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SARS-CoV-2 Pandemic and Pediatric Dental Practice Recommendations

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Abstract
Coronavirus disease 2019 (COVID-19) is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is transmitted primarily via inhalation, ingestion, and direct mucosal contact with saliva droplets. Most of the documented clinical signs, symptoms, progression, and prognosis of SARS-CoV-2 in children are milder compared to adults. Due to the presence of viral particles in saliva, dental professionals are considered high risk for becoming infected with the virus. At this time, there are no universal dental practice guidelines to mitigate community spread of SARS-CoV-2 in a dental practice setting and there is insufficient data regarding the dental implications of the SARS-CoV-2 pandemic. During the peak of the pandemic, dental treatment focus shifted from non-emergent to emergent dental care, with countries worldwide following different regulations. This article provides a literature review of relevant information including viral transmission, etiopathogenesis, clinical signs and symptoms in children, treatment options, and evidence-based pediatric dental practice recommendations. This article also discusses the impact of the SARS-CoV-2 pandemic on pediatric dental practice due to an increasing number of dental emergencies in children alongside a necessity to protect staff and patients. The recommendations in this paper are based on the review of literature and may vary depending on the guidelines laid down by state government and local regulation.

Key words: Coronavirus, dental practice recommendations, COVID19, SARS-CoV-2, pediatric dental practice

Introduction

Coronaviruses are enveloped, positive-stranded RNA viruses that belong to the family *Coronaviridae* and the order *Nidovirales.*[1,2] In the past two decades, there have been two significant instances where the transmission of coronaviruses from animals to humans resulted in severe global disease.[3] The first was the Severe Acute Respiratory Syndrome Coronavirus 1 (SARS-CoV-1) outbreak in 2002-2003, which resulted in 8,422 total cases and 916 deaths worldwide, with a case fatality rate (CFR) of 11%.[3,4] In 2012, the Middle East Respiratory Syndrome Coronavirus, also known as MERS-CoV, emerged in Saudi Arabia.[3] The 2012 MERS-CoV outbreak affected 2,494 people and caused 858 deaths, with a CFR of 34%.[3,4] In 2019, a novel virus was detected in throat swab samples in Wuhan, China and was subsequently named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). SARS-CoV-2 was later changed to COVID-19 because the CFR is lower compared to similar respiratory outbreaks in the past.[4,5] As of June 10, 2020, the World Health Organization (WHO) has reported 7,273,958 cases in 216 countries, encompassing every continent except Antarctica. There have been 413,372 confirmed deaths and the SARS-CoV-2 outbreak is categorized a global pandemic.

The true CFR of SARS-CoV-2 infection is difficult to estimate due to lack of data. However, estimates of CFR are reported between 0.5-5%.[5,6]

Dental professionals have a higher risk of contracting the SARS-CoV-2 disease. There are no universal practice protocols in place. Due to the fear of community transmission and spread, dental practices initially scaled down their operations to urgent and emergent services in compliance with local, state and national recommendations. The SARS-CoV-2 pandemic has had an immense social, financial and professional impact on pediatric dental practices worldwide. This narrative literature review provides basic information regarding SARS-CoV-2 infection transmission, treatment, and pediatric dental practice recommendations.

Etiopathogenesis
The causative agent for the 2019 coronavirus pandemic, SARS-CoV-2, commonly attaches and replicates in epithelial cells of the respiratory and gastrointestinal (GI) tract.[1] Zhou *et. al.* confirmed that similar to SARS-CoV-1, SARS-CoV-2 uses the angiotensin-converting enzyme 2 (ACE2) receptor for cellular entry[7,8]. It has been reported that the spike (S) glycoprotein on SARS-CoV-2 binds to human ACE2 receptors with a higher affinity than SARS-CoV-1 (10-20X) and prevents downstream signaling.[9,10] Hence, the S-glycoprotein is a critical target for vaccines, antibodies, and diagnostic tests.[10] Lung cells are the primary target cells of SARS-CoV-2, leading to the spectrum of respiratory symptoms.[8,11] However, some infected patients have reported non-respiratory related symptoms such as diarrhea, kidney failure, and acute liver and heart injury, implying that SARS-CoV-2 has the ability to cause a wide range of systemic problems.[8,9,11] Multi-organ involvement is further supported by the observation that human ACE2 receptors are expressed in numerous organs and tissues in the body.[7,11]

Clinical Signs & Symptoms
The signs and symptoms associated with SARS-CoV-2 in adults are characterized by non-specific initial symptoms such as fever, malaise, and dry cough. Reported findings suggest that commonly associated symptoms are fever, cough, dyspnea, myalgia, and GI symptoms such as diarrhea.[8,12] Chan *et. al.* reported that GI symptoms can be associated with the initial phase of the infection (three to six days).[12] Fatal complications of SARS-CoV-2 include organ failure, septic shock, pulmonary edema, severe pneumonia, and Acute Respiratory Distress Syndrome (ARDS).[3,4,9,12] The clinical findings and associated pathogenesis in the various phases of SARS-CoV-2 infection are discussed in detail in Table 1.[5,6,7,12–14]

Most documented clinical signs, symptoms, and the progression of disease in children are milder compared to adults. The majority of cases in the pediatric population are asymptomatic in nature with a better prognosis.[3,6,14,15] However, a small percentage of children require hospitalization and intensive care due to severe clinical manifestations of SARS-CoV-2 infection.[13,16] Although SARS-CoV-2 infection is reported in children of all ages, a higher percentage of SARS-CoV-2 cases are reported in infants and young children.[15] In previous coronavirus epidemics such as SARS-CoV-1 in 2002-2003 and MERS-CoV in 2012, children accounted for 6.9% and 2% of cases, respectively.[6] Detailed clinical, laboratory, and radiographic signs and symptoms along with associated comorbidities and risk factors reported in children are presented in Table 2.[5,6,12,13,15,17]

The milder form of SARS-CoV-2 infection in children could be due to exposure of a lower number of viral particles, absence of comorbidities such as smoking, concomitant exposure to other respiratory viruses, immaturity of ACE2 receptors, and history of a Bacillus Calmette-Guerin (BCG) vaccine.[5,6,18,19] BCG vaccination has demonstrated heterologous immunity to other pathogens via the involvement of innate cells such as macrophages, monocytes, and epithelial cells.[18] A negative correlation has been reported between SARS-CoV-2 positive cases and fatalities in countries where the BCG vaccine is widely used.[20] However, this could be an association rather than causation. Investigations for further understanding the causal relationship between the BCG vaccine and low severity of SARS-CoV-2 infection are underway. Additionally, there are few studies suggesting a protective role of Hep-A antibodies against SARS-CoV-2 infection.[21] Again, longitudinal data needs to be collected to determine any such correlation between SARS-CoV-2 and Hep-A antibodies.

A weekly report from the Centers for Disease Control and Prevention (CDC) on May 29, 2020 stated that SARS-CoV-2-related hospitalization rates for children 0-17 years old are much lower than influenza hospitalization rates at comparable timepoints. Furthermore, a study by Shekerdemian *et. al.* reported that the clinical course of SARS-CoV-2 was far less severe in children compared to adults, with hospital outcomes better in severely ill children compared to adults.[22] A cohort study from Debiasi *et. al.* reported that out of the 177 children and young adults with confirmed SARS-CoV-2, 25% required hospitalization.[23] Of the 25% that were hospitalized, 80% were not critically ill and 20% were critically ill.[23] Another study reported that out of the 48 children (4.2-16.6 years) who were admitted to U.S. and Canadian Pediatric Intensive Care Units (PICU) for SARS-CoV-2 infection, 73% had respiratory involvement, 38% required ventilation, 23% had organ failure involving two or more organ systems, and 2% (1 patient) required extracorporeal membrane oxygenation.[22] Two children who died had pre-existing comorbidities, with one of the two children being diagnosed with gram-negative sepsis prior to developing SARS-CoV-2 infection.[22] Severe respiratory symptoms were reported in 5.9% of children diagnosed with SARS-CoV-2 infection as compared to 18.5% in adult cases.[15]

Recently, there have been reports of children presenting with a multisystem inflammatory condition with features like Kawasaki disease and Toxic shock syndrome (TSS).[24] It is hypothesized that this inflammatory condition may be related to SARS-CoV-2 infection as recent publications showed that many patients presenting with this condition had either tested positive for SARS-CoV-2 or have been exposed to the virus.[24] Children who tested negative for SARS-CoV-2 on bronchoalveolar lavage or nasopharyngeal aspirates had positive history of exposure.[24] The full scale of this disease is not yet fully understood. As such, the WHO has encouraged an urgent collection of data describing clinical presentations, epidemiology, and outcomes of this condition (https://www.who.int/news-room/commentaries/detail/multisystem-inflammatory-syndrome-in-children-and-adolescents-with-covid-19 as accessed on July 8, 2020). The preliminary case definition criteria for multisystem inflammatory condition associated with SARS-CoV-2 is presented in Supplemental Table 1.

Radiographic Findings

Ground glass opacities on chest x-rays, indicative of pneumonia, are a characteristic feature of advanced SARS-CoV-2 infection in adults.[25–27] Chest radiographs may be normal in the early stages of the infection.[3,9] Chen *et. al.* reported that 75% of patients showed bilateral pneumonia and 25% of patients showed unilateral pneumonia on chest x-rays and computed tomographic (CT) images.[26] Radiographic changes have been noted on chest CTs even before the SARS-CoV-2 is detected through real time reverse transcriptase-polymerase chain reaction (RT-PCR).[3,28]

In children, conflicting radiographic findings of pneumonia have been reported. Ten children who tested positive for SARS-CoV-2 lacked radiographic signs of pneumonia, while other studies reported positive radiographic signs indicative of bilateral pneumonia in children.[5,25,29,30] Jiehao *et. al.* recommended radiographic monitoring to detect early progression of SARS-CoV-2 infection from mild to severe form in children.[12]

Laboratory Findings

Laboratory findings in adults can be non-specific.[3,31] There are limited studies reporting laboratory findings in children. Xu *et. al.* reported that laboratory findings including complete blood count, urine/stool analysis, coagulation function, blood biochemistry and infection biomarkers of 10 children who tested positive for SARS-CoV-2 were normal in all but one child.[25] A few pediatric cases showed leukopenia, leukocytosis, lymphopenia, or elevated transaminase, which differs from adult SARS-CoV-2 cases in which leukopenia, leukocytosis, lymphopenia and elevated transaminases have been frequently reported.[25–27] Detailed laboratory findings in pediatric patients are given in Table 2. [5,6,13,17,22–24]

Testing for SARS-CoV-2

The WHO testing guidelines include nasopharyngeal/oropharyngeal swabbing in ambulatory patients and sputum, serum for serological testing, and endotracheal aspirate or bronchoalveolar lavage in patients with more severe respiratory disease.[32] There is strong evidence that these respiratory testing methods detect the presence of SARS-CoV-2. The virus may also be detected in stool and blood.[3,31] It is important to note that testing at these respiratory sites is invasive and can be discomforting for young patients.[32]

A study by To *et. al.* reported that SARS-CoV-2 was detected in the saliva of 11 of the 12 infected patients in a Hong Kong hospital, with live virus present in the saliva of three patients.[32,33] This study showed consistent detection of SARS-CoV-2 in saliva.[32] Saliva testing is inexpensive and could be performed on an outpatient basis. Additionally, collection of saliva could be performed non-invasively in young patients. It requires minimal equipment, thereby preventing nosocomial transmission of SARS-CoV-2 to healthcare workers.[32,33] Additional studies are warranted to establish reliability of saliva samples for detection of viruses.

Transmission

The transmission of SARS-CoV-2 is mainly via inhalation, ingestion, and direct mucosal contact with saliva droplets. Droplets from infected people can become airborne and thus contaminated surfaces may be a potential source of exposure.[12] Survival of SARS-CoV-2 on surfaces (fomites) have been reported for up to nine days.[12] Transmission in children can be categorized as primary (direct exposure to virus) or secondary (exposure to virus through an infected caregiver).[6] Secondary infection (intra-family transmission) seems to be a more common mode of exposure in children.[6,12] Transmission of SARS-CoV-2 from mothers to newborns (vertical transmission) during pregnancy or childbirth has not been confirmed yet.[31,34,35] Chen *et. al.* reported the absence of SARS-CoV-2 in amniotic fluid, cord blood and neonatal swab. However, all nine pregnant women in the study had confirmed SARS-CoV-2-associated pneumonia, suggesting the absence of intrauterine fetal transmission during late stages of pregnancy.[35] Fecal-oral transmission could also be a possible mode of exposure as there is evidence of fecal shedding of the SARS-CoV-2 viral particles in the stools of children after 3-13 days of the disease onset.[12,36] Viral shedding of SARS-CoV-2 from the digestive tract may last longer than the respiratory tract.[25]

Treatment

The WHO has not recommended any specific treatment for children until the results of ongoing clinical trials are available.[6] Palliative care is the recommended treatment in children, including supplemental oxygen, nutritional support, and maintaining fluid-electrolyte balance.[5] Use of antiviral agents for the treatment of self-limited, non-severe SARS-CoV-2 infection is not recommended.[12] In severe cases, use of antibiotics, antipyretics, antiviral, or immunomodulatory medications should be prescribed after consultation with pediatric infectious disease physicians.[6] In critically ill newborns, intravenous administration of glucocorticoids or immunoglobulins, sustainable kidney replacement, and extracorporeal membrane oxygenation may be considered.[37]

Several medications are undergoing clinical trials for use against SARS-CoV-2 infection. Currently, four clinical trials are underway at Colorado's University Hospital.[38] Two of the clinical trials involve Remdesivir, one involves Sarilumab, and the fourth involves the infusion of blood plasma from a patient who has recovered from SARS-CoV-2 infection into a patient recently diagnosed SARS-CoV-2 infection. Various medications for treatment of SARS-CoV-2 are presented in the supplemental section along with information regarding mechanism of action and treatment recommendations (Supplemental Table 2).

Pediatric Dental Practice Implications and Recommendations

There is a lack of universal guidelines or protocols for treating a confirmed or suspected SARS-CoV-2 patient in a dental setting.[34] Since the start of the SARS-CoV-2 pandemic, the number of urgent dental cases decreased by 38%, suggesting an increased reluctance among patients to seek dental care during the pandemic.[34,39] The number of patients with untreated dental disease has been increasing exponentially.[34] Additionally, an overall shift of dental care from routine, non-emergent to emergent procedures during this pandemic has been noted.[34] This shift has occurred in response to various national and state guidelines, which were introduced to mitigate the community spread of SARS-CoV-2.[40] Dental practices have had to adapt their workflow and incorporate changes in order to be compliant with state and national health agencies to provide effective dental treatment while ensuring the safety of their patients, staff, and the community.[34,40] As private dental offices were closed for non-emergent services, some of the urgent, unmet needs have worsened, resulting in an increase in the number of dental emergencies reported to local children's hospitals with pediatric dental programs. This increases the burden on already-strained medical systems within hospitals.[34]

Healthcare workers are at great risk of acquiring SARS-CoV-2 infection.[3,41] Twenty-one percent of the total number of infected individuals during the SARS-CoV-1 outbreak in 2002 were healthcare workers.[3,41] At the time this article was written, there have been no reports of SARS-CoV-2 transmission in a dental setting (Alharbi, 2020). However, due to the presence of viral particles in saliva, dental professionals are considered at high risk for contracting the disease.[42]

Because children can be asymptomatic carriers, pediatric dentists are at increased risk.[6] Pediatric dental practice recommendations to mitigate community spread of SARS-CoV-2 are presented in Table 3.[30,34,36,43]

Aerosols are defined as solid or liquid particles less than 50μm in diameter, which are suspended in air.[40,44] Splatter is a mixture of air, water, and possibly solid substances that range from 50 μm to several millimeters in diameter and are visible to the naked eye.[40,44] Both aerosols and splatter can travel up to six-feet from the mouth during cough-inducing (CIDP) or aerosol-splatter generating dental procedures (ASGDP). Aerosols and splatter can carry SARS-CoV-2 viral particles (~120nm), increasing the risk of disease transmission.[36,40,42,44] The duration of patient contact and type of CIDP or ASGDP are crucial factors that can increase the chances of contracting a disease from a SARS-CoV-2 positive patient.[34,36,40] Human coronaviruses can remain active on inanimate surfaces for nine days.[3,45]

Rubber dam application reduces microbial contamination up to 70% in a three-foot diameter of the operational field when used in conjunction with appropriate personal protective equipment.[34,36,46] Single use disposable instruments, when used with autoclavable dental handpieces with anti-retraction valves/anti-reflux designs, have shown a significant reduction in the backflow of oral bacteria and viruses into the tubes of the handpiece and dental unit, thereby preventing cross infection.[36]

Surgical masks serve as a barrier against large particle droplets, splatter, and sprays.[47,48] It is well established that surgical masks provide insufficient respiratory protection against airborne transmission of SARS-CoV-2.[49] Surgical masks are regulated by the Food and Drug Administration (FDA), and no minimum level of filtration efficiency is required.[47] In contrast, the primary function of a respirator is to reduce the wearer's exposure to respirable particles (≤10 μm).[50] The filtration criteria for an N95 mask is set by the National Institute for Occupational Safety and Health (NIOSH) and must be at least 95% efficient when tested according to NIOSH criteria.[50] The WHO recommends that healthcare workers, including pediatric dentists, should wear a surgical mask when entering a room with a patient who is suspected or confirmed to be infected with SARS-CoV-2.[40] Additionally, respirators equivalent to a U.S. NIOSH N95 mask or a European Union standard FFP2 are highly recommended while performing CIDP or ASGDP.[40,49,51]

Various private and hospital-based pediatric dental settings are instituting preoperative patient screening protocols to prevent community spread of SARS-CoV-2. Some hospitals are using teledentistry visits to triage patients before they are scheduled for a routine, urgent or emergent dental service.[52] Teledentistry laws in the U.S. vary based on the state where the practice is located. State boards have amended dental practice statutes to facilitate the incorporation of teledentistry for prompt patient care during the SARS-CoV-2 pandemic. Additionally, pediatric dental practices are instituting safeguards to comply with the Health Insurance Portability and Accountability Act (HIPAA) while providing dental care using teledentistry. Effective use of HIPAA compliant patient portals for sharing information and photographs has increased during the SARS-CoV-2 pandemic. Standardized patient evaluation using questionnaires through telephonic or teledentistry applications has been vital for providing routine, urgent, and emergent services during the SARS-CoV-2 pandemic.

Practice recommendations during SARS-CoV-2 require that patients and parents complete a pre-visit questionnaire evaluating self-quarantine, travel history, and signs or symptoms. It is recommended that patients and parents put on masks before entering the dental facility, at which time body temperature is recorded. It is recommended that a single parent/ guardian accompany the child and that they wait in their cars until their appointment time to maintain social distancing. Changes in the waiting area of the clinic should be made, such as removing toys, books, and reading material, and ensuring a 6-foot distance between chairs. Use of antibacterial mouthwash before dental procedures is recommended to reduce viral load.[53] Eliminating CIDP or ASGDP whenever possible would limit the generation of aerosols. Additionally, effective use of extraoral imaging (extraoral bitewings) to avoid salivary transmission and gag reflex (which may induce vomiting) should also be explored. Some pediatric practices recommend SARS-CoV-2 testing before scheduling patients for CIDP or ASGDP. If CIDP or ASGDP procedures are performed, room disinfection should be delayed until after complete settling of aerosols and splatter in the dental operatory. The duration of delay is determined by the air-exchange rate in the dental operatory.[34]

Pediatric Dentistry Special Considerations

Data on the effect SARS-CoV-2 infection in immunocompromised children is limited. Three immunocompromised children who tested positive for SARS-CoV-2, demonstrated no clinical pulmonary symptoms due to the infection. It was hypothesized that immunocompromised children were not at a greater risk of severe SARS-CoV-2 infection as the intact functional host innate immune response is the main factor contributing to the respiratory complications.[54] A survey that studied 18 children across 11 countries who were receiving immunosuppressive treatment for kidney disease and had been diagnosed with SARS-CoV-2, appeared to have mild symptoms associated with the infection.[55] Extensive longitudinal data needs to be reviewed to study the impact of SARS-CoV-2 infection on immunocompromised children. However, in absence of any additional data, immunocompromised children are still considered at a higher risk for infection and complications.

The drastic change in daily life caused by the SARS-CoV-2 pandemic, including worldwide 'stay-at-home' orders, likely have a significant impact on dental care of special healthcare needs (SHCN) children and their caregivers. SHCN children have established routines, schedules, therapies, and school/professional programs to meet their daily needs.[56] Although 'stay-at-home' orders may be loosening in some areas, caregivers are reluctant to resume outside activities for their high-risk SHCN children with underlying medical conditions or comorbidities due to SARS-CoV-2 concerns.[56] There is a lack of data to understand how the SARS-CoV-2 has affected quality of life in SHCN children.

Conclusion

The symptoms of SARS-CoV-2 infection are milder in children as compared to adults and children may be asymptomatic carriers. Pediatric dentists are at higher risk of contracting the SARS-CoV-2 disease. The primary concern in dental practices is to limit the spread of SARS-CoV-2 from patient-to-patient or to the dental care staff and thereby prevent community spread. This complete article [LINK] summarizes the epidemiological data on SARS-CoV-2 pandemic to understand the causative agents, signs, symptoms and route of transmission. Moreover, this article provides evidence-based guidelines for pediatric and general dentists to prevent transmission of the SARS-CoV-2 in a dental practice setting. Some of the dental care concerns for special healthcare needs children during the SARS-CoV-2 pandemic and multiorgan inflammatory disease in young children are discussed in this paper. The recommendations in this paper are based on the review of literature and may vary depending on the guidelines laid down by state government and local regulation. The authors strongly encourage readers to follow the practice guidelines as endorsed and recommended by national and state regulatory agencies.

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List of Tables

Table 1: Stages of SARS-CoV-2 Disease Progression

Clinical Stage	Clinical Presentation	Associated Pathogenesis
Asymptomatic infections	• No clinical symptoms and/or no abnormal findings on chest x-ray	• Inhaled SARS-CoV-2 binds to and replicates in the epithelial cells of the nasal cavity • Virus can be detected by nasal swabs (low RT-PCR value) • Patient can be infectious
Acute upper respiratory tract infection	• Fever, cough, pharyngeal pain, fatigue, nasal congestion, headache, and myalgia • No signs of pneumonia on chest x-ray	• The virus propagates down the respiratory tract but is restricted to the upper conducting airways • Presence of virus in nasal swabs and saliva
Mild pneumonia/ Acute Respiratory Distress Syndrome	• In addition to clinical findings seen in the previous stage, chest x-ray reveals ground glass opacities with/without clinical signs of pneumonia	• The virus propagates along the lower respiratory tract • Virus detected in sputum and cough secretions
Severe pneumonia	• In addition to clinical and radiographic findings seen in the previous stage, evidence of severe hypoxia and intermittent apnea requiring oxygen support	• The virus infects alveolar cells in the lungs, where it replicates and propagates causing apoptosis of alveolar cells
Critical cases	• Respiratory failure requiring mechanical ventilation • Septic shock with or without multi-organ failure	• Irreversible scarring and fibrosis of the lung parenchyma due to multilocular infiltration • Exaggerated response in terminally ill and immunocompromised children and adults

Table 2: Findings Associated with SARS-CoV-2 in Children

	Common findings	Rare findings
Clinical Features	• Asymptomatic or present with fever, cough, sore throat, pharyngeal erythema, rhinorrhoea, and nasal congestion • Tachypnoea and tachycardia in advanced stages	• Diarrhea, lethargy, vomiting, abdominal pain, low oxygen saturation, dyspnea, muscle aches, and headaches • Nausea and disorientation are uncommon in children
Laboratory Findings	• Normal complete blood count (CBC), urine/stool analysis, coagulation function, blood biochemistry and leukocyte count • Elevated C-reactive protein, elevated procalcitonin, elevated D-dimer levels	• Leukopenia, leucocytosis, lymphopenia, neutropenia, neutrophilia, or elevated transaminases
Radiographic Findings	• Normal radiographic presentation • Bilateral, isolated or multiple ground-glass radiopacities	• Unilateral involvement with patchy shadowing/milled presentation • Signs of pleural effusion and interstitial abnormalities
Risk Factors	• Co-morbidities such as cardiovascular disease, asthma, broncho-pulmonary hypoplasia, respiratory tract anomalies, anemia, leukemia and diabetes	• Children in contact with SARS-CoV-2 positive patients or family members • Severe malnutrition
Complications	• Hospitalization with ventilation and extracorporeal membrane oxygenation • Multi-system organ failure	• Multisystem, inflammatory condition mimicking Kawasaki disease or Toxic shock syndrome • Death

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Table 3: Pediatric Dental Practice Recommendations During SARS-CoV-2 Pandemic

Risk of Exposure	Low Risk	Moderate Risk	High Risk
Contact/Exposure	Indirect contact	Direct patient contact for non-invasive procedures (non-CIDP or non-ASGDP)	Direct patient contact for CIDP or ASGDP in suspected or confirmed cases of SARS-CoV-2
Procedures	Collecting medical/dental/social history, pre-operative consent, anticipatory guidance, and parental education	Oral examination, vitality testing, recording of vitals	Radiographs, dental prophylaxis, flossing, Atraumatic Restorative Technique (ART), Silver Diamine Fluoride (SDF) application, Hall crowns, sealants, extractions, placement-removal of space maintainer, endotracheal intubation, tracheostomy, airway suctioning, permanent restorations or crowns, surgical extraction, endodontic-periodontal procedures
Recommendations	Handwashing, scrubs, surgical mask/cap	Handwashing, scrubs, impermeable gown, N95 respirator or higher, surgical cap, face shield or eye goggles, gloves, shoe covers, and preoperative antimicrobial rinse	Handwashing, scrubs, impermeable gown, N95 respirator or higher, surgical cap, face shield or eye goggles, gloves, shoe covers, and preoperative antimicrobial rinse and use of rubber dam when possible
Room Disinfections	500 mg/L chlorine containing disinfectants after every patient with contact time of 10-30 minutes depending on air exchanges in the dental operatory Medical waste disposal in accordance with the local and state regulations		

*Note: CIDP (cough-inducing dental procedure) and ASGDP (aerosol-splatter generating dental procedure). Disclaimer: The recommendations in this paper are based on the review of literature and may vary depending on the guidelines laid down by state government and local regulation.

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Supplemental Tables:

Supplemental Table 1: Preliminary Case Definition for Multisystem Inflammatory Syndrome Associated with SARS-CoV-2

Age-range and clinical findings	Children (0-19 years) with fever lasting more than 3 days
Presence of two criteria	1. Rash or bilateral non-purulent conjunctivitis or muco-cutaneous inflammation on extremities 2. Hypotension or shock 3. Features of myocardial dysfunction, pericarditis, valvulitis, or coronary abnormalities (including ECHO findings or elevated Troponin/NT-proBNP) 4. Evidence of coagulopathy (elevated PT, PTT or D-dimers) 5. Acute gastrointestinal problems (diarrhea, vomiting, or abdominal pain)
Markers of inflammation	Elevated erythrocyte sedimentation rate, C-reactive protein, or procalcitonin
Microbial cause	No obvious microbial cause of inflammation including bacterial sepsis and staphylococcal or streptococcal shock syndrome
Association with SARS-CoV-2	Exposure to SARS-CoV-2with or without presence of SARS-CoV-2 antigen or antibody

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Supplemental Table 2: Medications for treatment of SARS-CoV-2infection

Treatment	Drug Class	Mechanism	Additional information	References
Ribavirin	Anti-viral; synthetic nucleoside analogue	Reduces RNA viral replication	• Commonly used to treat Hepatitis C • Demonstrated *in vitro* antiviral activity against SARS-CoV-1 • Has been used to treat SARS-CoV-2 infection	3,31,57–59
Lopinavir/Ritonavir	Anti-viral; HIV protease inhibitor	Contains hydroxyethylene, which mimics peptide bond cleaved by HIV-1 protease	• Commonly used to treat HIV infection • Reported to have a therapeutic effect against SARS-CoV-1 • Recommended for clinical treatment for SARS-CoV-2	3,31,60–62
Remdesivir (GS-5734)	Antiviral; nucleotide analogue	Inhibits RNA polymerase	• First described in 2016 to treat Ebola • Highly effective against SARS-CoV-2 *in vitro* • Issued an FDA Emergency Use Authorization for use in patients with severe SARS-CoV-2 infection	3,27,31,31,63,64
Nelfinavir	Antiviral; HIV-1 protease inhibitor	Selective inhibitor of HIV protease	• Strongly inhibited SARS-CoV-1 replication *in vitro*	31,65
Arbidol (Umifenovir)	Broad spectrum antiviral available in China & Russia	Inhibits viral fusion	• Used to treat pulmonary diseases caused by respiratory viruses • Reported activity against SARS-CoV-1 *in vitro* • May be superior to Lopinavir/Ritonavir against SARS-CoV-2	3,31,66–68
Chloroquine Phosphate	Aminoquinoline derivative	Inhibits viral infection by increasing endosomal pH required for virus/cell fusion; interferes with glycosylation of cellular receptors	• Well-known antimalarial and antiviral (flaviviruses, retroviruses, coronaviruses) • Highly effective against SARS-CoV-2 *in vitro* • Issued an FDA Emergency Use Authorization for SARS-CoV-2 infection	27,31,69
Type I Interferons (IFN-α/β)	Antiviral cytokines	Induce proteins that impair viral replication in targeted cells	• Broad spectrum antiviral activities against RNA viruses • Highly synergistic anti-SARS-CoV-1 action when combined with IFN-α and IFN-β *in vitro*	31,59,62,70
Glucocorticoids	Steroid	Anti-inflammatory action	• No evidence for or against use in patients with serious SARS-CoV-2 infection	71
Intravenous Immunoglobulin Therapy (IVIG)	NA	Neutralizes respiratory pathogens, inhibits target cell receptors and production of inflammatory factors	• Reported decreased ventilator use/shortened hospital stay when administered within 48 hours of admission to patients with SARS-CoV-2 infection • Efficacy against SARS-CoV-2 not fully established	72,73