The Impact of COVID-19 on Dental Research in Educational Settings: What are the Opportunities?

Mustafa Elhussein, Shoroog Agou

Department of Orthodontics, Faculty of Dentistry, Ibn Sina University, Khartoum, Sudan, *Department of Orthodontics, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia, *Board member of the Saudi Society of Medical Education, Riyadh, Saudi Arabia

Abstract

The COVID-19 pandemic has significantly impacted dental education and research activities, creating challenges for students, educators, and health-care professionals. The unfolding crisis has shed the light on how technology can facilitate not only the delivery of dental education and improving access to dental care but also new and ongoing research. While dental schools worldwide have re-structured their policies and curricula in terms of incorporating appropriate methods of distance learning, this now needs to be applied to dental research where appropriate. By conducting a “strengths, weaknesses, opportunities, and threats” analysis and describing the authors’ experiences, here we discuss the impact of the pandemic on various aspects of dental research to provide a timely perspective on dental research activity in academic institutions to help achieve research outcomes despite the pandemic’s impact.

Keywords: COVID-19, dental education, dental research, dental school

Objective

To highlight that, despite the threats presented by the pandemic, there are several opportunities for dental research including high-quality reviews, retrospective studies, questionnaire-based studies exploiting digital technologies, public health research, teledentistry, and materials and techniques studies targeting both the current pandemic and for preparedness for future pandemics.

Introduction

The rapidly evolving COVID-19 pandemic has significantly impacted the routine delivery of dental education. The pandemic has evoked a range of responses globally including cutting down face-to-face interactions such as teaching, assessments, and educational activities and implementing social distancing.[1] There has been an emergency shift to remote teaching in undergraduate and postgraduate education, with learning management systems and online meeting platforms used to facilitate didactic teaching, case-based learning, case presentations and discussions, and continuing education.[2,3] All dental students have suffered, but senior dental students in their final years have been most disadvantaged through the lack of the normal learning environment facilitating transition to practice.

However, this unexpected shift in approach has created online communities of practice in many parts of the world, where best practices, clinical tips, and “tricks of the trade” have been shared. While there is some variation worldwide, most dental schools have stopped clinical training and implemented social distancing measures. This unprecedented disruption has created anxiety and uncertainty among dental students in their final years, with their clinical training either being limited to the provision of urgent dental care or cancelled in its entirety.[4] Needless to say, dental students providing dental care procedures, along with other health-care providers, are at high risk of cross-infection.[5,6] Dental schools are increasingly adopting technology to facilitate online examinations where...
appropriate in an attempt to reduce the impact of the disruption and to enable students to progress to the next phase of their careers. Dental students are inevitably subjected to a frequent number of “potential contacts,” leading to their graduation requirements, particularly clinical skills requirements, being partially or entirely waved. The transition from dental school to practicing dentistry in the “real world” is often preceded by a period of structured foundation training and in light of the current climate, dental schools should offer unprecedented support and mentoring to the future dental workforce to ensure competency.[7]

Similarly, dental research has been affected by the pandemic, with some areas impacted more than others.[8] The pandemic has shifted demand and calls for research and development to COVID-19, with major funding redirected to COVID-19-related research. This has led to a paradigm shift in the global dental research agenda which has prompted, to name a few, an increase in public health research to support the COVID-19 response; the use of online survey platforms; limitations to clinical research and disruption to ongoing projects; and a focus on outcomes of clear aligner therapy in orthodontic treatment.

The potential impact of these events on dental research should not be disregarded. The advent of telehealth in various health-care settings has helped to bridge the gap between health-care providers and patients, consequently leading to dramatic changes in the provision of dental services and patient pathways. Electronic triage systems are now in place to carry out risk assessments to establish and determine whether a patient can be managed remotely or face to face.[9]

Most dental school programs have a research project component incorporated into the curriculum, and graduate students in particular may have ongoing research projects with a requirement to evidence completion of the curriculum. Based on strengths, weaknesses, opportunities, and threats (SWOT) analysis and the authors’ experiences, here we aim to highlight appropriate research opportunities for the dental school setting and describe a number of the experiences encountered.

**Methods**

The current COVID-19 literature was evaluated and complemented with a SWOT analysis of research opportunities in educational settings and our experiences conducting research in two universities in the Middle East and North Africa region. A narrative review was carried out rather than a systematic review, as the topic is based on the recent COVID-19 pandemic, as there are still some aspects awaiting to be revealed. We have searched PubMed and Google Scholar. In an attempt to capture all relevant information, no defined inclusion criteria were applied, and no attempt was made to exclude any relevant literature. The study was reviewed and approved by the Research Ethics Committee at the Faculty of Dentistry of King Abdulaziz University in Saudi Arabia on July/2020 (no. 004-150).

**The strengths, weaknesses, opportunities, and threats framework**

In the SWOT analysis, we aimed to review the current state of research in educational settings to provide a timely perspective to help others achieve research outcomes. Conceiving and designing studies to yield high-quality evidence and that are suited to dental schools in the current COVID-19 pandemic is challenging, and several types of research methodology may be more appropriate to dental schools than other educational settings.

**Results**

**STRENGTHS of dental research in educational settings**

Dental schools provide a considerable number of dental treatments, particularly in large cities. These dental services are mainly delivered by dental students and help make dental schools more accessible to patients, since the provision of dental services is free of charge, albeit with some variation. Hence, there are several advantages related to this, but not limited to the presence of research ethics committees; established mechanisms for obtaining funding and grants; a high volume of dental treatment; treatment carried out by well-qualified faculty and dental students under supervision; different patient populations; and interdisciplinary research settings. Among the disadvantages, the limited and sometimes highly selected patients treated in dental schools might not resemble those treated in clinical practice, i.e., the dental school setting may not mirror real-world settings.

The current environment favors conducting research projects that minimize “potential contacts.” Dental research can take various forms ranging from systematic reviews and meta-analyses, which are high in the evidence-based pyramid, to Case Reports (CARE), which are considered low-quality evidence. Clinical systematic reviews aim to synthesize the best-available evidence, ideally from controlled clinical trials, hence are considered to yield high-quality scientific evidence on interventions. Systematic reviews may also demonstrate or reveal knowledge or evidence gaps, thus guiding future research. Systematic reviews therefore appear to be a suitable form of research in the current COVID-19 pandemic. There has been an exponential growth in data and research on COVID-19, particularly from China and countries that were disproportionately affected in the early period of the pandemic like Italy.[9] Nevertheless, systematic reviews can be conducted collaboratively and remotely to incorporate their different elements including literature review and meta-analysis.[10]

**WEAKNESSES of dental research in educational settings**

While conducting research in dental schools has many strengths, it also has its limitations. For instance, the majority of dental treatment is carried out by faculty and students who are less susceptible to time constraints and cost-effectiveness than practitioners working in clinical practice.[11]

Nevertheless, clinicians in dental practices are increasingly involved in dental research. Such research activity can be
Conducted independently or in most instances mentored and in collaboration with academic institutions. Practice-based dental research has the advantage of being more inclusive, i.e., representing the real-world setting, since such practices have access to diverse patient cohorts. This can enhance the reliability and applicability of the research and ensure a balanced distribution of factors influencing intervention outcomes, provided that ethical considerations are heeded and diagnostics, and other confounding factors are calibrated, among other factors.

The time constraints imposed by a student’s course duration are a further weakness. While likely to hinder masters’ students more than doctoral students due to the shorter period of study, the length of the course impacts the type of project that can be carried out. For instance, a laboratory-based project generally needs more time to complete and must be carried out “in person” to produce robust and reproducible results.

**OPPORTUNITIES for dental research in educational settings**

Academic institutions worldwide are considered the dominant research force. As of September 12, 2020, an estimated 91,000 COVID-19-related articles have been published. This has rendered the unfolding COVID-19 pandemic a “publishing phenomenon,” particularly in the following top-five research categories: public health and health services; medical microbiology; medical and health sciences; clinical sciences; and biological sciences.

**Reviews**

There has been a substantial increase in the number of COVID-19-related review articles, which can be considered one of the main opportunities to address the impact of the pandemic on dental research. Such research has ranged from rapid reviews to systematic reviews and meta-analyses, helping and continuing to derive guidelines, inform policy, and establish operational procedures. These are currently being implemented in many settings worldwide.

**Retrospective studies**

In addition, given the high volume of treatment normally carried out in dental school clinics, the current environment provides an opportunity to design and carry out retrospective analyses of patient records and data, despite the limitations of this methodology.

**Questionnaire-based studies**

Further opportunities may also be derived from questionnaire-based studies, ideally adapted to the digital format. This is of particular interest to graduate students with ongoing research projects and who have had their studies and clinical training disrupted by the pandemic. Such innovation can be deemed a positive outcome from this catastrophe, as it can increase and enhance virtual research activity and collaborations worldwide.

**Public health research**

Dentistry is deemed to be one of the most at-risk health-care professions during the pandemic, creating an urgent need to establish guidelines and clinical protocols for the working environment. Public health research has already generated many COVID-19-related guidelines, particularly with regard to the resumption of dental services, patient management, workforce issues, and dental training. The epidemiology of COVID-19 is likely to reshape current and postpandemic research in different settings. Coronavirus pandemic-related data are continuously emerging, which will stimulate further investigations and influence the epidemiology of COVID-19.

**Efficacy of materials and techniques**

Innovation in materials and the evaluation of the efficacy of personal protective equipment will arise as opportunities for dental research. Given the surge in mask and glove wearing and handwashing, it would seem ideal and appropriate to assess new materials and techniques in this respect. Other clinical aspects relevant to protection against SARS-CoV-2 might also create opportunities in various areas including, but not limited to, infection control and risk strategies; aerosol-generating procedures and instruments; antiviral mouthwashes and oral microbiology; medical waste disposal; dental environment disinfection; dental unit water lines; and high-volume aspirators.

Nevertheless, in vivo evaluation of such innovations might be hindered due to the every-changing epidemiology of the disease. In vitro or ex vivo assessments may be more appropriate during early assessment phases where appropriate and feasible.

**Teledentistry**

Dental service provision is currently very variable. Government measures are still in place in most parts of the world to reduce the risk of cross-infection, limiting provision to emergency treatments and mandating the use of nonaerosol-generating procedures. Teledentistry has facilitated electronic triage and remote patient management to ensure appropriate allocation of dental services and to prevent unnecessary patient attendance.

This has created opportunities to explore the outcomes of clear aligners in orthodontic treatment. Clear aligners have been widely used over the past decade in orthodontic treatment. In contrast to conventional fixed appliances, clear aligners require minimal patient attendance and involve minimal or no aerosol-generating procedures in many cases. While they are inherently employed to manage mild malocclusions, they are increasingly being used to address more severe malocclusions. Nevertheless, effectiveness and efficacy studies of clear aligners compared to conventional fixed appliances are lacking.

**Inclusion and equity**

The unfolding COVID-19 pandemic has unveiled and highlighted biases and inequalities in health-care provision, with discrimination against patients and dental staff of various descents becoming apparent in some regions. Universities and the dental community must therefore support inclusive research environments for students and faculty during such
THREATS to dental research in educational settings
Clinical dental research is likely to be impacted the most by the pandemic, and it may become difficult to justify and obtain the necessary funding for clinical research. A considerable amount of dental school research is allocated to graduate students to partially fulfill their graduation requirements. The pandemic has led to university closures or suspension of usual operations, subsequently resulting in the postponement of the enrolment of undergraduate and graduate students and dental specialty trainees. This has particularly impacted dental specialty training that involves treating patients. A further threat may arise from a low volume of patients attending dental clinics and hospitals due to currently adopted patient pathways and a failure to reassure patients that the dental environment is safe. Ultimately, this will also impact practice-based research. Ongoing research has also been scaled back in laboratories, which may have also impacted graduate students’ research projects and delayed their academic progression.

OUR EXPERIENCE
Here, using two cases from our own experience, we highlight how research projects were allowed to progress in two different universities. The first example highlights a project conducted in the undergraduate dental setting and the second in the graduate setting.

Case 1 – Digital adaptation of visual analog scales
Telehealth has facilitated students and their mentors to collect, analyze, and disseminate data from home. A visual analog scale (VAS) is an instrument originally developed to help individuals self-rate the intensity of a subjective feeling such as pain and anxiety. For instance, using a 100-point VAS, a patient marks a point on a scale that corresponds to their perceived pain or anxiety. In dentistry, VAS has increasingly been utilized to obtain before and after ratings from patients receiving various types of dental care. Therefore, VAS is a useful tool in dental research, not least because it has been shown to be a reliable and valid measure, and VAS is adaptable to webpages for data collection, hence eliminating the risk of “potential contacts.”

As shown in Figure 1, data were collected in one study using two different methods: (1) A paper-based survey and (2) a web-based survey. The objective of the study was to investigate the perception of smile esthetics by dental students and to see how this compared to medical students at the same university, with the intention of evaluating the impact of dental training on developing smile esthetics perception. The two VAS types were used to collect data from undergraduate dental students and medical students, the intention being to compare the results obtained by the two methods and evaluate any differences. More generally, there has been an increase in the use of VAS with dental images or facial images, and this approach has become an established method for assessing smile esthetics. VAS has also been shown to be a reliable and valid tool for obtaining judgments from assessors on smile aesthetics in a number of studies.

Example 2 – Digital adaptation of dental indexes
In a second study, we adapted the Index of Orthodontic Treatment Need Aesthetic Component (IOTN-AC) to a webpage format, thus providing a guide for rating photographs in an online survey [Figure 2]. The objective of the study was to evaluate changes in esthetic appearance using photographs obtained before and after orthodontic treatment. The IOTN was developed to determine the threshold need for orthodontic treatment in UK National Health Service dentistry. Several indices have been developed to record malocclusion; the IOTN was designed for direct application to the patient’s occlusion or, in a slightly modified form, to dental plaster study models of patients. IOTN-AC is the second part of the IOTN consisting of a scale of ten colored photographs showing different levels of dental attractiveness [Figure 2b]. Grade 1 represents the most attractive arrangement of teeth, while Grade 10 represents the least. Hence, the grade reflects the esthetic impairment of an occlusion.

DISCUSSION AND CONCLUSION
As highlighted in our SWOT analysis, summarized in Figure 3,
there are numerous opportunities for dental research in spite of the constraints imposed by the current pandemic. Rather than reducing the quality of research, attempts should be made to leverage the current crisis and aim to carry out high-quality research despite the threats and weaknesses. The surge in COVID-19-related research is generating an enormous amount of untapped data that can be synthesized using best-practice methodologies to produce more reliable evidence such as systematic reviews. The current crisis provides an opportunity for educators and students to focus not only on generating results but also research training such as in the methodologies and statistical techniques that ensure competency and quality in research. For example, systematic reviews conforming to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines will not only produce research output of high quality but also develop necessary and relevant transferable research skills including critical appraisal, risk of bias assessment, data synthesis, and team building. At the other end of the quality of evidence pyramid, even CARE are of value when trying to understand a new threat like SARS-CoV-2 but, in terms of educational value and skills development, should adhere to best practice guidelines such as CARE.

Our case studies highlight that embracing technology also provides an opportunity for research continuity. In our examples, online surveys provide a modern, innovative, and relevant methodology for today’s dental students and facilitate the use of valid and reliable methods for data collection. The webpages used in the highlighted studies were developed using simple combination of JavaScript and the ASP.NET framework,
again providing an opportunity for contemporary training in basic computer programming. The pandemic has shed the light on the need for innovation; thus, there should be a shift toward digital adaptation of such tools, which are already frequently used in dental research, in the hope that they will reduce the negative impact of future spikes or waves on our profession. Provided that both educators and students are adaptable, the COVID-19 crisis provides an opportunity to re-evaluate how research is conducted and delivered in the dental school setting.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Bennardo F, Buffone C, Fortunato L, Giudice A. COVID-19 is a challenge for dental education – A commentary. Eur J Dent Educ 2020;24:822-4.

2. Zaharias P, Poylymenakou A. Developing a usability evaluation method for e-learning applications: Beyond functional usability. Int J Hum Comp Interact 2009;25:75-98.

3. Liu X, Zhou J, Chen L, Yang Y, Tan J. Impact of COVID-19 epidemic on live online dental continuing education. Eur J Dent Educ 2020;24:786-9.

4. Desai BK. Clinical implications of the COVID-19 pandemic on dental education. J Dent Ed 2020;84:512.

5. Burke FT, Mackenzie L, Sands P. Suggestions for non-aerosol or reduced-aerosol restorative dentistry (for as long as is necessary). Dent Update 2020;47:485-93.

6. Meng L, Hua F, Bian Z. Coronavirus disease 2019 (COVID-19): Impact on the dental profession. J Med Virol 2020;92:1386-90.

7. Doughty F, Moshkun C. The impact of COVID-19 on dental education and training. Dent Update 2020;47:272-8.

8. Barabari P, Moharamzadeh K. Novel coronavirus (COVID-19) and dentistry – A comprehensive review of literature. Dent J 2020;8:53.

9. Armocida B, Formenti B, Usai S, Palestra F, Missoni E. The Italian health system and the COVID-19 challenge. Lancet Public Health 2020;5:e253.

10. Long Y, Hu T, Liu L, Chen R, Guo Q, Yang L, et al. Effectiveness of N95 respirators versus surgical masks against influenza: a systematic review and meta-analysis. JEBM 2020;13:93-101.

11. Burke F, Crisp R, Mc Cord J. Research in dental practice: A ‘SWOT’ analysis. Dent Update 2002;29:80-7.

12. Klinke T, Daboul A, Schwahn C, Frankenberger R, Hickel R, Biffar R. Intervention to reduce aerosolized sprays administered to patients with suspected or confirmed COVID-19 infection to improve patient outcomes and to protect healthcare workers treating them. Cochrane Database Syst Rev 2020;9:CD013627.

13. Wilson NH, Mjör IA. Practice-based research: Importance, challenges and training. Dent Update 2020;47:485-93.

14. Meng L, Hua F, Bian Z. Coronavirus disease 2019 (COVID-19): Impact on the dental profession. J Med Virol 2020;92:1386-90.

15. Trivedy C, Mills I, Dhanyoa O. The impact of the risk of COVID-19 on Black, Asian and Minority Ethnic (BAME) members of the UK dental profession. Br Dent J 2020;228:919-22.

16. Office for National Statistics. Coronavirus (COVID-19) Roundup. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19roundup/2020-03-26. [Last accessed on 2020 Aug 09].

17. Aitken RC. Measurement of feelings using visual analogue scales. Proc R Soc Med 1969;62:121-3.

18. Appukuttan D, Vinayagavel M, Tadepalli A. Utility and validity of a single-item visual analog scale for measuring dental anxiety in clinical practice. J Oral Sci 2014;56:151-6.

19. Amralaite J, Jarutienė M, Vasiliauskas A, Sidlauskas A, Svalkauskiene V, Sidlauskas M, et al. Smile aesthetics as perceived by dental students: A cross-sectional study. BMC Oral Health 2018;18:225.

20. DeVellis RF. Scale development: Theory and applications. Vol. 26. California, United States:jm Sage publications; 2016.

21. Schabel BJ, McNamara JA Jr., Franchi L, Baccetti T. Q-sort assessment vs visual analog scale in the evaluation of smile esthetics. Am J Orthod Dentofacial Orthop 2009;135:561-7.

22. Khan M, Kazmi SM, Khan FR, Samejo I. Analysis of different characteristics of smile. BDJ Open 2020;6:6.

23. Flores-Mir C, Major PW, Salazar FR. Self-perceived orthodontic treatment need evaluated through 3 scales in a university population. J Orthod 2004;31:329-34.

24. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989;11:309-20.

25. Angle EH. Classification of malocclusion. Dent Cosmos 1899;41:350-75.

26. Reisch J, Krebs A, Solow B. A method for epidemiological registration of malocclusion. Acta Odontol Scand 1964;22:919-22.

27. Office for National Statistics. Coronavirus (COVID-19) Roundup. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19roundup/2020-03-26. [Last accessed on 2020 Aug 09].

28. Aitken RC. Measurement of feelings using visual analogue scales. Proc R Soc Med 1969;62:121-3.

29. Antonio-Zancajo L, Montero J, Albalead O, Otero-Calatayud MD, Alvarado-Lorenzo A. Pain and oral-health-related quality of life in orthodontic patients during initial therapy with conventional, low friction, and lingual brackets and aligners (Invisalign): a prospective clinical study. J Clin Med 2020;9:2088.

30. Aitken RC. Measurement of feelings using visual analogue scales. Proc R Soc Med 1969;62:121-3.

31. Appukuttan D, Vinayagavel M, Tadepalli A. Utility and validity of a single-item visual analog scale for measuring dental anxiety in clinical practice. J Oral Sci 2014;56:151-6.

32. Amralaite J, Jarutienė M, Vasiliauskas A, Sidlauskas A, Svalkauskiene V, Sidlauskas M, et al. Smile aesthetics as perceived by dental students: A cross-sectional study. BMC Oral Health 2018;18:225.

33. DeVellis RF. Scale development: Theory and applications. Vol. 26. California, United States:jm Sage publications; 2016.

34. Schabel BJ, McNamara JA Jr., Franchi L, Baccetti T. Q-sort assessment vs visual analog scale in the evaluation of smile esthetics. Am J Orthod Dentofacial Orthop 2009;135:561-7.

35. Khan M, Kazmi SM, Khan FR, Samejo I. Analysis of different characteristics of smile. BDJ Open 2020;6:6.

36. Flores-Mir C, Major PW, Salazar FR. Self-perceived orthodontic treatment need evaluated through 3 scales in a university population. J Orthod 2004;31:329-34.

37. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989;11:309-20.

38. Angle EH. Classification of malocclusion. Dent Cosmos 1899;41:350-75.

39. Björk A, Krebs A, Solow B. A method for epidemiological registration of malocclusion. Acta Odontol Scand 1964;22:919-22.

40. Evans R, Shaw W. Preliminary evaluation of an illustrated scale for the assessment of dental attractiveness. Eur J Orthod 1989;11:309-20.

41. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. J Clin Epidemiol 2009;62:e1-34.

42. Gagnier JJ, Kienle G, Altman DG, Moher D, Sox H, Riley D, et al. The CARE guidelines: Consensus-based clinical case reporting guideline development. J Med Case Rep 2013;7:223.