

# **Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation**

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Thesis submitted for the fulfilment of the requirements for the degree of Master of  
Research Practice



Institute for Sustainable Industries & Liveable Cities

Master of Research Practice

April 2023

## **Abstract**

The use of teledentistry by dental practitioners in Australia is on the rise, largely due to the COVID-19 pandemic. Previous studies have been conducted analysing the opinions of dental practitioners. These studies demonstrated that practitioners were optimistic about the technology, however they still identified flaws that made them hesitant to adopt it into their own practice. These studies were conducted prior to the COVID-19 pandemic. Since then, there have been large changes within teledentistry including the introduction of new item codes into the Australian Schedule of Dental Services and Glossary to allow clinicians to appropriately bill their patients and the technology behind teledentistry have improved. With these changes, opinions regarding the advantages, disadvantages and barriers to implementing teledentistry may have changed. Additionally, there have been no studies conducted to identify barriers to implementing teledentistry in Australia. This thesis involved research to address this gap.

The overall aim of this mixed methods study was to determine the advantages and disadvantages of teledentistry as well as identify barriers of implementing teledentistry from the clinicians' perspective and develop interventions to overcome these barriers. We aimed to complete this through 2 objectives.

1. To determine the advantages and disadvantages of teledentistry in a clinical setting from the perspectives of healthcare professionals using an e-questionnaire.
2. To explore the advantages and disadvantages of teledentistry while also determining the barriers of implementing teledentistry in a clinical setting and identifying interventions to overcome these barriers using focus groups.

The quantitative study (objective 1) involved a cross-sectional study involving an anonymous electronic questionnaire with a sample of 152 participants. The questionnaire contained 28 questions with a 5-point Likert-scale to assess the perceptions of general dentists about teledentistry regarding diagnosis, accessibility, patient care, technology and finances. Chi-squared test and analysis of variance (ANOVA) were used to analyse the results. The focus group (objective 2) involved 2 focus groups of 6 and 7 people each. The focus group discussions were transcribed and de-identified, after which a thematic analysis was conducted. A word cloud was also generated to analyse for themes and subthemes. Quotes were then selected to create a narrative regarding the themes and subthemes.

**Part 1:** The participants of the questionnaire believed that teledentistry was effective for consultations and diagnosing simple cases. They saw large benefits of teledentistry in improving access, delivering post-operative care, and triaging patients. They found it particularly useful during the COVID-19 pandemic. However, the participants felt that teledentistry was ineffective at diagnosing complex cases such as pathology. Concerns were also raised regarding the interventional capacity of teledentistry, the reliability of the technology, data security and medicolegal issues. In general, the participants preferred in-person compared to teledentistry. They were neutral regarding finances. Additionally, younger dentists perceived patients to be more accepting compared to the other age groups [20-64 years vs >65 years] ( $P = 0.0430$ ).

**Part 2:** The themes identified were technology utilisation, patient accessibility, clinical applications, patient centred care, difficulties for clinicians to adopt teledentistry, and finances. The participants of the qualitative focus group believed that teledentistry was able to improve accessibility and efficiency of their clinics. However, issues were raised regarding the technology, interventional capacity, communication issues as well as the difficulty in using the technology for clinicians and for patients. Some possible strategies to improve the implementation of teledentistry were increased funding and training to be able to purchase higher quality equipment and be effectively trained to use it and development of a streamlined process to be able to adopt and use teledentistry more easily. Patient convenience was believed to play a pivotal role in the success of implementation of teledentistry as well.

Clear benefits were observed by dental practitioners in Australia regarding teledentistry. However, there was still hesitancy to adopt it due to the limitations noted. This study identified potential strategies to improve the implementation of teledentistry. Streamlining the process of delivering teledentistry could encourage more dentists to adopt teledentistry into their own routine practice. It is important to continue research into teledentistry to benefit people who have difficulties accessing dental health services.

# Student Declaration

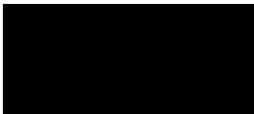
Master of Research Practice

I, Joshua Min-Hyong Lee, declare that:

The Master of Research Practice thesis entitled “Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation” is no more than 50,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

I have conducted my research in alignment with the Australian Code for the Responsible Conduct of Research and Victoria University’s Higher Degree by Research Policy and Procedures.

Signature

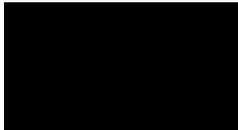
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Date: 16/03/2023

## **Ethics Declaration**

All research procedures reported in the thesis were approved by the Victoria University Human Research Ethics Committee [Project no. 2022/ET000369 and Project no. 2022/ET000370]

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Date: 16/03/2023

## **Acknowledgements**

This research was supported by an Australian Government Research Training Program (RTP) fee waiver. I would also like to acknowledge Victoria University for providing the facilities to be able to complete this degree. Additionally, I would like to thank the participants of my research for their time.

I also take this opportunity to thank my supervisors Professor Hua Wang, Dr Kate Wang and Dr Alex Park. The opportunities that they have provided me through supervising me for this project has opened doors that would have been almost impossible for me otherwise. Professor Hua Wang has provided me with support and guidance throughout the project and I am grateful for the opportunity to conduct research with him. Dr Kate Wang and Dr Alex Park stayed up countless nights during numerous late-night meetings to ensure that my work was kept on track. They have dedicated many hours of their time to help me achieve my goals and I am truly appreciative of their help and support. They have been amazing mentors and supervisors and without them, I would not be where I am today. I would like to particularly thank Dr Alex Park who is a role model that I will always have and somebody that I will always look up to.

I would like to also thank my friends and family for their support. My family has been steadfast with their support as I continue my journey. I am very grateful to have had their support throughout my entire life. I would also like to thank my partner, Catherine, who was there for me every single step of this journey. She would provide advice, help and support when I needed it the most. I am truly thankful to have her in my life and it is my privilege to be able to share my life with her.

# Declarations of Authenticity and Authorship Contribution in the Thesis with Publications

Publications arising from this dissertation

| Chapter No. | Publication Title  | Publication Status                          | Publication Details  |
|-------------|--|---|--|
| 2           | The Use of Telehealth in Dental Practice – A Literature Review   | Currently under review with minor revisions | Asia Pacific Journal of Health Management<br>Submitted: 25/01/2023   |
| 3           | Assessing the Utilisation of TELedentistry from Perspectives of Early Career Dental Practitioners: Development of the UTEL Questionnaire | Published                                   | Health Information Science<br>Published 25 Oct 2022 in <a href="https://link.springer.com/chapter/10.1007/978-3-031-20627-6_18">https://link.springer.com/chapter/10.1007/978-3-031-20627-6_18</a> |
| 3           | Cross-Sectional Analysis of Australian Dental Practitioners' Perceptions of Teledentistry  | Currently under review                      | BMC Oral Health<br>Submitted: 24/02/2023   |
| 4           | Advantages, Disadvantages and Barriers of Implementing Teledentistry – A Qualitative Analysis of Australian Dental Practitioners         | Currently under review                      | BMC Oral Health<br>Submitted: 13/03/2023   |

### **Conference publications associated with this dissertation**

Lee, J., Park, J. S., Wang, H., Feng, B. & Wang, K. N., 25 Oct 2022, Assessing the Utilisation of TELedentistry from the Perspectives of Early Career Dental Practitioners: Development of the UTEL Questionnaire, Health Information Science: 11th International Conference, HIS 2022 Virtual Event, October 28–30, 2022 Proceedings. Traina, A., Wang, H., Zhang, Y., Siuly, S., Zhou, R. & Chen, L. (eds.). Switzerland: Springer, p. 189–196 8 p. (Lecture Notes in Computer Science (LNCS); vol. 13705).

Declaration by: Joshua Lee

Signature



Date 16/03/2023

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# Chapter 1 - Overview

## 1.1 Introduction

Teledentistry is a subset of telehealth that uses a combination of telecommunications and dentistry. It is used to “remotely exchange clinical information and images over distances for dental consultation and treatment planning”.<sup>1</sup> Information and Communications Technology is used to provide this.<sup>2</sup> It has been used to plan treatment, diagnose oral health conditions such as malignancies and dental decay, triage patients and monitor treatment.<sup>3-13</sup> It also has the capabilities to conduct teaching to upskill clinicians in real time.<sup>14, 15</sup> Additionally, telehealth may be used in conjunction with AI and deep-learning to improve diagnostic accuracy.<sup>16-22</sup>

The biggest advantage of teledentistry is the ability to be able to provide care over distances. This provides the opportunity to overcome obstacles such as distance for people living in rural, regional or remote areas or obstacles caused by health, for example, frailty.<sup>2</sup> There has been a high satisfaction rate amongst patients but mixed opinions from clinicians.<sup>23, 24</sup> Additionally, there have also been studies showing that teledentistry has potential economic benefits.<sup>25</sup> However, teledentistry is not without limitations. It is complex, issues with technology have been noted, there is limited interventional capability and there is a high cost especially for the initial set up.<sup>24, 26</sup> Clinicians are also concerned regarding the accuracy of diagnosis and data security.<sup>24</sup> This has led to resistance from clinicians to adopt teledentistry into their own practice.<sup>26</sup>

Dental practitioners are “responsible for the prevention, diagnosis and treatment of diseases and disorders of the oral cavity and related structures”.<sup>27</sup> They are involved

in “the evaluation, diagnosis, prevention and/or treatment (non-surgical, surgical or related procedures) of diseases, disorders and/or conditions of the oral cavity, maxillofacial area and/or adjacent and associated structures and their impact on the human body”.<sup>27</sup> Although traditionally dental care and treatment is provided primarily in-person, in more recent times, teledentistry has also been utilised and incorporated into practice.<sup>28</sup>

Teledentistry as a concept was first discussed in 1989 at a conference funded by Westinghouse Electronics Systems Group in Baltimore, United States of America. However it was not until 1994 where it was first developed as part of a military project for the United States Army (US Army Total Dental Access Project) which aimed to “improve patient care, dental education, and effectuation of the communication between dentists and dental laboratories”.<sup>1</sup> This project demonstrated the ability of teledentistry to reduce costs while providing care to distant areas such as rural populations. It also allowed for the analysis of information over distances meaning more information would be available for a deeper insight.<sup>29</sup> The feasibility of teledentistry in a private setting was first studied by oral and maxillofacial surgeons in 1998 to assess the accuracy of planning orthognathic surgery through telehealth.<sup>6</sup> Since then, teledentistry has had expanded usage in all fields of dentistry to assist both clinicians and patients. For example, general consultations, limited exams, triage and post-operative care have been delivered using teledentistry. Additionally, it has improved communication between general practitioners and specialists to allow for improved patient care and upskilling of practitioners.<sup>3, 9, 30-33</sup>

In 2019, the coronavirus disease 2019 (COVID-19) appeared causing a global pandemic.<sup>34</sup> Due to the high transmission risk, the Australian government introduced lockdowns in March 2020 to protect the community from the disease.<sup>35</sup> These lockdowns led to closures of dental clinics with one multi-country cohort study showing that 75.9% of participants closed their own dental practices.<sup>36</sup> In order to ensure that patients could continue to access care, teledentistry saw increased adoption and new item codes were introduced to allow dentists to appropriately bill and provide health services.<sup>37</sup>

With the increased usage of teledentistry, it is important to analyse changing opinions of practitioners so we can identify the advantages to improve advocacy. Additionally, it is also important to identify the barriers so that those who access teledentistry are not disadvantaged. Therefore, this literature review will broadly cover teledentistry, in particular, the uses of teledentistry as a response to the COVID-19 pandemic. The review will aid in the justification for our research.

## **1.2 Study Motivation**

There were 2 main reasons that motivated me to research teledentistry. Firstly, whilst working as a dentist in the dental hospital, I noted that there were significant flaws in the teledentistry system that made it difficult for clinicians to effectively communicate with patients and provide them with adequate care. This made teledentistry frustrating to use for clinicians and patients. However, I saw great potential within the system to be able to improve healthcare provision and access to overcome large barriers. Therefore, I wished to conduct research to improve teledentistry to make it easier to

use for both clinicians and patients and to hopefully improve the interventional capacity of teledentistry.

The second reason was that a large proportion of patients that I provided teledentistry services to were patients living in regional, rural and remote areas. These patients would otherwise have to travel long distances to access care which would be easily done over the phone. Furthermore, patients who had poor health or with mobility issues also found it difficult to access care in-person. I wanted to improve the implementation of teledentistry amongst clinicians so that more patients would have access to teledentistry services so that the barriers of health and distance could be overcome. Additionally, I wanted to improve teledentistry so that only those who had access to teledentistry would not be disadvantaged.

### **1.3 Research Problem**

After analysing the existing literature 2 main areas for research were identified.

#### **Area 1:**

Only 2 studies have been conducted analysing the opinion of Australian dental practitioners regarding teledentistry. The most recent one conducted in 2021 analysed the opinions of a specific specialty instead of all dental practitioners.<sup>38</sup> Prior to this, a study was conducted in 2016 analysing the opinions of all dental practitioners.<sup>24</sup> However, this was prior to the COVID-19 pandemic and hence opinions regarding teledentistry may have changed. It is important to identify and changes in the advantages and disadvantages as the advantages can be used to

advocate for increased adoption whilst the disadvantages can be addressed to improve teledentistry.

## **Area 2:**

No studies have been conducted analysing barriers to implementing teledentistry and exploring strategies to overcome them in Australia. While there have been studies conducted in other countries, such as the United Kingdom, it is important to analyse barriers from an Australian perspective as the healthcare system may vary significantly between countries.<sup>39, 40</sup> Addressing the barriers to implementing teledentistry and identifying strategies to improve them is essential as it would increase patients' access to healthcare services regardless of barriers. This is particularly important in Australia where a large proportion of the population living in regional, rural and remote areas have difficulties accessing oral healthcare leading to increased hospitalisations and poorer oral health outcomes.<sup>41, 42</sup>

## **1.4 Practical Significance**

The most recent study to analyse teledentistry from the perspective of Australian clinicians was undertaken in 2021.<sup>38</sup> However, this was a qualitative analysis of oral and maxillofacial surgeons only and not all dental practitioners. Prior to this, teledentistry was studied from the perspective of Australian dental practitioners in 2016.<sup>24</sup> Since then, the COVID-19 pandemic has led to widespread implementation of teledentistry.<sup>43</sup> Increased usage has led to improved infrastructure with the introduction of new software designed for providing teledentistry as well as new item codes so clinicians can charge appropriately.<sup>37</sup> Therefore, opinions regarding

teledentistry are likely to have changed and hence it is important to analyse these changes.

Our study aimed to determine the advantages and disadvantages of teledentistry. By determining the advantages of teledentistry we will be able to maximise the benefits by determining situations in which teledentistry excels. Furthermore, by determining the strengths of teledentistry, it will be easier to advocate the adoption to clinicians by demonstrating the clear benefits. The disadvantages are important to identify as they are areas in which teledentistry can be improved to increase the efficacy of teledentistry. This will ensure that those who only have access to teledentistry are not disadvantaged.

Additionally, whilst it is important to determine advantages and disadvantages for reasons listed in the previous chapter, no studies have been conducted to determine strategies to improve the implementation of teledentistry in Australia. Therefore, this study was the first to address this. This study aimed to determine the advantages, disadvantages as well as barriers for implementing teledentistry in Australia and explore strategies to overcome these barriers. This will help to increase the implementation of teledentistry across Australia improving access for all. This will hopefully improve the timing of treatment reducing the risk of adverse outcomes and also to earlier identification of oral diseases improving prognosis. Improved access to teledentistry services will be particularly useful for people living in regional, rural and remote regions as well. This is because up to 80.6% of clinicians practice in metropolitan areas with only 19.4% practising in regional, rural and remote areas.<sup>44</sup> This indicates that people living in rural, regional and remote areas have difficulties

seeking general and specialist care increasing wait times. For example, in the public sector there are wait times of over 15 months to see a specialist clinician.<sup>45</sup> Teledentistry can hopefully be used to allow people living in these regions to gain access to specialist care without having to travel as far and will also allow more specialist clinicians to provide treatment therefore reducing waiting times.

## **1.5 Structure of Thesis**

**Chapter 2** provides an overview of the existing literature on teledentistry.

**Chapter 3** presents the study utilising a qualitative e-questionnaire analysing the advantages and disadvantages of teledentistry.

**Chapter 4** presents the study utilising focus groups to analyse the advantages, disadvantages and barriers to implementation of teledentistry. Additionally, potential strategies to overcome these barriers is also explored.

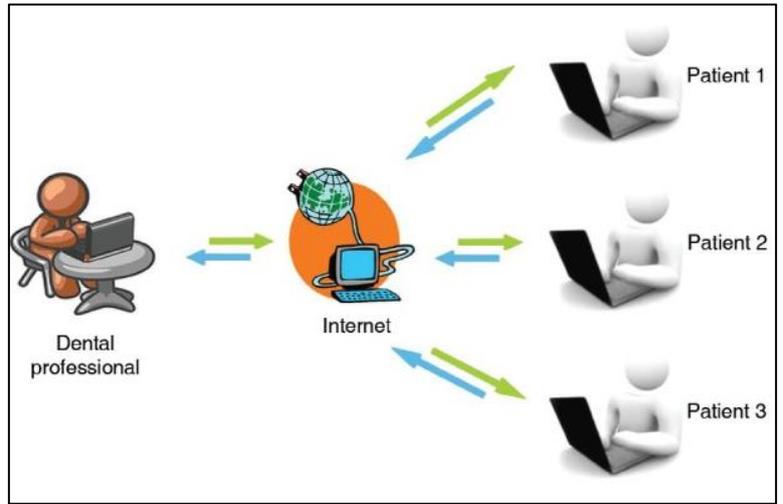
# Chapter 2 – Literature Review

## 2.1 Teledentistry

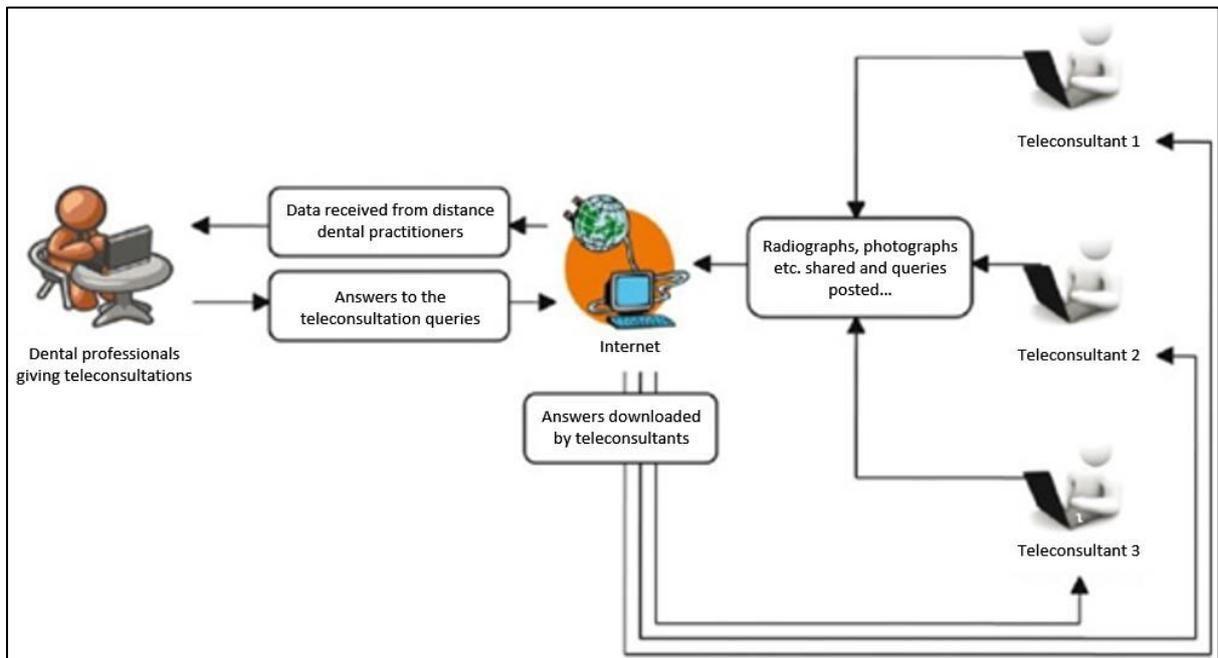
### 2.1.1 Introduction to Teledentistry

Teledentistry is defined by *Jampani* and colleagues as “a combination of telecommunications and dentistry involving the exchange of clinical information and images over remote distances for dental consultation and treatment planning”.<sup>1</sup> Video and audio applications are used to facilitate the exchange of this information.<sup>46</sup> It is an emerging field of dentistry that allows clinicians to provide treatment to patients whose access may be affected by distance, frailty, transport and health.<sup>2</sup> Teledentistry allows for swifter provision of care which reduces the risk of adverse outcomes due to delayed treatment.<sup>46</sup> It has traditionally been used to provide services to those living in regional, rural and remote areas especially to increase access to specialists.<sup>47</sup>

There are three types of telehealth services. These are synchronous, asynchronous and remote monitoring. Synchronous telehealth involves the delivery of health information in real time. This could involve live discussion between clinicians and patients or clinicians and other clinicians.<sup>48</sup> Asynchronous telehealth is when a patient or clinician collects data such as the medical history, images, pathology reports and examination findings to another clinician such as a specialist. An example would be referring a patient to a specialist clinician for treatment.<sup>48</sup> Remote monitoring is the continuous monitoring of patients through tests or images that are collected remotely.<sup>48</sup>



**Figure 2.1:** Figure demonstrating synchronous “real-time” teledentistry<sup>1</sup>



**Figure 2.2:** Figure demonstrating asynchronous teledentistry<sup>1</sup>

### 2.1.2 Coronavirus (COVID-19) Pandemic

The coronavirus disease 2019 (COVID-19) appeared in December 2019 leading to a global pandemic.<sup>34</sup> COVID-19 is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which first emerged in Wuhan, China which then rapidly spread worldwide.<sup>34</sup>

COVID-19 is transmitted between people through respiratory droplets that are generated by talking, singing, coughing and sneezing.<sup>49</sup> Respiratory droplets only affect people who are within 1 – 1.8m of an infected host.<sup>34</sup> Additionally, the virus is able to survive on plastic and stainless steel for 2-3 days, cardboard for approximately 24 hours and copper for 4 hours. All of these are materials commonly found in dental settings.<sup>34</sup> The virus can also be spread through aerosols. Aerosol particles remain suspended in the air for extended periods of time and over long distances. If the particles contain the virus and someone inhales these particles in a sufficient volume, they can become infected by the virus leading to COVID-19.<sup>49</sup> Dental professionals appear to be at high risk of contracting COVID-19 due to increased exposure to body fluids such as saliva and blood. The procedures conducted by dentists also generate a high amount of aerosols further increasing the risk of transmission.<sup>50</sup>

Globally there have been over 754 million confirmed cases and over 6.8 million confirmed deaths when this literature review was completed (Feb 2023).<sup>51</sup> In Australia, there have been over 11 million confirmed cases and over 18 000 deaths.<sup>52</sup> Furthermore, there continue to be over 2500 confirmed cases per day, nationally.<sup>52</sup>

In response to the highly infective nature and rapid spread of the disease, the Australian government introduced measures to reduce the transmission of the virus.<sup>53</sup> Face masks and social distancing were made mandatory and Australians diagnosed with COVID-19 or displaying symptoms were instructed to isolate at home. Lockdowns were also implemented to minimise contact between community members. This led to many people working from home and only leaving the house for essentials.<sup>49, 54</sup>

Medical procedures, including dental procedures, were also restricted in order to reduce the amount of aerosols being produced to further decrease the transmission risk.<sup>55</sup> These lockdowns led to closures of dental clinics with a multi-country cohort study of 3243 dentists reporting that 75.9% of the participants closed their practices.<sup>36</sup> This led to the increased risk of adverse outcomes with one German study of 974 individuals reporting that 22% of patients delayed treatment due to COVID-19 and 38% fewer patients had emergency dental visits.<sup>56</sup> In Australia, practitioners experienced disruption to their own practice, decreased patient care and management as well as compromised professional education and training.<sup>57</sup> There were also psychological affects with Australian dental practitioners expressing fears of contracting COVID-19, concerns about the safety of family and concerns regarding the negative impact on social life and activities. There were also concerns regarding the long-term consequences of being infected by COVID-19.<sup>57</sup> Teledentistry saw increased implementation to ensure that patients could continue to access dental care whilst both protecting patients' and clinicians' safety and wellbeing. New item codes were introduced accordingly to allow dentists to appropriately bill and provide these services.<sup>37</sup>

### **2.1.3 Teledentistry Usage**

The concept of teledentistry was first discussed at a conference funded by Westinghouse Electronics Systems Group in Baltimore, United States of America, in 1989. This conference discussed the application of dental informatics in dental practice to determine how to “directly affect the delivery of oral healthcare”.<sup>1</sup> Teledentistry as a subspecialist field of telemedicine first began in 1994 with a project funded by the United States Army. The US Army's Total Dental Access Project aimed

to improve patient care, dental education and effective communication between dentists and dental laboratories. This project demonstrated the ability of teledentistry to reduce the cost of care, provide care to people living in rural areas and provided opportunities for health care practitioners to access complete information that was required for deeper analysis and more accurate diagnosis.<sup>29</sup>

Telehealth first saw more widespread usage in 1998.<sup>6</sup> The specialty of oral and maxillofacial surgery explored teledentistry with a feasibility study assessing the accuracy of orthognathic surgery planning through telehealth.<sup>6</sup> This study demonstrated that teledentistry consultations could be used to accurately assess and diagnose patients to plan the surgery when compared to in-person consultations. Since then, teledentistry has been used in different aspects of oral and maxillofacial surgery such as telehealth consultations for assessing and planning dentoalveolar surgery, as well as assessment of temporomandibular joint disorders.<sup>4, 8, 11</sup> This has been quite effective with diagnostic capabilities being similar to in-person consultations for simple cases with 95.6 – 100% diagnostic accuracy being reported.<sup>10, 13</sup> However, it is important to note that these studies did not explore the accuracy of more complex cases. Teledentistry was also able to save time for patients and the clinicians as 92.2% of the time. The clinicians were able to perform a teledentistry consult after which they were able to perform the surgery accurately eliminating the extra travel required for an in-person consultation.<sup>13</sup> It has also been successfully used to provide post-operative follow-up reviews. A randomised controlled trial of 60 patients in Germany who had undergone dentoalveolar surgery demonstrated that 83.3% of patients preferred teledentistry, although this was a small sample size limiting the generalisability of the findings.<sup>58</sup> Teledentistry has also been useful for monitoring the success of surgery

following cancer resection and to determine if further intervention is required.<sup>59</sup> Trauma has been effectively triaged through teledentistry in hospital facilities. This has been particularly useful for rural and regional hospitals who do not typically have an oral and maxillofacial department on-site to assess patients.<sup>5, 7</sup> More recently, in Thailand, teledentistry has also been used to diagnose cancer using immunofluorescence with one study reporting a 79.41 – 85.29% diagnostic accuracy for oral malignant lesions however ideally the accuracy for diagnosing conditions such as cancer would be closer to 100%.<sup>12</sup>

Other dental specialties have also effectively used teledentistry. Orthodontists have used teledentistry to accurately monitor treatment reducing the number of times patients would need to present in person.<sup>3, 9</sup> Teledentistry has also been used by orthodontists to troubleshoot patients' problems and provide advice as required, for example with orthodontic elastics or retainers.<sup>60</sup> Teledentistry has also been used in the field of paediatric dentistry to assess trauma, conduct examinations and to plan treatment which was useful as many children are uncomfortable in a dental setting.<sup>31, 61, 62</sup> Oral medicine clinicians have also diagnosed oral lesions through teledentistry however this had a 51.7 – 80% accuracy.<sup>33, 63</sup> This low accuracy could be a concern as the diagnosis of conditions such as cancer could be misidentified.

Teledentistry has also been used in general dental practice. It has been used to diagnose caries which may be particularly beneficial for schoolchildren who may find a teledentistry exam less frightening than in-person examinations.<sup>64-66</sup> Caries detection through teledentistry has high specificity (95-98%) though sensitivity is lower (60-68%).<sup>67, 68</sup> Teledentistry has been used to triage trauma and dental emergencies

to determine who had significant enough issues to warrant treatment.<sup>30</sup> This was especially useful during the COVID-19 pandemic to reduce the transmission risk of the virus.<sup>69</sup> Clinical consultations for general restorative dentistry have also been conducted using teledentistry and was found to be of similar efficacy to in-person examinations.<sup>32</sup>

A large benefit of teledentistry is the ability for general dental practitioners to transfer patient information to specialists in order to plan treatment more effectively. For example, teledentistry has been used to assist general dentists to diagnose oral lesions more accurately. General dentists would upload images and clinical information to a cloud-based platform which would be reviewed by a specialist and discussed with the general dentist leading to the diagnosis of, for example, squamous cell carcinomas.<sup>70, 71</sup> With this support, general dentists reported a 61.8% reduction of in-person patient referrals as they were able to diagnose the lesions without referring to the specialist. This saved time for both the clinicians and the patients.<sup>70</sup> Teledentistry has also been used in the field of orthodontics to provide general dental practitioners with advice regarding treatment planning. The benefits of this are reduction of inappropriate referrals to orthodontists which allows for more efficient use of resources.<sup>14</sup> Prosthodontists in Finland have also used teledentistry to guide general dental practitioners living in rural areas during their consultations when planning for dentures and oral rehabilitations.<sup>72</sup> Teledentistry can be used to optimise communication between general dental practitioners and all specialist practitioners so that referrals can be appropriately managed in a timely manner.<sup>73</sup> This is quite important in cases such as oral cancer where timing is extremely important.

Dentists can also upskill through teledentistry by video and audio conferencing with specialist clinicians in real-time. For example, with the guidance of orthodontists, general dental practitioners were able to provide interceptive orthodontic treatment. This allowed patients to access vital treatment they would normally be unable to access due to geographic, financial and accessibility issues.<sup>14</sup> In prosthodontics, new graduate dentists working in rural regions of India were supervised by specialist prosthodontists while fabricating implant-retained dentures. This is normally a difficult task to complete without the correct knowledge and skills. The new graduate dentists were able to fabricate dentures to a satisfactory quality with the guidance provided.<sup>15</sup> Through the education of general dental practitioners, teledentistry improved the quality of care delivered to patients. This has been particularly beneficial to those living in regional, rural and remote regions.

#### **2.1.4 Advantages of Teledentistry**

The main advantage of teledentistry is that it allows healthcare to be delivered remotely. This improves access regardless of location improving healthcare provision to overcome of barriers caused by socioeconomic, geographical or accessibility issues.<sup>2</sup> The inverse care law proposed by Tudor Hart states that “the availability of good medical care tends to vary inversely with the need for it in the population served”.<sup>74</sup> In Australia, people living in rural communities experienced poorer oral health and were at greater risk of hospitalisation due to dental conditions compared to the rest of the population.<sup>41</sup> Additionally, *Feng* and colleagues conducted a study of public dental services in Victoria in 2022 which showed that only public patients who were in major metropolitan areas had access to specialists with no public patients in rural areas mentioning specialists.<sup>42</sup> This outlines the inability of patients to access

specialist care in rural areas which could lead to poorer oral health. Teledentistry would be able to improve access to those living in these communities to hopefully improve oral health and reduce hospitalisations.

Another advantage of teledentistry is that patients have a high satisfaction rate. One study of 31 patients stated a 100% satisfaction rate and another study in the United Kingdom of 228 participants showed that 80% of them would recommend a video consultation.<sup>23, 75</sup> Clinicians also perceive teledentistry to be beneficial. An Australian cross-sectional study of 169 participants demonstrated that 70% of clinicians agreed that teledentistry was beneficial.<sup>24</sup> Furthermore, 65% of practitioners agreed that teledentistry would benefit remote or rural areas and 80-90% of respondents believed that teledentistry would improve communication between patients and colleagues.<sup>24</sup> It has also been particularly useful during the COVID-19 pandemic for reducing transmission risk as it decreased the amount of time patients required to be present in-person.<sup>60</sup> This is exemplified by a Colombian cross-sectional study of 5370 dentists reporting 42.52% increased usage during the pandemic.<sup>43</sup> Teledentistry is also an economically viable alternative to traditional in-person visits with one study estimating potential savings of up to \$85 million AUD if screening of schoolchildren's oral health was conducted through teledentistry.<sup>25</sup> Similarly, switching to teledentistry for oral examinations in aged care facilities could save approximately \$4 AUD per resident.<sup>76</sup> Although it is important to note that there would be an initially high cost for the setup to be able to deliver teledentistry.

### **2.1.5 Limitations of Teledentistry**

However, teledentistry also has limitations. It is complex and dentists may have trouble implementing it into their own practices.<sup>77</sup> The current availability and quality of technology required, such as the internet connection and cameras, was also perceived to be inadequate.<sup>77</sup> Usage of the technology itself has also been difficult for clinicians and for patients.<sup>38</sup> This issue is further compounded as research has previously shown that there is a lack of knowledge and education provided to health care practitioners in relation to teledentistry.<sup>78, 79</sup> Clinicians also found teledentistry to have limited interventional capacity and had low confidence in diagnosing complex cases due to being unable to conduct a tactile examination.<sup>38</sup> Other issues raised were organisational incompatibility of teledentistry, high initial costs for setup and inadequate guidelines.<sup>77</sup> Issues regarding financial reimbursement have also been raised but this has been addressed, at least in-part, by the introduction of new item codes into the Australian Schedule of Dental Services and Glossary to allow clinicians to appropriately bill for services provided.<sup>37, 77</sup>

## **2.2 Research Methods**

### **2.2.1 Qualitative Research**

Qualitative research is an “umbrella term covering an array of interpretative techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world”.<sup>80</sup> Qualitative research aims to explore the experiences and views of the participants of the study in a natural setting to gain an insight into social phenomena.<sup>81</sup> It can be conducted through interviews, focus groups, observations and analysis of documents.<sup>80, 82</sup>

It was historically used in areas such as sociology, history, and anthropology.<sup>83</sup> Qualitative research was previously uncommon in healthcare research, however, it has recently gained traction with healthcare research that requires a social and cultural analysis.<sup>80</sup> This is because qualitative research is useful for “exploring questions about people’s experiences, inquiry into the meanings people make of their experiences and studying a person in the context of their social/interpersonal environment”.<sup>84</sup> Additionally, qualitative research is also beneficial “where it is difficult to develop a standardised instrument due to the lack of knowledge on the phenomenon”.<sup>84</sup>

Qualitative research is effective at examining the quality of healthcare and assessing views of services and healthcare provision. It is also beneficial at examining factors that hinder or encourage the use of a particular service.<sup>82</sup> This is due to the fact that qualitative studies are able to gain a rich and deep insight into people’s views of healthcare for both clinicians and patients.<sup>80, 83, 85</sup> Therefore, qualitative research is an effective way at analysing the opinions of general dental practitioners regarding teledentistry as well as identifying any factors that are hindering or encouraging adoption.

A large advantage of qualitative data is the flexibility it offers which allows for modifications to the research process to suit the aims of the study. Additionally, the research process can be redirected real time during the investigation. For example studies conducted through interviews can ask multiple follow up questions to further address the aims compared to, for example, a quantitative questionnaire in which the questions being asked are fixed.<sup>86</sup> Generally, the data produced through qualitative

research is also more easily summarised and more easily understood by the general public.<sup>87</sup> Furthermore, the data is a “source of well-grounded, rich descriptions and explanations” which allows us to obtain true insights into another person’s worldview and to understand how other people experience the world. The data can therefore be more compelling than quantitative data.<sup>83, 86</sup> Subtleties and complexities regarding the subjects or topics are also discovered which may have been missed with other research methods.<sup>86</sup>

The major disadvantage of qualitative research is that sometimes it is not well understood and accepted compared to quantitative research within the scientific community. However, others note that qualitative research is able to gain true insights into data that is complex.<sup>86, 87</sup> The analysis can also be more difficult and time consuming to complete due to the large volume of data created through qualitative research.<sup>86</sup> Additionally, the research quality is heavily dependent on the skill of the researcher and is more easily influenced by the researcher’s personal bias. Furthermore, the researcher’s presence during the gathering of the data can often influence the subjects’ responses. These issues are difficult to avoid. However, Elder & Miller noted that there is no need to remove bias within qualitative research and instead allow the researcher to become part of the research by describing any biases rather than trying to eliminate them.<sup>88</sup>

Qualitative research has been utilised in the literature to analyse medical practitioners’ experiences with telemedicine.<sup>89, 90</sup> Qualitative research has the ability to capture underlying beliefs and motivations of different people. It provides a deeper understanding and insight compared to quantitative research and also aids in the

identification of further research.<sup>91</sup> Qualitative studies are often used to “explore the experiences, perceptions and preferences” of a population.<sup>91</sup> Therefore, it is beneficial to use qualitative research to explore dental practitioners’ opinions regarding teledentistry and hence why we have chosen it for part of our study.

### **2.3 Gap in the Literature**

Teledentistry has the ability to increase access to dental services, including specialist care, particularly to those who live in regional, rural and remote communities. It can also be used to upskill general dentists, reduce wait times for accessing care, increase cost-savings and improve patient care. Therefore, it is essential for teledentistry to be easy to implement in all settings.

During the COVID-19 pandemic, the technology that drove teledentistry saw vast improvements that allowed them to become more streamlined and easier to use for clinicians and patients.<sup>92</sup> Additionally, to further streamline the provision of teledentistry, new item codes were introduced into the Australian Schedule of Dental Services and Glossary which allowed clinicians to charge the appropriate codes for services rendered and for patients to receive reimbursement from their private health insurers.<sup>37</sup> There have been no studies conducted since the start of the COVID-19 pandemic analysing the opinions of all dental practitioners in Australia. Therefore, there have been no studies conducted analysing the efficacy of these new measures. Additionally, with increased usage we expect that new difficulties and disadvantages would have been encountered and no studies have been conducted to identify these new difficulties and disadvantages. Furthermore, there have been no studies conducted in Australia analysing implementation difficulties of teledentistry. It is

important to identify these difficulties so that implementation of teledentistry can be improved. Two studies, divided over 2 chapters (Chapter 3 and 4), were conducted to address the gap in the literature through qualitative and quantitative mixed methods research. A mixed methods study was chosen to allow for a deeper analysis into the insights of Australian dental practitioners.

## **2.4 Researcher Development**

The three priority areas of research development identified through the Victoria University My HDR Plan were academic writing skills, academic presentation skills and data collection and management.

Academic writing skills are essential as research publications are a key part of academia. I have improved my academic writing skills through coursework, self-reflection and guidance from my supervisors. The systematic and structured method through which academic writing was introduced was beneficial to develop my own skills. Additionally, I was able to use the feedback provided from the course coordinators from the submitted drafts to further improve my skills. There were also drafts that I discussed with my supervisors where they provided feedback which was also very beneficial. Academic writing is something that I have developed over the last 12 months, and I have continued to develop these skills through online training through Victoria University. The writing skills I developed were also used to write publications and this thesis.

Academic presentation skills are also extremely important as we should be able to present our work in a way that is easily understood by a wide range of people.

Presentation skills were required for the 3-minute presentation as part of the coursework as well as the confirmation of candidature. Additionally, there were several discussions among my peers which required me to present my research so that the other higher degree by research students were able to understand. Both my supervisors and I believe that my academic presentation skills improved during this degree. I further improved my skills by presenting at the HIS conference and through workshops.<sup>93</sup> This is a skill that I will continue to hone in the future as I believe it is a very important skill as an academic.

Data collection and management is an important part of research. The coursework provided by Victoria University provided a solid foundation in establishing good data management practices and ethical data collection. Discussing the coursework with my supervisors to further expand my knowledge and skills was also beneficial. I also attended journal study clubs to learn research analysis, methodology and study design. These journal clubs also helped me to improve my presentation skills. I further improved by data collection and management skills by conducting research as well as attending online training. I continued to attend journal study clubs to be able to expose myself to a broad range of techniques to improve my own learning as well.

# Chapter 3 – Cross-Sectional Analysis of Australian Dental Practitioners' Perceptions of Teledentistry

## 3.1 Introduction

Teledentistry is the usage of information and communication technology to facilitate communication and remote consultations between health professionals and patients.<sup>67</sup> One of the main benefits of teledentistry is the ability to provide care to patients who experience disadvantages introduced through distance, frailty, transport and health.<sup>2</sup> Teledentistry provides the ability to plan treatment, diagnose oral diseases, triage patients and monitor treatment.<sup>3-13</sup> Additionally, it can be used to provide education to dentists to improve the level of care that can be provided to their patients.<sup>14, 15</sup>

During the coronavirus (COVID-19) pandemic, there was increased usage of teledentistry to be able to provide care for all patients during government mandated lockdowns. During these lockdowns, restrictions were imposed on patients limiting movement. Additionally, restrictions were also placed on dentists limiting the treatment they could provide. For example, treatment could only be provided if the patient was in extreme pain or if it was life-threatening.<sup>94</sup> Therefore, there was increased adoption of teledentistry to, for example, remotely consult patients so that they could be triaged and provided with emergency care when appropriate. Additionally, advice could be given if they were not eligible for in-person care due to the restrictions.<sup>95</sup> This allowed the continued provision of care while protecting the community and clinicians from contracting COVID-19.<sup>2</sup> While teledentistry has provided large benefits, particularly during the pandemic, there has been resistance to implementing it amongst dental practitioners. It is quite complex increasing the difficulty of use which is compounded

by the lack of education provided.<sup>38, 78, 79</sup> Concerns have also been raised about the quality and reliability of the technology, the limited interventional capacity, high cost for set up and data security.<sup>24, 26</sup> The quality of the technology as well as a lack of a physical examination also caused concerns regarding the diagnostic accuracy.<sup>38</sup> Financial reimbursement has also been raised as a concern in past studies however this issue has been partially resolved through the introduction of new item codes into the Australian Schedule of Dental Services and Glossary to allow clinicians to appropriately bill for services rendered. It also allowed for patients to be reimbursed by their private health insurers.<sup>37, 77</sup>

A previous study was conducted in 2016 analysing the opinions of general dental practitioners however this was prior to the COVID-19 pandemic. There was increased usage of teledentistry during the pandemic and there have been improvements in teledentistry. These include new applications to streamline the process of teledentistry as well as new item codes being introduced.<sup>37</sup> Therefore, it is important to analyse the opinions of general dental practitioners in order to identify the advantages of teledentistry to be able to advocate for increased adoption as well as identify any disadvantages to aid in the identification of strategies to overcome these limitations.

### **3.2 Aims**

The overall aim of this chapter was to explore teledentistry in a clinical setting from the perspectives of healthcare professionals to determine the advantages and disadvantages of teledentistry.

### 3.3 Objectives

The aim was explored by the following specific objective of this chapter:

- Determine advantages and disadvantages of teledentistry in a clinical setting from the perspectives of healthcare professionals

### 3.4 Research Questions

- What are the advantages and disadvantages of tele-dentistry from the perspective of clinicians?
- What are the biggest advantages that tele-dentistry provides over in-person?
- What are some of the aspects of teledentistry that makes clinicians hesitant to adopt it into their own practice?

### 3.5 Methods

This project built upon previous work conducted by *Estai* and colleagues 2016 and *Lee* and colleagues 2022.<sup>24, 38</sup> *Estai* and colleagues examined general dental practitioners' opinions regarding teledentistry in 2016 however the health landscape has changed significantly since then particularly due to COVID-19 leading to increased teledentistry uptake. *Lee* and colleagues examined the opinions of specialist oral and maxillofacial surgeons however did not assess the opinions of all dental practitioners.

This study involved a cross-sectional study utilising an anonymous electronic questionnaire (e-questionnaire) to quantitatively assess clinician's opinions regarding teledentistry. The study followed the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guidelines.<sup>96</sup> This guideline provides a framework for reporting Web-based surveys.

### **3.5.1 Questionnaire Instrument & Distribution**

During this study, a questionnaire was developed and then validated through peer review and published.<sup>93</sup> The e-questionnaire was created on Qualtrics® XM software (Provo, UT, USA). The questionnaire can be found in the appendices. The first section asked regarding their demographic and professional background. The second section had 28 questions with a 5-point Likert Scale divided into 5 sub-sections. The sub-sections were diagnosis, accessibility, patient care, technology and finances. The survey was piloted on a group of 5 practising dentists for feedback regarding the questionnaire and corrections made accordingly based on their response. These 5 responses were not included in the final data.

The quantitative portion of the study utilised convenience sampling. The Australian Dental Association, a representative organisation for dental practitioners, was asked to distribute the questionnaire amongst their members through email. This email was enclosed with a definition of teledentistry and a brief overview of the advantages and disadvantages of teledentistry. A reminder email was sent for those who did not respond after two weeks. Additionally, social media posts were utilised to contact additional dental practitioners. Both specialist and general practitioners were contacted. In total, 152 dental practitioners responded to the questionnaire. The non-response rate is unknown. The participants had the right to voluntarily withdraw from the questionnaire at any point with no consequence until they submitted the questionnaire.

### **3.5.2 Statistical Analysis**

The responses were imported into a Comma Separated Values (CSV) file and analysed using Microsoft Excel (Redmond, WA, USA), Stats iQ (Qualtrics® XM, Provo, UT, USA), and STATA version 17.0 (StataCorp. 2021. Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC). To compare the responses against categorical variables (age range, gender, work experience, location of main profession, working hours and hours of telehealth usage), Chi-squared test and analysis of variance (ANOVA) were used. The statistical significance for both parameters was set at  $P < 0.05$ .

The quantitative data generated from the 5-point Likert scale was displayed as graphs showing agreement or disagreement with the statements in the questionnaire.

### **3.5.3 Theoretical Framework**

This study was based on the theoretical framework of pragmatism, specifically Dewey pragmatism.<sup>97</sup> This study examined teledentistry in terms of its practical use and determining solutions that would allow teledentistry to be implemented more easily. Pragmatism is often selected due to its potential to create organisational action and change.<sup>97</sup> The framework allowed us to incorporate research through design as our research employed methods with the intention of generating new knowledge.<sup>98</sup>

## **3.6 Ethics**

Ethics approval was sought from the Victoria University Human Research Ethics Committee for the distribution of the questionnaire (Project no. 2022/ET000369).

### **3.6.1 Quantitative E-Questionnaire**

The quantitative portion of the project will follow the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guidelines.<sup>96</sup> The anonymous e-questionnaire was created on Qualtrics® XM software (Provo, UT, USA). The participants were provided with an information page prior to beginning the questionnaire and a box to tick to provide informed consent. As we were only interested in Australian dental practitioners, we only involved participants who were able to read and understand English. The first section asked regarding their demographic and professional background. The second section had 28 questions relating to diagnosis, accessibility, patient care, technology and finances.

The questionnaire was distributed through social media posts on dental practitioner groups. Additionally, the Australian Dental Association, a representative organisation for dental practitioners distributed a poster with the questionnaire link. There was no requirement for participants to be screened as only dental practitioners can become members of the Australian Dental Association and the social media groups are monitored by the group administrators to ensure that only dental practitioners can join. The participants will have the right to voluntarily withdraw at any time prior to submitting the questionnaire. Upon submitting the questionnaire, we would be unable to determine which answers correlated with specific participants hence withdrawal was not possible.

The quantitative research data only included anonymous and non-sensitive questionnaire data that poses no foreseeable risks or discomfort to the participants.

## **3.6.2 Management of Risks to Human Participants**

### *3.6.2.1 Recruitment*

Recruitment refers to the principle of justice. Justice is fair distribution of benefits and burdens and fair treatment of the participants.<sup>99</sup> Participants were burdened to spend 15 minutes of their time to share their opinion. The participants were Australian dental practitioners from Australia whom I will be hoping to benefit through publications of my findings. Therefore, I believe I distributed benefits and burdens fairly. Participants were recruited through social media posts and emails. No other individuals besides the research team members were involved in recruiting. Participants for the e-questionnaire had links to the survey posted on social media or through email along with a brochure with information regarding the research. The participants had sufficient time to consider the information and contact details of the researchers were provided to answer any questions. Participation was entirely voluntary. Informed consent was obtained by marking a checkbox prior to starting the survey. The participants had no relationship or conflict of interest with any of the researchers. We were unable to track who has participated or not and hence there was no pressure to participate. Since participants were able to withdraw at any time until submission with no consequence, there was no potential for coercion or exploitation. No reimbursement was provided.

### *3.6.2.2 Informed Consent*

Informed consent is the process through which participants agree to voluntarily take part in the research after fully comprehending the research project. It is a requirement for participants and ensures that the principle of autonomy and respect is maintained.<sup>99</sup> Informed consent was obtained for the e-questionnaire as per the national statement guidelines.<sup>99</sup> An information pamphlet was provided to the participants which outlined

in detail the nature of the research, what participants were expected to do, contact details of researchers, expected benefits, potential risks as well the potential outcomes. Due to the nature of the questionnaire, once submitted the participants were unable to withdraw from the study. However, as the results were de-identified and cumulative there is no risk of identifying the participants from the data. Prior to submitting the questionnaire, the participants were able to withdraw without consequence. We have submitted our findings for publication with the results de-identified to protect the participants' privacy.

#### *3.6.2.3 Risk*

Risk refers to the principle of beneficence. This is the obligation to not harm and to maximise possible benefits and minimise possible harms.<sup>99</sup> This project has no physical risk to the participants or researchers as the questionnaires were completed online with no physical interaction. Additionally, the topic being discussed was not controversial and hence there was no psychological or social risk to the participants of the e-questionnaire. There was also no perceived occupational health and safety risk to the researchers and participants. Regarding the identification of participants, there was no risk of being identified from the results. The data was anonymous and de-identified with demographic data asking for a range rather than specific values. Furthermore, the data was cumulative and hence made it difficult to discern individual answers. Therefore, the foreseeable risk of identification was deemed to be low.

This project had minimal risk while having the potential to improve teledentistry and improve the implementation of teledentistry. Therefore, I believe I am upholding the principal of beneficence.

### 3.6.2.4 Responsible Data Management

The Australian code for the responsible conduct of research states that it is the researcher's responsibility to "retain clear, accurate, secure and complete records of all research including research data and primary materials. Where possible and appropriate, allow access and reference to these by interested parties".<sup>100</sup> Any data obtained from the research was stored on the Victoria University R drive. The data was not stored on devices that are easily lost such as USB drives. Use of the R drive will prevent any data being stolen or lost and allow us to responsibly manage the data. It will also allow for access when required for journal publications.

## 3.7 Results

### 3.7.1 Demographics

A total of 152 results were obtained. The tables outlining demographics of the participants can be seen below.

**Table 3.1:** Table outlining the participants' age range

| Age   | Count |
|-------|-------|
| 20-34 | 70    |
| 35-44 | 37    |
| 45-54 | 29    |
| 55-64 | 12    |
| >65   | 4     |

**Table 3.2:** Table outlining the participants' gender

| Gender                  | Count |
|-------------------------|-------|
| Male                    | 65    |
| Female                  | 85    |
| Non-binary/third gender | 0     |
| Prefer not to say       | 2     |

**Table 3.3:** Table outlining the participants' work experience (years)

| Work Experience (Years) | Count |
|-------------------------|-------|
| 0 – 5                   | 60    |
| 6 – 10                  | 43    |
| 11 – 15                 | 19    |
| >16                     | 30    |

**Table 3.4:** Table outlining participants' main location of profession

| Main Location of Profession | Count |
|-----------------------------|-------|
| Major City                  | 89    |
| Inner Regional              | 30    |
| Outer Regional              | 31    |
| Remote/Very Remote          | 2     |

**Table 3.5:** Table outlining participants' working hours (per week)

| Working Hours (Per Week) | Count |
|--------------------------|-------|
| 1-19                     | 15    |
| 20-34                    | 72    |
| 35-49                    | 63    |
| 50-64                    | 2     |
| >65                      | 0     |

**Table 3.6:** Table outlining hours of telehealth usage (per week)

| Hours of Telehealth Usage (Per Week) | Count |
|--------------------------------------|-------|
| 1-9                                  | 138   |
| 10-19                                | 12    |
| 20-29                                | 1     |
| 30-39                                | 1     |
| >40                                  | 0     |

The results from the study are outlined in table 3.7. The results are also shown in graph form in each of the sections.

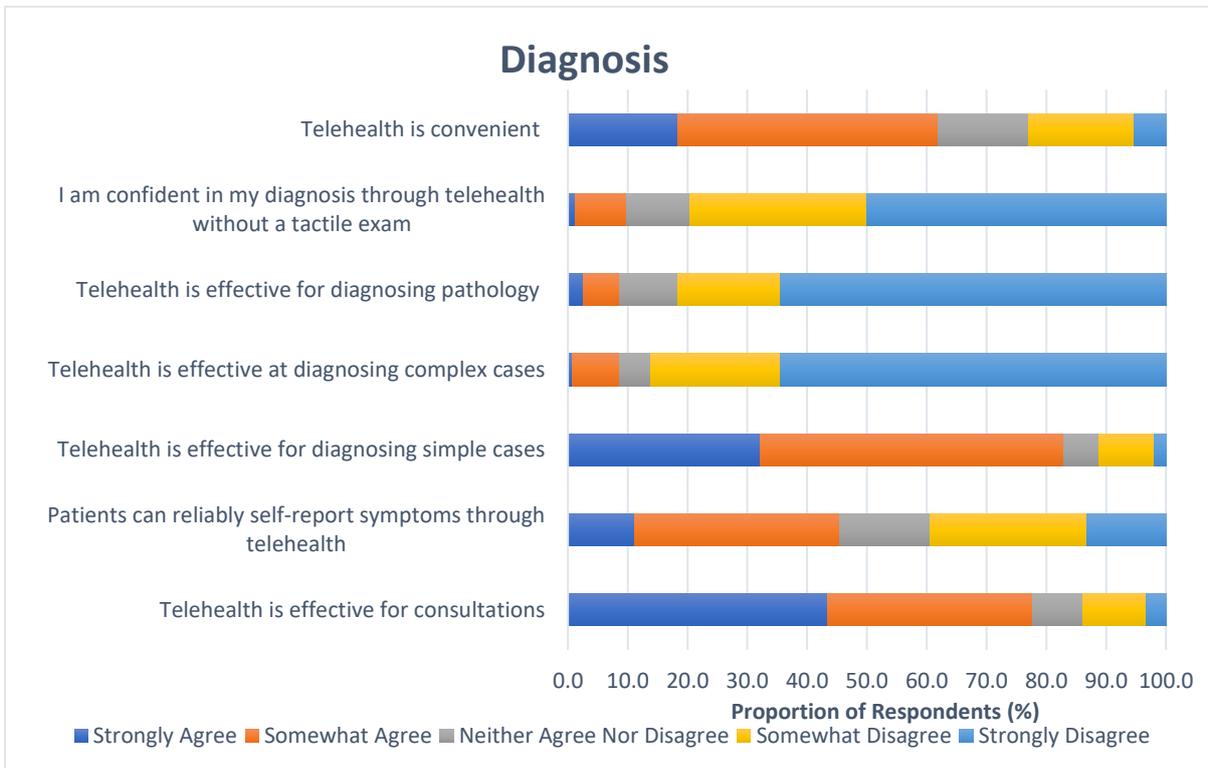
**Table 3.7:** Results regarding diagnosis, accessibility, patient care, technology and finances. 1 = strongly agree, 5 = strongly disagree, 3 = neither agree/disagree.

|               | Question   | Mean | Standard Deviation |
|---------------|--|------|--------------------|
| Diagnosis     | I believe that telehealth is effective for consultations                       | 1.96 | 1.11               |
|               | I believe that patients can reliably self-report symptoms through telehealth   | 2.96 | 1.26               |
|               | I believe that telehealth is effective for diagnosing simple cases             | 1.98 | 0.96               |
|               | I believe that telehealth is effective for diagnosing complex cases            | 4.41 | 0.95               |
|               | I believe that telehealth is effective for diagnosing pathology                | 4.35 | 1.05               |
|               | I am confident in my diagnosis through telehealth without a tactile exam       | 4.18 | 1.02               |
|               | Telehealth is convenient e.g., it saves time                                   | 2.48 | 1.14               |
| Accessibility | Telehealth improves access for remote and rural patients                       | 1.48 | 0.79               |
|               | Telehealth has been beneficial during the pandemic                             | 1.70 | 0.97               |
|               | Telehealth has been convenient for patients                                    | 1.88 | 0.94               |
|               | Telehealth has assisted in reducing wait times                                 | 2.43 | 1.07               |
|               | Telehealth provides improved flexibility compared to in-person                 | 2.47 | 1.11               |
|               | Telehealth is easily accessible for older patients                             | 2.72 | 1.24               |
| Patient Care  | Telehealth is useful for triaging patients                                     | 1.66 | 0.76               |
|               | Telehealth has effective interventional capacity                               | 3.23 | 1.17               |
|               | Telehealth is comparable to face-to-face                                       | 4.05 | 1.05               |
|               | Telehealth is useful for post-op care  | 1.76 | 0.73               |
|               | I am able to build patient rapport over telehealth                             | 2.41 | 1.11               |
|               | Patients are accepting of telehealth   | 2.21 | 0.84               |
| Technology    | I prefer telehealth over face-to-face  | 4.26 | 1.07               |
|               | The quality of the technology used in telehealth is adequate                   | 3.15 | 1.07               |
|               | I believe that data is secure over telehealth                                  | 2.75 | 1.02               |
|               | I am happy that medicolegal issues are not a problem over telehealth (Consent) | 3.09 | 1.05               |
|               | Patients are able to use the technology  | 2.59 | 0.91               |
|               | Telehealth technology is reliable  | 2.92 | 1.00               |

|          |   |      |      |
|----------|---|------|------|
| Finances | There are no issues regarding billing with telehealth         | 3.03 | 1.01 |
|          | The cost for delivering telehealth is similar to face-to-face | 3.18 | 1.00 |

### 3.7.2 Diagnosis

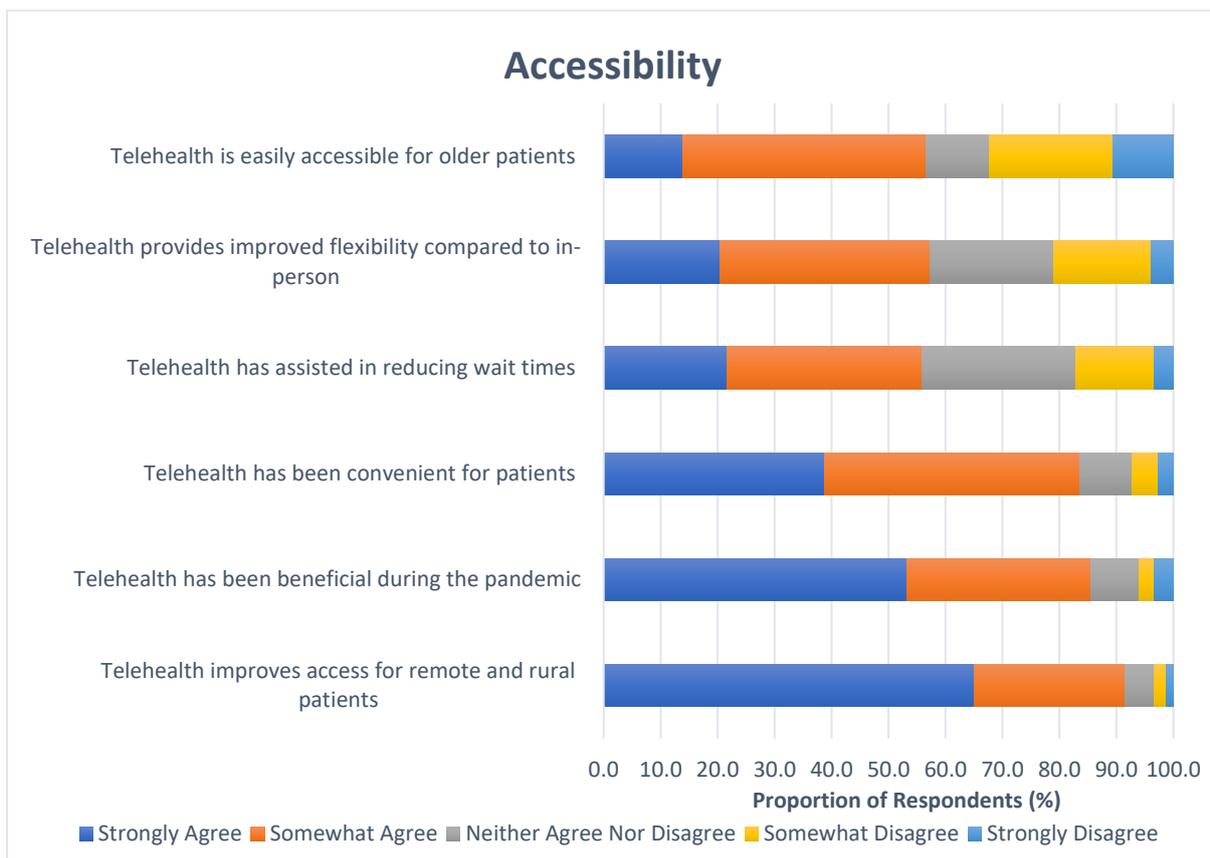
Over 77% of participants believed that teledentistry was effective for consultations and over 82% of participants believed that teledentistry was effective for diagnosing simple cases. Approximately 61% of the participants also believed that teledentistry was convenient and, for example, saved time. Opinions were mixed regarding the reliability of patients self-reporting symptoms through teledentistry with 45% agreeing that patients were reliable, 40% disagreeing and 15% neither agreeing nor disagreeing. Teledentistry was also believed to be ineffective at diagnosing complex cases by 86% of participants, 82% believed teledentistry to be ineffective at diagnosing pathology and 80% of the participants were not confident in their diagnosis through teledentistry due to a lack of a tactile exam. The results are displayed in the graph below.



**Figure 3.1:** Practitioners' perceptions of diagnosis through teledentistry

### 3.7.3 Accessibility

Most of the participants believed that teledentistry improved accessibility for their patients, particularly those living in remote and rural areas with over 91% agreement. Around 85% of participants believed that teledentistry was beneficial during the pandemic and 84% believed it to be convenient for their patients. Additionally, 56% believed that teledentistry was able to assist in reducing wait times, 57% found that there was increased flexibility compared to in-person and 56% believed that teledentistry was easily accessible for older patients. The results are shown in the figure below.

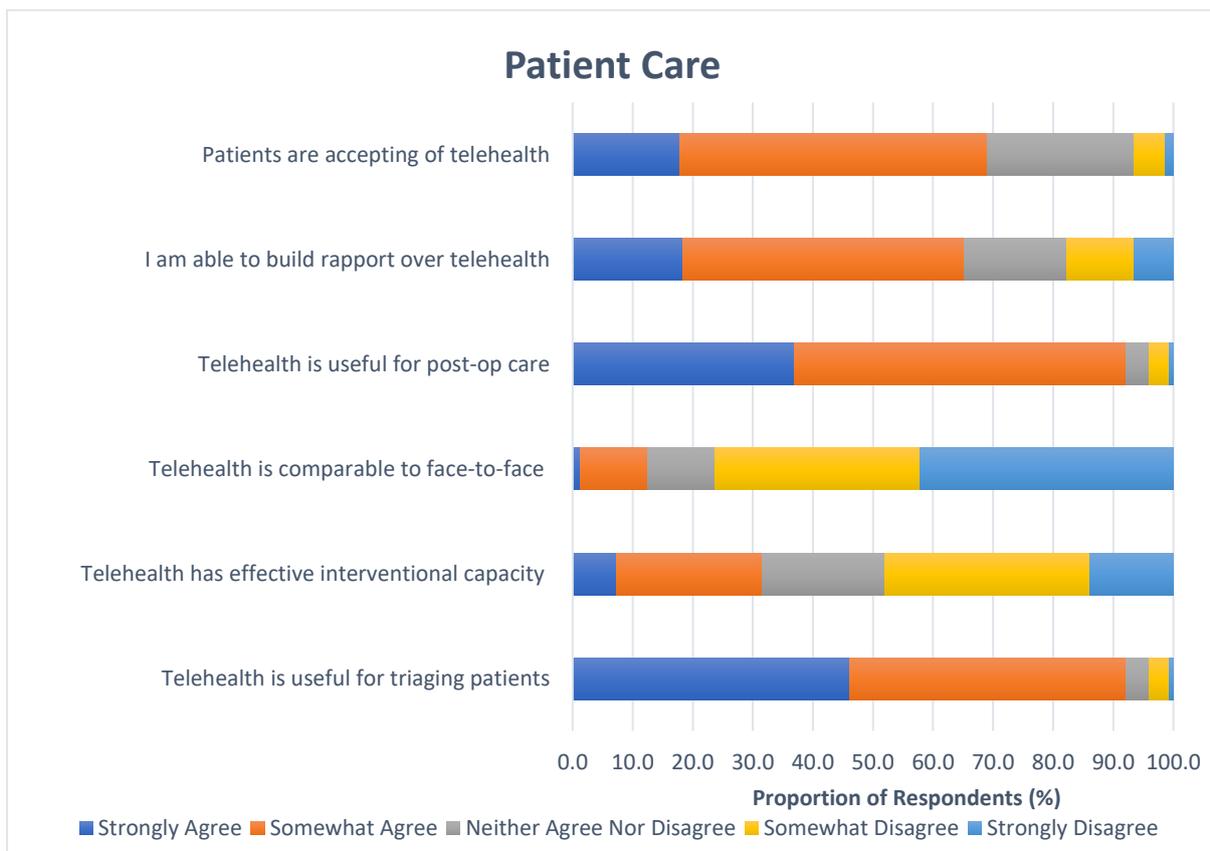


**Figure 3.2:** Practitioners' perceptions of accessibility and teledentistry

### 3.7.4 Patient Care

Regarding patient care, around 92% of the participants believed that teledentistry was useful for triaging patients, 92% believed that teledentistry was useful for post-

operative care, 65% believed that they were able to build rapport over teledentistry and 69% found that patients were accepting of teledentistry. However, 76% of the participants found that teledentistry was not comparable to in-person. The opinions regarding interventional capacity were mixed with 32% agreeing that teledentistry had effective interventional capacity, 20% neither agreeing nor disagreeing and 48% disagreeing. The results are shown in the figure below.

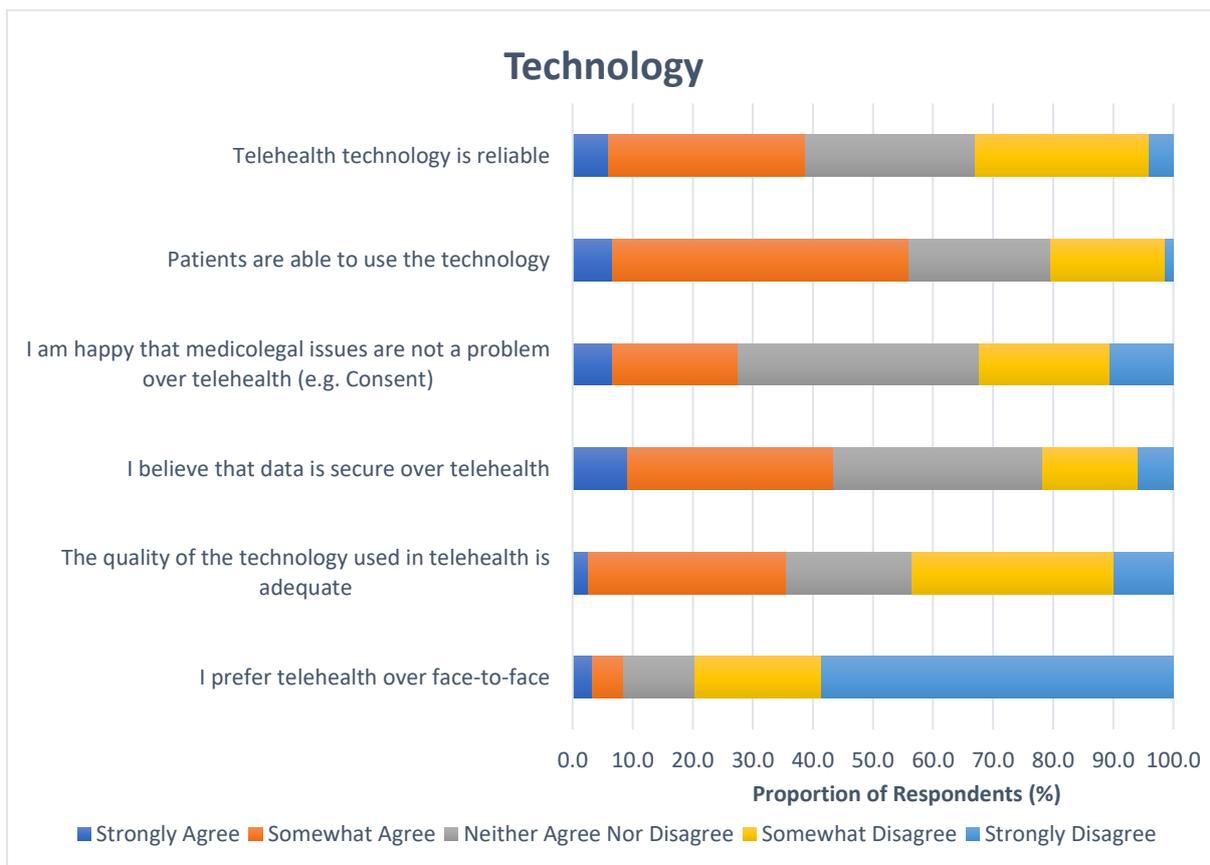


**Figure 3.3:** Practitioners' perceptions of patient care through teledentistry

### 3.7.5 Technology

The opinions regarding technology were mixed. Regarding the quality of the technology, 35% of the participants agreed that it was adequate, 21% were neutral and 44% disagreed. Approximately 43% believed that data was secure over teledentistry, 35% neither agreed nor disagreed and 21% disagreed. Additionally, 28% of the participants agreed that medicolegal issues such as consent were not a problem

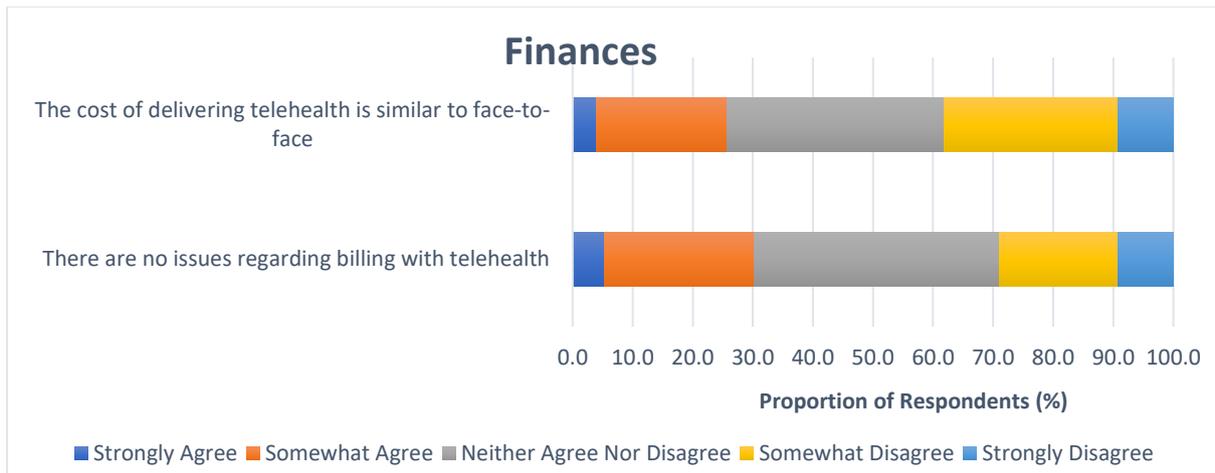
over teledentistry, 40% were neutral and 32% disagreed. Furthermore, 39% agreed that the technology for teledentistry was reliable, 28% were neutral and 33% disagreed. The participants did not prefer teledentistry over in-person with approximately 80% disagreeing with the statement “I prefer telehealth over face-to-face”. However, 56% believed that patients were able to use the technology effectively. The results are displayed in the figure below.



**Figure 3.4:** Practitioners’ perceptions of the technology of teledentistry

### 3.7.6 Finances

Regarding finances and teledentistry, the opinions were also mixed. Approximately 30% of the participants agreed that there were no issues regarding billing, 41% were neutral and 29% disagreed. Additionally, 26% agreed that the cost of delivering teledentistry was similar to in-person, 36% were neutral and 38% disagreed. The results are shown in the figure below.



**Figure 3.5:** Practitioners' perceptions of the finances of teledentistry

### 3.7.7 Chi-Squared Analysis

There was a strong statistically significant relationship between age range and hours of teledentistry usage (per week). Dentists aged between 35-54 years utilised teledentistry for 10-19 hours a week compared to other ages ( $P < 0.00001$ ). Age range and hours of teledentistry usage per week also had had a strong statistically significant relationship with younger dentists having lower teledentistry usage on a weekly basis [20-34 years vs >35 years] ( $P < 0.00001$ ).

Additionally, all age groups unanimously agreed that teledentistry was effective for diagnosing simple cases, although this was not statistically significant. There was also unanimous agreement that telehealth was effective for consultations amongst all age groups however, again, this was not statistically significant. Age range and the belief that patients can reliably self-report symptoms had a statistically significant relationship. Dentists aged between 35-54 years neither agreed nor disagreed with the statement ( $P = 0.0339$ ). However, the other groups agreed on a positive level. Finally, there was unanimous disagreement that teledentistry was effective at diagnosing especially without a tactile exam.

### **3.7.8 ANOVA**

ANOVA showed a statistically significant relationship between age range and the perceived reliability of teledentistry. Younger dentists had higher agreeance compared to the other age groups [20-34 years vs >35 years] ( $P = 0.008$ ).

Additionally, there was a statistically significant relationship between age range and perceived ability of patients' ability to utilise the technology. Older dentist neither agreed nor disagreed compared to the other age groups [>55 years vs 20-54 years] ( $P = 0.021$ ).

There was also a statistically significant relationship between age range and preference of teledentistry over in-person appointments. Older dentist more or so strongly disagreed compared to the younger age groups [>55 years vs 20-54 years] ( $P = 0.024$ ).

Finally, there was a statistically significant relationship between age range and perceived patients' acceptance of teledentistry. Younger dentists perceived patients to be more accepting compared to the other aged groups [20-64 years vs >65 years] ( $P = 0.0430$ ).

## **3.8 Discussion**

This chapter involved the first study that analysed the opinions of practising Australian dental practitioners regarding teledentistry since the increased usage seen during the COVID-19 pandemic. The participants viewed teledentistry positively regarding diagnosis of simple cases, consultations, triaging patients and the delivery of post-op

care. Patients appeared to be accepting of teledentistry and clinicians saw great benefits of teledentistry for patients living in rural and regional areas. Furthermore, teledentistry was seen as being beneficial during the COVID-19 pandemic and it was also seen as convenient for patients and clinicians. However, a large proportion of the participants expressed uncertainty regarding the diagnostic accuracy particularly with complex cases and pathology, reliability of patients to self-report symptoms and finances. There were also concerns regarding the quality of the technology and most participants preferred in-person compared to teledentistry. The lack of interventional capacity of teledentistry was also seen as an issue. Although clinicians appeared to be accepting of teledentistry particularly as the benefits of teledentistry were observed, the majority of the participants preferred in-person.

The diagnostic accuracy of teledentistry, and telehealth in general, has always been regarded with uncertainty.<sup>24, 101</sup> This has been largely due to the fact that a complete history and physical examination is unable to be conducted to be able to accurately diagnose disease.<sup>101</sup> This is particularly prevalent for more complex cases such as pathology.<sup>38</sup> Diagnostic accuracy is pivotal in cases such as oral cancer where early detection can improve the prognosis significantly.<sup>102</sup> However, the diagnostic accuracy of teledentistry have been shown to be similar to face-to-face in the diagnosis of dental decay and assessment for simple dentoalveolar surgery such as extractions.<sup>10, 67</sup> Additionally, more complex cases such as oral malignant lesions also have a high degree of accuracy with one study reporting 79.41 – 85.29% accuracy, however ideally for something such as oral cancer the accuracy would be higher.<sup>12</sup> The disparity between the accuracy of teledentistry between clinicians' opinions and the literature may be due to many clinicians requiring a physical examination to be confident in their

diagnosis. Unfortunately, this cannot be conducted through teledentistry, and this lack of a physical exam has been noted as an implicit disadvantage of teledentistry.<sup>38, 103</sup> This lack of physical interaction also limits the interventional capacity of teledentistry, particularly as in the field of dental practice much of the treatment is provided through physical clinical intervention.<sup>104</sup>

Technology is also regarded with uncertainty by the participants. Technology has previously been stated as a concern regarding teledentistry in the literature.<sup>24</sup> A large portion of the participants of this study found the quality of the technology to be inadequate, however there were some who were neutral and some who found it to be adequate. Interestingly, the participants of this study found that even though the quality of the technology was inadequate, it was at least seen as reliable. Furthermore, the data from teledentistry was also seen as secure. This is in contrast to the study conducted in 2016 by *Estai* and colleagues in which the participants expressed a large amount of concern regarding the reliability of the technology and the security of the data. This improvement could be due to the innovation of technology that has allowed, for example, high quality cameras to be available on smartphones which have widespread use.<sup>105</sup> Additionally, many new telehealth applications have been created to allow the process of consulting, obtaining consent and billing to become more streamlined.<sup>46</sup> Improving technology has been shown to be an effective method of improving the perception of teledentistry in the literature, and this has been demonstrated in our study as well.<sup>40</sup> However, health practitioners must be wary about the increasing adoption of technology in patient care. Increased usage of technology in healthcare by clinicians has led to complaints about “physicians spending more time looking at computer screens than their patients”.<sup>103</sup> Teledentistry is delivered purely

by technology and hence it could create more issues with patients as the clinician will not be physically present.<sup>106</sup>

Finances were previously seen as a large uncertainty of teledentistry due to the cost as well as unclear remuneration guidelines.<sup>24</sup> Prior to the pandemic, there were large issues seen with remuneration particularly as many private health companies did not support online consultations.<sup>107</sup> However, in response to the COVID-19 pandemic, the Australian Dental Association introduced new item codes into the Australian Schedule of Dental Services and Glossary specifically to allow practitioners to charge and write notes appropriately and to allow private health insurers to reimburse clinicians and patients.<sup>37</sup> This introduction could have potentially contributed to the improvement in opinion regarding finances.

The participants of this study viewed teledentistry very favourably regarding accessibility particularly for those living in regional, rural and remote areas. Improving access to healthcare for people living in these areas has been documented within the literature as one of the main benefits of telehealth services.<sup>108</sup> This is because teledentistry allows patients to gain improved access to healthcare, particularly specialists, as well as improved quality of care.<sup>14, 15, 70-72</sup> Additionally, teledentistry allows general dental practitioners to communicate, for example in real-time, with specialists further improving the quality of care provided to patients.<sup>14, 15</sup> Teledentistry also had large benefits in improving access during the COVID-19 pandemic as it allowed care to be delivered remotely meaning even patients infected with COVID-19 could access treatment without any risk of transmission, protecting both patients and the clinicians.<sup>2, 69</sup>

Teledentistry was also seen to improve the efficiency of delivering healthcare through reduction of wait-times and through things such as triaging patients and delivering post-op care. Teledentistry is effective at improving efficiency with previous studies demonstrating reduction of wait times to access specialist services in dental hospitals as well as improving the efficiency of hospital emergency departments.<sup>24, 36</sup>

### **3.8.1 Limitations**

One of the limitations of this chapter of the study was the low sample size for the questionnaire. We only managed to recruit 152 participants. However, analysing the demographics reveals that we managed to capture a broad range of participants from various ages and working groups and hence we believe that our sample can be considered representative. Furthermore, the previous study conducted in 2016 only had 135 participants. We managed to recruit more participants than the previous study strengthening our findings. This study could also be used as a platform to conduct larger studies with a higher number of participants.

Additionally, the questionnaire recruitment was primarily done through social media. Although emails were sent through representative organisation such as the Australian Dental Association, since social media was the primary recruitment tool this could potentially introduce selection bias into our results. We do not anticipate this to have a large effect on our results. Additionally, we acknowledge that our recruitment methods may not be truly random as we are unable to truly randomise recruitment which will limit the generalisability of our findings. Based on our methodology, we believe that our results will be as generalisable as feasible.

### **3.8.2 Strengths**

This questionnaire is a widely adaptable tool that can be used to track the changes of the perceptions of teledentistry for dental practitioners. Future studies can continue to use this questionnaire to allow for the analysis of perceptions regarding teledentistry. Additionally, the questionnaire was peer-reviewed and published further improving the validity of the questionnaire instrument.

### **3.8.3 Implications**

Although there is support from dental practitioners for teledentistry, there are also large concerns expressed through this study. In particular, concerns regarding the diagnostic accuracy, quality of the technology and lack of interventional capacity. However, there have been improvements in the perceptions regarding the technology, accessibility and finances which are likely due to the improvements made to teledentistry over the past few years. Addressing these concerns would encourage dental practitioners to adopt teledentistry to further improve access to healthcare.

### **3.8.4 Future Research**

This research has explored the opinions of general dental practitioners' regarding teledentistry. Large scale studies recruiting a larger sample size should be conducted in the future to increase the generalisability of the findings.

## **3.9 Conclusion**

This study has provided an insight into dentists' opinions regarding teledentistry in the post COVID-19 pandemic era. It appears that opinions have improved slightly, however there are still immense hurdles to overcome before teledentistry becomes

highly accepted within the dental community. However, it is vital that we continue to conduct research in this field as teledentistry has large benefits particularly for those living in regional, rural, and remote areas. Teledentistry will likely continue to play a role within the field and therefore we should continue innovating teledentistry so it can continue to be improved.

# **Chapter 4: Advantages, Disadvantages and Barriers of Implementing Teledentistry – A Qualitative Analysis of Australian Dental Practitioners**

## **4.1 Introduction**

Teledentistry is the use of information and communication technologies to deliver dental care across geographic distances.<sup>1</sup> This helps to overcome obstacles such as distance, frailty or health.<sup>2</sup> It can be used to plan treatment, diagnose oral health conditions such as cancer or dental decay, triage patients and monitor treatment.<sup>3-13</sup> Teledentistry can also be used to upskill dentists in real-time to allow patients living in rural and regional areas to receive specialist-level care from a general dentist in the area.<sup>14, 15</sup> The accuracy of teledentistry has also been noted to be similar for in-person when diagnosing simple conditions such as decay.<sup>10, 13</sup> The patient satisfaction rate is also quite high.<sup>58</sup>

However, there has been resistance from dental practitioners in Australia to adopt teledentistry and this could be due to the limitations present. Teledentistry is quite complex meaning it is difficult to use for clinicians and patients.<sup>38</sup> This issue becomes compounded by the lack of education and knowledge provided to health care professionals.<sup>78, 79</sup> There have also been concerns raised with the technology's quality and reliability. Additionally, concerns were raised regarding the limited interventional capacity, high cost for set up and data security.<sup>24, 26</sup> There are also issues with the accuracy of the diagnosis particularly for more complex cases due to the inability of conducting a physical examination.<sup>38</sup> Previous studies also noted that financial reimbursement was a concern however there have been efforts to rectify this by the

introduction of new item codes to allow clinicians to appropriately bill for services provided and for private health insurers to be able to reimburse patients as well.<sup>37, 77</sup>

A previous study was conducted in 2016 analysing the opinions of general dental practitioners however this was prior to the Coronavirus disease 19 (COVID-19) pandemic. During the pandemic, teledentistry saw increased usage as well as improvements such as the introduction of new applications to streamline the process of teledentistry as well as new item codes being introduced.<sup>37</sup> Therefore, it is important to analyse the opinions of general dental practitioners in order to identify if there have been any changes in the advantages of teledentistry to be able to advocate for increased adoption as well as identify any disadvantages to identify strategies to overcome these limitations. Additionally, there have been no studies exploring the barriers to implementing teledentistry in Australia nor any studies to create interventions to overcome implementation barriers. It is important to identify barriers for implementation so that we can create strategy to overcome these barriers so that those who only have access to teledentistry are not disadvantaged.

## **4.2 Aims**

The overall aim of this chapter was to explore teledentistry in a clinical setting from the perspectives of healthcare professionals to determine the advantages, disadvantages and the barriers to implementing teledentistry. We also aimed to explore potential solutions to overcome these barriers.

### **4.3 Objectives**

The aim was explored by the following specific objective of this chapter:

- Explore the advantages and disadvantages of teledentistry. Additionally, explore the barriers of implementing teledentistry in a clinical setting and prioritise interventions to overcome these barriers via focus groups

### **4.4 Research Questions**

- What are the advantages and disadvantages of tele-dentistry from the perspective of clinicians?
- What are the barriers to implementing teledentistry in Australia?
- What are some strategies to overcome the barriers?
- What are some of the aspects of teledentistry that makes clinicians hesitant to adopt it into their own practice?

### **4.5 Methods**

This study involved focus groups to qualitatively analyse the advantages, disadvantages, and implementation barriers of teledentistry and to prioritise strategies to overcome these barriers. This study followed the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines which provides a framework for reporting qualitative research.<sup>109</sup>

A qualitative approach was adopted for this part of the study to conduct an in-depth examination of the opinions of a small sample of clinicians. It allowed us to gain a deeper and richer insight which also provided us the opportunity to explore the barriers of implementing teledentistry and identify interventions, directly addressing the study aims.<sup>87</sup>

#### **4.5.1 Focus Group**

The focus group discussions were facilitated by one author (J.L.) using a topic guide. The same author facilitated all of the sessions to ensure uniformity. In total there were 13 participants in 2 focus groups, one with 6 participants and the other with 7. A discussion guide was used during the focus group which can be found in the appendices.

#### **4.5.2 Study Sample and Recruitment**

Each focus group consisted of participants who were practising Australian dentists. Snowball sampling techniques were applied. Recruitment occurred through professional organisations and networks such as the Australian Dental Association and the Royal Australasian College of Dental Surgeons. They were contacted through telephone and emails.

#### **4.5.3 Setting**

The focus groups were conducted via online conferencing for example Zoom (San Jose, CA, USA) and Microsoft Teams (Redmond, WA, USA). The audio from the discussions were recorded to allow for transcribing and analysis.

#### **4.5.4 Statistical Analysis**

The focus group discussions were transcribed and hand coded. The data was then imported into NVIVO 12 (QSR International Pty Ltd., MA, USA) which is a qualitative data analysis program. A thematic analysis was conducted to identify main themes and sub-themes to determine common factors. After analysis, central themes emerged which were used to identify barriers for implementing teledentistry and subsequent

solutions to overcome these barriers also identified. Quotes were then selected to create a narrative regarding the themes and subthemes. A word cloud was generated to identify and display common phrases and to identify potential additional themes.

The focus groups generated qualitative data. Audio recordings were kept from the groups to aid with word for word transcriptions. All data was de-identified.

#### **4.5.5 Theoretical Framework**

This study was based on the theoretical framework of pragmatism, specifically Dewey pragmatism.<sup>97</sup> This study examined teledentistry in terms of its practical use and determining solutions that would allow teledentistry to be implemented more easily. Pragmatism is often selected due to its potential to create organisational action and change.<sup>97</sup> The framework allowed us to incorporate research through design as our research employed methods with the intention of generating new knowledge.<sup>98</sup>

#### **4.6 Ethics**

Ethics approval was sought from the Victoria University Human Research Ethics Committee for conducting of the focus groups (Project no. 2022/ET000370).

##### **4.6.1 Data Collection and Management**

Data collection and management are related to the principle of beneficence. Poor data collection and management practices leads to increased risk and harm to the participants and the researchers.<sup>99</sup>

#### **4.6.2 Qualitative Focus Groups**

The qualitative portion of the project followed the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines.<sup>109</sup> Participants were recruited using snowball sampling. Each focus group consisted of participants who were practising Australian dental practitioners. They were contacted through emails and the telephone. There were 2 focus groups with 6 and 7 participants each. The focus groups explored the advantages and disadvantages of teledentistry as well as the barriers for implementation. Strategies to overcome these barriers were also discussed.

The focus groups were conducted through online conferencing, for example, Zoom (San Jose, CA, USA) and Microsoft Teams (Redmond, WA, USA). Participants were provided with a pamphlet outlining information regarding teledentistry and information regarding my research project prior to the discussion. They were provided this information once more on the day of the discussion and an opportunity to ask questions was given. Once participants were satisfied that they understood the research, they were asked to sign an informed consent form. The participants have the right to voluntarily withdraw at any stage of the study until publication with no consequence.

The discussions had the audio recorded so that accurate transcriptions could be made whilst also allowing the facilitator to focus on the discussion. The introductions were not recorded, and the video not recorded to minimise the amount of personal, identifiable data collected. The audio was transcribed and de-identified. The transcripts were then coded and analysed using NVivo (QSR International). The

themes were then consolidated for easier analysis. Additionally, coding the data further de-identified the information protecting participants' privacy.

Only myself and my supervisors have access to the data collected with no external individuals or organisations having access to the data. The data is non-identifiable for the focus groups. No future projects will be undertaken using the data collected from this project. The data collected will be stored and organised on the Victoria University R Drive and kept for 7 years post-publication. Use of this drive will ensure that the data is secure and not lost. Furthermore, it will mean the data is available if required for journal publications. Additionally, the drive will ensure that we are safely storing our data in accordance with the Australian Code for the Responsible Conduct of Research.<sup>100</sup> The research supervisors Professor Hua Wang, Dr Kate Wang and Dr Alex Park will be responsible for the data storage after completion of the project. After the data-retention period they will also assess whether the data requires further retention or removal. If appropriate, the data will be destroyed using disposal software.

### **4.6.3 Management of Risks to Human Participants**

#### *4.6.3.1 Recruitment*

Participants for the focus group were recruited via social media posts and emails. The focus groups took about 45 minutes and hence the burden for the Australian dentist participants was slightly higher compared to the e-questionnaire. However, the principle of justice was still be maintained as we are aiming to improve teledentistry for the participant population, i.e., Australian dental practitioners. Only research team members were involved in recruiting to maintain privacy. Participants were sent brochures regarding the focus group with an email address to message if they have

questions or were interested in participating. The participants had sufficient time to consider joining the focus groups and it was voluntary. Informed consent was obtained by signing a consent form electronically. There was no prior relationship or conflict of interest between the participants and the researchers. Since this was a voluntary opt-in system, there was no pressure for participation. Participants were also able to withdraw at any time with no consequence hence there was no risk of coercion or exploitation. No reimbursement was provided.

#### *4.6.3.2 Informed Consent*

Informed consent is the process through which participants agree to voluntarily take part in the research after fully comprehending the research project. It is a requirement for participants and ensures that the principle of autonomy and respect is maintained.<sup>99</sup> Informed consent was obtained for the focus groups as per the national statement guidelines.<sup>99</sup> Participants involved in the focus group were given an information pamphlet with similar information. Additionally, prior to beginning the focus group session, an in-depth discussion was undertaken to ensure that they were fully informed of the nature of the research and expected outcomes. The participants were able to withdraw at any time prior to the publication of the research. We have submitted our findings of the research for publication with the results de-identified to protect the participants' privacy.

#### *4.6.3.3 Risk*

Risk refers to the principle of beneficence. This is the obligation to not harm and to maximise possible benefits and minimise possible harms.<sup>99</sup> There was no physical risk to participants or researchers. The focus groups were conducted through online

conferencing and hence there was no physical interaction. The topic being discussed was not controversial hence there was no psychological risk to participants or researchers. There was the possibility of mild social risk to participants of the focus groups. The participants were discussing personal opinions among colleagues and peers. However, the topic being discussed was not controversial and hence we deem there to be a low risk of mild discomfort. Additionally, there was deemed to be minimal occupation health and safety risk to the researchers and participants.

Participants of the focus groups have a low risk of being identified from the results. However, the audio transcriptions were de-identified and therefore anonymous reducing risk of identification. Additionally, themes and sub-themes were coded from the audio transcriptions. Therefore, specific details were not published reducing risk of identification. Therefore, the foreseeable risk was low. The topic was also not controversial hence the potential risks are low.

The focus group participants were advised that the discussion was confidential, and I advised them to avoid discussing topics covered in the group with people outside of the study. However, this is difficult to enforce and therefore there is a risk that participants will have discussions regarding the focus group. Since the topic was not controversial, we deem there to be a low risk of mild discomfort.

This project had minimal risk while having the potential to improve teledentistry and improve the implementation of teledentistry. Therefore, I believe I am upholding the principal of beneficence.

#### *4.6.3.9 Responsible Data Management*

The Australian code for the responsible conduct of research states that it is the researcher's responsibility to "retain clear, accurate, secure and complete records of all research including research data and primary materials. Where possible and appropriate, allow access and reference to these by interested parties"<sup>100</sup>. Any data obtained from the research was stored on the Victoria University R drive. The data was not stored on devices that are easily lost such as USB drives. Use of the R drive will prevent any data being stolen or lost and allow us to responsibly manage the data. It will also allow for access when required for journal publications.

## **4.7 Results**

In total there were 2 focus groups with 13 participants. The first focus group had 7 participants and the second group had 6 participants.

### **4.7.1 Thematic Analysis**

Six key themes arose from the focus group: Technology utilisation, Patient accessibility, Clinical applications, Patient centred care, Difficulties for clinicians to adopt teledentistry, and Finances. Words from the most common phrases recorded are highlighted in the word cloud generated shown in Figure 4.1.



*“They also have some difficulty hearing what the patient is saying and vice versa.”* [Participant 6]

One of the respondents further raised a comment outlining difficulty of accessing the equipment to deliver teledentistry services efficiently.

*“I’m just wondering how we can improve it so that we can still paint an accurate picture without the video access, or do we really need to have another practitioner there to take a photo of them in a hub or a community hub where there is access to all of this”* [Participant 5]

Furthermore, another participant raised the issues of software utilisation presenting as a potential barrier for implementation.

*“The main thing isn’t the hardware, it’s the software and algorithms that are involved. That’s where the complexity of the technology comes from”*  
[Participant 2]

Participants also raised issues of patients’ utilisation of the technology causing difficulties.

*“Even if some people have cameras, they have difficulties using them but also to take a photo in the mouth is very difficult”* [Participant 7]

#### **4.7.3 Patient Accessibility**

It was unanimously agreed that teledentistry improved accessibility for patients, particularly those in more vulnerable situations.

*“I think you access a lot more people”* [Participant 10]

*“Sometimes when people are having chemo and things like that. Um they’re not keen on going out and about more than they have to and when they’re not well enough to. Teledentistry can be used to deliver care to these people.”*

[Participant 10]

Within this theme, patient convenience played a pivotal role in the success of teledentistry. Even if physical treatment cannot be provided, one of the participants stated that indirect symptomatic management could be a viable and time-saving option.

*“... I have written prescriptions for patients, as I am confident that they need this and then converting them to come in even if they have to travel quite far. So, I think rather than a phone call, video when it does work can work really well”* [Participant 1]

*“Using telehealth to triage patients, to get a better understanding of what their situation is like so they can be treated in a timely manner.”* [Participant 13]

Benefits were also seen for patients living in rural, regional, and remote communities.

*“I have heard of other surgeons as well who consult rural patients through telehealth”* [Participant 4]

Due to issues with the Coronavirus (COVID-19) pandemic, the safety of both patients and the clinician is paramount. Teledentistry was able to be used to treat patients without endangering the community or the clinician.

*“Telehealth can be used to gain access to care without the risk of virus transmission”* [Participant 10]

In addition, teledentistry could be used to deliver care to patients in the aged-care sector, particularly if there are issues with disease transmission, for example, during the recent pandemic.

*“I think there is a lot of need for more of these sorts of services with aged care”*

[Participant 8]

#### **4.7.4 Clinical Applications**

Teledentistry was able to improve the efficiency of the participants' clinics.

*“Our clinic has been using teledentistry to make clinical work much faster so if there's any of what we call low-risk reviews we actually don't bring the patient in anymore and instead of a 20-minute review, to make it quicker we make it a 5-minute telehealth review”* [Participant 7]

Telehealth could potentially improve collaborative care between clinicians, for example, to clarify treatment plans for patients.

*“Occasionally we will clarify the plan for the patients”* [Participant 3]

For patients with COVID-19, teledentistry could be used to deliver treatment without compromising clinicians' health to ensure that care could be provided. In addition, alternative options could be provided if treatments could not be offered in the dental clinic.

*“If our receptionist booked in for any emergencies, they would ask any cold or flu symptoms, any signs of covid and if they did, that's when they decide if the patient actually needs to come in or not”* [Participant 7]

*“...If there was a COVID positive patient, they called the hotline and then were directed to a hospital which had a negative pressure room” [Participant 10]*

#### **4.7.5 Patient Centred Care**

The majority of the participants raised the point that teledentistry could be viable particularly if consultations with specialists were required.

*“What we would do is try and photograph the pathology as best as we can. Do a case outline, email it to the oral medicine specialists in metro south... We have a little discussion over the phone. Sometimes they would guide us through the biopsy needed” [Participant 3]*

Teledentistry when used with video could also be used to observe the signs to be able to more effectively determine whether a patient requires treatment or not.

*“Video conference works really well in the situations where someone tells you they have major swelling or finding it difficult to swallow... You are able to see these signs yourself.” [Participant 1]*

It could also be used to triage patients to ensure that treatment could be delivered in a timely manner.

*“Using telehealth to triage patients, to get a better understanding of what their situation is like so they can be treated in a timely manner.” [Participant 13]*

Teledentistry was seen as particularly useful for delivering post-operative care.

*“When patients are in pain just reassuring the patient, that really helps and just asking them if they have any problems or letting them know that they can come in if they have any major issues” [Participant 12]*

One dentist had raised the suggestion that auxiliary staff could potentially be recruited to play a vital role in assisting the dentists to maximise the effectiveness of teledentistry. This could be essential during pandemics.

*“I think mainly towards the start of the year if our receptionist booked in for any emergencies, they would ask any cold or flu symptoms, any signs of COVID and if they did that’s when they would do more of the like deciding if the patient actually needs to come in or not”* [Participant 7]

However, the clinicians found that teledentistry had low interventional capacity and diagnostic accuracy particularly when comparing to in-person.

*“I think it boils down to us as clinicians needing to most of the time, if not all of time, you kind of need to see the problem in-person”* [Participant 4]

#### **4.7.6 Difficulties for Clinicians to Adopt Teledentistry**

The clinicians raised concerns regarding their confidence in diagnosing patients through teledentistry due to a lack of a physical examination.

*“I remember getting messages or having the receptionist showing me texts of caries in anterior teeth... We haven’t done any clinical testing or vitality tests and x-rays to see how deep it is. For example, if it into the pulp or not.”*  
[Participant 12]

Difficulties in communication could have also compounded this issue, particularly if interpreters were required.

*“...the patients also have a hard time describing what is going on...”* [Participant 9]

*“...interpreters over the phone are terrible...”* [Participant 4]

Due to the novelty of teledentistry, clinicians expressed their disappointment in the lack of institutional support. This could have potentially been due to difficulties in implementing teledentistry at a large scale, for example, in public hospitals.

*“...if it [teledentistry] was going to be done regionally or at the nearest hospital to triage people to start with, this would be difficult to implement on a wide scale in most hospitals”* [participant 10]

Inadequate training was also seen as a barrier to implementing teledentistry.

*“We are not given adequate training and are instead told to have a crack at it and see what happens”* [Participant 1]

*“None of us knew how to set it up so we had to call in the specific person in the hospital to set it up and do the settings.”* [Participant 3]

*“We are not given any training in private practice in how to use the software or how to consistently examine people over the phone”* [Participant 12]

*“From my experience there is no formal component in an education in program regarding teledentistry”* [Participant 2]

The high start-up cost and infrastructure requirements was also seen as a barrier.

*“It is also quite expensive to have to buy all the equipment to be able to do videoconferencing, etc. Not to mention the cost of the software, particularly now when it is a subscription, making it an ongoing cost.”* [Participant 4]

#### **4.7.7 Finances**

The participants believed that teledentistry could be more economical.

*“My bosses find that to be a lot more economical I guess to the practice”*  
[Participant 7]

*“A hospital triage nurse could be trained to save money”* [Participant 10]

However, operational costs may be a potential obstacle.

*“...at the individual clinic level, it doesn't pay. It doesn't work financially. You know the financial aspect for any practice, forget about this. You're not doing consults, they don't do anything it's just a loss. You're doing a phone consult where you don't make any money, a serious practice manager is not going to let that stay and continue”* [Participant 2]

#### **4.7.8 Strategies for Increasing Teledentistry Utilisation**

During the focus group, strategies to improve teledentistry were discussed. One of the main points raised was that teledentistry had to have a consistent feasible process to be able to obtain funding to improve implementation.

*“You need to have a process outlined that could be really integrated into our current I guess private dental practices as well as public. I think once you have*

*a process that's quite feasible then getting some funding to make it happen would be good.*" [Participant 4]

One point that was brought up was the inconsistency between different states. If a unified approach could be created, it could potentially improve the utilisation.

*"Every state is different as well which makes it difficult to have a national consistency"* [Participant 10]

Increasing training and funding was also seen as a strategy to improve the implementation of teledentistry.

*"More funding, training, resources are required so that more people are able to buy the equipment, more effectively utilise it and also deliver it well."* [Participant 7]

Being able to demonstrate tangible benefits to hospitals for example could also potentially improve utilisation.

*"Public always has a process where it goes through the board of review, so they need to have some tangible benefit whether that is less taxpayer money required, greater number of patients seen and increased access to healthcare, you need some kind of tangible benefit there."* [Participant 4]

## **4.8 Discussion**

This was the first study to the best of our knowledge to explore strategies to improve the implementation of teledentistry in Australia. We were also able to gain a rich insight into the opinions of Australian dental practitioners regarding teledentistry.

One of the main benefits that the participants of the focus group noted was the improved access to those affected by distance, for example living in rural and remote areas., frailty or health. Through teledentistry, dentists working in regional, rural or remote areas are able to communicate with specialists who lived in metropolitan areas.<sup>110</sup> They could coordinate care for patients which was extremely beneficial in allowing patients to access care that would have otherwise been difficult. This is a large benefit documented in the literature.<sup>38, 108</sup> Additionally, real-time education can be provided allowing patients to access improved levels of care without having to travel long distances.<sup>14, 15, 70-72</sup> The focus group participants also spoke highly about the ability of teledentistry to improve access to those living in aged care facilities further reinforcing the ability of teledentistry to overcome barriers introduced by frailty of health that has also been documented in the literature.<sup>111</sup>

Teledentistry was also very valuable during the COVID-19 pandemic. While the lack of physical interaction can be a barrier for delivering care, being able to deliver care without physically seeing the patient was very beneficial at reducing the spread of COVID-19.<sup>112</sup> Patients infected with COVID-19 or who were a close contact, could still access treatment without any risk of transmission which protected the community, the patient and the clinicians.<sup>2, 69, 95</sup> The protection of clinicians was also important as it meant the health workforce could be maintained ensuring that patients could continue to access care in a timely manner.<sup>112</sup> The benefits of teledentistry during the pandemic were very clear and hence teledentistry specific item codes were introduced into the Australian Schedule of Dental Services and Glossary to allow clinicians to bill appropriately and patients to be reimbursed by private health insurers.<sup>37</sup>

Teledentistry was also perceived to have beneficial clinical applications. The participants noted that it was able to improve the efficiency of their own practice as it allowed the clinic to work faster by delivering post-operative reviews, consultations, and triage patients through teledentistry. Telehealth, in general, allows for rapid and more frequent communication between patients and clinicians.<sup>113</sup> Post-operative reviews, consultations and triaging patients can be effectively completed through verbal communication and hence the increased frequency of communication could be a contributing factor to the improved efficiency of these through teledentistry. The increased efficiency would create extra time for clinicians, and this is a clear benefit demonstrated in previous literature as well that could be used as an avenue to advocate for increased adoption of teledentistry.<sup>103</sup>

A large concern of teledentistry that was raised was the lack of physical interaction which limited the interventional capacity and could create uncertainty regarding diagnostic accuracy. Concerns regarding diagnostic accuracy were particularly high with more complex cases such as pathology. The lack of physical interaction is a known limitation of teledentistry and particularly affects dentistry as dental practitioners rely on a physical exam to make an accurate diagnosis and treatment is usually provided through physical clinical interaction.<sup>103, 104</sup> Unfortunately, this is not a barrier that can easily be overcome. However, through innovations such as e-prescriptions, the lack of interventional capacity can be partially addressed.<sup>114</sup> Although, if a clinic lacks the ability to dispense e-prescriptions like some of our participants did, this is not possible.

Another issue identified with teledentistry was the technology. In particular, the quality of the cameras, issues with equipment, software, lack of access and utilisation issues for clinicians and patients. Additionally, issues were raised with being able to obtain the appropriate equipment and a lack of infrastructure such as a secure and fast internet connection. Even with the innovation of improved cameras and software, our focus group participants still expressed dissatisfaction with the technology. This could be due to the fact that new technology can be difficult to operate for clinicians and patients. The difficulty of usage has been noted to be a barrier in teledentistry and although attempts have been made to improve this through the development of applications to streamline the process, it appears that further work is required in this department.<sup>46</sup> The large amount of technology required to access teledentistry was also seen as a barrier due to the high start-up cost however, there are tangible economic benefits present through utilising teledentistry which could help offset the cost in the long term.<sup>25, 76</sup> In order to improve the implementation of teledentistry, the technology could be improved to both increase the quality and the ease of use for clinicians and patients. This has been shown to be an effective method of improving implementation with a study in the United Kingdom demonstrating that improved dependability, lower cost as well as better audio and video quality all helped to make telehealth more easily accessible in the medical field.<sup>40</sup> Improving the technology could also increase clinician's confidence in accurate diagnosis which could also improve the adoption of teledentistry. However, it is imperative to maintain the provider-patient relationship as the use of technology has been a large area of complaint for patients as they have noted that "physicians spending more time looking at computer screens than their patients".<sup>103</sup> It is important for clinicians in the future to

take care that the relationship with their patients does not deteriorate even when using teledentistry.

Inadequate training was seen as a large barrier to implementing teledentistry. The lack of training would compound issues mentioned previously such as difficulties with utilising the technology and software. Resistance to adopting new technologies due to unfamiliarity and a lack of training has also been previously documented in the literature.<sup>78, 79</sup> This issue could be overcome through introducing teledentistry at the university level. Awareness campaigns have also been suggested to familiarise clinicians with telehealth to increase implementation and ease of use.<sup>115</sup> A suggestion made by the focus group was to create a single workflow in implementing teledentistry to simplify the process and allow for better advocacy of adoption whilst also making teledentistry easier to learn. In the literature, creating bespoke workflows that “mirror clinic workflows” helped to make video consultations easier for clinicians and patients and was a more scalable option.<sup>39, 40</sup> A unified approach amongst states was also suggested in our focus group to further streamline the delivery of teledentistry to improve the ease of use.

Some other suggestions to improve the implementation of teledentistry were raised within the focus group. Firstly, increasing the amount of training received, for example in university or post-graduate courses, would be very beneficial to familiarise clinicians with the technology and make them more willing to use teledentistry. Additionally, increased funding to be able to purchase better quality technology and improve the infrastructure, for example the internet connection, would also be very beneficial as this is a large barrier for both clinicians and patients.<sup>106</sup> There were also suggestions

to create a bespoke workflow. This would make it easier for clinicians and patients to learn and use the system but also make it easier to advocate for adoption in larger facilities such as hospitals. Also, studies have shown that having a bespoke workflow that mimics the in-person clinic workflow makes teledentistry easier to use.<sup>39, 40</sup> Attempting to use programs poorly aligned with the normal clinic workflow created issues for clinicians and patients making delivery difficult.<sup>40</sup> Additionally, there were also suggestions in the focus group to recruit auxiliary staff to take on more responsibility in the teledentistry workflow to maximise the effectiveness and efficiency.

#### **4.8.1 Limitations**

Qualitative research in general usually has a lower sample size when compared to quantitative research. This limits the generalisability of the findings, and this is a limitation of qualitative research, including focus groups.<sup>86</sup> However, the data collected is rich and powerful as the data is based on human experience which allowed us to gain a deeper insight into our participants' perceptions regarding teledentistry. The findings of our focus group are also transferrable to other settings and can become a foundation to conduct more research.<sup>86</sup>

We acknowledge that our recruitment methods may not be truly random as we are unable to truly randomise recruitment which will limit the generalisability of our findings. Based on our methodology, we believe that our results will be as generalisable as feasible. However, previous studies analysing saturation for focus groups determined that 2 -3 focus groups with 6 – 8 participants obtained 80% of the themes especially if the study population is homogenous.<sup>116</sup> Therefore, we believe that our 2 focus groups

of 6 and 7 participants were enough to capture the main themes and hence improve the generalisability of our findings.

#### **4.8.2 Strengths**

The main strength of this study was the large number of participants within the focus groups. There were 13 participants which produced a large volume of data that was able to reach the saturation point during our analysis. We were able to create 2 separate focus groups with 6 and 7 participants which previous studies have suggested will achieve saturation.<sup>116</sup>

#### **4.8.3 Implications**

There appears to still be some reluctance in adopting teledentistry by Australian dentists due to unfamiliarity with the technology, uncertainty regarding the quality of the technology, lack of confidence in diagnosis and inadequate training. However, the benefits of teledentistry are quite large. These include improved efficiency, delivery of post-operative care, triaging patients, benefits during pandemics as well as improving access for people living in regional, rural and remote areas. These strengths can be used to advocate for increased adoption of teledentistry.

Furthermore, this study has also identified strategies to improve the implementation of teledentistry as these features can be advertised to dentists. These include improved training, creating bespoke workflows and improving funding to be able to purchase better equipment as well as improve infrastructure.

Some specific strategies identified for dental practitioners to individually improve the ease of use of teledentistry for themselves could be to create their own workflows in their own practice. This would ensure that all staff involved in the delivery of teledentistry would understand the process to make it smoother to deliver. Technology was also seen as an issue and therefore buying better quality cameras and investing in applications to deliver teledentistry could also be beneficial, however, there is a high cost associated with this meaning that this solution is not ideal. Additionally, focussing on using teledentistry for things such as post-operative care, consultations and triaging would be beneficial as this is a clear strength of teledentistry. Attempting to provide treatment or more complex diagnosis through teledentistry should be avoided as clinicians have identified this as a weakness of teledentistry.

For patients, it may be beneficial to manage expectations of teledentistry. The participants of our focus groups identified that obtaining accurate diagnosis of complex conditions and providing treatment is very difficult through teledentistry. Therefore, if patients do not expect these things from a teledentistry appointment, it could help to improve satisfaction and adoption.

#### **4.8.4 Future Research**

Future avenues of research to be explored include a pilot study utilising the changes advised to see what is the most beneficial. A qualitative assessment of this would be very beneficial to continue gaining a deep and rich insight into the perspectives of dental practitioners to be able to assess if the changes are effective or not. Additionally, a cost saving analysis of these changes could be implemented to determine which interventions could be the most financially beneficial.

## **4.9 Conclusion**

This study highlighted the barriers of implementation of teledentistry including unfamiliarity with the technology, inadequate training as well as the lack of a physical exam. While these are difficult to overcome, potential strategies have also been developed to overcome these barriers. These include increasing the training, for example in university or professional courses, increasing funding to allow for the purchase of equipment, as well as the creation of specific workflows designed for teledentistry. Further studies should be conducted to determine the potential success of these strategies and to also continue to identify and develop strategies to improve implementation of teledentistry.

# **Chapter 5 – Conclusion**

## **5.1 Summary and Conclusions of the Thesis**

Teledentistry is an exciting field of dentistry that provides the opportunity to improve access to healthcare and overcome barriers introduced through socioeconomic, geographical or accessibility issues. Furthermore, it has the ability to improve the standard of care accessible to these patients through increased access to specialists as well as through education of practitioners to upskill them. Therefore, it is important to continue to research teledentistry so that it can be further improved and refined.

This thesis aimed to determine the advantages and disadvantages of teledentistry as well as identify barriers of implementing teledentistry from the clinicians' perspective and develop interventions to overcome these barriers. This thesis focussed on teledentistry from the perspectives of Australian clinicians. The aims were explored using a mixed methods study with an e-questionnaire and focus groups.

The participants of our research believed that there were clear benefits for teledentistry such as the ability to perform consultations, diagnose simple cases, improve access for patients and the delivery of post-operative care. Although the participants appeared generally optimistic regarding teledentistry there were still concerns raised regarding diagnostic accuracy, particularly for more complex oral health conditions. Additionally, issues were raised regarding the technology, interventional capacity, and difficulties of using the technology by clinicians and patients. One suggestion to improve the implementation of teledentistry was increased funding to be able to purchase higher quality equipment. Furthermore, the development of a streamlined process that is easy to implement would also allow for easier adoption of teledentistry into clinical practice.

Additional training as well as patient convenience was also believed to be important to improve the adoption of teledentistry.

## **5.2 Limitations**

The main limitation of the e-questionnaire was the low sample size which limits the generalisability of our findings. However, we were able to recruit a wide variety of participants with broad demographic backgrounds from various age and working groups. Additionally, our study is the largest study analysing the opinions of Australian dental practitioners in Australia regarding teledentistry which strengthens the generalisability of our findings. However, additional larger scale studies should still be conducted and hence this study could be utilised as a platform to conduct further research.

Generalisability was also a limitation of the qualitative focus group. As noted previously, qualitative studies generally have a lower sample size when compared to quantitative research.<sup>86</sup> However, more data is generated in qualitative studies compared to quantitative studies which allows for a richer and deeper insight into participants' perceptions which means that our sample size did not need to be as large. Additionally, we recruited sufficient participants to achieve saturation which further improved the generalisability of our findings.

Recruitment was also a limitation in this study as it was not truly random. Recruitment was mainly conducted through social media groups and emails through representative dental organisations. This may have introduced selection bias onto our results while

also limiting the generalisability of our findings. However, based on our methodology we do not believe that this had a large effect on our results.

The strategies developed to overcome the barriers for implementation of teledentistry are also untested and hence we are uncertain regarding their ability to improve adoption. Further studies are required to determine the validity of the strategies in improving the adoption of teledentistry in Australia.

### **5.3 Strengths**

The main strength of the focus group was the large number of participants which provided us with a vast amount of data that was rich and powerful. This allowed us to gain a deep and meaningful insight into the participants' opinions regarding teledentistry.

The strength of the e-questionnaire was that it was validated through peer review, improving the validity of the questionnaire. The questionnaire itself is also a widely adaptable tool that can be used for future studies to analyse the opinions of dental practitioners to track any changes within the field.

### **5.4 Future Research**

This research has created a platform to be able to perform larger scale studies. Having a large sample size would particularly benefit the e-questionnaire as it would increase the generalisability of the findings. Additionally, pilot studies should be conducted to explore the proposed solutions to improving the implementation of teledentistry. This could determine the most beneficial and effective solutions. Furthermore, a cost saving

analysis could be implemented to see which solutions would be the most financially viable. Additional studies to create solutions to improve the implementation of teledentistry would also be helpful to further increase the adoption of teledentistry into clinical practice.

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# Appendix 1 – Ethics Approval

Questionnaire (Chapter 3):



THE UNIVERSITY OF  
**WESTERN  
AUSTRALIA**

Human Ethics  
Office of Research

**Our Ref:** 2022/ET000369

Thursday, 16 June 2022

Dr Alex Park  
School of Allied Health

Dear Dr Park

## **HUMAN RESEARCH ETHICS APPLICATION APPROVAL – THE UNIVERSITY OF WESTERN AUSTRALIA**

*Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation – A quantitative survey*

Ethics approval for the above project has been granted in accordance with the requirements of the National Statement on Ethical Conduct in Human Research (National Statement) and the policies and procedures of The University of Western Australia. Please note that the period of ethics approval for this project is five (5) years from the date of this notification. However, ethics approval is conditional upon the submission of satisfactory milestone reports by the designated renewal date. Therefore, initial approval has been granted from 16 Jun 2022 for 12 months.

You are reminded of the following requirements:

1. The application and all supporting documentation form the basis of the ethics approval and you must not depart from the research project that has been approved.
2. The Human Ethics office must be approached for approval in advance for any requested amendments to the approved research project.
3. The Chief Investigator is required to report immediately to the Human Ethics office any adverse or unexpected event or any other event that may impact on the ethics approval for the project.
4. The Chief Investigator must submit a final report upon project completion, even if a research project is discontinued before the anticipated date of completion.

Any conditions of ethics approval that have been imposed are listed below:

1. None.

The University of Western Australia is bound by the National Statement to monitor the progress of all approved projects until completion to ensure continued compliance with ethical principles.

The Human Ethics office will forward a request for a Progress Report approximately 30 days before the due date.

If you have any queries please contact the Human Ethics office at [humanethics@uwa.edu.au](mailto:humanethics@uwa.edu.au). Please ensure that you quote the file reference – 2022/ET000369 – and the associated project title in all future correspondence.

Yours sincerely



Shihab Mundekkadan

Senior Officer- Human Ethics & Clinical Trials

# MEMO

TO Dr Alex Park  
Victoria University

DATE 7/11/2022

FROM Associate Professor Deborah Zion  
Chair  
Victoria University Human Research Ethics Committee

SUBJECT Ethics Application – HREC Approved Application External to Victoria University

Dear Dr Park

Thank you for submitting this request for ethical approval of the project entitled:

*“Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation – A quantitative survey”*

***(Project approved by The University of Western Australia – Project no. 2022/ET000369)***

The proposed research project has been accepted and deemed to meet the requirements of the National Health and Medical Research Council (NHMRC) ‘National Statement on Ethical Conduct in Human Research (2018)’ by the Chair of the Victoria University Human Research Ethics Committee. Approval has been granted from **3<sup>rd</sup> November 2022 to 3<sup>rd</sup> November 2024**. Any variations to the protocol must be approved through the original approving HREC and notified to VUHREC.

Please note that the Human Research Ethics Committee must be informed of the following: any changes to the approved research protocol, project timelines, any serious events or adverse and/or unforeseen events that may affect continued ethical acceptability of the project. In these unlikely events, researchers must immediately cease all data collection until the Committee has approved the changes. Researchers are also reminded of the need to notify the approving HREC of changes to personnel in research projects via a request for a minor amendment. It should also be noted that it is the Chief Investigators’ responsibility to ensure the research project is conducted in line with the recommendations outlined in the National Health and Medical Research Council (NHMRC) ‘National Statement on Ethical Conduct in Human Research (2018).’

On behalf of the Committee, I wish you all the best for the conduct of the project.

Kind regards,

**Associate Professor Deborah Zion**  
Chair  
Victoria University Human Research Ethics Committee



THE UNIVERSITY OF  
**WESTERN  
AUSTRALIA**

Human Ethics  
Office of Research

**Our Ref:** 2022/ET000370

Thursday, 6 October 2022

Dr Alex Park  
School of Allied Health

Dear Dr Park

**HUMAN RESEARCH ETHICS APPLICATION APPROVAL – THE UNIVERSITY OF WESTERN AUSTRALIA**

*Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation - A Qualitative Study*

Ethics approval for the above project has been granted in accordance with the requirements of the National Statement on Ethical Conduct in Human Research (National Statement) and the policies and procedures of The University of Western Australia. Please note that the period of ethics approval for this project is five (5) years from the date of this notification. However, ethics approval is conditional upon the submission of satisfactory milestone reports by the designated renewal date. Therefore, initial approval has been granted from 06 Oct 2022 for 12 months.

You are reminded of the following requirements:

1. The application and all supporting documentation form the basis of the ethics approval and you must not depart from the research project that has been approved.
2. The Human Ethics office must be approached for approval in advance for any requested amendments to the approved research project.
3. The Chief Investigator is required to report immediately to the Human Ethics office any adverse or unexpected event or any other event that may impact on the ethics approval for the project.
4. The Chief Investigator must submit a final report upon project completion, even if a research project is discontinued before the anticipated date of completion.

Any conditions of ethics approval that have been imposed are listed below:

1. None.

The University of Western Australia is bound by the National Statement to monitor the progress of all approved projects until completion to ensure continued compliance with ethical principles.

The Human Ethics office will forward a request for a Progress Report approximately 30 days before the due date.

If you have any queries please contact the Human Ethics office at [humanethics@uwa.edu.au](mailto:humanethics@uwa.edu.au). Please ensure that you quote the file reference – 2022/ET000370 – and the associated project title in all future correspondence.

Yours sincerely



Shihab Mundekkadan  
Senior Officer- Human Ethics & Clinical Trials

# MEMO

TO Dr Alex Park  
Victoria University

DATE 7/11/2022

FROM Associate Professor Deborah Zion  
Chair  
Victoria University Human Research Ethics Committee

SUBJECT Ethics Application – HREC Approved Application External to Victoria University

Dear Dr Park

Thank you for submitting this request for ethical approval of the project entitled:

*“ Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation - A Qualitative Study”*

**(Project approved by The University of Western Australia – Project no. 2022/ET000370)**

The proposed research project has been accepted and deemed to meet the requirements of the National Health and Medical Research Council (NHMRC) 'National Statement on Ethical Conduct in Human Research (2018)' by the Chair of the Victoria University Human Research Ethics Committee. Approval has been granted from **3<sup>rd</sup> November 2022 to 3<sup>rd</sup> November 2024**. Any variations to the protocol must be approved through the original approving HREC and notified to VUHREC.

Please note that the Human Research Ethics Committee must be informed of the following: any changes to the approved research protocol, project timelines, any serious events or adverse and/or unforeseen events that may affect continued ethical acceptability of the project. In these unlikely events, researchers must immediately cease all data collection until the Committee has approved the changes. Researchers are also reminded of the need to notify the approving HREC of changes to personnel in research projects via a request for a minor amendment. It should also be noted that it is the Chief Investigators' responsibility to ensure the research project is conducted in line with the recommendations outlined in the National Health and Medical Research Council (NHMRC) 'National Statement on Ethical Conduct in Human Research (2018).'

On behalf of the Committee, I wish you all the best for the conduct of the project.

Kind regards,

**Associate Professor Deborah Zion**  
Chair  
Victoria University Human Research Ethics Committee

## Appendix 2 – Candidature Budget Form

### 3. Candidature Budget

Please specify the Disciplinary Area Study and Degree Level as per the Candidature Budget Guide (see Step 2 in the following link): <https://www.vu.edu.au/researchers/candidature/preparing-for-candidature>

Standard-Cost Area of Study Masters by Research

### 4. Outline of Candidature Budget: (Please specify items to be purchased)\*

| Candidature Budget Expense Description                  | Estimated Cost \$ | Candidature Funded \$ | Supervisor/ External funds \$ |
|---|-------------------|-----------------------|-------------------------------|
| Questionnaire advertising (Printing Flyers)             | 50                | 50                    | -                             |
| Poster printing for conferences                         | 100               | 100                   | -                             |
| Facebook and Professional Network Advertising           | 400               | 400                   | -                             |
| Funding for focus group participants (\$50 x 10)        | 500               | 500                   | -                             |
|   |                   |                       |                               |
|   |                   |                       |                               |
|   |                   |                       |                               |
|   |                   |                       |                               |
|   |                   |                       |                               |
|   |                   |                       |                               |
| <b>TOTAL</b>  | <b>1050</b>       | <b>1050</b>           | <b>-</b>                      |
| <b>**Professional Development/Conference attendance</b> | <b>\$</b>         | <b>\$</b>             | <b>\$</b>                     |
| Conference attendance                                   | 1700              | <del>1700</del>       | 0                             |
|   |                   | \$ 700                |                               |
|   |                   |                       |                               |
| <b>TOTAL</b>  | <b>1700</b>       | <b>-1700</b>          |                               |

\*\*Professional Development Expenses (Conferences, Workshops/Seminars & Training etc.)

\$ 700

- Doctoral candidates will automatically receive \$1300 towards Professional Development Expenses
- Master degree candidates will automatically receive \$700 towards Professional Development Expenses

## Appendix 3 – Questionnaire Instrument



Dr Joon Soo (Alex) Park  
School of Allied Health  
The University of Western Australia  
35 Stirling Highway, WA 6009  
Tel: +61 8 6457 7874  
Email: alex.park@uwa.edu.au

### Participant Information Form

**Project title:** Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation

**Name of Researchers:** Joshua Lee, Boxi Feng, Kate Wang, Joon Soo (Alex) Park

#### **Invitation:**

You are invited to participate in a project of Teledentistry in a Clinical Setting: Advantages and Barriers of Implementation. You are asked to take part in this project because you are a practising Australian dental practitioner (General or Specialist)

#### **Aim of the Study (What is the project about?)**

Teledentistry has allowed the provision of care remotely which has been useful for people living in regional, rural and remote communities. It has been particularly beneficial during the coronavirus pandemic to reduce transmission of the virus and to allow for the provision of care during mandated lockdowns.

This study aims to assess the perception of dental practitioners in Australia regarding teledentistry. We aim to determine the advantages and barriers of implementing teledentistry in a clinical setting from the perspectives of dental practitioners.

#### **What does participation involve?**

Participants will be required to answer an e-questionnaire developed on Qualtrics XM. The first section will ask for demographic information and professional

background. The second section has 28 questions with a 5-point Likert Scale divided into 5 topics; diagnosis, accessibility, patient care, technology and finances. The survey will take approximately 10-15 minutes to complete.

### **Voluntary Participation and Withdrawal from the Study**

This study is completely voluntary. Participants can choose to withdraw from the study at anytime without giving explanation. There will be no consequences for withdrawal.

### **Your privacy**

Your participation in this study and any information you provide will be treated in a confidential manner. The data will be kept in a non-identifiable format in a password protected server for a minimum of seven years.

### **Possible Benefits**

We hope to publish the findings of this study in a peer-reviewed journal. We also aim to share these findings with the Australian Dental Association to allow recommendations for potential improvements for implementation of teledentistry.

### **Possible Risks and Risk Management Plan**

The largest risk of this project is the identification of the participants. However, the risks of this will be quite low as the data will be de-identified and therefore anonymous. Furthermore, the data will be cumulative and hence risk of identification low. The topic is also not controversial therefore we deem this project to be low risk.

### **Contacts**

If you would like to participate or discuss any aspect of this study, or receive the published results, please feel free to contact either Dr Joon Soo (Alex) Park on [alex.park@uwa.edu.au](mailto:alex.park@uwa.edu.au).

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time. In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Ethics office at UWA on (08) 6488 4703 or by emailing to [humanethics@uwa.edu.au](mailto:humanethics@uwa.edu.au). All research participants are entitled to retain a copy of any Participant Information Form and/or Participant Consent Form relating to this research project.

### **Participant Consent Form**

I have read the information provided and any questions I have asked have been answered to my satisfaction. I understand that the data I submit will be anonymous and aggregated and hence withdrawal is not possible once data are submitted. Knowing this, I agree to participate in this research project.

I understand that all identifiable information that I provide is treated as confidential and will not be released by the investigator in any form that may identify me unless I have consented to this. The only exception to this principle of confidentiality is if this information is required by law to be released.

Yes

No

End of Block:

---

Start of Block:

Q1 Age range (Years)

20-34

35-44

45-54

55-64

>65

---

Q2 Gender

Male

Female

Non-binary / third gender

Prefer not to say

---

Q3 Work experience (Years)

- 0-5
  - 6-10
  - 11-15
  - >16
- 

Q4 Location of main profession

- Major city
  - Inner regional
  - Outer regional
  - Remote / Very remote
- 

Q5 Working hours (per week)

- 1-19
  - 20-34
  - 35-49
  - 50-64
  - >65
-

Q6 Hours of telehealth usage (per week)

- 1-9
  - 10-19
  - 20-29
  - 30-39
  - >40
-

Q7 Diagnosis

|  | Strongly agree        | Somewhat agree        | Neither agree nor disagree | Somewhat disagree     | Strongly disagree     |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| I believe that telehealth is effective for consultations                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I believe that patients can reliably self-report symptoms through telehealth | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I believe that telehealth is effective for diagnosing simple cases           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I believe that telehealth is effective for diagnosing complex cases          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I believe that telehealth is effective for diagnosing pathology              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I am confident in my diagnosis through telehealth without a tactile exam     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth is convenient e.g. it saves time                                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |

Q8 Accessibility

|  | Strongly agree        | Somewhat agree        | Neither agree nor disagree | Somewhat disagree     | Strongly disagree     |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| Telehealth improves access for remote and rural patients       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth has been beneficial during the pandemic             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth has been convenient for patients                    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth has assisted in reducing wait times                 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth provides improved flexibility compared to in-person | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth is easily accessible for older patients             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |

Q9 Patient Care

|  | Strongly agree        | Somewhat agree        | Neither agree nor disagree | Somewhat disagree     | Strongly disagree     |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| Telehealth is useful for triaging patients         | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth has effective interventional capacity   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth is comparable to face-to-face           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth is useful for post-op care              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I am able to build patient rapport over telehealth | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Patients are accepting of telehealth               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |

Q10 Technology

|  | Strongly agree        | Somewhat agree        | Neither agree nor disagree | Somewhat disagree     | Strongly disagree     |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| I prefer telehealth over face-to-face  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| The quality of the technology used in telehealth is adequate                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I believe that data is secure over telehealth                                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| I am happy that medicolegal issues are not a problem over telehealth (Consent) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Patients are able to use the technology  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| Telehealth technology is reliable  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |

Q11 Finances

|   | Strongly agree        | Somewhat agree        | Neither agree nor disagree | Somewhat disagree     | Strongly disagree     |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| There are no issues regarding billing with telehealth         | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |
| The cost for delivering telehealth is similar to face-to-face | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>      | <input type="radio"/> | <input type="radio"/> |

End of Block:

---

Start of Block:

Additional Question We will be conducting a focus group to discuss barriers of implementing teledentistry and develop strategies to overcome these barriers. If you are interested in participating, please leave your email address below. We will be unable to link your answers to your email address, your answers will remain anonymous

\_\_\_\_\_

End of Block:

---

## **Appendix 4 – Focus Group Discussion Guide**

### **Prior to starting the focus group**

Provide each participant with outlining information regarding teledentistry at the time they agree to participate in the focus group. Provide a second copy when they arrive for the focus group so each participant can see the document. This document will outline that we aim to potentially publish our findings in a peer-reviewed journal. Ask the participants if they wish to have the article sent to them after we publish our findings.

Provide a slide during the video conference with a definition of teledentistry for all to view. Present at end of the document.

### **Introduction**

1. Good [morning, afternoon, evening] and welcome to this focus group discussion. My name is Joshua Lee and on behalf the University of Western Australia and myself I would like to thank you for your attendance. This discussion is entirely voluntary, and you are able to leave at any time and any discussion from you will be removed if you wish.

2. This focus group aims to determine the advantages and disadvantages of teledentistry. Additionally, we hope to determine barriers for implementation and prioritise interventions to overcome these barriers.

3. We will start by going through some ground rules for the discussion

### **Rules**

1. There are no correct or incorrect answers. We are examining your opinions about teledentistry. I would like everyone present to participate as I am interested in everyone's opinions. The more information I receive from you, the better my research will be and therefore the greater the benefits.

2. I encourage all participants to express their opinions. Please be respectful to your fellow participants even if their opinions differ from yours as we all have different

points of view. All comments are welcome. Please ensure that everyone is given the opportunity to speak. Please everyone speak one at a time as it will be easier later when reviewing the discussion.

### **Procedure**

1. This focus group will be recorded so that I can devote my full attention to this discussion. The recording will allow for accurate transcription of the discussion. The information obtained will be used as part of my thesis and may be presented and conferences an in publications. The information will be completely de-identified. To ensure anonymity, the recording will start after the introductions.
2. This discussion is strictly confidential. Please do not share what is said in this discussion with anyone outside of this room to ensure that these discussions remain confidential. Please indicate your agreeance by putting your hand up
3. The session will last about 45 minutes. There will be to time for designated breaks however feel free to get up and take breaks if you require.
4. At the end of the discussion, I kindly request that you record your key points from the topics discussed and any comments you wish to write down in the document provided.

### **Consent Form**

1. Before we begin our discussion, please take a few minutes to complete the consent I have emailed to you. Please also take the time to complete the demographics questions at the end of the document. Once completed, please send them back via email.

### **Self-Introductions**

We'll start by introducing ourselves. My name is Joshua Lee. I am a researcher from xx. I remind you once more that I will be recording audio only after the introduction so that I can transcribe our discussion afterwards for coding.

Now please introduce yourselves and let us know a bit about yourselves.

1. Where do you work (metropolitan, regional, rural, remote + Public vs private)?
2. How have you used teledentistry in your own practice?

Does anyone have any questions before we begin? I will begin audio recording now.

**Discussion**

You have all been provided with a brief outline of teledentistry but I will give a brief overview again

- Teledentistry is a combination of telecommunications and dentistry involving the exchange of clinical information and images over remote distances for dental consultation and treatment planning
- Allows for remote provision of care
- Can be done via telephone, online conferencing or telehealth specific software

| Discussion Theme                           | Discussion prompts  |
|--|---|
| Role of Teledentistry in clinical practice | Diagnosis<br>Treatment<br>Triageing   |
| Role of Teledentistry Improving Access     | Benefits for patients<br>Benefits for clinicians  |
| Disadvantages of teledentistry             | Examinations<br>Technology  |
| Barriers for implementation                | Health professional barriers?<br>How is the software?<br>Is the technology adequate?<br>Do you think you have received sufficient training and information?<br>Is it cost-effective to use teledentistry?<br>Do you think the barriers differ between public and private? Why?<br><br>Patient barriers? |

|                                      |  |
|--------------------------------------|--|
|                                      | Ease of use<br>Accessibility   |
| Strategies to improve implementation | Healthcare workers:<br>Funding<br>Additional training?<br>Support resources?<br><br>Patients:<br>Support instructions? |

### **Conclusion**

For the last 5 minutes could you please identify in order what was important for you in regards to today's discussion regarding improving implementation of teledentistry. If you have anything else that you would like to write down, please do so.

I thank you for your time. I really appreciate it.

# Appendix 5 – Author Co-Authorship Declarations



THE NEW WAY TO DO UNI

## OFFICE FOR RESEARCH TRAINING, QUALITY AND INTEGRITY

### DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

*This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.*

#### 1. PUBLICATION DETAILS (to be completed by the candidate)

**Title of Paper/Journal/Book:**

Assessing the Utilisation of TELedentistry from Perspectives of Early Career Dental Practitioners: Development of the UTEL Questionnaire

**Surname:** Lee

**First name:** Joshua

**Institute:** Institute for Sustainable Industries and Liveable Cities

**Candidate's Contribution (%):** 80

**Status**

Accepted and in press:

Date: 16/8/2023

Published:

Date:

#### 2. CANDIDATUREECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures - <https://policy.vu.edu.au/>



Signature

17/02/2023

Date

#### 3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;

2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
3. There are no other authors of the publication according to these criteria;
4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and
5. The original data will be held for at least five years from the date indicated below and is stored at the following **location(s)**.

The data will be stored for 5 years on the VU R drive

| Name(s) of Co-Author(s) | Contribution (%) | Nature of Contribution  | Signature | Date       |
|-------------------------|------------------|---|-----------|------------|
| Joshua Lee              | 80               | Conceptualization<br>Data curation<br>Formal analysis<br>Investigation<br>Methodology<br>Project administration<br>Resources<br>Software<br>Validation<br>Visualization<br>Writing – original draft<br>Writing – review & editing |           | 17/02/2023 |
| Joon So Park            | 5                | Supervision<br>Data curation<br>Methodology<br>Project administration<br>Resources<br>Software<br>Validation<br>Visualization<br>Writing – original draft<br>Writing – review & editing   |           | 17/02/2023 |
| Hua Wang                | 5                | Supervision<br>Project administration<br>Resources  |           | 17/02/2023 |
| Boxi Feng               | 5                | Conceptualization<br>Data curation<br>Writing – review & editing  |           | 17/02/2023 |
| Kate N Wang             | 5                | Supervision<br>Conceptualization<br>Data curation<br>Methodology<br>Project administration<br>Validation<br>Visualization<br>Writing – review & editing   |           | 17/02/2023 |

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#### **1. PUBLICATION DETAILS (to be completed by the candidate)**

**Title of Paper/Journal/Book:**

The Use of Telehealth in Dental Practice – A Literature Review

**Surname:** Lee

**First name:** Joshua

**Institute:** Institute for Sustainable Industries and Liveable Cities

**Candidate's Contribution (%):** 80

Status – Currently under review with minor revisions

Accepted and in press:

Date:

Published:

Date:

#### **2. CANDIDATUREECLARATION**

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures - <https://policy.vu.edu.au/>



Signature

17/02/2023

Date

#### **3. CO-AUTHOR(S) DECLARATION**

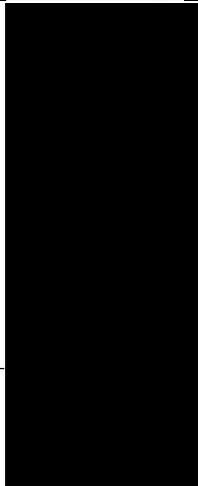
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3. There are no other authors of the publication according to these criteria;
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**Title of Paper/Journal/Book:**

Cross-Sectional Analysis of Australian Dental Practitioners' Perceptions of Teledentistry

**Surname:** Lee

**First name:** Joshua

**Institute:** Institute for Sustainable Industries and Liveable Cities

**Candidate's Contribution (%):** 80

Status – Currently under review

Accepted and in press:  Date:

Published:  Date:

#### **2. CANDIDATUREECLARATION**

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| Joon So Park            | 5                | Supervision<br>Data curation<br>Methodology<br>Project administration<br>Resources<br>Software<br>Validation<br>Visualization<br>Writing – original draft<br>Writing – review & editing   |  | 25/02/2023 |
| Hua Wang                | 5                | Supervision<br>Project administration<br>Resources  |  | 25/02/2023 |
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**Title of Paper/Journal/Book:**

Advantages, Disadvantages and Barriers of Implementing Teledentistry - A Qualitative Analysis of Australian Dental Practitioners

**Surname:** Lee

**First name:** Joshua

**Institute:** Institute for Sustainable Industries and Liveable Cities

**Candidate's Contribution (%):** 80

Status – Currently under review

Accepted and in press:  Date:

Published:  Date:

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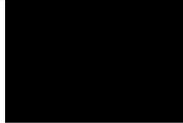
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