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Coronavirus COVID-19 Outbreak & Dentistry; Routes of Transmission & Infection- Control Challenges and Responsibilities

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ABSTRACT

The 2019 coronavirus disease (COVID-19) pandemic, originating in Wuhan, China, is becoming a major public health problem for not only China, but countries all over the world as well. The World Health Organization (WHO) has reported that outbreaks of the novel coronavirus have become a globally worried public health emergency. As of February 4, 2021, COVID-19 has been recognized in 235 countries, with more than105.000.000(one hundred and five millions) laboratory-confirmed cases and above 2.280.000 (million) deaths. To prevent the virus from further spreading and to help manage the disease situation, infection control measures are necessary. The risk of cross contamination can be high between patients and dental practitioners because of the characteristics of dental settings. Strict and efficient infection management protocols are urgently needed for dental practices and hospitals in areas which are (potentially) affected by COVID-19. This article, based on our experience and relevant guidelines and research, introduces essential knowledge about COVID-19 and nosocomial infection in dental settings and provides recommended management protocols for dental practitioners and students in (potentially) affected areas.

KEYWORDS: *Corona Ncovid-2019, infection control, dental public health, dental education, transmission, dental practice management*

Introduction

A novel coronavirus was officially confirmed on January 8 , 2020 by the Chinese Center for Disease Control and Prevention (Li et al. 2020) as the causative pathogen of COVID-19. The 2019 coronavirus disease epidemics (COVID-19) started in Wuhan , China, in December 2019 and have become a major public health concern not only for China, but also for other countries around the world.[1] On January 30, 2020, WHO announced that this outbreak had constituted a public health emergency of international concern.2 The novel coronavirus was initially named 2019-nCoV and officially as severe acute respiratory syndrome coronavirus [2] (SARSCoV-2). As of October 2, COVID-19 has been recognized in 235 countries, with above34.000.000 laboratory-confirmed cases and more than 1.000.000 deaths (WHO 2020b).[3]

Recently, the transmission routes, treatments, and results of COVID-19 are increasingly receiving more and more research attention. What is clear so far is that, while airborne transmission has not been ruled out, the route of transmission is by direct contact and in the form of droplets. The Chinese authorities have advised that people go to crowded places as often as possible since late January 2020 to avoid cross-infection.[4] On the other hand, because of its latest and fast transmission, people's fear of COVID-19 makes them hesitate to go to public places, including medical and dental hospitals.

The literature shows that many dental procedures contain aerosols and droplets that are infected with bacteria, viruses, and blood and have the potential to spread infections in the dental clinic to dental staff and other individuals.[5] The health authorities of some cities in China and around the world were ordered by dental institutions to suspend general non-emergency dental treatment while providing emergency dental services only. Policy variables and personal interests have deterred patients from pursuing dental treatment, even in an emergency.[6]

1.The routes of transmission

As stated in the 6th Edition of the COVID-19 Treatment Regimen (Trial Implementation) released by the National Health Commission of the People's Republic of China (2020), the possible routes of 2019-nCoV transmission are primarily direct contact and droplet transmission. Aerosol transfer is also a possible transmission route when exposure to high aerosol concentrations occurs in a relatively closed environment.Routine dental procedures generate aerosols, posing potential risks to dental care staff and patients. Although there are no confirmed cases of coronavirus transmission in the dental community, given the high transmissibility of the disease, dental teams should be alert and ensure a healthy atmosphere for both employees and patients.[7]

Several possible transmission scenarios with COVID-19 have been identified. Talking, coughing, sneezing (related to human respiratory activity) and aerosols emitted during clinical procedures are expected, as is the case with other respiratory infections, to be transmitted through droplet contact. The nasopharyngeal or oropharyngeal can be the origin of the droplets, usually associated with saliva.On the other hand, larger droplets may lead to viral transmission to nearby subjects, and long-distance transmission is likely to result in viral transmission of smaller droplets polluted with air-suspended viral particles.[8]

Given that laboratory diagnostic tests are also conducted on blood samples, attention should also be given to the infected transmission of blood. In this sense, healthcare staff, such as dentists, can unknowingly provide direct care for COVID-19 patients who are infected but not yet identified, or who are considered to be suspected surveillance cases.[9,10] Asymptomatic infections tend to be possible [11] and transmission may occur before the manifestations of the disease tend. A recent clinical study reveals that healthcare staff is 29 % of 138 hospitalized patients with COVID-19 contaminated pneumonia in Wuhan, China.[12] As in bronchoscopy, [13] Inhalation in patients with COVID-19 of airborne particles and aerosols formed during dental procedures can be a high-risk procedure in which dentists are directly and closely exposed to the virus. Therefore, it is critical for dentists to enhance preventive measures to avoid COVID-19 infection by focusing on patient positioning, hand hygiene, all personal protective equipment (PPE), and caution in performing aerosol-generating procedures.As more information about COVID-19 infection and transmission becomes available, the CDC Interim Guidance for Healthcare Professionals has been updated and is subject to change.

Diagnosis of COVID-19 is theoretically carried out using salivary diagnostic platforms. For as long as 29 days after infection, some strains of viruses have been found in saliva.[14, 15], indicating that a non-invasive platform for the rapid differentiation of saliva biomarkers could boost the detection of diseases.[16]

Samples of salivamight be collected in patients who present with oropharyngeal secretions as a symptom.[9,10] Given the need for close contact for the collection of nasopharyngeal or oropharyngeal samples between healthcare workers and infected patients, the likelihood of saliva self-collection would substantially reduce the risk of transmission of COVID-19. In addition, nasopharyngeal and oropharyngeal collection, especially in patients with thrombocytopenia who are infected, causes pain and can promote bleeding.In the lower respiratory tract, just 28 % of COVID-19 patients developed sputum, which suggests a strong limitation for diagnostic evaluation as specimens.[17]

At least three different pathways are suggested for the presence of COVID-19 in saliva: first, COVID-19 in the lower and upper respiratory tracts. 18,19which reaches the oral cavity along with the liquid droplets often exchanged by these organs.

Secondly, COVID-19 present in the blood may reach the mouth through crevicular fluid, an oral cavity-specific exudate that contains local proteins derived from extracellular matrix and serum-derived proteins.[20] Finally, inflammation of major and minor salivary glands, with the subsequent release of saliva particles through the salivary ducts, is another way for COVID-19 to occur in the oral cavity. It is important to point out that shortly after infection in rhesus macaques, SARS-CoV may infect salivary gland epithelial cells, suggesting that salivary gland cells may be a key source of this virus in saliva.[21] Furthermore, the synthesis of SARS-CoV-specific secretory immunoglobulin A (sIgA) in the saliva of intra-nasally immunized animal models has previously been demonstrated.[22] Considering the similarity of both strains, we speculate that it is possible to conduct salivary diagnosis of COVID-19 could also be performed using specific antibodies to this virus. The potential for saliva to be a non-invasive specimen type was demonstrated by K for the diagnosis and viral load monitoring of 2019-nCoV. Yeah, K.-W., et al. Since saliva may be administered by patients without invasive procedures, the use of saliva specimens can reduce the risk of nosocomial transmission of 2019-nCoV and is sufficient for circumstances where the collection of nasopharyngeal specimens may be contraindicated.[23]

Due to the features of dental environments, the risk of cross-infection between dental practitioners and patients can be high. For dental practices and hospitals in countries / regions which are (potentially) affected by COVID-19, strict and effective infection control protocols are urgently needed.Based on our experience and related guidance and study, this article introduces the critical awareness of COVID-19 and nosocomial infection in dental settings and provides dental practitioners and students in (potentially) affected areas with suggested management protocols. In addition to the usual precautions, this analysis has raised several special precautions that should be taken during an outbreak.

2. Aerosol transmission and its implication in dentistry

Large droplets or aerosols are formed (> 5 μm diameter) and tiny (~ 5 μm diameter) if a person coughs, sneezes, breathes, smiles, or talks deeply. Larger droplets easily fall to the ground due to gravity; thus, droplet transmission requires near physical contact between an infected person and a susceptible person.

On the other side, for small droplets or tiny particle traces of evaporated droplets, there is a low settling velocity, meaning they can linger in the air for a longer period of time and migrate farther until they can reach the respiratory tract or contaminate surfaces (WHO, 2014). Aerosols from highly virulent pathogens such as severe acute respiratory syndrome coronavirus (SARSCoV) can travel more than six feet, results from a previous study showed.[24]

A number of nosocomial pathogens have been found to be transmitted via contaminated surfaces. 25 While human coronaviruses have limited capacity to live on a dry surface, like SARS-CoV and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), several studies have indicated that they can persist on the surface for a few days, particularly when suspended and under human secretion.25, 26Hand contact with contaminated surfaces may lead to pathogen acquisition and transmission to the eyes, nose, or mouth, resulting in a new case of infection.[25]

Recent high-tech methods are used by Kazuhiro tatedo, the president of the Japanese Infectious Diseases Association and his staff to document the travel, spread and distribution of droplets in many places and in various circumstances close to general and dental conditions (Figures 1, 2, 3, 4). This person may be present in the dental hospital waiting room, the reception area, the administrative area or the denture area.This illustrates the infection prevention problems because these bio-aerosols and microdroplets are easily infected with bacteria, fungi, and viruses and have the ability to float in the air for a prolonged period of time and to be inhaled by dentists or other patients, [27,28] and because by routine in dental schools and offices constructed from smooth floors and walls and the covid-19 may stay on smooth areas about 4-5 days.

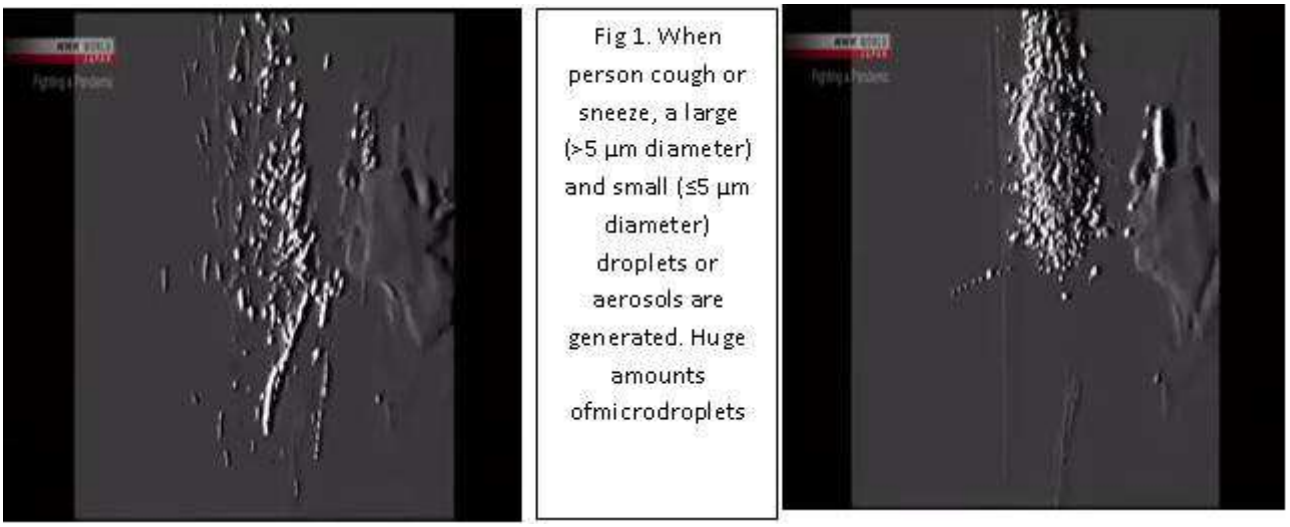
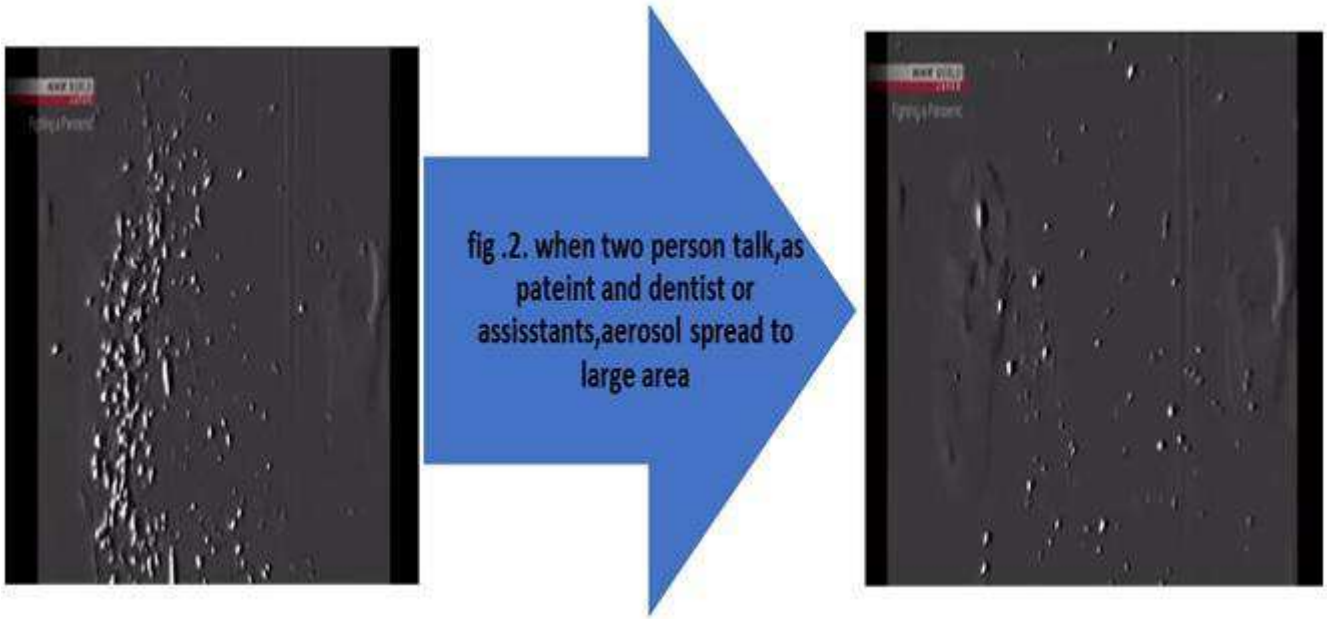


Fig 1. When person cough or sneeze, a large (>5 µm diameter) and small (≤5 µm diameter) droplets or aerosols are generated. Huge amounts ofmicrodroplets



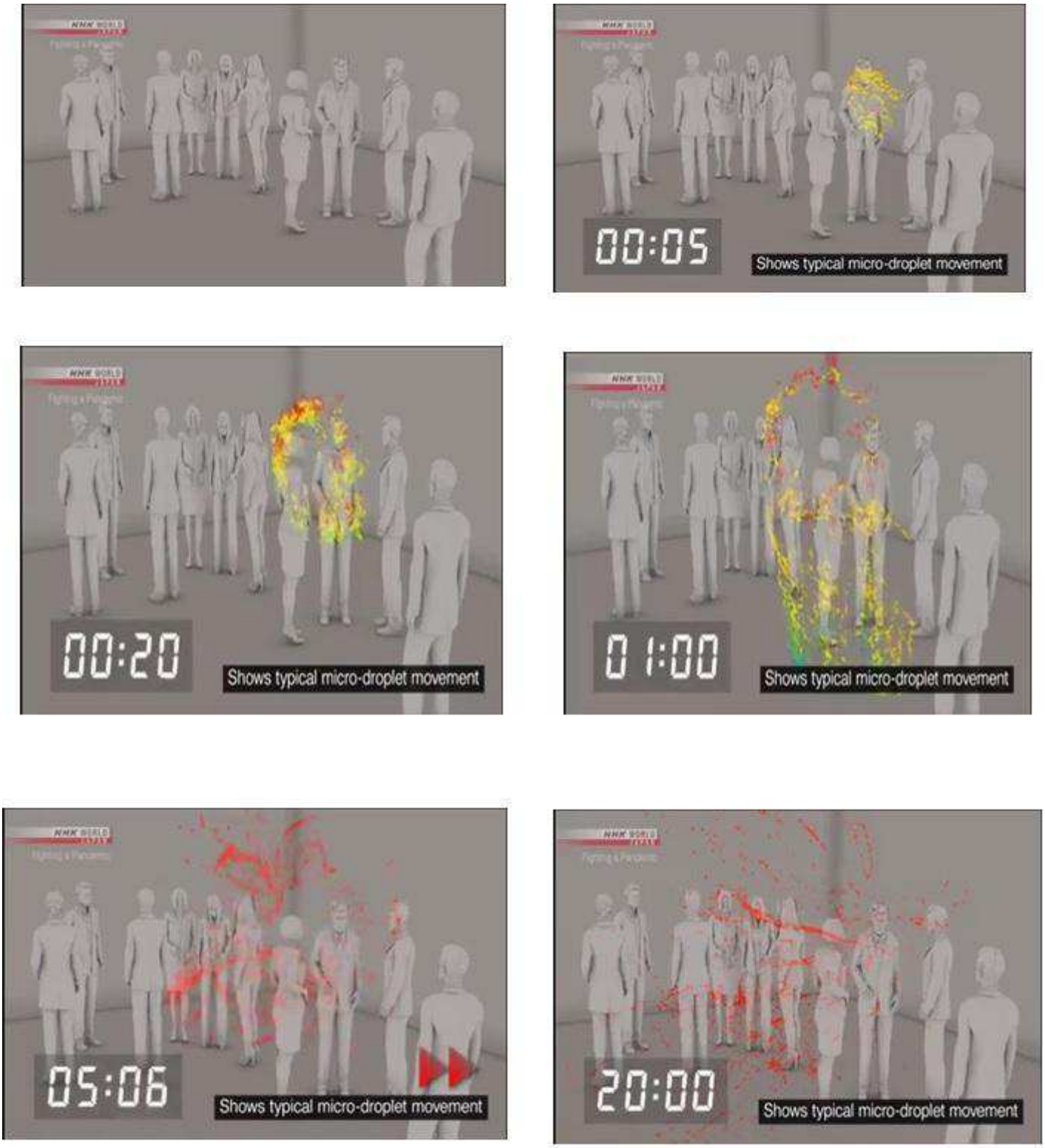


Fig.3. this sequenced photo by Japanese teamwork of ***Japanese Association of Infectious Diseases*** *showed the risk of grouping in anywhere especially in hospitals, dental clinics and the importance of time factor in waiting in any place*

Droplets and aerosols in dental setting

When performing dental procedures with a high speed handpiece, friction between the tooth and the rapidly moving bur will produce unnecessary heat. Without a coolant, the heat can cause damage to hard dental tissue and lead to pathological changes to the dental pulp. It is also a general consensus to use a water coolant when performing dental procedures, including tooth preparation, oral prophylaxis, and oral surgery, in order to minimize heat gain,29 as shown in Fig. 4.

Aerosols might be produced by the water coolant, though. These bio-aerosols are typically infected with bacteria, fungi, and viruses and have the ability to float in the air for a prolonged amount of time and to be inhaled by dentists or other patients when mixed with body fluids in the oral cavity, such as blood and saliva.[26, 27].fig.4.

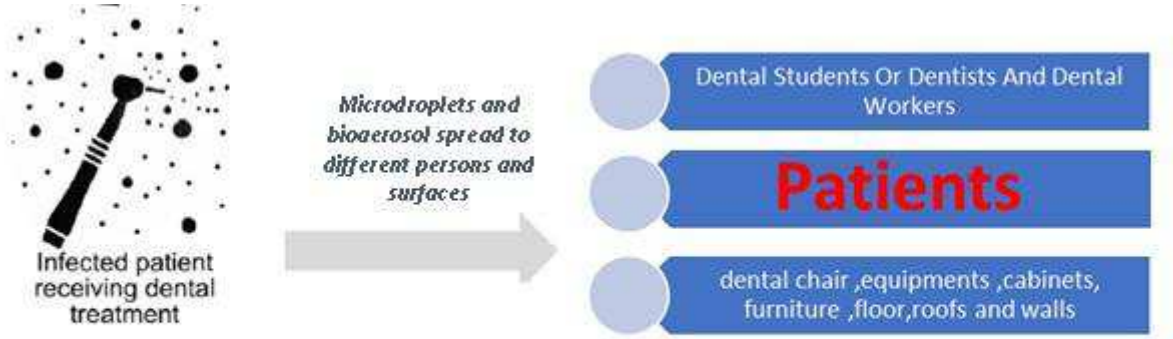


Fig.4. the aerosol produced by contra similar to person sneezing, coughing, deeply breathing or yawing and spread to all person and clinic units , equipment's, cabinets ,furniture, floor ,roof and walls

A study conducted by Zemouri, et al,(2017) 30 found that in the dental clinic, [38] types of microorganisms, like Legionella pneumophila, the causative agent of severe pneumonia, could be present in the air. After being treated in a dental clinic, patients contracting pneumonia have been confirmed.31 Another community in the UK reported a tuberculosis epidemic among dental patients who contracted the infection at their local dentist.[32] As far as coronavirus is concerned, Wang, et al, (2004) [33] investigated the oral cavity of SARS patients and found a large amount of SARS-CoV RNA in their saliva ((7.08-103) to (6.38-108) copies / mL), suggesting the likelihood of transmission of coronavirus through oral droplets. Previous research has shown that most cases of SARS-CoV and MERS-CoV have been related to hospital nosocomial transmission, partly due to aerosol-generating procedures in patients with respiratory dystrophy.34Based on current epidemiological data, 2019-nCoV has greater transmissibility than SARS-CoV and MERS-CoV (Chen, 2020).35 During this outbreak, therefore, it is essential to modify the standard precautionary and infection control regimen aimed at 2019-nCoV.

Infection-control challenges in dental field

The outbreak of COVID-19 has clearly put health professionals at risk. 2019-In health care workers (HCWs), nCoV infection has been discovered, and the number of such cases is gradually increasing.[36]

Based on information obtained from China's Infectious Disease Information System, a total of 1716 HCWs have been infected with 2019-nCoV, with five confirmed deaths (The Novel Coronavirus Pneumonia Emergency Response Epidemiology Unit, 2020). As an infected HCW might also constitute a cross-transmission vector, it is necessary to ensure the health and personal safety of HCWs.

Luckily, there are no confirmed cases of COVID-19 transmission in the dental area. However, with the evidence given that the incubation period lasts up to 14 d.37, it is not always possible to detect asymptotic carriers at an early stage or without examination. In addition, from asymptomatic contact, there has been a report of infection transmission, implying that during the incubation period, COVID-19 is contagious.38 Thus, aside from following the principle of universal precaution, special precautionary measures targeted toward aerosol transmission should also be taken to prevent andcontrol the spread of this highly contagious disease.

Interestingly, a group of Chinese scientists have confirmed that the 2019-nCoV infection cell receptor for angiotensin-converting enzyme II (ACE2) is highly expressed in the oral cavity mucosa. Notably, this receptor is present in significant quantities in the epithelium of tongue cells.39 These findings indicate that the oral cavity is a potentially high-risk carrier of 2019-nCoV infection and can be used in future prevention measures in the dental / clinical community.fig.5 [40].

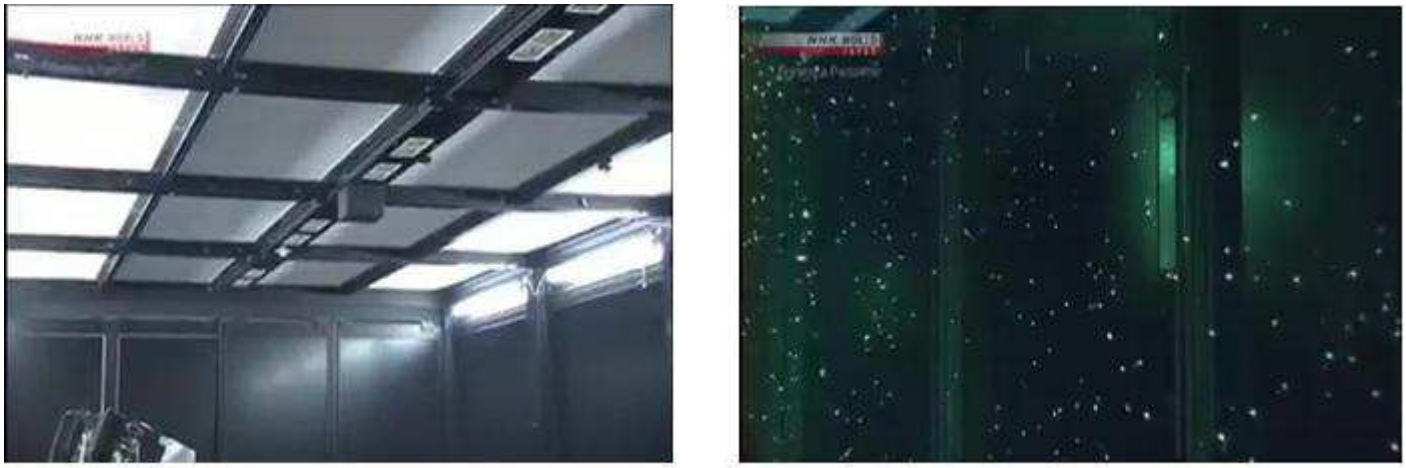


Fig.6 .a simulation to dental hospital or dental clinics. And how the air flow is very important in the direction of air, aerosol and microdroplets spreading and stagnation on all the surface by different rates and amounts, so any building should have two air openings to largely decrease the infectious susceptibility

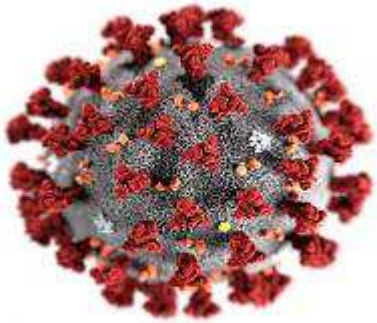


Fig.5 Illustration of the SARS-CoV-2 virion [38].

Recommended Measures during the COVID-19 Outbreak
Recommendations for Management

The National Health Commission of China added COVID-19 in January 2020 to the category of Group B infectious diseases, which includes SARS and highly pathogenic avian influenza. However, it also recommended that all health care workers, a category reserved for highly infectious pathogens such as cholera and plague, use protective measures similar to those indicated for infections in group A.Since then, in most cities in mainland China, only dental emergency cases have been handled when strict implementation of infection prevention and control measures is recommended.Normal dental operations have been suspended until further notice, in line with the pandemic situation. Moreover, after the COVID-19 outbreak, quality control centers and professional societies related to dentistry in many provinces and cities have made recommendations for dental facilities, which can be useful as additional measures to ensure the quality of infection control.[41]

Current Status of Our School and Hospital

The faculty and Hospital of dentistry, Assiut university provided dental care (including oral and maxillofacial surgery) to around 20,000 patients last year and is home to 120 staff and 800 students. Our hospital does not have a fever clinic or belong to a designated one for patients with COVID-19. Any staff member who has fever, cough, sneezing, or COVID-19–related symptoms or has a close family member who is confirmed with the infection is advised to undergo a medicalexamination in a designated hospital and cease working. Since the starting emergence of positive case, the dental hospital stopped the routine dental treatment and act only for emergencies dental management only According to the instructions from the Ministry of high Education of Egypt, all students, including those in our faculty, have been required to not return to faculty until further notification. Students are recommended to learn online until further notifications.

Treatment of Emergency Cases

In the latest 31-3-2020 update, the ADA published guidelines that could change as the COVID-19 pandemic progresses. Dental emergencies are potentially life-threatening and require immediate treatment to prevent continued tissue bleeding, reduce extreme pain or infection, and provide emergency care, including:

1.Uncontrolled bleeding,

2.Cellulitis or a diffuse soft tissue bacterial infection with intra-oral or extra-oral swelling that potentially compromise the patient's airway

3. Trauma involving facial bones, potentially compromising the patient's airway and the Urgent dental care focuses on the management of conditions that require immediate attention to relieve severe pain and/or risk of infection and to alleviate the burden on hospital emergency departments. These should be treated as minimally invasively as possible.

4.Severe dental pain from pulpal inflammation

5.Pericoronitis or third-molar pain
6.Surgical post-operative osteitis, dry socket dressing changes
7.Abscess, or localized bacterial infection resulting in localized pain and swelling
8.Tooth fracture resulting in pain or causing soft tissue trauma
9.Dental trauma with avulsion/luxation
10. Dental treatment required prior to critical medical procedures
11.Final crown/bridge cementation if the temporary restoration is lost, broken or causing gingival irritation
12.Biopsy of abnormal tissue .[42]

Dental emergencies can occur and intensify within a limited period of time and thus require immediate treatment. Rubber dams and high-volume saliva ejectors can help remove aerosols or spatters in dental procedures. Furthermore, for high or low-speed water spray drilling, face shields and goggles are essential.43During the epidemic, according to our clinical knowledge, if a carious tooth is diagnosed with symptomatic permanent pulpitis, pulp exposure should be made with the removal of chemo-mechanical caries under rubber dam isolation and after local anaesthesia with a high-volume saliva ejector; then pulp devitalization may be done to minimize pain.

Depending on age, dental tissue traumatic severity, apex growth, and tooth avulsion duration, the treatment plan for tooth fracture, luxation, or avulsion.44- 46If the tooth has to be cut, an absorbable suture is preferred. For patients with facial soft tissue contusion, debridement and suturing should be performed. It is recommended to slowly clean the wound and use the saliva ejector to stop spraying.Life-threatening cases of oral and maxillofacial compound injuries should be admitted immediately to the hospital, and chest CT should be administered to remove suspected infection if possible because, in addition to the time-consuming RT-PCR test, a pan-coronavirus laboratory or specialized SARS-CoV-2 detection capability is required.

Special precautions in dental emergency during COVID-19 outbreak

Because of the special characteristics of dentistry and the high transmissibility of COVID-19, dental hospitals and clinics across China are temporarily closed to avoid the potential risk of infection. However, there are dental emergencies that require urgent treatment and supervision, some of which are amended by ADA by 31-3-2020.42 Therefore, special precautions should be followed when treating dental emergencies.

1. Patient screening:Dentists should take from each patient a full medical history, as is the routine, and at each recall visit confirm the health status. During this outbreak, targeted screening questions for COVID-19 must be asked. Such questions should include personal, travel, and epidemiological history.

It is important to closely track the temperature and symptoms of the lower respiratory tract. Remember that symptoms of fever and fatigue may be caused by acute dental infection, so the aetiology should be verified.

2. Emergency care should be performed using the normal dental emergency regimen for patients whose infections are of dental origin.

3. For reported / verified cases of COVID-19 that are medically stable, laboratory testing and multidisciplinary team consultations should be conducted. After the outbreak, the patient should be reprogrammed if necessary to ensure the safety of patients and HCWs.

4. For reported / verified cases of COVID-19 that require urgent dental treatment, the highest level of personal protection should be implemented. To encourage natural ventilation, WHO (2020a)[47] suggests using a negative pressure room with a minimum of 12 air changes per hour or at least 160 L / s per patient. Mechanical ventilation should start sooner before treating the next patient.

Special precautions in urgent cases practice

Waiting area

Post an instruction at the entrance of the waiting room on cough etiquette. Ensure that all patients cover their nose and mouth with a tissue or their elbow while coughing or sneezing; instruct them to dispose of used tissues in a waste bin immediately after use and ensure hand hygiene.Patients should be placed in a well-ventilated waiting room. For rooms with natural ventilation, 60 L / s per patient is considered sufficient ventilation.[48] Spatial separation between patients of at least 1 m should be maintained. Equipment such as blood pressure cuffs and thermometers should be washed and disinfected with 70 percent ethyl alcohol after each use, as proposed by the WHO (2016).[49]

Hand hygiene

There is a growing awareness of the importance of hand washing in preventing acute respiratory infections. Several epidemiological studies showed that during the outburst of SARS, hand washing with soap and 70 %-90 % alcohol-based hand rubs (ABHRs) were effective in curbing SARS transmission.[50,51] The WHO (2020c)[52] Noted that either hand washing with an ABHR or soap and water is required for hand hygiene; both techniques are equally efficient.

ABHRs are recommended when the hands are not clearly soiled; water and soap should be used when the hands are obviously soiled, as indicated by WHO (2009)53, before touching a patient, before any washing or aseptic surgery is performed, after exposure to body fluid, after touching a patient, and after touching a patient's area.

Personal protective equipment

During dental procedures, particularly in the inner part of the eyes and around the nose, the spread of oral microorganisms radiates mainly to the face of the dentist, which are important areas for the transmission of infection. 54, [55] Personal protective equipment (PPE) may form an effective barrier against most of the aerosol hazards produced from the operating site.

1. Protective eyewear and face shields: It is clinically clear that COVID-19 can also be transmitted by contact with the mucous membranes of the skin, as the human conjunctival epithelium can easily be infected by infectious droplets.[56] Protective eyewear or face mask should be worn during the operation and disinfected between patients in order to protect the eyes from aerosols and debris produced during the dental procedure.

2. Face masks: at least, medical masks (surgical or procedural masks) have been used while working at a distance of less than 1 m from the patient. When performing aerosol generation procedures (using a high-speed handpiece, air-water syringe, and ultrasonic scaler), a particulate respirator that is at least as protective as the National Institute for Occupational Safety and Health (NIOSH)-certified N95, European Standard Filtering Face Piece 2 (EU FFP2) or equivalent was used.A higher level of respiratory safety, such as EU FFP3 respirators conforming to European Standard 149 (EN149), should be considered when performing emergency dental care in suspected cases of COVID-19.

3.One of the most effective methods of reducing the proportion of oral aerosol microorganisms is pre-procedural mouth rinse.43,57 A meta-analysis found that the use of pre-procedural mouth rinse, including chlorhexidine (CHX), essential oils, and cetylpyridinium chloride (CPC), resulted in a mean reduction of 68.4 percent in colony-forming units of dental aerosol.58Although the effect of pre-procedural mouth rinse against coronavirus is still unknown, many infectious viruses, including herpes simplex virus (HSV), human immunodeficiency virus (HIV), and hepatitis B virus (HBV) have been shown to be effective against CHX.59About 0.12% CHX was used as a pre-procedural mouth rinse. For patients who develop mucosal irritation or other side effects such as tongue stain, 0.05% CPC could be a good alternative.[57]

4.Rubber dam isolation

During dental procedures that contain aerosols, the rubber dam provides barrier protection from the primary source and will effectively eliminate any contaminants resulting from respiratory secretion. If the rubber dam is correctly located, the tooth undergoing treatment would be the only source of contamination.60Rubber dam application showed a significant decrease of 90% in the spread of microorganisms during cavity preparation.61 Rubber Dam is used in all aerosol-generating activities. One drawback to the use of the rubber dam is that it is not feasible in processes requiring subgingival instrumentation, such as subgingival restoration and subgingival crown margin planning. In many respects, we propose modified alternativesin Table 1.[62]

5.Removal/filter of contaminated air

There are many ways to eliminate / filter contaminated air in treatment areas; the two most commonly used devices include the inexpensive high-volume evacuator (HVE) and the expensive high-efficiency particulate arrestor (HEPA) filters.

HVE filter: It is a suction device which helps remove air at a rate of up to 2.83 m3 per minute. It is the best way to remove dental aerosols as they are formed and will effectively reduce emissions generated by the operating site by 90 %.63The system should, however, be kept at a proper distance from the active ultrasonic tip (approximately 6-15 mm). One drawback of the HVE is that clinicians can encounter trouble operating it with one hand without a dental assistant. There are updated HVEs that tackle this issue in the market.

HEPA filter: It is an air filtration system that can eliminate 99.97 % of the 0.3 µm in diameter measuring particles. One downside is that if the retained microorganisms proliferate and return into the filtered air, the filter may become a source of microbes.64 In addition, it is difficult to clean and costly to repair soiled HEPA filters.[65] Modified proposal for middle-east countries from Ge et al. / J Zhejiang Univ-Sci B in review 26-2-2020 propose alternative dental treatments in urgent situation.[62]

Environmental surface disinfection

On the surrounding surfaces, droplets containing infectious pathogens can be obtained during aerosol generation procedures. A review of 22 studies found that human coronaviruses, such as SARS and MERS, could survive on inanimate surfaces for up to 9 days. However, they can be inactivated effectively by surface disinfectors within one minute. These surface disinfectants contain 62 % -71 % ethanol, 0.5 % hydrogen peroxide, and 0.1 % (1 g / L) sodium hypochlorite.66 Surfaces are disinfected after each patient visits, especially surfaces in close proximity to the operating areas.

Table 1 Strategies to reduce droplet generation in different dental disciplines

Dental discipline	Special precaution
Endodontics	If no pain or swelling maybe delayed after the end of virus outbreak **If urgent,** ✓ Rubber dam must be applied during endodontic treatment ✓ Root canal treatment usually requires a number of endodontic instruments and devices, therefore minimizing unnecessary hand contact with surfaces and equipment in the dental office to reduce possibility of fomite transmission
Restorative dentistry and pediatric dentistry	If no pain or swelling is delayed after the conclusion of the outbreak of the virus, stop the use of rotary instruments during cavity preparation if urgent. Consider using the elimination of chemo-chemical caries or atraumatic restorative technique in selective cases.
Periodontics	If no pain or swelling maybe delayed after the end of virus outbreak Hand and ultrasonic instrumentation are equally effective in removing plaque and calculus deposits; if required, manual scaling and polishing are recommended (Krishna and de Stefano, 2016)
Prosthodontics	✓ To stop gagging, salivary suction must be carried out with caution. ✓ To stop cough reflex, pick and change trays to the correct size for impression taking. ✓ For particularly sensitive patients, consider applying oral mucosal anaesthesia to the throat before making an effect. ✓ Treatment alternation can be considered to integrate rubber dam application during fixed partial denture or single-crown preparation. Supra-gingival margin configuration for the posterior bridge, for example, or using a split-dam technique (Li et al., 2004) ✓ Avoid hitting any items in the dental office when accessing the saliva of patients during removable partial denture or full denture try-in. ✓ Dental prosthesis, impressions, and other prosthodontics products (e.g. bite registration) should be properly disinfected by a disinfectant of at least intermediate level operation upon removal from the mouth of the patient.
Oral-maxillofacial surgery	Treat the patient in a supine position while performing simple extraction to prevent operating in a patient's breath mode.
orthodontics	Changes elastics or wire by manual

Table 1 Strategies to reduce droplet generation in different dental disciplines. Modified proposal for middle-east countries from Ge et al. / J Zhejiang Univ-Sci B in review 26-2-2020 propose alteranative dental treatments in urgent situation.[62]

Further studies are needed to investigate the potential diagnosis of COVID-19 in saliva and its impact on saliva transmission, which is important for improving effective prevention strategies, especially for aerosol-generating procedures performed by dentists and healthcare professionals. Saliva can play a key role in human-to- human transmission and salivary diagnostics can provide an easy and cost-effective point-of - care method for COVID-19 infection.

Recommendations for Dental Education

For medical and dental schools, as well as their associated hospitals, challenges related to education are important. In order to improve mutual trust and facilitate appropriate cooperation, open contact was reported between students, clinical teachers, and administrative staff.67 We have a few basic dental education recommendations during an outbreak, based on the experience with SARS and related highly pathogenic infectious diseases.[68] First, during the outbreak period, online workshops, case studies, and problem-based learning tutorials should be introduced in order to avoid unnecessary accumulation of people and the related risk of infection (Patil et al . 2003). Current mobile devices and apps have also made it possible for learners to listen to and replay lectures, whenever and wherever possible. Our students, in fact, started learning online on March 17th.

Second, by making good use of online resources and learning about emerging academic trends, students should be encouraged to engage in self-learning. Third, during this period, it is easy for students to be affected by disease-associated fear and pressure, and dental schools should be able to offer psychological services to those who need them.[33] In order to prevent, track and stop the spread of COVID-19 with enhanced knowledge of viral features, epidemiological characteristics, clinical scope, and treatment, successful methods have been adopted. The infection prevention and control strategies we have introduced are characterized by the fact that we are at the center of COVID-19. Other regions should adopt guidelines from disease control centers for infection prevention and control according to the local outbreak situation.

What are we doing to improve the latest infection prevention and control methods after the outbreak? How will we respond in the future to similar infectious diseases? These are open questions in need of further discussion and research. We must be constantly aware of infectious threats that can threaten the current infection control regime, particularly in dental practices and dental medicine schools.

Conclusions

Dentists, by nature, are at high risk of exposure to infectious diseases. The emergence of COVID-19 has brought new challenges and responsibilities to dental professionals. A better understanding of aerosol transmission and its implication in dentistry can help us identify and rectify negligence in daily dental practice. In addition to the standard precautions, implementation of special precautions could prevent disease transmission from asymptomatic carriers. These special precautions would not only help control the spread of COVID-19 but also serve as a guide for managing other respiratory diseases.

Compliance with ethics guidelines

I declare that they have no conflict of interests. This article does not contain any studies with human or animal subjects performed by the authors.

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