Neurology®
Clinical Practice

A peer-reviewed clinical neurology journal for the practicing neurologist
An Official Journal of the American Academy of Neurology

Neurology: Clinical Practice Publish Ahead of Print
DOI: 10.1212/CPJ.0000000000200099

# Feasibility and Acceptability of a Multidisciplinary Academic Telemedicine System for Memory Care in Response to COVID-19

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**Figure Count:**
0

**Table Count:**
7

**Search Terms:**
[ 14 ] All Clinical Neurology, [ 25 ] All Cognitive Disorders/Dementia, [ 38 ] Assessment of cognitive disorders/dementia, [ 334 ] All Practice Management, [ 327 ] Models of care

**Acknowledgment:**
We thank our dedicated clinical staff and our patients for their generous contribution to science.

**Study Funding:**
This work was funded by the National Institute on Aging.

**Disclosures:**
All authors involved certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in this manuscript.

**Preprint DOI:**

**Received Date:**
2022-04-01

**Accepted Date:**
2022-09-26

**Handling Editor Statement:**
Submitted and externally peer reviewed. The handling editor was Associate Editor Jack W. Tsao, MD, DPhil, FAAN.

**Abstract**

**Background**

In response to the restrictions imposed by the COVID-19 pandemic, the University of California San Francisco Memory and Aging Center (UCSF MAC) has deployed a comprehensive telemedicine model for the diagnosis and management of Alzheimer's disease and related dementias.

**Objective**

This review summarizes a large academic behavioral neurology clinic's experience transitioning to telemedicine services, including the impact on clinic care indicators, access metrics, and provider's experience. We compared these outcomes from three years before COVID-19 to 12 months after the transition to video teleconferencing (VTC) encounters.

**Methods**

Patient demographics and appointment data (dates, visit types, and departments) were extracted from our institution's electronic health record database from January 1, 2017, to May 1, 2021. We present data as descriptive statistics and comparisons using Wilcoxon rank-sum tests and Fisher exact tests. Results of anonymous surveys conducted amongst the clinic's providers are reported as descriptive findings.

**Results**

Following the implementation of telemedicine services, the proportion of clinic encounters completed via VTC increased from 1.9% to 86.4%. There was a statistically significant decline in both the percentage of scheduled appointments that were canceled (32.9 vs. 27.9%; $p<0.01$) and total cancelations per month (mean 240.3 vs. 179.4/month; <0.01). There was an increase in the percentage of completed scheduled appointments (60.2 vs. 64.8%; $p<0.01$) and an increase in the average estimated commuting distance patients would need to drive for follow-up appointments (mean 49.8 vs. 54.7 miles; $p<0.01$). The transition to telemedicine services did not significantly impact the clinic's patient population as measured by age, gender, estimated income, Area Deprivation Index, or self-reported racial/ethnic identity. Results of the provider survey revealed that physicians reported a more positive experience relative to neuropsychologists. Both types of providers reported telemedicine services as a reasonable equivalent and acceptable alternative to in-person evaluations with notable caveats.

**Conclusions**

UCSF MAC's comprehensive integration of telemedicine services maintained critical ambulatory care to patients living with dementia during the COVID-19 pandemic. The recognized benefits of our care model suggest dementia telemedicine may be used as a feasible and equivalent alternative to in-person ambulatory care in the post-COVID era.

**Keywords**
health informatics, telemedicine, video teleconferencing, COVID-19, video consultation, pandemic, dementia, Alzheimer's disease, health disparities

## Introduction

Dementia care specialists face a future of exponential demand and constrained supply foreshadowing a public health crisis. According to the U.S. Census Bureau, within five years, half of all baby boomers will be over the age of 65. There will be 14 million people living with dementia in the United States by 2050[1]. These challenges are further exacerbated by a chronic shortage of dementia care specialists[2–4]. Individuals living with dementia often face a complex myriad of behavioral problems whose nuanced management is often beyond the capacity of their primary care providers. Without specialist guidance, these patients often face less than optimal clinical outcomes, including but not limited to the overuse of psychotropic medications and longer hospital admissions[5–8]. Alzheimer's disease and related dementias (ADRD) are among the most critical challenges of the 21st century and will require the integration of preventative, behavioral health, and risk reduction strategies into the healthcare system to meet the growing demand of an aging population[9,10]. New comprehensive and sustainable approaches to dementia care are critically needed.

The use of telemedicine for the provision of ADRD-related care has been in active practice internationally since the beginning of modern video teleconferencing (VTC) telemedicine. South Korea has some of the world's most well-established telemedicine information technology infrastructure dating back to 1988[11] and was among the first countries to implement telemedicine for ADRD management in 1999[12]. Since the adoption of ADRD telemedicine in South Korea, multiple international studies have shown it to be a reproducible and cost-effective means of providing care that is acceptable to caregivers and patients with varying degrees of cognitive impairment[13–17]. Comparative studies have found agreement between in-person and telemedicine assessments using standardized neurocognitive assessments and dementia rating scales[18–20]. Multiple investigations have demonstrated that ADRD specialist evaluations performed via VTC are comparable to in-person examinations in terms of accuracy of diagnosis[18,21] and effectively improving access to quality ADRD care in remote regions[22,23]. Regardless of these benefits, acceptance, and integration of telemedicine into ADRD care delivery models have not been significantly implemented outside academic and government health services[11,12,24]. Widespread adoption of telemedicine care for ADRD has been stifled by many of the similar barriers faced by medicine globally, including but not limited to inconsistent reimbursement, legal restrictions, patient inexperience with technology, and a lack of acceptance by providers who report concerns about the inadequacy of VTC to evaluate complex chronic conditions like ADRD[25–29]. Despite these concerns, widespread ADRD telemedicine services were rapidly adopted nationally in response to the significant disruptions to care services imposed by the COVID-19 pandemic. The feasibility and consequences of integrating multidisciplinary telemedicine into dementia care have not yet been fully explored.

This study analyzed clinical care indicators and provider experience of a telemedicine dementia care model at the University of California, San Francisco (UCSF) Memory and Aging Center (MAC), a multidisciplinary behavioral neurology outpatient continuity clinic. We provide a comprehensive overview and analysis of the feasibility and acceptability of the telemedicine model for dementia care at a large academic medical center to guide policymakers, inform stakeholders, and support the growing number of health providers invested in developing effective telemedicine programs. This report is aimed primarily at memory clinic providers and managers and is also intended to provide insights for researchers interested in evaluating healthcare information and communications technologies.

## Methods

This study was performed at the UCSF MAC, an Alzheimer's disease and related dementias outpatient specialty clinic predominantly serving the nine-county San Francisco Bay Area and providing in-person and remote care nationally and internationally. The clinic includes specialists in neurology, neuropsychology, geriatrics, geropsychiatry, pharmacy, nursing, social work, and speech pathology, who collectively participate in a patient's evaluation and management. The current study describes the change in provider experiences and patient access related to neurological and neuropsychological evaluations following the transition to telemedicine services during the COVID period. Please see eAppendix 1 in the Supplement: UCSF Telemedicine Clinic Model for a full description of this transition.

### Data and Participants

#### Clinical care indicators.

Data from the Epic electronic health records (EHR) system was accessed using UCSF-specific built-in data extraction tool. The extraction protocol identifies all outpatient encounters, including three categories of telemedicine encounters (video new, video follow-up, and scheduled telephone follow-up). This study uses VTC to refer exclusively to patient encounters performed through audio and video software. In contrast, telemedicine refers to clinical encounters conducted through VTC or telephone. Telephone encounters included all components of a VTC encounter except visualization of the patient and a remote physical examination. Unscheduled telephone calls by a provider in response to a patient message were not considered telephone encounters and were not included in the analyses. We assessed all appointments scheduled between January 1, 2017, to January 1, 2020 (pre-telemedicine) and between May 1, 2020, and May 1, 2021 (telemedicine). Additional variables extracted from EHR included patient age, sex, race, ethnicity, ZIP+4, insurance type, and use of interpreter services. Median household income was estimated using data from the US Census Bureau. We used ZIP+4 codes to derive the Area Deprivation Index (ADI) national percentiles, a widely validated measure of neighborhood disadvantage[30]. The national percentiles were coded as low (ADI values 1-24), midrange (ADI values 25-75), and high (ADI values 76-100) disparity neighborhoods.[30] In addition, we used ZIP+4 to calculate the estimated commuting distance patients would need to travel from their home address to be seen at the clinic in person.

#### Provider experience.

Nine months following the rollout of telemedicine services, we conducted an anonymous survey of 46 clinic providers (neurologists, psychiatrists, geriatricians, and neuropsychologists). The survey was designed to assess providers' satisfaction with telemedicine services, acceptability and feasibility of telemedicine services, and interest in practicing telemedicine in the future. The survey was designed and piloted among a small group of providers and distributed via a secure online survey system. The full version of the survey is available in the eAppendix 2 in the supplementary materials. Out of 46 total providers contacted, 30 (65%) completed the survey.

#### Statistical analyses.

For EHR data, we conducted between-group analyses to evaluate the differences in clinical care indicators (number of encounters) and patient demographics pre-and post-introduction of the telemedicine care model. Fisher exact tests were used for categorical variables, and the Wilcoxon rank-sum tests were used for continuous variables. Provider survey data were analyzed using descriptive statistics. All analyses were conducted separately for physicians (neurologists, psychiatrists, geriatricians) and neuropsychologists. All analyses were performed using R Project for Statistical Computing (v.4.1.0) with a two-tailed significance level set at $P < .05$.

**Standard Protocol Approvals, Registrations, and Patient Consents**

This study was approved by the University of California San Francisco's Institutional Review Board (21-33610). All analyses were performed in accordance with the institutional Health Insurance Portability and Accountability Act (HIPAA) compliant framework. Informed consent was obtained before the survey of clinic providers.

**Data Availability**

Due to HIPAA restrictions, raw data is not publicly available, but a limited dataset can be requested by qualified researchers using standard data request procedures.

## Results

**Clinical Care Indicators**

A total of 26,283 scheduled appointments resulting in 15,810 completed clinical encounters were performed during the pre-telemedicine period between January 1, 2017, and January 1, 2020. Following the transition to telemedicine services between May 1, 2020, and May 1, 2021, a total of 7,717 scheduled appointments resulted in 5,000 completed clinical encounters, and the proportion of completed clinical encounters via telemedicine (scheduled telephone or video teleconferencing) increased from 13.1 to 95.8% of all clinical encounters. The number and types of encounters in the pre-telemedicine and telemedicine periods are presented in Table 1. Compared to the pre-telemedicine period, there was a decrease in the average number of scheduled appointments made per month (mean 730.1 vs. 643.1/month; $p<0.01$), but not in the average number of completed appointments per month (mean 439.2 vs. 413.8/month; $p=0.11$). We found a decrease in the average number of canceled appointments per month during the telemedicine period (mean 240.3 vs. 179.4/month; $p<0.01$) that did not significantly vary based on patients' age, gender, race/ethnicity, or ADI. Consistently, we found a decrease in the percentage of appointments that resulted in cancelations (32.9 vs. 27.9 %; $p<0.01$) and a minor increase in the percentage of scheduled appointments that resulted in no-shows (6.8 vs. 7.1 %; $p =0.13$) during the telemedicine period.

We then evaluated changes in the number of clinical encounters separately for physicians and neuropsychologists. For physician encounters, there was a minor decrease in the average number of scheduled physicians' appointments per month (543.1 vs. 513.4; $p=0.09$). We observed a decrease in the percentage of scheduled physician appointments that were canceled (32.2 vs. 25.4 %; $p<0.01$) and a decline in the average number of physician appointment cancellations per month for both new (44.3 vs. 33.7/month; $p<0.05$) and follow-up appointments (127.3 vs. 94.2/month; $p<0.01$). We observed a minor increase in the percentage of scheduled physician appointments that were completed (60.9 vs. 67.5%; $p=0.13$) and completed follow-up appointments per month (mean 234.9 vs. 250.6/month; $p=0.09$) and a minor decrease in the number of completed new appointments per month (87.8 vs. 85.5/month; $p=0.33$). However, there was an increase in the number of patients who completed a follow-up appointment within a calendar year of their first appointment (32.1 vs. 52.3 %; $p<0.01$) and within a calendar year of a follow-up appointment (24.9 vs. 28.2 %; $p<0.01$).

In contrast, we could not reliably compare neuropsychologist appointment data between the pre-telemedicine and telemedicine periods due to a change in our clinic's workflow model. Pre-telemedicine, all new patients were seen by neuropsychology on the day of their first physician encounter. During the COVID-19 pandemic, most neuropsychological clinical encounters were seen by referral after their first physician clinical visit and were labeled as follow-up encounters preventing any further meaningful comparison between years.

**Patient Demographics and Access**

Demographic and socioeconomic characteristics of the patient population during the pre-telemedicine and telemedicine periods are presented in Table 2. Following the implementation of telemedicine services, there was a small increase in the average age of the patients (mean 70.5 vs. 71.3

y/o; p<0.01). This correlated with a small increase in the percentage of patients using Medicare (mean 67.3 vs. 71.6[%]; p<0.01) and a decrease in the percentage of patients with private (mean 26.4 vs. 22.6%; p<0.01) insurance types.

There was a decrease in the percentage of patients identifying as White/Caucasian (mean 72.5 vs. 66.9 [%]; p<0.01) and Other (mean 9.1 vs. 8.1 [%]; p<0.01), while the number of patients reporting unknown (mean 4.5 vs. 8.8 [%]; <0.01) race increased. This observation correlated with a decrease in the number of patients who ethnically identified as non-Hispanic/Latino (mean 87.9 vs. 80.1 [%]; p<0.01) and an increase in those who did not identify ethnically (mean 4.9 vs. 19.2 [%]; p<0.01). There were no differences in the percentage of patients who identified as Black/African American, Hispanic/Latino, Asian, American Indian, and Pacific Islander following the implementation of telemedicine services. Following the implementation of telemedicine, there was a decrease in the percentage of all scheduled appointments that involved an interpreter (10 vs. 8.1%; p<0.01) without a change in the percentage of these appointments that were completed, canceled, or resulted in no shows.

There were no differences in the estimated household income of patients before and after the implementation of telemedicine services. Following the implementation of VTC services, the percentage of scheduled appointments made by in-state patients who lived in low, midrange, and high disparity neighborhoods did not significantly change. There was an increase in the percentage of patients from midrange and high disparity neighborhoods who were able to attend in-person or VTC follow-up appointments following the implementation of telemedicine (88.5/11.2/0.5 vs. 86.9/12.6/0.7 [%]; p<0.05; Table 3).

Clinic accessibility data, as measured by estimated home-to-clinic travel distance pre-and post-implementation of telemedicine services, is presented in Table 3. Following the implementation of VTC services, the average estimated travel distance of new in-state patients who canceled their appointment decreased (mean 61.8 vs. 50.4 miles; p<0.01; Table 4). The average estimated distance that in-state patients would need to travel for in-person appointments did not change for new appointments (mean 61.1 vs. 58.3 miles; p = 0.18) but increased for follow-up appointments (mean 46.8 vs. 55.2 miles; p<0.001). This corresponded with a decrease in the average estimated travel distance of patients that relied on the telephone for follow-up encounters (mean 61.5 vs. 51.1 miles; p<0.01). There were no changes in cancellations or completed clinical encounters for out-of-state patients.

**Provider Experience**

The demographic characteristics of 30 providers who completed the online survey are summarized in Table 5. Most respondents to the provider experience survey were male (66.7%), neurologists (63.7%), faculty staff (66.7%), and the average age was 36.7 years. The experience of transitioning to telemedicine services was notably different between physicians and neuropsychologists. More physicians (78%) reported prior telemedicine experience than neuropsychologists (43%; Table 6). Physicians reported more satisfaction and interest in the future application of telemedicine than neuropsychologists (Table 6). Physicians reported they found telemedicine "quite acceptable" for new and "extremely acceptable" for follow-up evaluations. In contrast, neuropsychologists reported that the application of telemedicine was moderately acceptable for new assessments and less so for follow-up assessments. Table 7 highlights the perceived benefits and challenges of telemedicine. Both physicians and neuropsychologists agreed that telemedicine improved the accessibility to care for patients and their families while noting concern regarding the capacity of patients to use the technology due to either technological literacy or sensory impairment. Both specialists were concerned about the quality of their respective evaluations; neurologists about their physical examination and neuropsychologists about their limited battery of neurocognitive tests that could be provided through VTC and the lack of validation data through this medium. More specifically, physicians reported having less confidence in the sensory and motoric aspects of their exams, while neuropsychologists had less confidence in their assessment of executive function abilities (See eTable 1 in Supplement). Most physicians and neuropsychologists reported slightly less confidence in their diagnosis. Physicians noted that several clinical syndromes (most

commonly Parkinson's spectrum syndromes and motor neuron disease) were better suited for in-person evaluations.

## Discussion

The COVID-19 pandemic presented new challenges that telemedicine was uniquely situated to solve. Changes that would typically encompass months of planning and pilot testing were compressed into weeks. We demonstrate that the rapid implementation and expansion of telemedicine services at the UCSF Memory and Aging Center outpatient clinic was feasible and acceptable to providers and did not significantly impact the clinic's utility and accessibility metrics.

Following the implementation and transition to telemedicine, our clinic reached and surpassed prior clinic utility metrics. Despite an overall drop in scheduled appointments during the COVID pandemic, canceled appointments declined while the number of completed physician encounters per month increased. Multiple factors drove this increase in clinic accessibility. Implementation of VTC reduced the rate of follow-up appointment cancellations for patients who lived in midrange disparity neighborhoods and those who lived greater than 50 miles from the clinic. Furthermore, the implementation of VTC was associated with a reduction in the number of new patients that canceled their appointments, possibly suggesting that VTC reduced an unmeasured barrier to care. Multiple features of VTC increased the opportunity for patients from mid and high disparity neighborhoods to attend in-person or VTC follow-up appointments and increased the probability of new patients attending a follow-up clinical encounter within one calendar year of their first appointment. Overall, these results favor the use of VTC for ambulatory ADRD evaluations in physician clinical encounters.

The U.S. Healthcare system has adopted telemedicine with remarkable speed for COVID-19–related care and chronic disease management. Given that telemedicine has become the default means of delivery of care during the COVID pandemic, it is imperative that we proactively evaluate and address telemedicine's potential impact on health disparities in our vulnerable ADRD population. The observations mentioned above suggest that the implementation of telemedicine services at our clinic did not significantly impact the diversity of our clinic's population based on ethnic/racial status, estimated household income, age, gender, or ADI. Regarding our clinic’s accessibility to non-English speakers, the available data can only comment on accessibility related to the use, but not the request for, interpreting services. As such, our data provides a limited window into whether language is a barrier to telemedicine services. There was a decrease in the total number of patients scheduled and seen in the clinic with an interpreter compared to the pre-telemedicine era. However, established patients who required an interpreter maintained the same access to our clinic. As our clinic’s capacity to provide in-person/virtual interpreters did not change following the implementation of telemedicine, the decline in new patients who required an interpreter was likely related to an unmeasured accessibility variable before or during the scheduling of new patients. These results suggest that ADRD telemedicine services did not exacerbate health disparities in vulnerable populations. At the same time, these results reinforce the observation that, nationally, patients with preexisting disparities in healthcare, such as language barriers, have experienced increased barriers to care during the COVID pandemic.[31,32] Further analysis is warranted following the lifting of COVID restrictions to confirm the pandemic's influence on patient referrals and scheduling.

Finally, we gained valuable insights by surveying physician and neuropsychologist experiences with telemedicine. First, physicians reported more prior telemedicine experience than neuropsychologists, likely given the lack of a well-established tele-neuropsychology model[33(p19)]. Prior to COVID-19, the American Psychological Association endorsed limited guidelines for remote services that were not readily in use or relevant to the challenges imposed by the pandemic[33–35]. It would not be until July 2020 that the Interorganizational Practice Committee would issue a new set of guidelines for formal tele-neuropsychological evaluation applicable to pandemic limitations[36]. At this point, the UCSF MAC clinic had already changed its clinic model and reestablished pre-telemedicine patient volume. This new model fundamentally disrupted our neuropsychologist’s workflow, which we suspect was a major component of our neuropsychologists' negative experience compared to physicians. Of particular interest, while

physicians reported that telemedicine was more appropriate for follow-up visits than new encounters, neuropsychologists reported the opposite. We suspect the contrast is likely due to nuanced differences in each group's clinical evaluation. Physicians reported considerably less confidence in their physical exam, which is often necessary for diagnosing new patients with dementia syndromes defined by subtle motoric features. Neuropsychologists conversely lacked a reliable battery of tele-neurocognitive tasks with proven equivalence to in-person evaluations. Accordingly, follow-up evaluations that relied on comparison to prior in-person assessments proved more problematic than new evaluations dependent on the new measures. Both groups reported similar key perceived benefits (improved patient access, family participation, and patient convenience) with minor differences related to the nuanced work experiences of the subspecialties. Finally, both groups reported concerns that the quality of their evaluations was diminished through the modality of VTC. Examples include VTC magnifying the impact of a patient's sensory (hearing/visual) deficit or a lack of technology literacy, causing another barrier to effective care. These results are promising and suggest that key stakeholders in ADRD-related care overall found telemedicine services to be a reasonable and acceptable alternative to in-person evaluations with notable caveats. Ongoing use and future deployment of ADRD telemedicine services must address and validate these quality concerns related to diagnosis and deploy nuanced triage protocols to determine an individual patient's suitability for telemedicine evaluations.

**Controversy and Future Directions**

Telemedicine has historically been embroiled in controversies related to the sanctity of face-to-face visits and the metaphysical relationship between patients and physicians. Yet, over 20 years of international experience with ADRD telemedicine programs have demonstrated that telemedicine can be an equivalent and acceptable alternative to providers and patients alike that may be a more practical solution to care in the modern world. Regardless there remain critical limitations that have not yet been addressed. Future research must address our lack of knowledge related to the diagnostic quality and economics of VTC encounters.

Though prior research has investigated the capacity of VTC to diagnose MCI versus unspecified ADRD, to the author's knowledge, no study has addressed the specificity of diagnosis beyond the MCI-Dementia dichotomy nor appraised ADRD VTC clinical outcomes. The survey of providers' telemedicine experience highlighted this concern. Neuropsychologists reported concerns that VTC assessment of executive function abilities was limited by the testing methods available and the uncontrollable environment of the VTC encounter. Physicians' reported concerns focused on the limitations of the physical evaluations, specifically the ability to differentiate Parkinson's spectrum syndromes (DLB, PDD, etc.) and motor neuron disease spectrum (FTD-ALS), further evidenced by their ranking of least appropriate clinical syndromes to be seen via VTC. Given the nature of our retrospective review and the limitations of available data, we cannot reliably comment on whether the implementation of telemedicine services objectively impacted the ability of providers to make certain diagnoses accurately. Future research must address the shortcomings of video-based physical examination and limited reliable measures of executive function through video telemedicine. We suspect that given the current limitations of ADRD telemedicine, new triage and pre-clinical screening protocols will be necessary to determine which patients are clinically appropriate for telehealth evaluations. Neuropsychologists will need to create new digital neurocognitive assessments that can be performed remotely without close supervision and verify their sensitivity and specificity relative to gold standard in-person assessments[33(p19)]. ADRD specializing physicians will need to explore the use and test the validity of new digital surrogates for physical examination components such as eye movement, muscle tone, and cortical sensory deficits[37]. Should we be unable to replace certain aspects of the physical examination reliably, it will be necessary to support the creation of remote VTC clinic sites where an in-person medical staff and facilitate the examination of a remote ADRD specialist. Comparing the effectiveness of remote patient monitoring using technologies like telemedicine with standard in-person care has been listed as one of the top 50 priorities for health care by the National Institute of Medicine in the US[38], highlighting the issue of access to health care as a global one[39]. If ADRD telemedicine is unable to reliably differentiate certain

conditions, the potential benefits of this technology may not be worth the shortcomings of inaccurate neurodegenerative phenotyping.

Determining the socioeconomic savings of ADRD telemedicine is another challenge. Our study only touched the surface of these complex issues and found that reducing travel barriers increased clinic accessibility. From the patient's perspective, the continued availability of appropriate telemedicine services provides the opportunity to access healthcare services while avoiding travel-related costs and decreasing time spent away from work or other obligations. But for providers, the socioeconomic impact is less clear. Telemedicine can be efficiently delivered at a cost lower than in-person services, given the decreased need for physical space and staff support. However, the incremental resources and associated costs of electronic platforms and staff required to help patients remotely have increased the overall cost of telemedicine infrastructure and may negate any potential savings. Future research must address the need to balance the opposing market forces while facilitating collaborative efforts with our partners in public health, insurance providers, and primary care to prevent bottlenecking the referral process for patients already at risk for health disparities. We will need to begin streamlining our referral and care management networks to find and fill gaps in clinical care. Further, we will need to begin standardizing state laws and coding/billing practices that would further facilitate ADRD teleneurology. If such implementation is successful, financial and, care-related performance improvements could be significant.

**Limitations**

There are several key limitations of this study that need to be acknowledged. We did not evaluate the qualitative or clinical outcomes of telemedicine encounters, including patient satisfaction or a cost-benefit analysis. The study is from a single, large academic center, and our findings may not be generalizable to other specialties, practices, or locations. In particular, minority populations who may have lacked VTC technology may have been underrepresented in this study. Furthermore, this study has compared telemedicine implementation data between pandemic and pre-pandemic epochs. Accordingly, unmeasured psychosocial and economic disturbances experienced by our patients during the COVID pandemic may have created significant biases that have affected the observed rate of cancellations and no-shows. ADRD telemedicine, despite 20 years of experience, remains an underdeveloped domain of neurology for which there remain many questions of accuracy, equity, and practicality. Regardless, this study provides valuable insights into the experience of a memory clinic transition to ADRD telemedicine services in response to COVID-19 and is the first study to describe how this transition impacted clinic utility metrics, patient populations, and provider experiences relative to clinic performance before the COVID-19 pandemic.

**Conclusions**

In the UCSF Memory and Aging Center, we have demonstrated that the integration of telemedicine into dementia care is a feasible and acceptable alternative to in-person care leading to an increase in follow-up encounters and a decrease in cancelations without negatively impacting clinic demographics. The COVID-19 pandemic has forced us to radically rethink and change our memory care delivery models. We anticipate that evidence will demonstrate that virtual visits are valuable in certain clinical contexts and, in time, will be integrated alongside in-person evaluations into a new model of care. How our profession adapts to this technology in the coming years will determine whether we shape its deployment to meet our needs or adjust our practice to meet its demand.

**Table 1.** Clinic Utilization Between January 2017 to January 2020 (Pre-telemedicine) and May 2020 to 2021 (Telemedicine)

| | 2017-2018 (N = 8808) | 2018-2019 (N = 8517) | 2019-2020 (N = 8958) | Pre-Telemedicine 2017-2020 (N=26283) | Telemedicine 2020-2021 (N=7717) | p-value |
|---|---|---|---|---|---|---|
| Out-of-State no.(%) | 410 (4.7) | 346 (4.1) | 339 (3.8) | 1094 (4.2) | 359 (4.7) | 0.38 |
| No Show Appts no.(%) | 670 (7.6) | 542 (6.4) | 563 (6.3) | 1775 (6.8) | 550 (7.1) | 0.19 |
| Canceled Appts no.(%) | 2854 (32.4) | 2701 (31.7) | 3097 (34.6) | 8652 (32.9) | 2155 (27.9) | **<0.01** |
| Completed Appts no.(%) | 5266 (59.8) | 5261 (61.8) | 5283 (58.9) | 15810 (60.2) | 5000 (64.8) | **<0.01** |
| In-Person no.(%) | 4696 (89.2) | 4525 (86.0) | 4511 (85.4) | 13732 (86.9) | 209 (4.2) | **<0.01** |
| Telemedicine no.(%) | 570 (10.8) | 736 (13.9) | 772 (14.6) | 2078 (13.1) | 4791 (95.8) | **<0.01** |
| VTC no.(%) | 87 (1.7) | 65 (1.2) | 155 (2.9) | 307 (1.9) | 4321 (86.4) | **<0.01** |

VTC (Video Teleconferencing), Telemedicine (VTC and Scheduled Telephone Encounters)

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**Table 2.** Clinic Patient Characteristics Between January 2017 to January 2020 (Pre-Telemedicine) and May 2020 to 2021 (Telemedicine)

| Characteristic | Pre-Telemedicine (N=15810) | Telemedicine (N=5000) | p-value |
|---|---|---|---|
| Age - yr. | 70.5±12.5 | 71.3±11.9 | **<0.01** |
| Sex no. (%) | | | 0.16 |
| Male | 7572 (47.9) | 2378 (47.6) | |
| Female | 8235 (52.1) | 2620 (52.4) | |
| Insurance - no. (%) | | | |
| Commercial | 4174 (26.4) | 1132 (22.6) | **<0.01** |
| Medicare | 10645 (67.3) | 3578 (71.6) | **<0.01** |
| Medicaid | 795 (5.0) | 242 (4.8) | 0.59 |
| Other, such as workers' compensation | 44 (0.3) | 10 (0.2) | 0.34 |
| Unknown, Uninsured or Self-Pay | 152 (1.0) | 38 (0.8) | 0.19 |
| Est. Household Median Income -$ | 80209±28394 | 801120±28133 | 0.85 |
| Race - no. (%) ‡ | | | |
| White | 11466 (72.5) | 3343 (66.9) | **<0.01** |
| Black or African American | 624 (3.9) | 213 (4.3) | 0.35 |
| Asian | 1837 (11.6) | 546 (10.9) | 0.23 |
| American Indian or Alaska Native | 74 (0.5) | 34 (0.7) | 0.07 |
| Native Hawaiian or Other Pacific Islander | 108 (0.7) | 33 (0.7) | 0.06 |
| Other | 1441 (9.1) | 404 (8.1) | **<0.05** |
| Unknown | 620 (3.9) | 430 (8.6) | **<0.01** |
| Ethnicity - no. (%) | | | |
| Hispanic/Latino | 1142 (7.2) | 322 (6.4) | 0.06 |
| Not His/Lat | 13891 (87.9) | 4038 (80.1) | **<0.01** |
| Unknown/Declined | 777 (4.9) | 640 (19.2) | **<0.01** |
| Interpreter Services Required | 2704 (10.3) | 623 (8.1) | **<0.01** |

‡ May add to greater than 100% as some individuals report multiple races

**Table 3** State ADI of In-State Patients Compared between January 2017 to January 2020 (Pre-Telemedicine) and May 2020 to 2021 (Telemedicine)

| | Type of Appointment | Pre-Telemedicine | | | Telemedicine | | | p-value |
|---|---|---|---|---|---|---|---|---|
| | | Low N = 21209 | Mid N = 3205 | High N = 149 | Low N = 5781 | Mid N = 826 | High N = 51 | |
| State-ADI | **Canceled - no. (%)** | | | | | | | |
| | All | 6917 (85.5) | 1124 (13.9) | 53 (0.7) | 1622 (87.4) | 220 (11.9) | 14 (0.8) | 0.06 |
| | Follow Up | 4092 (86.5) | 609 (12.9) | 34 (0.8) | 1087 (87.7) | 143 (11.6) | 10 (0.9) | 0.44 |
| | New | 2703 (84.3) | 488 (15.3) | 18 (0.6) | 520 (87.6) | 70 (11.8) | 4 (0.7) | 0.09 |
| | **Completed - no. (%)** | | | | | | | |
| | All | 12805 (86.9) | 1855 (12.6) | 91 (0.7) | 3760 (86.5) | 562 (13) | 27 (0.7) | 0.83 |
| | Follow Up (In-Person, VTC, Telephone) | 7623 (87.9) | 1010 (11.7) | 42 (0.5) | 2950 (86.7) | 433 (12.8) | 22 (0.7) | 0.14 |
| | Follow Up (In-Person, VTC) | 6213 (88.5) | 782 (11.2) | 29 (0.5) | 2568 (86.9) | 370 (12.6) | 20 (0.7) | **0.03** |
| | Follow Up (Telephone) | 1410 (85.5) | 228 (13.9) | 13 (0.8) | 382 (85.5) | 63 (14.1) | 2 (0.5) | 0.81 |
| | New | 4907 (85.3) | 802 (14) | 46 (0.8) | 729 (86.8) | 107 (12.8) | 4 (0.5) | 0.37 |

ADI = Area Deprivation Index; Low = Low Disparity Communities indicated by State ADI 1-24, Mid = Midrange Disparity Communities indicated by State ADI 25-75, High = High Disparity Communities indicated by State ADI 76-100; VTC = Video Teleconferencing

**Table 4.** Estimated Home-to-Clinic Driving Distance by Patients Compared between January 2017 to January 2020 (Pre-Telemedicine) and May 2020 to 2021 (Telemedicine)

| | Type of Appointment | Pre-Telemedicine N=25466 | Telemedicine N=6746 | p-value |
|---|---|---|---|---|
| In-State | **Canceled -** no. (mean distance in miles) | | | |
| | All | 7686 (56.8) | 2129 (54.8) | 0.136 |
| | Follow Up | 4209 (54.2) | 1182 (55) | 0.369 |
| | New | 1418 (61.8) | 362 (50.4) | **0.004** |
| | **Completed -** no. (mean distance in miles) | | | |
| | All | 14208 (54.3) | 4509 (55.6) | 0.145 |
| | Follow Up (In-Person, VTC, Telephone) | 7932 (49.8) | 3454 (54.7) | **0.001** |
| | Follow Up (In-Person, VTC) | 5620 (46.8) | 3032 (55.2) | **0.000** |
| | Follow Up (Telephone) | 1628 (61.5) | 422 (51.1) | **0.005** |
| | New | 2801 (61.1) | 934 (58.3) | 0.182 |
| | **Type of Appointment** | **Pre-Telemedicine N=922** | **Telemedicine N=312** | **p-value** |
| Out-of-State | **Canceled -** no. (mean distance in miles) | | | |
| | All | 293 (1084.2) | 105 (1045.1) | 0.713 |
| | Follow Up | 236 (1074.1) | 73 (1060.6) | 0.915 |
| | New | 52 (1160.4) | 32 (1009.5) | 0.476 |
| | **Completed -** no. (mean distance in miles) | | | |
| | All | 588 (1081.5) | 191 (1048.0) | 0.667 |
| | Follow Up (In-Person, VTC, Telephone) | 279 (971.6) | 131 (941.6) | 0.742 |
| | Follow Up (In-Person, VTC) | 221 (1045.8) | 124 (938.7) | 0.274 |
| | Follow Up (Telephone) | 58 (689.0) | 7 (993.6) | 0.305 |
| | New | 299 (1190.8) | 58 (1317.1) | 0.378 |

VTC = Video Teleconferencing

**Table 5.** Demographic Characteristics of Survey Respondents

| **Characteristic** | **N (%)** |
|---|---|
| Completed Surveys | 30 |
| Faculty | 20 (66.7%) |
| Fellows | 10 (33.3%) |
| Gender | |
| Female | 10 (33.3%) |
| Male | 20 (66.7%) |
| Specialty | |
| Neurology | 21 (63.7%) |
| Geriatrics | 2 (6.1%) |
| Neuropsychology | 7 (21.3%) |
| Age | |
| <34 | 10 (30.4%) |
| 35-44 | 11 (33.4%) |
| 45-54 | 7 (21.3%) |
| 55-64 | 2 (6.1%) |

| Table 6. Telemedicine Experience/Impression Survey Questions | | |
|---|---|---|
| | **Neurologists/Geriatricians N=23** | **Neuropsychologists N=7** |
| **Did you have Clinical Experience using telemedicine before COVID-19?** | | |
| Yes | 18 (78%) | 3 (43%) |
| **How satisfied are you with providing clinical services via telemedicine** | | |
| More satisfied | 16 (70%) | 2 (29%) |
| About the Same | 2 (9%) | 0 (0%) |
| Less satisfied | 5 (22%) | 5 (71%) |
| **How interested are you in continuing to use telemedicine as part of usual practice post-COVID?** | | |
| Extremely Interested | 15 (65%) | 0 (0%) |
| Quite Interested | 5 (22%) | 2 (29%) |
| Moderately Interested | 2 (9%) | 2 (29%) |
| Slightly Interested | 0 (0%) | 3 (43%) |
| Not at all | 1 (4%) | 0 (0%) |
| **How acceptable do you think new patient evaluations via telemedicine are as an alternative to in-person visits?** | | |
| Extremely Acceptable | 3 (13%) | 1 (14%) |
| Quite Acceptable | 7 (30%) | 1 (14%) |
| Moderately Acceptable | 6 (26%) | 3 (43%) |
| Slightly Acceptable | 4 (17%) | 2 (29%) |
| Not at all | 3 (13%) | 0 (0%) |
| **How acceptable do you think follow-up patient evaluations via telemedicine are as an alternative to in-person visits?** | | |
| Extremely Acceptable | 12 (52%) | 0 (0%) |
| Quite Acceptable | 8 (35%) | 2 (29%) |
| Moderately Acceptable | 3 (13%) | 2 (29%) |
| Slightly Acceptable | 0 (0%) | 2 (29%) |
| Not at all | 0 (0%) | 1 (14%) |
| **How confident do you feel in diagnosing new patients via telemedicine?** | | |
| More confident | 0 (0%) | 0 (0%) |
| About the Same | 8 (35%) | 2 (29%) |
| Less Confident | 15 (65%) | 5 (71%) |

| Table 7. Top 5 Survey Questions | | | | |
|---|---|---|---|---|
| | **Neurologists/Geriatricians N=23** | | **Neuropsychologists N=7** | |
| | **Top Five Benefits** | | | |
| 1 | Increased Access | 23 (100%) | Increased Access | 5 (71%) |
| 2 | Continuity of Care | 22 (96%) | Family Participation | 5 (71%) |
| 3 | Patient Convenience | 22 (96%) | Patient Convenience | 5 (71%) |
| 4 | Family Participation | 21 (91%) | Personal Convenience | 4 (57%) |
| 5 | Ability to Assess Living Environment | 18 (74%) | No Rooming Issues | 4 (43%) |
| | **Top Five Challenges** | | | |
| 1 | Reliable Exam | 18 (74%) | Limited range of measures | 7 (100%) |
| 2 | Technology Familiarity | 18 (74%) | Limited Validation Data | 5 (71%) |
| 3 | Sensory Impairment | 14 (57%) | Sensory Impairment | 5 (71%) |
| 4 | Interpreters | 12 (49%) | Greater Disparities | 5 (71%) |
| 5 | Technology Disruptions | 10 (43%) | Technology Familiarity | 4 (57%) |
| | **Top Five Diagnosis that should be done in-person (Physicians Only)** | | | |
| 1 | Progressive Supranuclear Palsy | 26 (85%) | | |
| 2 | Motor Neuron Disease | 24 (80%) | | |
| 3 | Corticobasal Syndrome | 23 (75%) | | |
| 4 | Diffuse Lewy Body Dementia/Parkinson's Disease Dementia | 23 (75%) | | |
| 5 | Rapidly Progressive Dementia | 15 (50%) | | |

CPJ-2022-200098_sup-http://links.lww.com/CPJ/A383

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Neurology® Clinical Practice

# Feasibility and Acceptability of a Multidisciplinary Academic Telemedicine System for Memory Care in Response to COVID-19

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*Neurol Clin Pract* published online October 18, 2022
DOI 10.1212/CPJ.0000000000200099