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REVIEW ON CONTROL OF TRANSMISSION ROUTES OF COVID 19 IN DENTAL CLINICAL PRACTICE- PART 1

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ABSTRACT

The recent spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and its associated coronavirus disease has gripped the entire international community and has caused widespread public health concerns. Despite global efforts to contain the disease spread, the outbreak remains on an increase due to the community spread pattern of this infection. Dental professionals, can encounter patients with suspected or confirmed SARS-CoV-2 infection and may got to act diligently not only to provide care but at the same time prevent nosocomial spread of infection. Thus, the aim of this article is to provide a brief overview of the epidemiology, symptoms, and routes of transmission of this novel infection. In addition, specific recommendations for practice are suggested for patient screening, infection control strategies, and patient management protocol.

KEYWORDS: Corona virus; COVID-19; dental; endodontics; severe acute respiratory syndrome coronavirus 2; SARS-CoV-2.

INTRODUCTION

An emergent pneumonia outbreak originated in wuhan city,in the late December 2019.[1] The pnemonia infection has rapidly spread from Wuhan to most other provinces and other 24 countries.[2,3] The novel coronavirus belongs to a family of single stranded RNA viruses known as Coronaviridae.[4] This family of viruses are known to be zoonotic or transmitted from animals to humans.These include severe acute respiratory syndrome coronavirus(SARS-COV). fisrt identified in 2002, and the middle East respiratory syndrome coronavirus (MERS-COV), first identified in 2012.[5]

On January 30, 2020, the World Health Organization (WHO) declared the rampant spread of SARS-CoV-2 and its associated disease (COVID-19) a public health emergency with a currently known overall mortality rate to be as high as 3.4%.[6,7] According to the WHO situation report (March 27, 2020) update on COVID-19, there have been more than 500,000 reported cases and 23000 deaths worldwide[8] and this number continues to increase. Therefore, measures for prevention, identification, and management must be in place for appropriate mitigation of further spread.

Given the widespread transmission of SARS-CoV-2 and reports of its spread to health care providers[5,9], dental professionals are at high risk for nosocomial infection and can become potential carriers of the disease.These risks can be attributed to the unique nature of dental interventions, which include aerosol generation, handling of sharps, and proximity of the provider to the patient's oropharyngeal region.

In addition, if adequate precautions are not taken, the dental office can potentially expose patients to cross contamination. As the understanding of this novel disease is evolving, dental practices should be better prepared to identify a possible COVID-19 infection, and refer patients with suspected, confirmed, or a history of COVID-19 infection to appropriate treatment centers.

In this article, we summarize different routes of transmission of coronavirus and infection control measures in dental practice.

CHARACTERISTIC OF CORONAVIRUS 2019-

Coronavirus belong to the family of Coronaviridae, of the order Nidoviridae, compromising large, single, plus stranded RNA as their genome.[10,11] Currently, there are

four genera of coronaviruses; Alpha CoV, Beta CoV, Gamma CoV, Delta CoV.[12,13] Most of the coronavirus can cause the infectious disease in humans and vertebrates. The Alpha CoV nad Beta CoV mainly infect the respiratory, gastrointestinal and central nervous system of humans and mammals,while Gamma CoV and Delta CoV mailnly infect birds.[10,14-16]

The SARS-CoV and MERS-CoV belong to the beta CoV.[17,18] 2019 –nCoV explored in Wuhan also belongs to the Beta CoV according to the phylogenetic analysis based on the viral genome.[19,20] Although the nucleotide sequence similarity is less than 80% between 2019-nCoV and SARS-CoV(about 79%) or MERS-CoV (about 50%), 2019-nCoV can also cause the fetal infection and spread more faster than the two other coronaviruses.[21,22,20,23-25]

A research team from the South China Agricultural University has invested more than 1000 metagenomic samples from pangolins found that 70% pangolins contained β-CoV.[26] One of the coronaviruses they isolated from the pangolins comprised a genome that was very similar with that from 2019-nCoV, and the genome sequence similarity was 99%, indicating that the pangolin may be the intermediate host of 2019-nCoV.[27]

2019-nCoV possessed the typical coronavirus structure with the "spike protein" in the membrane envelope[28], and also expressed other polyproteins, nucleoproteins, and membrane proteins, such as RNA polymerase, 3-chymotrypsin-like protease, papain-like protease, helicase, glycoprotein, and accessory proteins.[19,20,28] The S protein from coronavirus can bind to the receptors of the host to facilitate viral entry into target cells.[29,30] Although there are four amino acid variations of S protein between 2019-nCoV and SARSCoV, 2019-nCoV can also bind to the human angiotensinconverting enzyme 2 (ACE2), the same host receptor for SARSCoV, as 2019-nCoV can bind to the ACE2 receptor from the cells from human, bat, civet cat, and pig, but it cannot bind to the cells without ACE2.[20, 31-33] A recombinant ACE2-Ig antibody, a SARSCoV-specific human monoclonal antibody, and the serum from a convalescent SARS-CoV-infected patient, which can neutralize 2019nCoV, confirmed ACE2asthehostreceptor for 2019-nCoV.[34,37] The high affinity between ACE2 and 2019-nCoV S protein also suggested that the population with higher expression of ACE2 might be more susceptible to 2019-nCoV.[38,39] The cellular serine protease TMPRSS2 also contributed to the S-protein priming of 2019-nCoV.[34]

CLINICAL MANIFESTATION

Patients with covid 19 usually present with clinical symptoms of fever, dry cough, and myalgia. In addition, less obvious symptoms such as nausea, diarrhea, reduced sense of smell (hyposmia), and abnormal taste sensation (Chen, Zhou, et al. 2020; Guan et al. 2020). Among patients who underwent chest computed tomography (CT), most showed bilateral pneumonia, with ground-glass opacity and bilateral patchy shadows being the most common patterns (Guan et al. 2020; Wang et al. 2020).

Among hospitalized patients in Wuhan, around one-fourth to one-third developed serious complications, such as acute respiratory distress syndrome, arrhythmia, and shock, and were therefore transferred to the intensive care unit (Chen, Zhou, et al. 2020; Huang et al. 2020; Wang et al. 2020). In general, older age and the existence of underlying comorbidities (e.g., diabetes, hypertension, and cardiovascular disease) were associated with poorer prognosis (Kui et al. 2020; Wang et al. 2020; Yang et al. 2020).

ROUTES OF TRANSMISSION

SARS-CoV-2 infections typically spread through respiratory droplets or by contact[40] Therefore coughing or sneezing by an infected person can render SARS-CoV 2 airborne, potentially infecting individuals in close contact(within radius of approximately 6ft). This led to the recent recommendation of social distancing to minimize community spread of the disease.

Another important route of transmission is if droplets of SARS-CoV-2 land on inanimate objects located nearby an infected individualand are subsequently touched by other individuals.[40] Thus, disinfection of objects and handwashing are essential for halting the spread of this disease. This recommendation is strengthened considering that people touch their face on an average of 23 times per hour, with 44% of these occurrences involving the mucous membranes of the mouth and/or nose.[41] In addition, studies have shown the presence of SARS-CoV-2 in both saliva and feces of the affected patients.[42,43]

It is known that SARS-CoV-2 can bind to human angiotensin-converting enzyme 2 receptors, which are highly concentrated in salivary glands; this may be a possible explanation for the presence of SARS-CoV-2 in secretory saliva.[44,45]

Therefore, there is a potential for transmission of COVID-19 via aerosol, fomites, or the fecal-oral route that may contribute to nosocomial spread in the dental office setting.[46]

POSSIBLE TRANSMISSION ROUTES OF 2019-NCOV IN DENTAL CLINICS

Since 2019-nCoV can be passed directly from person to person by respiratory droplets, emerging evidence suggested that it may also be transmitted through contact and fomites.[47] The incubation period for asymtomatic individuals infected with 2019-nCoV has been reported to be 1-14 days and individuals were reported after 24 days and it was confirmed that those asymptomatic individuals can spread the virus.[49,50] To et al. reported

that live viruses were present in the saliva of infected individuals by viral culture method.[47]

Furthermore, it has been confirmed that 2019-nCov enters the cell in the same path as SARS coronavirus, that is, through the ACE2 cell receptor.[23] 2019-nCoV can effectively use ACE2 as a receptor to invade cells, which may promote human-to-human transmission.[20] These ACE 2+ cells are morphologically compatible with salivary gland epithelium and they are abundantly found throughout respiratory tract. ACE2+ epithelial cells of salivary gland ducts were demonstrated to be a class early targets of SARSCoV infection[51], and 2019-nCoV is likely to be the same situation, although no research has been reported so far.

Due to characteristics of dental settings, the risk of cross infection can be high between patients and dental practioners as it involves face to face communication and frequent exposure to saliva, blood and other body fluids and handling of instruments. The pathogenic microorganisms can be transmitted in dental settings through inhalation of airborne microorganisms that can remain suspended in the air for long periods[52], direct contact with blood, oral fluids, or other patient materials[53], contact of conjunctival, nasal, or oral mucosa with droplets and aerosols containing microorganisms generated from an infected individual and propelled a short distance by coughing and talking without a mask[54], and indirect contact with contaminated instruments and/or environmental surfaces.[51] Infections might be present through any of those conditions involved in an infected individual in dental clinics and hospitals, especially during the outbreak of 2019-nCoV (Fig. 1).

Illustration of transmission routes of 2019-nCoV in dental clinics and hospitals

Fig 1.

AIRBORNE SPREAD

Many literatures have well reported the airborne spread of SARS-CoV. The dental papers show that a lot of dental procedures produce aerosols and droplets that are contaminated with virus.[55] Similarly the airborne transmission through droplets and aerosols of 2019-nCoV is a matter of concern in dental clinics and hospitals as the generation of giant amout of droplets and aerosols from patients saliva and blood during dental practice is unavoidable also dental handpiece uses high speed gas and work with running water. When dental devices add the patient's mouth, an outsized amount of aerosol and droplets mixed with the patient's saliva or maybe blood are going to be generated. Particles of droplets and aerosols are sufficiently small to remain airborne for an extended period before they choose environmental surfaces or enter the tract .Hence droplets and aerossols from infected individuals are potential weapons to spread 2019-nCoV.

CONTACT SPREAD

Dental professionals frequently exposed to saliva, blood, other body fluids and also to contaminated sharp instruments which makes a possible route to the spread of virus.In addition dental professional and patients have exposed to aerosols containing micro-organism generated from an infected person propelled a short distance by coughing and talking without mask. Effective infection control strategies are needed to stop the spread of 2019-nCoV through these contact routines.

CONTAMINATED SURFACE SPREAD

Contaminated surfaces spread Human coronaviruses such as SARS-CoV, Middle East Respiratory Syndrome coronavirus (MERS-CoV), or endemic human

coronaviruses (HCoV) can persist on surfaces like metal, glass, or plastic for up to a couple of days.[52,56] Therefore, contaminated surfaces that are frequently contacted in healthcare settings are a possible source of coronavirus transmission. Dental practices derived droplets and aerosols from infected patients, which likely contaminate the entire surface in dental offices. In addition, it had been shown at temperature that HCoV remains infectious from 2h up to 9 days, and persists better at 50% compared with 30% ratio. Thus, keeping a clean and dry environment within the dental office would help decrease the persistence of 2019nCoV.

INFECTION CONTROL FOR DENTAL PRACTICE

Dental professionals should be conversant in how 2019-nCoV is spread, the way to identify patients with 2019-nCoV infection, and what extra-protective measures should be adopted during the practice, so as to prevent the transmission of 2019-nCoV. Here we recommend the infection control measures that ought to be followed by dental professionals, particularly considering the very fact that aerosols and droplets were considered because the main spread routes of 2019-nCoV. Our recommendations are supported the rule for the Diagnosis and Treatment of Novel Coronavirus Pneumonia (the 5th edition) (http://www.nhc.gov.cn/yzygj/s7653p/202002/3b09b894ac9b4204a79db5b8912d4440.shtml), the rule for the Prevention and Control of Novel Coronavirus Pneumonia in Medical Institutes (the 1st edition) (http://www.nhc.gov.cn/yzygj/s7659/202001/b91fdab7c304431eb082d67847d27e14.shtml), and the Guideline for the Use of Medical Protective Equipment in the Prevention and Control of NovelCoronavirus Pneumonia (http://www.nhc.gov.cn/yzygj/s7659/202001/e71c5de925a64eafbe1ce790debab5c6.shtml) released by the National Health Commission of the People's Republic of China, and therefore the practice experience in West China Hospital of Stomatology associated with the outbreak of 2019-nCoV transmission.

PATIENT MANAGEMENT

 supported the experience gained from the previous outbreak of SARS-CoV and therefore the data available on SARS-CoV-2 and its associated disease (COVID-19), certain specific measures are discussed for dental patient management during this epidemic period of COVID-19 (Fig 2).

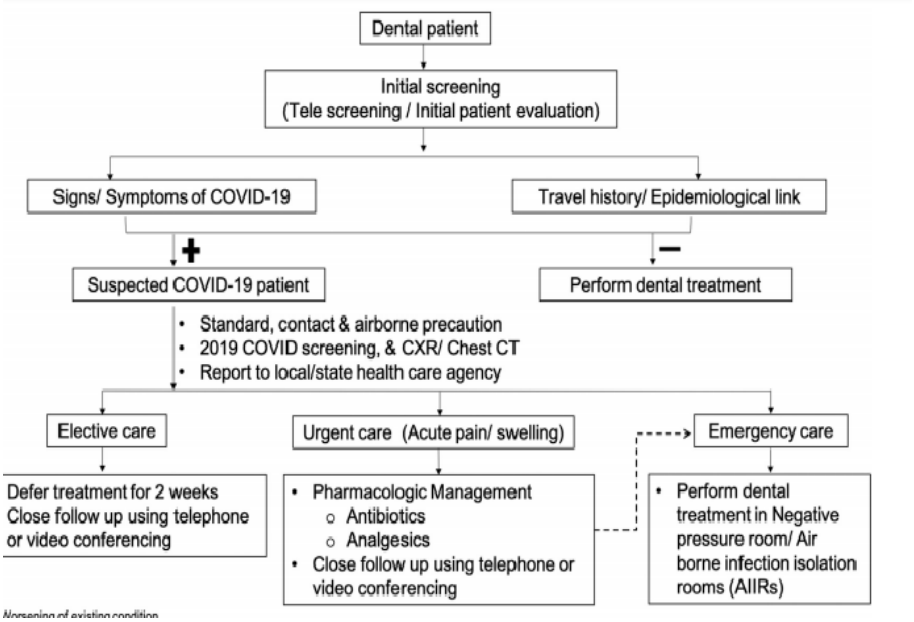

Fig 2.

TELESCREENING AND TRIAGING

 Initial screening via telephone to identify patients with suspected or possible COVID-19 infection can be performed remotely at the time of scheduling appointments.(Fig 2).

 The 3 most pertinent questions for initial screening should include any exposure to a person with known or suspected COVID-19 presentation, any recent travel history to an area with high incidence of COVID-19 or presence of any symptoms of febrile respiratory illness such as fever or cough.

 Importantly, to identify high-risk areas, live global tracking of reported cases can be done using the dashboard made accessible by the Center for Systems Science and Engineering at Johns Hopkins University 57.

 A positive response to either of the 3 questions should raise initial concern, and elective dental care should be deferred for at least 2 weeks (Note: As mentioned previously, the incubation period for SARS-CoV-2 can range from 0–24 days).

 These patients should be encouraged to engage in self-quarantine and contact their primary care physician by telephone or email58.

PATIENT EVALUATION AND COHORTING

 Upon patient arrival in dental practice, patients should complete a detailed medical history form, COVID-19 screening questionnaire and assesment of a true emergency questionnaire.(Fig 3 and Fig 4).

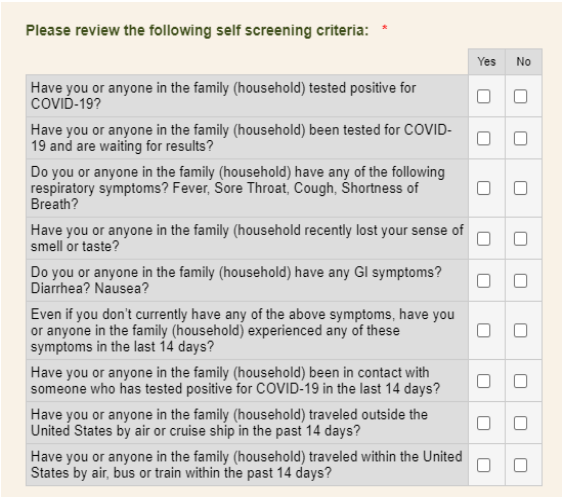

Fig 3.

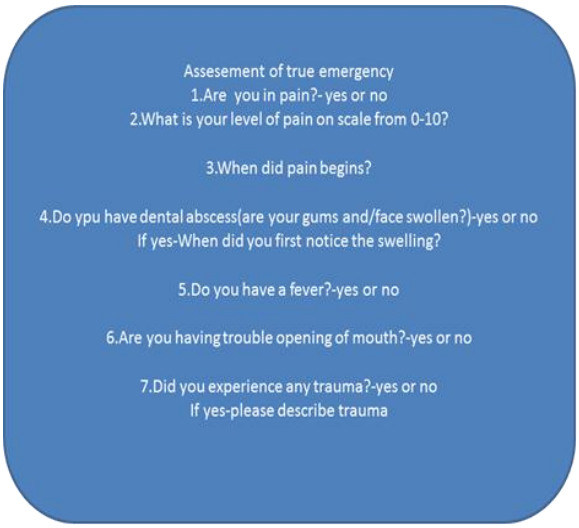

Fig 4.

 Dental professionals should measure the patient's body temperature using a non-contact forehead thermometer or with cameras having infrared thermal sensors.[46]

 Patients who present with fever (.100.4F 38C) and/or respiratory disease symptoms should have elective dental care deferred for at least 2 weeks.

 As per the Centers for Disease Control and Prevention guidelines, individuals with suspected COVID-19 infection should be seated in a separate, well-ventilated waiting area at least 6 ft from unaffected patients seeking care.[59]

 Patients should be requested to wear a surgical mask and follow proper respiratory hygiene, such as covering the mouth and nose with a tissue before coughing and sneezing and then discarding the tissue.[59]

 After informing the patients to self-quarantine themselves, dentists should instruct the patients to contact their physician to rule out the possibility of COVID-19.

SPECIFIC DENTAL TREATMENT RECOMMENDATIONS

HAND HYGIENE

Fecal–oral transmission has been reported for 2019-nCoV, which underlines the importance of hand hygiene for practice. Reinforcement for good hand hygiene is of the utmost importance. A two-beforeand-three-after hand hygiene guideline is proposed by the infection control department of the West China Hospital of Stomatology, Sichuan University, to reinforce the compliance of hand washing. Specifically, the oral professionals should wash their hands before patient examination, before dental procedures, after touching the patient, after touching the environment and equipment without disinfection, and after touching the oral mucosa, damaged skin or wound, blood, body fluid, secretion, and excreta.Dental professionals must be cautious to avoid touching their mouth, eyes, and nose.

PERSONAL PROTECTIVE MEASURES FOR DENTAL PROFESSIONALS

At present, there's no specific guideline for the protection of dental professionals from 2019-nCoV infection within the dental clinics and hospitals. Although no dental professional has been reported to accumulate 2019-nCoV infection to the date the paper was drafted, the last experience with the SARS coronavirus has shown vast numbers of acquired infection of medical professionals in hospital settings.[60] Since airborne droplet transmission of infection is taken into account because the main route of spread, particularly in dental clinics and hospitals, barrier-protection equipment, including protective eyewear, masks, gloves, caps, face shields, and protective outwear, is strongly recommended for all healthcare givers within the clinic/hospital settings during the epidemic period of 2019-nCoV.

Based on the likelihood of the spread of 2019-nCoV infection, three-level protective measures of the dental professionals are recommended for specific situations. (1) Primary protection (standard protection for workers in clinical settings). Wearing disposable working cap, disposable surgical mask, and working clothes (white coat), using protective goggles or face shield, and disposable latex gloves or nitrile gloves if necessary. (2) Secondary protection (advanced protection for dental professionals). Wearing disposable doctor cap, disposable surgical mask, protective goggles, face shield, and working clothes (white coat) with disposable isolation clothing or surgical clothes outside, and disposable latex gloves. (3) Tertiary protection

(Protection from patient with suspected or confirmed 2019-nCoV infection). A patient with 2019-nCoV should be avoided for dental treatment but if any dental emergency occurs, practioner should use special protective outwear. If protective outwear isn't available, working clothes (white coat) with extra disposable protective clothing outside should be worn. In addition, disposable doctor cap, protective goggles, face shield, disposable surgical mask, disposable latex gloves, and impermeable shoe cover should be worn.

 Dentists should follow standard, contact, and airborne precautions including the appropriate use of personal protective equipment and hand hygiene practices

 Fig 5- Centers for Disease Control and Prevention guidelines for putting on and removing personal protective equipment. Due to the uncertainity of this outbreak, there might be a shortage of personal protective equipment.

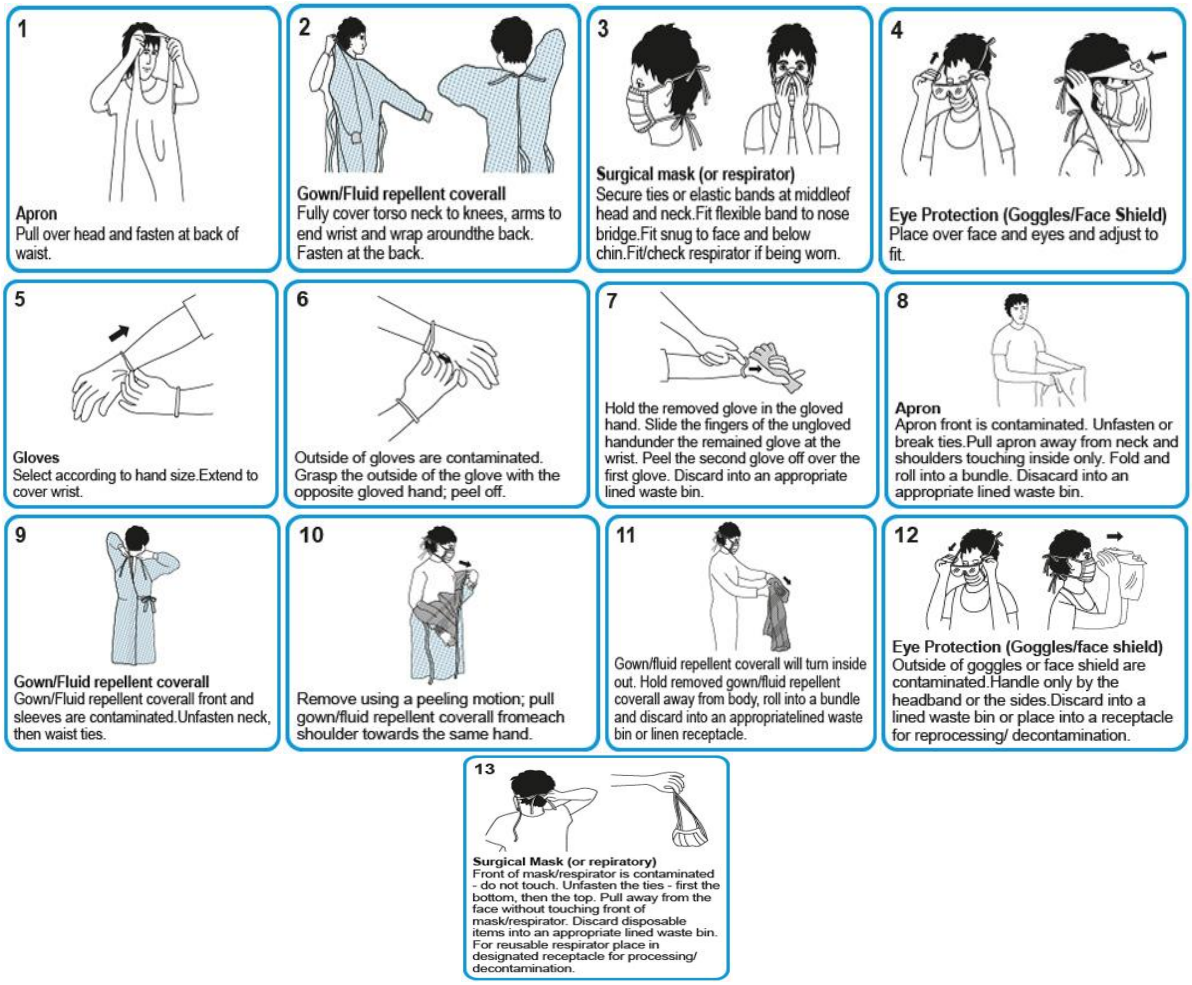

Fig 5.

 Therefore, it is advisable to use them judiciously and follow the Centers for Disease Control and Prevention guidelines for N95 respirator use and reuse (Fig 6)

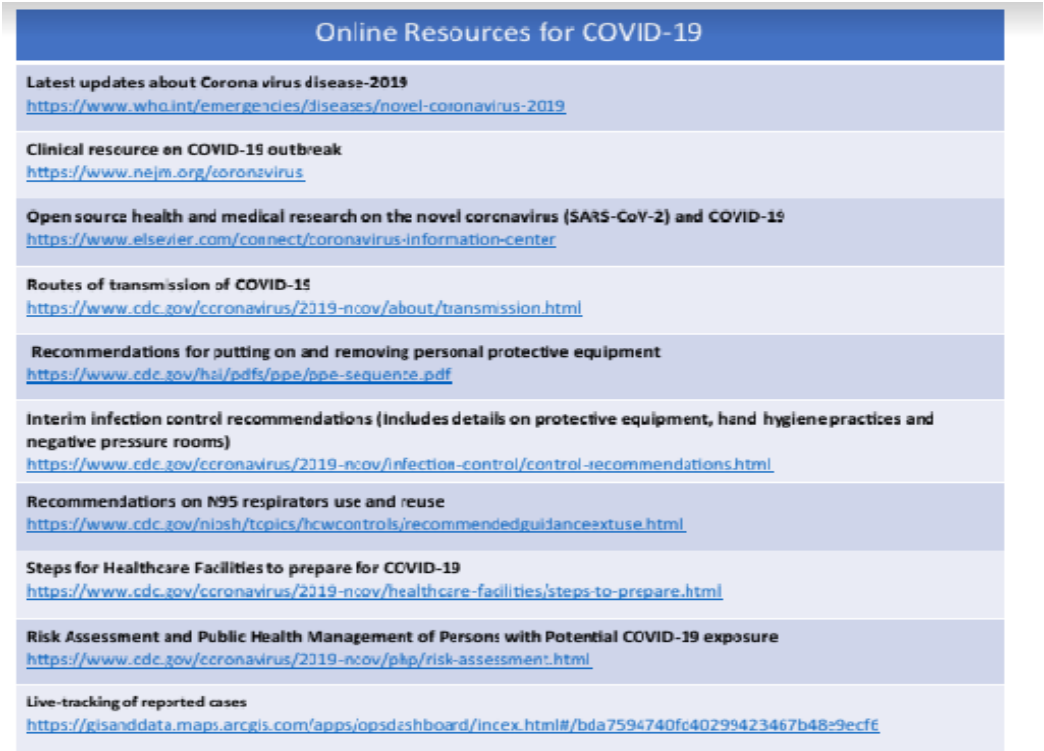

Fig 6.

MOUTH RINSE BEFORE DENTAL PROCEDURE

A preoperational antimicrobial mouthrinse is usually believed to scale back the amount of oral microbes. However, as instructed by the Guideline for the Diagnosis and Treatment of Novel Coronavirus Pneumonia (the 5th edition) released by the National Health Commission of the People's Republic of China, chlorhexidine, which is usually used as mouthrinse in practice, might not be effective to kill 2019-nCoV. Since 2019-nCoV is susceptible to oxidation, preprocedural mouthrinse containing oxidative agents like 1% peroxide or 0.2% povidone is suggested, for the aim of reducing the salivary load of oral microbes, including potential 2019-nCoV carriage. A preprocedural mouthrinse would be most useful in cases when rubber dam can't be used.

RUBBER DAM ISOLATION

The use of rubber dams can significantly minimize the assembly of saliva- and blood-contaminated aerosol or spatter, particularly in cases when high-speed handpieces and dental ultrasonic devices are used. It has been reported that the use of rubber dam could significantly reduce airborne particles in ~3-foot diameter of the operational field by 70a. When rubber dam is applied, extra high-volume suction for aerosol and spatter should be used during the procedures along with regular suction.[62] In this case, the implementation of an entire four-hand operation is additionally necessary. If rubber dam isolation isn't possible in some cases, manual devices, like Carisolv and hand scaler, are recommended for caries removal and periodontal scaling, so as to minimize the generation of aerosol as much as possible.

ANTIRETRACTION HANDPIECE

The high-speed dental handpiece without anti-retraction valves may aspirate and expel the debris and fluids during the dental procedures which may result in cross inefection and also. The function of antiretraction dental handpiece is to reduce the backflow of bacteria and viruses in the tube of handpiece and dental unit.[63] Hence, it is advisable to use high speed dental handpieces with anti retraction function during covid 19 epidemic because of its specially designed anti retractive vales and anti reflex design.[62] Therefore, the use of dental handpieces without antiretraction function should be prohibited during the epidemic period of COVID-19.

DISINFECTION OF THE CLINICAL SETTINGS

Medical institutions should take effective and strict disinfection measures in both clinic settings and public area. The clinic settings should be cleaned and disinfected in accordance with the Protocol for the Management of Surface Cleaning and Disinfection of Medical Environment (WS/T 512-2016) released by the National Health Commission of the People's Republic of China. Public areas and appliances should also be frequently cleaned and disinfected, including door handles, chairs, and desks. The elevator should be disinfected regularly.While using elevators to wear mask and avoid direct contact with other objects.

MANAGEMENT OF MEDICAL WASTE

Management of medical waste The medical waste (including disposable protective equipment after use) should be transported to the temporary cargo area of the medical institute timely. Pretreatment cleaning, sterilization and storage of reusable intruments and items

must be in accodrding with the Protocol for the Disinfection and Sterilization of Dental Instrument (WS 506-2016) released by the National Health Commission of the People's Republic of China. The medical and domestic waste generated by the treatment of patients with suspected or confirmed 2019-nCoV infection are considered infectious medical waste, for this double-layer yellow color medical waste package bags and "gooseneck" ligation should be used. The surface of the package bags should be marked and disposed according to the requirement for the management of medical waste.

SUMMARY

The rapidly increasing number of cases and evidence of human-to-human transmission suggested that the virus was more contagious than SARS-CoV and MERS-CoV9.[22,23,25,64] By mid-February 2020, a large number of infections of medical staff have been reported65, and the specific reasons for the failure of protection need to be further investigated. Although clinics like stomatology are closed during the epidemic, an outsized number of emergency patients still attend the dental clinics and hospitals for treatment. We have summarized the possible transmission routes of 2019-nCov in stomatology, like the airborne spread, contact spread, and contaminated surface spread. Several detailed practical strategies to block virus transmission to supply a reference for preventing the transmission of 2019-nCov during dental diagnosis and treatment, including patient evaluation, hand hygiene, personal protective measures for the dental professionals, mouthrinse before dental procedures, rubber dam isolation, anti-retraction handpiece, disinfection of the clinic settings, and management of medical waste has been reviewed in this article.

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