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RESEARCH ARTICLE

Telemedicine as a path to bridging inequities in patients with epilepsy

Ruta Yardi[1] | **Christopher J. McLouth**[2] | **Sally Mathias**[1] | **Lara Jehi**[3]

[1]Kentucky Neurological Institute, University of Kentucky, Lexington, Kentucky, USA

[2]Department of Biostatistics, University of Kentucky, Lexington, Kentucky, USA

[3]Cleveland Clinic, Cleveland, Ohio, USA

Correspondence
Ruta Yardi, Kentucky Neurological Institute, University of Kentucky, Lexington, KY, USA.
Email: yardi.ruta@gmail.com

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Abstract

Objective: Access to epilepsy specialist care is not uniform in the USA, with prominent gaps in rural areas. Understanding the reasons for nonattendance at epilepsy appointments may help identify access hurdles faced by patients. This study was undertaken to better understand clinic absenteeism in epilepsy and how it may be influenced by telemedicine.

Methods: In this retrospective study, social determinants of health were collected for all adult patients scheduled in epilepsy clinic, as either an in-person or telemedicine appointment, at University of Kentucky between July 2021 and December 2022. The primary outcome measure was attendance or absence at the appointment. Subgroup analyses were done to better understand the drivers of attendance at telemedicine visits and evaluate telemedicine utilization by underserved populations.

Results: A total of 3025 patient encounters of in-person and telemedicine visits were included. The no-show rate was significantly higher for in-person visits (32%) compared with telemedicine visits (20%, $p < .001$). A nominal logistic regression model identified seven factors increasing risk of absenteeism, including in-person visits, prior missed appointments, longer lead times to appointment, Medicaid/Medicare as payors, no significant other, lower mean annual income, and minority race. For each $10 000 increase in mean annual income, the odds of missing the appointment decreased by 8% (odds ratio = .92, 95% confidence interval = .89–.96, $p < .001$). Forty-one percent of underserved population opted for telemedicine visits, and they had a lower no-show rate (22%) as compared with in-person visits (33%, $p < .001$). Predictors of no-shows to televisits (1382) included Medicare/Medicaid coverage (as opposed to private insurance), no significant others, and a history of missing appointments.

Significance: Telemedicine is effective at improving attendance, overcoming socioeconomic hurdles, and widening access to epilepsy care, particularly among underserved populations. Access to telecare depends on insurance coverage and emphasizes the need to include telemedicine in insurance plans to ensure uniform access to high-quality epilepsy care, irrespective of socioeconomic status.

KEYWORDS

epilepsy care, health inequities, health policy, no-show, telemedicine

1 | INTRODUCTION

Epilepsy affects 3.4 million people in the USA. Specialist care is essential for timely diagnosis, effective therapy, and ultimately for reducing premature mortality.[1] Yet, access to epilepsy specialists is lacking in rural regions[2] and among lower socioeconomic and some ethnic groups.[3] Cognitive impairments and driving restrictions unique to persons with epilepsy (PWE) further compound this access inequity.

The COVID-19 public health emergency (PHE) triggered legislative changes that enabled widespread adoption of telemedicine. Although the benefits of telemedicine in bridging the access gap have become apparent,[4] our understanding of its full potential lags. With the PHE at an end, important health care policy decisions are looming. The Telehealth Benefits Expansion for Workers Act proposes employers offer standalone telehealth benefits to workers, similar to dental and vision plans, supplementing traditional health care plans.[5] Meanwhile, the Department of Health and Human Services is maintaining telemedicine support exclusively for mental health services.[6] The future of telemedicine in epilepsy and other chronic disease care is uncertain.

"No-show" refers to when a scheduled patient fails to honor their appointment. In ambulatory neurology clinic, the no-show rate can range between 5% and 34%.[7] These missed appointments cause delays in diagnosis, longer wait times, wasted resources, reduced provider efficiency, and financial losses. By extension, a patient's inability to attend their specialist appointment emphasizes the challenges they may face in accessing essential care. A study of the factors influencing nonattendance, with particular attention to the nature of the appointments (telehealth vs. standard), provides an opportunity to identify and address the health care gap.

In this study, we aimed to identify the factors contributing to clinic absenteeism in epilepsy and how they were influenced by telemedicine, to evaluate telehealth's impact on epilepsy care and inform future public health strategies.

Key Points

- In this study, we investigate factors for absenteeism at epilepsy clinic and the impact of televisits on them, to better understand barriers to health care delivery
- We show that telemedicine significantly decreases the likelihood of missing appointments by 45%, making it easier for people to access care
- Lower annual income, belonging to a minority race, lacking a caregiver, and relying on Medicaid/Medicare as payors were other significant drivers of no-shows
- In a subgroup analysis that focused on underprivileged groups, 41% opted for telemedicine visits and it reduced the odds of not showing by 52%

2 | MATERIALS AND METHODS

2.1 | Patient selection

With approval from our institutional review board, data were retrospectively gathered from records of Epilepsy clinics at the University of Kentucky (UK). We included all the scheduled visits of adult epilepsy patients seen at the Kentucky Neurological Institute of UK between July 1, 2021 and December 31, 2022. During this time, options of either telemedicine or an in-person visit were equally available for patients who could choose freely. We included new patients and follow-up encounters. Patients at this clinic were referred from primary care/family medicine practitioners internal and external to the university, as well as community neurologists and cross subspecialty referrals from within the university. Per our standard clinic protocol, all patients receive a mail appointment reminder once an appointment has been made, followed by a text/phone call reminder 3 days prior to the appointment and a MyChart automated email from the electronic medical record system.

2.2 | Data collection and outcome variables

Clinical as well as patient characteristics including age, sex, race, marital status, ZIP code of residence, insurance information, diagnosis, and type of visit were collected. Several categorical groups were defined for the purpose of analysis including sex, race, marital status, insurance status, and month of appointment. Numeric variables collected included patient's age, lead time to the appointment (from date the appointment was scheduled to appointment date), distance traveled from

residence to hospital, and mean annual income calculated from the ZIP code of residence (using publicly available information from the US Census bureau's mean income in 2021 inflation-adjusted dollar amounts).

The primary outcome measure was show or no-show to the scheduled clinic visit. Secondary subgroup analyses were done to identify and understand the trends of no-shows specifically in the minority and underprivileged population and to define drivers of attendance at telemedicine visits.

2.3 | Statistical methods

Categorical variables were described using percentages and frequencies, whereas continuous variables were described using means and SDs (for normally distributed data) or medians and interquartile range (IQR; for non-normal data). To evaluate the association between variables and no-shows to appointments, Pearson chi-squared tests were employed for categorical data, whereas Student *t*-test was utilized for continuous variables. Furthermore, a nominal logistic regression model was used to analyze the relationship between social and demographic patient variables and clinic absenteeism.

PWE encounter extra obstacles in attending medical appointments, particularly if they lack a caregiver, have low socioeconomic status, or belong to minority races. For our research, we focused on patients meeting one or more of these criteria and conducted a subgroup analysis to assess the utilization and effects of telemedicine on this specific group. To compare attendance rates between telemedicine and in-person appointments, we employed Pearson test. A subgroup analysis was performed specifically on telemedicine visits to investigate the factors that influence attendance at these appointments. Independent variables from the logistic regression analysis were included as predictors of attending their scheduled visit. A generalized linear mixed model (GLMM) with a logit link was used to account for multiple observations on some individuals. Parameters were estimated and reported as odds ratios and corresponding 95% confidence intervals. A p-value $< .05$ was used for statistical significance.

All statistics were conducted using JMP version 17.0.0 and SAS version 9.4 (SAS Institute Inc., 1989–2021).

3 | RESULTS

3.1 | Patient characteristics

Data were collected for a total of 3029 individual clinic visits from 1640 unique patients; 3025 visits fulfilled study criteria after three records were excluded due to incomplete or erroneous entries. Patients had a median age of 37 years (IQR = 26.0–56.0). Fifty-seven percent were female, 86% were Caucasian/White, whereas 14% belonged to other minority groups. Sixty-seven percent were either divorced, separated, widowed, or single, whereas 33% were married or reported a significant other. Mean annual income based on ZIP codes of residence was estimated to be 71,644 US dollars (SD = 22,134 dollars). Sixty-five percent of the patients were insured through Medicare or Medicaid, and 35% carried private insurance.

Of the total visits, 54% were in-person appointments, whereas 46% were telehealth.

3.2 | Overall predictors of epilepsy clinic nonattendance: Univariate analysis

The overall no-show rate was 27%. A complete description of patient and visit attributes in the show and no-show groups is detailed in Table 1.

Patients scheduled for a telehealth visit were more likely to keep their appointments compared with in-person visits ($p < .01$). Patients belonging to a lower mean annual income category ($p < .01$), with Medicare or Medicaid as payors ($p < .01$), those who were divorced, single, or separated, those who had previously missed appointments, those belonging to a minority race, and patients with longer appointment lead times had a significantly greater probability to no-show ($p < .001$).

In this cohort, no relationship seemed to exist between season at the time of appointment or distance traveled and clinic attendance.

3.3 | Overall predictors of epilepsy clinic nonattendance: Regression model

For the multivariable model, a nominal logistic regression model was used to analyze the relationship between social and demographic patient variables consistently identified in the literature and clinic absenteeism.[7] Mode of appointment (televisit or in-person), found to be significant in the univariable analysis, was also included.

After a nominal logistic regression analysis, seven variables retained significance in the final model (Figure 1). Holding all other predictor variables constant, the odds of missing the appointment decreased by 45% for telemedicine visits compared with in-person visits (odds ratio [OR] = .59, 95% confidence Interval [CI] = .49–.71, $p < .001$). The odds of missing

TABLE 1 Predictors of epilepsy clinic nonattendance.

Variable	*n*	Statistics	Shows, *n* = 2221	No-shows, *n* = 804	*p*
Sex	3025				.51
Female		1730	1278 (73.9)	452 (26.1)	
Male		1295	943 (72.8)	352 (27.1)	
Race	3025				**<.0001**
Caucasian		2609	1952 (74.8)	657 (25.1)	
Minority		416	269 (64.6)	147 (35.3)	
Telehealth mode	3025				**<.0001**
In person		1643	1114 (67.8)	529 (32.2)	
Video		1382	1107 (80.1)	275 (19.9)	
Insurance payor	3025				**<.0001**
Medicare/Medicaid		1957	1371 (69.9)	590 (30.1)	
Private		1068	850 (79.9)	214 (20.1)	
Marital status	3025				**<.0001**
Divorced/separated/single		2018	1422 (70.4)	596 (29.5)	
Married/significant other		1007	799 (79.3)	208 (20.6)	
Previous no-show	3025				
No		2630	1981 (75.3)	649 (24.6)	**<.0001**
Yes		395	240 (60.7)	155 (39.2)	
Season of appointment	3025				.06
Spring		524	257 (79.0)	68 (20.9)	
Summer		825	610 (73.9)	215 (26.0)	
Fall		1100	800 (72.7)	300 (27.2)	
Winter		576	554 (71.4)	221 (28.52)	

Continuous variables		Shows, median [IQR]	No-shows, median [IQR]	*p*
Age, years	3025	37 [26–53]	37 [26–51]	.39
Lead time to appointment, days	3025	62.5 [13.3–111.3]	84.3 [34.4–113.1]	**<.0001**
Distance traveled to appointment, miles	3025	43.2 [10.2–108.8]	43.2 [9.6–107.3]	.35
Mean annual income, US dollars	3025	86 658 [57 663–108 116]	64 810 [56 075–78 568]	**<.0003**

Note: Boldface indicates statistical significance.

Abbreviation: IQR, interquartile range.

the current appointment were 1.90 times higher for individuals who had previously missed appointments (OR = 1.90, 95% CI = 1.58–2.51, $p < .0001$). The odds of a Medicaid or Medicare patient missing an appointment were 40% higher than for those with private insurance (OR = 1.40, 95% CI = 1.14–1.79, $p < .0001$). For each $10 000 increase in mean annual income, the odds of missing the appointment decreased by 8% (OR = .92, 95% CI = .89–.96, $p < .001$), whereas a lead time increase of 30 days was associated with 1.08 times higher odds of no-show to the appointment (OR = 1.08, 95% CI = 1.03–1.13, $p < .001$). Finally, not having a significant other was associated with 1.38 times higher odds of not showing to the appointment (OR = 1.38, 95% CI = 1.10–1.73, $p < .001$) and minority races had 40% higher odds of not showing to the appointment compared with Caucasians (OR = 1.44, 95% CI = 1.15–1.82, $p < .001$).

3.4 | Subgroup analysis of underserved population

To understand the utilization and effect of telemedicine on underserved groups and epilepsy-specific vulnerabilities, we included patients who had Medicaid or Medicare as payors, had no significant others, and belonged to a minority race. A total of 2593 encounters met inclusion criteria, of which 1145 (44.1%) opted for telemedicine visits. Again, a significantly lower no-show rate (22%) was seen with a video visit as compared with 33% for in-person visits (OR = 1.9, 95% CI = 1.61–2.26, $p < .001$; Figure 2).

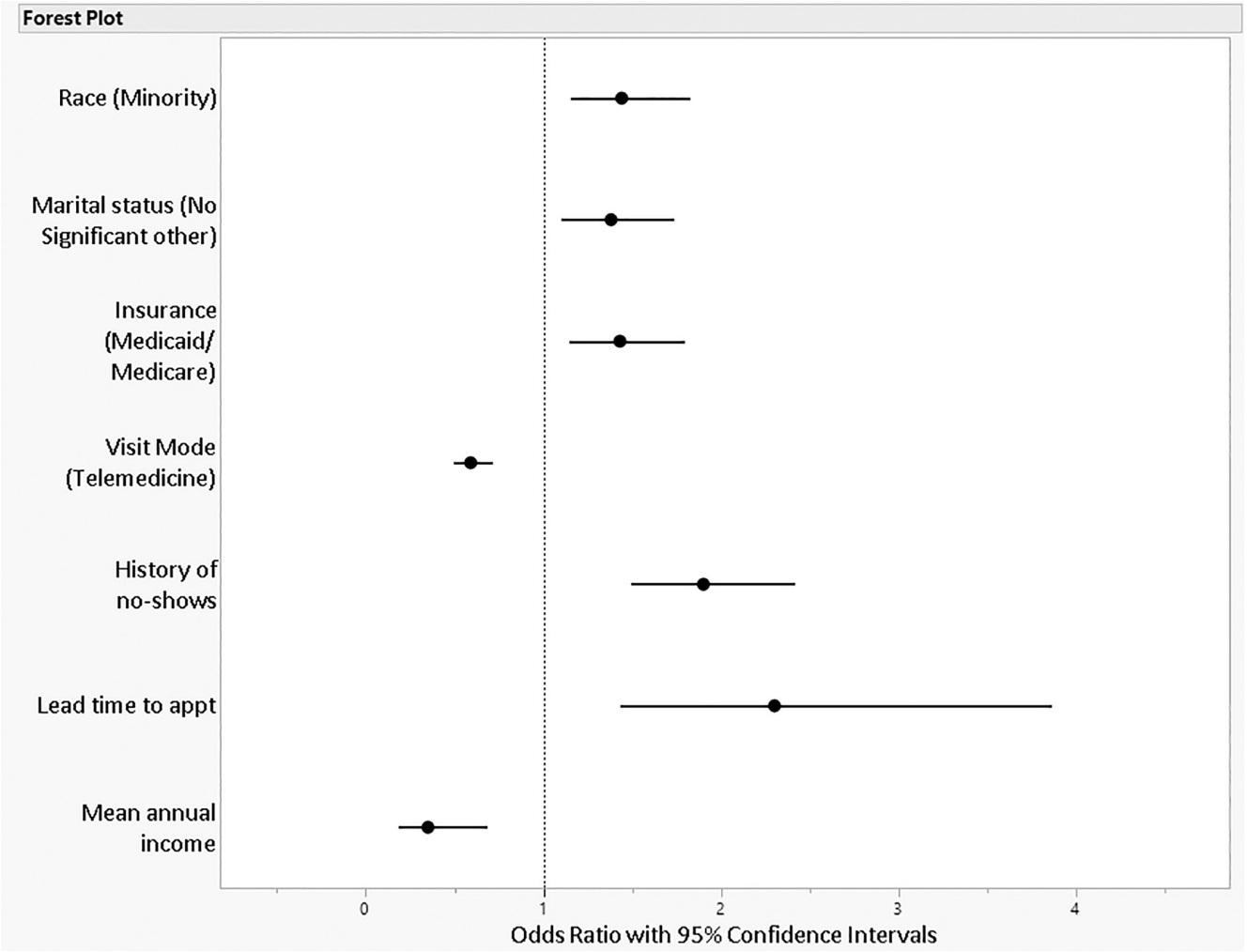

FIGURE 1 Forest plot showing nominal regression model of no-shows to appointments.

3.5 | Subgroup analysis for attendance to telehealth visits

The telemedicine visits were separated for a subgroup analysis to understand factors that determine attendance at these appointments. A total of 1382 encounters were televisits. An overall no-show rate of 20% was observed in this cohort. Following a univariable analysis, several characteristics were found to significantly influence the likelihood of keeping a telemedicine visit. Specifically, the results revealed that the following factors were significant determinants:

1. Previous missed appointment: Individuals who had previously missed an appointment were less likely to keep a telemedicine visit compared to those who had not missed any appointments.
2. Insurance type: Patients with Medicaid or Medicare insurance were less likely to show up for their telemedicine visit compared to patients with private insurance.

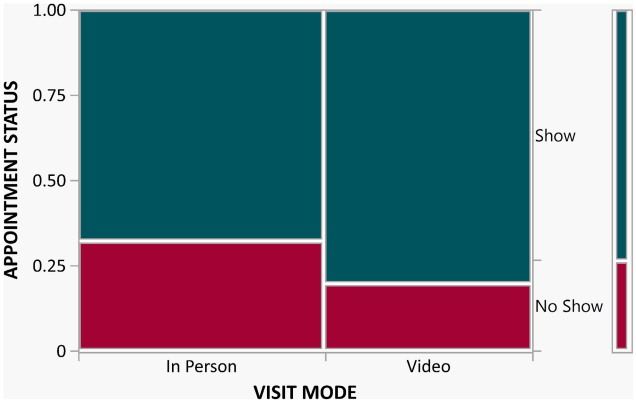

FIGURE 2 Subgroup analysis of no-shows with visit type in underprivileged and vulnerable population.

3. Relationship status: Patients who were not in a relationship were more likely to miss their telemedicine appointment compared to those who reported a significant other.

4. Mean annual income: Individuals with a lower mean annual income were significantly more likely to miss their telemedicine appointment compared to individuals with higher incomes.

3.6 | Prediction model

A GLMM was used to predict appointment status using the four independent variables identified above. Individuals with private insurance were more likely to show up for their appointment than individuals with Medicaid/Medicare (OR = 1.58, 95% CI = 1.14–2.19, $p = .006$). Individuals who were married or who had a significant other were more likely to show up for their appointment (OR = 1.71, 95% CI = 1.23–2.37, $p = .002$). Individuals who did not have a history of no-showing for appointments were more likely to show up (OR = 2.08, 95% CI = 1.42–3.30, $p < .001$). Higher mean annual incomes were associated with a greater likelihood of showing up for an appointment ($10 000 increase: OR = 1.07, 95% CI = .99–1.15, $p = .063$), although this was not statistically significant.

4 | DISCUSSION

Inequity in epilepsy is a growing concern, with social determinants of health acting as a significant barrier to specialized care.[8,9] The problem is further amplified by geographic hurdles, resulting in unequal access to services.[2] A perfect world calls for uniform distribution of specialized centers in the country, but a realistic expectation would be to provide uniform delivery of care. Telemedicine offers a potential solution by transcending geographic limitations. However, it remains unclear whether this technology can effectively address the socioeconomic challenges faced by this unique patient population. Our study used clinic nonattendance as a proxy to identify the barriers in epilepsy care and examined the impact of telemedicine on them. Using a large cohort of >3000 scheduled epilepsy clinic visits, we found that use of telemedicine had a strong influence on decreasing nonattendance, reducing the odds of absenteeism by 45%.

Consistent with existing literature, our findings corroborate that low annual income, reliance on Medicare or Medicaid payors, and belonging to minority races are drivers of nonattendance. Low annual income and use of federal assistance programs often go hand in hand, as individuals with low income are eligible for government medical insurance. These individuals may face challenges in keeping visits such as limited financial resources to own a motor vehicle, difficulties in affording transportation costs, and potential difficulties in taking unpaid leave from work.[10] Although the prevalence of epilepsy is higher in non-White individuals, studies consistently demonstrate that minority racial groups underutilize specialized care. This observation was replicated in our results. Several factors have been proposed to explain this phenomenon, including socioeconomic status, lack of social support, patient education, behavior, and language barriers among non-English-speaking populations.[9] Finally, our study also revealed the absence of a significant other impacted the ability to attend clinic visits. This could be attributed to poor cognitive and memory status in PWE making it difficult to remember scheduled appointments, while driving restrictions make them dependent on caregivers. These reasons make epilepsy patients without a social support system particularly disadvantaged.

In a subgroup analysis, we discovered that most of our study cohort (85% of the visits) was disadvantaged or had epilepsy-specific vulnerabilities (depended on federal insurance or were racially underrepresented or had no significant other). Nearly half (44%) of these visits were conducted through telemedicine and exhibited a significantly lower no-show rate of 22% percent as compared with 33% for in-person visits. The utilization of telemedicine in racial minority populations has been a topic of concern in the existing literature.[11,12] However, contrary to popular belief, our findings demonstrate that disposal of specialist care improved among racial minorities and underprivileged individuals with telemedicine. The possible explanations for minimization of the digital divide are (1) postpandemic changes in the trend of telehealth usage: the pandemic has catalyzed the utilization of technology since various aspects of life including remote work, education, and shopping for groceries or household goods became almost entirely digitized; (2) specific to Kentucky, 42% of the population resides in rural areas and 49 of 120 counties are in the remote Appalachian region, which makes easy to access telecare a lucrative option[13]; and (3) finally, data from the Pew research organization on use of smartphones for online access shows greater usage among Hispanic (25%) and African American(17%) groups when compared with Caucasian Americans (12%).[14] These results present exciting opportunities in implementing this technology to deliver equitable care in epilepsy.

To examine the factors influencing attendance at telemedicine visits, a subgroup analysis was conducted, involving 1382 virtual visit encounters. The analysis revealed that insurance type, the absence of a significant other, and prior history of no-shows were the only predictors that remained significant. This further reinforces

the notion that access to telemedicine visits may not be a limiting factor in racial or socioeconomic minorities. Additionally, our results also emphasize that the ability to utilize telecare is strongly contingent on the insurance coverage available to the patient. During the COVID-19 PHE, policy restrictions were temporarily relaxed and both private and federal payers were encouraged to provide reimbursement for telehealth services. Moreover, Centers for Medicare and Medicaid Services permitted providers to practice telehealth across state lines,[6,15,16] allowing improved access to care in rural areas and states without specialized epilepsy centers.[2] However, the potential end of the PHE threatens a reversal of these policies. The findings from our study stress the need for continuing legislative and financial support for telemedicine, particularly for chronic neurologic conditions like epilepsy. Furthermore, our results advocate for the inclusion of telemedicine benefits in Medicare, Medicaid, and private insurance plans.

5 | LIMITATIONS

This is a single center study, which may result in selection bias. Data acquisition by mining electronic medical records comes with inherent disadvantages of nonuniform data entry, which prevented us from capturing variables like visit diagnosis and new versus established visit types. The artificial atmosphere of fear and uncertainty surrounding in-person interactions during the COVID-19 pandemic might have generated unique perspectives on such interactions, varying across subgroups. The demographics of individuals utilizing telemedicine could potentially evolve as we move farther from the pandemic, making it crucial to determine the optimal candidates for this technology.

6 | FUTURE DIRECTIONS

Ongoing monitoring of patient engagement with digital health tools, including telehealth, will be essential as the landscape of health care delivery continues to evolve.

7 | CONCLUSIONS

This study highlights that telemedicine is effective at improving attendance, overcoming racial and socioeconomic hurdles, and widening access to epilepsy care. It stresses the need to incorporate telemedicine in epilepsy as a complementary approach to minimize health inequity.

The current legislative climate poses a threat to dissolution of support for telemedicine services with the end of the PHE. In this pressing time, it is crucial to carefully consider individuals at risk of health inequity and advocate for the uniform dissemination of specialist care using technology to bridge the health care gap.

AUTHOR CONTRIBUTIONS

Ruta Yardi: Study design; data collection; analysis; writing manuscript. **Christopher J. McLouth:** Data analysis; writing portions of manuscript. **Sally Mathias:** Writing portions of manuscript. **Lara Jehi:** Formulating research idea; analysis; writing portions of manuscript.

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CONFLICT OF INTEREST STATEMENT

None of the authors has any conflict of interest to disclose. We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

ORCID

Ruta Yardi https://orcid.org/0000-0001-7914-9585
Christopher J. McLouth https://orcid.org/0000-0002-5434-9748
Sally Mathias https://orcid.org/0009-0003-2928-8036
Lara Jehi https://orcid.org/0000-0002-8041-6377

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