





REVIEW

A five-step risk management process for geriatric dental practice during SARS-CoV-2 pandemic

Karthik Sivaraman¹  | Aditi Chopra²  | Aparna Narayana¹  |
Raghu A. Radhakrishnan³ 

¹Department of Prosthodontics and Crown and Bridge, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, India

²Department of Periodontology, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, India

³Department of Oral and Maxillofacial Pathology, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, India

Correspondence

Raghu A. Radhakrishnan, Wellcome Trust/DBT IA Fellow, Professor, Department of Oral Pathology, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal 576104, India.
Email: raghu.ar@manipal.edu

Abstract

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an RNA virus that causes coronavirus infection (COVID-19). COVID-19 is a highly contagious disease transmitted through respiratory droplets, saliva and other contact routes. Within 10 months of its outbreak, SARS-CoV-2 has infected more than 23 million people around the world. Evidence suggests that older adults are the most vulnerable to infection and have an increased risk of mortality. Reduced immunity and underlying medical conditions make them risk-prone and vulnerable to critical care. Older adults affected with the SARS-CoV-2 virus present with distinct clinical manifestations necessitating specific treatment needs and management protocols. While it is crucial to prevent the spread of novel coronavirus (2019-nCoV), the role of oral healthcare workers in addressing the specific needs of ageing adult patients by adopting specific guidelines and appropriate infection control protocols is timely. This paper aims to develop specific guidelines and protocols for the dental management of geriatric patients during the COVID-19 pandemic.

KEYWORDS

COVID-19, dental clinics, frail elders, older adults, oral health, SARS-CoV-2

1 | INTRODUCTION

SARS-CoV-2 infection, also referred to as the novel CoV-19 (nCoV-19), has emerged as a significant public health emergency of international concern, having a severe impact on the global economy. Within ten months of its outbreak, SARS-CoV-2 has infected more than 23 million people in 213 nations and territories, resulting in approximately 0.9 million deaths worldwide. SARS-CoV-2 is a large enveloped RNA virus of about 60 to 140 nanometres with distinctive spikes of nine to 12 nm giving the appearance of a “corona” around the sun.¹

The nCoV-19 started in the Wuhan wet market in the Hubei district of China.² Evidence suggests that COVID-19 emerged from a single animal-to-human transmission, with subsequent genetic

mutations, resulting in a rapid and continued human-to-human spread.³⁻⁶ The genetic clues to the evolution of the SARS-CoV-2 strain are mapped to Chinese horseshoe bats (*Rhinolophus sinicus*), with Malayan pangolins (*Manis javanica*) as an intermediate host.³⁻⁵ While this contagion's exact origin is debatable, Andersen et al (2020)⁷ claimed that “SARS-CoV-2 could have originated either by natural selection in an animal following zoonotic transfer or by natural selection in human following zoonotic transfer.”

With no cure or vaccine developed yet for this highly transmissible viral infection in humans, the risk of community spread is increasing worldwide. Globally, SARS-CoV-2 disease is severe among the geriatric population, as 95% of the deaths have been reported in individuals above 60 years. Additionally, 8 out of 10 deaths occur in individuals with at least one underlying co-morbid

condition, such as cardiovascular diseases, hypertension and diabetes.⁸ Apart from the existing systemic co-morbidities, which weaken the immune system, many factors make the geriatric population more vulnerable to SARS-CoV-2 infection.⁹ With the geriatric population expected to reach around 1200 million by 2025, understanding the elements that make them susceptible to SARS-CoV-2 is critical.¹⁰ There is an impending need to formulate specific guidelines/protocols for managing the older adults in the backdrop of COVID-19, considering the physiological, psychological and treatment needs of geriatric patients, which are unique. This paper aims to develop a stepwise protocol for the dental management of geriatric patients.

2 | RECOMMENDATIONS FOR DENTAL MANAGEMENT OF GERIATRIC PATIENTS IN THE WAKE OF COVID-19

For effective screening, diagnosis and management of geriatric patients against the COVID outbreak, we propose “five basic steps,” as described below: (Table 1). These steps are initiated through telephone, text monitoring or video calls even before the patient arrives.

2.1 | Step - 1: Documenting personal details and chief complaint

In the beginning, it is mandatory to record the demographic details such as the name, hospital record number, age, gender, postal address, marital status and other personal information before the actual examination. The patient's residential address aids the clinician to take appropriate steps should the patient be from a COVID hotspot. It may also help assess the socioeconomic status as it determines the patient's psychological and general well-being. Older adults in developed countries tend to stay in institutionalised settings like nursing homes, making them vulnerable to infection. The general condition of the institution must be investigated. It may be preferable to obtain the details over telephone or email, to avoid long appointments and unnecessary exposure.

Many countries acknowledge that the SARS-CoV-2 casualties are much higher than reported, should the fatalities outside the hospital be taken into account. According to a published report by the London School of Economics, about 42 to 57% of deaths related to COVID-19 occurred in nursing homes across five developed countries in Europe (Belgium (42%), France (45%), Italy (53%), Ireland (54%) and Spain (57%).¹¹

The patient's recent travel history must be noted within the district or outside the state or country. Those who have resided or travelled through a COVID hotspot may have to follow simple quarantine norms or get tested. Based on the information gathered, an appointment could be scheduled at the earliest in case of an emergency.

2.2 | Step 2: Recording dental, medical and drug history

After obtaining the demographic details, the patient's dental, medical and drug history must be recorded. Any preexisting medical condition, including the treatment regimen and the route of drug administration, has to be known. Medication known to interfere with dental procedure or produce side effects must be noted. Available evidence suggests that ageing individuals with underlying medical disorders are more susceptible to SARS-CoV-2 infection than healthy individuals.¹² Thus, older adults at higher risk to contract SARS-CoV-2 infection include those with diabetes, asthma, immunocompromised state, chronic renal ailments requiring dialysis and individuals with liver dysfunction. Additionally, individuals with pulmonary and cardiac conditions such as chronic obstructive pulmonary disease (COPD), emphysema and chronic bronchitis, idiopathic pulmonary fibrosis and cystic fibrosis, coronary artery diseases, congenital heart disease, cardiomyopathies, and pulmonary hypertension are also at a higher risk of acquiring SARS-CoV-2 infection.

Yang et al (2020)¹³ assessed the prevalence of co-morbidities in SARS-CoV-2 infected patients and concluded that the risk is greater among individuals with hypertension, diabetes, cardiovascular and respiratory disorders in decreasing order. In addition to these co-morbidities, ageing patients undergoing chemotherapy, radiotherapy, prolonged corticosteroid therapy and organ transplantation are risk-prone for SARS-CoV-2 infection due to their suppressed immune status.

Documentation of these systemic co-morbidities should help the healthcare provider obtain medical clearance, timely schedule appointments and prescribe the right medication before planning treatment. The details obtained should be seen in the context of factors that increase geriatric patients' vulnerability to SARS-CoV-2 infection. These factors are presented along with a risk analysis scoring chart in Table 2.

TABLE 1 Overview of the 5 steps for dental management of geriatric patients in the wake of COVID-19

| Steps | Description |
|--------|---|
| Step 1 | Documenting personal details and chief complaint |
| Step 2 | Recording Dental, Medical and Drug History |
| Step 3 | Evaluation for specific clinical manifestations of SARS-CoV-2 Infection |
| Step 4 | Treatment Planning based on the chief complaint and urgency |
| Step 5 | Recommendations—before, during and after dental treatment |

Note: Steps 1-4 to be performed through telephone/video conferencing and then verified on arrival at the clinic

TABLE 2 Risk analysis chart increase to assess the vulnerability of geriatric patients to SARS-CoV-2 infection

| SI No | Risk analysis Chart | Yes | No |
|-------|---|-----|----|
| 1 | Any travel by the patient or their household member to severely affected areas of COVID 19? | | |
| 2 | Any known contact with a COVID positive patient for the patient or their household member? | | |
| 3 | History of fever in the last 14 d? | | |
| 4 | Any symptoms of shortness of breath, cough, fever, chills, rigours, muscle pain, headache, sore throat? | | |
| 5 | Any episodes of sudden loss of taste and smell in the last 14 d? | | |
| 6 | Any dermal lesions or intra oral lesions of inexplicable nature in last 14 d? | | |
| 7 | Any neurological symptoms like headache and seizures for inexplicable reasons in last 14 d? | | |
| 8 | Has the patient been diagnosed with and seeking treatment for hypertension? | | |
| 9 | Has the patient been diagnosed with and seeking treatment for diabetes? | | |
| 10 | Has the patient been diagnosed with and undergoing treatment for cardiovascular problems? | | |
| 11 | Has the patient been diagnosed with and undergoing treatment for respiratory problems? | | |
| 12 | Has the patient been diagnosed with and undergoing treatment for obesity? | | |
| 13 | Has the patient been diagnosed with any immunocompromised condition? | | |
| 14 | Is the patient currently taking any medications? | | |
| 15 | Does the patient complain of dry mouth/eyes? | | |
| 16 | Does the patient reside in an assisted institution/old age home? | | |

2.2.1 | Physiological factors

Ageing is a significant risk factor that has an enormous effect on the overall functioning of the immune system and an individuals' healing capacity. Studies have documented a reduction with age in the production of B and T cells in bone marrow and thymus, along with the diminished function of mature lymphocytes in secondary lymphoid tissues.¹⁴ A lowered immune response, compounded by poor nutrition among the older adults', makes them vulnerable in responding to a microbial challenge, unlike the young.¹⁵ A crucial aspect of geriatric oral health care is to be aware of impaired healing capacity and reduced immunity while managing COVID positive adults.

The age-associated physiologic changes in the oral cavity that predispose geriatric patients to viral infections include thinning epithelium, enabling easier passage of viral particles into the host cells. The healing capacity of oral tissues is also impaired due to reduced collagen turnover rate, loss of elastin and adipose tissue in the sub-mucosa, an increase in the fibrous stroma and degenerative changes in the collagen. The reduced epithelial thickness contributes to the onset of burning sensations, ulceration and bleeding from gums among geriatric patients. Oral care specialists have to be aware of the condition of the oral epithelium before preparing the patient for preprocedural mouth rinses with high alcohol content.

It is well-known that ageing influences the flow rate and composition of saliva, and alters the taste sensation by affecting the ionic channels and receptors of the gustatory cells.¹⁶ Reduced salivary flow impairs saliva's flushing action and increases the risk of plaque formation. This predisposes the geriatric patients to the risk of bacterial and viral infection. Besides the reduced salivary rate associated with the ageing adult population, saliva has a lower protein and salivary immunoglobulin content.¹⁷ Thus, it is necessary to assess

the salivary flow rate among older adults, which is reduced due to medications, hormonal changes and depression.

2.2.2 | Obesity

Obesity, identified as one of the significant epidemics, has been identified as a novel and independent risk factor of SARS-CoV-2 infection.¹⁸ Obesity is known to lower immunity and cause severe impairment of organ and tissue function. It creates multiple systemic complications involving the heart, type-2 diabetes, cancers, osteoarthritis and psychological disturbance.¹⁹ Most of the complications linked to obesity are due to increased oxidative stress and the release of adipokines. Obesity interferes with the respiratory function by decreasing the lung volume, particularly the expiratory reserve volume and functional residual capacity.¹⁹ The weak respiratory movements due to elevation of intra-abdominal and pleural pressures will compromise breathing and result in the shortness of breath, further precipitating breathing complications in SARS-CoV-2 infection. The baseline inflammatory state in obese patients also presents a barrier to the induction of a robust antiviral response. Since the local innate and adaptive immune responses are blunted, viral spread is severe in the obese host.^{20,21}

2.2.3 | Poor oral hygiene

Poor oral hygiene status is considered to be a major risk factor for acquiring viral infections. Lack of manual dexterity and over-dependency among older people hampers regular oral hygiene maintenance.²² In a large cohort of older adults, the prevalence of

dental caries among the dentate elderly was 22%, with 20% of the 75- to 84-year-olds presenting active root decay.²³ Accumulation of bacterial plaque with periodontally compromised teeth is the most frequent finding among the ageing adults.²⁴ When oral hygiene continues to remain poor, loss of teeth and edentulism occurs. Incidentally, tooth loss has been shown to have a positive relationship with mortality from all causes²⁵ and to the reduced quality of life impairment.²⁶ Geriatric patients with poor oral health are an independent in-hospital mortality predictor.²⁷

It has been demonstrated that angiotensin-converting enzyme 2 (ACE2) receptors are the primary sites for SARS-CoV-2 entry into the host cells. The spike (S) protein of SARS-CoV-2 recognises the host cell receptors and fuses with the cell membranes before gaining admission in oral mucosa, tongue and salivary glands.²⁸ Individuals infected with SARS-CoV-2 have higher viral loads in the saliva, oropharynx, nasal passages and upper respiratory tract.²⁹ Poor oral hygiene can increase the risk of pneumonia, acute respiratory distress syndrome, sepsis, septic shock and death in COVID positive geriatric patients.³⁰ It is found that the neutrophil to lymphocyte ratio at an early stage of COVID-19 predicts patients who are likely to develop critical illness.³¹ Patients in ICU exhibit an exceptionally high bacterial load. Thus, it is obligatory to check the modifiable risk factors such as diet, poor oral hygiene and overall glycemic control. The oral cavity's viral load should be lowered by adopting effective oral and throat hygiene, and by seeking professional dental care.³²

2.3 | Step 3: Evaluate for specific clinical manifestations of SARS-CoV-2 infection

Apart from obtaining the necessary personal, medical, and drug history, and performing the risk analysis, dentists need to look for any signs and symptoms related to SARS-CoV-2 infection.³³ It is vital to recognise potential carriers and test suspected patients before undertaking any dental procedure.

As per the WHO bulletin, the common symptoms of SARS-CoV-2 infection include fever, dry cough, and fatigue. Few patients might complain of body ache and pain, nasal congestion, sore throat, running nose or diarrhoea. The Center for Disease Control and Prevention (CDC) USA reported the presence of shortness of breath, cough, fever, chills, rigours, muscle pain, headache, sore throat and a net loss of taste or smell in COVID-19 patients. In multicenter European studies by Leichner et al, (2020)³³ and Passali and Bentivoglio (2020),³⁴ it was reported that 85.6% of COVID-19 patients presented with olfactory and gustatory dysfunction, before the appearance of other symptoms. These symptoms generally appeared between 2 and 14 days after exposure to the virus. Around 80% of infected patients had mild symptoms and recovered from the disease without requiring hospital treatment. One in five people developed serious illness necessitating medical assistance. The majority of patients who required hospitalisation were older adults. Thus, it is crucial to record even the mildest symptoms during clinical examination and record temperature and travel history.

Apart from the signs and symptoms mentioned above, geriatric patients might present with severe difficulty in breathing, bluish lips, confused state of mind, persistent pressure on the chest and inability to stay awake. There have been reports of SARS-CoV-2 patients presenting with myalgia, encephalopathy, encephalitis, necrotising haemorrhagic encephalopathy, stroke, epileptic seizures, rhabdomyolysis and Guillain-Barre syndrome.^{35,36} Mao et al, (2020)³⁷ observed that, among patients who experienced neurological symptoms, 36% were mostly older adults. Additionally, patients with severe infection presented with neurologic manifestations in the form of acute cerebrovascular diseases, impaired consciousness and skeletal muscle injury. The onset of neurological symptoms is due to direct infection of the brain stem or as a result of the strong activation of the immune system. SARS-CoV-2 possibly targets the central nervous system (CNS) through the olfactory bulb and infecting the olfactory neurons, which enables the virus to spread from the respiratory tract to the brain. The infection then spreads to other parts of the brain by a synapse-connected route and trans-synaptic transfer. This infects the Pre-Botzinger complex in the brainstem, the respiratory centre of the brain controlling the lungs, shutting down breathing and causing potential death.³⁸ There have been reports which state that SARS-CoV-2 infection can also cause inflammation of the brain and indirectly cause neurological damage and neurodegenerative changes such as Alzheimer's and Parkinson's.³⁹⁻⁴¹

Incidentally, cutaneous lesions related to SARS-CoV-2 and referred to as COVID toes, have been reported.⁴² With geriatric patients having a weak immune response, dermatological manifestations may offer some clues during screening. A recent report highlighted an irregular oral ulcer, suspected to be the inaugural oral symptom for SARS-CoV-2.⁴³ However, this needs to be observed in a larger cohort of patients before confirmation.

In light of these developments, it is prudent to screen all the patients for SARS-CoV-2. If any of the signs and symptoms are noted, the dental team must refrain from carrying out any dental treatment, unless it is an emergency. While the dentist has to record a detailed clinical history, noting the telltale signs and symptoms associated with SARS-CoV-2 infection, it is also important to note that the mere presence of these manifestations may not confirm that the patient is COVID-19 positive. Some of these may present as co-morbidities related to old age, malnourishment, or other chronic ailments in multiple organs. However, the sudden onset of these clinical manifestations, particularly among the geriatric population, may provide necessary pointers to test for SARS-CoV-2 infection. It could pose a severe risk of community transmission or prove fatal in other geriatric patients if SARS-CoV-2 is not diagnosed early. Further investigations by medical practitioners in the form of computerised tomography imaging and reverse transcriptase-polymerase chain reaction (RT-PCR) tests, according to WHO (2020a) standards, need to be performed to confirm the presence COVID 19. Dentists should be aware that in geriatric patients infected with SARS-CoV-2, there is an increased risk of stroke, heart attack, coagulation disorders, lung complications and multiple organ dysfunction.⁴⁴

2.4 | Step 4: Treatment schedule based on priority

It is essential to categorise the treatment needs into, not important and not urgent (elective); important but not very urgent; important and urgent (emergency). Optimum planning would help to minimise dental visits and the overall duration of the dental treatment (Table 3). It is vital to prioritise emergency and urgent treatment to ensure that geriatric patients stay indoors unless the situation demands professional intervention. These are as follows:

- Patients requiring emergency dental procedures but have no fever or symptoms consistent with COVID-19 infection should be seen in a dental operator with appropriate protocols (Step 5) and PPE in place.
- Patients requiring urgent/emergency treatment, having fever associated with dental conditions like a periapical abscess/periodontal abscess, intraoral swelling, and no other signs or symptoms of COVID-19 infection should be seen in a dental operator. Wear appropriate PPE, as recommended in Table 4, under infection control recommendations.
- Patients requiring urgent/emergency treatment who exhibit signs and symptoms of SARS-CoV-2 infection should be referred for medical consultation and treatment. Emergency treatment is limited to the prescription of antibiotics and analgesics. It is recommended that the dentists give sufficient time for patients to recover from the infection before attending to their treatment needs.

However, for geriatric patients who test positive for COVID-19, emergency treatment could be provided, even if they are in the acute phase of the disease after following the guidelines highlighted in Step 5. It is crucial to amend the protocol for patients residing in assisted institutions/nursing homes who might find it difficult to visit the dental office. This amendment might be inevitable in some cases if these areas have been sealed off as a containment zone or due to the non-availability of healthcare workers/staff to bring them to the dental office. Under these circumstances, community dental health coordinators should consider arranging a mobile dental infrastructure at their disposal to provide on-site treatment, taking necessary precautions. This approach is undoubtedly advantageous as it assures optimal geriatric dental care to non-ambulatory patients who are relatively safe in their residence and minimises community transmission among the inmates at the institution. It is recommended that appropriate PPE be worn and the mobile dental unit be sanitised before and after the procedure.

2.5 | Step 5: Recommended guidelines before, during and after dental treatment

2.5.1 | Recommendations before dental treatment

It is of utmost importance to comply with infection control protocols in the dental clinic to prevent the risk of healthcare-associated

TABLE 3 Prioritising patient appointments based on the nature of treatment

| Sl. No | Scheduling priority | Nature of treatment |
|--------|---------------------|--|
| 1 | Emergency treatment | Avulsion/Luxation Tooth fracture resulting in pain Trauma involving facial bones Cellulitis or diffuse soft tissue infections manifesting with intraoral or extraoral swelling Acute apical abscess Acute pain in relation to TMJ |
| 2 | Urgent treatment | Denture repair Recementation of crown or FPD. Teeth which have undergone root canal treatment and require crown. Replacement of missing teeth in the anterior region Occlusal problems with or without TMJ involvement |
| 3 | Elective Treatment | New set of dentures either removable or fixed with existing dentures that are in a satisfactory condition. Implant-based treatment for situations with satisfactory treatment solutions Aesthetic treatment solutions |

infections.⁴⁵ The infection control protocol should be adopted immediately the patient enters the dental clinic and continues through to completion of the procedure and the patient's departure. There is an agreement among the health professionals that the transmission of SARS-CoV-2 is mainly through large respiratory droplets and secretions, with a droplet particle size ranging from >5 to 10 µm in diameter. Particles < 5 µm in diameter, are referred to as the droplet nuclei. Droplets are often heavy enough that they do not travel very far and fall from the air after moving up to six feet.⁴⁶

It is best to assign selected days/timings for geriatric patients in a week to reduce the waiting time and reduce their contact with other patients. Before examining the patient, the dental assistants have to record the patient's body temperature, using a non-contact forehead thermometer, or with cameras having infrared thermal sensors. Patients having fever with or without accompanying respiratory disease symptoms should have their elective dental care deferred for at least 2 weeks.

It is essential to plan the waiting area in a manner that ensures social distancing. Reading materials like magazines, newspapers and other objects that tend to be frequently touched by patients in the reception area need to be removed. Patients should be educated regarding the importance of practising good cough and sneeze etiquette, using disposable tissues to cover the mouth, and to keep their hands clean to prevent the spread of infection. Print resources and other communication materials may be placed in a

TABLE 4 Online resources and guidelines: Before, during and after dental treatment

| Sl. No | Online resources |
|--------|--|
| 1 | OSHA Guidelines on preparing workplace for COVID-19 https://www.osha.gov/Publications/OSHA3990.pdf |
| 2 | Routes of transmission of COVID-19 https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations |
| 3 | 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 |
| 4 | 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 |
| 5 | Interim infection control recommendations (Includes details on protective equipment, hand hygiene practices and negative pressure rooms) https://www.nabh.co/images/COVID19/Interim%20Infection%20Prevention%20and%20Control%20Recommendations%20for%20Patients%20with%20Suspected%20or%20Confirmed%20Coronavirus%20Disease%202019%20in%20healthcare%20facili.pdf |
| 6 | Environmental protection agency approved COVID-19 chemical disinfectants https://www.epa.gov/coronavirus/disinfectant-use-and-coronavirus-covid-19 |
| 7 | Risk Assessment and Public Health Management of Persons with Potential COVID-19 exposure https://www.cdc.gov/coronavirus/2019-ncov/php/risk-assessment.html |
| 8 | Steps for Healthcare Facilities to prepare for COVID-19 https://www.cdc.gov/coronavirus/2019-ncov/hcp/steps-to-prepare.html |
| 9 | Recommendations for putting on and removing personal protective equipment https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf |
| 10 | Recommendations on N95 respirators use and reuse https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html |

visible area in the dental office. It may be in the form of posters to encourage the:

- Use of disposable tissues and handkerchiefs during coughs and sneezes.
- Disposal of tissues and handkerchiefs into a garbage bin immediately after use.
- Hand hygiene tips, after cough and sneeze.

The availability of alcohol-based hand rubs (containing 60%-95% alcohol) and touchless receptacles for disposal at healthcare facility entrances, waiting rooms and patient check-ins are the general dental clinic requirements. It may be essential to let the patient know before entering the dental clinic that they would have to take their shoes or footwear off and sanitise their hands and feet with soap and water or alcohol-based sanitisers.

Geriatric patients frequently arrive with an assistant/helper. It is advisable to have only the patient enter the clinical operating area. However, if the entry of the assistant/helper cannot be avoided, this person has to be thoroughly screened for COVID-19 signs and symptoms before entering. Patients with special needs requiring wheelchairs and crutches have to be sanitised before entering the dental operatory.

Dentists and dental auxiliary personnel must be trained to wear and remove the PPEs appropriately to prevent the spread of infection. It is also essential to change the mask when soiled or worn.⁴⁷ It is critical to avoid touching the mask, or any inanimate objects with bare hands, as the transmission of the COVID-19 virus can occur either by direct contact with an infected person or indirect contact with objects in the immediate environment used by the infected person. Utmost precaution must be taken not to touch the eye and nose when

working in the dental clinic and to use a face shield and head cap while interacting with patients. The patient waiting area, screening zone, door and knob of the entrance must be frequently cleaned with an alcohol-based spray.

2.5.2 | Recommendation during the dental procedure

Due to the inherent risks that dentists and dental assistants are exposed to, in form of droplet, splatter, contact and aerosols, the Occupational Safety and Health Act (OSHA) have placed dentistry in the high-risk occupation category.³² Under the current circumstances, four-handed dental practice is best recommended as it ensures increased efficiency of treatment and reduced contact time with the patient. Four-handed dental practice helps to provide better patient care, reduces stress and fatigue of both the operator and the assistant, and maximises the dental team's productivity.

Aerosol generation, which is a common occurrence in the dental clinic, increases the vulnerability to SARS-CoV-2 infection. Airborne transmission facilitates microbes' viability in the air for more extended periods and their transmission over distances greater than 1 m.⁴⁸ Verity et al,⁴⁹ reported that viral loads in nasopharyngeal swabs from a group of patients with severe COVID-19 were 60 times higher than the viral loads among patients with a mild form of the disease. If such patients, with viral particles confined to the nasopharynx, were to be treated in a dental setting, and the procedure involved the generation of aerosols, other people would have increased susceptibility due to aerosol production.

Dentists have to incorporate necessary modifications in their operatory to minimise aerosol production and prevent disease

transmission from emitted particles. A critical step to reduce the salivary viral load is by enforcing the practice of preprocedural rinse with Povidone-Iodine (PVP-I) in patients.^{50,51} Studies have shown that SARS-CoV and MERS-CoV were highly susceptible to PVP-I mouth rinse. Therefore, preprocedural mouth rinses with 0.2% povidone-iodine might reduce the load of SARS-CoV-2 in saliva.⁵²⁻⁵⁴ Alternatively, the use of 0.5%-1% hydrogen peroxide mouth rinses has demonstrated non-specific virucidal activity against coronaviruses. However, one has to use hydrogen peroxide judiciously in geriatric patients. Hydrogen peroxide is a highly caustic and a reactive substance, which can damage oral soft tissues when used in high concentrations and for a prolonged duration.⁵⁵

It is necessary to minimise intraoral imaging as patients tend to elicit a gag or cough reflex. When intraoral imaging is mandated, sensors should have a double barrier to prevent perforation and cross-contamination.⁵⁶ Latex finger cots used in conjunction with the standard plastic sheaths covering direct digital radiography (DDR) sensors may effectively prevent cross-contamination than plastic sheaths alone. However, dentists are recommended to use extraoral imaging, such as panoramic radiography or cone-beam computed tomography (CBCT). It is also necessary to disinfect the radiograph holders and machine heads after each patient.

Studies have shown that sonic and ultrasonic scalers have a higher particle transmission incidence, followed by air polishing, air/water syringes and high-speed handpieces.⁵⁷ Miller et al (1995)⁵⁸ reported that ultrasonic instrumentation transmits nearly 100 000 microbes per cubic foot with aerosolisation of up to six feet. The use of ultrasonic scalers is best avoided. Instead, hand scalers/curettes should be employed for periodontal treatment. High-speed handpieces for cavity and tooth preparation, and 3-way syringes, are discouraged to reduce the risk of contamination of air and water tubes within the dental units and to prevent cross-infection. A dentist should perform an atraumatic restorative technique (ART) procedure using hand instruments instead of conventional rotary instruments to avoid generating aerosol. Dentists can also explore alternative means for removing decay on teeth employing chemico-mechanical means like CariSolv. Apart from eliminating the generation of aerosol or aspiration of viral particles, this technique ensures that only the carious dentine is removed without removing sound dentine.⁵⁹ If root canal treatment (RCT) has to be performed, manual preparation of the root canal is preferred over rotary techniques. To reduce the older adults' visits to the clinic, it may be worth considering a single visit RCT.

Ideally, the aerosol-generating procedures are planned for the last appointment of the day. As per WHO (2020) and OSHA recommendations, the patients should be transferred to a safer room with negative pressure ventilation and with 12 air changes/hour "ACH" or 160 L/s/patient.⁶⁰ The same protocol is recommended for emergency treatment of geriatric patients who test positive for COVID-19. It is strongly recommended that an anti-retraction dental handpiece is used with specially designed anti-retractive valves or other anti-reflux designs as a preventive measure for cross-infection.^{61,62} When indicated, dentists must place rubber dams to

minimise splatter generation and aspiration of viral particles from the oral cavity to nasopharynx. It is also necessary to use high volume evacuators (HVE) while performing any dental procedure.

Adequate care must be taken to minimise injury during extraction, helping to avoid the complications of a dry socket. Oral surgical procedures should be performed along with HVE to remove the fluids and debris from the surgical site. For surgical procedures requiring suturing, it is recommended to use a resorbable suture lasting 3-5 days in the oral cavity to eliminate the need for a follow-up appointment.

Geriatric individuals who are fully or partially edentulous may have a removable or fixed intraoral prosthesis. Removing and maintaining the hygiene of these prostheses, in general, improves the well-being of the patient. Unfortunately, institutionalised elderly often neglect oral care because of frailty, which impacts oral health. For prosthetic procedures, it is advised to evaluate the urgency of the treatment before scheduling an appointment. If the patient's existing denture is broken or a fixed prosthesis is dislodged, it should be disinfected before the dentist or the technician handles it. It is necessary to plan a treatment that requires fewest appointments. It is advisable to prepare for an immediate denture if the extraction of teeth is planned. One could even explore the possibility of immediate implant placement with temporisation after removal of the tooth on the same day.

Rational and appropriate use of personal protective equipment (PPE), including head cap and mouth masks with a timely change in attitude, perception and behavioural change among healthcare workers, is the key to reducing the impact of SARS-CoV-2 infection. The PPE advocated for airborne agents (ie aerosol-transmissible) is different from the PPE used to prevent transmission by large droplets or direct contact. For the dentist and staff working in areas of direct contact with aerosols, recommended PPEs include R/P95, N/R/P99 or N/R/P100 filtering facepiece respirator; an air-purifying elastomeric (eg half-face or full-face) respirator with appropriate filters or cartridges; powered air-purifying respirator (PAPR) with high-efficiency particulate arrestance (HEPA) filter; or supplied-air respirator (SAR).³²

2.5.3 | Recommendations after the dental procedure

Clear post-operative instructions should be given to the patient. The dentist must ensure that the prescribed medication is not contraindicated or interferes with the current medication. There are some concerns related to the use of NSAIDs, as there may be a slated adverse effect noted when used in patients with acute viral respiratory infections, including COVID-19.⁶³ However, WHO has confirmed that there is no evidence of severe adverse events in patients with COVID-19 due to the use of NSAIDs.⁶⁴ The dental team must emphasise the importance of maintaining oral hygiene to the patient as a part of post-operative instructions. It is advisable to have a counsellor as a part of the dental team to address

mental health issues and other apprehensions during the site visits mentioned in Step 4.

The "OSHA Guidelines on preparing the workplace for COVID-19" and "Environmental protection agency approved COVID-19 chemical disinfectants" are listed in Table 4. The dental team should disinfect the impression tray with or without impression materials, casts and temporary dentures appropriately before sending them to the laboratory. The dental team could indicate the COVID status of the patient to the laboratory for further precautions at their end. Disposal of the biomedical waste generated in the clinic is a necessary procedure and should be performed according to established protocols.⁴⁵

The existing knowledge on COVID-19 is currently limited as researchers around the globe are intensifying their efforts to develop an effective vaccine. It has been reported that SARS-CoV-2 may remain viable in aerosol and survive for up to 3 days on inanimate surfaces at room temperature, with a higher preference for humid conditions.^{45,49} With most of the dental procedures generating a significant amount of aerosol, dentistry is classified as one of the most high-risk jobs amidst the pandemic. Disinfecting the inanimate surfaces using chemicals recently approved for COVID-19, and maintaining a dry environment to prevent the virus's spread is critical.

3 | SUMMARY

The outbreak of the SARS-CoV-2 pandemic is a global concern that poses a severe threat to human health, well-being and survival. The SARS-CoV-2 pandemic has resulted in a higher mortality rate among the elder/geriatric age group. Addressing the unique needs of geriatric patients who present with co-morbid conditions is critical to reducing mortality and preventing the spread of SARS-CoV-2 infection. In this paper, we have proposed generic protocols and stepwise guidelines for the effective management of geriatric patients in a dental setting. Universal guidelines to specifically meet the challenges of geriatric patients in the dental setting ensure the health of vulnerable sections of the society and the well-being of the community at large.

ACKNOWLEDGEMENTS

Authors acknowledge Dr Barry Berkovitz, Emeritus Reader, Anatomy and Human Sciences, Biomedical and Health Sciences, King's College London, UK and Visiting Professor, Oman Dental College, Oman for diligently proof reading this manuscript.

AUTHORS' CONTRIBUTION

Karthik Sivaraman and Raghu Radhakrishnan involved in conceptualisation. Karthik Sivaraman and Aditi Chopra involved in data curation. Karthik Sivaraman and Raghu Radhakrishnan involved in methodology. Aparna Narayana and Raghu Radhakrishnan involved in resources. Raghu Radhakrishnan involved in supervision. Aparna Narayana and Raghu Radhakrishnan involved in validation. Karthik


Sivaraman and Aditi Chopra involved in original draft. Aparna Narayana and Raghu Radhakrishnan involved in review & editing.

ORCID

Karthik Sivaraman  <https://orcid.org/0000-0002-1512-6488>

Aditi Chopra  <https://orcid.org/0000-0003-4805-5943>

Aparna Narayana  <https://orcid.org/0000-0002-3190-2379>

Raghu A. Radhakrishnan  <https://orcid.org/0000-0003-0088-4777>

REFERENCES

1. Zhu NA, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*. 2020;382(8):727-733.
2. Phelan AL, Katz R, Gostin LO. The novel coronavirus originating in Wuhan, China: challenges for global health governance. *JAMA*. 2020;323(8):709.
3. Chan J-W, Yuan S, Kok K-H, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*. 2020;395(10223):514-523.
4. Liu J, Liao X, Qian S, et al. Community transmission of severe acute respiratory syndrome coronavirus 2, Shenzhen, China, 2020. *Emerg Infect Dis*. 2020;26(6):<https://doi.org/10.3201/eid2606.200239>
5. Malik YS, Sircar S, Bhat S, et al. Emerging novel coronavirus (2019-nCoV)-current scenario, evolutionary perspective based on genome analysis and recent developments. *Vet Q*. 2020;40(1):68-76.
6. Del Rio C, Malani PN. 2019 Novel coronavirus—important information for clinicians. *JAMA*. 2020;323(11):1039.
7. Andersen KG, Rambaut A, Lipkin WI, Holmes EC, Garry RF. The proximal origin of SARS-CoV-2. *Nat Med*. 2020;26(4):450-452.
8. Kluge HHP. Statement – Older People Are at Highest Risk from COVID-19, but All Must Act to Prevent Community Spread. <http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/statements/statement-older-people-are-at-highest-risk-from-covid-19,-but-all-must-act-to-prevent-community-spread>. Accessed May 20, 2020.
9. Lee PG, Cigolle C, Blaum C. The co-occurrence of chronic diseases and geriatric syndromes: the health and retirement study. *J Am Geriatr Soc*. 2009;57(3):511-516.
10. Bulletin of the World Health Organization. More Oral Health Care Needed for Ageing Populations. <https://www.who.int/bulletin/volumes/83/9/infocus0905/en/index1.html>. Accessed May 25, 2020.
11. Comas-herrera A, Zalakaín J, Litwin C, Hsu AT, Lane N, Fernández J. Mortality associated with COVID-19 outbreaks in care homes: Early International Evidence. 2020. <https://itccovid.org/wp-content/uploads/2020/05/Mortality-associated-with-COVID-3-May-final-6.pdf>
12. Centers for Disease Control and Prevention. Older Adults. 2020. <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html>. Accessed May 22, 2020.
13. Yang J, Zheng YA, Gou XI, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *Int J Infect Dis*. 2020;94:91-95.
14. Pae M, Meydani SN, Wu D. The role of nutrition in enhancing immunity in aging. *Aging Dis*. 2012;3(1):91-129.
15. Montecino-Rodriguez E, Berent-Maoz B, Dorshkind K. Causes, consequences, and reversal of immune system aging. *J Clin Invest*. 2013;123(3):958-965.
16. Rivera C, Droguett D, Arenas-Márquez M-J. Oral mucosal lesions in a Chilean elderly population: a retrospective study with a systematic review from thirteen countries. *J Clin Exp Dent*. 2017;9(2):e276-e283.

17. Xu F, Laguna L, Sarkar A. Aging-related changes in quantity and quality of saliva: where do we stand in our understanding? *J Texture Stud.* 2019;50(1):27-35.
18. Michalakis K, Ilias I. SARS-CoV-2 infection and obesity: common inflammatory and metabolic aspects. *Diabetes Metab Syndr.* 2020;14(4):469-471.
19. Dixon AE, Peters U. The effect of obesity on lung function. *Expert Rev Respir Med.* 2018;12(9):755-767.
20. Honce R, Schultz-Cherry S. Impact of obesity on influenza A virus pathogenesis, immune response, and evolution. *Front Immunol.* 2019;10:1071.
21. Almond MH, Edwards MR, Barclay WS, Johnston SL. Obesity and susceptibility to severe outcomes following respiratory viral infection. *Thorax.* 2013;68(7):684-686.
22. Manini T. Development of physical disability in older adults. *Curr Aging Sci.* 2011;4(3):184-191.
23. Thomson WM. Dental caries experience in older people over time: what can the large cohort studies tell us? *Br Dent J.* 2004;196(2):89-92.
24. Hirotsu T, Yoshihara A, Yano M, Ando Y, Miyazaki H. Longitudinal study on periodontal conditions in healthy elderly people in Japan. *Community Dent Oral Epidemiol.* 2002;30(6):409-417.
25. Peng J, Song J, Han J, et al. The relationship between tooth loss and mortality from all causes, cardiovascular diseases, and coronary heart disease in the general population: systematic review and dose-response meta-analysis of prospective cohort studies. *Biosci Rep.* 2019;39(1):BSR20181773.
26. Emami E, de Souza RF, Kabawat M, Feine JS. The impact of edentulism on oral and general health. *Int J Dent.* 2013;2013:498305.
27. Maeda K, Mori N. Poor oral health and mortality in geriatric patients admitted to an acute hospital: an observational study. *BMC Geriatr.* 2020;20(1):26.
28. Li S-R, Tang Z-J, Li Z-H, Liu X. Searching therapeutic strategy of new coronavirus pneumonia from angiotensin-converting enzyme 2: the target of COVID-19 and SARS-CoV. *Eur J Clin Microbiol Infect Dis.* 2020;39(6):1021-1026.
29. Xu R, Cui B, Duan X, Zhang P, Zhou X, Yuan Q. Saliva: potential diagnostic value and transmission of 2019-nCoV. *Int J Oral Sci.* 2020;12(1):11.
30. World Health Organization. Clinical management of severe acute respiratory infection when Novel Coronavirus (2019-nCoV) infection is suspected: interim guidance. 2020. <https://apps.who.int/iris/handle/10665/330893>. Accessed June 1, 2020.
31. Liu J, Liu Y, Xiang P, et al. Neutrophil-to-lymphocyte ratio predicts critical illness patients with 2019 coronavirus disease in the early stage. *J Transl Med.* 2020;18(1):206.
32. U.S. Department of Labor. Guidance on Preparing Workplaces for COVID-19.
33. Lechien JR, Chiesa-Estomba CM, De Siati DR, et al. Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study. *Eur Arch Oto-Rhino-Laryngol.* 2020;277(8):2251-2261.
34. Passali GC, Bentivoglio AR. Comment to the article "Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study". *Eur Arch Oto-Rhino-Laryngol.* 2020;277(8):2391-2392.
35. Carod-Artal FJ. Neurological complications of coronavirus and COVID-19. *Rev Neurol.* 2020;70(9):311-322.
36. Helms J, Kremer S, Merdji H, et al. Neurologic features in severe SARS-CoV-2 infection. *N Engl J Med.* 2020;382(23):2268-2270.
37. Mao L, Jin H, Wang M, et al. Neurologic manifestations of hospitalized patients with coronavirus disease 2019 in Wuhan, China. *JAMA Neurol.* 2020;77(6):683.
38. Gandhi S, Srivastava AK, Ray U, Tripathi PP. Is the collapse of the respiratory center in the brain responsible for respiratory breakdown in COVID-19 Patients? *ACS Chem Neurosci.* 2020;11(10):1379-1381.
39. Toscano G, Palmerini F, Ravaglia S, et al. Guillain-Barré syndrome associated with SARS-CoV-2. *N Engl J Med.* 2020;382(26):2574-2576.
40. Zhao H, Shen D, Zhou H, Liu J, Chen S. Guillain-Barré syndrome associated with SARS-CoV-2 infection: causality or coincidence? *Lancet Neurol.* 2020;19(5):383-384.
41. Amor S, Puentes F, Baker D, van der Valk P. Inflammation in neurodegenerative diseases. *Immunology.* 2010;129(2):154-169.
42. Recalcati S. Cutaneous manifestations in COVID-19: a first perspective. *J Eur Acad Dermatol Venereol.* 2020;34(5):e212-e213.
43. Chaux-Bodard A-G, Deneuve S, Desoutter A. Oral manifestation of Covid-19 as an inaugural symptom? *J Oral Med Oral Surg.* 2020;26(2):18.
44. Klok FA, Kruip M, van der Meer N, et al. Incidence of thrombotic complications in critically ill ICU patients with COVID-19. *Thromb Res.* 2020;191:145-147.
45. Sehulster L, Chinn RYW. Guidelines for Environmental Infection Control in Healthcare Facilities. 2003. <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm>. Accessed May 15, 2020.
46. Galton J, Tovey ER, McLaws M-L, Rawlinson WD. Respiratory virus RNA is detectable in airborne and droplet particles. *J Med Virol.* 2013;85(12):2151-2159.
47. Ong SWX, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA.* 2020;323(16):1610-1612.
48. WHO. Modes of Transmission of Virus Causing COVID-19: Implications for IPC Precaution Recommendations. 2020; <https://apps.who.int/iris/handle/10665/331601>
49. Verity R, Okell LC, Dorigatti I, et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. *Lancet Infect Dis.* 2020;20(6):669-677.
50. Marui VC, Souto MLS, Rovai ES, Romito GA, Chambrone L, Pannuti CM. Efficacy of preprocedural mouth rinses in the reduction of microorganisms in aerosol: a systematic review. *J Am Dent Assoc.* 2019;150(12):1015-1026.e1.
51. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Guidelines for infection control in dental health-care settings-2003. *MMWR Recomm Rep.* 2003;52(RR-17):1-61.
52. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci.* 2020;12(1):9.
53. Eggers M. Infectious disease management and control with povidone iodine. *Infect Dis Ther.* 2019;8(4):581-593.
54. Kariwa N, Fujii N, Takashima I. Inactivation of SARS coronavirus by means of povidone-iodine, physical conditions and chemical reagents. *Dermatology.* 2006;212(Suppl):119-123.
55. Walsh LJ. Safety issues relating to the use of hydrogen peroxide in dentistry. *Aust Dent J.* 2000;45(4):257-269.
56. Hokett SD, Honey JR, Ruiz F, Baisden MK, Hoen MM. Assessing the effectiveness of direct digital radiography barrier sheaths and finger cots. *J Am Dent Assoc.* 2000;131(4):463-467.
57. Harrel SK, Molinari J. Aerosols and splatter in dentistry: a brief review of the literature and infection control implications. *J Am Dent Assoc.* 2004;135(4):429-437.
58. Miller RL. Characteristics of blood-containing aerosols generated by common powered dental instruments. *Am Ind Hyg Assoc J.* 1995;56(7):670-676.
59. Maru VP, Shakuntala BS, Nagarathna C. Caries removal by chemomechanical (CarisolvTM) vs. rotary drill: a systematic review. *Open Dent J.* 2015;9:462-472.

60. Atkinson J, Chartier Y, Pessoa-Silva CL, et al. *Natural Ventilation for Infection Control in Health-Care Settings*. Geneva, Switzerland: World Health Organization; 2009.
61. Hu T, Li G, Zuo Y, Zhou X. Risk of hepatitis B virus transmission via dental handpieces and evaluation of an anti-suction device for prevention of transmission. *Infect Control Hosp Epidemiol*. 2007;28(1):80-82.
62. Samaranayake LP, Peiris M. Severe acute respiratory syndrome and dentistry: a retrospective view. *J Am Dent Assoc*. 2004;135(9):1292-1302.
63. Russell B, Moss C, Rigg A, Van Hemelrijck M. COVID-19 and treatment with NSAIDs and corticosteroids: should we be limiting their use in the clinical setting? *Ecancermedalscience*. 2020;14:1023.
64. World Health Organization. The Use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) in Patients with COVID-19. 2020. WHO/2019-nCoV/Sci_Brief/NSAIDs/2020.1

How to cite this article: Sivaraman K, Chopra A, Narayana A, Radhakrishnan RA. A five-step risk management process for geriatric dental practice during SARS-CoV-2 pandemic. *Gerodontology*. 2020;00:1-10. <https://doi.org/10.1111/ger.12499>