

**EMERGENCY REMOTE TEACHING WITH TECHNOLOGY DURING COVID-19 AND THE IMPACT IT HAS HAD
ON DENTAL AND DENTAL HYGIENE EDUCATION IN THE UNITED STATES**

MASTER'S DEGREE IN DENTAL HYGIENE

DENTAL HYGIENE RESEARCH

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Abstract

The coronavirus (Covid-19) is an acute infectious disease leading to a global pandemic (Gaudin, 2020). Dental and dental hygiene education have changed due to the COVID-19 pandemic which resulted in the need to introduce different ways to address educational methodologies. The dental and dental hygiene curriculum includes didactic/lecture/problem based learning, laboratory and clinical skill training which all had to be addressed due to the pandemic thus necessitating changes in the delivery methods of the educational curriculum. Many educators and students did not have a choice and emergency remote learning became the new norm. Educators and students were not familiar with or knowledgeable about the different types of technology that was available and had to learn together. The COVID-19 pandemic has led to an urgent need for engaging alternatives to traditional laboratory, clinical and lecture based exercises, which have not been used before in dental and dental hygiene education.

The purpose of this study was to determine how emergency remote teaching with technology during Covid-19 has been addressed and the impact it has had on dental and dental hygiene education. It was used to determine if remote online learning had a positive or negative effect on instruction via different technological platforms. It was also used to gain an understanding of how teaching with technology impacted students' experiences of didactic, laboratory and clinical skills acquisition.

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CHAPTER 1

Introduction

Statement of the Problem

This study is designed to evaluate emergency remote teaching during Covid-19 and the impact that it had and will continue to have on dental and dental hygiene education in the United States. To what extent has the transformation of online teaching with the use of technology impacted the education of dental and dental hygiene students?

Purpose of the Study

The purpose of this study is to determine the methodology used to replace didactic, laboratory and clinical experiences and the resulting effects during Covid-19 on dental and dental hygiene education.

Significance of the Study

The significance of the study is that the value of this research will prove if the emergency remote learning methods and the implemented technology have had a positive or negative effect on dental and dental hygiene education. The information will benefit educators by provide teaching practices during a pandemic. It will also prepare educators with different teaching options that can be incorporated into dental and dental hygiene curriculums in the event of future challenges where didactic, clinical and laboratory exercises cannot be conducted on campus. Future research will enable educators to gain a thorough understanding of the impact of evolving technology and the tools that are at their disposal that can benefit dental and dental hygiene students throughout the curriculum.

Limitations of the Study

The Covid-19 pandemic is barely a year old in terms of academic research and thus, few publications and peer reviewed studies are available.

Delimitations of the Study

Due to this lack of research from US 2020/2021 dental/dental hygiene students and faculty, it was challenging to determine a comprehensive and complete impact of dental and dental hygiene education during the pandemic. Due to the large number of potential participants required for the dental and dental hygiene students and the newness of the pandemic I was unable to find research that would provide the necessary information to answer my research statement.

We know that the Covid-19 pandemic has fundamentally changed the role of educators. There were about 103 million confirmed cases and 2.2 million deaths to date (John Hopkins University, 2021). Covid-19 pandemic had an impact on social, economic and political life. The restrictions of mobility created by the social distancing caused one of the largest disruptions in the educational system. One billion six hundred million students in more than 190 countries have been affected (United Nations, 2020). The closure of schools has affected 94% of students worldwide. With the students at home, institutions needed to continue classes, upholding the quality of education while maintaining proper social distancing (Iyer, et. al., 2020). Dental education has a very direct, interactive curriculum particularly in preclinical. Due to the hands-on nature of the profession, students rely heavily on feedback from instructors regarding their preclinical work.

ADEA's member institutions are actively responding to the novel Covid-19 pandemic in dental education (ADEA, 2021). Schools and programs are working with their colleges, universities, academic health centers and state health departments to make informed decisions to ensure not only the safety of their patients, but of all members of the health and education team (ADEA, 2021).

Classroom instruction has been moved online and preclinical simulation instruction is continuing at some institutions but is being conducted with social distancing (ADEA, 2021). Most schools and programs limited patient care only to urgent or emergency needs, with advanced dental education residents and faculty providing most of this care (ADEA, 2021). External rotations and travel have generally been cancelled either by the school or the facility (ADEA, 2021). Many licensure examination agencies rescheduled examinations and graduation ceremonies and associated events were delayed, cancelled or moved online in some virtual manner (ADEA, 2021).

The ongoing COVID-19 pandemic and its impacts on educational institutions, curriculum, and clinical practice is arguably unprecedented. Dental and dental hygiene students are not immune to the effects of COVID-19 especially as it relates to their psychological well-being, uncertainty, and concerns related to training. Dental education needs to be responsive, adaptive, and must include a focus on psychological well-being, including efforts to reduce anxiety levels of its students and workforce. Educators need to quantify the impact of emergency remote learning during COVID-19 and the psychological well-being of dental/dental hygiene students through a pandemic.

This is a time where dental educators have the opportunity to enhance the curriculum to more specifically focus on strategies for practicing during a pandemic. Regular, transparent, and compassionate communication with students are needed to address concerns related to an adaptive and/or expanded curriculum, as this may relieve some of the anxiety and stress they experience (Wu, et. al, 2020).

Each year over 6,700 dental hygiene students graduate from close to 330 Commission on Dental Accreditation (CODA) accredited US dental hygiene education programs (Yiyang, et. al, 2020). The American Dental Education Association (ADEA) requires that dental hygiene education programs teach every clinical skill routinely performed by a registered dental hygienist to competency. In addition to general education, basic sciences, and dental science courses, accredited dental hygiene programs require an average of 659 clocked hours of supervised instruction in pre-clinical and clinical practice both within the institution and at extended clinical facilities in the community or in public health settings. However, difficulties lie for students as they move from the classroom to the clinic even though they have been trained and educated on the basic skills for risk assessment, scaling, polishing, patient education, etc. via traditional dental hygiene curricula (Yiyang, et. al, 2020).

Minimal research exists to examine the COVID-19 impact on dental hygiene education. Data is still limited, particularly when considering preclinical and clinical training success (Machado, et. al, 2020). Therefore, it is important to investigate this impact considering the seemingly overnight change from educational setting lectures to online learning. Additionally, the lack of student clinical time in a clinical environment, and lack of laboratory exercises in a

laboratory setting must also be examined, all with the singular purpose to help understand the impact of the current learning methodologies.

Coronavirus disease 2019, officially changed to COVID-19 by the World Health Organization (WHO) in early February 2020, was initially identified in Wuhan, China on New Year's Eve day of 2019 (Jena, 2020). The disease has affected over 4.5 million global citizens (WHO) and 90% or more of the world's students according to a UNESCO report (Jena, 2020). The Covid-19 pandemic has spread globally and forced governments to enact strict social distancing as a combative measure against the disease (Jena, 2020). As a result, many country's economic future could be uncertain because of the correlating disruption to the education sector (Jena, 2020).

The WHO began advising governments to enact social distancing and lockdowns as a preventative means to control or flatten the infection rate and most education sectors across the globe were closed (Jena, 2020). In a matter of one week, all dental hygiene programs in the U.S. were closed. Dental hygiene education would never be the same and for the past several months dental hygiene program directors, faculty, students, professional associations, state dental boards, and legislators have been grappling with COVID-19 (Stolberg, 2020). In the United States as well as the rest of the world, proper dental education and recommendations for social distancing to protect students, faculty, staff and patients' were few and far between (Machado, et. al., 2020). Student's schedules and traditional classroom/laboratory experiences were shuttered as well forcing educators to look to digital modeling. (Jena, 2020). Educators needed to incorporate a students' wellbeing not limited to loneliness and familiar losses (Machado, et. al., 2020). Complying with state and government agency recommendations while

engaging and motivating students to continue to learn is a struggle for the most tenured faculty and administrator (Iyer, et. al., 2020).

Covid-19 distressed the globe and continues to be challenging for all to bear while the education sector continues to be one of the worst sectors of the Coronavirus outbreak (Onyema, et. al., 2020). UNESCO Director-General Azoulayals, cited by VOA News (2020), warned that “the global scale and speed of the educational disruption due to coronavirus is unparalleled and, if prolonged, could threaten the right to education” (Onyema, et. al., 2020). Indeed, school closures could lead to student engagement drop-off leading to a lack of interest and poor performance. This could undoubtedly result in significant poor academic performance (Onyema, et. al., 2020). Successful graduation models were rebuilt as professors continued to both work from home (WFH) while providing remote courses and examinations (Machado, p. 1). Although technology can augment many elements of the traditional classroom and clinical and laboratory characteristics, including face-to-face video interactions, it cannot completely replace hands-on and physical demonstrations (Onyema, et. al., 2020). However, educators, although scrambling, are adapting to not only the government mandated social distancing and self-quarantine, but social isolation and duration of the pandemic (Machado, et. al., 2020).

As a new reality for institutions, educators and students set in, cutting edge technologies and new technological platforms surfaced to meet educators needs to mitigate the impact of epidemic disease (Onyema, et. al., 2020). Necessity continually breeds innovation and intensively used platforms for theoretical content exchange such as email, Google educational tools, Skype, Facebook, Instagram, YouTube, WhatsApp, etc. were adapted (Machado, et. al., 2020). In fact, mathematical model and empirical analysis suggest the

proactive closures of school and teaching facilities proves to be a significant beneficial intervention to mitigate the epidemic impact. Conversely, reactive closures in past epidemics indicate that community cases decrease approximately 25% and postpone the peak by a mere week or two (Machado, et. al., 2020).

As a result of the lockdown and the subsequent cancellation of classes, exams, internships, etc., educational institutions chose online modes (Jena, 2020). Due to the confinement forced by the COVID-19 pandemic, face-to-face educational activities were suspended nationwide (Machado, et. al., 2020). At first, all involved, both educators and students, struggled with coping and understanding the magnitude and scope of the pandemic effects only to realize later that the lockdowns served as yet another learning opportunity (Jena, 2020). The fact is that Covid-19 forced educational institutions to both improve their infrastructure and strengthen their technological knowledge and capacity (Jena, 2020).

The delivery of lectures through video maintained didactic courses while other educational activities online added continuity to the learning experience. In addition, new forms of classroom conference were implemented in many institutions via videoconferencing systems like Zoom, Jitsi, Microsoft Teams and Webex (Machado, et. al., 2020). Still other institutions advocated the use of personal platforms to improve communication between professors and students like Moodle (Machado, et. al., 2020). Some nations, such as China, had already established a centralized system which may have yielded a simpler version of digital learning (Jena, 2020). This is in stark contrast to a country such as India where students are not well equipped with the advantages of high-speed internet connectivity nor advanced digital products (Jena, 2020). In addition to the students, most educational institutions in India cannot

cope with the change to online education from their traditional education model (Jena, 2020). However, little evidence exists regarding how these educational matter adaptations and media platforms actually impact student formation and knowledge solidification (Machado, et. al., 2020). As aforementioned, US dental institutions continue to reel from the consequences of COVID-19 (Iyer, et. al., 2020).

Little information exists for dentistry to ensure the continuity of dental education when considering recommended guidelines including “shelter in place” with social distancing to protect students, faculty, staff and patients (Iyer, et. al., 2020). With such a fluid environment, it is essential that dental schools implement policies and protocols to protect staff, students, faculty and patients in an appropriate and timely manner (Iyer, et. al., 2020). Successful graduation models were rebuilt as professors continued to both work from home while providing remote courses and examinations (Machado, et. al., 2020).

As we navigate through the pandemic, the dental community continues to discover and re-discover technology and tools that have been available for nearly two decades (Amyot, 2020). A chance exists for the dental community to embrace technology and advance the world of teaching and learning (Amyot, 2020). From this crisis, educators can re-take their command of educating students by using their knowledge and experience to define both what is and what is not helpful in teaching and learning environments (Amyot, 2020). The opportunity exists for many dental schools to invest in online training for faculty to capture new and creative online modules for their courses (Iyer, et. al., 2020).

CODA released a statement allowing programs to maximize on-line learning (Stolberg, 2020). If faculty could demonstrate competency assessment on-line, it was acceptable.

Program directors and faculty had the opportunity to think outside the box and find new ways to ensure graduates were competent. Dental hygiene faculty now have a huge cadre of on-line assessment and teaching methods that stretched their creativity and skills. The immediate move to on-line only education required stamina, patience and collaboration including webinars which focused on creative and useful on-line learning methodologies (Stolberg, 2020).

The future effects of COVID-19 on dental education are yet to be realized. Budgets are of grave concern. While students don't generate large amounts of income in the educational clinics, some programs rely on that income to stay in business (Stolberg, 2020). Colleges of all sizes, in all locations, are facing large budget shortfalls due to decreased state government support and/or loss of income from students leaving campuses and dormitories. Program directors are forced to deal with budget shortcomings while also purchasing more PPE than ever before (Stolberg, 2020).

Along with the pandemic, a national crisis on diversity and inclusion has surfaced. What are the mental health considerations for dental hygiene students and faculty returning to their campus communities? Faculty have lost loved ones. Students have lost jobs. Families have lost security. Dental hygiene programs are working hard to provide an equitable inclusive, safe, supportive and welcoming environment for all students (Stolberg, 2020). The role of the professional association has never been more important and the sense of community and networking offered by associations such as ADHA, is unmeasurable in times like this (Stolberg, 2020).

Organization of the Study

Chapter 1 has presented the introduction, statement of the problem, research statement, significance of the study, and limitations of the study. Chapter 2 contains the review of related literature related to Covid-19 and the impact on dental and dental hygiene education due to the emergency remote learning. The methodology used to gather data for the study are presented in Chapter 3. Chapter 4 contains a summary of the findings, conclusions drawn from the findings, a discussion, and recommendations for further study.

CHAPTER 2

Review of Literature

The focus of this research topic is emergency remote teaching in didactic, laboratory and clinical settings during Covid-19 and the impact it has had on dental hygiene education. This chapter will provide an understanding of the demand for dental education during a pandemic. This is important because the epidemiology experts predict that a second and third wave of COVID-19 pandemic is highly likely. Dental institutions were required to adhere to strict regulations and clinical requirements set for its students and residents by the Commission on Dental Accreditation (CODA). CODA is the respective US national accrediting agency that serves the public and the profession by ensuring the continuous quality of dental education programs. Considering this and to ensure continuity of education, dental school interim policies and protocols to protect staff, faculty and patients must be implemented by making appropriate and timely teaching and learning method modifications (Iyer, et. al., 2020).

Dental Hygiene Education

Dental hygiene education is mainly composed of three parts: The first is a Lectures/Problem Based Learning part. (Chang, et. al., 2020). The second part is a laboratory course and the third part a clinical skill training. All dental schools must determine potentially successful anticipated pandemic related educational program modifications considering associated institutional, operational, teaching and learning capacities (Iyer, et. al., 2020). Dental and dental hygiene schools are competitive, rigorous, and demanding learning environments. They differ fundamentally from medical education with respect to instruction in technique and

education in scientific and critical thinking. Dentistry as a profession demands both intellectual and technical skills that depend on clinically relevant education in the basic sciences and scientifically informed education in clinical care. Within the U.S. context, dental schools have a 2-year preclinical and a 2-year clinical sciences curriculum designed to prepare students for licensure and practice after graduation.

Simply put, dental education is a profession with close contact between human beings (Chang, et. al., 2020). The onset of the ongoing novel coronavirus disease 2019 (COVID-19) pandemic had direct implications for student training. Dental providers, including trainees, are at high risk of infection given the mode of transmission of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Indeed, the Occupational Safety and Health Administration (OSHA) classified dental providers as very high-risk category because of the potential for exposure to the novel coronavirus through aerosol-generating procedures. This presents a unique challenge for the dental and dental hygiene students due to the nature of the clinical environment, where high aerosols and droplets are generated during routine dental procedures.

Academic dental institutions across the U.S. have actively responded to the COVID-19 pandemic according to their institutional setting, resources, and state and federal guidelines. Student training has specifically been impacted given the implementation of various response strategies, including but not limited to moving classroom instructions online, limiting patient care, canceling external rotations and professional meetings, and rescheduling of licensure examinations. The resulting postponement of direct patient care, a key component of the

dental and dental hygiene curriculum, has been the biggest challenge to dental and dental hygiene education.

Online lectures or demonstrations becomes an inevitable technique for future dental education (Chang, et. al., 2020). Students and faculty must become technologically competent (Chang, et. al., 2020). The increasing use of technology in education has modified teaching methodology from the traditional approach that often place them as dispensers of knowledge to a more flexible approach where they act more as facilitators, mentors and motivators to inspire students to participate and learn (Onyema, et. al., 2020). Unfortunately, for some it comes at the price of a steep learning curve (Iyer, et. al., 2020). It has been challenging for faculty members to adapt entire curriculum and evaluation methods in a short period of time and to evaluate and choose between synchronous and asynchronous online teaching and learning, to relay to students distance education etiquettes and protocols, and yet still be flexible enough to deviate from the original plan of content delivery (Iyer, et. al., 2020). Despite this, educational institutions need to proactively include online courses or elements of e-learning in courses and measure their effectiveness from an academic, organizational, teaching, and learning perspective (Iyer, et. al., 2020).

The opportunity exists to significantly increase skillsets in a teaching and learning technological world (Amyot, 2020). Classroom, lab and clinic based faculty have the real time choice to define how technology enhances or detracts the learning environment (Amyot, 2020) E-learning success will depend not only on the experience and attitudes of student, but also the attitudes and interactive teaching styles of faculty (Iyer, et. al., 2020). In fact, dental faculty have managed to produce an online curriculum by utilizing teleconference and file-sharing

platforms to deliver virtual lectures, facilitate group discussions and promote student engagement. Despite dental educators' best efforts, some challenges persist.

Online Learning Section

Online education is a general concept for teaching and learning online with the aid of technology tools and platforms (Onyema, et. al., 2020). Successful online education depends on factors that may or may not be available to faculty and students including, good internet connections, learning software, digital skills, availability and access to technology (Onyema, et. al., 2020). Emerging platforms support education and online learning and have their roots in distance education. The emergence of digital technologies facilitate the efficient and reliable delivery of lectures, virtual classroom sessions and other instructional materials and activities via the internet (Onlineeducation.com, 2020). This online technology facilitates Remote learning, Distance learning, Machine learning, Ubiquitous learning, Virtual learning, Blended learning, Mobile learning, Distributed learning, Deep learning, Cooperative and Collaborative learning (Onyema, et. al., 2020). Knowledge of technology increases educators' and students' interest, competence, confidence, creativity, employability and output, and prepares them for the future (Onyema, et. al., 2020).

Didactic Section

Since didactic courses can be incorporated in flipped classroom methodologies, didactic classes are the easiest to manage online and are effective in dental education (Iyer, et. al., 2020). VoiceThread (VT) is an excellent cloud-based program that advances the integration of videos in a PowerPoint presentation (Iyer, et. al., 2020). In addition, faculty can moderate discussions on VT and the enhanced features of this software allow for collaboration and peer

learning among students that can be both synchronous and asynchronous (Iyer, et. al., 2020). There are different systems available via the internet such as ZOOM Meeting, Google Classroom, Google Meet, and Skype (Chang, et. al., 2020). Virtually all the didactic classes at US dental schools have been converted to remote instruction according to adea.org. (Iyer, et. al., 2020).

Laboratory Section

In most laboratory instances, a student will practice a skill once a faculty member has demonstrated the correct method. This may be done virtually if the students have the materials needed such as impressions, sealants, etc. Hands-on training is essential for the simulation laboratory course of dental education, a simple and easy-to-use virtual reality (VR) haptic device must be developed (Chang, et. al., 2020). Otherwise, it may simply be impossible to bring the simulation laboratory course online (Chang, et. al., 2020).

Clinical Section

With patient care coming to a halt, major concerns of academic institutions include how will they ensure that students are clinically competent? How will they satisfy clinical requirements imposed by accreditation councils? Currently, CODA requirements have not changed despite the COVID-19 crisis, while schools are struggling to find innovative solutions to meet these requirements.

The pandemic has led to clinic closures, university closures and postponement of exams and interview which has resulted in a deficit in clinical exposure for undergraduates and trainees (UK dental). This is the most important infrastructure of dental education and there

will inevitably be close contact between the dental hygiene student, the patient and the teacher (Chang, et. al., 2020). This normal physical environment is now the most difficult part of dental education with which to deal (Chang, et. al., 2020). Most dental schools in the US have suspended clinical activities except for dental emergencies, and some are practicing ever-changing social distancing protocols in their preclinical laboratory courses (Iyer, et. al., 2020). The biggest challenge has been to postpone direct patient care which is arguably the most important component of the dental curriculum (Iyer, et. al., 2020). No virtual sessions can duplicate the close experience with patients and the student's ability to efficiently administer services (Iyer, et. al., 2020). Extramural rotations have also been cancelled further limiting these experiences (Iyer, et. al., 2020).

It is crucial moving forward to design a standard assessment that includes the skills, knowledge, aptitude, and behavior needed to be a competent dental hygienist post pandemic (Iyer, et. al., 2020). A possible solution could be to use a multidisciplinary Objective Structured Clinical Exam (OSCE) combined with a written exam for the second-year students, similar to the Canadian OSCE Licensing exam. Resources could be shared among schools to create such an exam (Iyer, et. al., 2020).

Examinations

The Lockdown Browser is used for the student examinations in some of the US dental schools (Chang, et. al., 2020). A lockdown browser prohibits a students' search on the internet to find an answer during an internet examination and is a tool utilizing modern information technology to prevent exam cheating (Chang, et. al., 2020). A dedicated online examination platform for dental education will need to be developed (Chang, et. al., 2020). As a short term

measure, changes in examination format have been implemented to prevent delays in course completions in both the UK and US.

National and State Licensure

COVID protocol mandates that students taking regional licensure examinations on live patients do so without the use of ultrasonic instruments. Also, student licensure is being delayed so if students are competent, the issue now is now one of licensure. However, it is noted that the American Dental Hygienists' Association (ADHA), the American Dental Education (ADEA) and the American Dental Association (ADA) have been previously been working on the elimination of single encounter live patient clinical examination for licensure long before the era of COVID-19. The Coalition for Modernizing Dental Licensure was formed in October 2018 to move this agenda forward, however, not with the sense of urgency in today's climate.

As a result state governors and dental boards were motivated to move quickly on this issue because live patient clinical examinations stopped, nor could they resume in the near future considering the social distancing requirements and amount of Personal Protective Equipment (PPE) necessary to conduct an exam. Regional testing agencies developed manikin base exams for consideration. States such as Washington, Utah, Illinois, and Vermont chose to allow temporary licensure to dental hygiene graduates until such time a regional board examination can be conducted. In addition, thanks to the efforts of dental hygiene educators rallying their state legislators and dental boards, Oregon, Arkansas, Texas, Connecticut and other states now allow for manikin-based exams for dental hygiene licensure indefinitely.

States have begun to understand that a single encounter live patient examination is not in the best interests of students, patients, and is not possible during a national crisis. Of course

the National Dental Hygiene Board Examination still poses yet another licensure barrier. When the lockdown was implemented over 5,000 dental hygiene students had not yet taken the nine-hour, dental hygiene national board. This examination, administered at computerized testing centers, had come to a standstill across the nation. Months of testing appointments were cancelled. Computerized testing has resumed in most states, and the Joint Commission on National Dental Examinations made the difficult decision to reduce the exam time by 50%, so that more applicants could test in a day (Stolberg, 2020). Alternative methods such as the ADEX simulation examination are also being explored as an option for students to complete their remaining clinical requirements and potentially for state licensing board examination.

As the landscape normalizes, many licensure examination agencies are rescheduling examinations. As several licensing examinations involve live patients, it will be a challenge to ensure patient and student safety in the post-COVID era because of public fear which may last indefinitely. Perhaps, restructuring the format of licensure examinations to transition away from live-patient exams may be a timely strategy. Recently in the US, the Joint Commission on National Dental Examination (JCNDE) released a new Dental Licensure Objective Structured Clinical Examination (DLOSCE) which is designed to reliably and accurately reflect the practice of clinical skills with a particular focus on the assessment of clinical judgment and decision-making. This type of evaluation method does not require procedures to be performed on live patients and is currently used by the National Dental Examining Board of Canada (NDEB) to award dental licensure.

Lasting Impact

The COVID-19 pandemic has an immediate and lasting impact on the professional and

personal lives of faculty members and students. Students are at increased risk of developing mental health issues such as anxiety and depression precipitated by worries about their return to school, academic performance and financial situation. Other members of the dental team may be worried about the potential recession and its impact on the job market, heavy student debt and occupational hazards of performing dentistry in the world post-COVID-19. In addition, graduation ceremonies, which students and their families typically enjoy, have been postponed, cancelled or moved online.

With the interruption of clinical care, dental institutions are confronted with significant financial burden associated with the loss of income generated by teaching clinics and the burden of reimbursing clinic fees to students. This is a major challenge for dental institutions as they struggle between losing hundreds of thousands to millions of dollars in revenue while maintaining the ability to pay faculty and support staff. To mitigate this, there are increased educational cooperation, knowledge sharing and research collaborations between academic dental institutions. For example, dental academies, societies and industries have united to provide access to free continuing education (CE) content and virtual conferences to promote professional collaboration and solidarity. In addition, dental education programs have gained valuable experience in adapting and improving educational methodologies for students and trainees during this public health crisis. Together, our dental education community and partners will join forces to persevere through this turbulent pandemic.

CHAPTER 3

Methodology

The overall approach to the research was to continue to search for relevant content related to this under-researched topic and explore the impact of Covid-19 on dental hygiene education. I used secondary data and information that was collected from various reports prepared by national and international agencies on the COVID-19 pandemic. Information was collected from Google Scholar, Wahlstrom Library-Dentistry and Oral Sciences in addition to OneSearch. The date range that I focused on was from 2017-2021. I reviewed several earlier articles that provided information on previous pandemics.

I searched the literature and made decisions about the suitability of material and read abstracts to determine which articles supported my research question: What is the impact on dental hygiene education during COVID-19? After reading several of the articles I modified my question to emergency remote teaching during Covid-19 and the impact it has had on the adoption of remote learning technology and dental hygiene education. Presented materials are representative of didactic, laboratory and clinical education in healthcare environments that would be utilized for research purposes. I concentrated on prior studies that included dental hygiene and pandemics other than Covid-19.

The rationale for my research is that when subsequent pandemics occur, I will be able to take the knowledge from the current pandemic and apply it to future crises. The research also provided methods that have had a positive effect on faculty and student's education. We will gain a better understanding of what might have a positive impact verses what might have a negative impact.

My search included Covid-19, Coronavirus, SARS CoV2, dental hygiene education, SARS, MERS, pandemic, emergency remote learning, online learning. I used AND, OR and NOT as my Boolean Operators. I researched online programs, but I am continuing to look for additional information that incorporates the important point that the dental hygiene programs were placed in an emergency. I will include subtopics based upon factors that relate to emergency remote teaching in dental hygiene education, specifically the clinical courses and the laboratory courses. The population within my study was Dental Hygiene programs in the United States.

There was sparse written material on the subject because Covid-19 and the world governments response was unprecedented in regards to modern academic studies and research. I am thinking about adding a section about relevant papers from other pandemics and the impact on the dental hygiene curriculum. I researched recent dental hygiene education to baseline and compare the changes with Covid-19. I determined the relevance of the articles and journals and eliminate ones that include biases. Overall, I would posit that there are some limitations to the material that is available.

Quantitative methods were used to describe dental hygiene education prior to Covid-19. I used quantitative research to document the impact of dental hygiene education during Covid-19 which included clinical, laboratory and didactic course outcomes. I used data from existing dental hygiene programs, and described the impact of Covid-19 and dental hygiene education. The research I used was case study methodology to describe the didactic, clinical and laboratory scenarios. This was needed to understand what the impact of the Covid-19 has had on dental hygiene education.

It was also important to understand what changes have been implemented in the dental hygiene curriculum since Covid-19. Understanding the facts related to the experiences and outcomes considering the changes in the dental hygiene curriculum will be researched. Without this information we would not have a clear understanding whether the changes to the dental hygiene education during Covid-19 made positive or negative impacts.

Justification was required in this research because the pandemic response was both extraordinary and novel. The pandemic response dictated emergency remote teaching had to be implemented and we needed to ascertain if the new teaching methodologies had a positive or negative effect on dental hygiene education.

I reviewed case studies to determine if distinct characteristics of a dental hygiene education scenarios exist. These provided me with detailed data to identify the characteristics of Covid-19 and the impact that it has had on dental hygiene education. Having the ability to use data that was previously been collected allowed me to access data from previous pandemics.

CHAPTER 4

Findings

Summary

While clear that academic dental institutions have had to modify dental/dental hygiene students' training in response to COVID-19. Prior research on disruption to the clinical learning environment was reported to have minimal impact on students' assessment performance when students had time to adapt to the disruption. However, this has not been the case for the COVID-19 outbreak, which represents an unexpected/abrupt disruption of training with no immediate return to normalcy. Even with anticipated disruption, lack of knowledge on the extent of the disruption can negatively impact clinical dental training.

As a result of COVID-19, significant impacts on dental education will undoubtedly occur for the next decade. If we, as a society and learning institutions, cannot meet the needs because of rigid and intractable rules and guidelines that are not adaptable to the current environment in which we find ourselves, the outcomes will be severe. It is time for us to think outside the box regarding "how it has always been done" to determine new ways to ensure our graduates are competent, our patients receive quality dental care in a safe environment, and the high standards that have always existed at our institutions are maintained (ADEA, 2020).

COVID-19 and the disruption it has caused, while initially perceived negatively, could also be harnessed for innovations in artificial intelligence technology in pre-clinical education virtual recruitment, and retention efforts, particularly for historically underrepresented groups, and new teaching modalities. Furthermore, incorporating emergency preparedness protocols into the dental and dental hygiene curriculum may prove helpful for years to come.

Discussion

The ongoing pandemic and modifications that are needed to protect the dental work force further underscore the need to develop and teach students COVID-19-specific infection control protocols and engineering controls to reduce the levels of dental aerosols. A comprehensive description of the impact of COVID-19 on dental education in the United States has not been reported yet (Iyer, et. al., 2020). It is time for faculty who are actually in the classrooms, labs and clinics to redefine how technology does, or does not, advance our teaching and learning environments (Amyot, 2020). We need greater educational research to assist us in making evidence-based decisions about what technologies will be most effective in our learning environments (Amyot, 2020). Create a practicum experience for senior dental hygiene students who over the course of their last semester are able to interact with dental hygienists in their area who are practicing (Amyot, 2020).

ADEA Connect provides a resource to share ideas about teaching modalities connecting faculty and administrators. Clinical videos that enhance the learning experience can be created by faculty (Iyer, et. al., 2020). It can be time-consuming to create the videos, it might be beneficial to share these resources with other schools (Iyer, et. al., 2020). Preclinical didactic and case-based exercises could be delivered as videos with embedded quiz questions using a platform such as EDpuzzle (Iyer, et. al., 2020). EDpuzzle is an innovative tool that converts video watching into a student-centered activity by increasing student engagement. It allows faculty to embed timestamped questions with instant feedback in a clinical video for students to answer while watching the video (Iyer, et. al., 2020).

Assessment strategies can include formative exams on learning management systems

like Canvas and summative exams on ExamSoft, with third-party online proctoring by ProctorU, Honorlock, Respondus Monitor, and Examity (Iyer, et. al., 2020). Small group discussions using WebEx can be used to stimulate active discussion on the concepts learned, with PBL to encourage critical thinking (Iyer, et. al., 2020).

The administration of dental hygiene schools should reassess the existing policies in the clinic and protocols in place for emergencies and learn how to improve them in the event of another emergency in the future (Iyer, et. al., 2020). A detailed contingency plan should be in place in case of future pandemics (Iyer, et. al., 2020). A comprehensive effort inclusive of adeptly designed clinical and curriculum experiences paired with wellness interventions and support tailored to students is needed (Garcia, et. al., 2021).

Building online lectures, developing Virtual Reality devices for online simulated training, developing an online exam system, and creating guidelines for dental education under the pandemic situation are all things to be considered for future research. The advantage of online courses is that they can be disseminated to as many students over the internet to address to determine the main courses for the core competency of dental and dental hygiene students to reach a consensus of core competency in the US. There is a need for future research to determine what dental and dental hygiene schools are doing during pandemics to prevent transmission to dental students and how dental and dental hygiene schools are managing students and their general anxiety about redesigned classes, patient care, inability to fulfill clinical requirements for graduation, and concerns for safety.

Future research can be used to design an assessment that includes the skills, knowledge,

aptitude, and behavior needed to be a competent dentist and dental hygienist (Iyer, et. al., 2020). This can be approached by creating a team of dental and dental hygiene faculty members by using their resources to create this assessment in examination form. Further research on developing a protocol that shows how to proceed the clinical skill training courses during COVID- 19 should be a priority.

Future research is needed to prove which technological tools should be tried and applied to dental and dental hygiene education and which ones have positive and negative effects when teaching didactic, clinical and laboratory exercises. Future educational research is needed to assist us in making evidence based decisions about what technologies will be most effective in our learning environments (Amyot, 2020). Future research is needed to show how technology in teaching and learning should be employed and when it is appropriate. Future research is needed to determine students' and faculty perceptions about how the pandemic impacted their learning.

Future research is needed to gain an understand about the Covid-19 transmission due to oral hygiene instruction in addition to gaining a comprehensive description of the impact of covid-19 on dental education in the United States, which has not been reported (Iyer, et. al., 2020). Future research is needed to determine if dental and dental hygiene students are less productive and less efficient students. Future studies are needed to discover favorable aspects and difficulties associated with virtual teaching and learning.

Future research is needed to gain an understanding of the best available technological tools, techniques and new perspectives on dental and dental hygiene education. Future studies

are needed to discover ways to deliver theoretical-practical training without the face-to-face preclinical and clinical activities. Future studies are needed to determine if online simulation with manikins is effective in dental and dental hygiene education. Future studies regarding instructional videos and the impact of learning psychomotor skills and the utilization of tools for critical thinking and problem solving in dental and dental hygiene education during Covid-19 are necessary to gain an understanding of the variety of option in remote teaching.

Conclusion

COVID-19 has adverse effects on education including, learning disruptions, and decreased access to education and research facilities, Job losses and increased student debts (Onyema, et. al., 2020). The damaging effects of COVID-19 on education sector and the need for all educational institutions, educators, and learners to adopt technology, and improve their digital skills in line with the emerging global trends and realities in education (Onyema, et. al., 2020).

How to achieve balance between continued learning for dental students but not inducing the spread out of infected cases is an important issue for dental education. After the pandemic lifting the shutdown may induce another pandemic crisis because of the inevitable social contact in dental education (Chang, et. al., 2020). Dental education should be preparing in advance to face the future challenge of another pandemic (Chang, et. al., 2020). The COVID-19 outbreak has really impacted the academic timeline. The effects on the knowledge and skills is difficult to access and consequences are currently not visible (Gaudin, et. al., 2020). Students and faculty responses from the multiple peer-reviewed journals and articles that I read did not provide me with enough data regarding the impact of Covid-19 on the dental and dental

hygiene curriculum. New perspectives regarding teaching clinical activities, patient care, laboratory courses and didactic courses resulted in an e-learning and e-teaching process having both positive and negative effects.

The outbreak of Covid-19 has reminded us that change in the delivery methodologies of educational content is inevitable. The opportunity for dental educators to enhance curriculum to more specifically focus on strategies for practicing in pandemic situations must be addressed. Each dental and dental hygiene school must consider the institutional, operational, teaching and learning capacity in determining what types of modifications to the educational program would be successful during pandemics. Additional studies to include enrolled students in United States based dental and dental hygiene education during the pandemic from at least 20 dental and 20 dental hygiene schools would provide substantial data to gain an understanding of the Covid-19 pandemic impact related effect on dental and dental hygiene education.

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Table 1.1 Technology Tools and Platforms**APPENDICES**

1. GoToMeeting
2. Skype
3. Google Classroom/Open Online Education (edu.google.com)
4. YouTube.com
5. Blackboard.com
6. udemy.com
7. coursera.org
8. memory.com
9. alison.com
10. edx.org
11. easyclass.com
12. vedamo.co
13. Khanacademy.org
14. TED-Ed (ed.ted.com)
15. Codeacademy.com
16. Stanford Online
17. Futurelearn.com
18. rcampus.com
19. learnopia.com
20. Peer to peer University (p2pu.org)
21. Teachers pay Teachers (teacherspayteachers.com)
22. Thinkific (thinkific.com)
23. MOOC.org
24. openculture.com
25. academicearth.org
26. itunesU Free courses (apps.apple.com)
27. lessonpaths.com
28. memrise.com
29. Edmodo (edmodo.com)
30. Schoology (schoology.com)
31. Classdojo (classdojo.com)
32. Google hangouts (hangouts.google.com)
33. Zoom (zoom.us)
34. Whatsapp.com