Health and Technology (2022) 12:205–214
https://doi.org/10.1007/s12553-021-00627-6

ORIGINAL PAPER

Improving safety in dental practices during the COVID-19 pandemic

Asma Gasmi Benahmed[1] · Amin Gasmi[2] · Wajiha Anzar[3] · Mehreen Arshad[4] · Geir Bjørklund[5]

Received: 23 March 2021 / Accepted: 18 November 2021 / Published online: 10 January 2022

Abstract
Coronavirus disease 2019 (COVID-19) is caused by a novel coronavirus, known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It originated from the Chinese city of Wuhan and very quickly became a challenging public health problem. On 11 March 2020, the World Health Organization termed this potentially deadly disease a pandemic due to its rapid spread in various parts of the world, giving rise to international health emergencies. This virus is transmitted from human to human in the form of respiratory droplets, and in specific circumstances, airborne transmission may occur. Additional sources of exposure for dentists include blood and infected sharps. Due to the contagious nature of COVID-19 many health care providers have also been disproportionately affected, such as physicians, dentists, nurses, and paramedical staff. Dentists and dental staff are at high risk of cross-infection due to their nature of work. Therefore, they face a dual challenge in protecting themselves and their patients from infection transmission while ensuring that patients receive urgent dental care. In this review, the authors highlight the epidemiology, modes of cross-infection, and recent data on SARS-CoV-2 related to dental practice. The primary purpose is to make dental health care providers aware of the pathophysiology of COVID-19 and to increase their preparedness and understanding of this challenge, which will aid in controlling transmission. The information collected will be useful for the dental community in providing effective patient management through evidence-based recommendations for infection control and disinfection protocols.

Keywords COVID-19 · SARS-CoV-2 · Public health problem · Dental practice · Dentistry · Patient management · Infection control

1 Introduction

In the past few years, coronavirus outbreaks have been a source of emerging public health problems. Coronavirus belongs to a family of positive-sense RNA viruses that mainly attack the respiratory system of humans [1]. Some recent strains of coronavirus have been named Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), which have appeared in cows, camels, and cats exhibiting zoonotic transmission [2]. The new viral strain, never seen before, was initially named "the new coronavirus" (nCoV) and subsequently "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2) [3]. Since then, it has become a significant international challenge and a pandemic was declared by the World Health Organization (WHO) [3]. The increasing spread of coronavirus disease 2019 (COVID-19) has prompted many governments to introduce extraordinary measures to suppress the spread of infection. Recently, several variants of coronavirus have emerged [4]. Since health is a primary concern, an increase in the number of cases and deaths has led to enforced quarantine and isolation at home being imposed in many countries and general restrictions on travel and movement, greatly affecting the daily and working life of populations [5, 6]. The pandemic has impaired the quality of life of the general

This articleis part of Topical Collection on *COVID-19 Health Technology: Design, Regulation, Management, Assessment.*

✉ Geir Bjørklund
bjorklund@conem.org

1 Académie Internationale de Médecine Dentaire Intégrative, Paris, France

2 Société Francophone de Nutrithérapie et de Nutrigénétique Appliquée, Villeurbanne, France

3 Dow University of Health Sciences, Karachi, Pakistan

4 National University of Sciences and Technology, Islamabad, Pakistan

5 Council for Nutritional and Environmental Medicine, Mo i Rana, Norway

public and health care workers (HCWs), which has led to various psychological issues, including generalized anxiety disorder, depression, and poor sleep quality [7]. Widespread transmission of the disease has also shown its spread into health care providers, which have been identified as potential carriers due to being in the front line of infected patient management [8]. The rapid spread of COVID-19 all around the world has startled health care experts. There is a significant concern in dental practices because of the pathogenicity of the virus and transmission modes via saliva aerosols [9]. Dentists are at the front-line of this pandemic because they have close interaction with patients and are at risk for developing COVID-19 and other respiratory diseases. Standard protective measures in regular dental clinical settings are inadequate in preventing the spread of COVID-19 due to the nature of dental treatments and the huge number of droplets and aerosols that can be produced [10]. Several studies are available, which provide accurate reports of the situation for each country regarding infections by health care professionals, as stated by WHO, particularly among dental professionals [11]. Preliminary reports have also suggested that HCWs are prone to infection at the workplace and in the community due to wide interaction [12].

The primary purpose of this review is to describe how the prevalence of SARS-COV-2 can affect dental practitioners and what preventive approaches and strategies they should adopt at dental clinics to avoid contracting infection. The pathophysiology of COVID-19 is described to increase the preparedness and understanding of health care professionals when dealing with this challenge and to aid in controlling the transmission of this potentially life-threatening condition.

2 Pathogenesis of SARS-COV-2

SARS-COV-2 belongs to a family of viruses known as coronaviridae, order nidovirales, which possess single positive-stranded RNA genes. Due to this characteristic, they are capable of causing infectious diseases in humans and other animals [12]. However, mostly they cause a milder form of respiratory illness. On phylogenic analysis of the genome, it was demonstrated that SARS-COV-2 belongs to the beta (β)-CoV variant, due to which it is capable of infecting adults and children and has a tendency to spread faster in contrast to other types previously seen [13]. It carries the genome of humans and bats (BatCoVRaTG13). More than 1,000 samples of pangolins have been tested by South China Agricultural University, out of which 70% of pangolins carried β-CoV, which confirmed its pathogenicity [14].

This virus alters immunity by lowering the lymphocytes count. Immunity helps in fighting against invasive pathogens. A positive aspect of this virus is that most people tend to exhibit mild symptoms and recover quickly. Only a few develop severe conditions impacting multiple organs making this virus fatal [15]. The virus can pass through the mucosal membrane, particularly in nasal areas and areas around the larynx, and enter the lungs via the respiratory tract. The primary symptoms of the infection include fever and a cough. Later on, it spreads to peripheral blood from the lungs, where it becomes highly pathogenic by binding with targeted organs that have receptor angiotensin-converting enzyme II (ACE2) on the surface for instance kidneys, lungs, heart, and the gastrointestinal region [16].

Samples of fecal material have also shown the presence of SARS-COV-2, as this virus is likely to travel from the bloodstream to the lungs and further to the intestines. As it enters the lungs, it causes symptoms of respiratory distress and pneumonia on approximately the eighth day. Following infection, the second wave occurs in patients on the 7^{th} to 14^{th} day, when the clinical condition worsens. Initially, leucocyte counts are normal. However, B lymphocytes decline during the early phase of the infection and alter the antibody production ability of patients [17]. Those who are unable to defend against the virus experience aggravated symptoms within 7 to 14 days, accompanied by neutrophilia, as well as elevated blood urea and creatinine levels [18].

3 Symptoms of COVID-19

Clinical manifestations of COVID-19 are categorized as per the severity of the condition. Patients with infections mainly exhibit symptoms like a dry cough, fever, shortness of breath, myalgia and/or fatigue. Other symptoms like gastrointestinal disturbance followed by diarrhea, nausea, altered taste, and hyposmia have also been recognized. Some patients might present nausea and gastrointestinal disturbances before the onset of fever. Some also present with complaints of headache and hemoptysis or are asymptomatic, indicating nonspecific symptoms of the condition. The majority of the patients, nearly 80%, only report mild symptoms similar to allergies and seasonal flu, making diagnosis difficult [19].

The virus's incubation period varies from 0 to 24 days, and during this phase, the carrier might be asymptomatic but can transmit it to others. Infection symptoms usually appear after five days[20].

Computed tomography scans of the chest have revealed signs of respiratory distress, pneumonia, and even cardiac arrest in a few individuals. Radiographs have revealed areas of ground-glass-like opacities in the chest that can be single or multiple and are found in subpleural areas of the lungs [21]. Asymptomatic patients act as a reservoir for the disease and are active carriers to the community, and reports have revealed that virulence increases with the severity of symptoms of the carrier [21]. Older men are commonly

affected, particularly those who are immunocompromised [22]; such individuals are prone to respiratory failure leading to irreversible alveolar destruction and other organ damage, making it fatal in some cases. In patients above 70 years, symptoms aggravate faster as compared to the younger age group. On laboratory examinations, a decline in patients' total leucocyte count and platelets might appear, while elevated C-reactive proteins are accompanied by prolonging thromboplastin time. Hence, a clinician must look for symptoms like upper respiratory tract infections, fever accompanied by lymphopenia, or decreased leukocyte count [23]. These symptoms show similarities with earlier coronavirus strains, like a dry cough, breathing difficulty, fever, and ground-glass-like opacities within the lungs. However, COVID-19 has a distinguishing feature in that it attacks the upper respiratory tract of patients, exhibiting features like a runny nose, a sore throat, and sneezing [24].

It has also been suggested that fecal material and urine of infected individuals should be tested to exclude any possibility of transmission to HCWs [25].

4 Epidemiology of COVID-19 of dental practitioners

Globally, on 14 September 2021, there have been 225,024,781 confirmed cases of COVID-19, including 4,636,153 deaths and a total of 5,534,977,637 vaccine doses have been administered [26]. The highest numbers of cases are witnessed in the USA, followed by Europe, South-East Asia, Eastern Mediterranean, Africa, and Western Pacific.. Compared to the previous week, there has been a 13% decrease in COVID-19 cases globally. However, this infection is still a serious threat for the world due to the continued spread of more transmissible variants such as B.1.1.7 (202,012/01) (originally identified in the United Kingdom), B.1.351 (501Y.V2) (originally identified in South Africa), P.1 (originally identified in Brazil). In addition, another reason for the increased viral spread is the relaxation of public health and social control measures and a reluctance to continue adhering to preventative measures, such as avoiding crowds, social distancing, increased hand hygiene, wearing masks, and improving ventilation.

Furthermore, the immunity provided by vaccination takes weeks to be established, and it may take longer to observe impacts for the whole population [27]. On 11 April 2020, WHO highlighted the issue of infection in HCWs in the situational report number 82 [28]. In the context of COVID-19, HCWs play a crucial role in dealing with critically ill patients and participate in ensuring that preventive measures are correctly enforced to restrict infections in health care personals. Another publication from the Centers for Disease Control and Prevention (CDC) China, dated 17 February 2020, confirmed the prevalence of COVID-19 as 1,688, with five deaths (approximately 3.8%) in HCWs [29]. A report from Italy on 10 April 2020 stated 1,5314 numbers of infections in HCWs [30]. However, most of the infections were mild, but severe outcomes including deaths have also been reported. Few publications have raised this alarming issue, but literature has suggested that HCWs are commonly infected in the workplace during community services or by other infected family members [31]. The International Council of Nurses update (13 January 2021) reported that, on average, around 10% (with a range of 0–15%) of all confirmed COVID-19 infections were among HCWs. As of 31 December 2020, the cumulative number of reported COVID-19 deaths in nurses in 59 countries was 2,262 [32]. Dentists rank the highest for infection risk, most likely due to insufficient personal protective equipment (PPE). WHO has recommended airborne precautions in dentistry and other high-risk areas to avoid transmission via aerosols. Also, understanding the correct role of PPE, for example, appropriate hand hygiene is mandatory for proper removal and disposal. A risk assessment tool has been formulated by WHO, which has identified exposed doctors and dentists so that better epidemiology and distribution of the Covid-19 risk can also be observed. Comprehensive epidemiological surveillance tools are available, which are being used in many countries to gather information to improve the data about current and past HCW infection rates [33]. WHO has also implemented occupational safety and health measures for promoting physical and mental health in health care providers [34].

5 General modes of transmission

The general COVID-19 transmission mode is contact between humans [35]. The virus is airborne and spreads through respiratory droplets, which originate from sneezing and coughing. Initially, the virus was thought to have originated from a wet market in Wuhan City from consumption of foods, including bats and seafood [36]. These patients were admitted to hospitals, from where the number of cases amplified to include health care staff, nurses, and physicians who were treating the infection. With time, the virus was observed in those who had not consumed any bats and seafood [36]. In addition, the mechanism of the spread of all three strains of coronavirus SARS, MERS, and SARS-CoV-2 is similar. That is, it spreads via respiratory droplets or human secretions [37].

However, the current global pandemic is spreading more rapidly than previous outbreaks [1]. The characteristics of COVID-19 have made it extremely challenging to control. During a quarantine period, it is difficult to identify infected people, which adds up to the burden of the disease

by amplifying the magnitude of the condition in the community [38]. It is also a fact that those patients undergoing recovery are also a potential source of virus transmission. In health care settings and dental practice, the virus can transmit through nasal, conjunctival, oral secretions, or even when talking at shorter distances without a face mask. Infections can spread via infected patients in hospitals and dental clinics, as well.

During the incubation period of the virus, infected individuals can also serve as carriers for COVID-19. Especially, asymptomatic patients can transmit the disease to others; a large number of studies have confirmed the possibility of asymptomatic transmission [39]. The article of Peng et al. [40] which examined nine pregnant women also suggested the possibility of maternal transmission to the fetus. However, the potential adverse effects on pregnancy showed varying results and conflicting evidence [22]

6 Transmission routes in dental practice

Dental clinics are at high risk because dental treatments involve procedures that generate aerosols, such as through the use of high-speed handpieces or ultrasonic instruments that may infect the surrounding area and the dentist [10]. In dentistry, infections can transmit through the coughs and sneezes of infected patients. The presence of the live virus in the saliva of those who had infections upon culturing with the viral culture method has also been confirmed [41]. Equally, contaminated instruments can be a potential threat to other patients [42].

In dental settings, which involve aerosol-generating procedures (AGP), transmissions can also occur in the form of droplets and are inevitable. Hence, routine precaution is not sufficient to prevent the spread. Such particles are minute and can remain airborne before landing on surfaces in the dental clinics. The particles can persist on metal, plastic, or glass surfaces, which dentists and dental assistants frequently touch, making them more vulnerable to infection [43]. The experiments on surface stability of COVID-19 in comparison to SARS showed that aerosols remained viable for 3 h, and the COVID-19 virus could remain more stable on stainless steel and plastic. It is challenging to identify carriers via history alone, as many of them might be in the asymptomatic incubation period and not aware of their subclinical or pre-clinical stage [44].

Moreover, at room temperature, COVID-19 is highly infectious on surfaces such as dental chairs, their handles, the spittoon, and dental instruments for a duration of up to three days. Therefore, the persistence of the novel coronavirus can only be restricted in dental clinics by regularly disinfecting and cleaning the surfaces in the clinic [45]. Patients with active respiratory illnesses are not likely to present for elective dental procedures; hence, it is the practitioner's responsibility to gauge the need for urgent dental management and defer treatment accordingly.

The American Dental Association (ADA), the National Association of Italian Dentists (ANDI), and other numerous scientific dental associations have provided recommendations for the need for deferring non-urgent dental treatment. All dentists should follow their guidelines to avoid transmission in dental practice [46, 47]. Figure 1 summarizes possible modes of transmission in a dental setting.

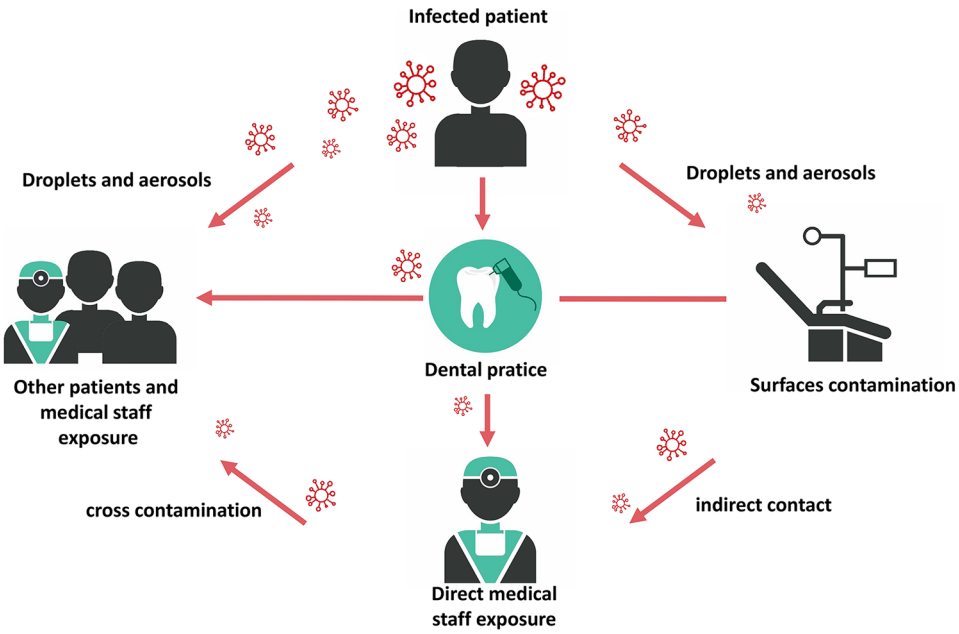

Fig. 1 COVID-19 transmission modes in dental settings

7 SARS-CoV-2 in the oral cavity in the early COVID-19 stage

Studies have revealed that ACE2—a protein on the surface of many cell types—acts as a receptor for binding with COVID-19, facilitating its entry into the cell. ACE2 + cells are present in abundance in the respiratory tract and the ducts of the human salivary gland, covering its epithelium [48, 49]. The strains of the virus can be detected in saliva even after 29 days of infection [18]. However, salivary biomarkers can only be tested in patients who exhibit symptoms of oropharyngeal secretions [50]. A saliva sampling, instead of a nasopharyngeal swab, reduces the possibility of nosocomial transmission between healthcare professionals and the potential carriers [41]. In patients with thrombocytopenia, taking a swab can also cause nasopharyngeal and oropharyngeal bleeding [51]. Three different pathways are suggested. Firstly, COVID-19 in the respiratory tract migrates in the oral cavity along with liquid and droplets. The second mechanism suggests COVID-19 is present in blood and can reach the mouth through exudate in the oral cavity. The third way is due to the infection of the salivary glands, which causes the release of particles into saliva through the salivary ducts. This mechanism suggests that COVID-19 can travel through the major and minor salivary glands into the oral cavity [21].

A study by Chen et al. [52] assessed oral features in COVID-19 patients and found that ACE2 was present in detectable levels in salivary glands. In four critically ill patients, there was a positive detection of the virus in the saliva. Dry mouth and loss of taste were the most frequent symptoms [53]. Hence, oral symptoms might be taken into consideration for the identification of SARS-COV-2 at the initial stages. The use of saliva can be a non-invasive and cost-effective method in infection investigation [23].

8 Prevention strategies for dental practitioners

Once dental practitioners understand the mode of viral transmission, it is easier to practice prevention and infection control measures. However, extra precautions are needed to control the spread of COVID-19 [54]; it is essential to adopt the guideline for the diagnosis and management of COVID-19 [55]. Firstly, patient evaluation is mandatory, and every individual must be considered a potential case of COVID-19. Patients with fever must have their treatment deferred immediately. In all patients, their temperature should be recorded using infrared thermometers. Tele-screening must be performed initially before booking appointments. For walk-in patients, a non-clinical examination must be performed in the form of a questionnaire before starting any clinical procedure [56]. A set of questions includes a history of fever in the last 14 days, acute infections like cough, flu; symptoms like respiratory distress or travel history from affected areas, or if any family member has tested positive for the virus. If the patients answer yes to any of these questions and have a temperature below 37.3 degrees, the patients should be instructed to self-quarantine at home. If the answer is yes and the temperature is higher than 37.3 degrees, this must be immediately reported to the local health care unit [8].

Once the dentist is sure that a patient has no symptoms or additional risk factors, dental treatment can be performed using a standardized protocol since fecal–oral virus transmission has also been reported. Therefore, hand hygiene must also be practiced, ie:washing hands before and after patient treatment to avoid cross-infection. Special consideration should be given to advanced PPE usage in dentistry, including eyeglasses, face shields, surgical caps, and disposable clothing [57]. Every time the patient comes for dental treatment, he or she must be offered mouth rinses of 0.2% hydrogen peroxide, and all treatment must be done in the presence of a rubber dam to avoid splashes [58]. Dental hospitals and clinics should follow strict disinfection protocols. The protocols for surface cleaning and disinfection also emphasize the disinfection of desks, chairs, and door handles and avoid touching any buttons in the dental office [59]. Lastly, proper waste disposal must be followed in waste bags, coded in a double-layer yellow-colored waste bag [60]. Many recommendations for dental practice settings have been published previously, recommending that non-emergency dental treatment be postponed and only emergency dental treatments be provided [61]. The Advisory Task Force on Dental Practice Recovery (ADA) and the CDC have announced recent interim recommendations for dental practitioners returning to work under COVID-19 practice restrictions [62]. Dentists are returning to their regular practices at different times, based on a variety of factors. Before resuming routine oral health treatment, each team/institution must make judgments based on their understanding of the local prevalence of COVID-19 cases, patients' needs, and operational improvement. CDC previously advised dentists to prioritize urgent appointments and postpone elective procedures during the pandemic [62]. A new framework for providing non-COVID-19 related healthcare facilities was announced on 30 June 2020 [63]. The need for health professionals to return for essential/emergency? assistance was indicated in this document while still obeying the local level of COVID-19 transmission and considering changes over time. Some amendments were also made in the interim infection prevention and control guidelines developed for health care practitioners during the COVID-19 pandemic on 15 July 2020 [62]. Lastly, on 28 August,

the CDC updated the interim infection prevention and control guidance for dental settings during the COVID-19 pandemic. This document outlined specific infection prevention and control considerations, such as prioritizing the most critical dental services to reduce patient harm and potential SARS-CoV-2 infection, as well as the importance of staying home if symptomatic (for both patients and dental care staff) and procedures to follow when dealing with symptomatic patients [64]. Recently, Tovani-Palone et al. [65] published recommendations that should be implemented for safe dental practices in the time of COVID-19 for pediatric patients. Researchers recommended the use of mouthwash before proceeding with the dental procedure for both outpatients as well as patients admitted to the hospital. Moreover, they suggested the use of specific types of mouthwash depending on the circumstances of the patient. They also added that an age-appropriate toothbrush must be used for children with erupted teeth. In children without erupted teeth, the gingival mucosa must be cleaned with sterile gauze immersed in an appropriate antiseptic solution [65]. Figure 2 summarizes preventive strategies to be adopted in dental settings.

9 Dental practice in intensive care units (ICU) during COVID-19

Recent reports demonstrated that over 33% of COVID-19 infected hospitalized patients would need intensive care, and approximately 20% of hospitalized COVID-19 patients may also need invasive mechanical ventilation [66]. The risk of developing oral complications is equally present in COVID-19 patients. Some common oral complications, including perioral pressure ulcers, oral candidiasis, herpetic and hemorrhagic oral ulcers, and acute macroglossia, were reported in COVID-19 patients admitted in ICUs. Along with immunosuppressive drugs provided for this particular group of patients, continuous prone positioning with ventilator systems in the ICU exacerbated such oral mucocutaneous problems [67]. Moore et al. conducted a comprehensive evaluation of the current body of research and advised using pressure redistribution support surfaces/positioning devices, safety coverings during pronation, and simple and regular changes in the patient's posture and device position. Clinicians are highly encouraged to regularly examine common pressure ulcer risk sites and ensure that the skin is clean and moisturized [68]. Monitoring and managing pressure ulcers at an early stage demands strong teamwork between ICU professionals, anesthesiologists, nursing staff, dermatologists, and dentists. COVID-19 may be one of the causes for the high prevalence of perioral pressure ulcers since literature analysis revealed that in many countries, less trained healthcare professionals may be present in the ICU due to burden of COVID-19 [69, 70].

Antiviral mouthwashes are considered to be the most suitable option to reduce the viral load of the SARS-CoV-2 in saliva [64, 71–73]. Mouthwashes used by ICU admitted COVID-19 patients are typically prescribed before executing everyday routine practices with a substantial risk of producing aerosols, or droplet emission during the care of patients infected, and droplet emission from those without mechanical ventilation, which should doubtlessly help to reduce the risks of COVID-19 transmission to health care professionals of ICU. It is important to mention that strict guidelines must be meticulously addressed to ensure adequate oral hygiene in ICU admitted COVID-19 patients [73]. Although significant advancements in practices for ICU admitted COVID-19 patients, the concerned professional teams should always select treatments with a lower risk of creating aerosols or droplet emissions, as this offers greater protection in the healthcare setting. Furthermore, the role of intensive care dentists is critical to the overall care of such patients. As a result, a systematic approach for effective monitoring and management of COVID-19 is strongly advised, suggesting that dermatologists, oral healthcare professionals, and medics must be included in the ICU personnel.

10 Dental care in COVID-19 pandemic

During the outbreak, only patients with emergencies and non-postponable treatments should be managed. A list of emergency treatments should be include cases like hemorrhage, trauma, severe pain, acute infections, oral and maxillofacial infections, and oral lesions are to be addressed[74]. People generally avoid seeking medical attention for unnecessary dental treatments and routine follow-up appointments [75]. A Chinese study found that only 38% of people presented to outpatient departments during epidemics needed urgent pain management [76]. Although with this decline in the number of patients, it is still difficult for dental institutions to perform effective infection control. The study by British Endodontic Society [77] showed that during epidemics, mostly people presented with complaints of abscesses, pulpitis, and periapical lesions. Due to fear of the current situation, people usually delay their treatments until their pain levels are unbearable [77]. As already mentioned, patients requiring urgent management should be screened via a phone call before attending the clinic. This tele-screening will help identify suspected cases beforehand [78]. When dealing with an infected or suspect patient, using a filtering facepiece (FFP) or N-95 respirator mask is best. This precaution is necessary because the number of cases is still increasing [40]. Patients must also visit clinics with appropriate personal protection [56]. Demand for dental care is likely to increase rapidly after the epidemic's end in the post-COVID-19 period. However, the delay in dental

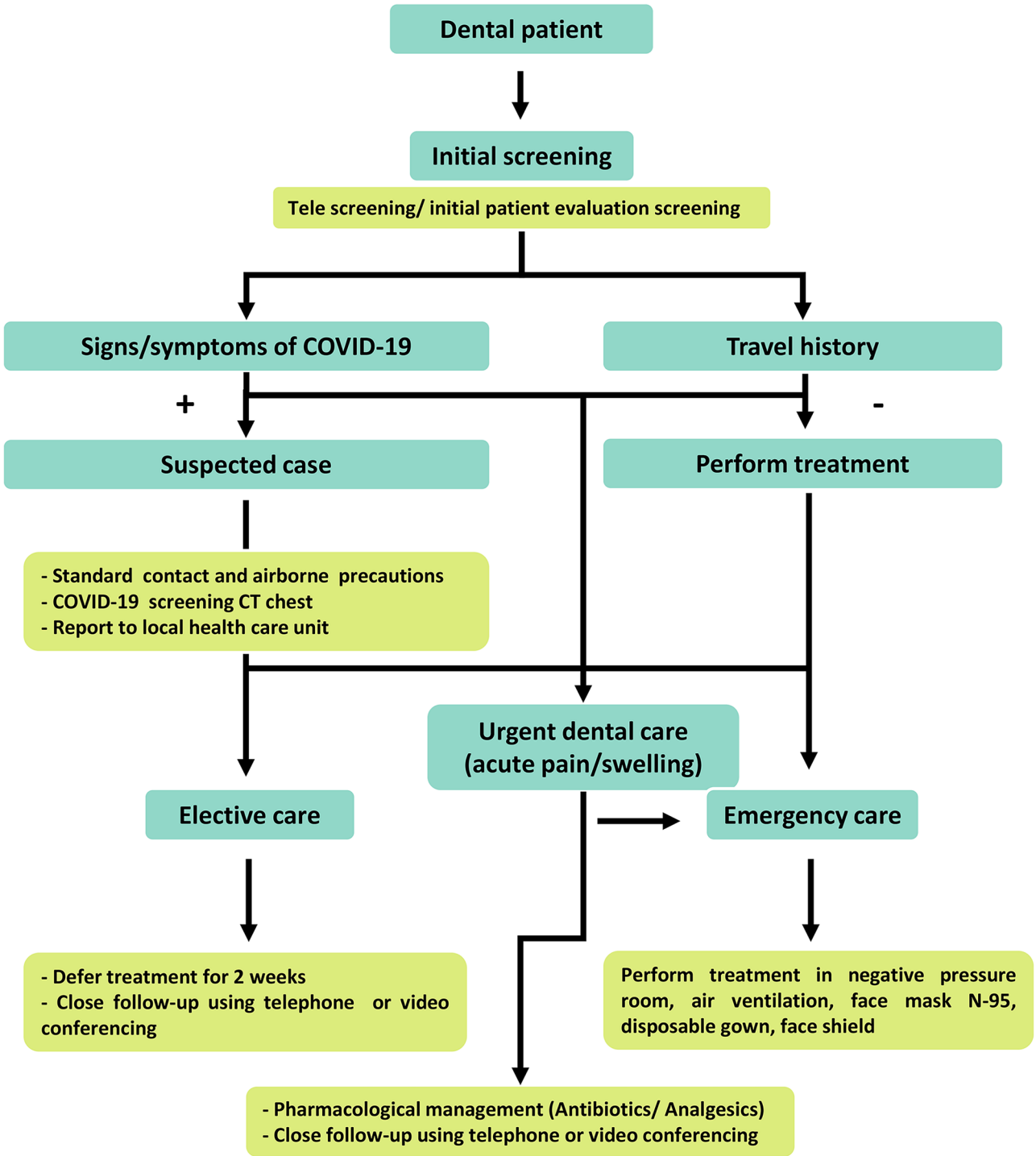

Fig. 2 Preventive strategies for dental settings

treatments and may lead to a need for more extensive forms of management and treatment in the future [79].

All paramedics and doctors must wear ocular, nasal, and mouth protective coverings when in contact with patients (even those not identified as having SARS-CoV-2 infection). An N-95 respirator or a respirator that provides an equivalent or higher level of protection is required for aerosol-generating processes. Only absolutely necessary people can accompany the patient's dental appointment for support, and both must use a fabric face covering or facemask until treatment begins. Patients suspected of having COVID-19 should wait until the isolation period is over (virus incubation period). Patients

with COVID-19 symptoms should avoid non-emergency dental treatments [62]. To avoid dental problems, it is recommended to maintain good dietary habits and effective oral hygiene in adults and children. Therefore, it is necessary to follow a home care regimen through good brushing of the teeth, appropriate dental floss, and mouthwash to limit plaque and overcome the development of oral diseases.

11 Conclusion

The incidence of infection has shown that a higher number of health care providers and dental practice teams are at increased risk of SARS-CoV-2 exposure due to face-to-face interactions with the patients and exposure to blood from infected peoples, contaminated saliva, other body secretions, and infected sharps. It is the responsibility of health care professionals to adopt high infection control standards, and timely clinical decisions are important in this regard by promoting a proper health strategy. Dental practices remain a difficult environment for controlling the spread of the infection. Consequently, level-appropriate strategies must be established in dentistry settings. These include patient pre-evaluation, the use of proper PPE, hand hygiene, the use of a rubber dam, and possibly the anti-retraction handpiece. Moreover, the disinfection of the clinic, along with proper prompt waste disposal, is needed.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Peeri NC, Shrestha N, Rahman MS, Zaki R, Tan Z, Bibi S, et al. The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned? Int J Epidemiol. 2020:dyaa033.
2. Guarner J. Three emerging coronaviruses in two decades: the story of SARS, MERS, and now COVID-19. Oxford University Press US; 2020.
3. Catrin S, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, et al. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). 2020.
4. Burki T. Understanding variants of SARS-CoV-2. Lancet. 2021;397(10273):462.
5. World Health Organization. Mental health and psychosocial considerations during the COVID-19 outbreak, 18 March 2020: World Health Organization; 2020. Available from: https://apps.who.int/iris/handle/10665/331490.
6. Tang B, Xia F, Tang S, Bragazzi NL, Li Q, Sun X, et al. The effectiveness of quarantine and isolation determine the trend of the COVID-19 epidemics in the final phase of the current outbreak in China. Int J Infect Dis. 2020;95:288–93.
7. Anzar WBQ, Afaq A, Taheer T, Amar S. Impact of infodemics of generalized anxiety disorders, depressive symptoms, sleep quality among Pakistani Social Media Users during epidemics of COVID19. Merit Res J Med Med Sci. 2020;8(3):069–73.
8. Li W, Wang D, Guo J, Yuan G, Yang Z, Gale RP, et al. COVID-19 in persons with chronic myeloid leukaemia. Leukemia. 2020;34(7):1799–804.
9. Pereira LJ, Pereira CV, Murata RM, Pardi V, Biological P-D, social aspects of Coronavirus Disease,. (COVID-19) related to oral health. Braz Oral Res. 2019;2020:34.
10. Meng L, Hua F, Bian Z. Coronavirus disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. J Dent Res. 2020;99(5):481–7.
11. Adams JG, Walls RM. Supporting the Health Care Workforce During the COVID-19 Global Epidemic. Jama. 2020.
12. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. J Autoimmun. 2020;109:102433.
13. Cruz AT, Zeichner SL. COVID-19 in Children: Initial Characterization of the Pediatric Disease. Pediatrics. 2020;145(6):e20200834.
14. Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. Nat Microbiol. 2020;5(4):536–44.
15. Xu Z, Shi L, Wang Y, Zhang J, Huang L, Zhang C, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir Med. 2020;8(4):420–2.
16. Patel AB, Verma A. COVID-19 and Angiotensin-Converting Enzyme Inhibitors and Angiotensin Receptor Blockers: What Is the Evidence? Jama. 2020.
17. Tian S, Hu W, Niu L, Liu H, Xu H, Xiao SY. Pulmonary Pathology of Early-Phase 2019 Novel Coronavirus (COVID-19) Pneumonia in Two Patients With Lung Cancer. J Thorac Oncol. 2020;15(5):700–4.
18. Sabino-Silva R, Jardim ACG, Siqueira WL. Coronavirus COVID-19 impacts to dentistry and potential salivary diagnosis. Clin Oral Investig. 2020;24(4):1619–21.
19. Bogoch II, Watts A, Thomas-Bachli A, Huber C, Kraemer MUG, Khan K. Pneumonia of unknown aetiology in Wuhan, China: potential for international spread via commercial air travel. J Travel Med. 2020;27(2):taaa008.
20. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, et al. The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. Ann Intern Med. 2020;172(9):577–82.
21. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan. China Lancet. 2020;395(10223):497–506.
22. Gasmi A, Peana M, Pivina L, Srinath S, Gasmi Benahmed A, Semenova Y, et al. Interrelations between COVID-19 and other disorders. Clin Immunol. 2021;224:108651.
23. Azzi L, Carcano G, Gianfagna F, Grossi P, Gasperina DD, Genoni A, et al. Saliva is a reliable tool to detect SARS-CoV-2. J Infect. 2020;S0163–4453(20):30213–9.
24. Yoon SH, Lee KH, Kim JY, Lee YK, Ko H, Kim KH, et al. Chest Radiographic and CT Findings of the 2019 Novel Coronavirus Disease (COVID-19): Analysis of Nine Patients Treated in Korea. Korean J Radiol. 2020;21(4):494–500.
25. Gu J, Han B, Wang J. COVID-19: Gastrointestinal Manifestations and Potential Fecal-Oral Transmission. Gastroenterology. 2020;158(6):1518–9.
26. Organization WH. WHO Coronavirus (COVID-19) Dashboard 2021. Available from: https://covid19.who.int/.
27. Organization WH. COVID-19 Weekly Epidemiological Update 2021. Available from: https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---14-september-2021.

28. Organization WH. Coronavirus disease 2019 (COVID-19): situation report, 82 2020. Available from: https://apps.who.int/iris/handle/10665/331780.
29. Chinese Center for Disease Control and Prevention. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. Zhonghua Liu Xing Bing Xue Za Zhi. 2020;41(2):145–51.
30. Istituto Superiore di Sanità. Integrated surveellance of COVID-19 in Italy 2020. Available from: https://www.epicentro.iss.it/en/coronavirus/bollettino/Infografica_10aprile%20ENG.pdf.
31. McMichael TM, Currie DW, Clark S, Pogosjans S, Kay M, Schwartz NG, et al. Epidemiology of Covid-19 in a Long-Term Care Facility in King County, Washington. N Engl J Med. 2020;382(21):2005–11.
32. International Council of Nurses. ICN COVID19 update report FINAL 2020. Available from: https://www.icn.ch/sites/default/files/inline-files/ICN%20COVID19%20update%20report%20FINAL.pdf.
33. Shanafelt T, Ripp J, Trockel M. Understanding and Addressing Sources of Anxiety Among Health Care Professionals During the COVID-19 Pandemic. Jama. 2020.
34. Kluytmans M, Buiting A, Pas S, Bentvelsen R, van den Bijllaardt W, van Oudheusden A, et al. SARS-CoV-2 infection in 86 healthcare workers in two Dutch hospitals in March 2020. medRxiv. 2020:2020.03.23.20041913.
35. Phan LT, Nguyen TV, Luong QC, Nguyen HT, Le HQ, Nguyen TT, et al. Importation and Human-to-Human Transmission of a Novel Coronavirus in Vietnam. N Engl J Med. 2020;382(9):872–4.
36. Guan W-j, Ni Z-y, Hu Y, Liang W-h, Ou C-q, He J-x, et al. Clinical characteristics of 2019 novel coronavirus infection in China. medRxiv. 2020:2020.02.06.20020974.
37. Zhang W, Du RH, Li B, Zheng XS, Yang XL, Hu B, et al. Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes. Emerg Microbes Infect. 2020;9(1):386–9.
38. Del Rio C, Malani PN. COVID-19-New Insights on a Rapidly Changing Epidemic. Jama. 2020.
39. Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, et al. Presumed Asymptomatic Carrier Transmission of COVID-19. JAMA. 2020;323(14):1406–7.
40. 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.
41. To KK, Tsang OT, Chik-Yan Yip C, Chan KH, Wu TC, Chan JMC, et al. Consistent detection of 2019 novel coronavirus in saliva. Clin Infect Dis. 2020;71(15):841–3.
42. Ge Z-y, Yang L-m, Xia J-j, Fu X-h, Zhang Y-z. Possible aerosol transmission of COVID-19 and special precautions in dentistry. J Zhejiang Univ Sci B. 2020.
43. Kadam A, Karjodkar F, Sansare K, Vinay V. Covid 19–Facts And Its Infection Control Measures For Dentists. IOSR J Dent Med Sci. 2020;19(4):43–52.
44. Mathur N, Tyagi S, Dwivedi V, Narang A, Tyagi P, Nath KS. Dental considerations amidst COVID-19 SCARE scare. Int J Med Biomed Stud. 2020;4(3).
45. Mallineni SK, Innes NP, Raggio DP, Araujo MP, Robertson MD, Jayaraman J. Coronavirus disease (COVID-19): Characteristics in children and considerations for dentists providing their care. Int J Paediatr Dent. 2020;30(3):245–50.
46. Izzetti R, Nisi M, Gabriele M, Graziani F. COVID-19 Transmission in Dental Practice: Brief Review of Preventive Measures in Italy. J Dent Res. 2020:22034520920580.
47. Wong JEL, Leo YS, Tan CC. COVID-19 in Singapore—Current Experience: Critical Global Issues That Require Attention and Action. JAMA. 2020;323(13):1243–4.
48. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020;395(10224):565–74.
49. Shamsoddin E, DeTora LM, Tovani-Palone MR, Bierer BE. Dental care in times of the COVID-19 pandemic: a review. Med Sci. 2021;9(1):13.
50. Wang WK, Chen SY, Liu IJ, Chen YC, Chen HL, Yang CF, et al. Detection of SARS-associated coronavirus in throat wash and saliva in early diagnosis. Emerg Infect Dis. 2004;10(7):1213–9.
51. Tang YW, Schmitz JE, Persing DH, Stratton CW. The Laboratory Diagnosis of COVID-19 Infection: Current Issues and Challenges. J Clin Microbiol. 2020.
52. Chen L, Zhao J, Peng J, Li X, Deng X, Geng Z, et al. Detection of 2019-nCoV in Saliva and Characterization of Oral Symptoms in COVID-19 Patients. Available at SSRN 3556665. 2020.
53. Martelli-Júnior H, Machado RA, Martelli DRB, Coletta RD. Dental journals and coronavirus disease (COVID-19): A current view. Oral Oncol. 2020;106:104664.
54. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020;395(10223):497–506.
55. Yu J, Zhang T, Zhao D, Haapasalo M, Shen Y. Characteristics of Endodontic Emergencies during Coronavirus Disease 2019 Outbreak in Wuhan. J Endod. 2020;46(6):730–5.
56. Ather A, Patel B, Ruparel NB, Diogenes A, Hargreaves KM. Coronavirus Disease 19 (COVID-19): Implications for Clinical Dental Care. J Endod. 2020;46(5):584–95.
57. Spagnuolo G, De Vito D, Rengo S, Tatullo M. COVID-19 Outbreak: An Overview on Dentistry. Int J Environ Res Public Health. 2020;17(6).
58. Marui VC, Souto MLS, Rovai ES, Romito GA, Chambrone L, Pannuti CM. Efficacy of preprocedural mouthrinses in the reduction of microorganisms in aerosol: A systematic review. J Am Dent Assoc. 2019;150(12):1015–26 e1.
59. Kirk-Bayley J, Challacombe S, Sunkaraneni S, Combes J. The Use of Povidone Iodine Nasal Spray and Mouthwash During the Current COVID-19 Pandemic May Protect Healthcare Workers and Reduce Cross Infection. Available at SSRN 3563092. 2020.
60. Sandle D. COVID-19 and dental practice. Dental Nursing. 2020;16(4):194–5.
61. Beltrán-Aguilar E, Benzian H, Niederman R. Rational perspectives on risk and certainty for dentistry during the COVID-19 pandemic. Am J Infect Control. 2021;49(1):131.
62. Pereira LJ, Murata RM, Pardi V, Mattos FF. Streamlining the dental care during COVID-19 pandemic: updated clinical recommendations and infection control management framework. Braz Oral Res. 2021;35.
63. Openshaw JJ, Travassos MA. COVID-19 outbreaks in US immigrant detention centers: the urgent need to adopt CDC guidelines for prevention and evaluation. Clin Infect Dis. 2021;72(1):153–4.
64. Cavalcante-Leão BL, de Araujo C-M, Basso I-B, Schroder A-G-D, Guariza-Filho O, Ravazzi G-C, et al. Is there scientific evidence of the mouthwashes effectiveness in reducing viral load in Covid-19? A systematic review. J Clin Exp Dent. 2021;13(2):e179.
65. Tovani-Palone MR, Shamsoddin E, Franchi T. Recommendations for safe paediatric dental practices during the COVID-19 pandemic: An update. Eur J Paediatr Dent. 2021;22.
66. Bastos GAN, Azambuja AZd, Polanczyk CA, Gräf DD, Zorzo IW, Maccari JG, et al. Clinical characteristics and predictors of mechanical ventilation in patients with COVID-19 hospitalized in Southern Brazil. Revista Brasileira de Terapia Intensiva. 2020(AHEAD).

67. Hocková B, Riad A, Valky J, Šulajová Z, Stebel A, Slávik R, et al. Oral complications of ICU patients with COVID-19: case-series and review of two hundred ten cases. J Clin Med. 2021;10(4):581.
68. Moore Z, Patton D, Avsar P, McEvoy NL, Curley G, Budri A, et al. Prevention of pressure ulcers among individuals cared for in the prone position: lessons for the COVID-19 emergency. J Wound Care. 2020;29(6):312–20.
69. Perrillat A, Foletti J-M, Lacagne A-S, Guyot L, Graillon N. Facial pressure ulcers in COVID-19 patients undergoing prone positioning: How to prevent an underestimated epidemic? J Stomatol Oral Maxillofac Surg. 2020;121(4):442–4.
70. Ibarra G, Rivera A, Fernandez-Ibarburu B, Lorca-García C, Garcia-Ruano A. Prone position pressure sores in COVID-19 pandemic. Madrid experience. J Plast Reconstr Aesthet Surg. 2020.
71. Moosavi M-S, Aminishakib P, Ansari M. Antiviral mouthwashes: possible benefit for COVID-19 with evidence-based approach. J Oral Microbiol. 2020;12(1):1794363.
72. Vergara-Buenaventura A, Castro-Ruiz C. The Use of mouthwashes against COVID-19 in dentistry. Br J Oral Maxillofac Surg. 2020.
73. Tovani-Palone MR, Shamsoddin E. Use of mouthwashes in the management of COVID-19 patients in intensive care units: recommendations and current evidence. Einstein (São Paulo). 2021;19.
74. Alharbi A, Alharbi S, Alqaidi S. Guidelines for dental care provision during the COVID-19 pandemic. Saudi Dent J. 2020;32(4):181–6.
75. Dave M, Seoudi N, Coulthard P. Urgent dental care for patients during the COVID-19 pandemic. Lancet. 2020;395(10232):1257.
76. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases From the Chinese Center for Disease Control and Prevention. Jama. 2020.
77. British Endodontic Society. British Endodontic Society Information and Advice on Triage and Management for Primary Dental Care and other healthcare providers during the COVID-19 Pandemic Advice, Analgesia and Antibiotics. 2020.
78. Holmes S, Hutchison I, Chatzopoulou D. Broken jaws in the COVID era. Br Dent J. 2020;228(7):488.
79. Farooq I, Ali S. COVID-19 outbreak and its monetary implications for dental practices, hospitals and healthcare workers. Postgrad Med J. 2020.