PPE administrator to control of the entire life cycle of PPEs and other virus prevention materials, and to avoid waste or loss. Second, establish more procurement channel and consider cross-border e-commerce and other new foreign trade modes when necessary. Third, keep in touch with other den-

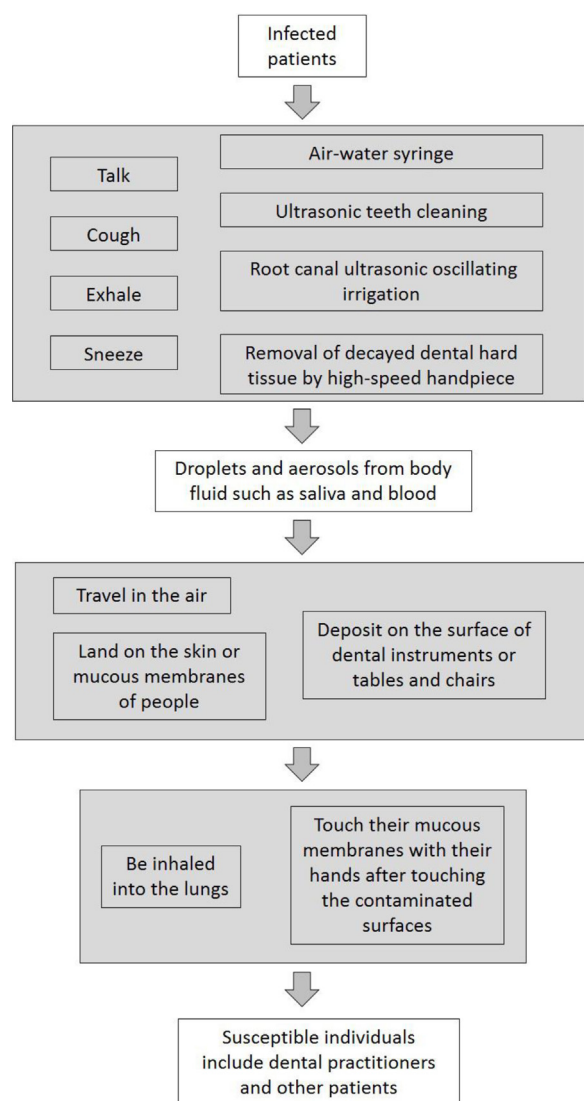


Fig. 1. The Challenges in dental clinics.

tal clinics to exchange of the needed PPEs. Dental clinics which are lack of PPEs should refer the suspected and confirmed patients to dental clinics with sufficient PPEs to reduce the risk of infection.

It's hard to identify asymptomatic coronavirus carriers in the dental clinics under current circumstance. We will further consider nucleic acid testing or delayed treatment for patients in specific populations requiring dental treatment. In the region where there are new confirmed cases each day, when a patient come to the dental clinic, we will check their health code. If the code is green which means they are healthy, we will take a nucleic acid. If the result is negative, we will carry on the treatment. If the result is positive or if the code is red or yellow which means they are suspected cases or from the key infection areas, we will postpone the treatment except for the dental emergency. In the region where there is no new confirmed case, we only check the health code. If it is green, we will carry out the treatment.

The awareness and knowledge of COVID-19 prevention and control need to be further enhanced. Health Committee will continue to launch COVID-19 public awareness campaigns both in print and electronic media, carrying out lectures on TV programs and designing posters on preventive measures. People can download and print the posters to put up around workplace or for personal use. Furthermore, the dental clinic could launch some targeted quizzes to

test dental practitioners' and patients' knowledge of COVID-19 prevention before treatment. As the public awareness of COVID-19 increased, targeted measures in COVID-19 epidemic prevention and control could be further improved. The dental practitioners can take measures according to the local epidemic situation. It is the responsibility of every dental practitioner to fully understand the characteristics of COVID-19 and strictly implement prevention and control measures and adopt the most appropriate protective measures or equipment prevent the risk of infection during dental treatment.

### The precautions related to the patients

Patients in the dental clinics should follow the instructions to prevent COVID-19 infection [18,19]. To control the number of patients, patients need to follow a strict telephone appointment system and try not to bring escorts. The nurses will ask the medical history, take body temperature, screen the symptoms of COVID-19 and take nucleic acid tests, then triage the patients. The patient's clothes and personal articles need to be disinfected in the triage area, and then the patients could enter the waiting area and need to keep a distance of more than 1 m from others. For suspected or confirmed patients with COVID-19, non-emergency dental treatment should be delayed, and emergency dental treatment should be carried out in the negative pressure clinic according to the designated independent isolation route. Patients without suspected symptoms of COVID-19 and with negative nucleic acid tests should wear surgical masks and be placed in the waiting room with effective ventilation conditions (air exchange at least once within 3 min) and should be arranged in accordance with the principle of one person in one room to ensure that each patient is treated in a separate clinic. When patients leave the dental clinic, they are asked to wear masks again [20]. The patients were asked to contact the dental clinic by the telephone number or WeChat provided if they have suspected symptoms or are confirmed of COVID-19 within 14 days since their visit. The nurses will flush water pipeline with chlorine disinfectant, clean the surfaces of the objects with quaternary ammonium salt and disinfectant wipes, clean the floor with chlorine disinfectant, spray air with 2% peracetic acid and turn on the ultraviolet light for more than an hour [21]. If the patient is later confirmed to have COVID-19, the dentists and nurses who contact the patients directly will be asked to take a nucleic acid test and further measures will be taken. To avoid the infection caused by the patient who is later confirmed of COVID-19, dental personnel need to strictly stick to the principle one person one room and disinfect the room after each treatment.

### Infection control measures during dental treatment in clinics

In face of the high risk of COVID-19 infection, dental personnel should strictly follow the occupational protection system and regional isolation regulations, stick to the principle one person one room. The dental clinics need to set full-time personnel for prevention and control of COVID-19 and train the dentists and nurses to follow the disinfection rules, hand hygiene system, individual protection process, and so on to make sure the control measures are implemented strictly (Table 1).

### Protection measures at different levels for dental practitioners

Dental practitioners should take appropriate personal protective measures against different types of patients, including wearing goggles, masks, gloves, disposable protective clothing, etc. in correct

**Table 1**  
Preventive and control measures for COVID-19 transmission in dental clinics.

| Control measures                                                                                     | Main contents                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Protective effects                                                                                                                                                                                  | Applicable people                                                                |
|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Standardize occupational protection system                                                           | Hospital management system of hand hygiene, hospital management system of disinfection and sterilization, environmental disinfection and sterilization detection system, hospital waste management system, occupational protection and management system, infection prevention and control system in dental clinic, disinfection and isolation system in dental clinic, isolation system of dental clinic, hospital staff management system of occupational protection [15] | Improve infection control and strengthen the protection system of dental personnel                                                                                                                  | Dental personnel                                                                 |
| Regional isolation                                                                                   | Divide the entire dental clinic area into clean areas (blue line), potential contaminated area (yellow line) and contaminated area (red line). Set up special channels for the suspected or confirmed COVID-19 patients. The individuals should wear appropriate personal protective equipment in different areas [15]                                                                                                                                                      | Prevent cross infection                                                                                                                                                                             | Dental personnel and patients                                                    |
| Set independent treatment rooms                                                                      | Only one patient at a time is allowed to receive dental treatment in the isolated and independent dental clinic. Escorted personnel should be avoided to enter the clinic. After the treatment, strict environment and surface disinfection should be carried out                                                                                                                                                                                                           | Reduce cross infection                                                                                                                                                                              | Dental personnel and patients                                                    |
| Clinic disinfection                                                                                  | The virus is sensitive to ultraviolet and heat, and can be inactivated at 56°C for 30 min and lipid solvents such as ether, 75% ethanol, chlorine-containing disinfectant, peracetic acid and chloroform. All these lipid solvents can be used to disinfect the environment of the dental clinic and the surface of objects [8,16]                                                                                                                                          | Reduce the risk of surface contact and airborne infection                                                                                                                                           | Dental personnel and patients                                                    |
| Vaccination                                                                                          | Vaccine against COVID-19 is currently under development and is expected to be available for clinical use in the coming months or years. Dental health care workers (DHCW), including dentists, dental nurses, dental students, nursing students, dental technicians, laboratory technicians who are in clinical contact, pharmacists, volunteers and administrators, need to be vaccinated [10,16,22]                                                                       | Reduce the risk of infection among dental personnel                                                                                                                                                 | Dental personnel                                                                 |
| Hand hygiene                                                                                         | Put up eye-catching hand hygiene posters in the dental clinic to remind dental personnel and patients when and how to practice hand hygiene. Provided hand sanitizers containing 75% ethanol and disposable paper tissues in triage and waiting area. Standardize hand hygiene (hand washing, hand sanitization and surgical hand sanitization) operation procedure and hand hygiene facilities requirements, etc [23–25]                                                   | Reduce cross infection and nosocomial infection                                                                                                                                                     | Dental personnel and patients                                                    |
| Individual protection                                                                                | Isolation gowns/protective suits, sterile medical gloves, masks/surgical masks/protective masks, medical round caps and goggles                                                                                                                                                                                                                                                                                                                                             | Reduce the risk of infection of dental personnel                                                                                                                                                    | Dental personnel                                                                 |
| Set up full-time personnel for prevention and control of COVID-19                                    | Train dental personnel to use PPE(Personal Protective Equipment), monitor and manage virus infections among dental personnel, manage and distribute protective materials, guide and check the dress code, remind dental personnel of replenishing water and energy before work, register disinfection supplies, etc.                                                                                                                                                        | Provide advice of infection prevention and control, materials and psychological support to dental personnel                                                                                         | Dental personnel                                                                 |
| Application of rubber dam                                                                            | Standardize the operation procedures of rubber dam [18,19,26]                                                                                                                                                                                                                                                                                                                                                                                                               | Improve surgical approaches, reduce the amount of atomized fluid and microorganisms and reduce risk of infection during treatment                                                                   | Dentists and nurses                                                              |
| Mouth rinse before dental procedures                                                                 | Preprocedural mouth rinses (PPMR). Rinse with chlorhexidine and other mouthwashes [27,28]                                                                                                                                                                                                                                                                                                                                                                                   | Reduce the initial amount of potentially aerosolized pathogenic microorganisms                                                                                                                      | Dentists and nurses                                                              |
| Install cooling part and air extractor or portable HEPA (High Efficiency Particulate Air) air filter | Improve dental ultrasound treatment and dental cutting techniques, install cooling part and local air extraction devices, use a portable HEPA air filter during treatment [12,29]                                                                                                                                                                                                                                                                                           | Reduce the aerosols in the dental office and shorten the time the virus stays in the air                                                                                                            | Dentists and nurses                                                              |
| Disposable anti-splash isolation device                                                              | Locate a dental treatment anti-splash isolation device around the patient's head or upper body, and the dental personnel could put hands into the device                                                                                                                                                                                                                                                                                                                    | Reduce transmission of blood, saliva, and droplets                                                                                                                                                  | Dentists and nurses                                                              |
| Purification and monitoring of pipeline water                                                        | Purify, disinfect and update the water of the DUWL (Dental Unit Water Lines), monitor the water quality of the pipeline, and test the water quality to ensure it meets the safe drinking water standard (<500 CFU/mL)                                                                                                                                                                                                                                                       | Reduce the risk of water contamination                                                                                                                                                              | Equipment maintenance personnel, dentists and nurses                             |
| Air purification system                                                                              | Arrange air purification system and ventilation system, monitor air quality in dental clinic [30,31]                                                                                                                                                                                                                                                                                                                                                                        | Reduce the trapped or recycled polluted air caused by confined space and inefficient ventilation in the dental office and reduce the risk of prolonged exposure to a high concentration of aerosol. | Equipment maintenance personnel, cleaning personnel, infection control personnel |
| Set up the negative pressure isolation treatment room                                                | The suspected and confirmed patients should be treated in the negative pressure isolation room during dental emergency treatment, and the dentists and nurses should take strict occupational protection [32]                                                                                                                                                                                                                                                               | Reduce the risk of infection                                                                                                                                                                        | The suspected and confirmed patients of COVID-19                                 |

**Table 2**  
Graded protection standards against COVID-19 in dental clinics.

| Protection level     | Protection standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Target people                                                                                  |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| General protection   | The dental personnel should strictly abide by the standard prevention principles; wear work clothes, medical latex gloves, surgical masks, work caps and goggles or face masks; strictly perform hand hygiene procedures                                                                                                                                                                                                                                                                                                                                                                                                      | Dental personnel who treat patients without suspected symptoms of COVID-19                     |
| Primary protection   | The dental personnel need to strictly abide by the standard prevention principle and rules and regulations on disinfection and isolation; Wear overalls, medical sterile gloves, isolation gown, surgical mask, medical cap and goggles or face mask, strictly perform hand hygiene procedures [36]. Pay attention to the protection of respiratory system and mucosa membrane at work and dispose the personal protective equipment in an appropriate way when off duty                                                                                                                                                      | Dental personnel who treat patients with fever                                                 |
| Secondary protection | The dental personnel should follow the prevention principle strictly, abide by the rules and regulations on disinfection and isolation, perform hand hygiene procedures strictly. Clean area, potential pollution area and pollution area need to be set up and treatment should be carried out in the negative pressure isolation room. Dental personnel should wear isolation gown, medical sterilize gloves, surgical masks, medical cap and goggles or mask. The procedures should be followed strictly when wear and remove the protective equipment [36]. Body temperature and physical signs are monitored twice a day | Dental personnel who contact the patients suspected of infectious respiratory diseases         |
| Advanced protection  | The dental personnel should wear full-face respirators besides the procedures of secondary protection [36]. Body temperature and physical signs are monitored twice a day                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Dental personnel who contact with the confirmed patients of the infectious respiratory disease |

order, to achieve the best protective effect and minimize the risk of infection during the spread of COVID-19 [26,33]. The protection measures at different levels are also called the graded protection. The graded protection standards are as follows [8,15,26,34,35] (Table 2).

### Emergency dental treatment for confirmed COVID-19

The non-emergency dental treatment of the confirmed patients should be delayed. They could make an appointment for dental treatment after the COVID-19 treatment with a negative nucleic acid test. For dental emergencies of the confirmed patients, dental personnel need to take advanced protection and place the patients in a negative pressure dental treatment room in a contaminated isolation area with a portable HEPA filter or anti-splash isolation device. Under the condition of not affecting the treatment effect, dentists should give priority to performing necessary non-invasive or minimally invasive dental procedures with manual instruments, try to avoid aerosol generation steps such as using ultrasound machines and air water syringes, and shorten the treatment time. After the treatment, the room and equipment should be cleaned and disinfected strictly in accordance with infection control guidelines for dental facilities. The nurses should flush water pipeline with chlorine disinfectant, clean the surfaces of the objects with quaternary ammonium salt and disinfectant wipes, clean the floor with chlorine disinfectant, spray air with 2% peracetic acid and turn on the ultraviolet light for more than an hour [21]. Dental personnel should delay admission to the negative-pressure dental clinic to treat another confirmed patient, until the potentially infectious droplets and particles are removed. All PPEs used by dental personnel and dental consumables used by the patients in the negative pressure room are disposable, and should be destroyed as the infectious articles. Covid-19 transmission is currently under-studied in dentistry. It is not recommended for dental personnel to treat the confirmed COVID-19 patients if there is a lack of PPEs or no isolation negative pressure dental treatment room. Dental personnel could contact a dental clinic or hospital with the above protective standards and make a referral [20,37].

### Conclusion

Dental practitioners face unprecedented challenges since COVID-19 is a highly contagious and fatal disease. Dental procedures could easily generate a large number of droplets and aerosols which make the virus difficult to prevent and control. In this review,

we have summarized the characteristics of COVID-19 briefly, and introduced some protective measures for dental practitioners, providing a reference for the infection prevention for dental clinics in other region. However, the global epidemic is still severe and there are still some limitations that should be considered. How to carry out oral diagnosis and treatment on regular prevention and control of COVID-19 is an open issue to be discussed.

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