

REVIEW ARTICLE

Coronavirus Disease 19 (COVID-19): Implications for Clinical Dental Care

Amber Ather, BDS, DDS
 Biraj Patel, BDS
 Nikita B. Ruparel, MS, DDS, PhD
 Anibal Diogenes, DDS, MS, PhD
 and Kenneth M. Hargreaves,
 DDS, PhD

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 is still on a rise because of the community spread pattern of this infection. This is a zoonotic infection, similar to other coronavirus infections, that is believed to have originated in bats and pangolins and later transmitted to humans. Once in the human body, this coronavirus (SARS-CoV-2) is abundantly present in nasopharyngeal and salivary secretions of affected patients, and its spread is predominantly thought to be respiratory droplet/contact in nature. Dental professionals, including endodontists, may encounter patients with suspected or confirmed SARS-CoV-2 infection and will have 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 dental practice are suggested for patient screening, infection control strategies, and patient management protocol. (*J Endod* 2020; ■:1–12.)

KEY WORDS

Coronavirus; COVID-19; dental; endodontics; severe acute respiratory syndrome coronavirus 2; SARS-CoV-2

The outbreak of coronavirus disease 2019 (COVID-19) in the area of Wuhan, China, has evolved rapidly into a public health crisis¹ and has spread exponentially to other parts of the world (Fig. 1)². The novel coronavirus belongs to a family of single-stranded RNA viruses known as *Coronaviridae*³. This family of viruses are known to be zoonotic or transmitted from animals to humans. These include severe acute respiratory syndrome coronavirus (SARS-CoV), first identified in 2002, and the Middle East respiratory syndrome coronavirus (MERS-CoV), first identified in 2012⁴. There is strong evidence that this novel coronavirus has similarity to coronavirus species found in bats and potentially pangolins, confirming the zoonotic nature of this new cross-species viral-mediated disease^{5,6}. As the published genome sequence for this novel coronavirus has a close resemblance with other beta-coronaviruses such as SARS-CoV and MERS-CoV, the Coronavirus Study Group of the International Committee on Taxonomy of Viruses has given it the scientific name SARS-CoV-2, even though it is popularly called the COVID-19 virus^{7,8}. 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%^{9,10}. 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 worldwide¹¹ and this number continues to increase (Fig. 1). 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^{4,12}, 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

SIGNIFICANCE

Dental care providers need to be aware and prepared for tackling any impending infectious disease challenge as might be the case in the current outbreak of SARS-CoV-2 transmission and its associated coronavirus disease, which can be life-threatening to susceptible patients.

From the Department of Endodontics, University of Texas Health Science Center at San Antonio, San Antonio, Texas

Address requests for reprints to Dr Amber Ather, Department of Endodontics, University of Texas Health Science Center at San Antonio, 8210 Floyd Curl Drive, San Antonio, TX 78229.

E-mail address: ather@livemail.uthscsa.edu
 0099-2399/\$ - see front matter

Copyright © 2020 American Association of Endodontists.

<https://doi.org/10.1016/j.joen.2020.03.008>

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 current recommendations for diagnosing and managing patients with COVID-19. Although this information is current up to March 2020, we anticipate that new information will emerge and have provided URLs to several useful websites (Fig. 2).

SYMPTOMS

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 (dysguesia) have also been reported¹³. In addition, abnormal chest X-ray and computed tomographic findings such as ground-glass opacities are typically found in the chest¹⁴. Notably, about 80% of these patients have only mild symptoms that resemble flulike symptoms and seasonal allergies, which might lead to an increased number of undiagnosed cases¹⁵. These asymptomatic patients can act as “carriers” and also serve as reservoir for re-emergence of infection. Although SARS-CoV-2

is known to be highly transmissible when patients are most symptomatic, it is noteworthy that the incubation period can range from 0 to 24 days, therefore transmission can occur before any symptoms are apparent^{14,16}. Severe forms of this disease have a predilection for men with a mean age of 56 years with preexisting chronic illnesses such as cardiovascular disease or immunosuppression. The higher-risk patient population manifests symptoms typical of pneumonia or acute respiratory distress syndrome¹⁴.

ROUTES OF TRANSMISSION

SARS-CoV-2 infections typically spread through respiratory droplets or by contact¹. Therefore, coughing or sneezing by an infected person can render SARS-CoV-2 airborne, potentially infecting individuals in close contact (within a radius of approximately 6 ft). 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 individual and are subsequently touched by other individuals¹. 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 nose¹⁷. In addition, studies have shown the presence of SARS-CoV-2 in both saliva and feces of the affected patients^{18,19}. 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^{20,21}. 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 setting²².

PATIENT MANAGEMENT AND PREVENTION OF NOSOCOMIAL INFECTION

Based on the experience gained from the previous outbreak of SARS-CoV and the data available on SARS-CoV-2 and its associated disease (COVID-19), certain specific measures are discussed for dental patient management in this epidemic period of COVID-19 (summarized in Fig. 3).

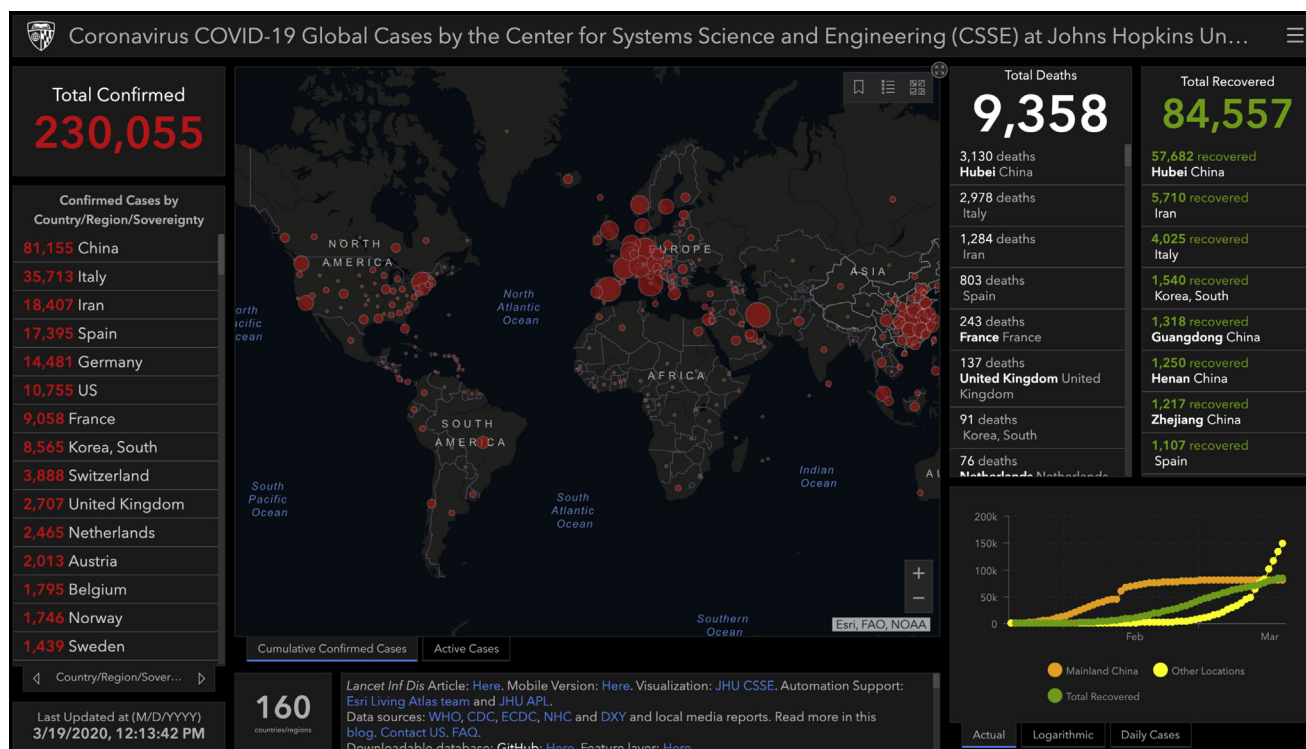


FIGURE 1 – A screenshot of an interactive map of the global cases of COVID-19 by the Center for Systems Science and Engineering at Johns Hopkins University². This dashboard is continually updated and can be accessed at <https://coronavirus.jhu.edu/map.html>. Site accessed March 27, 2020.

Online Resources for COVID-19	
Latest updates about Corona virus disease-2019	https://www.who.int/emergencies/diseases/novel-coronavirus-2019
Clinical resource on COVID-19 outbreak	https://www.nejm.org/coronavirus
Open source health and medical research on the novel coronavirus (SARS-CoV-2) and COVID-19	https://www.elsevier.com/connect/coronavirus-information-center
Routes of transmission of COVID-19	https://www.cdc.gov/coronavirus/2019-ncov/about/transmission.html
Recommendations for putting on and removing personal protective equipment	https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf
Interim infection control recommendations (Includes details on protective equipment, hand hygiene practices and negative pressure rooms)	https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html
Recommendations on N95 respirators use and reuse	https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html
Steps for Healthcare Facilities to prepare for COVID-19	https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/steps-to-prepare.html
Risk Assessment and Public Health Management of Persons with Potential COVID-19 exposure	https://www.cdc.gov/coronavirus/2019-ncov/php/risk-assessment.html
Live-tracking of reported cases	https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6
Environmental protection agency approved COVID-19 chemical disinfectants	https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
American Dental Association (ADA) Coronavirus Center for Dentists	https://success.ada.org/en/practice-management/patients/infectious-diseases-2019-novel-coronavirus
Interim Infection Prevention and Control Guidance for Dental Settings During the COVID-19 Response	https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html
ADA guidance on dental emergency and non-emergency care	https://www.ada.org/en/publications/ada-news/2020-archive/march/ada-develops-guidance-on-dental-emergency-nonemergency-care

FIGURE 2 – A list of online resources for COVID-19.

Telescreening and Triageing

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. 3). 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 University². Figure 1 represents a screenshot of interactive tracking of COVID-19.

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 email²³.

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 (Figs. 4 and Fig. 5). Dental professionals should measure the patient's body temperature using a non-contact forehead thermometer or with cameras having infrared thermal sensors²². Patients who present with fever (>100.4°F = 38°C) 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

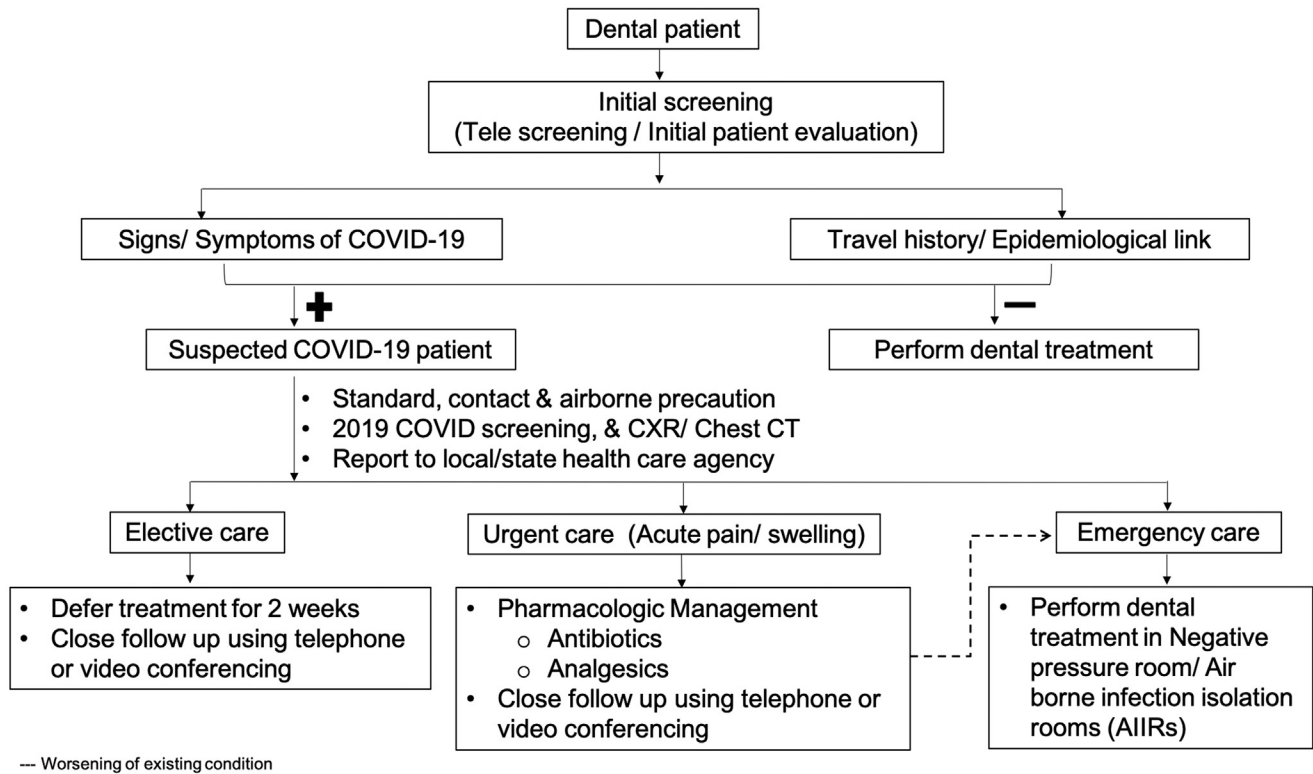


FIGURE 3 – An overview of patient screening for COVID-19 and dental management.

with suspected COVID-19 infection should be seated in a separate, well-ventilated waiting area at least 6 ft from unaffected patients seeking care²⁴. 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 tissue²⁴. 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.

Pharmacologic Management

In suspected or confirmed cases of COVID-19 infections requiring urgent dental care for conditions such as tooth pain and/or swelling, pharmacologic management in the form of antibiotics and/or analgesics is an alternative. This approach may offer symptomatic relief and will provide dentists sufficient time to either refer the patient to a specialist or deliver dental care with all appropriate measures in place to prevent the spread of infection.

SPECIFIC DENTAL TREATMENT RECOMMENDATIONS

Patients with active febrile and respiratory illness will most likely not present to dental practices. Based on the assessment of emergency questionnaire (Fig. 5), clinicians can gauge the severity of the dental condition and make an informed decision to either provide or defer dental care. In order to have a clarity on what constitutes an emergency condition, dentists can refer to recent

Date: _____
 Name (last name, first name): _____
 Date of Birth (mm/dd/yy): _____

Yes	No	COVID-19 Screening Questionnaire
		In the past 14 days, have you or any household member traveled to areas with known cases of COVID-19? If so, please note location:
		In the past 14 days, have you or any household member had any contact with a known COVID-19 patient?
		Have you or any household member have a history of exposure to COVID-19 biologic material?
		Have you had any history of fever in the last 14 days?
		Have you had any symptoms such as cough, difficulty breathing, diarrhea, nausea, body ache, loss of smell or loss of taste in the last 14 days?
		Urgent Dental Need Question Do you have uncontrolled dental or oral pain, infection, swelling or bleeding or trauma to your mouth?

FIGURE 4 – COVID-19 screening questionnaire.

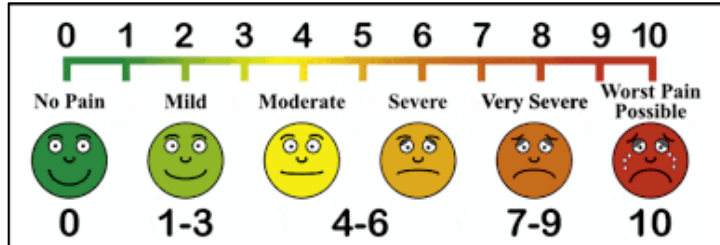
Assessment of a True Emergency

(Circle Patient's Response wherever appropriate)

1) Are you in pain?

Yes or No

2) What is your level of pain on a scale of 0-10?



3) When did the pain begin?

.....

4) Do you have a dental abscess (Are your gums and/or face swollen?)

Yes or No

- If **Yes**, when did you first notice the swelling?

.....

5) Do you have a fever?

Yes or No

6) Are you having any trouble swallowing?

Yes or No

7) Are you having any trouble opening your mouth?

Yes or No

8) Did you experience any trauma?

Yes or No

- Please describe the trauma

.....

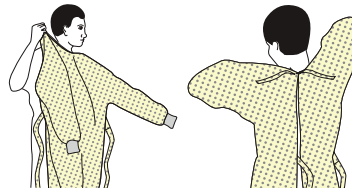
FIGURE 5 – Assessment of a true emergency questionnaire.

SEQUENCE FOR PUTTING ON PERSONAL PROTECTIVE EQUIPMENT (PPE)

The type of PPE used will vary based on the level of precautions required, such as standard and contact, droplet or airborne infection isolation precautions. The procedure for putting on and removing PPE should be tailored to the specific type of PPE.

1. GOWN

- Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back
- Fasten in back of neck and waist



2. MASK OR RESPIRATOR

- Secure ties or elastic bands at middle of head and neck
- Fit flexible band to nose bridge
- Fit snug to face and below chin
- Fit-check respirator



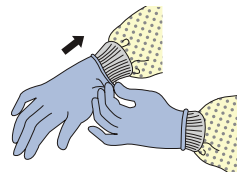
3. GOGGLES OR FACE SHIELD

- Place over face and eyes and adjust to fit



4. GLOVES

- Extend to cover wrist of isolation gown



USE SAFE WORK PRACTICES TO PROTECT YOURSELF AND LIMIT THE SPREAD OF CONTAMINATION

- Keep hands away from face
- Limit surfaces touched
- Change gloves when torn or heavily contaminated
- Perform hand hygiene



CS250672-E

FIGURE 6 – Centers for Disease Control and Prevention recommendations for putting on and removing personal protective equipment for treating COVID-19 patients. From: <https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf>. Site accessed March 17, 2020.

American Dental Association recommendations (Fig. 2). Certain instances such as dentoalveolar trauma and progressive fascial space infection warrant emergency dental intervention. In the unlikely event of providing dental care to suspected or confirmed cases of COVID-19 infection, dentists should be cognizant of the following recommendations:

- Dentists should follow standard, contact, and airborne precautions including the appropriate use of personal protective equipment and hand hygiene practices²⁴. Figure 6 illustrates Centers for Disease Control and Prevention guidelines for putting on and removing personal protective equipment. Due to the uncertainty of this outbreak, there might

be a shortage of personal protective equipment. 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. 2).

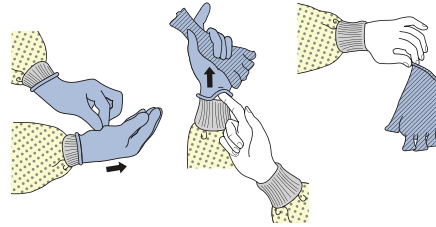
- Preprocedural mouth rinse: previous studies have shown that SARS-CoV and MERS-CoV were highly susceptible to

HOW TO SAFELY REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE) EXAMPLE 1

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



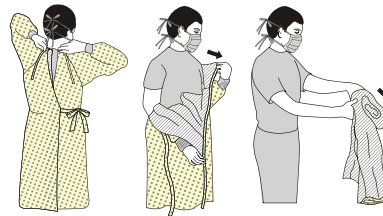
2. GOGGLES OR FACE SHIELD

- 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



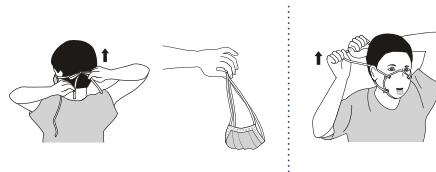
3. GOWN

- 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

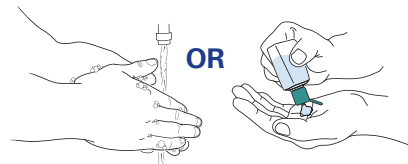


4. MASK OR RESPIRATOR

- 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



CS250672-E

FIGURE 6 – (Continued)

povidone mouth rinse²⁵. Therefore, preprocedural mouth rinse with 0.2% povidone-iodine might reduce the load of corona viruses in saliva^{22,26}. Another alternative would be to use 0.5-1% hydrogen peroxide mouth rinse, as it has non specific virucidal activity against corona viruses²⁷.

- Use of disposable (single-use) devices such as mouth mirror, syringes, and blood

pressure cuff to prevent cross contamination is encouraged.

- Radiographs: extraoral imaging such as panoramic radiography or cone-beam computed tomographic imaging should be used to avoid gag or cough reflex that may occur with intraoral imaging. When intraoral imaging is mandated, sensors should be double barriered to prevent perforation and cross contamination²⁸.

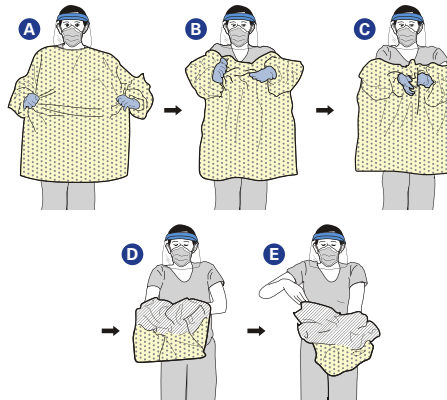
- Dentists should use a rubber dam to minimize splatter generation (of course, this is the standard of care for nonsurgical endodontic treatment). It may be advantageous to place the rubber dam so that it covers the nose.
- Dentists should minimize the use of ultrasonic instruments, high-speed handpieces, and 3-way syringes to reduce

HOW TO SAFELY REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE) EXAMPLE 2

Here is another way to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. **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. GOWN AND GLOVES

- Gown front and sleeves and the outside of gloves are contaminated!
- If your hands get contaminated during gown or glove removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Grasp the gown in the front and pull away from your body so that the ties break, touching outside of gown only with gloved hands
- While removing the gown, fold or roll the gown inside-out into a bundle
- As you are removing the gown, peel off your gloves at the same time, only touching the inside of the gloves and gown with your bare hands. Place the gown and gloves into a waste container



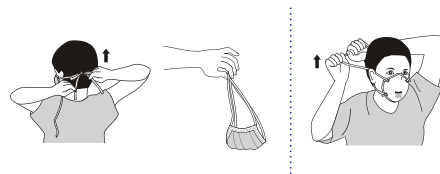
2. GOGGLES OR FACE SHIELD

- 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 and without touching the front of the goggles or face shield
- If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container

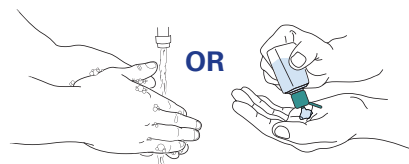


3. MASK OR RESPIRATOR

- 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



4. 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**



CS250672-E

FIGURE 6 – (Continued)

the risk of generating contaminated aerosols.

- In this time of public health crisis, endodontic practices can dilute the sodium hypochlorite irrigant solution to 1% concentration, to extend the supplies without compromising on treatment outcome²⁹.
- Negative-pressure treatment rooms/airborne infection isolation rooms (AIIRs): it

is worth noting that patients with suspected or confirmed COVID-19 infection should not be treated in a routine dental practice setting. Instead, this subset of patients should only be treated in negative-pressure rooms or AIIRs. Therefore, anticipatory knowledge of health care centers with provision for AIIRs would help dentists to provide emergent dental care if the need arises²⁴.

- SARS CoV-2 can remain viable in aerosol and survive up to 3 days on inanimate surfaces at room temperature, with a greater preference for humid conditions³⁰. Therefore, clinic staff should make sure to disinfect inanimate surfaces using chemicals recently approved for COVID-19 and maintain a dry environment to curb the spread of SARS-CoV-2³¹.

DIAGNOSIS	PRIMARY MANAGEMENT	SECONDARY MANAGEMENT
Symptomatic Irreversible pulpitis/ Symptomatic Apical Periodontitis	<p>Pain Management:</p> <ul style="list-style-type: none"> 1st line: Ibuprofen 600mg + Acetaminophen 325-500mg^{33,34,35} 2nd line: Dexamethasone 0.07- 0.09mg/kg³⁶ <p>Consideration for supplementation with long acting local anesthetic - 0.5% Bupivacaine for immediate pain relief³⁷</p>	Full Pulpotomy ^{38,39}
Acute Apical Abscess	<p>Intraoral Swelling:</p> <ul style="list-style-type: none"> Incision and Drainage Augmentin 500mg b.i.d. x 5 days/ Clindamycin 300mg q.i.d. x 5 days⁴⁰ Ibuprofen 600mg + Acetaminophen 325-500mg^{33,34,35} <p>Consideration for supplementation with long acting local anesthetic - 0.5% Bupivacaine for immediate pain relief³⁷</p> <p>Extraoral Swelling:</p> <ul style="list-style-type: none"> Augmentin 500mg b.i.d. x 5 days/ Clindamycin 300mg q.i.d. x 5 days⁴⁰ Ibuprofen 600mg + Acetaminophen 325-500mg^{33,34,35} 	Call Oral & Maxillofacial Surgery for further instructions for a possible referral
Avulsion/ Luxation	<p>If tooth is replanted, follow pain management protocol: Pain Management- dependent on age</p> <ul style="list-style-type: none"> 1st line: Ibuprofen 600mg + Acetaminophen 325-500mg^{33,34,35} 	If tooth is not replanted, replant and follow IADT guidelines ^{41,42} as best as possible
Tooth fracture resulting in pain	<p>Pain management :</p> <ul style="list-style-type: none"> Ibuprofen 600mg + Acetaminophen 325-500mg^{33,34,35} 	Vital Pulp Therapy ^{38,39,43}
Trauma involving facial bones, potentially compromising the patient's airway	Refer to Oral & Maxillofacial Surgery	
Cellulitis or a diffuse soft tissue bacterial infection with intra-oral or extra-oral swelling that can potentially compromise the patient's airway	Refer to Oral & Maxillofacial Surgery	

FIGURE 7 – Recommendations for dental emergency management during COVID-19 outbreak.

DISCUSSION

The rampant spread of SARS-CoV-2 worldwide increases the likelihood that dental health care professionals will treat this subset of the patient population. Universal precautions are crucial to minimize the spread of this virus and its associated disease. As presented in this review, further precautions are necessary that includes careful prescreening of patients and additional measures if treatment of patients with confirmed COVID-19 is deemed necessary. The latest update (March 16, 2020) by the American Dental Association recommends dentists nationwide to defer elective dental treatment for the next three weeks and focus on emergency care³². As there is a surge in the number of COVID-19 cases, it is quite possible that this deferment might be extended. Therefore, in order to help

dentists during this period, we have put together a set of recommendations for management of dental emergencies (Fig. 7). It is advisable to assess the emergencies on a case-by-case basis and use clinical judgement to aid in decision making.

Endodontists are in a unique situation as they may be called upon for the assessment and management of odontogenic pain, swelling, and dental alveolar trauma in suspected or known COVID-19 patients. It is worth noting that case presentations can be dynamic, and there is a good chance that dental practices might treat some of the patients with asymptomatic COVID-19 infections since the incubation period can range from 0 to 24 days and most patients only develop mild symptoms^{14,16}. Thus, every patient should be considered as potentially infected by this virus, and all dental practices need to review their

infection control policies, engineering controls, and supplies. Health care providers must keep themselves up-to-date about this evolving disease and provide adequate training to their staff to promote many levels of screening and preventive measures, allowing dental care to be provided while mitigating the spread of this novel infection.

In conclusion, health care professionals have the duty to protect the public and maintain high standards of care and infection control. This new emerging SARS-CoV-2 threat could become a less pathogenic and more common infection in the worldwide population. Indeed, it is predicted to persist in our population as a less virulent infection with milder symptoms, if it follows the same evolutionary pattern of the other coronavirus infections (ie, SARS-CoV and MERS-CoV). Thus, it is important to make

informed clinical decisions and educate the public to prevent panic while promoting the health and well-being of our patients during these challenging times. The prudent

practitioner will use this review as a starting point and continue to update themselves with useful online information as this outbreak continues (Fig. 2).

ACKNOWLEDGMENTS

The authors deny any conflicts of interest related to this study.

REFERENCES

- Centers for Disease Control and Prevention. Transmission of coronavirus disease 2019 (COVID-19). Available at: <https://www.cdc.gov/coronavirus/2019-ncov/about/transmission.html>. Accessed 18 March, 2020.
- Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis* 2020. [https://doi.org/10.1016/S1473-3099\(20\)30120-1](https://doi.org/10.1016/S1473-3099(20)30120-1).
- Gorbalenya AE, Baker SC, Baric RS, et al. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol* 2020. <https://doi.org/10.1038/s41564-020-0695-z>.
- Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. *Can J Anaesth* 2020. <https://doi.org/10.1007/s12630-020-01591-x>. Accessed 18 March, 2020.
- Zhou P, Yang X-L, Wang X-G, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 2020;579:270–3.
- Wahba L, Jain N, Fire AZ, et al. Identification of a pangolin niche for a 2019-nCoV-like coronavirus through an extensive meta-metagenomic search. *bioRxiv* 2020. <https://doi.org/10.1101/2020.02.08.939660>.
- Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020;382:727–33.
- Gorbalenya AE. Severe acute respiratory syndrome-related coronavirus – the species and its viruses, a statement of the Coronavirus Study Group. *bioRxiv* 2020. <https://doi.org/10.1101/2020.02.07.937862>.
- Sohrabi C, Alsafi Z, O'Neill N, et al. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). *Int J Surg* 2020;76:71–6.
- WHO director-general's opening remarks at the media briefing on COVID-19 - 3 March 2020. Available at: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-3-march-2020>. Accessed 11 March, 2020.
- Situation Report-67 SITUATION IN NUMBERS total and new cases in last 24 hours. Available at: https://who.int/docs/default-source/coronaviruse/situation-reports/20200327-sitrep-67-covid-19.pdf?sfvrsn=b65f68eb_4. Accessed 27 March, 2020.
- Lan L, Xu D, Ye G, et al. Positive RT-PCR test results in patients recovered from COVID-19. *JAMA* 2020. <https://doi.org/10.1001/jama.2020.2783>.
- Giacomelli A, Laura Pezzati L, Conti F, et al. Self-reported olfactory and taste disorders in SARS-CoV-2 patients: a cross-sectional study, *Clinical Infectious Diseases*, , ciaa330, <https://doi.org/10.1093/cid/ciaa330>
- Guan W, Ni Z, Hu Y, et al. Clinical characteristics of 2019 novel coronavirus infection in China. *medRxiv*. Available at: <https://www.medrxiv.org/content/10.1101/2020.02.06.20020974v1>. Accessed March 11, 2020.
- Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020. <https://doi.org/10.1001/jama.2020.2648>.
- Rothe C, Schunk M, Sothmann P, et al. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *N Engl J Med* 2020;382:970–1.
- Kwok YL, Gralton J, McLaws ML. Face touching: a frequent habit that has implications for hand hygiene. *Am J Infect Control* 2015;43:112–4.
- To KK, Tsang OT, Yip CC, et al. Consistent detection of 2019 novel coronavirus in saliva. *Clin Infect Dis* 2020. <https://doi.org/10.1093/cid/ciaa149>.

19. Zhang J, Wang S, Xue Y. Fecal specimen diagnosis 2019 novel coronavirus–infected pneumonia. *J Med Virol* 2020. <https://doi.org/10.1002/jmv.25742>.
20. Hoffmann M, Kleine-Weber H, Schroeder S, et al. SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. *Cell* 2020. <https://doi.org/10.1016/j.cell.2020.02.052>.
21. Sabino-Silva R, Jardim ACG, Siqueira WL. Coronavirus COVID-19 impacts to dentistry and potential salivary diagnosis. *Clin Oral Investig* 2020. <https://doi.org/10.1007/s00784-020-03248-x>.
22. Peng X, Xu X, Li Y, et al. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci* 2020;12:9.
23. Wang Y, Wang Y, Chen Y, Qin Q. Unique epidemiological and clinical features of the emerging 2019 novel coronavirus pneumonia (COVID-19) implicate special control measures. *J Med Virol* 2020. <https://doi.org/10.1002/jmv.25748>.
24. Centers for Disease Control and Prevention. Infection control: severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Available at: <https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html>. Accessed 9 March, 2020.
25. Eggers M, Koburger-Janssen T, Eickmann M, Zorn J. In vitro bactericidal and virucidal efficacy of povidone-iodine gargle/mouthwash against respiratory and oral tract pathogens. *Infect Dis Ther* 2018;7:249–59.
26. Kariwa H, Fujii N, Takashima I. Inactivation of SARS coronavirus by means of povidone-iodine, physical conditions, and chemical reagents. *Jpn J Vet Res* 2004;52:105–12.
27. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. *J Hosp Infect* 2020;104:246–51.
28. List N: EPA’s registered antimicrobial products for use against novel coronavirus SARS-CoV-2, the cause of COVID-19. Washington, DC: United States Environmental Protection Agency. Available at: <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>. Accessed March 18, 2020.
29. Verma N, Sangwan P, Tewari S, Duhan J. Effect of Different Concentrations of Sodium Hypochlorite on Outcome of Primary Root Canal Treatment: A Randomized Controlled Trial. *J Endod* 2019;45:357–63. <https://doi.org/10.1016/j.joen.2019.01.003>.
30. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1. *N Engl J Med* 2020 March 17. <https://doi.org/10.1056/NEJMc2004973>.
31. Hokett SD, Honey JR, Ruiz F, et al. Assessing the effectiveness of direct digital radiography barrier sheaths and finger cots. *J Am Dent Assoc* 2000;131:463–7.
32. ADA recommending dentists postpone elective procedures. Available at: <https://www.ada.org/en/publications/ada-news/2020-archive/march/ada-recommending-dentists-postpone-elective-procedures>. Accessed March 18, 2020.
33. Watts K, Balzer S, Drum M, et al. Ibuprofen and acetaminophen versus intranasal ketorolac (Sprix) in an untreated endodontic pain model: a randomized, double-blind investigation. *J Endod* 2019;45:94–8.
34. Smith EA, Marshall JG, Selph SS, Barker DR, Sedgley CM. Nonsteroidal anti-inflammatory drugs for managing postoperative endodontic pain in patients who present with preoperative pain: a systematic review and meta-analysis. *J Endod* 2017;43:7–15.
35. Taggar T, Wu D, Khan AA. A randomized clinical trial comparing 2 ibuprofen formulations in patients with acute odontogenic pain. *J Endod* 2017;43:674–8.
36. Liesinger A, Marshall FJ, Marshall JG. Effect of variable doses of dexamethasone on posttreatment endodontic pain. *J Endod* 1993;19:35–9.
37. Gordon SM, Mischenko AV, Dionne RA. Long-acting local anesthetics and perioperative pain management. *Dent Clin North Am* 2010;54:611–20.
38. Eren B, Onay EO, Ungor M. Assessment of alternative emergency treatments for symptomatic irreversible pulpitis: a randomized clinical trial. *Int Endod J* 2018;51(Suppl 3):e227–37.
39. Hasselgren G, Reit C. Emergency pulpotomy: pain relieving effect with and without the use of sedative dressings. *J Endod* 1989;15:254–6.
40. Baumgartner JC, Xia T. Antibiotic susceptibility of bacteria associated with endodontic abscesses. *J Endod* 2003;29:44–7.

41. Diangelis AJ, Andreasen JO, Ebeleseder KA, et al. Guidelines for the management of traumatic dental injuries: 1. fractures and luxations of permanent teeth. *Pediatr Dent* 2017;39:401–11.
42. Andersson L, Andreasen JO, Day P, et al. Guidelines for the management of traumatic dental injuries: 2. avulsion of permanent teeth. *Pediatr Dent* 2017;39:412–9.
43. Cvek M. A clinical report on partial pulpotomy and capping with calcium hydroxide in permanent incisors with complicated crown fracture. *J Endod* 1978;4:232–7.