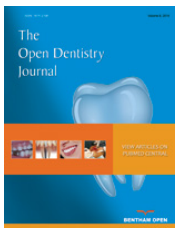

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REVIEW ARTICLE

Dental Education in the COVID-19 Era: Challenges, Solutions and Opportunities

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Abstract:

Objective:

The COVID-19 crisis has caused considerable disruption to medical education and has stimulated creative and rapid changes in the way technology is adopted and utilized for education. This change is accompanied by many challenges related to education, patient care, research, faculty development and collaboration, finances, and the psychological well-being of stakeholders.

Methods:

A review of the literature on dental education during the COVID-19 pandemic was conducted. Published articles addressing the challenges, solutions and opportunities in dental education during the COVID-19 era were assessed.

Results:

COVID-19 was a catalyst for a significant amount of change in dental education. Despite the magnitude of the challenges, this pandemic has influenced many positive solutions and opportunities in dental education.

Conclusion:

The COVID-19 pandemic forced dental educators to rethink models of curricular delivery, as it disrupted traditional delivery methods. The use of technology was adapted to ensure the continuity of education. With that, a number of challenges surfaced that were tackled creatively. Reflecting over the whole experience with COVID-19, the multiple opportunities that have been identified can improve the way we educate our students in the future.

Keywords: COVID-19, Dental Education, Curriculum, Dentistry, SARS-CoV-2, Dental colleges.

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1. BACKGROUND AND INTRODUCTION

COVID-19 is a disease caused by a novel coronavirus identified as the seventh member of its family to have infected humans, named acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1 - 3]. The disease caused by this pathogen became known as coronavirus disease 2019 or COVID-19 when an outbreak of pneumonia with an unknown etiology occurred in Wuhan, China, in December 2019 [4]. The virus is believed to have been initially transmitted from bat to person, followed by person-to-person transmission *via* droplets and aerosols [2 - 4]. On 30 January 2020, the World Health Organi-zation (WHO) declared this outbreak an international public health emergency [3, 4]. Later, on 11 March 2020, the WHO announced that COVID-19 was a pandemic due to its global spread [2]. The ease of transmission of this virus from person to person has caused an overwhelming number of cases globally, thus putting a significant burden on healthcare systems around the world [5]. As of 21 August 2020, there were over 22,492,312 confirmed COVID-19 cases in more than 200 countries, causing over 788,503 fatalities [6]. Although most cases are mild or asymptomatic, frail older adults and patients with pre-existing medical conditions appear to be at higher risk of developing severe complications related to the disease [1, 7].

Following the WHO's announcement and the pronounced repercussions of the COVID-19 pandemic, many countries

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around the world began to implement lockdown measures on their populations and limited or prohibited professional activities. This included the suspension of academic activities along with activities in other key sectors [1, 3, 8]. During this pandemic, dental practitioners have been shown to have a high infection risk and to possibly provide routes for virus transmission across patients [3, 4]. Therefore, many governments and dental governing bodies have issued regulations recommending the temporary closure of practices or considerable restrictions to the dental care provided [3, 8].

Dental colleges in academic institutions have the unique nature of being, in essence, small hospitals with complex infrastructures that provide in-house patient care on top of their role as educational and research facilities [9]. Consequently, it was vital for these colleges to make appropriate and prompt modifications to both the delivery of their curricula and the provision of patient care [3]. Most dental colleges have quickly transferred to online curricular delivery [10, 11]. With regard to patient care, dental colleges in many areas of the world have suspended student clinics and limited care to emergency treatment provided by faculty or postgraduate residents [8]. The goal of implementing such modifications is to decrease the risk of infection among patients, students, faculty, and staff. However, the greatest challenge is ensuring the simultaneous delivery of high-quality dental education and the continuity of students' academic progress [1, 3, 12, 13].

Although the difficulties in these unprecedented times are huge and are affecting populations in every corner of the globe, they also provide an unmatched opportunity to experience quick adaptation, creativity, and collaboration. The disruption caused by the pandemic is large enough that many long-held beliefs in education are being challenged and broken, while the new norms are being simultaneously defined and will most likely be carried into the post-pandemic era [14]. This article provides a comprehensive review of the global efforts related to dental education reformation in the time of the COVID-19 pandemic with a specific focus on challenges, solutions and future opportunities. A review of the literature on dental education during the COVID-19 pandemic was conducted. Inclusion criteria included published articles written in English, addressing aspects related to the challenges, solutions and/or opportunities in dental education during the COVID-19 era. A total of 55 articles were assessed, out of which 27 articles were included.

2. KEY CHANGES IN THE DELIVERY OF DENTAL CURRICULA

Globally, Dental colleges have made significant changes in the way their curricula are being delivered in response to COVID-19. These modifications were made based on contingency plans that were set while taking into consideration the safety of students, faculty and staff, ensuring the continuity of and maintaining the quality of dental education and complying with the guidelines and policies issued by governing bodies [9, 15]. Table **1** outlines the common changes implemented by dental colleges globally in response to the COVID-19 pandemic. On-campus teaching was suspended in most colleges, along with most research and clinical activities. The academic activity resumption plan was set and periodically re-evaluated for possible updates. Didactic components of the curriculum, along with any "virtualizable" practical components, were transitioned to online delivery [9, 16, 17]. For dental colleges that chose to continue preclinical simulation exercises on campus, social-distancing measures were planned and implemented. Elective dental care was suspended, and urgent care was exclusively provided on campus or through teledentistry consultations whenever appropriate [17, 18]. External rotations were canceled, and travel by students and faculty was banned. The clinical and practical experience that was not compatible with online delivery was replaced with other activities with similar learning outcomes. Dental licensure exams were either canceled or rescheduled, and graduation ceremonies were either canceled, rescheduled or moved online [18]. Administrative meetings were held online, dedicated communication hotlines were made available and wellness centers were offering their services virtually [9, 17]. Exams were redesigned to be delivered online, and requirements for successful graduation were reconsidered [9, 16].

3. CHALLENGES AND SOLUTIONS

3.1. Education

The COVID-19 pandemic has had a major influence on dental education in every aspect and at every level, from application to admission all the way to graduation and licensing. After the implementation of the lockdown measures, the sudden halt in academic and clinical activities necessitated each dental college to promptly re-evaluate its capacities in multiple dimensions and creatively explore available options to determine the nature of curricular modifications that would be feasible and successful [18 - 20]. Then, prompt implementation and execution were required to ensure the uninterrupted remote delivery of curricular content [18, 19]. Naturally, faculty and students were required to swiftly adapt to the implemented changes, which in many cases meant a completely virtual dental curriculum [2, 11, 20, 21]. In order facilitate the implementation of creative and quick changes in the manner that was observed during the pandemic, it was necessary to have freedom from the usual constraints and regulations, which inevitably led to variability in curricular modifications among different colleges in the same country. In an attempt to maintain documentation for guidance, comparison, and evaluation purposes, some accreditation and educational governing bodies required dental colleges to submit standardized reports that comprehensively described the changes made to their curricular design and delivery [18, 11].

In most dental colleges, online instruction replaced any didactic classroom-based or "virtualizable" components of the curriculum using synchronous (live delivery) and asynchronous (on-demand) approaches [16, 19 - 23]. For that purpose, faculty utilized a variety of technological platforms with teleconferencing and file-sharing functionalities to facilitate the delivery of virtual lectures, conduction of group discussions and enhance student engagement [20, 23, 24].

Table 1. Common changes observed or implemented by dental colleges in response to the COVID-19 pandemic.

Domain	Observed or Implemented Changes
Education	
Method of curriculum delivery	-
• Didactic components	Online delivery
• Practical components	-
o If virtualizable	Online delivery
o If not virtualizable	Replaced by other teaching strategies that fulfill related learning outcomes; example: case-based group discussions, procedural videos
• Clinical components	Replaced by other teaching strategies that fulfill related learning outcomes; example: case-based group discussions, procedural videos, teledentistry
External rotations	Cancelled
Assessment	-
• Method of delivery	Online
• Tools used	A variety of tools including multiple-choice questions, essays, virtual oral examinations, OSCE and video production
• Exam security	Third-party proctoring, identity authentication and automated plagiarism detection
• Grading scheme	Changed
Licensure examinations	Cancelled or rescheduled
Graduation ceremonies	Cancelled, rescheduled or moved online
Meetings	Conducted online
Admission interviews	Conducted online
Patient Care	
• Elective care	Rescheduled
• Urgent care	Provided on campus or through teledentistry
Research	
• Basic and clinical research	Temporarily suspended
• COVID-19 research	Increased
• Writing and publication	Increased
Faculty development, retention and collaboration	
Faculty development activities	-
• Method of delivery	Online
Faculty tenure and promotion	Provided more time

It is essential to keep in mind the inequality of teaching and learning experiences that exists as a result of the variations in the quality and availability of the networks, software, and hardware utilized by faculty and students [16, 20]. In consideration of students with financial constraints who may not be able to cope with the prompt virtual transition, some institutions planned to deliver the online curricular content again through in-person classrooms following the resumption of on-campus academic activities [16]. Other institutions reduced the duration of daily virtual teaching schedules to minimize data usage [10].

Additionally, due to its sudden implementation, faculty and students with inadequate experience with these platforms were challenged by a steep learning curve [20, 23]. Thus, many institutions provided training sessions relevant to the platforms they intended to use in addition to technical support whenever required. [11, 16, 20, 25] Virtual attendance from home can also constitute a challenge for those living in different time zones or who are caring for younger children due to a lack of childcare options during the crisis. Special considerations were given to these disadvantaged members of the dental education community [23]. Students' engagement in these virtual sessions delivered without in-person interaction was improved using a variety of interactive teaching styles that break the feeling of isolation and maximize the benefits gained from the sessions [25]. The faculty incorporated timestamped questions and provided meaningful feedback frequently during sessions. Students and faculty used discussion forums available within learning management systems to discuss clinical cases or provide updates and feedback [25]. Additionally, clarifying expectations to students and documenting those expectations in course descriptions, while possibly adding extra points for student participation in online teaching sessions, can enhance student performance. On the other hand, this may be unfair for those students who have limited access due to the technical, financial and social constraints described earlier. A wise and appropriate selection between synchronous and asynchronous teaching is also beneficial. Small group discussions with problem-based learning (PBL) and flipped classroom techniques, which require students to review online modules before participating in seminars, can be used to stimulate active discussion, aid in the comprehension of important concepts and build on critical thinking while also improving student engagement [11].

Despite the successful experience with online delivery of the didactic components of the curriculum, reproducing the

same success with practical and clinical training remains the main challenge. The fidelity of live patient encounters and simulation-based training in laboratories is difficult to provide in virtual form for two primary reasons [11, 22]. First, with the currently available technology, competency in skill performance cannot be confirmed without direct physical supervision. Second, there is a considerably high cost associated with task trainers (manikins, online virtual solutions, typodonts, *etc.*), so it would be difficult to provide them for everyone. Some of these training tools also require significant technical and logistic support that is difficult to provide for home use. Unfortunately, these practical and clinical activities requiring the demonstration of competencies, which were dramatically reduced in the modified curricular plans, occupy the bulk of the overall training requirements in the field of dentistry [19]. Some colleges resumed practical simulation-based training on campus while practicing social-distancing measures [11]. For the colleges that did not have that option, practical training on manikins was very difficult to deliver virtually due to time, human resource, and technology constraints described earlier. Virtual reality systems and haptic technology, even when available, are not currently portable, do not cover all areas of dentistry and are very expensive, which prevent their use for such purposes [11, 26]. Regardless, positive experiences have been documented with other practical courses, such as oral pathology education, where the alternative online teaching method has been reported to be superior to the conventional microscopic approach [26]. This highlights the importance of keeping an open mind and avoiding exclusivity when making strategic decisions about course delivery methods in crisis times, such as the COVID-19 pandemic. Individual analysis and classification of all courses in the curriculum should be performed based on their virtualization feasibility.

Some dental colleges modified their assessment plans or extended program end dates to provide time for additional hands-on experience. Other institutions reduced their clinical graduation requirements [18, 26]. In countries such as the United States and Canada, dental colleges are obliged to follow strict regulations that guide the setting of clinical requirements for their students and residents to ensure the quality of the provided dental education. Under the current circumstances, the challenge lies in ensuring adequate clinical exposure to meet the required standards [23].

There is a common agreement that greater efforts should be made to compensate for lost clinical time and allow students to receive adequate hands-on training before graduation [19]. Dental colleges have been striving to offer alternatives that may reduce the negative impact of losing hands-on training in laboratories and clinical encounters during the lockdown while at the same time ensuring the safety of everyone involved. Procedural videos and case-based discussions using clinically based scenarios are important tools employed for this purpose [10, 16, 19, 22, 26]. Teledentistry is also an important tool that has been utilized by many colleges, when appropriate, to compensate for lost clinical time and canceled external rotations [16, 23].

Despite all the efforts made to compensate for lost clinical time and experience, graduating dental students and residents are ultimately the most negatively affected. For many of them, essential graduation requirements were unmet at the time of the lockdown. In addition, they may be deprived of opportunities to participate in important externships outside their home institutions before graduation due to mandated national infection control measures [2]. Their graduation may be delayed due to unfulfilled clinical requirements, or alternatively, they may graduate without full clinical experience [7]. Because of this, the responsibility may fall on dental colleges to certify the competency of graduating dental students and residents [11].

Dental colleges have creatively used online assessment during the pandemic with a variety of tools, including multiple-choice questions, essays, virtual oral examinations, and video production [16, 18, 22]. To increase the security of online assessment tools, third-party proctoring, identity authentication and automated plagiarism detection have been utilized by many institutions. [11, 27] Despite its questionable validity, online assessment is a practical alternative to face-to-face exams [19]. The online assessment is cost-effective and facilitates student attendance from various geographic locations [27]. That being said, many licensure examination agencies are rescheduling or cancelling examinations [11, 23]. Several licensing examinations cannot be conducted online because they require the presence of a live patient, which would be a risk to patient and student safety [23]. One of the timely strategies currently under consideration is restructuring the format of licensure and competency examinations. Licensure examinations are required to assess the skills, knowledge, aptitude, and behavior needed to be a competent dentist [11]. Objective structured clinical examinations (OSCEs) along with simulation-based practical assessments could be a valid alternative in many situations, and resources could be shared among colleges to create these exams [11, 19, 23, 28]. Additionally, novel forms of competency assessment with special emphases on diagnostic, critical thinking, and clinical reasoning skills are being considered. Additionally, a more longitudinal and global assessment of student progress toward overall competence is being considered over traditional single-point assessment [28].

In regard to admission applications for new students, the digital platforms that are usually used for applications remain functional. However, to minimize the risk of disease transmission, in-person interviews may transition to virtual interviews. Additionally, grading schemes that have been changed in many dental colleges during the past semester may pose a problem for graduating students when their applications are being considered for residency programs [18]. Incoming class sizes may be reduced, potential applicants might consider postponing their dental training, and the commencement dates of many programs remain uncertain, pending the national status of the disease [18, 23].

While it is fair to assume that student clinics should be resumed following issued directives from governing bodies, it is critical to realize the economic catastrophe that this pandemic has generated and the likely lag in patient flow following the resumption of clinical activity [8, 26]. Putting the financial factor aside, the patient flow will also be affected by modifications to the clinical setup and time schedules that were

made to comply with social-distancing measures in the transitional period following the end of the pandemic, and this will affect overall capacity and the turnover rate [16, 23]. It is therefore imperative that dental colleges continue to create and update contingency plans to account for the medium- and long-term effects of the COVID-19 pandemic on dental education [26]. It is expected that aspects of this modified curriculum may need to persist in making up for the possible reduction in patient flow after the pandemic ends [8]. Contingency plans should also address a possible second COVID-19 wave that may require additional periods of a lockdown or social distancing [28].

Finally, planning how and when dental colleges should return to "normal" and establishing a new routine are considerable challenges that require extensive discussion and elaboration of policies and protocols [16]. Considering that different countries have different experiences and are at different stages of the COVID-19 crisis, it would be very interesting to observe the variety of plans that emerge from different colleges around the world and the manner in which they will be executed [16]. Formulating these strategic and contingency plans may require the formation of a committee within the dental college to carry out this daunting task [16].

The plan should consider epidemiological trends, governmental policies, safety and infection control measures recommended by governing bodies; the availability of human resources; access to COVID-19 testing and adequate personal protective equipment (PPE); modifications to the timetables and physical layout of dental clinics; and preclinical laboratories that allow their operation at a reduced capacity to accommodate small groups at a time in compliance with recommended social distancing [16, 23]. The duration of clinical sessions may need to be reduced to accommodate additional group turnover during the day and compensate for the time needed to perform adequate infection control between groups. Patient reception and waiting areas may need to be redesigned to reduce capacity and ensure social distancing [16]. A pre-entry checkpoint for all patients, faculty, staff and students before entering the clinic is required. At these checkpoints, the temperature is checked, identification, travel and COVID-19 history are verified, and hand sanitizer is provided [16]. It is also recommended that all patients use a hydrogen peroxide mouthwash before treatment [16]. The use of rubber dams and high-volume suction also needs to be reinforced, as they can minimize aerosol production. [16, 11]

3.2. Patient Care

Due to the risk of disease transmission in the dental setting, teaching clinics within dental colleges have been suspended. Student practice has been limited to participation in teledentistry consultations as part of the remote learning experience in some colleges [23]. Most dental colleges have offered urgent dental care provided exclusively by faculty and advanced dental education residents [23]. However, even emergency treatments are limited in many colleges to non-aerosol-generating procedures as recommended by the Centers for Disease Control and Prevention and dental governing bodies [23].

Patients of low socioeconomic status and those without dental insurance rely heavily on the dental care provided at dental colleges and are therefore the group most affected by the disruption of regular dental care during the pandemic. [18] Additionally, with the limitations that are implemented on dental practices in general and the suspension of the dental care that was provided by students in dental colleges, it is expected that delayed diagnoses of diseases with significant clinical impact, such as squamous cell carcinoma (SCC), will occur. This will lead to diagnoses in advanced clinical stages, increasing related mortality and morbidity [28].

The transitional period that will follow the end of the pandemic is a gray area that puts dental colleges in a challenging position. As mentioned earlier, the decision to fully operate dental clinics within colleges is complex and multifaceted [23]. Meanwhile, teledentistry consultations have been utilized during the pandemic to provide patient care while minimizing direct patient contact and in-person appointments. Such consultations also serve to compensate for students' canceled external rotations and lack of clinical exposure. Teledentistry can be used in four main ways: consultation, diagnosis, triaging and monitoring [28, 29]. Although it lacks the essential tactile assessment, teledentistry has proven to be very beneficial for ensuring continuity of patient care, prioritizing patients' needs and potentially alleviating anxiety caused by significant delays in scheduling office visits due to the pandemic [17]. Teledentistry can also reduce the use of PPE and other highly valuable clinical resources during the pandemic [18]. Teledentistry, however, is still struggling with acceptance by both dentists and patients [23, 29].

In addition to the needed virtual infrastructure, which may or may not be adequate, and the current incompatibility with healthcare systems, dentists who are used to conventional in-person patient care may find teledentistry complex, as it requires that they learn new skills, especially if they are technologically challenged. They may also be concerned about making inaccurate diagnoses and the financial burden of the process and its setup. For patients, the lack of in-person communication may lead to apprehension about the possible inadequacy of proper communication of their problems to their dentists [20, 29].

To overcome this challenge, adequate training should be provided to dentists to familiarize them with the details of this technology. Looking ahead, it may be beneficial to routinely teach teledentistry within dental curricula as a solution for the prevention of disease transmission, particularly in times of crisis. In addition, adequate funding and integration of teledentistry within existing healthcare systems will be required [29]. For patients, the acceptability of teledentistry will increase in parallel with the acceptability of telemedicine in general, which is on the rise [29].

3.3. Research

With the suspension of academic activities in dental academic institutions, both basic laboratory-based and clinical research have been negatively affected, leading to a significant hindrance to the research productivity of individual researchers and their institutions [18, 19, 23]. Many ongoing studies are

already delayed and possibly terminated, leading to significant time and financial losses. Grant applications and graduate students' thesis submissions and defenses may be delayed due to a lack of experimental results. In addition, as a consequence of the financial restraints imparted by the pandemic, many institutions have announced hiring freezes, significantly threatening job opportunities for postdoctoral fellows, who are key players in institutional research productivity [23].

On the bright side, manuscript writing and publication activities have been positively impacted during the lockdown as faculty utilize the time that was usually spent in the clinic and for patient care [19]. Research related to COVID-19 has also been on the rise, and it may be a chance for researchers to pursue research in this domain even during the pandemic. Institutional review boards (IRBs) have been expediting the review process of proposals related to COVID-19, allowing researchers to study all aspects of the pandemic and its effects on dentistry and communities at large [28].

3.4. Faculty Development and Collaboration

The research challenges described earlier will consequently affect the promotion and tenure of faculty members involved in the research. Therefore, some universities have implemented policies that provide faculty members additional time to compensate for their reduced research productivity before they are required to challenge for promotion [18].

Although multiple conferences and scientific meetings have been canceled during the pandemic, [18] continuing education activities, whether in the form of conferences, summits, seminars or workshops, have been successfully conducted online at national and international levels [28, 30]. Their popularity and wide acceptance within the dental education community is attributed to their ability to overcome the place constraints of traditional settings, allowing professionals across the world to share ideas by utilizing technology that is readily available and accessible through smartphones, laptops, tablets and personal computers [28, 30].

3.5. Finances

The suspension of clinical activities in teaching clinics within dental colleges has led to a serious financial burden that affects current and future financial management due to the loss of clinical revenue [18, 23]. This burden is further magnified by the need to reimburse clinic fees to students and maintain the ability to pay faculty and staff [23].

With the pandemic negatively affecting the economy at large, patients' ability to afford dental treatment it is doubtful. It is also unclear whether dental colleges will maintain the ability to recruit sufficient patients to their clinics, as they will have to cover additional expenses precipitated by the additional precautions required for infection control and adjustments made to clinical layouts to maintain social distancing [23].

3.6. Psychological Well-Being of Students, Faculty and Patients

The COVID-19 pandemic has affected members of the dental education community on both professional and personal levels. Dental colleges are facing a significant increase in anxiety among students, faculty, staff and patients [11, 23] and therefore must plan strategies to keep them motivated and reduce their anxiety [26].

There is a great deal of anxiety among students who must adjust to modified curricula while being fearful for their safety and concerned about their academic performance, financial debt, and a potential recession's impact on the job market [11, 23, 26]. Guidance and emotional support through counseling sessions in addition to open communication and readily available up-to-date information can help alleviate student anxiety. [11, 14, 16, 26] Attendance and assessment policies should also be modified to reduce anxiety among students [11]. Despite all efforts to contain the negative impact of the pandemic, the student dropout rate is expected to increase. This aspect must also be carefully considered by institutions [26].

Additionally, faculty have been under significant pressure as they attempt to balance the need to convert quickly to unfamiliar new methods of teaching and assessment, comply with dynamic policies set by governing bodies, and at the same time, keep students engaged and motivated [11, 26]. With the new nature of working from home, faculty may find it difficult to set clear boundaries between their personal and professional schedules [3]. For that reason, faculty should reprioritize goals, obtain training on online teaching and receive clear policies and protocols with regard to expectations and responsibilities [3]. Finally, with the pandemic negatively affecting research productivity, colleges should be tolerant with regard to promotion and tenure decisions for faculty [11].

Patients should be able to access information on the school website and be reassured regarding the measures taken by dental colleges to ensure their safety during dental appointments [11]. They can also be offered alternative patient care through teledentistry whenever appropriate. This will help reduce their anxiety regarding significant delays in clinical appointments [17].

While there is no question that this unique journey will impact our profession in significant ways even in the long run, it has allowed us to support each other, give and receive compassion and remember our similarities and common goals [14, 26]. While we may be a long way from the finish line of this pandemic, we must utilize this time to make intentional choices about how we wish to emerge from it as individuals, institutions and societies [14].

4. OPPORTUNITIES

The disruptive, global changes caused by the COVID-19 pandemic are vast and apparent in every discipline including dental education [18, 22]. Despite the magnitude of challenges and tragedies, this pandemic has also influenced many positive outcomes in dental education [23]. The crisis forced dental schools around the world to challenge the status quo and creatively and quickly adapt to ensure the continuity of teaching and learning [18, 25]. This was facilitated by the rapid and innovative use of technology, which is expected to persist after the pandemic [15, 18, 22]. In addition, one of the significantly favorable outcomes that emerged from this public health crisis is the unpreceded level of connection and

communication within the dental education community. This was demonstrated through growing educational cooperation, research collaborations and freedom to create and share learning content. [22, 23] It will be interesting to observe if this current trend will be maintained after the pandemic. Another important outcome is the invaluable experience that dental colleges have gained while managing this crisis. Furthermore, heartwarming compassion has been practiced in the way institutions and their communities have provided key resources to help one another during these difficult times [23].

The pandemic and the way it has influenced dental education by rapidly integrating distance learning has resulted in increased awareness and acceptance of the innovative potential of technology. This could introduce a variety of interesting and new opportunities for learners, such as offering access to part-time students in different parts of the world and providing expedited programs for gifted students [22, 25]. The COVID-19 crisis may be revolutionizing how we will teach in the future [25]. However, while it was necessary to remove all obstacles and ease regulations to allow for maximum creativity in managing education during the COVID-19 crisis, it will be necessary to find a balance where creativity can still be expressed in the presence of appropriate governing regulations. It is essential to evaluate the future pedagogical effects of the different educational methods that were implemented and will perhaps persist after the COVID-19 pandemic ends [12].

There is no replacement for hands-on clinical experience, but this pandemic revealed several alternative domains that may become the future of dental education [18]. Technologies based on haptic and virtual reality (VR) and augmented reality (AR), when adequately enhanced and made affordable and portable, have the potential to mimic patient encounters and aid in the virtual continuity of clinical education and assessment during crises [18]. This may necessitate the development of educational programs such as "learning engineering" related to the utilization of emergent technologies and their use in designing meaningful, versatile, and immersive learning experiences [18, 22].

Meanwhile, it was also suggested that dental colleges should invest in applications and software focused on complex clinically based scenarios that can be used in virtual group discussions to improve students' decision-making and diagnostic skills [26]. Dental colleges can also use this disruption and forced change as an opportunity to invest in online training for faculty so they can create online modules for their courses [11].

Reflecting upon the potential gaps that were identified in dental curricula during this period, several areas of improvement were suggested [18, 31]. Incorporating the topic of infection control further and more comprehensively into the curriculum was suggested [31]. Teaching and practicing teledentistry within dental curricula was also proposed as a potential solution to increase the acceptability of this important modality with dentists and patients [18, 29]. Even after the current pandemic passes, it is expected that teledentistry will remain a part of routine practice in some areas of dentistry, such as oral medicine and surgery, which is an additional justification for its incorporation into dental curricula [17, 27]. It was also suggested that dental colleges should adopt and/or reinforce a high standard infection control-monitoring policy and monitor its implementation through dedicated committees or units [31].

Finally, as we rethink our dental curricula in the context of the future of our profession following this global crisis, dentistry will have to ensure greater convergence with medicine [9, 26]. Our students should be educated more comprehensively and systematically to be able to incorporate medical and social factors into care delivery models [26, 28].

CONCLUSION

The COVID-19 pandemic forced dental educators to rethink models of curricular delivery, as it disrupted traditional delivery methods. The use of technology was adapted to ensure the continuity of education. With that, a number or challenges surfaced that were tackled creatively. Reflecting over the whole experience with COVID-19, the multiple opportunities that have been identified can improve the way we educate our students in the future.

LIST OF ABBREVIATIONS

COVID-19	=	Coronavirus Disease 2019
SARS-CoV-2	=	Severe Acute Respiratory Syndrome Coronavirus 2
WHO	=	World Health Organization
PBL	=	Problem Based Learning
OSCE	=	Objective Structured Clinical Exam
PPE	=	Personal Protective Equipment
SCC	=	Squamous Cell Carcinoma
IRB	=	Institutional Review Board
VR	=	Virtual Reality
AR	=	Augmented Reality

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