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Sterilization and Infection Control Practices to Prevent Transmission of COVID-19 in Dental Office

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Abstract

Aim of the review was to evaluate the role of infection control measures and control of SARS-CoV-2 infection in dental office. The Objectives of the study was to evaluate the infection control measures before and after the visit of patient, to evaluate the awareness of dentists regarding SARS-CoV-2, to evaluate the knowledge, attitude and practices of dentists regarding infection control measures and control of SARS-CoV-2 infection in dental office. And to evaluate their ability in identifying the source of infection and measures to curb it.

This review sought to answer a clearly focused question to assess the infection control measures in dental practice during COVID-19 pandemic began with a literature search covering the electronic databases: Cochrane library, PubMed, PubMed Central, Science Direct and Google scholar. The string of English search term "COVID-19" yielded 118,179 articles and when the search was further refined using terms like "COVID-19" AND "dentistry" and infection control" 261 articles were obtained. All the titles of studies generated by the search strategy were studied for relevance, and then abstracts of relevant studies were assessed.

The transmission of SARS-CoV-2 occurs mainly through direct contact with micro droplets or core droplets that remain suspended as aerosol over a long period of time. Moreover, it has been reported that infected subjects, both with and without clinical signs of COVID-19, can transmit the virus. SARS-CoV-2 virus enters human body mainly through direct contact and inhalation that is through mouth, nose, and eyes when they are touched by infected hands.

Dental practice poses highest risk of transmission of SARS-CoV-2 infection due to generation of aerosol and contact with saliva. Considering the virus' route of transmission, a specific protocol should be applied to reduce the risk of infection in addition to measures that prevent the spread of infection from a patient to another person or medical tools and equipment (cross-infection).

The practice of dentistry without proper infection control practices may result in the spread of SARS-CoV-2 infection because of droplet infection. Dental patients, dentists, and their co-workers can be easily exposed to novel corona virus infections since SARS-CoV-2 can be transmitted from person to person through droplets, contact, and saliva. Hence, dental professionals belong to a high-risk group of contracting SARS-CoV-2 infection. This review focused on the methods, protocols, and recent reports regarding the nCoV-19 infection and the transmission process, which could occur during routine dental treatment and surgeries. While the current evidence does not show a clear and direct link between dental care or surgery and the chance of COVID-19 transfer, there is obviously the chance of transmission. Following the protective protocols in the COVID-19 crisis is therefore essential in a dental context, according to the existing literature. Surface disinfectants with a concentration of 62 to 71 percent ethanol and a concentration of 0.1 to 0.5 percent sodium hypochlorite are considered the best. There are certain limits to this review. There are a limited and heterogeneous number of primary sources directly related to the repercussions of SARS-CoV-2 on the dental discipline in the literature due to the current emergency. In the future, more research will be required.

Keywords: Dental office; Prevention; SARS-CoV-2; COVID-19

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Introduction

The WHO declared COVID-19 a pandemic after months of devastation across several nations and continents. However apart from frontline healthcare workers, people from other professions and socio-economic/cultural backgrounds have also been affected [1]. Dentistry, like other healthcare professions, requires dentists to work close to patients' oral cavity, increasing

their risk of virus exposure, especially during open and invasive dental procedures. Dental plaque contains opportunistic and pathogenic microorganisms that can cross-contaminate and cause systemic infections [2]. Despite this, patient-to-dental professional transmission of infectious microorganisms was rarely reported until recently. Some of the reasons for infection spread were unsafe injection practices, improperly sterilized dental hand pieces or instruments between patients, and inadequate autoclave monitoring [3].

Infection control in dentistry should aim to prevent the spread of disease-causing bacteria, viruses, and fungi between patients, or from patients to dental staff [4].

The traditional classification of diseases is into bloodborne, airborne, and fomites. Understanding these diseases allows dentists to implement strict protocols and protective measures during dental procedures. This may help reduce infection spread in the clinical setting [4]. Blood and saliva are two major routes of cross-transmission in dentistry. Infectious skin and mucosal lesions can cause bloodborne contamination. Pathogens from dental hand pieces can cause airborne transmission, affecting both patients and dentists. The risk of transmission is dependent on the frequency of exposure, the dose of pathogens transmitted per exposure, the pathogen's virulence, and finally the host's immune status [2].

Nosocomial infections are acquired in a hospital or dental practice and include occupational infections spread among staff. Examples of nosocomial viruses include hepatitis B and C, herpes simplex, varicella-zoster, HIV, *Rotavirus*, and *Enterovirus* [5].

In December 2019, Wuhan, China, reported a viral pneumonia outbreak caused by an unknown coronavirus. An SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus) caused the disease and has become a major public health issue [6]. The World Health Organization (WHO) declared the disease a public health emergency of international concern on January 30th, and named it Coronavirus disease 2019 on February 11th (COVID-19) [7].

Because SARS-CoV-2 has been found in infected patients' saliva, dental professionals must follow strict infection control protocols and policies. They must also work diligently to prevent the disease from spreading among the population [8].

Thus, the current review assessed the role of infection control methods in preventing SARS-CoV-2 infections in dentistry. The review assesses dentists' knowledge, attitudes, and behaviors in relation to infection control and the prevention of SARS-CoV-2 infection in dental offices, as well as their ability to identify the source of infection and take preventative measures.

History

An unusually high number of human infections by three novel Coronaviruses (nCoV) prompted a public health emergency. Although the first SARS cases were reported in Guangdong province in China in November 2002, the disease's novel Coronavirus (SARS-CoV-2) was discovered in February 2003 [9]. Since then, 8096 cases and 774 deaths have been reported from SARS across 26 countries in Asia, Africa, Europe, and North America [10]. The WHO decided to contain the outbreak in July 2003, and SARS incidence has been almost zero globally since then.

In June 2012, Saudi Arabia reported the first cases of a new disease called Middle East Respiratory Syndrome (MERS). MERS-CoV was the pathogen [11], since then, 27 countries have reported multiple outbreaks, with most cases coming from Saudi Arabia and outside the Middle East. Travelers' were mostly infected before returning home [12]. Data confirms 2,519 cases of MERS with 866 deaths as of January 2020 (37.1%) [13]. On January 7th, 2020, a novel virus was isolated from patients with pneumonia in Wuhan, China [14]. The International Committee on Taxonomy of Viruses originally named this novel coronavirus, which was later renamed by WHO to "Severe Acute Respiratory Syndrome Coronavirus-2" [15]. Infection from China then spread to neighboring countries like Thailand, Japan, and South Korea before eventually affecting the entire world [16].

Epidemiology of the Coronavirus Pandemic

In the last week of December 2019, pneumonia cases of unknown etiology were recorded in Wuhan, the geographical heart of the People's Republic of China [17], with the Chinese competent authorities confirming 6,000 cases of patients with SARS-CoV-2, by the second half of January. Eighty thousand cases were estimated by then though [18]. Unlike SARS-CoV-1, the greater and rapid human-to-human transmission characteristic of SARS-CoV-2, with an R0 varying between 1.4 and 6.5, and an incubation period ranging from 2 to 14 days (an average of 7 days) [19], alarmed the seriousness of situation and demanded a quick action.

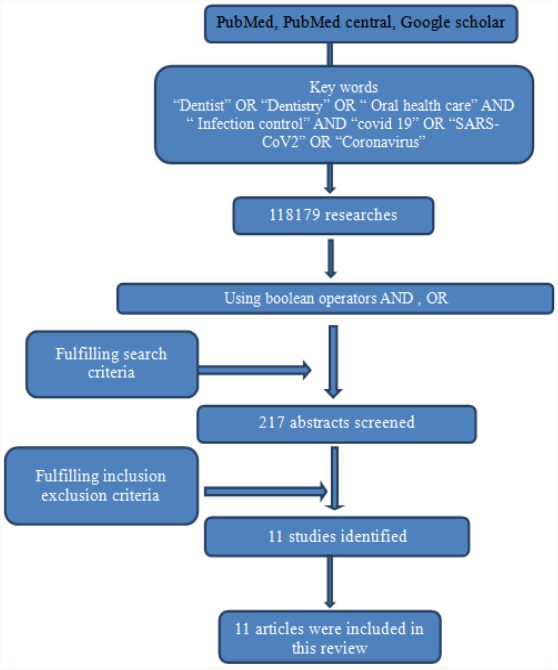
It was towards the end of January however, that the United States of America (USA), Australia and France reported their first cases. France was presumably, the first European country to be affected. As on January 31st, 2020, 213 deaths from 19 different countries were confirmed globally [19]. In mid-February, cases were also identified from African continent (in Egypt) [11] and South America (in Brazil) [19] by the WHO.

Interestingly, there was a drop in the number of new cases from China, towards March 2020, thus shifting the epicenter of the epidemic to Europe. Largest outbreaks of cases came from Italy and then from Spain. On March 12th, with the disease reported in more than 100 countries, COVID-19 was officially declared a pandemic [12]. During April, May and June, the epicenter of the epidemic shifted once again, to America, mostly the USA, Brazil and Chile. The following months, even those countries that succeeded in bringing the epidemic under control, became the victims of new foci or the second wave and there was a sharp rise in more than 100 countries [12]. This trend resulted in making COVID-19 the leading cause of death in some countries [13].

As of December 27th, 2020, COVID-19 cases reached 79,231,893 across the globe, among which 1,754,574 resulted in death, corresponding to a case fatality rate of 2.2%. (CFR, in % - number of reported deaths/ numbers of reported cases) [20]. But, slight variations in the CFR from different parts of the world have been observed: Africa- 2.2%; America- 2.4%; Eastern Mediterranean- 2.5%; Europe- 2.2%; South-East Asia- 1.5%; and Western Pacific- 1.8% [21].

Such differences seem to be related to a multitude of factors ranging from geographic and cultural differences of the countries in those regions, the methods used for counting cases, the mean age of the population, the severity of the outbreak, to the type of containment measures adopted and the spontaneity with which they were adopted [21].

Infections in patients older than 65 years have a higher risk of



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death [19]. To add to it, COVID-19 CFR has also been greater in individuals with a previous chronic disease, which correspond to more than half reaching 90% of the cases of infection [17]. Most COVID-19 confirmed cases have been identified in patients above 30 years, even of which more than 90% involved patients over 45 years old [22]. Severity of COVID-19 plays a crucial role in determining the mitigation strategies and planning for healthcare needs, to be implemented, as the pandemic evolves.

But on the whole, CFR is a poor indicator of the mortality risk because a large number of cases are either asymptomatic or present with mild symptoms and more so, testing has not been done on the entire population [23]. A rather better way to estimate the mortality risk is the infection fatality rate (IFR= number of deaths from COVID-19/total number of infected individuals). Published COVID-19 data revealed an overall IFR ranging from 0.2% to 1.6% in the first months of the pandemic [24]. It is also important to note that the estimated age-specific IFR is very low for children and younger adults (e.g., 0.002% at age 10 and 0.01% at age 25) and increases progressively to 0.4% at age 55, 1.4% at age 65, 4.6% at age 75, and 15% at age 85 [25].

COVID-19 pandemic turned out to be one of the greatest public health challenges of this century because of its high infection rate and mortality. With the COVID-19 pandemic involving a significant geographic distribution across the globe, all countries have implemented strict measures aimed at reducing interpersonal COVID-19 transmission. Some additional measures to contain the possible transmission of the disease in the health sector-dentistry in particular- have been implemented.

Aim

To evaluate the role of infection control measures and control of SARS–CoV-2 infection in dental office.

Objectives

- To evaluate the infection control measures before and after the visit of patient.
- To evaluate the awareness of dentists regarding SARS-CoV-2.
- To evaluate the knowledge, attitude and practices of dentists regarding infection control measures and control of SARS–CoV-2 infection in dental office.
- To evaluate their ability in identifying the source of infection and measures to curb it.

Methodology

Criteria for considering studies for this review: Types of studies

- Cross-sectional/Longitudinal/retrospective studies that were published after 2019 were included in the review.
- Studies published only in English language were included.
- Studies carried out on dentists only were included without any limitation of the demographic factors like age, gender and locality.
- Studies not assessing the dentist's perspective on infection control were not included.

Types of participants

Dentists practicing either in public or private sector.

The review was concerned with: Providing practical advice to dentists based on the current literature, which may be useful in reducing the risk of COVID-19 spread, especially during the phases following the pandemic period.

Inclusion criteria

- Study conducted on dentists.
- Study should be published in English.

Exclusion criteria

- Study on animals and in-vitro study were not included.
- Studies published before 2019 were not included.
- Case reports, editorials, case series, Previews, reviews, comments were not included in study.

The rationale behind using broad based inclusion criteria was that the reviewers could scan the reference sections of all studies to try to identify additional studies that could be considered for possible inclusion in this review.

Types of outcome measures

The primary outcome of studies was to assess the infection control measures in dental practice during COVID-19 pandemic and the knowledge, attitude and practices of dentists towards infection control.

Search Strategy

This review sought to answer a clearly focused question to assess the infection control measures in dental practice during COVID-19 pandemic began with a literature search covering the electronic databases: Cochrane library, PubMed, Pubmed Central, Science Direct and Google scholar.

Our search strategy attempted to identify all relevant studies written in English language and published after 2019. The reference

lists of all eligible studies were also hand searched for additional relevant studies.

In order to search databases, strings of search terms, consisting of relevant key words and Boolean links, were constructed. The string of English search term "COVID-19" yielded 118,179 articles and when the search was further refined using terms like "COVID-19" AND "dentistry " and infection control" 217 articles were obtained. All the titles of studies generated by the search strategy were studied for relevance, and then abstracts of relevant studies were assessed. Full text was checked in case of uncertainty. Reviewer studied them in detail for the above mentioned inclusion and exclusion criteria's making a total of 11 articles were also included for review.

Data Collection and Analysis

Study selection

Two review authors independently carried out the selection of papers on the basis of the title, keywords and abstract, and the decisions about eligibility. The full text of every article considered for inclusion was obtained. If the information relevant to the inclusion criteria was not available in the abstract or if the title was relevant but the abstract was not available, the full text of the report was obtained (Pie Chart).

Data extraction

Data were extracted independently by two review authors. The data pertaining to the methodology, design, participants, settings, outcome and exposure variables and important results about the infection control was extracted from the relevant studies. The data whatever was available in the articles in the form of charts, figures was all identified and presented in the tables and description form in results (Table 1).

Discussion

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is a novel Coronavirus first identified in Wuhan, China, and the etiological agent of Corona virus Disease-2019 (COVID-19). COVID-19 has become a major pandemic in recent times and has caused millions of deaths worldwide. The causative agent is a coronavirus called SARS-CoV-2. Human corona viruses are RNA viruses that can cause diseases of the respiratory, gastrointestinal, and central nervous systems [37].

In the mid-1960s, the first Human Coronavirus (HCoV) was discovered. The seventh corona virus known to infect humans was discovered in China (Wuhan city, Hubei Province) in December 2019. The WHO declared the novel corona virus outbreak a pandemic on March 11th, 2020. The scientific community is still working hard to figure out the virus's etiology, pathogenicity, and characteristics, as well as the mechanisms underlying human-to-human transmission and potential therapies [38].

The transmission of SARS-CoV-2 occurs mainly through direct contact with micro droplets or core droplets that remain suspended as aerosol over a long period of time. Moreover, it has been reported that infected subjects, both with and without clinical signs of COVID-19, can transmit the virus. SARS-CoV-2 virus enters human body mainly through direct contact and inhalation that is through mouth, nose, and eyes when they are touched by infected hands [39].

Dental practice poses highest risk of transmission of SARS-CoV-2 infection due to generation of aerosol and contact with saliva. Considering the virus' route of transmission, a specific protocol should be applied to reduce the risk of infection in addition to measures that prevent the spread of infection from a patient to another person or medical tools and equipment (cross-infection) [40].

The practice of dentistry without proper infection control practices may result in the spread of SARS-CoV-2 infection because of droplet infection. Dental patients, dentists, and their coworkers can be easily exposed to novel corona virus infections since SARS-CoV-2 can be transmitted from person to person through droplets, contact, and saliva [41].

Hence, dental professionals belong to a high-risk group of contracting SARS-CoV-2 infection. Inhalation of airborne pathogenic microorganisms that can stay trapped in the air for long periods of time; direct contact with blood, oral fluids, or other patient materials; and contact of the conjunctival, nasal, or oral mucosa with droplets and microorganism-containing aerosols generated by an infected person and propelled by coughing or using high-pressure irrigation systems such as the hand piece or ultrasonic scalers; and indirect contact with contaminated instruments and/or environmental surfaces can be risk factors for acquiring SARS-CoV-2 infection [42].

The World Health Organization (WHO) has suggested that only emergency/urgent procedures should be performed during the Coronavirus outbreak. Since dental treatment procedures like restoration and ultrasonic scaling procedures generate enormous amount of aerosols and droplets, use of elective procedures should be primarily used for handling dental emergencies and treatment of esthetic and chronic treatment should be postponed till the pandemic subsides [43].

Dental practitioners and organizations have paid close attention to the idea of "infection management." According to the latest guidelines from the Center for Disease Control and Prevention (CDC) and other global health agencies, preventive measures have risen to higher levels with the advent of emerging infectious diseases or sources of infection. Protecting themselves and their patients from possible infections has always been a priority for dental professionals. However, the extreme Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection also known as Coronavirus Disease (COVID-19), has presented dental professionals with a new and unexpected problem [42].

The reality is that in cases of airborne infections like COVID-19, normal Personal Protective Equipment (PPE) is insufficient. By updating PPE with materials such as specific masks (e.g., N-95), face protection or shield, gown or coverall, head cover, and rubber boots, the next stage of infection control "transmitted-base precaution" should be implemented. Several COVID-19 transmission scenarios have been proposed, all of which agree on droplet transmission and a distribution that is significantly greater than that of seasonal influenza.

All preventive measures are relevant as safety measures for dental professionals in triage areas, ranging from social distancing and hand washing to protective equipment such as surgical masks, face shields, gowns, and gloves. In addition to the above-mentioned safety steps, a N95 or similar or higher-level respirator is recommended in cases of suspected or confirmed SARS-CoV-2 infection.

Several precautionary measures were adopted by dentists who continued to work after SARS-CoV-2 outbreak, the measures were grouped in during treatment, and the following precautionary steps

may be taken. Dentists are known to be passionate about their profession and may have limited knowledge of viral respiratory infections. Dentists, on the other hand, are an important part of the health workforce, and in the face of such a deadly pandemic, they should be well-educated so that they can pass on their experience to their patients and play a role in the war.

Ren et al. [44], have reported that with the assumption that DHPs work fulltime and wear a N95 mask, the annualized probability for a DHP to acquire COVID-19 infection in a dental office, become symptomatic, and die from the infection is estimated at 1:13,000 (0.008 %) in a medium sized city in the US at the peak of the pandemic. The risk estimate is highly age-dependent. Risk to DHPs under the age of 70 is negligible when prevalence of asymptomatic cases is low in the local community.

Dental treatment should be delivered only to patients with urgent or emergency condition. Screening of patients should be done to rule out COVID-19 and based on the responses patients can be divided into three groups of (a) apparently healthy, (b) suspected for COVID-19, and (c) confirmed for COVID-19. Separate waiting and operating rooms should be assigned to each group of patients to minimize the risk of disease transmission. All groups should be treated with the same protective measures with regard to PPE for the dental clinicians and staff [45].

Keyhan et al. [46] have reported that strategies for prevention of SARS-CoV-2 infection in dental offices include treatment planning approaches, fundamental elements needed to prevent transmission of SARS-CoV-2 virus in dental healthcare settings, Personal Protection Equipment (PPE) for dental health care providers, environmental measures, adjunctive measures, and rapid point of care tests in dental offices.

Pre-appointment measures

The care of patients in the dental office involves very strict biosafety protocols, and patients must be aware of the protection barriers implemented to allow satisfactory, safe dental care. Bio-safety measures must be taken before, during, and after dental practice following the arrival of COVID-19. The main measures include telephone triage, recording temperature on arrival at the dental clinic, organization of the waiting room to reduce transmission of infection, washing hands before entering the dental clinic. The dental patients must comply with all the bio-safety measures established by international protection standards and implemented by dentists before, during, and after dental practice to reduce the possibility of COVID-19 infection. Appointments must be spaced to avoid overcrowding the waiting room. Postponing the dental treatment of elderly patients or others with systemic diseases [47].

Measures adopted in the waiting room

The most widely used step taken prior to the patient's arrival was the postponement of appointments in order to avoid overcrowding the waiting room. The most commonly implemented interventions were frequent ventilation of the waiting room (88.98%) and hand washing of the operators before and after each operation (91.64%).

Detecting the patient’s body temperature

Patients' body temperatures must be measured before any dental procedure, according to the vast majority of respondents (92 percent). Other studies have mentioned this infection management metric. Consolo et al. [48], for example, indicated that practicing dentists in Italy would consider monitoring the patient's temperature to reduce the risk of COVID-19 transmission to dental staff and/or other patients.

Majority of dentist believed that measuring a patient's body temperature is needed before performing any dental procedure. Furthermore, social distancing has been advocated as a critical step in preventing COVID-19 infection transmission. According to the findings of this study, about three-quarters of participating dentists claim that "so-called social distancing," or reducing the number of patients in waiting rooms, is used in their practices. Dentists consider this approach to be the most important for preventing COVID-19 infection transmission [48].

Other methods for preventing COVID-19 infection transmission, such as patients wearing a face mask in the waiting room and hand washing/sanitizing before entering the waiting room, were less common, according to the survey results. Disinfection of pushbuttons, POS, chairs, several times a day should be carried out. It is essential to verify the patient’s current health status on access.

Proper ventilation of waiting rooms is essential. There is evidence for an airborne route to be considered, as the virus remains viable in aerosols for at least 3 h and that wearing mask was the best intervention to prevent infection. Heating, Ventilation and Air Conditioning Systems (HVAC) are used as a primary infection disease control measure. However, if not correctly used, they may contribute to the transmission/spreading of airborne diseases as proposed in the past for SARS. The authors believed that airborne transmission is possible and that HVAC systems when not adequately used may contribute to the transmission of the virus [49]. Ventilation of the operating area for at least 10 min after each patient Removal of magazines and books from the waiting area. Storage of coats, bags and other items outside the operating area.

Measures adopted in the operating room

Use of mouth rinses prior treating the patients: The proximity to the patient during dental care, high generation of aerosols, and the identification of SARS-CoV-2 in saliva have suggested the oral cavity as a potential reservoir for COVID-19 transmission. Mouthwashes are widely-used solutions due to their ability to reduce the number of microorganisms in the oral cavity. Although there is still no clinical evidence that they can prevent the transmission of SARS-CoV-2. Pre-operative rinse with mouthwash containing 1% hydrogen peroxide, chlorhexidine 0.12% to 0.2%, 0.2% to 1% povdine Iodine, alcohol and essential oils, Cetylpyridinium chloride at 0.05% to 0.10% have been recommended to reduce the number of microorganisms in aerosols and drops during oral procedures [50].

Disinfection of the surfaces: SARS-CoV-2 can persist on inanimate surfaces like metal, glass or plastic for up to 9 days, but can be efficiently inactivated by surface disinfection procedures with 62% to 71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 min. Other biocidal agents such as 0.05% to 0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective. As no specific therapies are available for SARS-CoV-2, early containment and prevention of further spread will be crucial to stop the ongoing outbreak and to control this novel infectious thread.

Cleaning surrounding surfaces after each patient's visit to the dental clinic is one of the most effective infection control prevention procedures for COVID-19. This is consistent with the results of a recent multicounty study, which revealed a lack of understanding of COVID-19's ability to remain infectious on inanimate surfaces for

Table 1: Results in tabular form and characteristics of included studies.

S. no	Title and authors	Aim	Methodology	Results	Conclusion
1	"Knowledge, stress levels, and clinical practice modifications of Turkish dentists due to COVID-19: A survey study" [26]	To assess the anxiety and stress levels surrounding the threat of infection among dentists working during the current viral outbreak.	A 15-question online survey was sent to Turkish dentists from May 5 to 12, 2020. The survey was about dentists' demographics, COVID-19 knowledge, stress levels, and dental clinic COVID-19 prevention measures.	COVID-19 symptoms that dentists knew best were high fever (99.4 percent). 99.2% of them said COVID-19 was spread through eye, mouth, and nasal mucosa contact with infected people's droplets. While female dentists had higher stress levels than male dentists, dentists with over 20 years of experience had lower stress levels. Concerning the precautions to be taken when returning to work, only 38.4% of dentists wore a N95 mask, while 86.6 percent increased daily patient care intervals.	The uncertainty of Turkish dentists' working conditions during the COVID-19 pandemic period has increased stress levels, as it has for dentists worldwide. They will likely increase personal and professional protective measures when they return to their normal clinical practices.
2	"Coronavirus (COVID-19) in Italy: Knowledge, management of patients and clinical experience of Italian dentists during the spread of contagion" [27]	To assess the knowledge about the new corona virus, the perception of risk and the clinical management of the risk related to infection during the first month of the Italian epidemic in an online survey of Italian dentists.	Following the data published in the international literature as well as the guidelines and directives constantly updated by the WHO and by the national health authorities, a questionnaire to be completed anonymously was submitted online to Italian dentists using social tools and online professional platforms.	The gender distribution was equal (48.8 percent males and 51.2 percent females). Fifty percent of respondents said visits haven't decreased since the outbreak. More than 65% of patients asked about the corona virus. Nearly 73 percent correctly defined corona virus, 63.2 percent correctly defined CoV, and 44.1 percent correctly defined SARS-CoV-2. Most respondents, however, misdefined COVID-19 (almost 69 percent). Although 65.2 percent of dentists said patients have inquired about the corona virus, they agree that fear of infection from dental care has not emerged (61.3 percent). Most dentists (69%) took extra precautions, indicating a growing and widespread awareness (87.5%) of the risk of spreading infection through dental activity.	Dentists at this time, however, should only work if they have the individual protective equipment recommended to high-risk healthcare workers. After the pandemic emergency when people's professional activities and lives can slowly return to normal, the experience and the not-quite-finished risk of a recurrence of new cases of infection will require that dentists also follow new health safety protocols whose definition will be necessary.
3	Knowledge of dentists, dental auxiliaries, and students regarding the COVID-19 pandemic in Saudi Arabia: A cross-sectional survey [28]	To assess the knowledge of dentists and dental auxiliaries and students in Saudi Arabia regarding SARS-CoV-2, as they are considered a high-risk group for infection, and investigate the potential gaps in knowledge that may affect health and safety in the dental workplace	A cross-sectional survey was conducted using a questionnaire which was developed to assess various dental professionals from both governmental and private sectors through online and social media outlets.	The results show that 1 033 questionnaires were collected (273 dental students, 193 dental auxiliary personnel, 544 dentists). 63.4% of those polled said they worked in a hospital. 44.9 percent worked in government hospitals, 33.4 percent in academia, and 21.7 percent in the private sector. The incubation period and transmission path of SARS-CoV-2 were known to all dental professionals. Dental practitioners knew hand-soap cleaning time differently ($p<0.001$). SARS-CoV-2 survival outside the host was a major source of debate among dentists ($p <0.001$). Moreover, 92 percent of respondents believed droplet inhalation was the mode of transmission for COVID-19. Symptoms of COVID-19 include fever, coughing, and shortness of breath. At least half of the participants chose the most basic dental preventative measures.	dental professionals seem to be consistent regarding their knowledge of the incubation period of SARS-CoV-2. The professionals' knowledge of viral survivability and suggested hand-soap-washing time, on the other hand, varied significantly. Both dental practitioners had a high level of anxiety about suspected COVID-19 patients. Campaigns to raise pandemic awareness among healthcare providers are important.

4	COVID-19 Outbreak in North Italy: An Overview on Dentistry. A Questionnaire [29]	To assess the symptoms/ signs, preventive measures, sensitivity, and perception levels regarding COVID-19 among dentists in Lombardy, Italy.	An online questionnaire was sent to all of Lombardy's dentists. Personal data, precautionary measures (before patient arrival; in the waiting room; in the operating room), understanding, and interpretation were the four domains of the questionnaire. . In addition, the answers obtained in areas with varying levels of disease prevalence were analyzed.	There were 3,599 questionnaires analyzed. Five hundred two (14.43%) of the participants had COVID-19 symptoms. Thirty-one people tested positive for SARS-CoV-2, and 16 got sick. There was a difference in confidence between dentists working in low and high COVID-19 prevalence areas (61.24, 61.23, and 64.29 percent, respectively, p<0.01). The Milan area (71.82%) had a statistically higher level of awareness (p<0.01).	Despite having more symptoms/ signs than the rest of the sample, dentists in the COVID-19 highest prevalence region were the ones who used multiple precautionary measures less frequently and were the most optimistic in preventing infection, according to this study.
5	The Attitudes and Professional Approaches of Dental Practitioners during the COVID-19 Outbreak in Poland: A Cross-Sectional Survey [30]	To assess the reasons and factors that influenced dentists' decisions regarding their professional approaches and disengagement from clinical work during the outbreak of the pandemic in Poland	a cross-sectional survey of Polish dental practitioners was conducted. A specifically designed online Google Forms questionnaire was used to collect information. Four major Facebook groups dedicated to Polish dentists were used to assemble a diverse sample group of dentists. Dentists were contacted via e-mail and asked to inform their patients about the study and encourage them to participate.	71.2 percent of dentists surveyed agreed to suspend clinical practice during that time. Deficient PPE, subjective perceptions of COVID-19 contraction, and general anxiety and confusion about the COVID-19 situation all contributed to this finding. The number of patients admitted weekly in April 2020 (12.06; SD 11.55) was significantly lower than before the pandemic was declared on March 11, 2020 (49.21; SD 24.97). Due to the lack of preparedness in the dental sector, both public and private, most Polish dentists have voluntarily suspended clinical practice to prevent disease spread. The COVID-19 pandemic has revealed flaws in the dental care system, including a lack of advanced PPE and insufficient global coordination of health services.	The COVID-19 epidemic has exposed a number of flaws in the dental care system, including a shortage of advanced PPE and inadequate global coordination of health services linked to the pandemic. This has resulted in an overwhelming sense of fear, uncertainty, and anxiety among dental professionals in Poland, as well as a sharp drop in the number of dental procedures performed. Dental practitioners will, hopefully, be better prepared and adapted to global health care disruptions in the future, based on recent experience and the introduction of appropriate strategic and long-term interventions.
6	Dentists' Knowledge, Attitudes, and Awareness of Infection Control Measures during COVID-19 Outbreak: A Cross-Sectional Study in Saudi Arabia [31]	To assess dentists' awareness, attitude, and perception of COVID-19. Infection control measures in the dental environment were also evaluated.	When the COVID-19 outbreak in Saudi Arabia was just getting started, an online questionnaire was sent out to dentists across the country. Demographic factors, knowledge, attitude, risk perception, and preparedness for COVID-19 were all assessed using the questionnaire. In addition, there were questions about infection control measures.	43 percent knew the virus's incubation period. COVID-19 symptoms include fever, cough, and shortness of breath (98.9 percent, 95.5 percent, and 93.3 percent respectively). Participants aged 60, 50-59, and 20-29 were more likely than those aged 30-39 and 40-49 to consider COVID-19 a very dangerous disease. COVID-19 was well-understood and accepted by dentists in Saudi Arabia.	Improving dentists' level of knowledge could be achieved through increasing their accessibility to materials provided by dental health care authorities, which specifies the best and safest approaches for dealing with patients during and after the outbreak.
7	COVID-19-Awareness and Practice of Dentists in Saudi Arabia [32]	To assess dentists' knowledge and awareness of COVID-19 and the use of infection control methods in Saudi Arabia.	A cross-sectional descriptive study as conducted using a 24-item questionnaire which was developed and distributed to 627 dentists in Saudi Arabia via social media.	177 questionnaires were completed (28.2 percent response rate). 90% knew about COVID-19 transmission, incubation period, and clinical symptoms. Almost 83 percent of respondents recognize that droplets, aerosols, and airborne particles can spread COVID-19 in the dental clinic. Take the patient's temperature before starting any dental work (88.7%), wash the dental clinic's surfaces after each patient (91.5%), and only treat dental emergencies (90%). (91.5 percent). (82.5%) COVID-19 appears to be fairly common among Saudi dentists.	The surveyed dentists' procedures tend to be largely in line with existing COVID-19 infection prevention guidelines and recommendations in the dental clinic. Some drawbacks in the knowledge and a number of inappropriate practices can be identified and require the attention of health authorities.

8	Impact of COVID-19 on the work of Spanish dentists: An early response to the pandemic [33]	To evaluate the quality of COVID-19 information given to Spanish dentists, their opinion of health-care institutions' behaviour, their understanding of the risk of infection at work, and the security measures in place to avoid contagion.	From March 18th to March 20th, 2020, a detailed questionnaire was created and made available online. Dentists practicing in Spain were asked to reply. The questions were divided into four sections: demographic details and professional activity; COVID-19-specific information and opinions on decisions made by Dental Councils and Health Authorities; and risk assessment for SARS-CoV-2 in dental practice. Chi-square tests were computed ($p<0.05$).	The survey received 873 responses. This report found that most dentists (86.37 percent) thought health officials mishandled the epidemic, and that they feared getting sick at work (83.16 percent) and spreading it to their patients (72.97 percent). COVID-19 caused 59.11 percent of dentists to change their practices, 60.17 percent to only treat emergencies, and 39.18 percent to quit.	Conclusions of this study showed that most dentists, especially women and dentists from COVID-19-affected areas, were concerned about infection in the workplace. Almost 90% of those surveyed believe that the pandemic will affect the way they provide dental care in the future.
9	Estimating COVID-19 prevalence and infection control practices among US dentists [34]	A longitudinal study was conducted to track infection prevention procedures and infection rates among US dentists.	In June 2020, the authors invited licensed US dentists who work mainly in private practice or public health to take part in a web-based survey. Dentists from every state in the United States were asked about COVID-19 symptoms, SARS-CoV-2 infection, mental and physical health conditions, and infection control procedures in their primary dental practices.	SARS-CoV-2 was detected in 3.7% of dentists' respiratory samples, 2.7% in blood samples, and 0.7% in salivary samples. 0.3 percent of those not examined had a possible COVID-19 diagnosis. In total, 20 out of 2,195 dentists had SARS-CoV-2, and 0.9 percent (95 percent confidence interval, 0.5 to 1.5) had confirmed or probable COVID-19 infection. Dentists reported depression and anxiety (8.6% each) (19.5 percent). Disinfection, COVID-19 screening, social distancing, and wearing face masks were all introduced in 99.7% of dentists' primary practices. According to CDC interim guidelines, most practicing dentists (72.8%) used personal protective equipment.	COVID-19 prevalence and testing positivity rates among practicing US dentists were found to be poor in this study. This suggests that existing infection prevention recommendations in dental settings may be adequate to avoid infection.
10	Awareness of Dental Practitioners and Intern Dental Practitioners in Northern Cyprus towards Pandemic of SARS-CoV-2. [35]	To evaluate the perception, attitude, and awareness of Dental Practitioners (DPs) and intern DPs towards SARS-COV-2 by comparing the Awareness-Attitude Score (AAS).	Google Forms are used to create an online survey. All DPs in Northern Cyprus (n=270) and intern DPs at Near East University (n=200) received an invitation email. From March to May 2020, data was collected blindly. For each correct answer, participants received one point. An AAS was calculated by adding all of the collected points. The information was statistically evaluated.	The study found 228 DPs completed the questionnaire (84 percent response rate). In terms of AAS, there was no gender difference (P=0.301). In terms of AAS, the dentist academician group scored higher (P=0.006). Other variables (specialty, mode of employment, location, and tenure) had no effect on the AAS (P=0.05). Age and AAS had a statistically significant relationship. Age increases linearly with AAS (P=0.011, Linear Regression). 182 intern DPs also responded (91 percent response rate). There was no gender difference (P=0.378). Age and AAS had no correlation (P=0.933).	Occupation is the only variable significantly influencing awareness attitude point of dental practitioners. Academicians exhibited superior knowledge regarding SARS-CoV-2 compared to non-academician dental practitioners. Although the difference was statistically insignificant; it is seen that the awareness attitude point of dental practitioners is superior. On the other hand, awareness attitude point is moderate in both dental practitioners and intern dental practitioners.
11	Pandemic preparedness of dentists against coronavirus disease: A Saudi Arabian experience. [36]	To determine dentists' preparedness and perceptions of infection control measures in the context of the COVID-19 pandemic.	The impact and perception of the COVID-19 pandemic on dental practice in Saudi Arabia was the subject of this online survey. There were 26 closed-ended questions in the survey. Frequency distributions of percentages were used in descriptive statistics. The Chi-square test was also used to determine the importance of the various demographic variables and questions about dentists' perceptions of the COVID-19 pandemicCOVID-19 management in dental clinics differed in terms of adherence to Ministry of Health (MOH) guidelines, according to the findings of this study.	The screening questionnaire for dental patients was well-accepted (67%) but the concern about airborne infection in the isolation room was not (15 percent). Almost two-thirds of those polled agreed the dental reception area followed COVID-19 guidelines. Their responses to questions about dentists' perceptions of the COVID-19 pandemic ranged from 64% to 85%. Furthermore, dentists' perceptions of the COVID-19 pandemic varied depending on their age and work experience (p 0.05).	The majority of dentists responded positively to the preparedness and understanding of infection control measures against the COVID-19 pandemic, according to this study. Dental clinics need to follow the MOH guidelines more closely, either in terms of facility preparedness or in terms of training their dentists and staff.

three to nine days.

Coronaviruses will remain infectious on surfaces for several days, even up to nine days, according to Fiorillo et al. [51]. Surface disinfection could be done with 0.1 percent sodium hypochlorite or 62% to 71% ethanol for 1 min, according to them.

Washing operators' hands before and after each procedure: To prevent virus transmission, the Centers for Disease Control and Prevention recommends frequent hand washing with soap and water. Hand hygiene products are available in a variety of forms, and while each of these formulations may be effective against COVID-19, they may also alter skin barrier integrity and function. Alcohol-based hand sanitizers with moisturizers have the least sensitizing and irritancy potential when compared to soaps and synthetic detergents. Hand washing is an effective method for prevention of COVID-19 [52].

The proper use of PPE, together with the adoption of other operational procedures, can provide effective protection against microorganisms being transmitted *via* body fluids or in the air. (256) Spread of aerosols and droplets.

It is also well known that rotary instruments produce a large number of aerosols/droplets, and that using a rubber dam and/or low-speed hand pieces will greatly reduce the spread and quantity of aerosols/droplets, and thus the risk of COVID-19 infection. The findings show that dentists are sufficiently aware of the involvement of droplets, aerosols, and airborne particles in the transmission of COVID-19 in the dental clinic [53].

In a systematic review, authors concluded that there were no studies that evaluated disease transmission *via* aerosols in a dental setting; and no evidence about viral contamination in aerosols. All of the included studies measured bacterial contamination using colony-forming units. There appeared to be some benefit from the interventions evaluated but the available evidence was very low certainty and unable to draw reliable conclusions. Authors did not find any studies on methods such as ventilation, ionization, ozonisation, UV light and fogging. Studies are needed that measure contamination in aerosols, size distribution of aerosols and infection transmission risk for respiratory diseases such as COVID-19 in dental patients and staff [54].

Dentist Knowledge, attitude and practices towards infection control in dental office

According to a study by Baracco et al. [33], the majority of dentists (76.40 percent) have modified their disinfection procedures since the COVID-19 outbreak, while 10.31% have not. The 23.14% increased disinfection timing, 21.88% increased disinfection timing and improved surface protection in surgery, 7.45% improved surface protection in surgery, 7.22% increased disinfection timing and upgraded disinfection products, 7.45% improved surface protection in surgery, 7.22% increased disinfection timing and upgraded disinfection products (bleach). Furthermore, 17.53% of respondents adopted all of the previously mentioned improvements.

Findings of another study revealed that 99.7% of dental offices use improved infection protection and management procedures, and many have also implemented advanced PPE. Dentists' reports of mask reuse or the use of surgical masks and respirators in combination can indicate current CDC guidance on PPE optimization due to supply issues.

When asked about the dental reception's COVID-19 prevention steps, the majority of the respondents (92 percent) acknowledged that patients were expected to take their body temperature before any dental operation, according to Al-Khalifa [36]. Patients should use an antiseptic mouth rinse before a dental operation, according to nearly half of the respondents (47%). 68 percent of respondents noticed that wearing a face mask was needed in the waiting area. Respondents observed a similar percentage of patients washing/sanitizing their hands before entering the waiting room. According to 77% of the respondents, social distancing was exercised in the waiting room.

Dentists aged 45 and up, as well as those who work longer hours (>35 h per week), were more aware of the new COVID-19 health online tools. Older practitioners are more likely to rely on research information, and since this is a new disease, accurate updated scientific resources would be available online, and with long working hours, it is more convenient for them to pursue online resources in their spare time. The MOH guidelines were modified on 88% of the respondents in this survey, with no substantial differences between demographic groups, demonstrating the MOH's outstanding efforts to spread information and understanding about COVID-19 to the majority of health professionals [55].

"Transmission-based precautions" are a higher level of infection control measures required to prevent the spread of diseases for which "universal precautions" have been proven ineffective, such as blood, airborne, or droplet transmission [56].

Dentists with more years of experience and longer working hours have substantially higher expectations of transmission-based safeguards. Furthermore, practitioners' longer working history would have exposed them to other infectious diseases, and they would have most likely encountered circumstances that necessitated the use of "transmission-based precautions." Dentists aged 45 and up demonstrated substantially higher compliance when questioned about using universal infection precautions on a regular basis. Other studies have shown that younger practitioners are more compliant with infection control measures, but this was not the case in this report. This result may be clarified by the fact that younger practitioners are more likely to work longer hours and in multiple clinics, putting a greater emphasis on the job or clinical practice rather than the infection control measure itself.

Al-Khalifa et al. [36] have reported that almost two-thirds of the respondents agreed that the dental reception area adopted the proper COVID-19 preventive measures. Greatest accord was observed in their answers on questions about dentists' perception of the COVID-19 pandemic, ranging from 64% to 89%. In addition, there were statistically significant differences in questions about the perception of dentists towards the COVID-19 pandemic by different demographic variables such as age and years of work experience ($p<0.05$).

Rossato et al. [57] have reported that Brazilian dentists significantly changed their routine dental practices. Biosafety measures were added in their offices by 98% of the dentists, increasing operating costs for 88.3% of dentists. Greater discomfort due to the increase in Personal Protection Equipment (PPE) worn during the pandemic was reported by 58.6%. Furthermore, 84.2% reduced their hours of service. It was found that the dentists decreased their workload, used additional PPE, and took additional biosafety measures.

Conclusion

This review focused on the methods, protocols, and recent reports

regarding the nCoV-19 infection and the transmission process, which could occur during routine dental treatment and surgeries. While the current evidence does not show a clear and direct link between dental care or surgery and the chance of COVID-19 transfer, there is obviously the chance of transmission. This could happen if contaminated dental fluids, saliva, or aerosols are transferred during close human-to-human contact during dental treatment, or if contaminated instruments or surfaces are contacted. Following the protective protocols in the COVID-19 crisis is therefore essential in a dental context, according to the existing literature.

Telephone and clinical triage backed by a questionnaire on recent symptoms and movements, body temperature measurement, oral rinses with 1% hydrogen peroxide, and the use of appropriate PPEs are all examples of COVID-19 prevention strategies in dental practice.

Anti-retraction dental hand pieces, four-handed work, the use of a rubber dam, and large-volume cannulas for aspiration are all pragmatic and technical recommendations for proper clinical practice. When compared to surgical masks, FFP2 (or N95) and FFP3 respirators offer better protection against viral respiratory infections.

Surface disinfectants with a concentration of 62% to 71% ethanol and a concentration of 0.1% to 0.5% sodium hypochlorite are considered the best.

There are certain limits to this review. There are a limited and heterogeneous number of primary sources directly related to the repercussions of SARS-CoV-2 on the dental discipline in the literature due to the current emergency. In the future, more research will be required.

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