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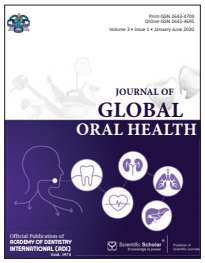

Opinion Piece Articles

COVID-19 and the dental profession: Establishing a safe dental practice for the coronavirus era

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ABSTRACT

The aim of this article was to provide evidence-based information for the oral health-care providers to better understand the COVID-19 disease and be prepared to treat their patients. The impact of the severe acute respiratory syndrome coronavirus 2 pandemic has been unprecedented, especially in health care. Overwhelming amount of information flooded the literature to the point that dentists and specialists alike might feel more confused than knowledgeable, which can make decision-making a challenge. Dental community is no stranger to infection control and to treat patients with highly infectious diseases. With careful planning, modifications, and sound clinical judgment, it is certainly feasible to provide routine care to the patients during the pandemic and serve the community. Negative pressure ventilation operatories and/or air purifiers are good addition to contain the droplet transmitted diseases including COVID-19. It is of particular importance for health-care providers to take appropriate measures to minimize the risk of infection to their patients, themselves, and other members of the dental team.

Keywords: Coronavirus, COVID-19, Infection control, Aerosol, Infectious diseases, Oral health care, Dental procedures, Respirators

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a novel coronavirus causing the disease referred to as COVID-19 by the World Health Organization.[1] SARS-CoV-2 is the seventh member of a family of coronaviruses known to infect humans.[2] This group of the coronavirus family, also referred to as Coronaviridae, is further divided into four subcategories: Alpha, beta, gamma, and sigma; alpha and beta are major concerns to humans.[3] Typically, these viruses cause mild clinical symptoms; however, in the past 18 years, there have been three noteworthy strains that belong to the beta-coronavirus subtype and have led to epidemics in their outbreak communities. These are SARS in 2002, Middle-East respiratory syndrome (MERS) in 2012, and now the SARS-CoV-2 which has emerged to cause the current pandemic with significant morbidity and mortality.[4-6]

Using genome sequencing, it was found that the natural host for COVID-19 began in a specific species of bat, *Rhinolophus affinis*, also known as the horseshoe bat, and used an intermediate host before becoming infectious to humans.[7] A study done in South China reported that 70% of pangolins tested positive for beta-CoV, one of which showed 99% match to the novel coronavirus.[8] For this reason, it is suspected that pangolins may be the intermediate host for

this virus, but this has not been firmly established. It is known, however, that SARS in a process called spillover, emerged from civet cats and MERS from camels.[9] Although the animal source of COVID-19 cannot be conclusively identified at this time, zoonotic transfer of COVID-19 virus to humans has been well documented.[10]

TRANSMISSION MODE AND IMPACT ON DENTISTRY

SARS-CoV-2 enters cells through the angiotensin-converting enzyme 2 (ACE2) receptors found in most cells of the respiratory system as well as salivary gland cells.[11] Salivary gland cells are believed to be the first sites where SARS can be detected, and it is theorized that COVID-19 follows the same path.[12] Similar to other viruses, SARS-CoV-2 is not a living organism and depends on host cells to replicate. It contains protein molecules covered by a protective layer of lipid, which binds to the receptors and fuses with the membrane of the host cell to begin viral entry.[13] Therefore, it is prudent to note that it cannot be killed and will only disintegrate under certain conditions.[14] The danger that SARS-CoV-2 poses, however, is related to its long incubation period and highly infectious nature.[15] This single-stranded RNA virus can be directly transmitted through respiratory droplets produced by the breathing, talking, sneezing, or coughing of an infected person who comes in contact of others.[16] It is also possible for indirect fomites transmission through the touching of contaminated nonliving materials or aerosolization transmission in a confined space.[17,18] However, at the time of writing of this paper, airborne transmission, while widely speculated, has not been reported.[19] Studies have demonstrated that large respiratory droplets of more than 10 μm in diameter can be dislodged from an infected person and travel up to 6 feet, with coughs traveling at a velocity of 10 m/s and sneezes traveling at 50 m/s.[20,21] Furthermore, aerosols including droplet nuclei can remain suspended in the air for an extended period of time and smaller particles of 0.5–10 μm have potential to enter and trap in the respiratory tract down to alveolar space.[21-25] Aerosolized particles have been reported to remain in the air up to 30 min post-dental procedures, but a recent study published by the New England Journal of Medicine demonstrated that the SARS-CoV-2 virus remained stable in aerosols for the duration of the experiment, lasting 3 h.[26,27] The WHO relents that this experiment was performed under conditions that do not accurately mimic coughing or a clinical setting.[28] These discrepancies indicate that further research is needed to accurately gauge the viability of SARS-CoV-2 in aerosols intra- and post-dental procedures. SARS-CoV-2 has a mean size of 0.125 microns and a median incubation period of 5–6 days from exposure to onset of symptoms, ranging from 2 to 14 days, making asymptomatic carriers the biggest threat to containment.[29,30] Posterior oropharyngeal saliva samples from patients with COVID-19 indicate that viral loads of RNA are highest on presentation and shortly after symptom onset, suggesting that the virus could be transmitted easily even when infected individual is asymptomatic.[31] Contact transmission of the virus can also be attributed to the abundance of ACE2 receptors found in the oral and nasal mucosa, as well as the nasopharynx.[32] This puts health care workers, especially dentists, dental hygienists, dental staff, oral, and maxillofacial surgeons, otorhinolaryngologists, and anesthesiologist at higher risk. In March 2020, Occupational Safety and Health Administration (OSHA) classified dentists/dental providers in the very high-risk group for COVID-19.[33] In addition, many dental procedures produce significant amount of droplets and aerosols; therefore, it is imperative for clinicians to know the transmission pathway and to be able to contain the spread of infection in dental office.[34]

RECOMMENDATIONS

While there are many organizations making reporting guidelines about patient care during the COVID-19 pandemic, our group focused on evidence-based recommendations to provide clear information, practices, and materials that general dentists, hygienist, specialists, and auxiliary teams could implement. This is to minimize the risk of COVID-19 exposure to themselves and their patients and continue to be used in post-pandemic. Furthermore, our knowledge of the SARS-CoV-2 is evolving rapidly and recommendations may change just as quickly. Therefore, current guidelines made by federal/state governments and governing organizations should be reviewed frequently.

Precautions

Standard precautions that apply to all patients regardless of suspected or confirmed infectious diseases should be supplemented by transmission-based precaution to prevent spread of coronavirus.[35] This, however, is not specific to COVID-19 and is applicable to other droplet transmittable diseases such as influenza or tuberculosis. It is understood that routine dental and surgical care should be delayed for these patients until resolution of illness. The Centers for Disease Control and Prevention, among many other organizations, also recommended to postpone elective non-life treating medical procedures.[36-38] At present, all patients admitted to most hospitals in the United States are tested for COVID-19 before emergency or elective operations.

Appointments

Barring a monumental breakthrough, social distancing in one form or the other will be the new normal and will include

the dental office. The number of patients in the waiting area should be limited. Another alternative is to ask patients to wait in their vehicle and call them when ready to be seen. In addition, procedures that may create aerosols should be moved to the last appointment of the day. OHCP should also limit the number of personnel in offices and/or operating rooms (OR).[39]

Hand hygiene

Proper hand hygiene is critical in disintegrating SARS-CoV-2 as soap and detergent cut the virus's fatty outer layer and is more effective than popular widely available hand sanitizers alone.[40,41] Due to the fragility of the virus, rubbing hands for at least 20 s, generating foam, will essentially dissolve the fat layer and the remaining protein molecule will dissolve on its own.[41] It is also recommended to moisturize after continuously washing, to improve the barrier protection function of skin.[42,43] Patients should also be asked to perform hand hygiene with alcohol based hand sanitizers on entry into the office, entry into the operatory, and again after the dental procedure at dismissal.[44]

Patient care

Pre-screening metrics of patients should be optimized in efforts to minimize exposure to COVID-19.[45] Emerging policies and procedures worldwide recommend triaging patients for COVID-19 for signs and symptoms of cough, shortness of breath, and body temperature of 38°C (100.4°F) or higher.[46] However, it should be interpreted with caution as these symptoms may mimic other underlying conditions and could provide false information.[47] Myalgia, malaise, ageusia (loss of taste), and anosmia (loss of smell) can also overlap with the flu symptoms. Furthermore, patients who have taken medications with antipyretic effect, for example, acetaminophen, may not have fever.[20,48,49] Patients with confirmed COVID-19 whether symptomatic or not should be treated in the hospital which has equipment and facility to deal with contagious diseases.[50]

Personal protection equipment (PPE)

PPE including impervious gown, facemask, eye protection, and disposable cap should be donned before entering the room to interact with patients. It is common practice for dentists to remove their masks when conversing with the patient before or after an appointment. This should be strictly avoided due to the potential exposure to aerosolized viral particles after dental procedures, as well as the confined nature of most dental operatories and offices that do not allow for proper social distancing. Limit the paperwork in the operatory after the procedure and doffing should be done before exiting the room to avoid possible cross-contamination. The US National Institute for Occupational Safety and Health has classified particulate filtering respirators into three categories: N (not resistant to oil), R (somewhat resistant to oil), and P (strongly resistant to oil). Available respirators are N95, N99, N100, P95, P99, P100, R95, R99, and R100. Number 95 indicates 95%; 99, 99%; and 100, 99.97% minimum filtration efficiency of the respirator.[51] Filtering facepiece particles (FFPs) are the European equivalent of N masks. FFP1 has an aerosol filtration of 80%, FFP2 masks that are equivalent to N95 have 94% filtration capability, and FFP3 99% filtration protective against very fine particles like asbestos.[52] Powered air purifying respirator (PAPR) which has blower to draw contaminated air through filters is mainly used in OR, hospitals, and ambulatory settings with excellent protection capability. Production of aerosol and splatter during most dental procedures has been well established in the literature. Surgical mask is sufficient and effective in preventing large particle droplets; however, the fit allows tenting and gapping which can result in ultrafine particles to enter through these voids. When dealing with the small particles generated in the aerosols of patients infected with the highly contagious diseases like SARS-CoV-2 virus, the mask must be as protective as possible. Therefore, a fit tested N95 mask, FFP2, reusable double filter respirator, or PAPR should be warranted for all patient interactions and procedures generating aerosols.[53-55] To optimize supplies, one can wear a surgical mask over the respirator. We strongly recommend reviewing each manufacturer's recommendations before sterilization and extended use of any respirator, soiled masks should be discarded. It is important to remember that OHCP must be fit tested for respirators, including N95 masks, as there are different sizes and types, otherwise, they may not be effective. The fit testing requirements are outlined by OSHA and these should be reviewed to ensure that the OHCP is adequately tested and fitted before rendering patient care.[56] It should also be noted that providers should take extra care to properly adjust the N95 to fit snugly every time. PAPR and reusable respirator with double filter are preferred by senior authors. Reusable mask is easier to breath and fits better than N95. Adjustment and proper function can also be confirmed after donning. PAPR is more comfortable to breathe in any other mentioned respirators and does not require fit testing, this could be an excellent option for dental hygienist as well. We recommend surgical mask be used under the PAPR hood.

Mouth rinse

SARS-CoV-2 appears to be sensitive to oxidization.[57] Pre-procedural use of 1.0% hydrogen peroxide or 0.2% povidone-iodine mouth rinse which has viricidal activity could be beneficial in reduction of oral and respiratory pathogens.[20,58,59] However, potential efficacy is unclear and requires further investigation.

Operatories

Due to the ability of COVID-19 to adhere to surfaces and/or suspend in air and to minimize spread of infection, open-bay multi-operatories should be equipped with efficient ventilation system and sufficient wait time should be given after disinfection before bringing in the next patient.[60,61] In open plan offices, auxiliary staff, including front desk personnel, is recommended to have N95 mask or similar respirators. A study conducted by NASA demonstrated that packed bed granular material like activated carbon that is utilized to remove harmful gases/airborne chemicals, and high efficiency particulate air (HEPA) filtration technology, a feature boasted by certain air purifiers, can filter almost 100% of various sized particulate matter including nanoparticles that range between 0.001 and 0.1 μm.[62] Although heating, ventilation, and air conditioning systems in most health-care facilities have HEPA, air purifiers could be an effective addition to improve ventilation and minimize spread of infectious aerosols in a dental office.[63] UV chambers may also be considered as coronaviruses are known to be sensitive to ultraviolet radiation.[64-66] If possible, at least one closed door operatory should be equipped with negative pressure ventilation and/or an efficient air purifier, to be used for procedures in which aerosol production is anticipated. One can plan the procedure at the last appointment to minimize spread of infection.[20] Recently, the Pennsylvania Department of Health was scrutinized for requiring dentists to practice in negative pressure ventilation rooms as this would be wholly impractical in most dental offices.[67] However, this is one of many suggestions of engineering controls that the OSHA outlines for preparing workplaces for COVID-19.[33]

Radiographs

Intraoral radiographs can stimulate salivation and cough, it is recommended that extraoral radiographs be taken (e.g., panoramic and cone-beam CT).[68] If diagnostic intraoral radiographs must be taken, the most experienced member of the team should perform this task.

Role of suction in preventing aerosolization

Use of suction during dental and oral surgical procedures is a debatable topic. Many independent policies and procedures quickly surfaced claiming that aerosolization can be created by suctioning.[28,36,69] However, they fail to explain that suction systems in OR and wall-mounted suctions in hospitals/ambulatory settings, outpatient clinics, or surgical centers are not capable of removing large volumes of air. They do not have designated stands, often hanging from trays or placed on the patient (draped with sterile sheets) in the OR causing cross-contamination and perhaps aerosolization in positive pressure rooms. Furthermore, regardless of COVID-19, use of suction during intubation by anesthesia team with often lack of adequate PPE has always been a major concern in regard to exposure and spread of respiratory pathogens. Open or closed suction systems for patients can also contribute to the risk of exposure of health-care providers to aerosols; this, however, does not apply to dentistry.[70] Contrary to this, the ADA recommends the use of high-volume evacuation suction, which is capable of removing up to 100 cubic feet of air per minute to remove droplets at the site in the oral cavity and reducing aerosolization of particles in an effort to reduce viral spread.[26,71] Saliva ejectors, although effective in evacuating fluids, may not be able to suction large volume of air and back flow during closed mouth has always been discussed as potential cross-contamination risk; however, with introduction of saliva ejectors with one-way valve, the risk is very minimal and benefits outweigh the downsides.[72,73] Avoiding suction in patients with strong gag reflex, children with hypersalivation, or pregnant patients will result in accumulation of blood and fluids that can cause the patient to cough or vomit, which can put patient and provider at greater risk of exposure to droplets and aerosols. Furthermore, during extraction of an infected/carious tooth, or incision and drainage, irrigation and suction are essential. Use of gauze without appropriate suction to collect debris, blood, and fluid can attribute to cross-contamination, and it is possible that displacement of the contaminated gauze may reintroduce pathogens into the air.[74]

Rotary instruments and irrigation

Dental handpieces can aspirate and expel debris and fluids during dental procedures, which can also contaminate the air and water tubes in a dental unit.[2] In the event that high-speed handpiece is necessary, it is recommended to use one with an anti-retraction valve.[75] The commonly employed air-water syringe should also be used with caution due to its potential to create droplets with the forcible ejection of air and/or water.[68,71] In such cases, PAPR that has shown to reduce transmission of the virus to medical personnel might be the best choice or full face shield in addition to complete transmission-based precaution with N95 or similar respirators as described.[36]

Rubber dam

Dental dam isolation is an effective method to reduce aerosol production and particle spread[76] and should be utilized for any procedure when feasible.

DISCUSSION

It is important to realize that, even pre-COVID-19, it was part of routine practice for all OHCP to update medical history and record vital signs including temperature for every

patient in every visit. Most providers agree that regardless of COVID-19, patients with symptoms of flu, respiratory, infectious, or other systemic diseases that put patients and providers at risk should seek medical care and elective dental procedures should be delayed. It is a known fact that oral health-care providers are at the forefront of infection control with an in-depth knowledge of cross-contamination and have always adhered to the state regulatory protocols in treating patients with infectious diseases, even before COVID-19. In contrast, with the exception of the OR, medical health-care providers and staff do not use adequate PPE during patient interaction and do not quite follow infection control guidelines as closely.[77] Therefore, it is not surprising to see numerous policy and procedures related to PPE emerged during the COVID-19 for medical staff in hospitals and medical facility alike.

There is a paucity of information about the length of time that aerosolized or droplet nuclei of SARS-CoV-2 can remain in the air after a dental procedure before settling on a surface or in a person's respiratory tract. With adequate ventilation, 30 min between patients following thorough disinfection is reasonable time for safety measure.[26] It should also be noted that children appear to have less serious symptoms to COVID-19 than adults but could be asymptomatic carriers. This may play an important role in decision making to treat pediatric populations for routine dental care.[78] With negative pressure ventilation rooms, air purifiers, and proper/adequate PPE, it is possible to begin providing routine dental care to many patients who are suffering at this time. Patient education and assurance are also important. As the interruption of care continues, manageable and restorable conditions can quickly change into emergencies with loss of teeth and supporting structures. Dental students and residents are also missing the opportunity to complete their educational requirements. This is a global dilemma, and in the United States, all dental schools in coordination with the Commission on Dental Accreditation are working hard to plan alternative solutions. Perhaps when FDA-approved testing becomes widely available, COVID-19-positive patients can be identified and should receive only emergency treatment until they have been shown to have resolved the disease. Those who test negative will be able to receive routine dental care with transmitted-based precaution. However, at this point, there are many variables and it may not be practically possible in a large scale. With information provided in this article, thoughtful considerations should be given to return to practice safely. As we are heavily affected by this seemingly ever-lasting pandemic, it is pertinent for all OHCP to remain up to date with new information due to the rapidly evolving nature of this virus. We are in the midst of the pandemic, we continue to learn about the disease and how to best manage and treat it. More scientific evidence and studies are required to understand the specific behavior and infectious nature of the novel SARS-CoV-2 virus that could lead to developing vaccine or medications to control the disease. Until then, the aforementioned precautionary measures are highly recommended, and the use of fit-tested respirators will be needed to enhance protection for the foreseeable future.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

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