

Mapping Teledentistry Encounters to Demographic and Diagnostic Groups: A Retrospective Evaluation of Claims Data in a US Dental Institution

Emily Wammer, BA ¹, Ryan H.L. Ip, BSc, PhD ², Aparna Shivanand Ingleshwar, BDS, MPH, PhD ¹, Boyen Huang, DDS, MHA, PhD ^{1*}

¹ University of Minnesota, School of Dentistry, Minneapolis, Minnesota, USA

² Auckland University of Technology, Department of Mathematical Sciences, Auckland, New Zealand

*Corresponding Author: Dr. Boyen Huang

Email: huan2321@umn.edu

ORCIDs:

Emily Wammer: 0009-0007-2562-031X

Ryan HL Ip: 0000-0001-8636-1891

Aparna Shivanand Ingleshwar: 0000-0003-3098-1578

Boyen Huang: 0000-0002-1246-7447

Tables: 3

Figures: 1

Word Count: 3,167

Abstract

BACKGROUND

Teledentistry expanded rapidly during COVID-19-related dental clinic closures, yet long-term utilization patterns, associated procedures, and patient characteristics remain insufficiently described. This study characterized teledentistry encounters by patient demographics and diagnoses and evaluated shifts in claim volumes and procedure patterns during and after clinic shutdown.

METHODS

A retrospective analysis evaluated 375 teledentistry claims from 288 patients at a university dental clinic (March 2020 – April 2024). Change-point detection identified structural shifts in weekly claim volume. Independent t-tests and chi-squared tests compared demographics and procedure prevalence between periods. Encounters were linked to most recent diagnoses within 90 days.

RESULTS

Most patients (83.7%) used teledentistry once. Claims peaked during shutdown (1.34/day) and declined thereafter (0.165/day). After the detected breakpoint in November 2020, average weekly claims decreased from 6.8 to 0.76. Limited oral evaluation was more common during shutdown than after (96.1% vs 82.6%; $p < 0.001$). Post-shutdown patients were younger (mean age 37.8 vs 42.7 years; $p = 0.042$), with no difference in sex ($p = 0.28$). Teledentistry services were more often covered by insurance post-shutdown (91.6% vs 77.0%; $p < 0.001$). Common diagnoses included benign oral lesions and temporomandibular disorders.

CONCLUSIONS

Teledentistry utilization surged during clinic closures but stabilized at low volumes post-reopening. While these findings specifically reflect US healthcare billing and clinic environments, the predominant reliance on teledentistry for limited evaluations and select diagnostic groups highlights targeted opportunities for virtual care. As noted in the broader literature, future efforts to support sustainable integration will rely on continued technological advancements and educational initiatives for patients and health professionals.

Keywords: COVID-19, dentistry, telehealth, teledentistry, ICD-10, demographic, oral examination

Introduction

Teledentistry refers to the use of telecommunications and information technology to deliver dental care and oral health education remotely. It enables communication between patients and dental providers, as well as collaboration among dental professionals^{1,2}. Originating in the 1990s, teledentistry was developed as part of a broader telemedicine initiative aiming to improve access to treatment and reduce the cost of care². Over the next two decades, rapid advances in technology and increasing attention to oral health equity allowed teledentistry to gain recognition as an alternative method for examination and diagnosis in dental care, although it was mainly used in public health surveillance and dental research³. In 2018, teledentistry codes were added to the Current Dental Terminology (CDT) code set in the United States⁴, allowing dental providers to submit teledentistry claims for services such as consultations, oral examinations, and preventative services delivered remotely.

As COVID-19 spread globally in early 2020, many countries implemented restrictions intended to contain the virus and mitigate its impact⁵. These measures included the suspension or postponement of non-emergency dental services in Australia⁶, Britain⁷, and the United States⁸. In mid-2020, the World Health Organization (WHO) also recommended deferring routine dental procedures, such as oral examinations and preventive dental care, as well as triaging patients virtually prior to providing necessary in-person care⁹. During this period, teledentistry rapidly emerged as a contact-free alternative for dental care¹⁰, enabling remote care while maintaining patient privacy¹¹. Concurrently, billing codes for teledentistry were introduced in Australia¹², New Zealand¹³, and certain provinces of Canada¹⁴. In the United States, oral healthcare, including services at university dental clinics, predominantly operates on a fee-for-service model, where teledentistry adoption and sustainability have relied heavily on expanding state-level Medicaid coverage policies and private insurance reimbursement mandates introduced during the pandemic^{15,16}. Moreover, research into teledentistry increased, with a focus on diagnostic accuracy¹⁷⁻¹⁹, user acceptance²⁰⁻²², technology usability²²⁻²⁴, and utilization status^{11,15,25-33}.

Although teledentistry gained attention from both researchers and policymakers during the pandemic, its utilization patterns varied considerably^{11,15,25-33}. One study reported a sixty-fold increase in teledentistry demand when non-emergency dental services were suspended¹⁵, whereas another contemporaneous study reported that fewer than 10% of prospective patients intended to utilize it²⁵. Comparisons across studies were complicated by differences in data sources including patient surveys^{25,26}, dental provider surveys²⁷⁻²⁹, and service records^{11,15,29-33}. Furthermore, prior research based on service records has either exclusively examined the initial years of the pandemic period^{11,30,33} or compared pandemic data with pre-pandemic benchmarks^{15,29,31,32}.

In May 2023, the WHO declared that COVID-19 was no longer classified as a public health emergency of international concern³⁴, marking the beginning of the post-pandemic period. To date, there is limited evidence comparing long-term utilization patterns, procedures associated with teledentistry use, and patient characteristics between the pandemic and post-pandemic periods. While global background context informs virtual care adoption, this study focuses specifically on US healthcare billing structures and clinical environments. Accordingly, the objective of this study was to characterize teledentistry encounters by patient demographics and diagnostic categories, and to evaluate temporal shifts in service delivery, procedural patterns, and claim volumes during and after the COVID-19-related clinic closure at

a university dental clinic in the United States. The null hypothesis posited no significant difference in teledentistry claim volumes, procedural patterns, patient demographics, or diagnostic categories between the pandemic and post-pandemic periods.

Methods

STUDY DESIGN AND SETTING

This retrospective observational study used electronic health service records from dental patients treated at the University of Minnesota School of Dentistry between March 2009 and April 2024. Although the dataset spans this entire period, teledentistry encounters were identifiable only from March 2020 onward, when teledentistry services were first implemented. Both single and repeated teledentistry visits were included, and each encounter was treated as an independent observational unit for analysis.

DATA SOURCES AND PATIENT SELECTION

This study utilized health service records from patients who had provided documented informed written consent for the use of their data in research. Records were eligible for inclusion if they contained claims associated with CDT codes for synchronous (D9995) or asynchronous (D9996) teledentistry procedures⁴. Records were excluded if they exhibited incomplete documentation. One outlier, who used teledentistry 28 times during the study period, was excluded from data analysis.

VARIABLES AND CODING

In addition to procedural codes for teledentistry services, the patient-level variables of age, sex, race, tooth count, and insurance status were extracted. Data were also collected on concurrent procedures delivered via teledentistry and the most recent diagnosis preceding the teledentistry encounter, defined as the International Classification of Diseases, Tenth Revision (ICD-10) code documented within 90 days prior to the teledentistry encounter.

TIME-PERIOD DEFINITION

The University's dental clinics ceased in-person operations on March 24, 2020, in response to Executive Order 20-09, which ordered the postponement of non-emergent or elective medical and dental procedures in the state of Minnesota³⁵. The clinics remained closed through July 12, 2020, the last day of the shutdown period. The period beginning with the first day of resumed clinic operations on July 13, 2020, and ending on April 30, 2024, is defined as the post-shutdown period.

STATISTICAL ANALYSIS

Data were analyzed using descriptive statistics and comparative tests. Descriptive measures included frequencies for categorical variables and means with standard deviations for continuous variables. Comparison of continuous variable means (age and tooth count) as well as insurance status was conducted using independent t-tests while categorical variables (sex, procedure prevalence) were evaluated using chi-squared or Fisher's exact tests. Structural changes were assessed using the *breakpoints* function from the *strucchange* R package implementing the optimal segmentation algorithm described by Zeileis et al. (2003)³⁶. Statistical significance was defined at $\alpha=0.05$.

ETHICAL APPROVAL

This study protocol was reviewed by the University of Minnesota Institutional Review Board (IRB ID: STUDY00021054) and determined not to constitute human subjects research under US Department of Health and Human Services (DHHS) and Food and Drug Administration (FDA) regulations; therefore, IRB approval was not required. Informed written consent for the use of health service records in research is routinely administered to all patients during clinical intake and periodically renewed. Only records from patients with active, documented research consent were included in this study. All data were de-identified and securely stored in a cloud-based content management system (Box, Inc., Redwood City, CA, USA).

Results

COHORT DESCRIPTION AND UTILIZATION PATTERNS

The data comprised 288 unique patients who used teledentistry at least once. 241 (83.7%) of these patients used teledentistry only once. Thirty-five (12.2%), eight (2.78%) and three (1.04%) of patients used teledentistry two, three and four times, respectively. One patient used teledentistry 28 times, which was designated as an outlier. In total, a teledentistry code (D9995 or D9996) was claimed 375 times. All claims occurred after the shutdown period began.

TEMPORAL TRENDS IN TELEDENTISTRY VOLUME

No teledentistry claims were made before the clinic shutdown on March 24, 2020. Following the beginning of the shutdown, teledentistry usage commenced and increased sharply through the first several weeks of the shutdown. The number of claims peaked in May 2020 before declining through June 2020. After the clinic reopened, claim numbers decreased more gradually, remaining low until the end of the study period. A total of 149 teledentistry claims occurred during the 111-day shutdown period, averaging 1.34 claims per day. After the clinic was reopened, only 226 claims occurred over the next 1387 days, averaging 0.164 claims per day. Structural change analysis of the average weekly number of claims showed a breakpoint in the week of November 8, 2020. Before this breakpoint, the average number of weekly claims was 6.8. After the breakpoint, there was an average of 0.76 claims per week. The usage frequency over the study period, excluding the outlier, is shown in Figure 1.

(Insert Figure 1 here)

CONCURRENT PROCEDURES

The teledentistry claim codes D9995 and D9996 are typically reported concurrently with codes for the procedure(s) performed during the teledentistry visit. 300 of the encounters that used one of the teledentistry codes included one or more additional procedural codes. The procedures performed concurrently with teledentistry were extracted and are summarized in Table 1. The most common procedures billed with the teledentistry codes were “D0140” (Limited Oral Evaluation - Problem Focused), “10150” (Treatment Continuation) and “10152” (Post-Op Appointment), which appeared 266, 15 and 12 times, respectively. 10150 and 10152 are not CDT codes but rather codes used in the

University's internal fee schedule to indicate continuation or follow-up of previous treatments. The frequency of the most common concurrently billed procedure, D0140, was compared between the shutdown and post-shutdown periods. Among the 128 claims during shutdown, D0140 was performed concurrently with 96.1% of the teledentistry claims that were billed concurrently with a procedural code. After shutdown, D0140 was involved in 82.6% of these claims, which was significantly lower ($p < 0.001$). For encounters including codes 10150 and 10152, the previous procedure codes were extracted. The most common previous procedures were M99203 (New patient visit; detailed), M99204 (New patient visit; comprehensive), and D0140.

(Insert Table 1 here)

PATIENT DEMOGRAPHICS AND INSURANCE STATUS

Demographic characteristics of the patient cohort, including race, sex, age, and number of teeth, were compared according to whether teledentistry was utilized during or after the shutdown period (Table 2). Patients who used teledentistry during the shutdown were significantly older on average than those who used teledentistry afterward ($p = 0.042$). Analysis of racial distribution was restricted to participants who reported race. Although a greater proportion of white patients used teledentistry after the shutdown period compared with during the shutdown, statistical testing was not performed because of small expected cell counts. Female patients represented a higher proportion of teledentistry users in the post-shutdown period compared with males; however, this difference was not statistically significant ($p = 0.28$). The mean number of teeth did not differ significantly between the two periods ($p = 0.41$). Insurance status was also evaluated. Of the 373 claims with available data, 320 claims (85.8%) were covered by insurance. During the shutdown period, 114 of 148 claims (77.0%) were insured, compared with 206 of 225 claims (91.6%) in the post-shutdown period. The proportion of claims covered by insurance was significantly lower during the shutdown period ($p < 0.001$).

(Insert Table 2 here)

DIAGNOSTIC MAPPING

Concurrent procedural claim codes (D0140, 10150, and 10152) accompanied 293 of the teledentistry encounters (D9995 or D9996). Because these procedural codes do not convey specific diagnostic details, and 284 of these 293 claims lacked any other concurrent diagnostic documentation, primary encounter data provided limited diagnostic insight. Under the assumption that these virtual visits addressed ongoing or recently established clinical conditions, the most recent ICD-10 diagnosis documented within the preceding 90 days was extracted. The most commonly observed recent diagnoses were K13.79 ("Other lesions of oral mucosa") and M26.623 ("Arthralgia of bilateral temporomandibular joint"), each appearing three times. Diagnoses were subsequently grouped into broader categories based on ICD-10 classifications, as shown in Table 3. Benign oral lesion diagnoses preceded 16 teledentistry visits, while temporomandibular joint disorders comprised nine cases. Additionally, seven diagnoses were classified as dentofacial anomalies, including malocclusion, five diagnoses involved orofacial pain and paresthesia, three involved neoplasms of uncertain behavior, and three did not fit into any diagnostic category.

(Insert Table 3 here)

Discussion

KEY FINDINGS

Teledentistry utilization rose steeply after the beginning of the shutdown, reaching a peak in May 2020 before declining rapidly thereafter. This early rapid adoption of teledentistry services was largely driven by the statewide moratorium on elective dental procedures. The subsequent decline in use, beginning even before the conclusion of the university clinic shutdown, likely corresponds to the executive order effective from May 11, 2020³⁷, permitting dental clinics to resume nonurgent in-person care under enhanced infection control protocols. Together, these temporal patterns indicate that teledentistry functioned primarily as an interim solution during the period of restricted in-person care but did not become a sustained replacement for conventional clinical encounters.

Analysis of concurrent procedure codes indicates that teledentistry was predominantly used for problem-focused evaluations and follow-up care within specific diagnostic categories. The majority of cases included the limited oral evaluation code D0140, indicating that most encounters were targeted assessments of specific concerns rather than comprehensive examinations. This pattern is consistent with the inherent constraints of remote care, which limit the ability to perform thorough intraoral assessments. As a result, teledentistry appears to have been employed for triage of defined concerns while most patients without acute or specific dental concerns likely deferred routine examination until in-person services resumed. The procedures that preceded the use of codes for treatment continuation and post-op appointment in conjunction with teledentistry suggest an additional role in post-procedural monitoring, including follow-up after interventions such as biopsies.

Diagnostic mapping demonstrates that teledentistry encounters were concentrated within a narrow range of clinical conditions associated with specific diagnostic categories. Specifically, 29 of 43 cases with a documented recent diagnosis involved benign orofacial lesions, temporomandibular disorders, or dentofacial anomalies. These findings suggest that teledentistry was selectively applied to conditions more amenable to remote evaluation and longitudinal monitoring. In contrast, the broader scope of dental care, which is often procedure-dependent, was likely deferred until in-person treatment became feasible.

Collectively, these findings support the interpretation that teledentistry was selectively implemented as a complementary treatment modality, particularly effective for triage, follow-up, and management of specific low-acuity conditions but with inherent limitations in its capacity to replace comprehensive, procedure-based care.

COMPARISON WITH EXISTING LITERATURE

Existing literature on the use of teledentistry in relation to the pandemic is relatively limited, especially during the time period after the initial, acute phase of the pandemic when many countries suspended non-

emergent dental services. Previous studies largely concur that teledentistry use significantly increased during the pandemic^{28, 31, 32, 38}. In addition, it has been reported that a large proportion of both dentists and patients used teledentistry for the first time due to the pandemic^{28, 38}. Although there is less record of teledentistry trends in late 2020, one study found that in-person dental visits rebounded to pre-pandemic levels in November 2020³¹, the same month this analysis found a breakpoint in average weekly teledentistry claims. Additionally, evidence on the overall level of teledentistry usage is inconclusive. One survey found that 29% of patients had used teledentistry³⁸ while another reported a rate of only 8%²⁶. Although temporal demographic analyses are also limited, findings generally align with the present study. It has been previously reported that patients using teledentistry were, on average, older during the pandemic with no significant difference in sex distribution between these periods³².

CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

The diagnostic patterns observed prior to the adoption of teledentistry highlights the opportunity to develop targeted virtual care pathways aligned with common patient needs. These trends can guide providers in creating structured teledentistry protocols that streamline triage, consultation, and follow-up for commonly encountered conditions. Benign oral mucosal lesions and temporomandibular disorders, in particular, appear well suited for remote monitoring via teledentistry after initial evaluation and diagnosis. For such conditions, virtual follow-up visits may provide an efficient mechanism for assessing symptom progression, delivering patient education, and adjusting conservative management strategies without requiring additional in-office visits. Incorporating teledentistry into follow-up care may reduce patient burden and alleviate demand on clinical resources for appointments that do not require direct procedural intervention.

Existing literature has highlighted the potential role of teledentistry in the triage, diagnosis, and treatment of conditions such as temporomandibular disorders, provided that clear clinical criteria and decision thresholds are established³⁹. Identifying areas in which teledentistry yields outcomes comparable to in-person care may be particularly valuable for addressing persistent access barriers, including geographic limitations faced by rural and underserved populations. However, further research is needed to evaluate treatment outcomes and patient-reported experiences across different applications of teledentistry.

Despite its promise, the limited sustained use of teledentistry reflects ongoing barriers to widespread implementation. Constraints inherent to remote care, such as the inability to perform tactile examinations, imaging, or certain diagnostic tests, may limit its applicability for many clinical scenarios. Additionally, logistical and regulatory challenges, including licensure restrictions and variability in reimbursement policies across state lines, continue to hinder broader adoption. Even within the United States, teledentistry regulation, scope of practice, and parity laws exhibit substantial variation from state to state¹⁶. Globally, structural barriers to teledentistry adoption are even more pronounced; a comprehensive international review noted that only 30% of surveyed countries possessed formal teledentistry policies or strategies, with minimal financial allocation or reimbursement mechanisms dedicated to teledentistry⁴⁰.

Integrating targeted teledentistry pathways into routine practice may enhance continuity of care, optimize resource utilization, and support more patient-centered delivery models. Achieving this will require coordinated efforts in policy development, technological innovation, and the creation of evidence-based guidelines. Integration with artificial intelligence-supported diagnostic tools⁴¹ may further strengthen the

sustainability of teledentistry services. As highlighted in the broader literature, long-term sustainability will also depend on overcoming technological and usability barriers, improving digital literacy, and providing targeted education for both patients and healthcare professionals^{42, 43}. Sustainable implementation will likely require teledentistry to be embedded into routine clinical workflows⁴⁴. For example, diagnosis-specific care pathways could automatically identify patients eligible for virtual follow-up at the time of the initial in-person visit, with predefined criteria for escalation to in-office evaluation if symptoms worsen or fail to improve. Embedding these decision points into existing scheduling and documentation processes may promote consistent utilization beyond periods of healthcare disruption.

Continued development of teledentistry policy, clinical pathways, and implementation frameworks is essential to prepare oral healthcare systems for future disruptions that limit in-person care. Standardized protocols for triage, referral, reimbursement, privacy protection, and interoperability with existing electronic health record systems will support more consistent adoption across practice settings⁴⁵. A clearer understanding of the scope, limitations, and optimal applications of teledentistry will also inform resource allocation and workforce planning. Evaluating utilization patterns and patient outcomes can help identify populations most likely to benefit from remote dental services, thereby guiding investments in digital infrastructure, provider training, and equitable access initiatives. Collectively, these efforts may strengthen continuity of care and enhance the capacity of dental health systems to respond effectively during periods of disrupted clinical operations.

STRENGTHS AND LIMITATIONS

This study is strengthened by its use of a comprehensive four-year dataset, which enabled the linkage of individual teledentistry encounters with concurrent billing codes and recent ICD-10 diagnoses. The extended observation period, which continued for nearly 4 years after the clinic reopened, facilitated comparison of demographic patterns during the shutdown with those in the post-shutdown period despite relatively low levels of teledentistry utilization. Furthermore, the application of breakpoint analysis provided a rigorous method for quantifying changes in average weekly visit volumes over time.

Multiple limitations should also be acknowledged. The dataset used was derived from a single clinical site, which may limit generalizability and introduce site-specific influences related to the clinic's patient population and location. In addition, the absence of patient-reported outcomes precluded assessment of the impact of teledentistry on clinical or experimental outcomes, as well as direct comparisons with traditional in-person visits for similar indications. Diagnostic mapping relied on the most recent ICD-10 code documented within 90 days prior to the encounter; thus, these results should be interpreted with caution, as the remote consultation may have addressed an unrecorded new concern or a condition diagnosed outside this 90-day window. Furthermore, comparing the 111-day shutdown period with the 1,387-day post-shutdown period involves highly asymmetrical time windows, which may introduce bias by diluting seasonal fluctuations or cyclical changes during the longer follow-up period. Finally, the observational non-randomized design introduces the potential for residual confounding, which may affect the interpretation of observed associations and limit causal interpretation of observed relationships.

Acknowledgements

The authors thank Ms. Nikhita Kutala for her assistance in extracting data from patient records. The study is also indebted to Dr. Richard Nadeau, Dr. Angela Hastings, Dr. Natalie Peterson, and Dr. Rachel Uppgaard for providing information on the clinic shutdown timeline, teledentistry policy, and patient-record coding. Portions of this work were presented at the 54th Annual Meeting & Exhibition of the American Associations for Dental, Oral, and Craniofacial Research (AADOCR, New York, USA, 2025).

Part of this manuscript was rephrased with the assistance of Microsoft Copilot, a generative artificial intelligence (AI) tool developed by Microsoft. The AI was used exclusively for language refinement and did not generate or modify any original scientific content, data, analyses, or interpretations. All AI-assisted text was reviewed and verified by the authors to ensure accuracy, integrity, and the absence of plagiarism.

Commented [R11]: Do you need to acknowledge Gemini now?

Author Contributions

Conceptualization: ASI, BH

Data curation: EW, BH

Formal analysis: RHLI

Investigation: ASI

Methodology: RHLI, ASI, BH

Project administration: EW, ASI

Supervision: BH

Validation: EW

Visualization: EW, RHLI

Writing – original draft: EW

Writing – review & editing: RHLI, ASI, BH

Statements and Declarations

ETHICAL CONSIDERATIONS

This study protocol was reviewed by the University of Minnesota Institutional Review Board (IRB ID: STUDY00021054) and determined not to constitute human subjects research under US Department of Health and Human Services (DHHS) and Food and Drug Administration (FDA) regulations; therefore, IRB approval was not required.

CONSENT TO PARTICIPATE

Informed written consent for the use of health service records in research is routinely administered to all patients during clinical intake and periodically renewed. Only records from patients with active, documented research consent were included in this study.

CONSENT FOR PUBLICATION

Not applicable

DECLARATION OF CONFLICTING INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article

FUNDING STATEMENT

BH's faculty start-up funding from the University of Minnesota School of Dentistry supported the \$49 submission fee. The authors received no other financial support for the research, authorship, or publication of this article.

Data Availability

Data will be made available upon reasonable request to the corresponding author.

References

1. Howell SEI and Fukuoka B. Teledentistry for patient-centered screening and assessment. *Dent Clin North Am* 2022; 66: 195-208. DOI: <https://doi.org/10.1016/j.cden.2022.01.002>.
2. Rocca MA, Kudryk VL, Pajak JC, et al. The evolution of a teledentistry system within the Department of Defense. *Proc AMLA Symp* 1999: 921-924.
3. Estai M, Kanagasingam Y, Huang B, et al. The efficacy of remote screening for dental caries by mid-level dental providers using a mobile teledentistry model. *Community Dent Oral Epidemiol* 2016; 44: 435-441. DOI: <https://doi.org/10.1111/cdoe.12232>.
4. American Dental Association. D9995 and D9996 – Guide to Understanding and Documenting Teledentistry Events [Internet]. Chicago: American Dental Association; 2023 [cited 2026 May 29]. Available from: https://www.ada.org/-/media/project/ada-organization/ada/ada-org/files/publications/cdt/v4_d9995andd9996__adaguidetounderstandinganddocumentingteledentistryevents_2023jan.pdf.
5. Jung F, Krieger V, Hufert FT, et al. Herd immunity or suppression strategy to combat COVID-19. *Clin Hemorheol Microcirc* 2020; 75: 13-17. DOI: <https://doi.org/10.3233/CH-209006>.
6. Mian M, Teoh L and Hopcraft M. Trends in dental medication prescribing in Australia during the COVID-19 pandemic. *JDR Clin Transl Res* 2021; 6: 145-152. DOI: <https://doi.org/10.1177/2380084420986766>.
7. Coulthard P. Dentistry and coronavirus (COVID-19) - moral decision-making. *Br Dent J* 2020; 228: 503-505. DOI: <https://doi.org/10.1038/s41415-020-1482-1>.
8. Papautsky EL, Rice DR, Ghoneima H, et al. Characterizing health care delays and interruptions in the United States during the COVID-19 pandemic: internet-based, cross-sectional survey study. *J Med Internet Res* 2021; 23: e25446. DOI: <https://doi.org/10.2196/25446>.
9. World Health Organization. Considerations for the provision of essential oral health services in the context of COVID-19: Interim guidance [Internet]. Geneva: World Health Organization; 2020 [cited 2026 May 29]. Available from: <https://iris.who.int/server/api/core/bitstreams/f794e455-9ced-40ccb3a2-cfe8e203d50a/content>.
10. Talla P, Levin L, Glogauer M, et al. Delivering dental care as we emerge from the initial phase of the COVID-19 pandemic: teledentistry and face-to-face consultations in a new clinical world. *Quintessence Int* 2020; 51: 672-677. DOI: <https://doi.org/10.3290/j.qi.a44920>.
11. Lin C, Goncalves N, Scully B, et al. A teledentistry pilot study on patient-initiated care. *Int J Environ Res Public Health* 2022; 19: 9403. DOI: <https://doi.org/10.3390/ijerph19159403>.

12. Australian Dental Association, Australian Dental Association Schedule Committee. *The Australian schedule of dental services and glossary*. 13th ed. St. Leonards, N.S.W: Australian Dental Association, 2022.
13. New Zealand Dental Council. ACC claim code: Dental Consultation by Telehealth for COVID-19 [Internet]. Wellington: Dental Council; 2020 [cited 2026 May 29]. Available from: <https://web.archive.org/web/20260314054143/https://dcnz.org.nz/resources-and-publications/updates/2020/acc-claim-code-dental-consultation-by-telehealth-for-covid-19>.
14. Kengne Talla P, Makansi N, Michaud P-L, et al. Virtual oral health across Canada: a critical comparative analysis of clinical practice guidances during the COVID-19 pandemic. *Int J Environ Res Public Health* 20. DOI: <https://doi.org/10.3390/ijerph20054671>.
15. Choi SE, Simon L, Basu S, et al. Changes in dental care use patterns due to COVID-19 among insured patients in the United States. *J Am Dent Assoc* 2021; 152: 1033-1043.e1033. DOI: <https://doi.org/10.1016/j.adaj.2021.07.002>.
16. Kassem I, Rossouw PE and Malik S. State-wise tele-dentistry guidelines and practice in the united states of America: A cross-sectional study. *Semin Orthod* 2026; 32: 713-721. DOI: <https://doi.org/10.1053/j.sodo.2025.09.016>.
17. Huang B, Estai M, Pungchanchaikul P, et al. Mobile health assessment of traumatic dental injuries using smartphone-acquired photographs: a multicenter diagnostic accuracy study. *Telemed J E Health* 2024; 30: 2592-2600. DOI: <https://doi.org/10.1089/tmj.2024.0012>.
18. Price MD, Ureles SD, Alhazmi H, et al. Diagnostic accuracy of detecting caries and other intraoral findings using parent-obtained smartphone photographs in teledentistry. *J Am Dent Assoc* 2025; 156: 601-610.e1. DOI: <https://doi.org/10.1016/j.adaj.2025.05.003>.
19. Lamas-Lara VF, Mattos-Vela MA, Evaristo-Chiyong TA, et al. Validity and reliability of a smartphone-based photographic method for detection of dental caries in adults for use in teledentistry. *Front Oral Health* 2025; 6: 1470706. DOI: <https://doi.org/10.3389/froh.2025.1470706>.
20. Ng BMM, Samaranayaka A, Ting G, et al. Acceptability of teledentistry use among residents and staff in aged residential care facilities in the Otago region of New Zealand. *Gerodontology* 2024; 41: 556-570. DOI: <https://doi.org/10.1111/ger.12752>.
21. Alrumaim S, Farsi N, Farsi N, et al. Feasibility and acceptability of pediatric teledentistry: a mixed-methods study. *Int J Paediatr Dent* 2025; 35: 954-963. DOI: <https://doi.org/10.1111/ipd.13312>.
22. Xiao J, Kopycka-Kedziewski D, Ragusa P, et al. Acceptance and usability of an innovative mDentistry eHygiene model amid the COVID-19 pandemic within the US National Dental Practice-Based Research Network: mixed methods study. *JMIR Hum Factors* 2023; 10: e45418. DOI: <https://doi.org/10.2196/45418>.
23. Niknam F, Mardani M, Bastani P, et al. Assessing the usability and reliability of a web-based teledentistry tool for remote diagnosis of oral lesions: a cross-sectional study. *BMC Oral Health* 2024; 24: 1094. DOI: <https://doi.org/10.1186/s12903-024-04696-7>.
24. Huang C-C and Chen J-W. Teledentistry for pediatric dental emergency: comparison between experienced and novice users. *Bioengineering* 2024; 11: 1054. DOI: <https://doi.org/10.3390/bioengineering11111054>.
25. VanDeWiele MD, Hastings AM, Evans MD, et al. Using the Unified Theory of Acceptance and Use of Technology (UTAUT) to predict the behavioral intent of teledentistry utilization amongst United States adults. *J Telemed Telecare* 2025; 31: 286-296. DOI: <https://doi.org/10.1177/1357633x231182405>.
26. Bugis BA. Patients self-reporting of utilizing teledental services during the COVID-19 pandemic in Saudi Arabia. *J Patient Exp* 2022; 9: 23743735221112209. DOI: <https://doi.org/10.1177/23743735221112209>.
27. Joseph AM, Alsalman RA, Almasoud WA, et al. Predicting the employment of teledentistry in clinical practice by the Saudi dental community using a theoretical model. *Digit Health* 2024; 10: 20552076241253739. DOI: <https://doi.org/10.1177/20552076241253739>.

28. Cheuk R, Adeniyi A, Farmer J, et al. Teledentistry use during the COVID-19 pandemic: perceptions and practices of Ontario dentists. *BMC Oral Health* 2023; 23: 72. DOI: <https://doi.org/10.1186/s12903-023-02772-y>.
29. Miranda-Hoover A, He P, Chau T, et al. Telehealth utilization in oral medicine and oral and maxillofacial surgery. *Telemed J E Health* 2024; 30: 780-787. DOI: <https://doi.org/10.1089/tmj.2023.0099>.
30. Schroeder K, Santoro M, Tranby EP, et al. Teledentistry utilization by oral health professionals and policy considerations: a mixed methods case study. *J Public Health Dent* 2024; 84: 393-406. DOI: <https://doi.org/10.1111/jphd.12640>.
31. Choi SE, Mo E, Sima C, et al. Impact of COVID-19 on dental care utilization and oral health conditions in the United States. *JDR Clin Transl Res* 2024; 9: 256-264. DOI: <https://doi.org/10.1177/23800844231165016>.
32. Parmar D, Kar AK, Kaur J, et al. Retrospective analysis of the impact of the COVID-19 pandemic on dental health and utilization of dental services: a tertiary care study between 2017 and 2022. *J Pharm Bioallied Sci* 2024; 16: S2628-s2630. 20240701. DOI: https://doi.org/10.4103/jpbs.jpbs_423_24.
33. Brecher EA, Keels MA, Carrico CK, et al. Teledentistry implementation in a private pediatric dental practice during the COVID-19 pandemic. *Pediatr Dent* 2021; 43: 463-467. PMID: 34937617.
34. World Health Organization. Statement on the fifteenth meeting of the IHR (2005) Emergency Committee on the COVID-19 pandemic [Internet]. Geneva: World Health Organization; 2023 [cited 2026 May 29]. Available from: [https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-coronavirus-disease-\(covid-19\)-pandemic](https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic).
35. State of Minnesota, Office of the Governor. Emergency Executive Order 20-09: Directing the Commissioner of Health to Limit Certain Actions to Prevent the Spread of COVID-19 [Internet]. St. Paul: Office of the Governor; 2020 [cited 2026 May 29]. Available from: https://mn.gov/governor/assets/Emergency%20Executive%20Order%2020-09_FINAL_As_Filed_tcm1055-424357.pdf.
36. Zeileis A, Kleiber C, Krämer W, et al. Testing and dating of structural changes in practice. *Comput Stat Data Anal* 2003; 44: 109-123. DOI: [https://doi.org/10.1016/S0167-9473\(03\)00030-6](https://doi.org/10.1016/S0167-9473(03)00030-6).
37. State of Minnesota, Office of the Governor. Emergency Executive Order 20-51: Requiring Facilities to Prioritize Surgeries and Procedures and Provide Safe Environment during COVID-19 Peacetime Emergency [Internet]. St. Paul: Office of the Governor; 2020 [cited 2026 May 29]. Available from: https://mn.gov/governor/assets/EO%2020-51%20Final%20%28002%29_tcm1055-431183.pdf.
38. O'Malley E, Surdu S and Langelier M. The impact of pandemic concerns on consumers' teledentistry use during the first months of the COVID-19 pandemic. *Public Health Rep* 2023; 138: 63S-71S. DOI: <https://doi.org/10.1177/00333549221133801>.
39. Emodi-Perlman A and Eli I. One year into the COVID-19 pandemic - temporomandibular disorders and bruxism: What we have learned and what we can do to improve our manner of treatment. *Dent Med Probl* 2021; 58: 215-218. DOI: <https://doi.org/10.17219/dmp/132896>.
40. El Tantawi M, Lam WYH, Giraudeau N, et al. Teledentistry from research to practice: a tale of nineteen countries. *Front Oral Health* 2023; 4: 1188557. DOI: <https://doi.org/10.3389/froh.2023.1188557>.
41. Jang L, Chiang Y-Y, Hastings AM, et al. OMNI-Dent: towards an accessible and explainable AI framework for automated dental diagnosis. In: *Proceedings – 2026 IEEE/CVF Winter Conference on Applications of Computer Vision Workshop (WACVW)*, Tucson, AZ, 6-10 March 2026, pp. 415–424. IEEE. DOI: <https://doi.org/10.1109/WACVW68408.2026.00048>.
42. Naresh A, Morse Z and Bettiol S. Teledentistry and one health: a sustainable framework for oral and planetary health. *Front Dent Med* 2025; 6: 1631548. DOI: <https://doi.org/10.3389/fdmed.2025.1631548>.

43. Mwogosi A, Mambile C, Simba R, et al. Integrating digital technologies in clinical dentistry training: a framework for competency-based education. *BMC Med Educ* 2025; 25: 1645. DOI: <https://doi.org/10.1186/s12909-025-07585-x>.
44. Nurjono M, Ho E, Lee JY, et al. Perceptions of community healthcare workers on the use of teledentistry for seniors in Singapore: A qualitative study. *Digit Health* 2025; 11: 20552076241312562. DOI: <https://doi.org/10.1177/20552076241312562>.
45. Schultz EC, Huang B, Shenouda M, et al. Perspectives of frontline clinicians and end-line users on smartphone-based photography for assessing traumatic dental injuries: focus group interview study and thematic analysis. *JMIR Hum Factors* 2026; 13: e82668. DOI: <https://doi.org/10.2196/82668>.

Legend

Figure 1. The weekly number of teledentistry claims from March 2020 to April 2024. The dashed lines represent the beginning and end of the clinic shutdown.

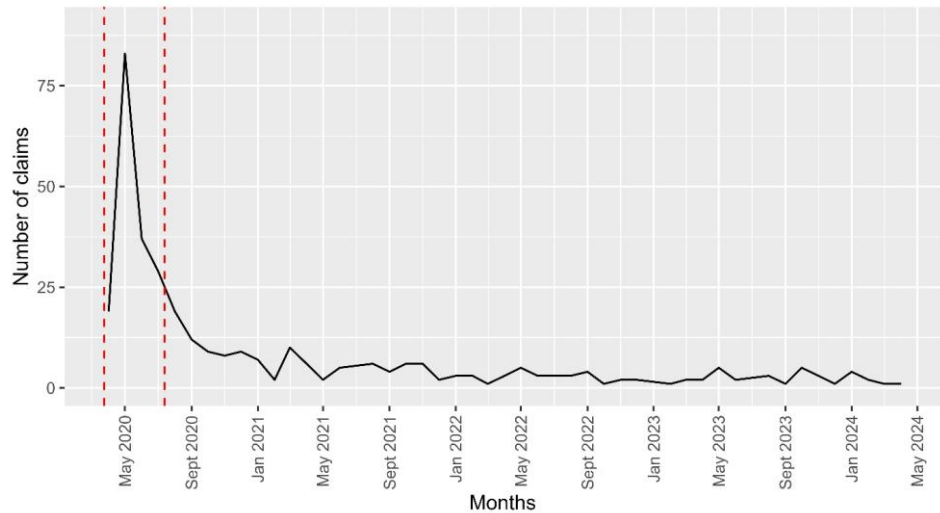


Table 1. Procedures performed concurrently with teledentistry claim codes D9995 and D9996. Codes beginning with “D” are Current Dental Terminology (CDT) codes while codes beginning with “M” are Current Procedural Terminology (CPT) codes and codes beginning with “C” are Healthcare Common Procedure Coding System (HCPCS) codes. Codes with no preceding letter are part of the University's internal fee schedule.

<i>CDT/CPT Code</i>	<i>Definition</i>	<i>n</i>	<i>CDT/CPT Code</i>	<i>Definition</i>	<i>n</i>
10150	Treatment continuation	15	D7230	Removal of impacted tooth – partially bony	1
10152	Post-op appointment	12	D8670	Periodic orthodontic treatment visit.	1
D0120	Periodic exam – established patient	1	D9222	Administration of deep sedation/general anesthesia – first 15-minute increment, or any portion thereof	1
D0140	Limited oral evaluation – problem focused	266	D9223	Administration of deep sedation/general anesthesia – each subsequent 15-minute increment, or any portion thereof	1
D0150	Comprehensive oral evaluation, new or established patient	2	D9420	Hospital and surgical center calls	1
D0170	Re-evaluation – limited, problem-focused	1	M99201	New patient office visit, problem focused	1
D0210	Intraoral – comprehensive series of radiographic images	1	M99211	Office or other outpatient visit for the evaluation and management of an established patient that may not require the presence of a physician	1
D1555	Removal of fixed space maintainer	1	M99213	Established patient office or other outpatient visit, 20-29 minutes	1
D7210	Extraction, erupted tooth requiring removal of bone and/or sectioning of tooth, and including elevation of mucoperiosteal flap if indicated	1	M99214	Established patient office or other outpatient visit, 30-39 minutes	1

Table 2. Demographics of patients using teledentistry during and after the shutdown period.

		<i>During shutdown</i>	<i>After shutdown</i>	<i>Significance</i>
<i>Race</i>	American Indian or Alaska Native	1	1	<i>Not calculated</i>
	American Indian or Alaska Native+White	1	0	
	Asian	4	2	
	Asian+Black or African American	0	1	
	Asian+White	1	0	
	Black or African American	24	24	
	Black or African American+White	4	2	
	White	67	81	
<i>Sex</i>	Female	61	86	$p = 0.28$
	Male	74	79	
<i>Age</i>	Mean	42.7	37.8	$p = 0.042$
	SD	21.5	19.5	
<i>Tooth count</i>	Mean	23.1	24.7	$p = 0.41$
	SD	7.80	23.1	

Table 3. Most recent ICD-10 codes documented within the preceding 90 days for teledentistry encounters identified using claim codes D0140, I0150, and I0152, grouped into broader diagnostic categories. Numbers shown indicate the number of claims associated with each code.

<i>Diagnostic Category</i>	<i>ICD-10 Code</i>	<i>n</i>	<i>Diagnostic Category</i>	<i>ICD-10 Code</i>	<i>n</i>	<i>Diagnostic Category</i>	<i>ICD-10 Code</i>	<i>n</i>
Benign Oral Lesions <i>n=16</i>	K06.1	1	Temporomandibular Joint Disorders <i>n=9</i>	M06.9	1	Dentofacial Anomalies <i>n=7</i>	Q37.5	1
	K11.6	1		M26.69	1		M26.52	1
	K12.2	1		M26.643	1		M26.29	1
	K13.21	2		M26.641	1		M26.221	1
	K13.29	2		M26.623	3		M26.12	1
	K13.5	1		M26.621	2		M26.09	1
	K13.70	1	Neoplasms of Uncertain Behavior <i>n=3</i>	D37.02	1		M26.03	1
	K13.79	3		D37.09	1	Orofacial Pain and Paresthesia <i>n=5</i>	S04.31 XA	1
	K14.3	1	Other <i>n=3</i>	D49.0	1		R20.2	1
	D10.39	1		Z01.21	1		R25.2	1
	M27.1	1		Z51.89	1		M79.11	1
	M27.40	1		R13.10	1		M79.12	1