

Review Article

Dentistry and Risk Management – A Challenging Balance in an Era of COVID-19

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ABSTRACT

The novel severe acute respiratory syndrome (SARS-CoV-2) originated in Wuhan, Hubei Province of China, in December 2019, and due to its rapid spread rate, the WHO declared COVID-19 a pandemic and a public health emergency of international concern. The transmission of any infection in a dental office can occur while coming in direct contact with body fluids of an infected patient, environmental surfaces or contaminated dental instruments, or from the infectious particles that have become airborne. Even though the main source of transmission are the patients showing symptoms of COVID-19, recently, asymptomatic patients and patients in their incubation period are reported to be also the carriers of SARS-CoV-2, thereby increasing the risk of spread to close contacts and health-care workers. Because any patient could be a potential asymptomatic COVID-19 carrier, it is advisable to perform tele-screening of all the patients reporting to the clinic. As the transmission of 2019-nCoV via droplets and aerosol is of grave concern, as despite all the precautions taken, it is almost impossible to reduce droplet and aerosol production to zero during dental procedures, hence it is wise that the dental health professionals should not be dependent on any single infection control strategy.

KEYWORDS: *Coronavirus, COVID-19, dental health, dental risk management, pandemic, SARS-CoV-2 infection control*

INTRODUCTION

Coronavirus disease 2019, also called COVID-19, is the latest respiratory tract infection caused by a newly emergent novel coronavirus, which is different from the old strain causing SARS-CoV but share the same host receptor, i.e., human angiotensin-converting enzyme-2.^[1] The novel severe acute respiratory syndrome (SARS-CoV-2) originated in Wuhan, Hubei Province of China, in December 2019; since then, it has rapidly spread to 215 countries so far.^[2] Hence, the World Health Organization (WHO) declared COVID-19 a pandemic and a public health emergency of international concern.^[3] While most of the COVID-19 positive cases show mild symptoms, 14% of these patients develop complications and might need hospitalization and oxygen support and 5% of them

can even require admission to an intensive care unit. In acute cases, there are additional complications involving acute respiratory disease syndrome, sepsis and septic shock, and multi-organ failure, including acute kidney injury and cardiac damage. Old age and comorbidities have been reported as risk factors for death, and a recent multivariable analysis confirmed that older age, higher Sequential Organ Failure Assessment score, and d-dimer >1 µg/L on admission were associated with higher mortality,^[4] while children do not appear to

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account for a large proportion of COVID-19 disease.^[1,5] In addition, mother–infant vertical transmission has not yet been confirmed,^[6,7] but researchers have identified SARS-CoV-2 in the stool of patients from China and the United States that signifies its risk of fecal–oral transmission.^[7]

Even though the main source of transmission are the patients showing symptoms of COVID-19, recently, asymptomatic patients and patients in their incubation period are reported to be also the carriers of SARS-CoV-2, thereby increasing the risk of spread to close contacts and health-care workers.^[7-9] The risk of cross-infection may be high between dental practitioners and patients because of the style and peculiarity of the dental setup.

It is been more than 2 months since the COVID-19 outbreak was declared a global pandemic; still, we do not have a clear picture of its impact on the field of dentistry. Regardless of the large-scale community spread of COVID-19, the urgency of dental care will always be there. Hence, this requires the urgent implementation of strict and effective infection control protocols for dental practices and hospitals in nations inflicted with COVID-19.^[7]

This article will provide some basic relevant guidelines and knowledge about preventing the spread of COVID-19 nosocomial infection in dental settings and management protocols for dental practitioners and students in (potentially) affected areas.

RISK FACTORS ASSOCIATED WITH DENTAL TREATMENT

Because it is a universal consensus to use a water coolant when performing dental procedures,^[10] the transmission of 2019-nCoV via droplets and aerosol is of grave concern, as despite all the precautions taken, it is almost impossible to reduce droplet and aerosol production to zero during dental procedures.^[11]

The transmission of any infection in a dental office can occur while coming in direct contact with body fluids of an infected patient, environmental surfaces or contaminated dental instruments, or from the infectious particles that have become airborne.^[12] A review conducted by Zemouri *et al.*^[13] reported the existence of about 38 types of microorganisms along with *Legionella pneumophila*, the causative pathogen of severe pneumonia in a dental environment, as patients had been found to infected with pneumonia postdental treatments.^[14] Similar observations of tuberculosis outbreaks following a dental visit have been documented by researchers in the UK.^[15]

Ultrasonic and air abrasion units, dental handpiece, etc., generate the most evident aerosols among all dental instruments. Air rotors also involve high-speed air to rotate along with water, which leads to the generation of a considerable number of droplets and aerosol mixed with patients' saliva and/or blood.^[12] Intraoral use of ultrasonic scalers may generate aerosols that contain infectious microorganisms and therefore pose a hazard to the health of the dental professional.^[12,16]

There are reports in medical literature mentioning a significant association of higher incidences of SARS-CoV and MERS-CoV cases with the nosocomial transmission in hospitals, resulting, partly, from the use of aerosol-generating procedures performed on patients with respiratory disease.^[10] Moreover, a large amount of SARS-CoV RNA (7.08×10^3 to 6.38×10^8 copies/mL) have been reported in the saliva of SARS-positive patients, suggesting the possibility of coronavirus transmission through oral droplets.^[17] Moreover, the virus has been found to remain stable and virulent in aerosols and on any inanimate object for a significant duration, hence it can be presumed that 2019-nCoV also has the possibility of being transmitted during a dental procedure, or from patients to clinic staff or other patients at the clinic.^[18]

Salivary and nasopharyngeal secretions, blood, plaque, tooth components, dental filling material used during the procedure, etc., are all primary components of aerosol generated after any treatment, though their percentage might vary for every patient and every procedure. Several recent studies have reported the presence of blood components in dental aerosols in addition to several bacteria.^[12,16]

TREATMENT CONSIDERATIONS

Pretreatment patient screening

Because any patient could be a potential asymptomatic COVID-19 carrier, it is advisable to perform tele-screening of all the patients reporting to the clinic. The dentist should inquire about any COVID-19-associated symptoms and/or any recent contact with confirmed COVID-19 patients and/or travel history to current disease epicenters. Alharbi *et al.* (2020)^[19] have suggested the following five groups post screening according to the urgency of required dental treatment:

- Asymptomatic and unsuspected, unconfirmed COVID-19 case
- Symptomatic and/or suspected, unconfirmed COVID-19 case
- Stable confirmed COVID-19 case
- Unstable confirmed COVID-19 case
- Recovered confirmed COVID-19 case.

As in the routine, dentists should take a thorough medical history from each patient and confirm the health status at each recall visit. During this outbreak, targeted screening questions for COVID-19 must be asked. These questions should include personal, travel, and epidemiological history. Temperature and lower respiratory tract symptoms should be closely monitored. Symptoms of fever and fatigue can also be the signs of acute dental infection; therefore, the etiology should be confirmed.^[10]

- Situation 1: If a patient replies “yes” to any of the screening questions, and his/her body temperature is below 37.3°C: In such a situation, the treatment can be deferred for at least 14 days postexposure event, and the patient should be advised to stay in self-quarantine at home and report any fever experience or flu-like syndrome to the local health department. If a patient replies “yes” to any of the screening questions, and his/her body temperature is no less than 37.3°C, he/she should be sent to quarantine immediately and also should be reported to the concerned authorities looking after infection control.
- Situation 2: If a patient replies “no” to all the screening questions, and his/her body temperature is below 37.3°C: Here, the dentist can treat the patient with extra protection measures and avoid spatter or aerosol-generating procedures to the best. The patient should be referred to special COVID clinics if the patient’s response is “no” to all the screening questions, but his/her body temperature is no less than 37.3°C.^[18,20]

Treatment planning

There is no universal protocol or guideline available for dental care provision to active or suspected COVID-19 cases till now. However, the categories of dental procedures suggested by Alharbi *et al.*^[19] can help dental practitioners around the world in the management of patients and can provide a solid base for further health-care guideline development.

Five categories of dental procedures as suggested were:^[19]

- A. Emergency management of life-threatening conditions: Fractures of jawbones, dental trauma, extraoral swelling, and uncontrolled bleeding from extraction sockets are usually managed by oral and maxillofacial surgeons
- B. Urgent conditions that can be managed with minimally invasive procedures and without aerosol generation: Teeth with pulpal pain or vertical tooth fracture indicated for extractions, deep carious lesion manageable by pulp capping dressings, fixing of a loose orthodontic bracket or managing defective

wire causing gingival impingement and discomfort, orthodontic removable appliance adjustment, denture trimming and adjustment, dry socket dressing, or dental management of acute pericoronitis related to third molars

- C. Urgent conditions that need to be managed with invasive and/or aerosol-generating procedures: Dental trauma with avulsion/luxation that needs invasive/aerosol-generating procedures, acute pain unmanageable with medicines and requires immediate intervention, and fractured fixed prosthesis causing gingival or mucosal discomfort
- D. Nonurgent procedures: Removable denture adjustments or repairs, asymptomatic fractured or defective restoration or fixed prosthesis
- E. Elective procedures: Routine dental checkups, restorations, oral prophylaxis, esthetic treatments, orthodontic therapies, and extractions of asymptomatic teeth.

Nonemergency dental treatment should be avoided at all cost and should be rescheduled after the outbreak, to ensure the safety of patients and dental staff and associates.^[10]

In case of the urgency of treatment for any suspected or confirmed COVID-19 patient, it should be performed in negative pressure rooms in a hospital setting. The dental treatment should only be considered under the guidance of the primary physician after thoroughly evaluating the disease history and current health status.^[19]

STANDARD PRECAUTIONARY STEPS DURING DENTAL PROCEDURES

Control of spatter and bioaerosol contamination and cross-infection

Due to the unique nature of dental care, which includes face-to-face proximity between patients and dentists; frequent exposure to saliva, blood, and other fluids; production of aerosols; and use of manual cutting instruments, biosafety measures are essential to prevent the transmission of microorganisms so that professionals and patients are protected. Therefore, it is important to understand aerosol transmission and its implications in dentistry.^[10]

During various dental procedures, microflora of the respiratory tract and oral cavity can easily become part of the aerosol generated and can contaminate the eyes, skin, and oro-pharyngeal and respiratory system of the dental personnel.^[21] These bioaerosols have the potential to float in the air for a considerable amount of time. Aerosols from highly virulent pathogens such as severe acute respiratory syndrome-coronavirus (SARS-CoV) can travel more than 6 feet. As they have a low settling

velocity, they may remain in the air for a longer time and travel further before they can enter the respiratory tract or contaminate surfaces.^[22]

Based on the current epidemiological data, 2019-nCoV has higher transmissibility than SARS-CoV and MERS-CoV and the aerosol transmission increases when there is an exposure to high concentrations of aerosols in a relatively closed environment.^[23] Hence, there is a dire need to analyze the risks involved from exposure to aerosol and splatter, both to dental team and patients, and modification of standard precaution and infection control regimen targeted toward 2019-nCoV is essential during this outbreak.^[10,12]

The simultaneous use of a high-performance sucking device and rubber dams can significantly decrease the production of harmful aerosol, particularly in situations when high-speed handpieces and dental ultrasonic devices are used. 70% reduction in airborne microbes in a 3 feet diameter around the operating zone has been reported with the use of rubber dam.^[24] Extra high-volume suction for aerosol and spatter should be in situations where isolation using rubber dam is not possible, and chemico-mechanical method, for example, Carisolv and Atraumatic Restorative Techniques (ART) for caries removal and hand scaler instead of ultrasonic scaling, can be used to minimize the generation of aerosol.^[18]

Dental handpieces with specially designed anti-retractive valves or other anti-reflux designs are strongly recommended as they significantly reduce the backflow of oral bacteria and Hepatitis B virus (HBV) into tubes of the handpiece and dental unit in comparison to the handpiece lacking anti-retraction action, thus averting cross-infection.^[18,25]

Airborne contamination arising from the operative site can be effectively eradicated by two available approaches, i.e., removing the contaminated material from the air either before it leaves the nearest area around the operating field or after it has become air borne. The commonly used mode of handling airborne contagion in a dental environment is a high-efficiency particulate air, or high-efficiency particulate arrestance (HEPA) filter, or ultraviolet chambers in the ventilation system. The most convenient and easy way of making the dental clinic free of as much airborne contamination is to remove it before it escapes the operating field with the aid of a high-volume evacuator (HVE), which has reported 90% reduction in airborne contamination in dental clinics.^[12]

In addition, preoperational mouth wash containing oxidative agents such as 1% hydrogen peroxide or 0.2% povidone^[26] is recommended, especially when rubber

dam cannot be used. 20–30 s of mouth rinsing can lower the risk of retraction of the oral cavity fluids and eventually curb the chances of cross-infection. Extraoral radiographs are recommended in patients with excessive salivation and gag reflex.^[19] When intraoral imaging is mandated, sensors should be covered with a double barrier to prevent perforation and cross-contamination.^[27]

Although there are no reported cases of coronavirus transmission in a dental setting given the high transmissibility of the disease, dental teams should be on high alert,^[23] and the precautionary adoption of appropriate barrier techniques or personal protective equipment (PPE) such as face masks, gloves, and eye protection can further reduce the risks of infection due to aerosol contaminations.^[28]

Emphasis on preventive dental services

During this phase of pandemic, the spotlight in dentistry should be on advice and self-help. This can be done by providing oral health education interventions through adequate remote information by using “social” digital platforms on which the pediatric dentist can publish and disseminate behavioral guides for protection of oral health of children. Pediatric dentists must provide adequate information regarding the cariogenic properties of specific foods and encourage intake of diet rich in fruit and vegetables. Discourage the consumption of soft and energy drinks which may cause enamel erosions, making them more susceptible to cariogenic bacteria. Faulty habits like night feeding of fermentable liquids containing carbohydrates or pacifiers dipped in honey or sugar should be discouraged and stopped.^[29] Guide the parents to supervise the child while brushing after every meal.^[29]

Because the therapeutic access to dental care is restricted, topical fluoride such as silver diamine fluoride (SDF) application can be followed to arrest active dental caries in children. In addition, the use of SDF is free from any kind of danger and can be safely applied both in adults and children, and a similar pattern of caries arrest is seen in primary and permanent teeth.^[30]

As children are now staying indoors for a longer time, they are at an increased risk of traumatic injuries. Hence, careful supervision of the child's activities is recommended and instruct to use protective mouthguards, if possible. In case the patient has dislodged temporary dressings, it is recommended to keep cavity free of food debris through mechanical brushing after meals to prevent the onset of painful symptoms and avoid too hot or too cold foods. If the dressing gets dislodged in an endodontically treated tooth, then wash it with water diluted with hydrogen peroxide using a special syringe

without a needle, followed by placing of cotton pellet at the time of eating. Dental emergencies such as acute pain with irreversible pulpitis require immediate endodontic therapy that should be performed under strict isolation, preferably with a rubber dam and a high-volume saliva ejector. The filling material can be replaced gently without a devitalizing agent later according to the manufacturer's recommendation.^[7]

Chronic periapical periodontitis can occur with dental pain when chewing, and antibiotic therapy with amoxicillin or cephalosporin and pain relievers such as ibuprofen is recommended to control symptoms. Antibiotics should not be prescribed in haste, or on a routine basis, or in dental conditions, for example, pulpitis. Suitable antibiotics should only be suggested in cases of bacterial infection after a proper assessment of the dental needs and patient's medical history.

In case of mobile primary teeth or delay in teeth exfoliation and the simultaneous eruption of the corresponding permanent teeth, the child should be motivated in chewing hard consistency food items such as raw fruit, that can stimulate the loss of the mobile deciduous tooth.^[6]

In case of eruptive gingivitis of permanent first molar (in 6- and 7-years-old), parents can use cleaning swabs that help the removal of food debris in the gingiva between tooth and gum, followed by rinsing with anti-inflammatory mouthwashes alternating with local chlorhexidine. For children undergoing orthodontic treatment such as using a removable orthodontic appliance, the first indication to the parents is to the correct hand hygiene measures before inserting the appliance into their mouth or activating it. Activations of fixed orthodontic appliances such as the rapid palatal expander cemented on the palatal arch, can be temporarily deferred and precautions should be taken while eating viscous foods, such as chewing gum, or hard foods that can lead to partial detachment of the device.^[7]

Barrier techniques for health-care workers and patients during the COVID-19 pandemic

Despite rigorous barrier techniques, dental personnel are exposed to a significant amount of spatter and aerosol distribution. Multi-layered, preformed, cup-style face masks are better than the conventional (single layered), preformed, cup-style masks, as they provide more effective filtration of deleterious airborne particles.^[31]

No specific guideline has been framed for the protection of dental professionals from 2019-nCoV infection in dental clinics and hospitals. In the last experience of SARS coronavirus, medical professionals in hospital

settings got infected in large numbers. Peng *et al.*^[18] have suggested the following three-level protective measures of dental professionals for definitive situations.

1. Primary protection for the dentist and associates comprises wearing a disposable surgical mask, head cap, and clinical attire such as white coat. Protective goggles or face shield, and disposable latex gloves or nitrile gloves, can also be used if necessary
2. Secondary protection or advanced protection for dental professionals involves wearing of disposable head cap, surgical mask, protective goggles, face shield, and clinical attire such as white apron along with disposable surgical clothes over it and disposable latex gloves^[18,24]
3. Tertiary protection or strengthened protection when coming in direct contact with patient with suspected or confirmed 2019-nCoV infection. Although it is not anticipated to perform dental treatment in a patient with a 2019-nCoV infection, in the unlikely event that this does occur, special protective external clothing such as hazardous material (hazmat) suits^[32] will be mandatory in addition to secondary protection. If hazmat suits are not at one's disposal, clinical attire or uniform with an additional external disposable protective clothing can be used.^[18,32]

While leaving dental office, the dentist or other health-care providers must change into their normal clothes, wash hand and face properly, should remove their shoes, take shower, and wash their clothes separately as soon they reach home.^[28]

Protective measures for patients

At a time, a single patient should be attended preventing any kind of contact with other patients.^[33] Especially in situations of pediatric dental setup, the patient's parents should only be allowed if absolutely necessary (e.g., a child attending with a parent during pediatric dental appointments). As far as possible, one guardian only should be allowed per patient, and this escort should be from the patient's household to minimize exposure risk.^[34]

On entering the clinic, both the patient and his/her parent should cover their footwears with disposable covers, wash their hands or use hand sanitizer, and wear a mask to follow respiratory hygiene. They should not be allowed to carry their personal items into the operatory.^[33] If face-to-face triage validation is required before treatment begins, patients and parents should be initially seen in a room large enough to provide social distancing, and the clinician should wear PPE in line with the Public Health England guidance. This is followed by checking of the body temperature of both patient and parent/guardian and analysis of respiration

issues and travel history.^[34] After the dental procedure is accomplished, the patient should be provided with a fresh face mask, instructed to sanitize their hands, and guided to the waiting area where the dentist can provide the posttreatment instructions and prescriptions, following that they pick their personal belongings, remove shoe covers, and move out of the department.^[33]

GENERAL PRECAUTIONARY STEPS

Waiting area

A safe workplace is equally important as a safe practice. Hence, protective measures must be taken to keep waiting areas safe. It can be done through the engineering controls which include installing high-efficiency air filters and increasing ventilation in the waiting area (60 L/s per patient is considered adequate ventilation);^[35] installing physical barriers, such as clear plastic sneeze guards; and installing drive-through window for customer service. Some particular office area should be demarcated and should be designated for patients who have to be safeguarded from the increased risk of administrative controls that require action by the worker or employer such as encouraging sick staff/ attendant to stay at home, minimizing contact among patients and dental team, encouraging Internet-based communications or telework, and enlightening the front desk personnel with knowledge on COVID-19 risk factors and precautionary protocols while coughing, care of PPE, etc.^[36]

Place a cough etiquette instruction at the entrance of the waiting room and ensure that all patients cover their nose and mouth with a tissue or their elbow when coughing or sneezing; instruct them to dispose used tissues into a waste bin immediately after use; and ensure hand hygiene. The spatial separation of at least 1 metre should be maintained between patients which should be ideally marked on chairs and floorings. The number of chairs must be reduced in the waiting area to maintain social distancing. If staff in the reception area is not able to maintain 2-metre distance from the patient due to space constraint, then they should be given fluid-resistant surgical masks to wear.^[34] Patients showing symptoms of any respiratory illnesses, should be provided with a disposable surgical face mask and have to be isolated to limit their direct contact with the staff and other patients.^[29] Equipment such as blood pressure cuffs, weighing machines, and thermometers should be cleaned and disinfected with 70% ethyl alcohol after each use, as recommended by the WHO 2016.^[37] All surfaces, chairs, tables, telephone, and doors that come into contact with health-care professionals and patients must be cleaned with alcoholic disinfectant and

complete sanitization of air-conditioning system must be done regularly.^[1] Magazines should be removed from the waiting room in order to avoid transmission via touching contaminated objects and then touching the mouth, eyes, or nose.^[38]

Personal hygiene measures

In the absence of any treatment or vaccines against COVID-19, one of the most effective ways of preventing its spread is soap and water. The simple act of thorough handwashing for 20 s with soap and water is one of the best ways of reducing the possibility of nosocomial infections, including COVID-19. The genetic component of virus is enclosed by a fatty membrane which can be broken by soap and water combination. The virus' "spike" proteins, which normally help it to invade human cells, get disrupted, rendering the virus inactive and the broken fragments are washed off with hand rinsing. Hence, hand hygiene is a must before and after touching the patient, before and after any procedure, after every exposure, and after touching a patient's surroundings.^[10,39]

DISINFECTION OF THE CLINIC SETTINGS

The clinic settings in all medical institutes should be cleaned and disinfected in agreement with the code of the Management of Surface Cleaning and Disinfection of Medical Environment (WS/T 512-2016), including the elevators, chairs, doorknobs, handles, and bathrooms.^[18] Clinics must be disinfected before and after each dental procedure and be adequately ventilated.^[33]

In between the appointments, PPE including a face shield and eyewear should be cleaned with soap and water followed by disinfection by 0.5% sodium hypochlorite solution after each use.

Nondisposable instruments such as dental chair, light, X-ray unit, and handpieces must be cleaned as per the manufacturer's instruction. Handpieces must be cleaned of all debris and heat sterilized after every patient.^[28] Dental impression and models of all the patients should be washed and sanitized with alcohol-based disinfectant, and it is better to use digital impression-making techniques.^[33]

There are pieces of evidence suggesting that coronaviruses can maintain its virulence on metal, glass, and plastic surfaces for several days, making these surfaces in dental clinics as a source of infection. Because the COVID-19 virus can be actively virulent at room temperature from 2 hours up to 9 days with a significant virulence at 50% humidity, maintaining a clean and dry dental environment can reduce the transmission of coronavirus to a greater extent.^[32,40]

MANAGEMENT OF MEDICAL WASTE

It should be mandatory for personnel handling soiled materials of COVID-19-infected patients to wear appropriate PPE and perform hand hygiene after removing PPE^[41] and to dispose of all the soiled clothing in a clearly marked, leakproof bags. These soiled linens can be machine washed or soaked in hot water (60°C–90°C) with detergent, followed by soaking in 0.05% chlorine for 30 min and sun drying.^[42] Medical waste generated from treating confirmed or suspected COVID cases must be placed in double-layered yellow color medical waste package bags with “gooseneck” ligation and disposed of according to the requirement for the management of medical waste.^[18]

CONCLUSION

In this time of the COVID-19 pandemic, it is wise that the dental health professionals should not be dependent on any single infection control strategy. They should be following a combination of multiple defense mechanisms ranging from personal protection barriers such as masks, gloves, and safety glasses; preoperational mouth rinses with 1% hydrogen peroxide or 0.2% povidone; installations of an HVE by a chairside attendant; and lastly having an additional layer of defense by HEPA filter for preventing aerosol contamination of the area. This is not a costly investment and should be routinely implemented.

Closure of dental practice may reduce the spread, however this can only be a short-term solution and in the long run, it will only increase the sufferings of the individuals needing immediate dental care. Hence, standard guidelines for dental care provision during the global pandemic should be formulated and implemented worldwide.

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Conflicts of interest

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