



**Review Article**

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## Infection control and management conventions for a dental health professional against a covid-19 pandemic virus

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### Abstract

The ongoing episode and outbreak of serious intense respiratory condition called as Covid-19 has caused health concerns affecting the entire world owing to the community spread pattern of infection. The infection caused by the virus manifests in nasopharyngeal and salivary secretions of affected patients causing pneumonia or severe acute respiratory disorder. The dental professionals are at the highest risk for transmission due to the possibility of aerosols produced by salivary droplets as well as face to face communication. These aerosols can be either inhaled or can contact the skin and has a tendency to accumulate on the surfaces in the dental clinics. The aim of article is to provide an insight over etiology, pathogenesis, screening modalities, patient education, infection control, research and essential knowledge about COVID-19 and management protocols amongst the health care professionals and clinical practitioners

**Keywords:** Covid, Dentistry, Sars Cov-2, Coronavirus.

### INTRODUCTION

A pneumonia of obscure reason was recognized in Wuhan, China and was presented to the WHO Office on 31st December, 2019. World Health Organization (WHO) distributed its hazard appraisal and guidance and gave an account of the status of patients and the general wellbeing reaction by national specialists to the bunch of pneumonia cases in Wuhan. This flare-up was followed to a newer strain of coronavirus, which was named 2019-nCoV by the World Health Organization (WHO), changed to SARS-CoV-2 according to the International Committee on Taxonomy of Viruses, prevalently called as Covid-19 infection. It was then pronounced 'A PANDEMIC', a Health emergency of International concern on 30th January 2020 [1].

The coronavirus comes from the family of Coronaviridae<sup>2</sup> which consists of a single stranded RNA combination. These group of infections are mainly known to be spread from animals to people. The other variations of these group were Severe Acute Respiratory Syndrome (SARS-CoV) in 2002 and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in 2012 suggesting that strong evidence of this novel coronavirus has likeness to coronavirus species found in bats and perhaps pangolins, attesting the zoonotic thought of this new cross-species [3]

With the increased transmission rates of SARS-Cov-2 to health workers, especially the dental specialists are at a high risk as they are in direct contact with patients mouth as well as aerosols generated from the procedures. Further-more, if additional precautions and measures are not taken, it can cause severe cross contamination of the disease. So, this article provides an insight over etiology, pathogenesis, screening modalities, patient education, infection control, research and essential knowledge about COVID-19 and management protocols amongst the health care professionals and clinical practitioners.

### ETIOPATHOLOGY

The morphology and structure of coronavirus is such that the outer portion contains spike proteins which has a variable receptor binding domain (RBD). This has an affinity towards the Angiotensin converting

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enzyme 2 (ACE-2) receptor usually found in heart, lungs, kidneys and gastrointestinal tracts therefore causing passage of viral cells into the targeted tissues or organs [4]. The genomic sequencing bears similarity to RaTG13, which was examined from bats (*Rhinolophus affinis*) It is, in this manner, accepted that the SARS-CoV-2 likewise began from bats and, in the wake of changing, had the option to taint different creatures. The pangolin is accepted to be the intermediate host of SARS-CoV-2. [Figure 1]

## SYMPTOMS

An incubation period is the time between when you contract a virus and when your symptoms start. As per a study<sup>3</sup>, the incubation period is ranging from 2-14 days, so transmission is highly likely during this stage and it can occur before any symptoms are shown.

According to a report<sup>5</sup>, more than 97 percent of people who contract SARS-CoV-2 show symptoms within 11.5 days of exposure. The average incubation period seems to be around 5 days. Individuals can a wide scope of manifestations from gentle side effects to extreme sickness.

These symptoms that may appear after the exposure varies greatly from mild to extreme forms and not all are symptomatic, few cases have also been diagnosed as asymptomatic. The common symptoms enlisted are fever, dry -cough, weakness, difficulty in breathing. Less common symptoms are muscle pain, loss of taste, rashes on skin, diarrhea, headache. Serious symptoms like shortness of breath, loss of movement may need prompt hospital admission. In, addition, most of patients might have mild symptoms making it difficult to differentiate from the virus, causing a higher presentation of undiagnosed cases. The virus has been found mostly in male populations and with existing co-morbidities.

## TRANSMISSION ROUTES

The quick spread concerning COVID-19 is firmly identified with the way in which SARS-CoV-2 is transmitted. Notwithstanding, the transmission methods of the infection have not been totally characterized. At present, the respiratory bead transmission mode and the contact transmission mode have been affirmed. COVID-19's irresistibility during the hatching time frame further convolutes its anticipation and control. As indicated by the most recent reports, the longest incubation time frame so far is 24 days.

SARS-Cov-2 contaminations commonly spread through [6]:

**a) Droplet spread:** Respiratory contaminations can be transmitted through beads of various sizes: when the drop particles are >5-10  $\mu$ -m in breadth they are alluded to as respiratory drops, and when at that point are <5 $\mu$ m in distance across, they are alluded to as drop cores. As per current proof, the transmission of this infection is via inhalation of the virus route and contact with the symptomatic patients. Droplet transmission happens when an individual is in close contact (inside 1 m) with somebody who has respiratory manifestations (e.g., hacking or sniffing) and is consequently in danger of having his/her mucosae (mouth and nose) or conjunctiva (eyes) presented to possibly infective respiratory beads. [Figure 3]

**b) Surface transmission:** The beads of SARS-CoV-2 land on lifeless things found close by a contaminated individual and are hence moved by others. For sure, an ongoing report proposes that the infection stays suitable for as long as 8-9 days such as on plastic or metal. Subsequently, sanitization of items and hand washing is basic for ending the spread of this illness. This proposal is fortified thinking about that individuals contact their face on a normal 23 times each hour, with 44% of these events including the mucous films of mouth or potentially nose.

**c) Airborne transmission:** This sort transmission is not quite the same as droplet transmission as it alludes to the nearness of microorganisms inside drop cores, which are commonly viewed as particles <5 $\mu$ m in

measurement, can stay noticeable all around for significant stretches of time and be transmitted to others over separations more prominent than 1m.

**d) Feco-oral transmission:** There is some proof that COVID-19 disease may prompt intestinal contamination and be available in defecation. Be that as it may, to date just one investigation has refined the COVID-19 infection from a solitary stool example. There have been no reports of faecal-oral transmission of the COVID-19 infection to date.

The work area of dentists and associated specialists includes the utilization of rotating dental instruments, for example, handpieces or injection needles, or ultrasonic scalers and air-water syringes. They make a noticeable splash that has enormous molecule beads of water, spit, blood and microorganisms. This splash voyages just a short separation and settles out rapidly, arriving on the floor, close by operatory surfaces, health workers, and the patient. The shower might also contain mist concentrates. Careful veils secure mucous films of the mouth and nose from bead splash, yet they don't give total assurance against inward breath of airborne irresistible specialists. [Figure 4] The dentists are regarded as extremely high risk to infection owing to the nature of work and explicit dental methodology [7].

## DIAGNOSIS AND LABORATORY TESTING

A concise history with associated symptoms and any related worldwide travel in the affected areas (past 14days) should give a positive correlation towards Covid-19 testing. The testing follows a usual protocol of taking a swab or wash from sputum, throat swab and nasopharyngeal secretions which is then sent to the lab for detection of any nucleic acid as seen with the morphology of the virus by using Real-time fluorescence(RT-PCR) [8].

The antibody testing can be done to detect any earlier infection. If the patient is affected with the virus, and produces antibodies in relation to it, it would suggest that the patient's immune system has acted upon to the virus and negate its's effects.

## PATIENT MANAGEMENT - PREVENTION AND TREATMENT IN DENTAL SETTING:

### I) TELEPHONE TRIAGE

Following the higher transmission rates of the virus, screening of the patients via telephone or videoconferencing should be a choice before any dental procedure is perceived. If the patient reports on having any signs or symptoms of respiratory infection, defer crisis dental consideration until the patient has recouped from the respiratory disease.

Assess the patient via video-conferencing and previous dental records, if in case there is an emergency the patient is then referred to the clinic. If there is no emergency, it can be managed by proper home dental hygiene instructions and prescription of medications to alleviate the pain.

### II) PRIOR TO THE DENTAL TREATMENT

A questionnaire [Figure 5] can serve as a guide to gauge and decide on the severity of the dental conditions to either provide or defer it. The difference between an urgency and emergency needs to be outlined. All procedures that warrant intervention such as swelling, abscess, dento-alveolar trauma and fractures, cariously destructed tooth with severe pain should be taken into emergency protocol [9].

The dentists should be cognizant of the following algorithms and take proper action to minimize the risk of transmission [9,10]. A list of essential and non-essential services has been given below according to the concerned specialty. [Figure 6,7,8]

### III) INFECTION CONTROL MEASURES IN DENTAL OFFICE:

#### A) BEFORE DENTAL CARE:

##### • CLINIC ENVIRONMENT & PATIENT ARRIVAL:

- i. The clinic should be thoroughly fumigated prior to the any treatments initiated. All the surfaces should be cleaned and covered with a thin plastic sheet if necessary. Clean and disinfect all the surfaces including door handles, chairs and bathrooms.
- ii. Standard instructions for respiratory hygiene before entering the clinic can be put up outside on a billboard or small hoarding showing images of coughing etiquettes and social distancing rules.
- iii. Ensure that there are proper supplies like alcohol-based hand rub, tissues at the entrances, waiting rooms, toilets.
- iv. Place a staff at the entrance to check for temperature of the patient before arriving at your dental office.
- v. The waiting room should be allowed for maximum of 2 patients, wearing a mask compulsorily or they can sit in their own respective cars till they have been called for the treatment.
- vi. A social distancing rule of 2metres/6 feet away from each other and avoidance of touching any of the clinical surfaces.
- vii. An adequate ventilation should be provided, the shaft should be cleaned daily to avoid any cross contamination.
- viii. Clean and disinfect all the surfaces including door handles, chairs and bathrooms using 0.1% Sodium Hypochlorite or 60-70% Alcohol based disinfectants.
- ix. Try to minimize the paperwork in recording all the details of the patient, rather use a computer or maintain it later with proper informed consent.

##### • PATIENT PREPARATION

- i. Once the patient is taken into operatory room for the required treatment, the temperature should be checked again, also oxygen saturation with pulse oximetry should be measured. Disposable shoes should be worn by the patient as well as the health care professional after entering the treatment room.
- ii. The patients should be given a separate apron or a large disposable gown to avoid cross-contamination with googles. Disposable shoes should be worn by the patient as well as the health care professional after entering the treatment room.
- iii. Proper hand hygiene recommended by CDC for 20seconds should be followed either by handwashing or use an alcohol-based sanitizer.
- iv. Prior to the treatment, alcohol-based mouth rinses should be given. Since SARS-CoV-2 may be vulnerable to oxidation, consider a pre-procedural rinsing with either 1% hydrogen peroxide or 0.2% povidone or 2% Chlorhexidine. Pre-medication for any existing conditions should be noted and given accordingly with proper dosages.

##### • DENTIST, DENTAL ASSOCIATES AND DENTAL ASSISTANT PREPARATION:

- i. All health care professionals including the dental doctor, associates and the staff should self-monitor themselves regularly to any symptoms pertaining to CoVid-19 virus.
  - ii. A sound knowledge to health care professional about use of PPE is important prior to any dental procedures. The dentist should educate their associates and assistants for the same to prevent any major lapse during use of the equipment.
  - iii. All dental procedures and associated precautions including Hand hygiene, cleaning of surfaces, careful disposing of biomedical waste, autoclaving should be practiced regularly.
  - iv. While selecting a PPE, consideration should be given to the type of exposure while working such as splashes, sprays or large volumes of blood or body fluids near the surgical field that might penetrate the clothing. The durability should also be taken into account whether it needs to be fluid resistant. Also, it should be properly fitting.
  - v. The health care professional should strictly adhere to the standard sequence of wearing and removal of PPE. [Figure 8.9]
- Goggles and face shield, Masks such as Triple layer surgical mask or N95 respirator, Surgical gloves (Latex/Nitrile), Disposable gown with hood (to be changed daily), Disposable Shoe covers.
  - i. Disposable surgical masks are to be used once only and safely discarded. Do not continue-on wearing a damaged mask. Replace it with new one, if need be. [Figure 10,11]

##### • CLINICAL TECHNIQUES AND HANDLING EQUIPMENT TO REDUCE TRANSMISSION-

- i. If an X-ray is required for a particular case, an extraoral radiograph is preferred rather than intraoral radiograph to reduce the contamination.
- ii. All the instruments should be kept ready in advance for required procedure. Disposable trays with coverings should be used, so that it is easy to de-clutter the waste and reduce any cross-contamination.
- iii. Reducing aerosol production during any treatment procedures by using a rubber dam.
- iv. Use ergonomically designed equipment to minimize unnecessary motion by using a 4-handed technique for controlling infection.
- v. The cross contamination can be prevented by additional protection by using of anti-retraction handpieces which causes anti suck back effect during procedures.
- vi. The preference to use the high-volume evacuators to minimize contamination.
- vii. After extraction of tooth, use of resorbable sutures is recommended to eliminate the need for a follow up.
- viii. After usage of handpieces, suction devices and 3-in-1 syringes for required procedures, disinfectants can be used to clean and reduce the viral load.

##### • PRECAUTIONS AFTER AN UNINTENTIONAL EXPOSURE-

- i. Do not panic.
- ii. Any procedure that would generate aerosols should be scheduled at the last. Proper PPE is advised and with a secure fit. If in case any

of these requirements aren't met, the required procedure is postponed.

- iii. If there is a possibility of patient being symptomatic or asymptomatic, a 14-day quarantine period is advised for the patient as well the health care professionals, associates and staff.
- iv. The patient should be directed to the appropriate testing facility and the entire case history and information should be passed on to the professionals in the Centre. Additionally, all the patients treated before in the clinic should be notified and any treatment should be deferred until then.

#### **B) AFTER DENTAL CARE:**

- i. The most important thing after every treatment should be change of air to minimize the aerosol contamination with the proper ventilation measures.
- ii. Recommended mouth wash rinses and handwashing for the patient and hand sanitization for health care staff as well as the dentist is required.
- iii. Routine cleaning and disinfection procedures of instruments and handpieces with heat sterilization.
- iv. For dentists and associates – WHO recommends washing for 60s and then adding 60% hydroalcoholic solution for hand hygiene before and after treatment.
- v. Prevention of bio-aerosol contamination<sup>11</sup>: Through filtration by high efficiency particulate arrestor (HEPA) is an air filter that removes particulates, by use of ultraviolet irradiation, Ionization and Ozonation. The dental clinic should be fumigated with formaldehyde on regular basis.
- vi. The health care professional should again fumigate the clinic once all the procedures have been attempted, cleaning of all the metal surfaces including door handles and glass doors, the waste management should be done in a proper manner.
- vii. Later, disinfect the mobile phones, camera and non-essential items to maintain cleanliness and avoidance of cross-contamination

#### **C) POST OPERATIVE INSTRUCTIONS FOR PATIENTS**

- i. NSAIDS such as Acetaminophen is best to treat any pulpal or dental intraoral swelling. Additional antibiotics can be prescribed.
- ii. Usage of mouth rinses and brushing of teeth twice a day to maintain oral hygiene.

#### **RESEARCH & DEVELOPMENT:**

##### **a) POINT OF CARE TESTING (POCT):**

The point of care testing would diagnose the virus as easy as the seasonal flu. This provides access to rapid diagnosis and predictive value key to realizing patient outcomes. This test kit by Abbott, could help in a faster determination of cases with reduced turn around time, improving patient morbidity and mortality and reduction in hospital admission. It generated positive results in 5 mins and negative in 13 mins.

##### **b) ANTI-RETROVIRAL, ANTI-INFLAMMATORY AND ANTI-MALARIAL DRUGS:**

As there has been no cure for the virus, certain drug combinations have proved to be vital in lengthening the course of disease with reducing its severity.

- The National Medical Products Administration of China has approved the use of Favilavir, an anti-viral drug.
- Emergency use for chloroquine and hydroxychloroquine as a treatment for COVID-19 has also been reported in various countries.
- Ritonavir/lopinavir and interferon-beta have been shown to have promising results.

**c) PLASMA THERAPY:** This has been initiated by Indian Council of Medical Research (ICMR) wherein they suggest using the serum of people who recovered from the virus into the active patient thereby introducing the antibodies that already have warded off the infection previously.

##### **d) NEWER DRUGS AND VACCINES:**

Most of the researchers are continuously working on creating a vaccine for coronavirus. Phase 1 and 2 trials have been already initiated, and human trials are underway. Here is compressive list of pharmaceutical companies which can have major breakthrough once approved after proper protocols and human trials. [Figure 12]

#### **STRENGTHS AND LIMITATIONS OF THE STUDY**

It is a review article which summarizes mainly on relevant research from articles, scientific papers and vigorous search of information through internet. In spite of the fact that, it can't mirror the whole collection of examination on COVID-19 around the world, it will give a few confirmations to future investigation and control.

The best source of information and latest updates can be found from these sites.

- The WHO Novel Coronavirus (COVID-19)
- Centres for Disease Control (CDC)
- The Johns Hopkins Center for Systems Science and Engineering site, tracks the spread of epidemic.

#### **CONCLUSION**

This new developing SARS-CoV-2 risk could turn into a not so much infectious but rather a typical disease in the overall populace. To be sure, it is anticipated to persevere in our populace as a less harmful disease with milder manifestations, in the event, that it follows the equivalent developmental example of the different coronavirus contaminations. In this way, it is critical to settle on educated clinical choices, instruct people in general to forestall alarm while advancing the wellbeing and prosperity of our patients as this outbreak ensues. As a dental health care professional, it is important to understand the etiopathogenesis of the disease, formulate treatment possibilities and treat the patient under proper protection and recommended guidelines.

#### **Financial Support**

Nil.

#### **Conflict of Interest**

The authors declare no conflict of interest.

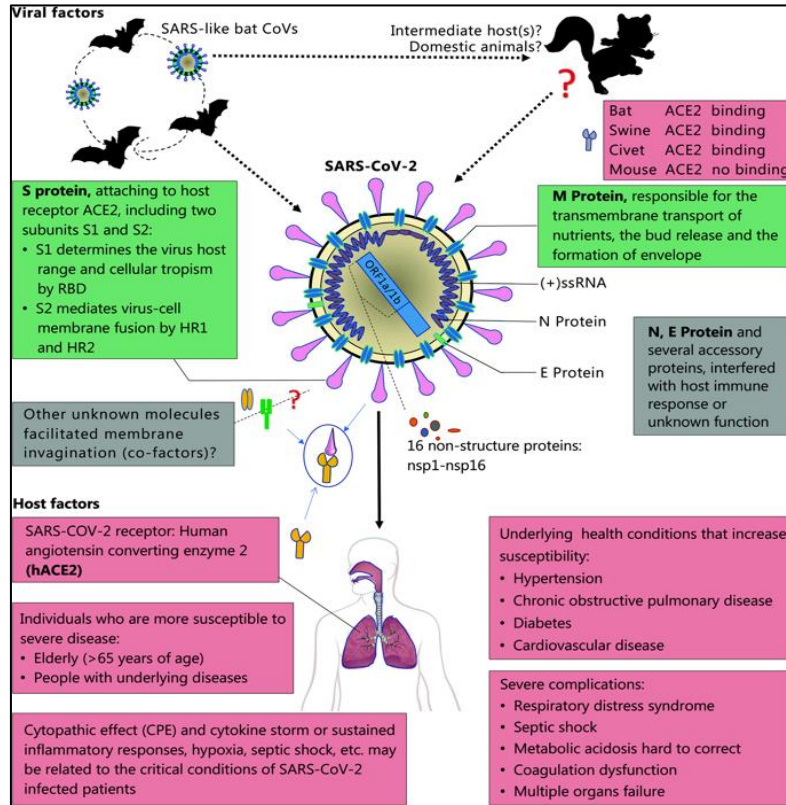


Figure 1: Viral and host factors that influence the pathogenesis of SARS-cov-2

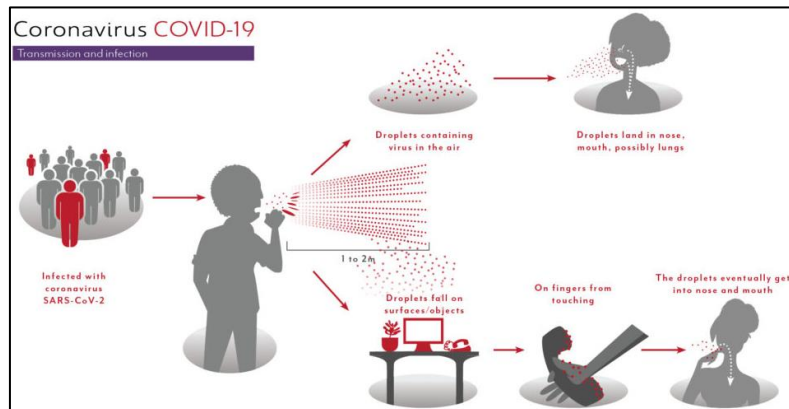


Figure 2: Transmission of Coronavirus (Covid-19)

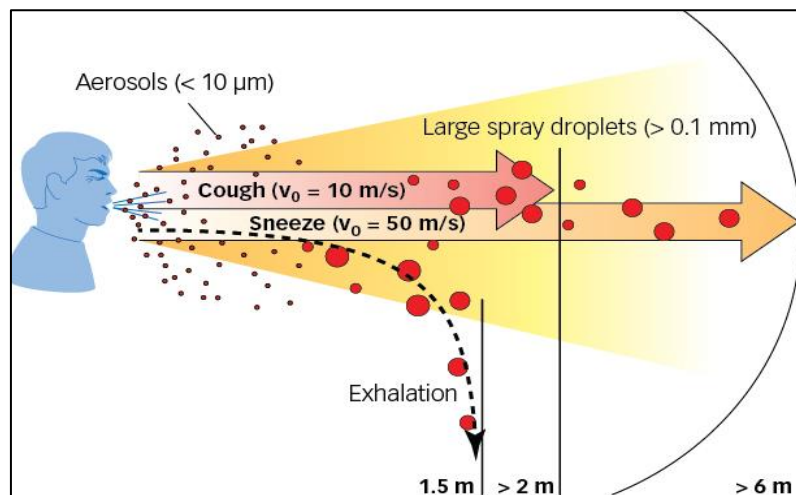


Figure 3: COVID-19 transmitted through aerosol particles during specific dental procedures

QUESTIONNAIRE	YES	NO
Q. In the past 14 days, have you or any household member travelled to international area (China, Iran, Italy, Japan, South Korea, or any European country) or anywhere else? If so, please note location:		
Q. In the past 14 days, have you or any household member had any contact with a known COVID-19 patient?		
Q. Have you had any history of fever, cough or breathing difficulty in the last 14 days?		
Q. Have you recently participated in any gathering, meetings, or had close contact with many unacquainted people?		
Q. Do you have uncontrolled dental or oral pain, infection, swelling or bleeding or trauma to your mouth?		
Q. Pain could be related to these urgent conditions: <ul style="list-style-type: none"> <li>• Severe dental pain from pulpal inflammation</li> <li>• Pericoronitis or third-molar pain</li> <li>• Surgical post-operative osteitis</li> <li>• Abscess, or localized bacterial infection resulting in localized pain and swelling</li> <li>• Tooth fracture resulting in pain or causing soft tissue trauma</li> <li>• Dental trauma with avulsion/luxation</li> <li>• Replacing temporary filling on endo access openings in patients experiencing pain?</li> </ul>		

Figure 4: Questionnaire for Initial screening of patients.

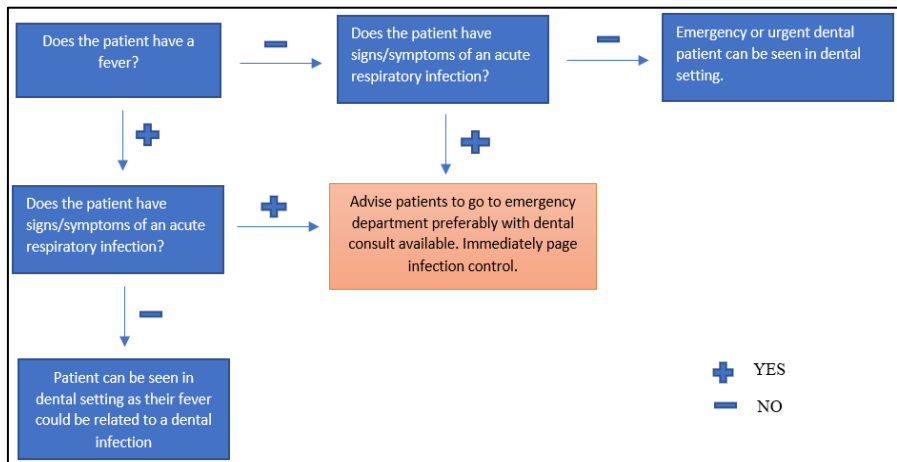


Figure 5: Emergency and urgent dental patients in this algorithm are being evaluated for COVID-19 infection signs/symptoms to determine in which clinical setting they should be seen.

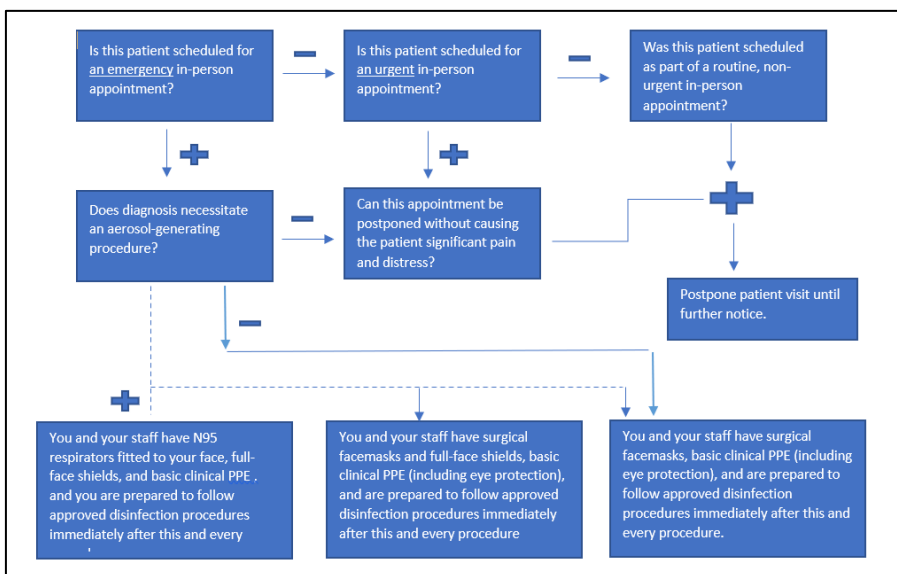


Figure 6: Interim Guidance to Minimize Risk of COVID-19 Transmission for Emergency and Urgent Dental Patients and HCP



<b>Essential vs. Non-Essential Dental Procedures</b>			
<i>This guide is to help dentists identify which dental procedures are considered <u>Essential vs. Non-Essential</u> during a national emergency. Dentists are to use the below as a guide, and encouraged to make professional judgement calls on the urgency of any procedure during emergencies. Patients with non-essential needs should be encouraged to maintain oral hygiene practices to maintain their current status. <u>Please note:</u> All procedures should also consider risk factors associated with demographics more susceptible to COVID-19, such as elderly patients.</i>			
<b>Specialty</b>	<b>Procedure Type</b>	<b>Essential</b>	<b>Non-Essential</b>
<b>Restorative</b>	<b>Fillings/Restorations</b>		
	<i>Incipient to Mild Decay</i>		<b>x</b>
	<i>Moderate Decay</i>	<b>x</b>	
	<i>Severe Decay</i>	<b>x</b>	
	<b>Fracture tooth repair</b>		
	<i>Pain</i>	<b>x</b>	
	<i>No Pain (If patient feels uncomfortable, consider that patient in pain)</i>		<b>x</b>
	<b>Crown</b>		
	<i>Crowns to be completed to navigate completion of care for moderate - severe decay as well as to complete RCT</i>	<b>x</b>	
	<i>Proactive replacement of restoration without decay</i>		<b>x</b>
<b>Veneers</b>		<b>x</b>	
<b>Cosmetics</b>	<b>Cosmetic procedures</b>		<b>x</b>
<b>Endodontics</b>	<i>Active Infection</i>	<b>x</b>	
	<i>Patient in Pain</i>	<b>x</b>	
	<i>Swelling or cellulitis</i>	<b>x</b>	
<b>Emergency Patients</b>	<i>Any patient who is contacting the practice with urgent needs should be seen to decrease overflow to Emergency Departments</i>	<b>x</b>	
<b>Hygiene</b>	<i>New Patient</i>		<b>x</b>
	<i>Recall</i>		<b>x</b>
	<i>Continuing Care</i>		<b>x</b>
<b>Oral Surgery</b>	<b>Extractions</b>		
	<i>Active Infection</i>	<b>x</b>	
	<i>Patient in Pain</i>	<b>x</b>	
	<i>Swelling or cellulitis</i>	<b>x</b>	
	<i>Third Molar without the above symptoms</i>		<b>x</b>
<b>Implants</b>		<b>x</b>	
<b>Orthodontics</b>	<i>New Bandings</i>		<b>x</b>
	<i>Patient complications (wire or bracket fractures)</i>	<b>x</b>	
	<i>Recall</i>		<b>x</b>
	<i>Debond*</i>		<b>x</b>
	<i>*Doctor to make judgement on if recall has extended time period and warrants a visit.</i>		
<b>Periodontics</b>	<b>Initial Therapy SRP or Maintenance</b>		
	<i>Patient has additional risk factors (Diabetes, Cardiac disease)</i>	<b>x</b>	
	<i>No additional risk factors</i>		<b>x</b>
<b>Prosthodontics</b>	<b>Bridges</b>		<b>x</b>
	<b>Dentures and Removables</b>	<b>x</b>	
<b>Pediatrics</b>	<i>Follow guidelines above for specific procedures.</i>		

Figure 7: List of essential and non-essential procedures during a COVID-19 pandemic virus.




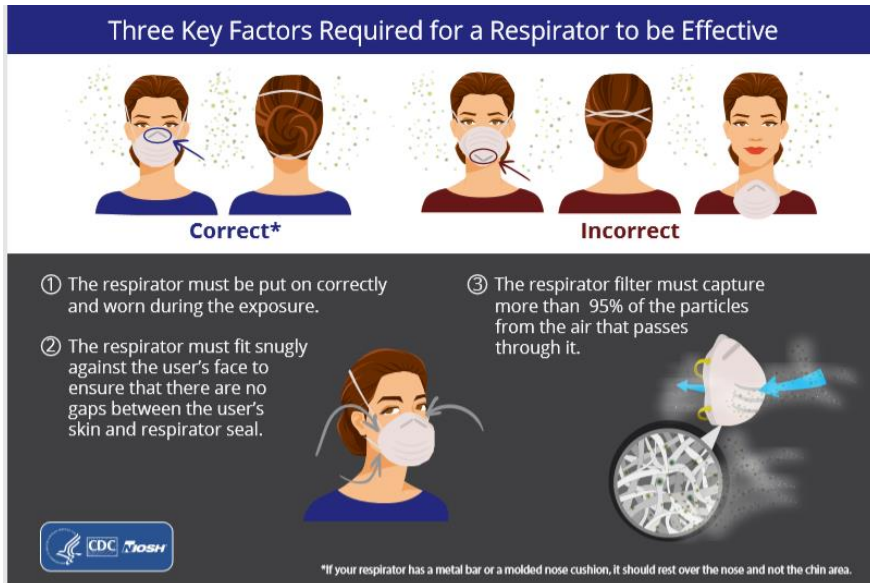
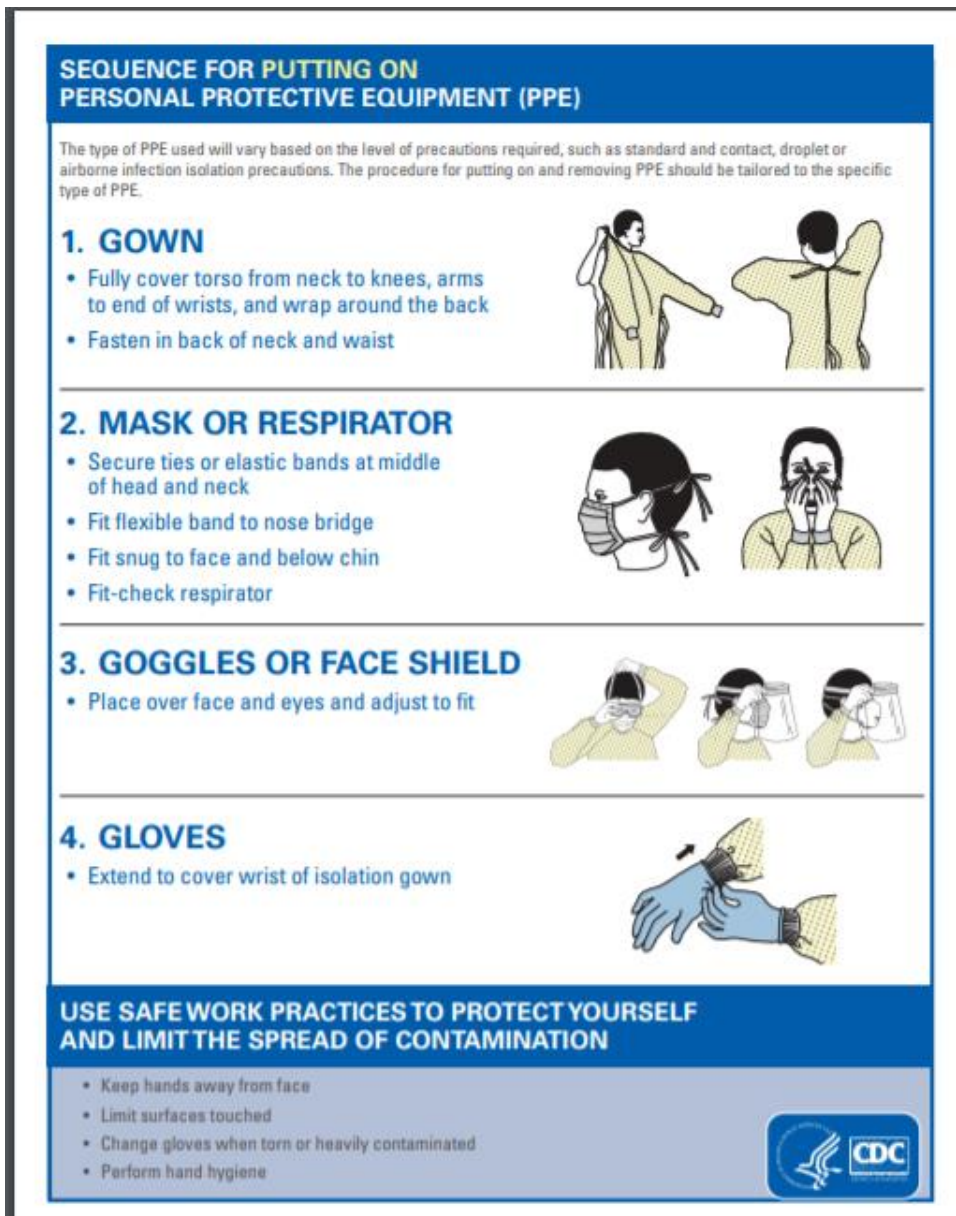
	 <b>SURGICAL MASK</b>	 <b>N95 MASK*</b>	 <b>N95 EQUIVALENT MASK KN/KP95, PFF2, P2, DS/DL2, KOREAN SPECIAL 1ST*</b>
<b>Testing and Approval</b>	Cleared by the U.S. Food and Drug Administration (FDA)	Evaluated, tested, and approved by NIOSH as per the requirements in 42 CFR Part 84	FDA Emergency Use Authorization (EUA)
<b>Sizing</b>	No	Yes. The sizing differs with each mask model. Some of the sizing options include small, small/medium, medium, medium/large, and large.	Yes. The sizing differs with each mask model. Some of the sizing options include small, small/medium, medium, medium/large, and large.
<b>Intended Use and Purpose</b>	Fluid resistant and provides the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids. Protects the patient from the wearer's mask emissions	Reduces wearer's exposure to particles including small particle aerosols and large droplets (only non-oil aerosols). OSHA recommends certifying the authenticity of masks to insure they provide the expected protection.	Reduces wearer's exposure to particles including small particle aerosols and large droplets (non-oil aerosols). Manufactured in compliance with standards of other countries and considered equivalent to NIOSH approved N95 masks. Authorized manufacturers are listed at: <a href="https://www.fda.gov/media/136663/download">https://www.fda.gov/media/136663/download</a>
<b>Face Seal Fit+</b>	Loose-fitting	Tight-fitting**	Tight-fitting**

Figure 8: Recommendations of wearing a mask during dental procedures



**Figure 9:** Factors required for a Respirator to be effective, CDC guideline.



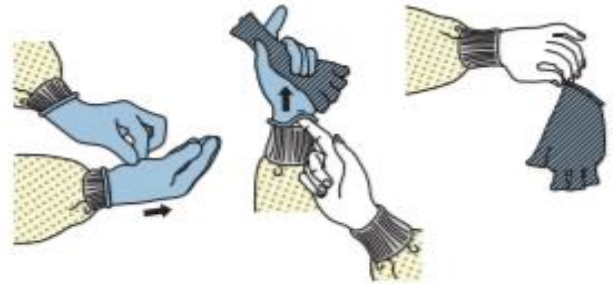
**Figure 10:** Sequence of wearing a PPE (CDC)



There are a variety of ways to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. Here is one example. **Remove all PPE before exiting the patient room** except a respirator, if worn. Remove the respirator **after** leaving the patient room and closing the door. Remove PPE in the following sequence:

## 1. GLOVES

- Outside of gloves are contaminated!
- If your hands get contaminated during glove removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Using a gloved hand, grasp the palm area of the other gloved hand and peel off first glove
- Hold removed glove in gloved hand
- Slide fingers of ungloved hand under remaining glove at wrist and peel off second glove over first glove
- Discard gloves in a waste container



## 2. GOGGLES OR FACE SHIELD

- Outside of goggles or face shield are contaminated!
- If your hands get contaminated during goggle or face shield removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Remove goggles or face shield from the back by lifting head band or ear pieces
- If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container



## 3. GOWN

- Gown front and sleeves are contaminated!
- If your hands get contaminated during gown removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Unfasten gown ties, taking care that sleeves don't contact your body when reaching for ties
- Pull gown away from neck and shoulders, touching inside of gown only
- Turn gown inside out
- Fold or roll into a bundle and discard in a waste container

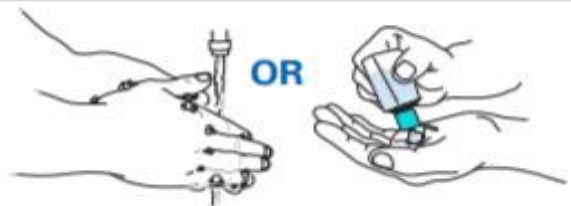


## 4. MASK OR RESPIRATOR

- Front of mask/respirator is contaminated — **DO NOT TOUCH!**
- If your hands get contaminated during mask/respirator removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Grasp bottom ties or elastics of the mask/respirator, then the ones at the top, and remove without touching the front
- Discard in a waste container



## 5. WASH HANDS OR USE AN ALCOHOL-BASED HAND SANITIZER IMMEDIATELY AFTER REMOVING ALL PPE



**PERFORM HAND HYGIENE BETWEEN STEPS IF HANDS BECOME CONTAMINATED AND IMMEDIATELY AFTER REMOVING ALL PPE**



Figure 11: Sequence of donning of a PPE after the intended use (CDC)

<b>DRUGS/VACCINES</b>	<b>COMPANIES</b>
Entos Pharmaceuticals	Fusogenix DNA vaccine 9 (Fusogenix drug delivery platform is a proteo-lipid vehicle that introduces genetic payload directly into the cells)
Roivant Sciences	Gimsilumab human monoclonal antibody. The drug targets granulocyte-macrophage colony stimulating factor (GM-CSF), which is a pro-inflammatory cytokine
Glaxo-Smith Line	GSK announced plans to collaborate with China's Xiamen Innovex on a potential vaccine to treat the COVID-19 coronavirus. The companies are testing a recombinant protein-based coronavirus vaccine candidate, which is being developed by Innovax with Xiamen University.
Johnson & Johnson	Johnson & Johnson, in partnership with the Rega Institute for Medical Research, University of Leuven (Belgium), are working to identify existing or new compounds with antiviral activity against COVID-19 that could contribute to providing immediate relief to the current outbreak.
Novartis	It plans to initiate a Phase III clinical trial in collaboration with Incyte to evaluate the use of Jakavi® (ruxolitinib) for treatment of a type of severe immune overreaction called cytokine storm that can lead to life-threatening respiratory complications in patients with COVID-19.
CSL Limited/ Seqirus	Is providing scientific and technical expertise and its established MF59® adjuvant technology to the University of Queensland in Australia to help fast-track the development of their CEPI-funded COVID-19 vaccine candidate, which uses novel molecular-clamp technology
Pfizer and biontech	Entered into a partnership to jointly develop biontech's mrna-based vaccine candidate BNT162 to prevent COVID-19 infection. The collaboration aims to accelerate global development of BNT162, which is expected to enter clinical testing by the end of April 2020.
Merck	As part of the global effort to investigate potential therapeutics for COVID-19 and their support of independent research, recently donated a supply of interferon beta-1a (Rebif®) to the French Institut National de la Santé et de la Recherche Médicale (INSERM) following a request for use in a clinical trial.
Naoviricides	Nanoviricides, a clinical-stage company, is working on developing a treatment for ncov-2019 using its nanoviricide® technology. The company's technology is used to develop ligands that can bind to the virus in the same way as a cognate receptor and attack various points of the virus.
Serum Insitute of India	Serum Institute of India (SII) is collaborating with Codagenix, a US-based biopharmaceutical company, to develop a cure for coronavirus using a vaccine strain similar to the original virus
Seagull biosolutions (PUNE)	The company is using Active Virosome Technology (AVT) for the vaccine. AVT is useful for producing novel, non-hazardous & economical active virosome agents expressing desired antigens from the target pathogen.
Hyderabad-based pharmaceutical company Bharat Biotech	Is collaborating with University of Wisconsin-Madison and US-based company flugen to develop the vaccine. According to reports the company will build on flugen's flu vaccine candidate M2SR and develop a 'one-drop nasal vaccine

**Figure 12:** List of newer developing vaccines for Coronavirus (COVID 19)

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