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Effective and practical recommendations to dental team when providing dental services in the era of COVID-19

Authors: G. Tuyishime[1,*]; M. E. Dusabimana[2]; M. C. Ineza[2]

Affiliations: *[1]Konkuk University, Seoul, South Korea; [2]University of Rwanda, Kigali, Rwanda*

ABSTRACT

Severe acute respiratory syndrome coronavirus 2 (SARS CoV 2) is the coronavirus that causes COVID-19 (coronavirus disease 2019). It is an airborne virus and can spread through small droplets of saliva.

Dental professionals work very close to the patient's mouth, putting them at high risk of contracting SARS-CoV-2. This is because aerosols and splatter are generated when performing some dental procedures, which are known to be the possible potential sources of some other serious diseases to the dental team and patients in the dental settings. During the COVID-19 pandemic, dental professionals continued to provide dental services to patients; however, dental professionals are more likely to become contaminated due to the nature of their work. Hence a cautious emergency implementation of extra-protective measures is paramount to limit viral contamination between patients and the dental team. This research review was performed to summarize essential practical recommendations to be adopted by the dental team when providing dental services to the patient during the COVID-19 period, to minimize the risks of COVID-19.

Keywords: SARS-COV-2, Coronavirus, Aerosols, Preventive Measures, Droplets, COVID-19

INTRODUCTION

Coronaviruses are a group of viruses that belong to the family of Coronavirida, order of Nidovirales [1]. They are RNA viruses that affect both humans and animals and cause respiratory illnesses ranging from mild to severe infections.

In the last decades, coronaviruses were thought to be infections of animals, but this perspective changed in 2002, when the world faced the first severe acute respiratory syndrome (SARS) outbreak caused by SARS-CoV infectious agent, which took place in one of the provinces of China known as Guangdong [2]. A few years later, another human coronavirus outbreak took place in Middle East countries and killed many people. The virus was identified as Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012 [3], but later on, it was also found in many other European countries. Recently at the end of 2019, the world experienced a novel coronavirus outbreak which was named by the International Committee on Taxonomy of Viruses (ICTV) as "SARS-CoV-2"[4], and its disease was identified as coronavirus disease 2019 (COVID-19) [5]. The virus originated in Wuhan, one of the business cities of China, this pandemic

***Corresponding author:** Gabriel tuyishime, Email:gabbyno2008@gmail.com, hone number:+821040942285, Konkuk University, Seoul, South Korea; **Potential Conflicts of Interest (CoI):** All authors: no potential conflicts of interest disclosed; **Funding:** All authors: no funding was disclosed; **Academic Integrity.** All authors confirm that they have made substantial academic contributions to this manuscript as defined by the ICMJE; **Ethics of human subject participation:** The study was approved by the local Institutional Review Board. Informed consent was sought and gained where applicable; **Originality:** All authors: this manuscript is original has not been published elsewhere; **Review:** This manuscript was peer-reviewed by three reviewers in a double-blind review process; **Type-editor:** Emilia (USA).

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killed more than eighteen thousand patients and infected thousands and thousands of individuals within its first fifty days of appearance [6].

An outbreak of severe pneumonia-like illness, thought to have originated in one of the markets in the central China metropolis, has put all governments on high alert worldwide due to its high prevalence rate and severe consequences associated with it. Various reports have identified the novel coronavirus as having clinical presentations that strongly resemble SARS [7, 8]; however, COVID-19 or SARS-CoV-2 spreads faster than its two ancestors, SARS-CoV and MERS-CoV. Based on data reported in 2020, the case fatality rate of COVID-19 is estimated to be approximately 2% [9], which is low compared to the case fatality rate of SARS-CoV, which is roughly 10% [10], and less than the case fatality rate of MERS-CoV which is around 40% [11].

According to the statistics reported by World Health Organization (WHO) in June 2021, in 222 countries, more than 180 million cases of COVID-19 were reported, with almost 4 million of the total number of confirmed deaths. Since the WHO declared COVID-19 as public health emergency of international concern, the most affected countries in terms of confirmed cases were listed as follows; the United States of America, India, Brazil, and Russia [12].

COVID-19 can affect every human being; however, some groups of people are at high risk of getting infected due to the nature of their work (for example, healthcare workers). Since the beginning of the COVID-19 pandemic, healthcare providers have been engaged in the diagnosis, treatment, and prevention of COVID-19 cases as well as providing their regular dental services and have worked tirelessly with high commitment despite fear of becoming infected [13].

Transmission of infectious diseases from an infected patient to healthcare providers or patients to other patients in hospital settings has been well documented in one study done to assess the risk of acquiring respiratory diseases to healthcare providers operating in high-risk settings. The results have shown a 2.5 risk ratio of being infected with viral or bacterial infections during care delivery [14].

Dental professionals are ranked among healthcare providers at high risk of getting infected with COVID-19 due to the nature of dental procedures, which may generate aerosols and the proximity of the dentist and patient. Hence there is an emergency need to highlight the risks of COVID-19 contamination associated with dental procedures and draw attention to possible extra-protective measures and strategies which could be vigorously adopted to curtail the spread of COVID-19 between dental professionals and patients. This research review was performed to summarize the essential practical recommendations to be adopted by the dental team when providing dental services to patients during the COVID-19 period and to minimize the risks of COVID-19 transmission in dental offices.

METHODOLOGY

During this research review, both electronic databases and hand searches were used to ensure that the most relevant articles of our research were identified. Some keywords such as SARS-COV-2, coronavirus, risk of contamination, preventive measures, recommendations, and dental professionals were used throughout database searches when searching in PubMed, HINARI, and Google scholar databases. Additionally, recommendations from the CDC (Center for diseases control), OSHA (Occupation Safety and Health Administration), and the world health organization (WHO) were considered for additional information. All the articles reporting direct evidence about practical recommendations to dental professionals when providing dental care to patients during the COVID-19 pandemic were considered. All reviewers performed readings of the full-text papers and retrieved articles were exported into Mendeley, where duplicates were removed.

COVID-19 MODE OF TRANSMISSION

Understanding the different transmission routes of COVID-19 is critical in developing effective strategies to contain the spread of infection in medical settings by breaking the chain of transmission. Different literature shows different modes of transmission of COVID-19, including vertical transmission from mother to child, contact, droplet, fecal-oral, and aerosol transmission [15]. This article will focus on three main transmission routes, which can happen in dental offices. Among them, there are indirect and direct contact, droplet, and aerosol transmission.

Contact and droplet transmission

Transmission of COVID-19 can occur in the dental office by direct or indirect contact with the body fluids of infected patients. Droplet contamination can occur when a person gets in contact with contaminated small liquid particles from an infected patient's mouth or nose released during speaking, singing, coughing, sneezing as well as breathing heavily resulting in infection [16,17]. Current evidence suggests that SARS-CoV-2 droplet transmission can happen when a healthy person is within one millimeter of an infected person or in close contact with sick people.

Indirect contact transmission of COVID-19 can happen in a dental office when the normal person gets in contact with virus-contaminated environmental surface areas or medical instruments. This mostly happens when respiratory droplets of infected patients land on those surfaces or objects, and then transmission occurs when the same person touches his mouth, nose, or eyes [18].

Aerosol transmission

Aerosol transmission is the outspread of an infectious agent through inhalation of contagious aerosol particles suspended in air or environment for some time and over long distances [19]. Aerosol and droplets are realized in the air from saliva and other body fluids in the surrounding environment and may further cause respiratory infections.

The aerosol transmission of SARS-CoV-2 occurs when performing aerosol-generating medical procedures (AGMPs) involving COVID-19 patients [20]. In the dental office, some AGMPs have been associated with increased risks of transmission of coronaviruses, such as ultrasonic scaling, cavity preparation, and dental polishing [21]. Most of them are procedures performed when using high-speed drills, lasers, and powered scalers in the presence of contaminated bodily fluids like saliva. These procedures produce aerosols and droplets which may contain different harmful microorganisms, including viruses such as SARSCOV-2 [22], that can contaminate all attendants in the dental office.

A study performed on 12 patients in Hong Kong has found that 91.7% of patients (11/12) had covid-19 in their saliva [23]. This is in line with another study conducted by Wei-Kung Wang and his colleagues to determine the load of SARS-COV in the throat and saliva of positive patients. The results of this study have found the presence of a high amount of SARS-COV RNA in patients 'saliva samples which was in the range of 7.08×10^3 to 6.38×10^8 copies/ml, which could verify the possibility of aerosol and droplet transmission of coronaviruses in dental settings [24].

Complementing research justifying the possibility of the presence of contaminated aerosol in dental offices has been highlighted by the results of another study conducted by Zemouri C et al., where the research team identified more than 38 virulent pathogens presented in the air of dental settings [25].

Aside from the transmission of SARS-CO-2 via aerosol-generating medical procedures, a few types of research have been done to support the aerosol transmission of the COVID-19 infectious agent in the absence of AGMPs. This transmission occurs when SARS-CoV-2 is emitted in aerosol exhalation [26], and the recipient becomes infected when inhaling contaminated aerosols. This is following the results of various studies conducted in hospital settings, where COVID-19 patients with symptoms were cared for without performing aerosol-generating medical procedures, and have found the presence of SARS-COV-2 in air samples collected in the same area [27, 28].

Touching on aerosol contaminated surfaces in hospital settings could be another way of transmitting many nosocomial infections. Studies have shown that SARC-COV and MERS-COV, when placed in body fluids, can survive on surfaces for a few days before being transmitted to another person [29]; the recipient will get contaminated when touching his eyes, and mouth or nosed or when even get injured by contaminated objects.

POSSIBLE SOURCES OF CONTAMINATION IN THE DENTAL SETTING

Different writings have listed saliva, dental instruments, respiratory sources as well as the operative site as the main sources of contamination in dental settings when delivering dental care to patients [30]. The high risk of contamination in dental settings is highly linked to procedures that generate aerosol and splatters containing virulent pathogens like bacteria as well as viruses which might increase transmission risks of viral infections [31].

In medicine, aerosols are defined as liquid or solid

particles of less than 50 micrometers (<50µm) in diameter, emitted into the air by different means such as medical instruments or machines, but also can be suspended in the air by human beings and animals [25]. However, splatter is described as a mix of air, water, and solid substance, bigger than 50 micrometers (>50 µm) in diameter and visible to the naked eye [32].

Writings have shown that dental aerosol represents a potential route for disease transmission as it is made of a mixture of saliva, blood, organic particles, as well as respiratory fluid and most frequently becomes contaminated with microorganisms located in the oral cavity [25]. Some years back, different kinds of literature have indicated that aerosol and splatter have played an imperative role in transmitting human viral diseases such as measles, herpes simplex, and severe acute respiratory syndrome [30].

Dental professionals perform daily aerosol-generating procedures in patients' mouths containing saliva, which is considered the reservoir for the generation of aerosols that might contain SARS-CoV-2and has been documented as one of the potential routes of transmitting COV-19 to dental professionals [33]. In general, healthcare providers are at high risk of acquiring serious infections from the hospitals due to the infectious nature of their work, the types of medical interventions as well as medical instruments that produce aerosols and splatters.

In dental offices, aerosols and splatters are generated by different accessories connected to dental chairs, including slow-speed handpieces, ultrasonic /sonic scaler, high-speed handpieces, and dental air-water spray guns[34], and their release aerosol in front of both patient and the operator.

Based on the ability of aerosol and splatter to travel a certain distance and fall and contaminate different areas, clinical contact surfaces in the operating room have been suggested as potential routes of diseases transmission [35, 36], including COVID-19, given that SARS-COV-2 can survive on the surface environment for 4 to72 hours [37], and can lead to indirect exposure after hand touch. Even if the patient has left the operating room, the clinical environment could be considered a dangerous source of infections in dental and hospital settings.

Moreover, an increase in transmission of COVID-19 was suggested to be related to the closer and prolonged contact established between dental operators and patients during dental care delivery [38]. It facilitates easy direct contact between the infected droplet and exposed tissues of the conjunctival of the eyes, nasal and oral mucosa [39], leading to transmission of SARS-COV-2 and putting at high risk both patients and dental care providers at risk. During dental treatment, operator and patient are in face-to-face contact of less than 1m distance which is considered a very high-risk position to get contaminated by COVID-19 in case dental care is provided to an infected patient [38]. In coronavirus breakouts, sitting in a crowded waiting room together with others is a risk of contracting COVID-19, as they might be infected people who don't show infections and could be the potential spreaders of the virus[40]. Reducing overcrowding and long waiting time in the clinic waiting room would increase patient satisfaction and significantly reduce the risk of transmission of SARS-CoV-2 among patients [41].

HIGH-RISK PROCEDURES IN DENTAL SETTINGS

While aerosols and splatters pose a risk for SARS-CoV-2 transmission, writings in literature have listed some main dental procedures that generate aerosols and splatters; consequently, this may contaminate the environment around the dental chair and further lead to human contamination. Most of them are procedures performed when using high-speed drills, lasers, and powered scalers in the presence of bodily fluids [21]. These can create risks for disease transmission between patients and healthcare providers. Apart from these mentioned procedures, some other procedures may present potential risks of viral transmission in the dental office. These include using low-speed handpiece in both restorations and dental polishing under the presence of water/saliva, during taking the intraoral x-ray, the use of air-water spray guns when treating patients and when patients are sneezing or coughing during dental treatment [34].

In a study done to determine the riskiest dental procedure to transmit infection, it was discovered that procedures performed with ultrasonic scalers produce the most airborne contamination, followed by procedures performed with high-speed handpieces, air polishing, and then procedures involving the use of an air-water syringe [42]. During this study, researchers have reported

the presence of low production of contaminated aerosol during tooth extraction as well as during oral screening [43].

In general, all non-surgical and surgical dental procedures using high and slow speed handpieces, ultrasonic scalers as well air/water syringes produce aerosol contaminated by infectious agents, which can contaminate the operating environment or directly can transmit the infection to the human being located in the operating area [44].

After the treatment of one patient, operating surfaces are more likely to be contaminated by aerosols, since SARS-CoV-2 may survive between 4 to 72 hours on clinical surfaces, which can result in indirect contamination after being in contact with a contagious agent from contaminated clinical areas [45].

STRATEGIES AND RECOMMENDATIONS TO PREVENT SARS-COV-2 TRANSMISSION IN THE DENTAL OFFICE

Given that SARS-COVID-2 is frequently found in saliva [23], dental professionals must adhere to rigorous preventive health measures to mitigate COVID-19 transmission, especially given the new variants of SARS-CoV-2 that are rapidly emerging in various geographic locations across Rwanda as well as in other countries.

During the COVID-19 era CDC (Center for diseases control and prevention) recommended dentists to provide emergency and urgent procedures as well as minimize aerosol generation to ensure disruption of COVID- 19 transmissions within dental facilities [46]. Dental emergency conditions are defined by the American Dental Association as life-threatening conditions, severe pain such as cellulitis, uncontrolled bleeding, and facial trauma that affects the patient's airway. On the other hand, urgent conditions are defined as severe pain from pulpitis, Pericoronitis, trauma with tooth avulsion, facial spaces infection related to the tooth, alveolar osteitis, crown or bridge replacement, and pain from broken orthodontic apparatus [47].

GUIDANCE ON THE USE OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

The WHO (World health organization) and CDC recommend that dental professionals should wear the highest level of personal protective equipment (PPE) more cautiously than before to avoid any contamination of infectious agents from aerosol and splatter realized when treating dental patients. Some recommended PPE are double gloves, surgical masks or N95/FFP2 or FFP3, gowns, goggles, and overshoes [48].

During the COVID-19 pandemic, it is recommended that all personnel working in a dental office who is not involved in dental procedures wear surgical masks. Dentists performing non-aerosol-generating dental procedures are recommended to wear a surgical mask and face shield or eye protection. However, when performing aerosol-producing dental procedures, a face shield and N95 mask should be worn to minimize the risk for transmission of SARS-CoV-2 [49].

Dental professionals should wear surgical gowns involving in-patient care, and non-surgical gowns should be worn by staff involved in instrument processing, lab work, and cleaning [50]. CDC recommends using surgical masks and gowns that meet standards for fluid resistance and bacterial filtration efficiency [51].

All staff involved in patient care, lab work, and instrument processing should wear gloves, and during aerosol-generating procedures, dental professionals should also wear head and foot covers [52].

COVID-19 PREVENTIVE MEASURES AND RWANDAN CULTURE

Rwandans live communal lives; we have different ways of supporting our communities in sickness, death, and other calamities [53]. For example, when a community member dies, friends gather to sympathize with the affected family and the entire community gathers to bury the dead. However, due to the COVID-19 pandemic, the government of Rwanda has decided to reduce the number of persons attending burial events by up to 50 attendants to minimize the spread of COVID-19 [54]. This new way of living would be considered a nuisance to the Rwandan culture.

In addition, greetings are essential in our culture. When greeting a friend or important person, Rwandans shake right hands or hug each other as a sign of respect [55]. One of the measures taught and implemented in the community to prevent the spread of COVID-19 includes urging citizens to avoid shaking hands and close body contact, such as hugging [56], which could be considered a cultural nuisance in Rwanda because it goes

against social norms. Furthermore, other new practices, daily use of masks and regular hand washing are unusual practices to the population but have no impact on Rwandan culture. Based on the above statements, an argument could be made that the government should put many efforts into containing COVID-19 by implementing social distancing and strict hygiene practices while protecting norms intrinsically linked to our culture.

Recommendations for dental professionals [57–60]

As far as possible, avoid direct interaction with the customer.
When a patient is already inside the operating room, restrict the entry of unessential persons in the dental office. Only Dental assistants are allowed to enter for assisting in dental procedures.
Handling contaminated tools and contact with clinical surfaces should be kept to a minimum.
When possible, minimize aerosol-generating operations and prioritize atraumatic restoration and minimally intrusive methods.
While performing aerosol-generating procedures, four hand dentistry, large volume suctions, rubber dams, and extra-oral vacuum aspirators are indicated.
Dentists should double-check their protective equipment (PPE) to ensure correctly worn and fitted throughout dental procedures.
Dentists should minimize clinical care, maintain a significant time interval between patients, and postpone non-urgent and non-emergency treatments.
Patients should use an antibacterial preoperative mouth rinse to prevent infection spread because the oral cavity is a high-risk area for COVID-19 infection.
Hand hygiene procedures should be followed before and after contacting patients and even after encountering contaminated surfaces; the use of alcohol-based hand rubs or water and soap for at least 20 seconds is recommended.
After performing dental procedures, the CDC recommends waiting 15 minutes before receiving a new patient to ensure proper cleaning and disinfection of the operating areas.
The Australian Dental Association recommends terminal cleaning of dental settings, which includes two-step cleaning by using detergents/disinfection of all surfaces, including the floor and reusable instruments, in case the aerosol-generating procedures are performed on confirmed or suspected cases of COVID-19.
Because it reduces saliva flow and coughing, panoramic radiography is a good alternative to intraoral radiography.
Dentists are recommended to use low-speed handpieces for emergency treatments.

Recommendation for patients [57–61]

Patients should use an alcohol-based hand rub or soap and water to clean their hands before entering the dental office.
The patient should lock their belongings in cabinetry outside the dental office and wear overshoes to enter the operating room (when possible).
Patients should refrain from touching their noses, and mouths or shaking hands in dental offices.
Patients are requested to keep at least a 1-meter gap in the waiting area when waiting outside the dental office.
Patients are encouraged to attend their appointment alone, and in the case there is an accompanying person, he/she is advised to come with a medical mask to the dental office.
All patients are encouraged to get the COVID-19 vaccine to minimize the risk of infection transmission.

Recommendation for dental secretaries [62–65]

In Rwanda, it is recommended to record all persons entering the dental office and their temperature, including staff and patients.
Reducing the number of appointments per dentist for non-urgent dental treatments.
Instruct patients to refrain from bringing visitors to their dental appointments.
Secretaries should get the COVID-19 vaccine and encourage patients to get vaccinated as well.
To minimize potential infection spread, secretaries should limit the movement of the patient within the dental facility.
Encourage appointment booking to manage the flow of people visiting the dental office.
Secretaries are recommended to extend their working hours to minimize crowding in the dental office.
Secretaries are recommended to comply with hand hygiene measures such as wearing a mask

all the time. Inform patients that they should bring their masks; one will be provided if they do not have one.

Recommendation to dental assistants [62–65]

In Rwanda, the number of dental assistants present during dental procedures should be limited to those who are necessary for patient care and procedure support.
If equipment is to be shared by patients, it must be cleared, disinfected, or sterilized between patients.
When assisting dentists, it is recommended that all dental assistants wear PPE and use them properly.
To reduce the risk of disease transmission from contaminated devices, it is advised to exercise greater caution when handling dental instruments and to adhere to sterilization guidelines.
Like other health care workers, dental assistants are required to be vaccinated in Rwanda.
Before and after assisting in any dental procedures, dental assistants should perform hand hygiene.

Recommendations in the waiting room [62–65]

It is recommended to disinfect all common areas in the dental office throughout the day, including the reception chairs and front desk counters. RBC (Rwanda biomedical center) recommends decontamination with 0.1 percent sodium hypochlorite if hospital disinfectants are in short supply.
To maintain good ventilation in the area, open doors and windows whenever possible.
Front desk staff should screen all patients before entering the dental office for their appointments.
Arrange the seats in waiting rooms so that patients can sit at least 6 feet apart.
Everyone entering a dental office in Rwanda should practice hand hygiene (using soap and water for 40-60 seconds or a hand sanitization).
It is recommended to have an available hand sanitizer and working sink with soap at the reception, treatment rooms, and other common areas.

Recommendations in the Operating room [62–66]

Minimal equipment and tools should be used in the operating room.
When the patient is already inside the operating room, restrict the entry of unessential persons in the area. Only Dental assistants are allowed to enter to assist in dental procedures, as recommended by Rwanda biomedical center (RBC).
Only sterile equipment should be utilized in operating rooms, and any exposed but not in use devices should be disinfected right after.
It's good to keep the operating room's ventilation at a high level.
The Australian Dental Association recommends terminal cleaning of dental settings, which includes two-step cleaning by using detergents/disinfection of all surfaces, including the floor and reusable instruments, in case the aerosol-generating procedures are performed on confirmed or suspected cases of COVID-19.
To reduce equipment contamination, dental chairs, dental handpieces, dental scalers, and other devices should be protected with disposable plastic.
After performing dental procedures, the CDC recommends waiting 15 minutes before receiving a new patient to ensure proper cleaning and disinfection of the operating areas.

CONCLUSION

The risk of COVID-19 infection by dental staff in dental practices is high due to dental procedures' unique characteristics, including the short distance to the patient, proximity to saliva, blood, spatter, and aerosol exposure. Since standard protective measures may be insufficient to prevent the spread of COVID-19 in everyday clinical work settings, the implementation of extra preventive measures and strategies could be efficient in preventing SARS-CoV-2 contamination in dental settings. Since the duration of the pandemic cannot be predicted and urgent and emergency dental treatments cannot be postponed, dental professionals are advised to cautiously implement extra-protective measures when offering dental services to limit viral contamination between patients and the dental team. As additional recommendations have been designed to keep dental professionals, staff, and patients safe, it is crucial to understand what each recommendation means for dentists and their practice to minimize the risk of spreading COVID-19.

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