REVIEW ARTICLE

CONTENTS

The impact of COVID-19 on dental practice and care: Adapting to unprecedented times

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ABSTRACT

Aim: This review aims to shed light on the ways dental practices and patient care strategies have evolved in response to the pandemic. It also investigates how patients' perspectives and dentist-patient dynamics have shifted, highlighting lessons for the future of dental healthcare systems.

Materials and methods: The study is based on a comprehensive analysis of previously published research articles and clinical reports on how dental practitioners adapted their practices during the COVID-19 pandemic. It includes qualitative and quantitative data reflecting both professional and patient experiences. The pandemic led to the rapid adoption of new technologies, heightened hygiene protocols, and increased mental health burdens on both patients and practitioners. Tele-dentistry, limited in-person visits, and stricter sterilization practices became the norm. Patients expressed both fear and appreciation for enhanced safety, altering their expectations of dental care, resilience and adaptability in dental settings.

Conclusions The lessons learned from COVID-19 experience underline the importance of incorporating dentistry into broader public health strategies. Moving forward, there is a need to invest in innovative technologies, uphold rigorous hygiene standards, and provide mental workers and patients. These steps are essential to prepare for future health emergencies and ensure the sustainability of dental care delivery.

KEY WORDS: COVID-19 and dentistry, dental practices, dentist-patient relationship dynamics, dentists' attitudes, dental care

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INTRODUCTION

The appearance of the COVID-19 virus and subsequent global pandemic completely changed the face of medicine and dentistry [1-2]. Because dentists are in close quarters with patients and are constantly exposed to respiratory droplets from patients, dentists have ended up at a much higher risk of contracting COVID-19 than the general public [3]. Dentists' perspective and attitudes towards the virus shape the security of dentists, their staff, and patients – in addition to the public health response [1]. In the context of a highly infectious illness, the inherent dangers of direct patient contact and close proximity these patients make it a dangerous occupation. This makes the dental industry one of the first in the healthcare system to have to change previous health suggestions for the virus and revise virus containment practices [4]. The quality of patient care and patients' confidence in these vital healthcare services are directly affected by dentists' perception of these risks as well as their ability to adapt and manage the dynamic situation. In addition, the pandemic has given dentists greatly increased hesitation over the best approach for containment practices [5]. Better understanding of the necessary containment practices, for instance, the use of better PPE (Personal Protection Equipment), adjustments to patient care, and stricter sanitization protocols, are vital in determining how the dental community responds to the COVID-19 pandemic [6-8]. Dental professionals, who have a responsibility for their patients while also securing their own and their employees' safety can easily get emotionally and psychologically impacted by such attitudes. When it comes to public health advocacy, dentists are indispensable, mainly by getting people to receive the COVID-19 vaccine and adhere to public health measures. There are several carriers that have revealed promising results in the development of COVID-19 vaccines using artificial intelligence in the past [9]. This study gathers data from a diversity of sites for a clearer image of how dentists dealt with the encounters of presenting care through a comunnity health emergency. The current study provides detailed insights into the pandemic conse-

quences for dental health services by studying changes in patient attendance, the adoption of strict biosafety measures, and the psychological influence on both providers and recipients of dental care. Correspondingly covered in this study are the more far-reaching impacts, which include dramatic changes to the dental industry's educational system and economic system. In addition to being a crucial device for assessing rapid reactions to COVID-19, this study plays a vital role in guiding the upcoming policy of dental healthcare and preparedness doctrines – which makes the industry a whole more resilient to future epidemics or crises of a similar kind.

AIM

This review aims to shed light on the ways dental practices and patient care strategies have evolved in response to the pandemic. It also investigates how patients' perspectives and dentist-patient dynamics have shifted, highlighting lessons for the future of dental healthcare systems.

MATERIALS AND METHODS

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The methodology was designed to identify and synthesize all relevant literature on the impact of COVID-19 on dental practices, patient perceptions, and the resulting adaptations.

INFORMATION SOURCES AND SEARCH STRATEGY

A comprehensive systematic search was performed across multiple electronic databases to identify relevant published literature. The databases included PubMed/MEDLINE, Scopus, Web of Science, and EMBASE. To ensure thorough coverage, the search was supplemented by a manual review of the reference lists of included studies and key review articles. Furthermore, a search of grey literature was conducted through Google Scholar and the websites of major dental associations and public health organizations (e.g., American Dental Association, World Health Organization) to identify clinical practice guidelines, reports, and other relevant documents.

The search strategy was designed to encompass the period of the COVID-19 pandemic, specifically from March 2022, up to March 2023. This timeframe was selected to capture the entire evolution of the pandemic's impact on dentistry.

SEARCH KEYWORDS

The search utilized a combination of Medical Subject Headings (MeSH) terms and free-text keywords related to the core concepts of the review included.

Population/Context: dentist, dental practice, dental care, dental patient, oral health.

Intervention/Phenomenon of Interest: COVID-19, SARS-CoV-2, coronavirus, pandemic.

Outcomes: adaptation, perception, attitude, anxiety, stress, tele dentistry, infection control, guidelines, personal protective equipment.

These terms were combined using the Boolean operators "AND" and "OR" as needed.

ELIGIBILITY CRITERIA AND STUDY SELECTION

The study selection process followed pre-defined eligibility criteria.

Inclusion Criteria:

1. Original research articles (e.g., cross-sectional surveys, cohort studies, qualitative studies) and clinical practice guidelines
2. Studies focusing on the impact of COVID-19 on dental professionals (e.g., knowledge, attitudes, psychological stress, practice adaptations) or dental patients (e.g., perceptions, fears, expectations)
3. Studies reporting on adaptations in dental care delivery, such as the implementation of tele dentistry, revised infection control protocols, or new triage systems. Publications in the English language.

Exclusion Criteria

1. Letters to the editor, opinion pieces, narrative reviews without systematic methodology, and conference abstracts.
2. Studies focusing exclusively on non-COVID-related topics in dentistry.
3. Studies for which the full text could not be retrieved.

The study selection was performed in two stages. Initially, two reviewers independently screened the titles and abstracts of all retrieved records against the eligibility criteria. Subsequently, the full texts of potentially relevant articles were assessed independently by the same two reviewers. Any disagreements at either stage were resolved through discussion or by consulting a third reviewer.

DATA EXTRACTION AND SYNTHESIS

From the final included studies, data were extracted using a standardized data extraction form. The extracted information included:

Study characteristics: first author, publication year, country, study design, and study period.

Table 1. Comparative overview of global studies on dentists and patients

Country/Region	Study Focus	Key Findings
Iran	Dentists' Knowledge & Attitude	Good knowledge about COVID-19, positive attitude towards dental care, challenges like PPE need and financial difficulties [16].
Mexico	Dentists' Awareness & Behavior	Awareness of COVID-19, knowledge gaps in symptoms and PPE use, willingness to provide emergency treatment [17].
Italy	Dentists' COVID-19 Perception	Informed about transmission, concerns about health and economic impact, need for clear guidelines and effective PPE use [18].
Libya	Online Dental Education	High satisfaction with online courses, despite challenges in e-learning infrastructure [20].
USA	Dental Patients' Perceptions	Concerns about contracting COVID-19 in dental settings, impact of demographic factors on perceived risk, conditions for returning to care [21].
International	Dental Specialists' Knowledge	Good overall knowledge and perception, variance based on age, knowledge source, and specialization [22].
Brazil	Dentists and Dental Undergraduates	General recognition of symptoms and transmission routes, knowledge variations among demographics [23].
China	Orthodontists' knowledge and attitudes	Development of knowledge, sureness, and preparedness of orthodontic professionals [24].
Poland	Dental Practitioners' Responses	Reduction in patient numbers, decision-making in clinic operations, impact of PPE shortages [19].
Kosovo	Dental Students' Knowledge	High awareness of COVID-19 symptoms, transmission, preventive measures, and related stress [25].
Jordan	Dentists' COVID-19 Awareness	Knowledge of symptoms, transmission modes, attitudes towards treating COVID-19 patients, importance of continuous education [26].
Austria	Dentistry Students' Attitudes	Dental students have a good grasp of COVID-19 basics but show gaps in hygiene protocols and infection control knowledge [27].

Source: Author's own work based on [16–27])

Population: sample size and characteristics (e.g., dentists, dental staff, patients).

Key findings related to the review's aims, including quantitative data (e.g., percentages, prevalence rates) and qualitative themes (e.g., perceived challenges, adaptive strategies).

Given the heterogeneity in the study designs and outcomes of the included literature (encompassing both quantitative and qualitative data), a narrative synthesis approach was adopted. The findings were organized thematically to address the key objectives of the review, such as changes in clinical practice, psychological impacts, shifts in the dentist-patient relationship, and lessons learned for future preparedness.

REVIEW AND DISCUSSION

PANDEMIC IMPACT AND ADAPTATIONS IN DENTAL PRACTICES

In the early phases of COVID-19, when the virus began to spread the most, a negative phenomenon was observed regarding dental attendance. Various dental offices, clinics, and health centers observed a sharp decrease in patient appointments. As a result of stringent public health measures and the closure of numerous dental clinics, the number of dental appointments has declined by a shockingly high ratio - 80%. Patient anxiety spiked (concurrent with this decline in dental serves), and with 60% of patients reporting increased worries [10]. The decline can be attributed to the implementation of lockdown techniques, the widespread panic from the virus among patients, and the advice to pause non-urgent dental appointments. As a result, dental offices had to reschedule patients' visits and many even placed an end to certain non-emergency treatments [11]. Decreasing patient flow and following social distancing norms both required this change, causing more stringent sterilization procedures and increased cleaning of surfaces and floors. These were the premier infection control strategies put in place by dental clinics worldwide [12-14]. Plexiglass barriers, distinct entry and departure methods, and rearranging waiting areas were used to impose social distancing and slow the spread of the virus. Staff received additional training on COVID-19 safety measures. The use of enhanced PPE became standard, including N95 masks, face shields, gowns, and gloves [15]. A study focused on the impact of COVID-19 on dental practices in the region of northern Iran and investigated the

dentist's knowledge about COVID-19, attempting to promote a positive attitude towards dental care. The study also highlights challenges such as the need for personal protective equipment (PPE), financial difficulties in relation with buying PPE during national shortages, and the necessity of health training programs for dental professionals for better containment of infectious diseases [16]. Another study indicated that most dentists were aware of COVID-19 and its transmission, but their knowledge of signs, symptoms, and consistent use of PPE was limited, and a significant portion of dentists were willing to continue providing emergency treatment during the pandemic [17]. A study that evaluated Italian dentists' knowledge about COVID-19 was conducted via a questionnaire in April 2020 and involved roughly 1,500 dentists who were informed about the mode of transmission but less knowledgeable about symptoms and patient presentation. The study highlighted concerns about health, economic impacts on practices, and the need for precise operating guidelines and effective use of PPE [18]. A Cross-Sectional Survey examined the response of Polish dentists to the pandemic, it highlights the significant reduction in patient numbers, the dentists' decision-making factors regarding clinic operations, and the importance of access to PPE. The study found a major impact on dental services due to PPE shortages and the need for enhanced infection control protocols [14]. In most countries, including Italy, Brazil, Jordan and many other, dental professionals demonstrated good general knowledge about COVID-19's symptoms and transmission as presented in Table 1.

DENTAL PATIENT PERCEPTIONS AND RESPONSES TO COVID-19

The COVID-19 pandemic has significantly impacted the dynamics of dentist-patient relationships, communication, and patient attitudes towards dental care. These changes are a direct response to the challenges posed by the pandemic and have reshaped the way dental care is delivered and received [19]. During the pandemic there has been a shift towards digital modes of communication, such as emails, text messages, and social media, to convey information about changes in practice operations, safety protocols, and appointment scheduling. Teledentistry has become more prominent, allowing for remote consultations, follow-ups, and triaging of dental emergencies, thereby reducing the need for in-person visits [20-21]. The shared experience of navigating the pandemic may lead to stronger dentist-patient relationships, with patients valuing the efforts made by dental practices to ensure safety. Both dentists and patients are adapting to a 'new normal' in dental care, which may include continued use of enhanced safety measures and a greater reliance on digital communication even post-pandemic [22]. The immediate need to adapt to new circumstances and manage care amidst the pandemic has significantly increased stress and workload for patients. Adhering to strict infection control measures, rescheduling their appointments, and managing a backlog of postponed treatments have been challenging [20]. Patients may demand higher standards of infection control and become more cautious about routine dental visits, affecting how dentists engage with and educate their patients [23]. Understanding dental patients' perceptions in the United States regarding the risk of COVID-19 transmission in dental settings, utilizing an electronic survey, the study gathered responses from 464 adults on their attitudes, beliefs, and perceived susceptibility to contracting COVID-19 in dental offices. Key insights include concerns about contracting the virus in dental settings, the impact of patients' demographic factors on their perceived susceptibility, and the factors influencing their willingness to return to routine dental care [23]. The role of Dentistry technologies in revolutionizing dental education and care amidst the COVID-19 pandemic, with twenty notable enhancements has been discussed in [20]. These advancements range from improved healthcare device connectivity to the implementation of smart transportation systems within hospitals. They have streamlined operational processes, boosted productivity, and enhanced treatment efficacy. This digital transformation underscores a significant shift in dental practices, marking a step forward in healthcare innovation. In a study with a 57% response rate, 86.2% of female and 57.8% of male dental students preferred offline learning, especially those over 22 years. A year-wise increase in offline exam preference peaked at 100% in the 4th year. Overall, 77.7% of students opposed continuing e-learning, highlighting a strong preference for traditional, in-person dental education [24]. WhatsApp application has been explored in dental care, with systematic searches yielding 327 articles, of which six met the criteria for randomized clinical trials. These articles highlight WhatsApp's effectiveness in remote consultations, oral hygiene maintenance, and disease diagnosis in underprivileged areas. The findings emphasize its role in enhancing doctor-patient interactions and knowledge sharing in orthodontics, leading to better patient compliance and engagement [25]. In a study involving 12 public dental practitioners from Sydney, teledentistry's adoption in Australian public oral health services was evaluated. Participants generally accepted teledentistry, appreciating standardized consultation templates and

Table 2. Challenges and Acceptance of Enhanced Safety Measures in Dental Practices during COVID-19

Aspect	Challenge	Acceptance
PPE Shortage	Significant initial shortage of masks, gowns, and face shields, posing challenges for dental practices.	Routine PPE use grew as supply chains stabilized, with widespread recognition of its necessity for safe practice.
Financial Burden	High costs for additional PPE and safety equipment, particularly burdensome for small or independent clinics.	Most dentists have accepted these costs as necessary for patient and staff safety and practice continuation.
Adaptation to New Protocols	Significant changes to practice operations were required to adapt to new safety protocols.	Growing integration and proficiency in these protocols among dental staff over time.
Physical Discomfort and Communication Barriers	Extended PPE use led to physical discomfort and communication issues with patients.	Adaptations like communication aids and regular breaks to alleviate discomfort.
Training and Compliance	Challenges in training staff and ensuring consistent compliance with new protocols in busy environments.	Higher compliance and acceptance achieved through continued education and importance reinforcement.
Patient Management and Scheduling	Changes in scheduling and patient interaction protocols needed to manage patient flow and implement social distancing.	Patients and staff adapting well to these changes, understanding their importance for safety.
Psychological Impact on Staff	High-risk work environment and stringent protocols lead to stress and psychological impact on dental professionals.	Ongoing challenge, with increasing support systems for mental well-being.
Public Perception and Patient Confidence	Ensuring patient safety and understanding new protocols in high COVID-19 areas was challenging.	Rebuilding patient confidence through effective communication and demonstration of safety measures.

Source: Author's own work based on [16–27]

communication among clinicians. Despite this, challenges in patient contact and technological difficulties had been noted – the study's result mentions the potential of teledentistry, indicating that more studies are needed to verify how to make it work best in the context of a public health setting.

PSYCHOLOGICAL IMPACT OF THE PANDEMIC

Dentists and their patients have been greatly affected psychologically by the COVID-19 pandemic [26]. Panic about contracting the virus, keeping up with ever-evolving standards, and fears about the future of their profession and their income all contributed to dentists' already high levels of stress and anxiety when COVID-19 was at its peak. Patients also reserved fears of contracting COVID-19 during their appointment, so several approaches were used to decrease the impact of these mental health issues [27]. Stress-controlling measures, regular and open contact with patients to calm their anxieties, and mental health care for dental staff were all part of the package. In this context, the role of antioxidants becomes increasingly relevant. Antioxidants have been shown to combat oxidative stress, which can be exacerbated by chronic psychological stress, thus potentially mitigating some of the negative health outcomes associated with heightened anxiety during the pandemic [28]. Addressing these psychological challenges also requires fostering a supportive work environment and advocating for a balanced approach to work and life [29]. The research investigated the perceived risk and preventive behaviours of dental students in Kosovo regarding COVID-19 [23]. The study included using a questionnaire that covered topics such as fear of COVID-19, symptoms, transmission, and stress connected to the virus. It involved 157 students from different study years. According to the findings, students are quite concerned about contracting COVID-19 and are well informed about the virus. This study looked at how the epidemic affected these students emotionally [29]. Despite dentists' best struggles, the mental toll of the pandemic implies they could use further assistance in adjusting their practices. Because the pandemic is still going strong, dentists need to be willing to deal with the emotional and mental toll as well as the physical ones [30]. The heightened emphasis on safety has had a psychological impact on dental professionals, while some express a sense of security due to these measures, others experience increased stress and anxiety related to the potential for infection and the responsibility of protecting their staff and patients. Several studies highlighting the psychological impacts including fears of infection, financial concerns, changes in work protocols, and the overall uncertainty

surrounding the pandemic. A study reported that dental professionals experienced significant anxiety, particularly related to the use of PPE and the effectiveness of infection control measures in preventing the spread of COVID-19 [31]. Numerous dentists feel overwhelmed by the demands of ensuring safety while providing effective treatment. This highlights the urgent requirement for supportive measures to address these mental health challenges [32]. Because of not knowing how long the epidemic would last and how it would affect the feasibility of dental practices, a survey published in "Community Dentistry and Oral Epidemiology" stated that dental professionals experienced increased burnout and emotional strain [33]. There was a correlation between Chronic Obstructive Pulmonary Disease COPD and OSA in meta-analyses, but no such correlation with asthma. The study revealed a correlation between periodontitis and COVID-related mortality as well as the necessity of assisted ventilation. Periodontal cure improved symptoms in COPD, asthma, and CAP. This section, where dental health and lung health, requires additional investigation and intervention trials [34]. The financial viability of dental practices was harshly affected by the temporary closure of practices and lower patient volume, which contributed to overall stress levels. The pandemic disproportionately affected younger dentists and those working in private practice, leaving them financially vulnerable [35]. Furthermore, dental practitioners' mental health and well-being were damagingly impacted by the pandemic. Challenges with handling patient care considering inexperienced regulations, concerns about infecting loved people, and interference with work-life stability were among the factors mentioned [36]. Despite these challenges, some research, such as a study by [37] that focused on the adaptability of dental practitioners during the pandemic. Many dentists employed various coping strategies, such as seeking assist from colleagues, remaining informed about COVID-19 updates, and prioritizing their health and safety guidelines. These ways reflect the requirement for flexibility in changing dental practices and ensuring compliance with new protocols, as highlighted in the paper examining dentists' experiences during the COVID-19 pandemic. The dentistry community's reactions to the COVID-19 safety measures, and it's clear that they were resilient and adaptable in the face of adversity as summarized in Table 2.

This summary highlights the continuing necessity for adaptation and support in the field, while also reflecting the dedication of dental professionals to maintaining safety standards during a worldwide health crisis.

LESSONS LEARNED AND FUTURE PREPAREDNESS

Imposing the vital constraint of strict infection control measures in dental settings is only one case of how the dentistry sector can use the lessons learned from the COVID-19 pandemic to future situations. Along with stressing the implication of flexibility, specifically when it comes to transitioning to emergency treatment and applying tele-dentistry [38]. Dentists should always be knowledgeable about new health hazards and they should communicate visibly with their patients. Furthermore, it highlighted the importance of mental health assistance for practitioners and patients and the requirement for robust emergency response plans, comprising the storage of personal protective equipment and the development of contingency operational methods. Many people in the dental sector around the world are working together to share their experiences and best practices because of the pandemic. The dentistry industry can use these findings to better handle future crises of a similar kind. Managing the epidemic has brought home to many dentists the magnitude of being ready for comparable public health emergencies in the future. Staying aware of emerging health concerns, having a plan for handling infectious diseases, and maintaining a stockpile of necessary supplies are all part of being prepared. Sights on the new precautions have altered as the pandemic has proceeded. As dentists have gained more experience with these procedures, their initial feelings of concern have mostly evaporated [39]. The capacity to promptly assimilate new safety norms and specifications is an extraordinary quality in numerous dentists. Their flexibility reflects their dedication to the wellbeing of patients and their sense of professional duty. Several dentists are selfassured about the effectiveness of their infection control procedures. This certainly stems from the fact that, before the pandemic, dental practices adhered to stringent hygiene and sterilizing measures. Improved personal protective equipment (PPE) and patient screenings, which are special to COVID-19, have added to this assurance [40]. The current literature supplies helpful information regarding the effects of COVID-19 on dentistry, but it also highlights the requirement for further comprehensive and varied research. The findings should be more broadly applicable if future research seeks to incorporate more countries, especially those with low or medium incomes. Research into the long-term consequences of the pandemic on dentistry education, practice, and policy is urgently required. Also, less-studied areas of dentistry and orthodontics should get additional research results

so that we can learn about the specific complications and solutions they faced during the pandemic. In addition, one of the most important ways to tackle the problems caused by the COVID-19 pandemic in dentistry is to incorporate new nanomaterials. The properties of nanomaterials are supreme [41] to assist in the advancement of cutting-edge dental procedures and improve procedures of infection prevention. Their usefulness covers a wide range of areas, including orthodontic biofilm prevention and the avoidance of microbial infections [42-43]. Dentists' flexibility in applying nano biomaterials and their dedication to patient safety have proven critical. This alteration in thinking highlights the consequence of ongoing training for dentists so they can keep up with new health technology. Nano biomaterials are a potential tool for strengthening infection control procedures, which could help the dentistry community adapt to future emergencies and remain strong in the face of global health issues. To understand the complete economic effect on dental offices and to guide sustainable company models in the aftermath of the epidemic, thorough economic evaluations are essential. At the end, filling these gaps will enhance our knowledge and make the dentistry sector more prepared to handle future global health emergencies.

CONCLUSIONS

To conclude, our review succinctly summarizes the far-reaching impact of the COVID-19 pandemic and how it transformed numerous avenues of dental policy and practice. Our review examines how the pandemic brought about a sweeping alteration in safety regulations and standards - centered on the importance of infection prevention. A critical development, like the rapid adaptation to digital instruments like tele-dentistry, guarantees continuity of care while reducing the risk of infection. The psychological toll on dental workers is considerable and highlights the necessity of improved mental health services in the sector. Due to the pandemic's impact on the global economy, management practices have been reevaluated to make sure that business models are stronger in case more economic shocks are witnessed. Crucial for sustaining trust and continuity of care, the pandemic has rethought the dentist-patient relationship, elevating the need for openness and education. The pandemic also prompted major shifts in the industry, which has rewarded the ingenuity and innovation needed to adapt to the new challenging conditions. To warrant patient safety and resilience in the future, learning from this experience is an imperative for the dental community to be better prepared for emergencies. The prospects of building a stronger and more efficient (yet patient-centered) model in the future will depend on these outcomes.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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