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**TECHNICAL REPORT**

# Safe dental practice during the COVID-19 pandemic

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**Abstract**

Coronavirus disease 2019 (COVID-19) has caused widespread public health concerns and many disruptions in our daily life. Dental professionals may encounter patients with COVID-19 infections in their practice. This technical report provides suggestions and recommendations for implementing infection control in the dental office during COVID-19 pandemic.

*Keywords: COVID-19, SARS-CoV-2, dental, infection control*

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## Introduction

An unknown pneumonia-like virus outbreak was first reported in Wuhan City, Hubei Province, China in late December 2019, originating from the Hunan South China Seafood Market (Guo *et al*., 2020). On the 12 January 2020, the World Health Organization (WHO) named the disease as 2019-nCoV, and later COVID-19 in February 2020 (Li *et al*., 2020; Sun *et al*., 2020). This highly infectious disease is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Gorbalenya *et al*., 2020). Genome sequencing revealed that the coronavirus has 96.3% genetic similarity to Yunnan bats (Hu *et al*., 2018; Zhou *et al*., 2020) and 99% genetic similarity to pangolins (Wahba *et al*., 2020), albeit the source of the virus remains unknown. The infection spread rapidly to other provinces in China and later to over 211 countries worldwide (Phelan *et al*., 2020), with the virus infection being classified as pandemic by the WHO on 12 March 2020. As of 16 November 2020, there are over 54.5 million confirmed cases worldwide with 1,318,884 deaths (approximately 2.42% mortality rate) (Dong *et al*., 2020).

## Routes of transmission

The virus is transmitted via direct inhalation of respiratory droplets when an infected individual coughs or sneezes in close proximity within one meter radius (Rodriguez-Morales *et al*., 2020), or indirectly by touching an infected surfaces and then contacting the nasal, oral or eye mucous membranes (Lu *et al*., 2020; Santarpia *et al*., 2020). Studies have also revealed the disease may be transmitted via saliva (Li *et al*., 2020; To *et al*., 2020) and feces *(Zhang et al*., 2020). Hoffmann *et al.* (2020) showed that SARS-CoV-2 could bind to human angiotensin-converting enzyme 2 (ACE-2) receptors which are concentrated in salivary glands, thus suggesting that saliva could serve as reservoir for the virus transmission. New evidence has also suggested that the virus is transmissible through asymptomatic

patients (Chan *et al*., 2020; Rothe *et al*., 2020). The incubation period was found to be up to 14 days before any symptoms appear (Backer *et al*., 2020; Guan *et al*., 2020; Huang *et al*., 2020), therefore transmission of SARS-CoV-2 is possible before any symptoms are evident. Backer and colleagues estimated that the mean incubation period to be 6.4 days, ranging from 2.1 to 11.1 days (Backer *et al*., 2020). Studies have also revealed that the virus can stay active for more than six days on different surfaces, such as plastic, metal and glass (Otter *et al*., 2016; Kampf *et al*., 2020).

**Symptoms**

Symptoms of a patient infected with SARS-CoV-2 may include dry cough, fever, loss of smell and/or taste, muscle weakness, hemoptysis, headache, sputum production and diarrhea (Chen *et al*., 2020; Giacomelli *et al*., 2020; Huang *et al*., 2020). More than 80% of the infected individuals can recover on their own since they have only mild symptoms that resemble flu-like symptoms (Wu & McGoogan, 2020). Individuals over 70 years old with medical problems such as diabetes, hypertension, cardiovascular disease and immunosuppression typically develop severe acute respiratory symptoms (Guan *et al*., 2020) which may require ventilator support; about 1 in 10 patients of aged 70 and over die *(*Chen *et al*., 2020; Huang *et al*., 2020; Sun *et al*., 2020).

**Transmission in dental practice**

Dental profession is in a high risk group for contracting the virus as the saliva (Li *et al*., 2020) and aerosol (Srirengalakshmi *et al*., 2020) can potentially transmit the disease if appropriate preventive measures are not taken. The risk of infection is high due to the close physical proximity of dentists to their patient's oropharyngeal region during the entire process of dental treatment, the long duration of close proximity and aerosol generation associated with many procedures in dentistry. There have been reports of SARS-CoV-2 spread to health care professionals given the high transmissibility of the disease (Lan *et al*., 2020; Wax & Christian, 2020). Typically in a dental setting, SARS-CoV-2 transmission occurs through four major routes: (1) direct inhalation of respiratory droplets or direct exposure to infected saliva or blood; (2) indirect contact with contaminated fomites; (3) inhalation of suspending airborne viruses; and (4) mucosal contact with contaminated droplets/aerosols (Harrel & Molinari, 2004; Liu *et al*., 2011; Chen, 2020; Cleveland *et al*., 2016; Kampf *et al*., 2020). Therefore, all dental team members must take appropriate measures for prevention and management to mitigate the further spread of SARS-CoV-2 in the dental environment.

The following recommendations and information are current up to October 2020. It is anticipated that new information and guidelines will emerge as this novel disease is evolving and new knowledge surfaces. Dental practitioner may use this report as a starting point and continue updating themselves with the latest information as this outbreak continues.

**Patient triage**

Prevention can start even before the patient arrives at the dental practice. Following the recommendations published by the Mayo Clinic (https://www.mayoclinic.org/covid-19), standard questions can be asked by the receptionists / nurses over the phone for initial screening to establish their COVID-19 risk (patient triage by telephone). The three most pertinent questions for triaging can include (Ather *et al*., 2020):

- Do you experience any flu or flu-like symptoms such as fever with temperature more than 37.5°C, cough, sore throat, runny nose, shortness of breath, wheezing, headache, tiredness, muscle aches and chills of sudden onset?
- Have you travelled overseas or to any red zone areas in the past fourteen days?
- Have you come in contact with anyone confirmed with COVID-19 / anyone under quarantine / person under investigation (PUI)?

Patients can also fill up health and travel declaration form on the arrival or the form can be emailed to them prior to their appointments. Patient triage is strongly recommended either before or upon patient's arrival at the clinic (Meng *et al*., 2020). Based on Centers for Disease Control and Prevention (CDC) 2020 and American Dental Association (ADA) 2020 guidelines for dentists on the coronavirus disease, should the answer to any of these questions is yes, these high-risk patients must be postponed for non-emergency dental appointments. Meng *et al*. (2020) suggested for postponing the non-emergency dental treatments in an asymptomatic patient up to fourteen days following close contact with an infected subject, or those individuals who have recently traveled to a red zone area owing to the incubation period of SARS-CoV-2. These individuals must self-quarantine and contact their local health authorities through telephone (Wang *et al*., 2020).

As per the recommendations by ADA (2020), genuine dental emergencies must be dealt with and treated appropriately, for example patients with severe dental pain, swelling, soft tissue infection, longstanding ulcers, soft tissue damage, dentoalveolar trauma, intra-oral trauma from denture, orthodontic appliances, broken bracket/tubes/bands with possibility of foreign body inhalation. Waiting and treatment time must be kept short, with patient seen on the last appointment of the day. Treatment is carried out in a dedicated separate room with limited staff in order to reduce the number of people exposed (Lockhart *et al*., 2020). Other requirements are similar to aerosol generating procedures (AGPs) guidelines which will be discussed later.

With regards to facility, points of entry need to be limited. This includes separation into staff and patient's entrance if feasible. Everyone coming into the building must be screened, with history taken and temperature check performed (Srirengalakshmi *et al*., 2020). The health status of all dental staff must be ascertained. Staff with flu symptoms need to be quarantined at home or visit a doctor.

Body temperature check should be performed at the reception on patient's arrival, preferably with a contact-free forehead thermometer (Li & Meng, 2020; Peng *et al*., 2020) or temperature sensor mounted on tripods (Srirengalakshmi *et al*., 2020). Hand sanitizer is provided for patients. Patients must be requested to wear a surgical mask in the waiting area and physical distancing of at least one meter must be observed at all times to minimize spread of the disease (Dorst, 2020). The flowchart in Figure 1 provides a simplified pathway from the time the patient arrives at the clinic until treatment completion for the new normal practice (Fallahi *et al*., 2020).

**Hand hygiene**

It is extremely important to have good hand hygiene in the dental practice, since oronasal route is one of the transmission routes of COVID-19 (Meng *et al*., 2020;

Peng *et al*., 2020). The principle of 'bare below elbow' should be practiced by all dental personnel: no wristwatch, no jewelry and short sleeves (Li & Meng, 2020). The recommended seven-step hand washing time by WHO is 40 to 60 seconds using water and soap (WHO, 2020) (Table 1).

Likewise, alcohol hand rub of at least 60% ethanol or 70% isopropanol must be adopted by dental health practitioners to reduce the risk of SARS-CoV-2 transmission (Lotfinejad *et al*., 2020). Hand rubbing time should be between 20 and 30 seconds as recommended by WHO (WHO, 2020) (Table 2).

In principle, good hand hygiene must be practiced before any patient contact, before any aseptic task, after body fluid exposure, after patient contact and after contact with patient surroundings (Li & Meng, 2020; Peng *et al*., 2020).

**Personal Protective Equipment (PPE) for dental professionals**

PPE must be worn for dental staff on duty as per the advice given by Occupational Safety and Health Administration (OSHA) (2020). PPE is not only just for clinicians, but also for all the other supporting staff in the dental clinic. There may be slight variations in certain dental clinics in terms of the level of PPE required. Many of the suggestions here are based on *'International Islamic University Malaysia (IIUM) Medical Centre: Infection Prevention & Control Orientation Checklist'*. These can be divided into level 1, level 2 (droplet), level 2 (airborne) and level 3 as illustrated in Table 3. It is advisable to always refer to your local setting for PPE recommendation.

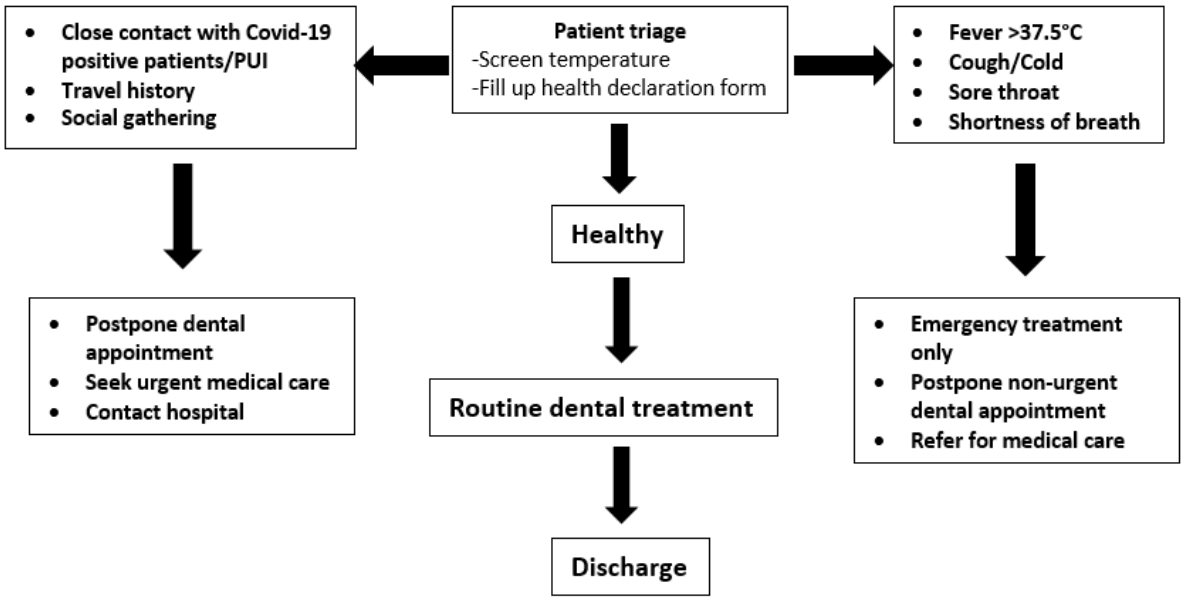



Figure 1. Dental clinic workflow during the COVID-19 pandemic (Fallahi *et al*., 2020)

Table 1. Seven steps of hand washing techniques

| | |
|---|---|
|  | Step 1<br><br>Hands are wet with liquid soap. Hands are rubbed from palm to palm. |
|  | Step 2<br><br>The back of both hands is rubbed. |
|  | Step 3<br><br>Palm to palm with fingers interlaced. |
|  | Step 4<br><br>Back of fingers to opposing palm, with fingers interlocked. |
|  | Step 5<br><br>Rotational rubbing of left thumb clasped in right palm, and vice versa. |
|  | Step 6<br><br>Rotational rubbing backward and forward with clasped fingers of right hand in left palm and vice versa. |
|  | Step 7<br><br>Right hand wrapped over left wrist using rotational movements up to mid forearm and vice versa. |

Table 2. Seven steps of hand rubbing techniques

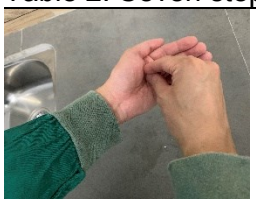
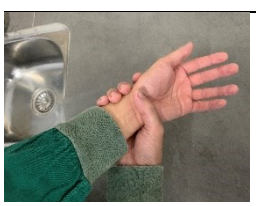
| | |
|---|---|
|  | Step 1<br><br>Adequate hand sanitizer is poured onto left palm. All fingers of the right hand are dipped onto the left palm and vice versa. |
|  | Step 2<br><br>Hands are rubbed from palm to palm. |
|  | Step 3<br><br>Right palm over left dorsum with interlaced fingers and vice versa. |
|  | Step 4<br><br>Palm to palm with fingers interlaced. |
|  | Step 5<br><br>Back of fingers to opposing palms with fingers interlocked. |
|  | Step 6<br><br>Rotational rubbing of left thumb clasped in right palm and vice versa. |
|  | Step 7<br><br>Rotational rubbing of left wrist clasped in right palm and vice versa. |

Table 3. PPEs required and the different levels of infection exposures

| | |
|---|---|
| Level 1<br>No suspected infectious agent<br>Suspected exposure to blood and / or other body fluids | • 3-ply surgical mask / Face shield / Goggles<br>• Plastic apron<br>• Gloves |
| Level 2 (Droplet)<br>Suspected or confirmed infectious agent spread by the droplet route e.g. respiratory viruses | • 3-ply surgical mask / Face shield / Goggles<br>• Plastic apron<br>• Full body gown<br>• Double gloves (Verbeek *et al*., 2019) |
| Level 2 (Airborne) (Fig 2)<br>➢ Suspected or confirmed infectious agent spread by the airborne route e.g. pulmonary TB, measles<br>➢ Aerosol-generating procedures | • N95 / Face shield / Goggles<br>• Plastic apron<br>• Full body gown<br>• Double gloves<br>• Head cover<br>• Shoes cover |
| Level 3<br>For suspected or confirmed infectious diseases of high consequence spread by direct/indirect contact/airborne route e.g. SARS, MERS-CoV, Ebola virus, Avian influenza | • N95 / Face shield / Goggles<br>• Jumpsuit<br>• Plastic apron<br>• Double gloves<br>• Shoes cover |

*Adapted from 'Infection Prevention & Control Orientation Checklist IIUM Medical Centre'*

PPE required depends on the risk of procedure, that is whether the procedure is aerosol generating (AGPs) or non-aerosol generating (non-AGPs). Aerosols are produced when air current moves across the surface of a film of liquid. The greater the force of the air, the smaller the particles that are produced (Jones & Brosseau, 2015). AGPs are defined as any procedure that results in the production of airborne particles (aerosols) (Gralton *et al*., 2011; Judson & Munster, 2019). These are relevant to COVID-19 transmission since this may occur via both direct air-borne infection (Judson & Munster, 2019) and indirect spread via contact with contaminated surfaces (Ferretti *et al*., 2020). Restriction of AGPs is, therefore, an important control measure. In essence, AGPs present high risk of virus transmission compared to non-AGPs. Examples of dental AGPs include the use of high/slow-speed handpieces, use of sonic/ultrasonic scalers, use of 3 in 1 air syringes, air polishing and air abrasion (Leggat & Kedjarune, 2001; Cleveland *et al*., 2016). Figure 2 illustrated the PPE required when performing an AGP.

There should be adequate time between each appointment and extra disinfection time must be taken into account between patients. As mentioned earlier, AGPs are scheduled towards the end of the day, and preferably it is performed in a separate treatment room. The room should have a good ventilation system with limited number of attending staff (Lockhart *et al*., 2020). Air should be exhausted directly to the outside building or filtered through a High Efficiency Particulate Air (HEPA filter) (Mousavi *et al*., 2020). A HEPA filter must remove at least 99.95% of particles in which the diameter is equivalent to 0.3 micron according to European Standard. Following AGPs, aerosol takes up to 60 minutes to settle in neutral pressure room (van Doremalen *et al*., 2020). Therefore, the treatment room door should be closed and windows facing out the building are opened (Izzetti *et al*., 2020).

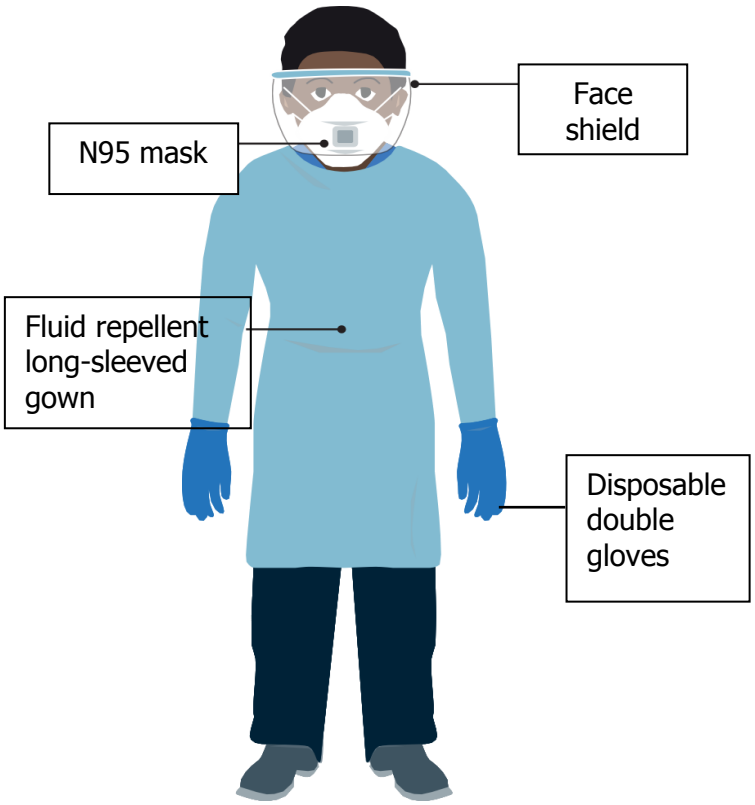



Figure 2. PPE required when involved in aerosol generating procedures (AGPs)
*(Figure adapted from 'Public Health England: A visual guide to safe PPE')*

Studies have proven the effectiveness of N95 masks in the prevention of viral respiratory infections among the health care workers (Radonovich *et al*., 2019; Long *et al*., 2020). N95 mask has the feature of good air tight and close facial fit during AGPs (Desai & Mehrotra, 2020), with high fluid resistance which is suitable when large amount of aerosols are being produced (Loeb *et al*., 2009). Mask filtration efficiency is measured by particle filtration efficiency (PFE) and bacterial filtration efficiency (BFE), and N95 mask can block more than 95% of 0.3 micron particles according to Food and Drug Administration (FDA). For fit checking of N95 mask, it should collapse slightly on inhalation and expand slightly upon exhaling. There should be no air leaking around the mask. Mask should be fitted firmly under the chin and conformed to the bridge of the nose and across the cheekbones. Straps must be positioned at the base of the neck and on the crown of the head. It is imperative that a fit check is performed every time the mask is applied before entering the surgery area to protect oneself from airborne diseases (Grinshpun *et al*., 2009). The mask should not be reused and must be changed after every patient. It should also be changed when the mask becomes wet or damaged during patient care. Hand hygiene must be performed before applying N95 mask, before and after its removal.

For 3-ply surgical mask, it must cover the nose and mouth to inhibit droplet transmission of viral or bacterial diseases (Desai & Mehrotra, 2020). The side of the mask that has a stiff bendable edge is the top and is molded to the shape of the nose, whilst the colored side is the front and the white side touches the face. If using surgical mask with ties, the upper tie is secured with a bow first before the bottom

tie. On removal, the bottom bow is untied first before the top bow. For face mask with ear loops, the loop is placed around each ear, and both ear loops are held and taken off gently on mask removal. Hand wash and hand rub must be performed before putting on and removing surgical mask. Mask must neither be hung under the chin, nor kept in the pocket. Face mask must be changed after every dental procedure (Izzetti *et al*., 2020). Used mask must be disposed of into clinical waste bin.

Goggles must fit well with a good seal and must cover the eyes. Some goggles come with elastic band. Anti-fog goggles are available, or anti-fog spray can be applied onto goggles. Goggles with holes or improper seal are unacceptable in dental setting. Head cover must cover the hair, whilst hijab cover should cover the hair, ears and neck. For plastic apron or gown, they should be waterproof. Plastic apron must be changed in between patient. Full body gown must fully cover torso from the neck to the knees, from the arms to the end of wrists, and wrap around the back. Hand rub must be performed after doffing the plastic apron and gown. They must also be disposed of into the clinical waste bin.

Gloves must be changed when torn or heavily contaminated. They should not be recycled and should not be regarded as substitute for hand hygiene. Gloves must extend to cover the wrist and over the gown to prevent wrist exposure during movement (Verbeek *et al*., 2019). Hand hygiene must be performed before and after wearing gloves. Meanwhile, the used gloves must be disposed of into clinical waste bin. The sequence of donning and doffing for level 2 (droplet), level 2 (airborne) and level 3 PPE material are outlined in Table 4 and Table 5 respectively. This recommendation is based on *'International Islamic University Malaysia (IIUM) Medical Centre: Infection Prevention & Control Orientation Checklist'*. Hand rub must be performed every time an item of PPE is removed assuming that the hands are contaminated.

**Pre-operative mouth rinse**

Although scanty information is available on the effectiveness of pre-operative mouth rinse, pre-treatment oxidizing mouth rinse, for example using 0.5-1% hydrogen peroxide (for 15-30 seconds) (Kampf *et al*., 2020) or 0.2% povidone-iodine (for 15-30 seconds) can be considered (Kariwa *et al*., 2004; Peng *et al*., 2020), since these chemicals contain oxidative agents that reduce the salivary load of oral microorganisms (Carrouel *et al*., 2020). In the past, chlorhexidine mouth rinse was used preoperatively but this may not be effective against virus, as the mouthwash is only effective against bacteria (Fehr & Perlman, 2015).

**Use of rubber dam**

Rubber dam isolation when possible, for example during simple restorative procedures, can reduce the aerosol at close distance (Al-Amad *et al*., 2017). A study by Samaranayake *et al*., (1989) showed that bacterial aerosol reduction was greatest at one meter from the headrest with the use of rubber dam, thereby minimizing the inhalation of infective aerosols by the dental personnel significantly up to 88%. The study also suggested procedure needed high volume suction following rubber dam placement to prevent aerosol spread. It has been reported that more than 90% of the aerosols were evacuated in the dental setting using high volume suction (Devker *et al*., 2012).

Table 4. Sequence of donning for level 2 (droplet and airborne) and level 3

| Level 2 (Droplet) | Level 2 (Airborne) | Level 3 |
|---|---|---|
| Hand wash & hand rub | Hand wash & hand rub | Hand wash & hand rub |
| ↓ | ↓ | ↓ |
| Surgical mask | N95 mask | N95 mask |
| ↓ | ↓ | ↓ |
| Head cover | Head cover | Jumpsuit |
| ↓ | ↓ | ↓ |
| Shoes cover | Shoes cover | Shoes cover |
| ↓ | ↓ | ↓ |
| Hand rub | Hand rub | Hand rub |
| ↓ | ↓ | ↓ |
| 1st layer of glove | 1st layer of glove | Plastic apron / Gown |
| ↓ | ↓ | ↓ |
| Full body gown | Full body gown | 1st layer of glove |
| ↓ | ↓ | ↓ |
| Plastic apron | Plastic apron | 2nd layer of glove |
| ↓ | ↓ | ↓ |
| 2nd layer of glove | 2nd layer of glove | Face shield |
| ↓ | ↓ | |
| Face shield | Face shield | |

**Anti-retraction handpiece**

Anti-retraction handpiece is paramount to reduce the backflow of debris and fluids into the dental units. Backflow may have the consequence of microbial contamination of the air and water tubes resulting in potential cross infection from the dispersion of aerosol and droplets (Samaranayake & Peiris, 2004; Hu *et al*., 2007). Therefore, anti-retraction dental handpiece with anti-retractive valves is strongly recommended in the current climate of pandemic.

**Surface disinfection**

All surfaces must be cleaned and disinfected regularly especially at the frequently touched surfaces such as door handles, light handles, switches, chairs and lift buttons, in view of the long persistence of SARS-CoV-2 on surfaces (Kampf *et al*., 2020). WHO recommended the usage of ethanol 70-90%, hydrogen peroxide ($H_2O_2$) of more than 0.5%, or sodium hypochlorite 0.1% for environment and 1% for blood and body fluid for disinfection (Fallahi *et al*., 2020). Ultraviolet light can disinfect small surface area, but its use can potentially harm the eyes if not protected (Srirengalakshmi *et al*., 2020). Atmosphere is kept dry to mitigate the virus spread, as evidence has suggested that coronaviruses have significantly higher activity at 50% humidity than 30% (Kampf *et al*., 2020). Staff performing decontamination should wear appropriate PPE and follow strictly the doffing procedure at the end of the process.

Table 5. Sequence of doffing for level 2 (droplet and airborne) and level 3

| Level 2 (Droplet) | Level 2 (Airborne) | Level 3 |
|---|---|---|
| Outer layer of glove | Outer layer of glove | Outer layer of glove |
| ↓ | ↓ | ↓ |
| Hand rub | Hand rub | Hand rub |
| ↓ | ↓ | ↓ |
| Plastic apron | Plastic apron | Plastic apron |
| ↓ | ↓ | ↓ |
| Hand rub | Hand rub | Hand rub |
| ↓ | ↓ | ↓ |
| Full body gown | Full body gown | Face shield |
| ↓ | ↓ | ↓ |
| Hand rub | Hand rub | Hand rub |
| ↓ | ↓ | ↓ |
| Face shield | Face shield | Head cover of jumpsuit |
| ↓ | ↓ | ↓ |
| Hand rub | Hand rub | Jumpsuit along with shoes |
| ↓ | ↓ | cover |
| Head cover | Head cover | ↓ |
| ↓ | ↓ | Hand rub |
| Hand rub | Hand rub | ↓ |
| ↓ | ↓ | N95 mask |
| Shoes cover | Shoes cover | ↓ |
| ↓ | ↓ | Hand rub |
| Hand rub | Hand rub | ↓ |
| ↓ | ↓ | Inner layer of glove |
| Surgical mask | N95 mask | ↓ |
| ↓ | ↓ | Hand wash |
| Hand rub | Hand rub | |
| ↓ | ↓ | |
| Inner layer of glove | Inner layer of glove | |
| ↓ | ↓ | |
| Hand wash | Hand wash | |

## Management of medical waste

Every dental practice should follow standard infection control protocol. All dental equipment must be sterilized if possible, with disposable wraps used for non-sterilizable items. Used items must be disposed of properly, including disposable PPE. Dental waste generated from the patient treatment must be regarded as infectious waste and be transported to the temporary storage area of the dental facility in a timely manner. Double layer yellow-colored medical waste bags with 'gooseneck' ligation should be used in accordance with the CDC Guidelines for environmental infection control in health-care facilities (2003).

## Summary

In summary, COVID-19 is a highly contagious disease. Dental professionals must be familiar with how SARS-CoV-2 is spread, how to identify patients with SARS-CoV-2 infection and what protective measures that should be adopted during dental practice to prevent the transmission of the disease. The underpinning evidence and sources regarding safe practice of dentistry amidst COVID-19 are highly variable. In view of the different guidelines and recommendations, clinicians should always follow local or institutional guidelines whenever appropriate. All dental personnel would need to adopt this 'new norm' to protect oneself, patients and the loved ones from contracting this novel coronavirus infection which is likely to stay for a long time.

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