EAI EndorsedTransactions
on Scalable Information Systems
Research Article EAI.EU

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

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Abstract

INTRODUCTION: There has been an increased use of teledentistry by dental practitioners in Australia as a response to the COVID-19 pandemic. Previous studies conducted analysing the opinions of dental practitioners were performed prior to the pandemic, and therefore it is important to determine if perceptions regarding teledentistry have changed following the outbreak.

OBJECTIVES: The aim of this study was to determine the perceptions of oral healthcare professionals regarding teledentistry in a clinical setting.

METHODS: The cross-sectional study involved an anonymous electronic questionnaire with a sample of 152 dental practitioners. The questionnaire contained 28 questions utilizing a 5-point Likert-scale to assess the perceptions of general dentists on teledentistry regarding diagnosis, accessibility, patient care, technology and finances. Chi-squared test and analysis of variance (ANOVA) were used to analyse the results and percentages of agreement and disagreement were calculated.

RESULTS: The participants of the questionnaire believed that teledentistry was effective for consultations and in the diagnosis of simple cases. They indicated large benefits of teledentistry in improving access, delivering post-operative care, and triaging patients, and found it particularly useful during the COVID-19 pandemic. However, the participants felt that teledentistry was ineffective in diagnosing complex cases such as pathology. Concerns were also raised regarding the interventional capacity of teledentistry, the quality of the technology, data security and medicolegal issues. In general, participants preferred in-person care in comparison with teledentistry. They were neutral regarding finance.

CONCLUSION: The study provided an insight into the perceptions of Australian dental practitioners regarding teledentistry post-COVID-19. Opinions have changed slightly, but there are large hurdles still to overcome before teledentistry is more widely accepted. Research should be continued to further improve teledentistry in the future.

Keywords: Teledentistry, Australia, Oral Health.

Received on 11 02 2024, accepted on 16 06 2024, published on 16 07 2024

doi: 10.4108/eetsis.5366

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1. Introduction

Teledentistry is the usage of information and communication technology to facilitate communication and remote consultations between health professionals and patients [1]. 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 [2]. Teledentistry allows for the possibility to plan treatment, diagnose oral diseases, triage patients and monitor treatment [3-13]. Additionally, it can be used to provide education to dentists to improve the level of care that can be provided to their patients [14, 15, 53, 54].

During the coronavirus (COVID-19) pandemic, there was an increased usage of teledentistry in order to be able to provide care for all patients during government mandated lockdowns. During lockdowns, restrictions were imposed on patients which limited movement. Additionally, restrictions were placed on dentists, limiting the potential treatment they could provide. For example, treatment could only be provided if the patient were in extreme pain or if the condition was life-threatening [16]. Therefore, an increased adoption of teledentistry occurred in cases, for example, where it was necessary to remotely consult patients so that they could be triaged and provided with emergency care when appropriate. Advice could be given if they were not eligible for in-person care due to the restrictions [17]. This allowed the continued provision of care while protecting both the community and clinicians from contracting COVID-19 [2]. While teledentistry has offered significant benefits, particularly during the pandemic, there has been resistance to implementing it amongst dental practitioners. Reasons for this can be quite complex; the difficulty of adoption is compounded by the lack of education provided [18-20]. Concerns have also been raised about the quality and reliability of the technology, the limited interventional capacity, the high cost for set up and in relation to data security [21, 22, 48-52]. The quality of the technology, as well as a lack of a physical examination, caused concerns regarding diagnostic accuracy [18, 55, 56, 62]. Financial reimbursement has been raised as a concern in past studies, although this issue has been partially resolved through the introduction of new item codes into the Australian Schedule of Dental Services and Glossary, allowing clinicians to bill appropriately for services rendered. This has also allowed for patients to be reimbursed by their private health insurers [23, 24].

A previous study was conducted in 2016 analysing the opinions of general dental practitioners prior to COVID-19. Following the pandemic there was increased usage of teledentistry alongside improvements within the technology of teledentistry itself. New applications improved and streamlined the process of teledentistry and introduced new item codes [24]. Therefore, it is important to analyse whether the opinions of general dental practitioners have changed following the limitations of this period. This study aimed to focus on determining the specific advantages and disadvantages of teledentistry. By focusing specifically upon the advantages, we will be able to maximise the benefits of future usage of teledentistry by determining the ideal situations in which it excels. Furthermore, by specifying the strengths of telehealth, it will be easier to advocate adoption to clinicians by delineating more clearly its essential benefits. The disadvantages are also important to identify so as not to underestimate the areas in which teledentistry can be improved to increase its efficacy. This ensure that those are limited to teledentistry care are not placed at a disadvantage. The aim of this study was to determine the perceptions of dental practitioners regarding the usage of teledentistry within a clinical setting.

2. Methods

This project built upon previous work conducted by Estai et al. (2016) and Lee et al. (2022) [18, 21]. Estai et al. examined general dental practitioners' opinions regarding teledentistry in 2016, though the health landscape has changed significantly since then, particularly due to COVID-19 leading to an increased teledentistry uptake. Lee et al. examined the opinions of specialist oral and maxillofacial surgeons, though there was a limitation of their study in that it did not assess the opinions of all dental practitioners.

This research adopted 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 [25], which provides a useful framework for reporting Web-based surveys.

2.1 Ethical approval and consent

This study was conducted according to the ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from all subjects. The study was approved by the Victoria University Human Research Ethics Committee in relation to the distribution of the questionnaire (Project no. 2022/ET000369).). The experimental protocols of the research were also approved.

2.2 Questionnaire Instrument

During this study, a questionnaire was developed and then validated via peer review and subsequently published [26]. The e-questionnaire was created on Qualtrics® XM software (Provo, UT, USA). This was an open questionnaire, meaning no password was required to access it. Qualtrics was selected to create the questionnaire, as it offered the ability to determine unique site visitors, used cookies to identify unique users, assessed IP addresses and used log file analysis for the identification of multiple entries. View rates, participation rates and completion rates were unable to be determined. The questionnaire can be found in the appendices. The first section asked questions related to demographic and professional background. The second section consisted of 28

questions using a 5-point Likert Scale divided into 5 sub-sections. The sub-sections were diagnosis, accessibility, patient care, technology and finance. The questions were not randomised questionnaire and all questions were listed on one page. The survey was piloted on a group of 5 practising dentists to allow for feedback regarding the questionnaire and for corrections to be made accordingly based on their response. These 5 responses were not included in the final data.

2.3 Questionnaire Distribution

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 telehealth. A reminder email was sent for those who do not respond after two weeks. Additionally, social media posts were utilised to contact additional dental practitioners. Both specialist and general practitioners were contacted. The questionnaire was open for a total period of 9 months. In total, 152 dental practitioners responded to the questionnaire. The non-response rate is unknown. The participants had the right to change their answers or voluntarily withdraw from the questionnaire at any point with no consequence until they submitted the questionnaire. No incentive was offered for completion of the questionnaire.

2.4 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). Incomplete questionnaires were not included in the statistical analysis. To compare the responses against categorical variables (age race, 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 $P < 0.05$. Furthermore, to calculate the percentage of agreement, the sum of the participants who "Strongly agreed" and "Somewhat agreed" was divided by the total number of participants. This was repeated to calculate the percentage of disagreement.

2.5 Theoretical Framework

This study was based on the theoretical framework of pragmatism, specifically Dewey pragmatism. The research examined teledentistry in terms of its practical use in order to determine solutions that would allow teledentistry to be implemented more easily. Pragmatism is often selected due to its potential to create organisational action and change [27]. The framework allowed us to incorporate research through design, as the research intentionally employed methods with the purpose of generating new knowledge [28].

3. Results

3.1 Demographics

A total of 152 results were obtained. The tables outlining the demographics of the participants can be seen below in Table 1.

Table 1: Table outlining participants' demographic information

Age		
20-34	70	46.1%
35-44	37	24.3%
45-54	29	19.1%
55-64	12	2.6%
>65	4	43%
Gender		
Male	65	42.8%
Female	85	55.9%
Non-binary/third gender	0	0.0%
Prefer not to say	2	1.3%
Work Experience (Years)		
0 – 5	60	39.5%
6 – 10	43	28.3%
11 – 15	19	12.5%
>16	30	19.7%
Main Location of Profession		
Major City	89	58.6%
Inner Regional	30	19.7%
Outer Regional	31	20.4%
Remote/Very Remote	2	1.3%
Working Hours (Per Week)		
1-19	15	9.9%
20-34	72	47.4%
35-49	63	41.4%
50-64	2	1.3%
>65	0	0.0%
Hours of Telehealth Usage (Per Week)		
1-9	138	90.8%

10-19	12	7.9%
20-29	1	0.7%
30-39	1	0.7%
>40	0	0.0%

The results from the study are outlined in Table 2. The results are also shown in graph form in each of the sections.

Table 2: 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

3.2 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 the lack of a tactile exam. The results are displayed in the graph below (Figure 1).

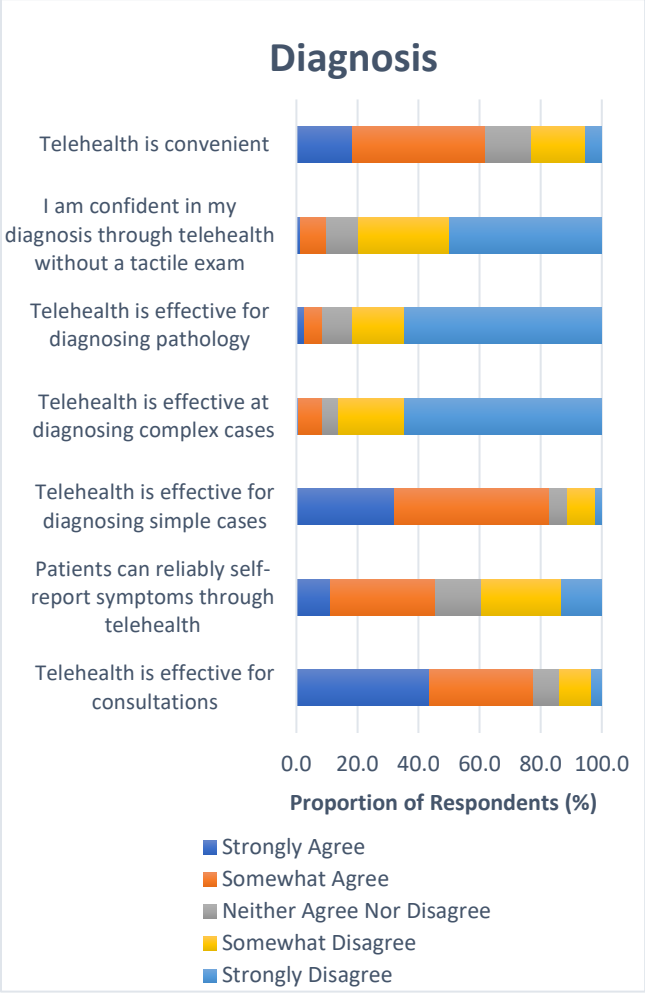

Figure 1: Practitioners' perceptions of diagnosis through teledentistry

3.3 Accessibility

Most of the participants believed that teledentistry improved accessibility for their patients, particularly those living in remote and rural areas, with over 91% in agreement. Around 85% of participants believed 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 waiting times, 57% found 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 2).

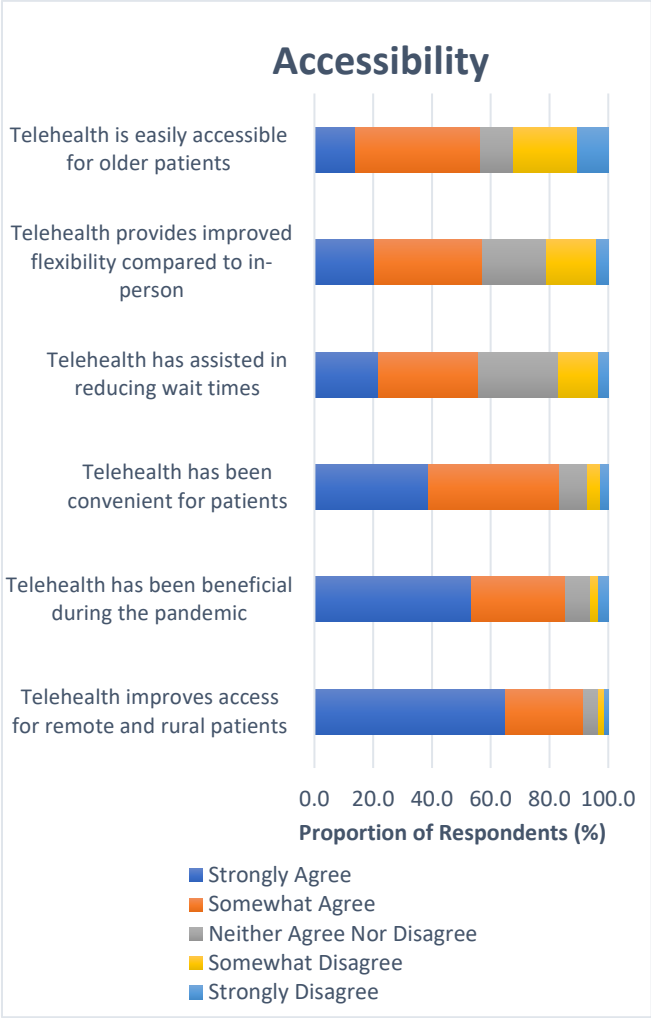

Figure 2: Practitioners' perceptions of accessibility and teledentistry

3.4 Patient Care

Regarding patient care, around 92% of the participants surveyed 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 utilizing teledentistry methods, and 69% found that patients were accepting of teledentistry.

76% of participants, however, found that teledentistry was just not comparable to in-person methods. Opinion

regarding interventional capacity was mixed, with 32% in agreement that teledentistry had an effective interventional capacity, but with 20% neither agreeing nor disagreeing and 48% disagreeing. The results are shown in the figure below (Figure 3).

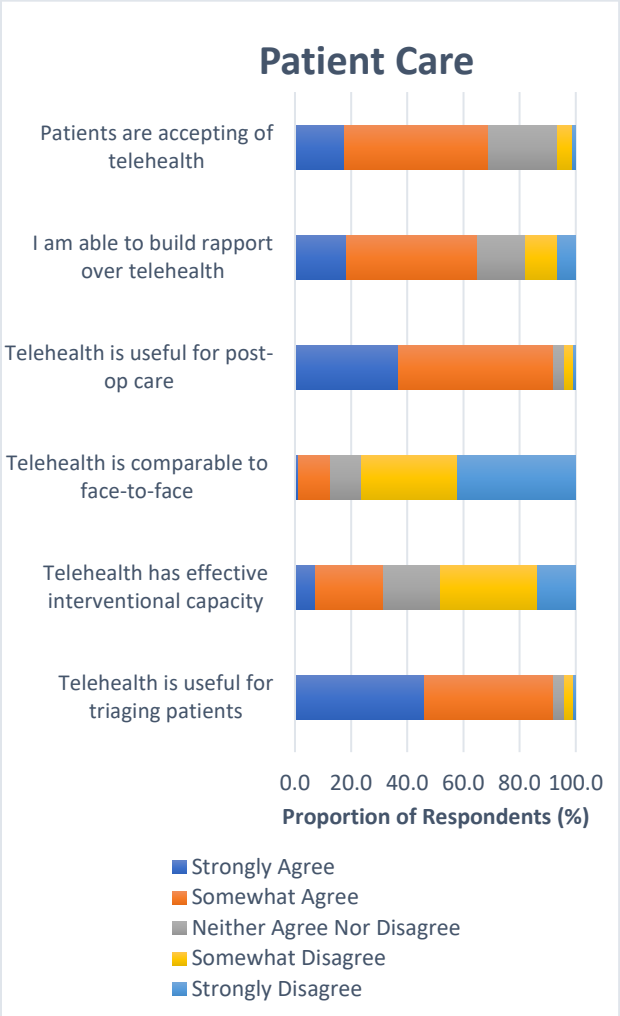

Figure 3: Practitioners' perceptions of patient care through teledentistry

3.5 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 in relation to teledentistry, 40% were neutral and 32% disagreed. Furthermore, 39% agreed that the technology for teledentistry was reliable, 28% were neutral and 33% disagreed. Participants did not prefer teledentistry above in-person methods, 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 4).

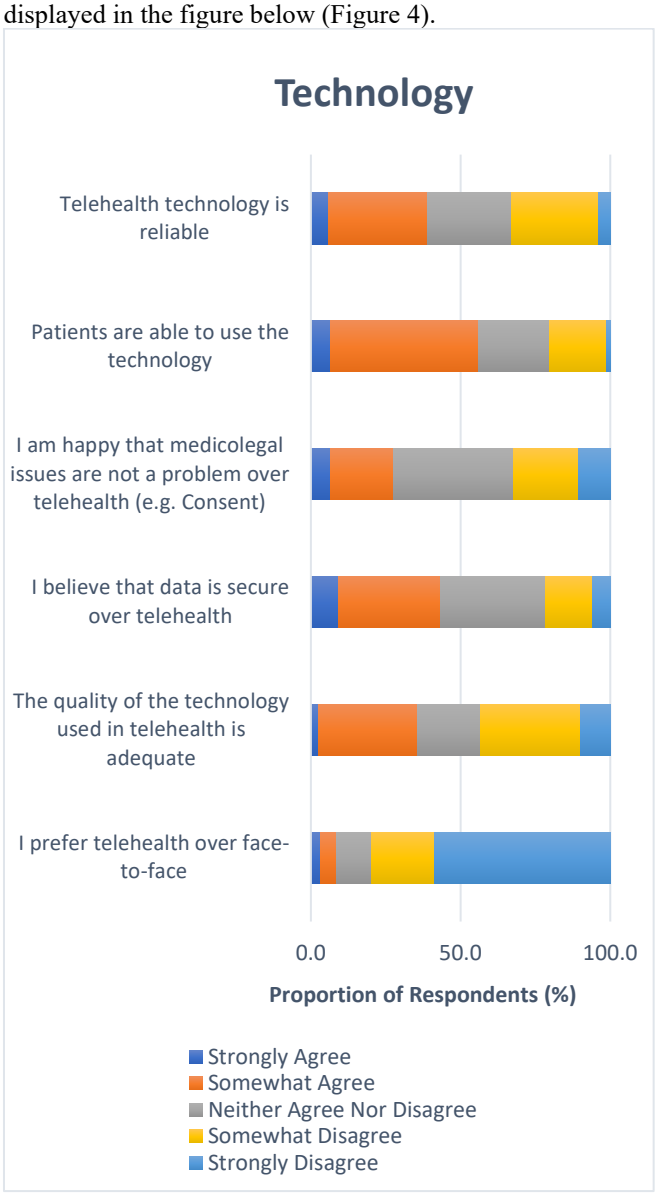

Figure 4: Practitioners' perceptions of the technology of teledentistry

3.6 Finance

Regarding finance and teledentistry, opinions were also mixed. Approximately 30% of the participants agreed that there were no issues regarding billing with teledentistry, 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 5).

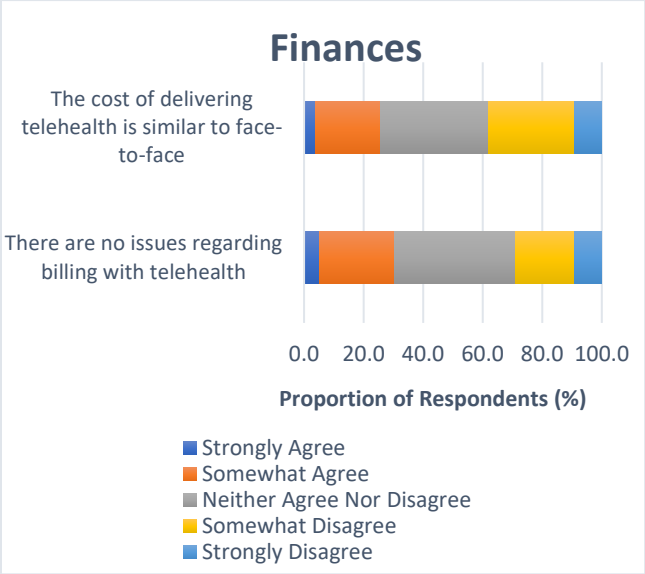

Figure 5: Practitioners' perceptions of the finances of teledentistry

3.7 Chi-Squared Analysis

Dentists aged between 35-54 years utilised telehealth for 10-19 hours a week compared to other ages ($P < 0.0001$). Age range and hours of telehealth usage per week also had had a statistically significant association, with younger dentists having lower telehealth usage on a weekly basis [20-34 years vs >35 years] ($P < 0.0001$).

Additionally, all age groups unanimously agreed that teledentistry was effective for diagnosing simple cases. There was also unanimous agreement that telehealth was effective for consultations amongst all age groups. 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 in cases where a tactile examination could not be performed.

3.8 ANOVA

A statistically significant relationship was found between age range and the perceived reliability of telehealth. 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 the perceived ability of patients to utilise the technology. Older dentists 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 telehealth over in-person appointments. Older dentists more 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 telehealth. Younger dentists perceived patients to be more accepting compared to the other aged groups [20-64 years vs >65 years] ($P = 0.0430$).

4. Discussion

This was the first study that analysed the opinions of practising Australian dental practitioners regarding teledentistry following the increased usage seen during and subsequent to the COVID-19 pandemic. The participants viewed teledentistry positively as they agreed that it could be effective regarding the 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 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, and with the reliability of patients to self-report symptoms, and in addition to financial aspects. There were also concerns regarding the reliability and quality of the technology, and most participants preferred in-person compared to teledentistry. The lack of interventional capacity of teledentistry was also seen as a significant 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 [21, 29]. 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 [29]. This is particularly prevalent for more complex cases such as pathology [18]. Diagnostic accuracy is pivotal in cases such as oral cancer where early detection can improve the prognosis significantly [30]. However, the diagnostic accuracy of teledentistry has been shown to be similar to face-to-face in the diagnosis of dental decay and assessment for simple dentoalveolar surgery such as extractions [1, 10]. 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, although ideally for something such as oral cancer the accuracy assessment should be higher [12]. The disparity between the accuracy of teledentistry and

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 [18, 31]. The lack of physical interaction also limits the interventional capacity, particularly as in the field of dental practice much of the treatment is provided through physical clinical intervention [32].

Technology is also regarded with uncertainty by the participants. Technology has previously been stated as a concern regarding teledentistry within research literature [21]. A large portion of the participants of this study found the quality of technology to be inadequate, although there were some who were neutral, and some participants who found it to be adequate [57, 61, 63]. 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, data from teledentistry was also seen as secure. This is in contrast to the study conducted in 2016 by *Estai* et al. in which the participants expressed a large amount of concerns regarding the reliability of 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 are now in widespread use [33]. Additionally, many new telehealth applications have been created to aid the process of consultation, allowing consent and billing to become more streamlined [34]. 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 this study as well [35, 65, 66]. 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" [31]. Teledentistry is delivered purely by technology and hence it could create more issues with patients due to the clinician not being physically present [36].

Finances were previously seen as a large uncertainty of teledentistry due to the cost as well as unclear remuneration guidelines [21]. Prior to the pandemic, there were large issues seen with remuneration particularly as many private health companies did not support online consultations [37, 44-47]. 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 [24]. 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 [38]. This is because teledentistry allows patients to gain improved access to healthcare, particularly specialists, as well as improved quality of care [14, 15, 39-41]. Additionally, teledentistry allows general dental practitioners to communicate, for example in real-time, with specialists further improving the quality of care provided to patients [14, 15]. 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 [2, 42].

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 remonstrating reduction of wait times to access specialist services in dental hospitals as well as improving the efficiency of hospital emergency departments [21, 43].

4.1 Limitations

One of the limitations of this 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, as social media was the primary recruitment tool this could potentially introduce selection bias into our results, although we do not anticipate this to have a large effect on our results.

We acknowledge that our recruitment methods may not be truly random as we are unable to truly randomise recruitment, which limits the generalisability of our findings. Based on our methodology, we believe that our results will be as generalisable as feasible.

Additionally, we used convenience sampling which may not be reliable for generalising the findings to a wider population. Although we conducted a sample size calculation to determine the appropriate number of participants, the number of participants was extremely large, and the study was not feasible to conduct with our limited resources. However, even with convenience sample we still managed to capture a broad demographic and hence we deem our sample to be representative which increases the generalisability of our findings.

4.2 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 its usage. Additionally, the questionnaire was peer-reviewed and published, which further emphasises the validity of the questionnaire instrument.

4.3 Implications

Although there is support from dental practitioners for teledentistry, there are also large concerns expressed within the responses to this study. In particular, concerns regarding the diagnostic accuracy, quality of the technology and lack of interventional capacity were significant [58-60, 64]. Some technical challenges perceived regarded the quality of cameras and being able to see detail in high enough clarity to diagnose dental conditions. There have been improvements in perceptions regarding the technology, however, and to accessibility and finance, which are likely due to the improvements made within the teledentistry industry over the past few years. Addressing these concerns would encourage dental practitioners to adopt teledentistry and further improve access to healthcare.

5. 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, and yet there are still immense hurdles to overcome before teledentistry becomes widely accepted within the dental community. It is vital that research continues to be conducted within this field, as teledentistry has large potential benefits in particular for those who live 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 that its possibilities can grow and further improvements can be made.

Funding

The authors received no funding for the completion of the study.

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