ORIGINAL RESEARCH

Impact and Recovery of VHA Epilepsy Care Services During the COVID-19 Pandemic

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Background: The Epilepsy Centers of Excellence (ECoE) is a network of facilities within the Veterans Health Administration that evaluates and treats veterans with epilepsy and seizure disorders. This article outlines how the COVID-19 pandemic impacted ECoE services and recovery.

Methods: Directors of 17 ECoEs were surveyed 4 times between May 2020 and July 2022 on 5 domains: functioning of outpatient epilepsy clinics, outpatient electroencephalogram, epilepsy monitoring unit, anticipated permanent operational changes, and utility of national and local recommendations. Data on the spread of COVID-19 and administrative workload data were compared with the availability of epilepsy services.

Results: There was an increase in in-person outpatient visits from May 2020 (1 of 13 sites) to June 2022 (all 16 sites). Similar increases were also observed for outpatient electroencephalogram from 4 of 13 sites and subsequently all 16 sites, and for epilepsy monitoring unit from 1 of 12 sites to 11 of 16 sites. The spread of COVID-19 did not correlate with the availability of services. Respondents predicted telehealth would be a permanent change.

Conclusions: Comprehensive ECoEs within the Veterans Health Administration increased services during the COVID-19 pandemic without demonstrating an association to the disease's spread.

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The COVID-19 pandemic affected diverse workplaces globally, leading to temporary and permanent changes across the health care landscape. Included among the impacted areas of care were epilepsy and electroencephalogram (EEG) clinicians and services. Surveys among epilepsy specialists and neurophysiologists conducted at the onset of the pandemic to evaluate working conditions include analyses from the American Epilepsy Society (AES), the National Association of Epilepsy Centers (NAEC), the International League Against Epilepsy, and an Italian national survey.[1-4] These investigations revealed reductions in epilepsy monitoring unit (EMU) admissions (23% decline), epilepsy surgery (6% decline), inpatient EEG (22% of respondents reported decline), and patients having difficulty accessing epilepsy professionals (28% of respondents reported decline) or obtaining medications (20% of respondents reported decline).[1-3]

While such research provided evidence for changes to epilepsy care in 2020, there are limited data on subsequent adaptations during the pandemic. These studies did not incorporate data on the spread of COVID-19 or administrative workload numbers to analyze service delivery beyond self reports. This study aimed to address this gap in the literature by highlighting results from longitudinal national surveys conducted at the Epilepsy Centers of Excellence (ECoE), a specialty care service within the Veterans Health Administration (VHA), which annually serves > 9 million veterans.[5] The ECoE represents epileptologists and neurophysiologists across the United States at the 17 primary facilities that were established at the time of this survey (2 ECoEs have been added since survey completion) in 4 geographical regions and for which other regional facilities refer patients for diagnostic services or specialty care.[6]

National surveys were conducted among the ECoE directors regarding adaptations made from May 2020 to June 2022 to provide a comprehensive account of limitations they experienced and how adjustments have been made to improve patient care. Survey responses were compared to administrative workload numbers and COVID-19 spread data from the Centers for Disease Control and Prevention (CDC) to provide a comprehensive analysis of performance during the pandemic.

METHODS

Data were collected as part of a quality improvement initiative by the VHA ECoE; institutional review board approval was not required. An 18-item survey covering 5 broad domains was sent to ECoE directors 4 separate times to accumulate data from 4 time periods: May to June 2020 (T1); December 2020 to February 2021 (T2); July to August 2021 (T3); and June to July 2022 (T4). These

TABLE 1. COVID-19 Transmission Level by Epilepsy Centers of Excellence Site at Time of Survey

Site	May - Jun 2020	Dec 2020 - Feb 2021	Jul - Aug 2021	Dec 2020 - Feb 2021
Albuquerque, NM	Moderate	High	NA[a]	High
Baltimore, MD	Substantial[b]	High	Moderate	High
Boston, MA	Substantial	High	High	High
Durham, NC	High	High	Moderate	High
Gainesville, FL	Low	High	High	High
Houston, TX	Substantial	High	Substantial	High
Madison, WI	Moderate	High	Moderate	High
Miami, FL	High	High	High	High
Minneapolis, MN	NA	High	Moderate	High
Portland, OR	Moderate	High	High	High
Richmond, VA	High	High	Substantial	High
San Antonio, TX	Moderate	High	High	High
San Francisco, CA	Moderate	High	High	High
Seattle, WA	NA	High	Substantial	High
Tampa, FL	NA	High	NA	High
West Haven, CT	NA	High	Moderate	High
West Los Angeles, CA	Substantial	High	High	High

Abbreviations: CDC, Centers for Disease Control and Prevention; NA, not available.
[a]CDC transmission data were not collected when survey data were not provided by sites.
[b]CDC categories "high" and "substantial" were consolidated into 1 category for statistical analyses for uniformity with survey categories.

periods correspond to the following phases of the pandemic: T1, onset of pandemic; T2, vaccine availability; T3, Delta variant predominant; T4, Omicron variant predominant.

Data on the spread of COVID-19 were collected from the CDC archived dataset, US COVID-19 County Level of Community Transmission Historical Changes (Table 1).[7] Administrative workload (patient counts) for EEG, EMU, and outpatient clinics were extracted from VHA administrative databases for the participating sites for the months prior to each survey: T1, April 2020; T2, November 2020; T3, June 2021; and T4, May 2022 (Table 2).

Survey Structure and Content

The survey was developed by the ECoE and was not validated prior to its use due to the time-sensitive nature of gathering information during the pandemic. The first survey (T1) was an emailed spreadsheet with open-ended questions to gauge availability of services (ie, outpatient clinic, EEG, EMU), assess whether safety precautions were being introduced, and understand whether national or local guidelines were thought to be helpful. Responses from this and subsequent surveys were standardized into yes/no and multiple choice formats. Subsequent surveys were administered online using a Research Electronic Data Capture tool.[8,9]

Availability of outpatient epilepsy services across the 4 time periods were categorized as unlimited (in-person with no restrictions), limited (in-person with restrictions), planned (not currently performed but scheduled for the near future), and unavailable (no in-person services offered) (eAppendices 1-6, available at doi:10.12788/fp.0488).

Statistical Analyses

Analyses were performed to compare survey responses to workload and CDC data on COVID-19 community spread. The

TABLE 2. Clinical Workload for Epilepsy Centers of Excellence Services

COVID-19 severity	Directors' perception				CDC transmission level			
	T1[a]	T2[b]	T3[c]	T4[d]	T1[a]	T2[b]	T3[c]	T4[d]
Outpatient								
Mild	48	36	263	81	5	–	–	–
Moderate	66	201	203	437	41	–	55	–
Severe	–	86	61	38	68	323	472	556
Electroencephalogram								
Mild	55	16	223	43	29	–	–	–
Moderate	62	201	146	309	25	–	74	–
Severe[e]	–	95	70	13	63	312	365	365
Epilepsy monitoring unit								
Mild	3	2	34	14	1	–	–	–
Moderate	10	38	29	56	4	–	21	–
Severe[e]	–	32	22	7	8	72	64	77

Abbreviation: CDC, Centers for Disease Control and Prevention.
[a]May to June 2020 (onset of pandemic).
[b]December 2020 to February 2021 (vaccine availability).
[c]July to August 2021 (Delta variant predominant).
[d]June to July 2022 (Omicron variant predominant).
[e]CDC categories "high" and "substantial" were consolidated into 1 category (severe) for uniformity with survey categories.

following associations were examined: (1) CDC COVID-19 spread vs respondents' perception of spread; (2) respondents' perception of spread vs availability of services; (3) CDC COVID-19 spread vs availability of services; (4) respondents' perception of spread vs workload; and (5) CDC COVID-19 spread vs workload. Availability of services was dichotomized for analyses, with limited or fully available services classified as available. As services were mostly open at T3 regardless of the spread of the virus, and the CDC COVID-19 spread classification for all sites was severe or high at T2 and T4, corresponding associations were not tested at these time points. For associations 1 through 3, Fisher exact tests were used; for associations 4 and 5, Mann-Whitney *U* tests (where the COVID-19 spread fell into 2 categories) and Kruskal-Wallis tests (for 3 categories of COVID-19 spread) were performed. All tests were 2-tailed and performed at 0.05 error rate. Bonferroni corrections were applied to adjust *P* values for multiple hypotheses tests.

RESULTS

From the 17 sites invited, responses at each time point were obtained from 13 (T1), 17 (T2), 15 (T3), and 16 (T4) centers. There was no significant association between self-reported COVID-19 spread and CDC classification of COVID spread. There were no associations between COVID-19 community spread (respondent reported or CDC severity level) and outpatient clinic availability (self-reported or workload captured). At T3, a positive association was found between the CDC spread level and workload ($P = .008$), but this was not significant after Bonferroni correction ($P = .06$).

EEG availability surpassed EMU availability at all time points, although EMU services made some recovery at T3 and T4. No associations were found between COVID-19 community spread (self-reported or CDC severity level) and outpatient EEG or EMU availability (self-reported or workload captured). At T3, there was a positive association between EEG workload and CDC COVID-19 severity level ($P = .04$), but this was not significant after Bonferroni correction ($P = .30$).

For outpatient EEG, staff and patient mask use were universally implemented by T2, while the use of full personal protective equipment (PPE) occurred at a subset of sites (T2, 6/17 [35%]; T3, 3/15 [20%]; T4: 4/16 [25%]). COVID-19 testing was rarely implemented prior to outpatient EEG (T1, 0 sites; T2, 1 site; T3, 1 site; T4, 0 sites). Within the EMU, safety precautions including COVID-19 testing, patient mask usage, staff mask usage, and aerosolization demonstrated a sustained majority usage across the 4 surveys.

National and Local Guidelines

The open-ended survey at T1 asked site directors, "Should there be national recommendations on how EEGs and related procedures should be done during the pandemic or should this be left to local conditions?" Responses were mixed, with 5 respondents desiring a national standard, 4 respondents favoring a local response, and 4 respondents believing a national standard should be in place but with modifications based on local outbreak levels and needs.

Surveys performed at T2 through T4 asked, "Which of the following do you feel was/will be helpful in adapting to COVID-19–related changes?" Overall, there was substantial agreement that guidelines were helpful. Most sites anticipated permanent changes in enhanced safety precautions and telehealth.

DISCUSSION

This longitudinal study across 4 time points describes how epilepsy services within the VHA and ECoE adapted to the COVID-19 pandemic. The first survey, conducted 2 months after COVID-19 was declared a pandemic, allowed a comparison with other concurrent US national surveys.[1,2,10] The subsequent surveys describe longitudinal adaptations to balance patient and staff safety with service availability and is a unique feature of the current report. Results demonstrate flexibility and adaptability by the ECoEs surveyed, which surprisingly did not show significant associations between CDC COVID-19 spread data and administrative workload data.

Trends in Availability of Services

The most significant impact of COVID-19 restrictions was during T1. There were no significant relationships between service availability/workload and objective CDC COVID-19 spread levels or subjective self-reported COVID-19 spread. Respondents' perceptions of local COVID-19 spread showed no association with CDC COVID-19 spread data. It appears that subjective perception of spread may be unreliable and factors other than actual or perceived COVID-19 spread were likely driving patterns for service availability.

In-person outpatient visits were most impacted at T1, similar to other civilian surveys, with only 1 site reporting in-person outpatient visits without limitations.[1,2] These numbers significantly changed by T2, with all sites offering either limited or unlimited in-person visits. While the surveys did not evaluate factors leading to this rapid recovery, it may be related to the availability of COVID-19 vaccinations within the VHA during this time.[11] The US Department of Veterans Affairs was the first federal agency to mandate employee vaccination.[12] By the most recent time point (T4), all responding sites offered outpatient visits. Outpatient EEGs followed a similar trend, with T1 being the most restrictive and full, unrestricted outpatient EEGs available by T3.

Fiscal year (FY) trends from ECoE annual reports suggest that encounters slowly recovered over the course of the pandemic. In FY 2019 there were 13,143 outpatient encounters and 6394 EEGs, which dropped to 8097 outpatient encounters and 4432 EEGs in FY 2020 before rising to 8489 outpatient encounters and 5604 EEGs in FY 2021 and 9772 outpatient encounters and 5062 EEGs in FY 2022. Thus, while clinicians described availability of services, patients may have remained hesitant or were otherwise unable to fulfill in-person appointments. The increased availability of home EEG (145 encounter days in 2021 and 436 encounter days in 2022) may be filling this gap.

In contrast to outpatient clinics and EEG, EMU availability showed relatively slower reimplementation. In the last survey, about 30% of sites were still not offering EMU or had limited services. Early trends regarding reduced staffing and patient reluctance for elective admission cited in other surveys may have also affected EMU availability within the VHA.[2,13] Consistent with trends in availability, ECoE annual report data suggest EMU patient participation was about one-half of prepandemic rates: 3069 encounters in FY 2019 dropped to 1614 encounters in 2020. By 2021, rates were about two-thirds of prepandemic rates with 2058 encounters in 2021 and 2101 encounters in 2022.

Early survey results (T1) from this study echo trends from other surveys. In the AES survey (April to June 2020), about a quarter of respondents (22%) reported doing fewer EEG studies than usual. The Italian national survey (April 2020) revealed reduced presurgical evaluations (81%), ambulatory EEG (78%), standard EEG (5%) and long-term EEG (32%).[4] In the NAEC survey (end of 2020)—which roughly corresponded to T2—outpatient EEGs were still < 75% of pre-COVID levels in one-half of the centers.

National and Local Guidelines

Both national and local guidelines were perceived as useful by most respondents, with national guidelines being more beneficial. This aligns with the NAEC survey, where there was a perceived need for detailed recommendations for PPE and COVID-19 testing of patients, visitors, and staff. Based on national and local guidelines, ECoE implemented safety procedures, as reflected in responses. Staff masking procedures appeared to be the most widely adopted for all services, while the use of full PPE waned as the pandemic progressed. COVID-19 testing

was rarely used for routine outpatient visits but common in EMU admissions. This is similar to a survey conducted by the American Academy of Neurology which found full PPE implementation intermittently in outpatient settings and more frequently in inpatient settings.[14]

Telehealth Attitudes

While most sites anticipated permanent implementation of safety precautions and telehealth, the latter was consistently reported as more likely to be sustained. The VHA had a large and well-developed system of telehealth services that considerably predated the pandemic.[15,16] Through this established infrastructure, remote services were quickly increased across the VHA.[17-19] This telehealth structure was supplemented by the ability of VHA clinicians to practice across state lines, following a 2018 federal rule.[20] The AES survey noted the VHA ECoE's longstanding experience with telehealth as a model for telemedicine use in providing direct patient care, remote EEG analysis, and clinician-to-clinician consultation.[1]

Trends in the number of telehealth patients seen, observed through patterns in ECoE annual reports are consistent with positive views toward this method of service provision. Specifically, these annual reports capture trends in Video Telehealth Clinic (local station), Video Telehealth Clinic (different station), Home Video Telehealth, Telephone Clinic, and eConsults. Though video telehealth at in-person stations had a precipitous drop in 2020 that continued to wane in subsequent years (898 encounters in 2019; 455 encounters in 2020; 90 encounters in 2021; 88 encounters in 2022), use of home video telehealth rose over time (143 encounters in 2019; 1003 encounters in 2020; 3206 encounters in 2021; 3315 encounters in 2022). Use of telephone services rose drastically in 2020 but has since become a less frequently used service method (2636 in 2019; 5923 in 2020; 5319 in 2021; 3704 in 2022).

Limitations

While the survey encouraged a high response rate, this limited its scope and interpretability. While the availability of services was evaluated, the underlying reasons were not queried. Follow-up questions about barriers to reopening may have allowed for a better understanding of why some services, such as EMU, continued to operate suboptimally later in the pandemic. Similarly, asking about unique strategies or barriers for telehealth would have allowed for a better understanding of its current and future use. We hypothesize that staffing changes during the pandemic may have influenced the availability of services, but changes to staffing were not assessed via the survey and were not readily available via other sources (eg, ECoE annual reports) at the time of publication. An additional limitation is the lack of comparable surveys in the literature for time points T2 to T4, as most analogous surveys were performed early in 2020.

CONCLUSIONS

This longitudinal study performed at 4 time points during the COVID-19 pandemic is the first to offer a comprehensive picture of changes to epilepsy and EEG services over time, given that other similar surveys lacked follow-up. Results reveal a significant limitation of services at VHA ECoE shortly after the onset of the pandemic, with return to near-complete operational status 2 years later. While safety precautions and telehealth are predicted to continue, telehealth is perceived as a more permanent change in services.

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Disclaimer

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Ethics and consent

Data were collected as part of a quality improvement initiative by the VHA ECoE. IRB approval was not required.

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eAPPENDIX 1. Results of Surveys 1 and 2[a]

		Survey 1, No.					Survey 2, No.				
Topics	**Survey questions**	**Responses**	**Yes**	**No**	**Limited**	**Planned**	**Responses**	**Yes**	**No**	**Limited**	**Planned**
Clinics	In-person visits	13	1 (1+0+0)	4 (4+0+0)	4 (1+3+0)	4 (1+3+0)	16	8 (0+6+2)	–	8 (1+4+3)	–
	Screening prior to clinic	2	2 (1+1+0)	–	–	–	–	–	–	–	–
	Face masks	1	1 (1+0+0)	–	–	–	–	–	–	–	–
Outpatient EEG	EEG being performed	13	4 (1+3+0)	–	1 (0+1+0)	8 (5+3+0)	17	13 (1+9+3)	1 (0+0+1)	3 (0+2+1)	–
	Hyperventilation	8	–	8 (4+4+0)	–	–	17	1 (0+1+0)	16 (1+10+5)	–	–
	Patient mask	6	6 (4+2+0)	–	–	–	17	17 (1+11+5)	–	–	–
	Staff mask	5	5 (2+3+0)	–	–	–	17	17 (1+11+5)	–	–	–
	Full PPE	2	1 (0+1+0)	–	1 (0+1+0)	–	17	6 (1+3+2)	11 (0+8+3)	–	–
	Disposable electrodes	2	2 (1+1+0)	–	–	–	17	12 (1+8+3)	5 (0+3+2)	–	–
	COVID-19 testing for EEG	12	–	12 (6+6+0)	–	–	17	1 (0+0+1)	16 (1+11+4)	–	–
EMU	EMU is functioning	12	1 (0+1+0)	5 (4+1+0)	1 (0+1+0)	5 (1+4+0)	17	5 (0+3+2)	4 (0+2+2)	4 (1+3+0)	4 (0+3+1)
	EMU COVID-19 testing	10	9 (4+5+0)	1 (0+1+0)	0	–	16	12 (1+8+3)	4 (0+3+1)	–	–
	Patient mask	2	2 (1+1+0)	–	–	–	16	13 (0+10+3)	3 (1+1+1)	–	–
	Staff mask	1	1 (1+0+0)	–	–	–	16	15 (1+11+3)	1 (0+0+0)	–	–
	Collodion (aerosolization)	4	1 (0+1+0)	2 (2+0+0)	1 (0+1+0)	–	16	11 (0+9+2)	5 (1+2+2)	–	–
Guidelines needed	National	13	9 (3+6+0)	4 (3+1+0)	–	–	17	16 (1+10+5)	1 (0+1+0)	–	–
	Local	7	7 (4+3+0)	–	–	–	17	12 (1+7+4)	5 (0+4+1)	–	–
Anticipated permanent change	Enhanced safety precautions	–	–	–	–	–	17	11 (1+7+3)	6 (0+4+2)	–	–
	Enhanced telehealth	–	–	–	–	–	17	16 (1+11+4)	1 (0+1+0)	–	–

Abbreviations: EEG, electroencephalogram; EMU, epilepsy monitoring unit; PPE, personal protective equipment.

[a]The values in parentheses represent responses broken down into categories according to directors' perception of COVID-19 spread (mild, moderate, severe).

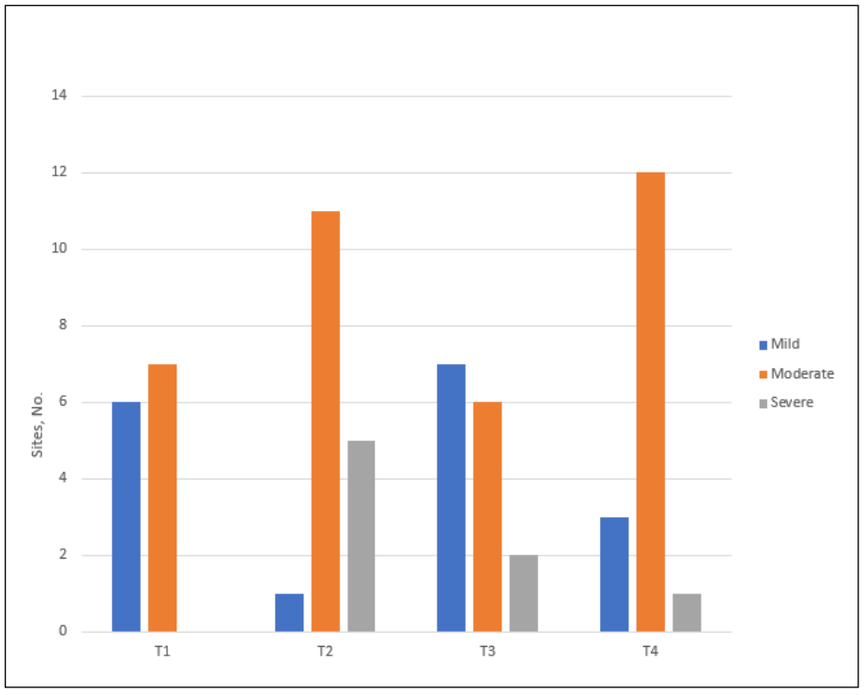
eAPPENDIX 2. Results of Surveys 3 and 4[a]

		Survey 3, No.					Survey 4, No.				
	Survey questions	**Responses**	**Yes**	**No**	**Limited**	**Planned**	**Responses**	**Yes**	**No**	**Limited**	**Planned**
Clinics	In-person visits	15	13 (6+5+2)	2 (1+1+0)	–	–	16	16 (3+12+1)	–	–	–
	Screening prior to clinic	–	–	–	–	–	–	–	–	–	–
	Face masks	–	–	–	–	–	–	–	–	–	–
Outpatient EEG	EEG being performed	15	15 (7+6+2)	–	–	–	16	16 (3+12+1)	–	–	–
	Hyperventilation	15	3 (0+3+0)	12 (7+3+2)	–	–	16	6 (1+5+0)	10 (2+7+1)	–	–
	Patient mask	15	14 (7+5+2)	1 (0+1+0)	–	–	16	16 (3+12+1)	–	–	–
	Staff mask	15	15 (7+6+2)	–	–	–	16	15 (3+11+1)	1 (0+1+0)	–	–
	Full PPE	15	3 (0+3+0)	12 (7+3+2)	–	–	16	4 (0+4+0)	12 (3+8+1)	–	–
	Disposable electrodes	15	10 (3+5+2)	5 (4+1+0)	–	–	16	10 (0+9+1)	6 (3+3+0)	–	–
	COVID-19 testing for EEG	15	1 (0+1+0)	14 (7+5+2)	–	–	16	–	16 (3+12+1)	–	–
EMU	EMU is functioning	15	12 (5+5+2)	2 (1+1+0)	–	1 (1+0+0)	16	11 (2+8+1)	1 (0+1+0)	3 (1+2+0)	1 (0+1+0)
	EMU COVID-19 testing	15	12 (5+5+2)	3 (2+1+0)	–	–	16	14 (3+10+1)	2 (0+2+0)	–	–
	Patient mask	15	10 (5+3+2)	5 (2+3+0)	–	–	16	9 (3+5+1)	7 (0+7+0)	–	–
	Staff mask	15	15 (7+6+2)	–	–	–	16	14 (3+10+1)	2 (0+2+0)	–	–
	Collodion (aerosolization)	15	11 (4+5+2)	4 (3+1+0)	–	–	16	14 (3+10+1)	2 (0+2+0)	–	–
Guidelines needed	National	15	10 (4+5+1)	5 (3+1+1)	–	–	16	11 (2+8+1)	5 (1+4+0)	–	–
	Local	15	9 (6+3+0)	6 (1+3+2)	–	–	16	11 (2+9+0)	5 (1+3+1)	–	–
Anticipated permanent change	Enhanced safety precautions	15	7 (3+4+0)	8 (4+2+2)	–	–	16	11 (1+10+0)	5 (2+2+1)	–	–
	Enhanced telehealth	15	12 (5+5+2)	3 (2+1+0)	–	–	16	13 (1+11+1)	3 (2+1+0)	–	–

Abbreviations: EEG, electroencephalogram; EMU, epilepsy monitoring unit; PPE, personal protective equipment.

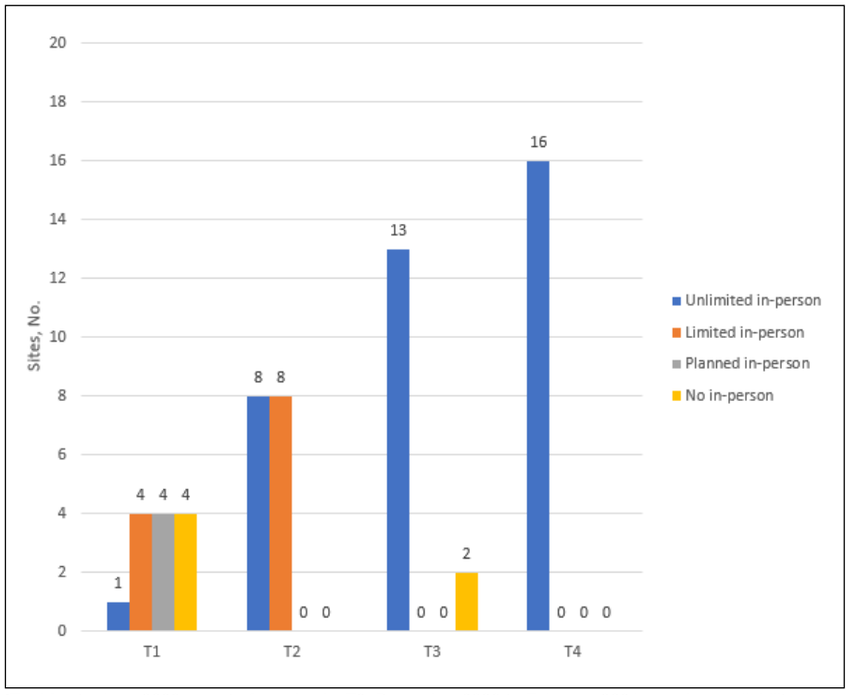
[a]The values in parentheses represent responses broken down into categories according to directors' perception of COVID-19 spread (mild, moderate, severe).

eAPPENDIX 3. Reported Local COVID-19 Spread[a]



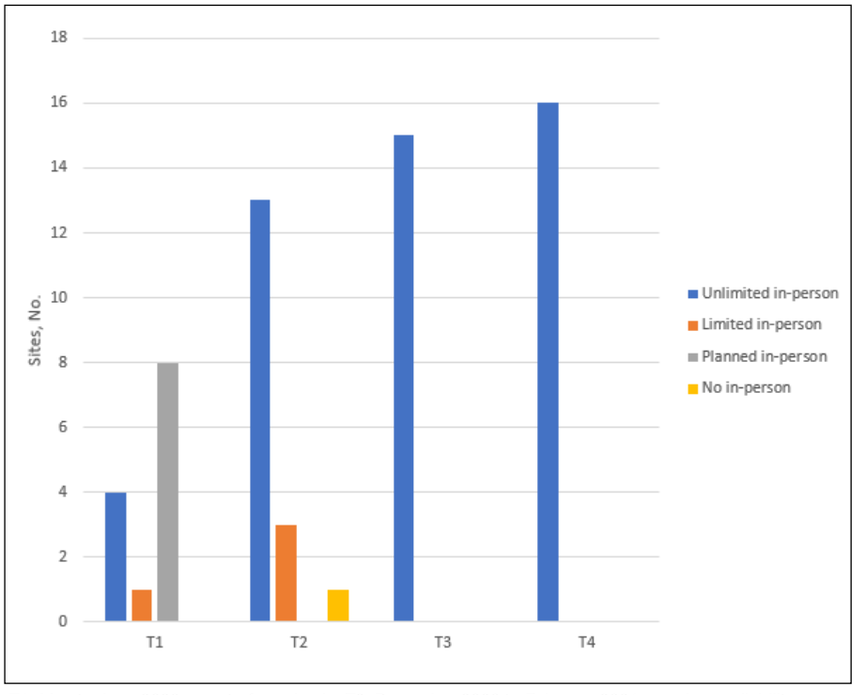
[a]T1, May to June 2020, onset of pandemic; T2, December 2020 to February 2021, vaccine availability; T3, July to August 2021, Delta variant predominant; T4, June to July 2022, Omicron variant predominant.

eAPPENDIX 4. In-Person Outpatient Epilepsy Services Availability[a]



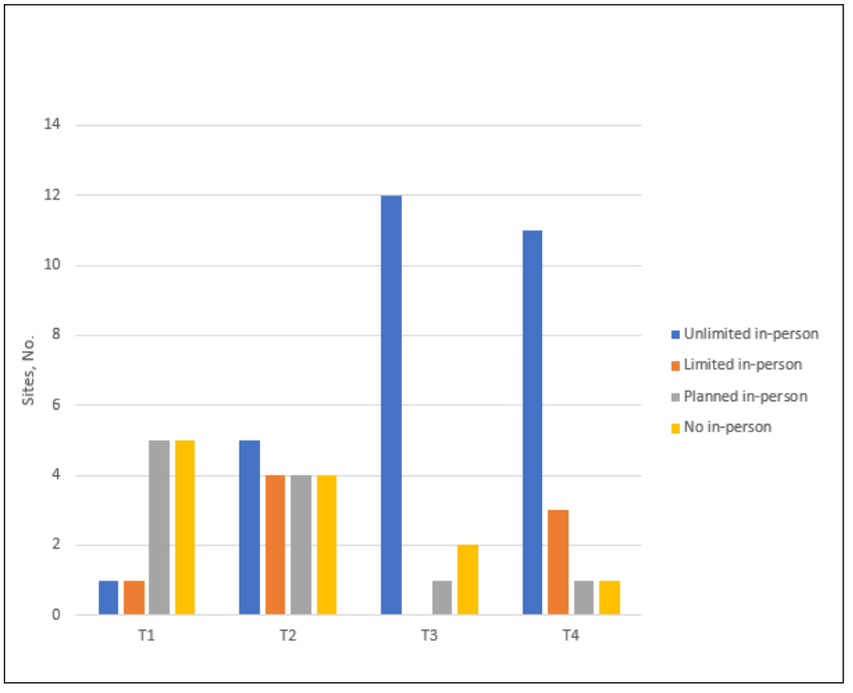
[a]T1, May to June 2020, onset of pandemic; T2, December 2020 to February 2021, vaccine availability; T3, July to August 2021, Delta variant predominant; T4, June to July 2022, Omicron variant predominant.

eAPPENDIX 5. Availability of Outpatient Electroencephalogram[a]



[a]T1, May to June 2020, onset of pandemic; T2, December 2020 to February 2021, vaccine availability; T3, July to August 2021, Delta variant predominant; T4, June to July 2022, Omicron variant predominant.

eAPPENDIX 6. Availability of Epilepsy Monitoring Unit[a]



[a]T1, May to June 2020, onset of pandemic; T2, December 2020 to February 2021, vaccine availability; T3, July to August 2021, Delta variant predominant; T4, June to July 2022, Omicron variant predominant.