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Original investigation

Risk of Admission to the Emergency Room/Inpatient Service After a Neurology Telemedicine Visit During COVID-19 Pandemic

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Abstract

Background: We compared emergency department (ED) and overnight inpatient admission (admission) rates within eight weeks of home-based telemedicine visits during COVID-19 in 2020 with in-person visits (conventional visit) in 2019. This was a quality improvement project prompted by an adverse event after a telemedicine visit.

Methods: We reviewed all completed telemedicine and conventional visits from March 26 to June 1 of 2020 and 2019 to identify patients who required an ED visit or hospital admission within eight weeks after the visit.

Results: In 2020, the overall rate of ED visits of hospital admission within eight weeks of a neurology visit was less than 5%. Comparing 2020 with 2019: (1) cohorts were similar for age, payor, state of residence, medical complexity, recommendation for close follow-up, new medications, or new tests ordered; (2) it took longer to present to the ED (by 10 days) or to be hospitalized (by three days); (3) planned admissions were approximately 50% lower; (4) on multivariate analysis, risk factors for any ED/admission included a patient call within seven days before the ED/admission (P = 0.0004) or being seen by an epilepsy specialist (P = 0.02); (5) a presenting complaint of worsening symptoms had a lower odds ratio of subsequent ED visit/admission (P = 0.005).

Conclusions: Telemedicine is safe, with a similar likelihood of ED or hospital admission during the pandemic in 2020 versus before the pandemic in 2019. In 2020, even if patients described worse symptoms at the time of their clinic visit, the odds of ED or hospital admission were lower than in 2019, but those who called after the telemedicine visit were more likely to be seen in ED or require hospitalization.

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Background and aim

We analyzed the factors associated with admissions to the emergency department (ED) and overnight inpatient admissions after a telemedicine visit in 2020 during the COVID-19 pandemic. This project was prompted by an adverse event after a new patient, home-based telemedicine evaluation early in the pandemic.

The COVID-19 pandemic changed the landscape of outpatient assessment in neurology throughout the world. Our institution had prior experience with home-based telemedicine visits since 2008. On March 11, 2020, at the outset of “stay-at-home” orders in Colorado, we were able to launch telemedicine clinics on a large scale and transitioned outpatient visits almost entirely to telemedicine. However, we did not convert without forethought or planning.

On March 16, all in-person outpatient visits (called conventional clinic visits henceforth) were converted to home-based telemedicine visits. In the days before March 16, we made broad guidelines about which patients could be triaged to telemedicine. We concurrently instituted periodic sessions led by clinicians...
experienced in telemedicine to highlight telemedicine examination techniques. Tip sheets were frequently circulated. In addition, each practitioner was advised to triage their upcoming clinic patients for a telemedicine or conventional visit based on the aforementioned guidelines, referral symptoms, known medical history, and perceived medical complexity.

However, within one month of transition to home-based telemedicine, there were two instances of concern that prompted further discussion of the telemedicine triage guidelines and ultimately comparison of outcomes between telemedicine and conventional clinic visits. The first was an infant who presented for initial evaluation of “developmental plateau.” A magnetic resonance imaging (MRI) was ordered with further telephone calls from the family about how to accomplish this during the COVID-19 pandemic. In addition, due to a telephone call from the referring provider about rapid head growth, MRI was expedited. The infant was subsequently found to have obstructive hydrocephalus requiring a third ventriculostomy nine days after the initial clinic visit. Macrocephaly was not a presenting complaint and was not appreciated on video inspection. In addition, a recent head circumference was not available and not measured at home at the time of the telemedicine visit.

The other patient who prompted re-evaluation of the guidelines was a teenager who was referred because of weakness. She had limited finger extension due to contractures; however, this was interpreted as weakness by video. She subsequently developed a progressive rheumatologic disorder with rash and weakness. There were several interval telephone calls about how and where to get her seen in the outpatient setting with an eventual intensive care unit admission more than eight weeks after the initial telemedicine visit.

The first patient led to modification of our triage and scheduling guidelines for infants (Supplemental Table). Discussion of this child highlighted the challenges of obtaining a reliable head circumference at home when evaluating patients referred for developmental plateau or macrocephaly. All new referrals for patients younger than 12 months were triaged to conventional visits unless they already had upcoming confirmed telemedicine appointments. Both patients prompted an evaluation of the factors during a telemedicine visit that may be associated with an increased likelihood of a subsequent ED visit or admission within eight weeks.

Methods

1. All completed telemedicine encounters between March 26, 2020, and June 1, 2020, that were followed by an encounter in the ED or admission within eight weeks were abstracted. These encounters were compared with a control group of patients seen conventionally during the same period in 2019. Variables abstracted included demographic data, payor, and state of residence. Through a manual chart review, additional specifics of the encounter, such as worsening symptoms as an entry complaint, provider specialty, diagnosis code, medical complexity as measured by number of diagnoses (more than one diagnosis was considered medically complex), neurological examination findings, testing ordered, recommendation of close follow-up, and medications prescribed were also abstracted.

2. Close follow-up was defined as follow-up within 12 weeks of telemedicine visit. Patient telephone call, if made, regarding worsening symptoms in the week before ED visit or admission was flagged. Planned admissions were also flagged (e.g., planned epilepsy monitoring unit admission or planned surgery).

3. If more than one diagnosis code was noted, the first diagnosis in the list for that stated encounter and chief complaint was chosen. For example, a patient with a chief complaint of seizures seen in the epilepsy clinic but with additional medical history of brain malformation and developmental delay was given three diagnoses but coded with epilepsy as the chief diagnosis for this article.

4. The Colorado Multiple Institutional Review Board deemed this research to be institutional review board exempt.

Statistical analysis

Summary data are presented as means and standard deviations for continuous variables and counts and percentages for categorical variables. Univariate logistic regression and multivariate logistic regression models were developed to identify variables that could differentiate between those who had ED and hospital admissions in 2020 and those who had ED and hospital admissions in 2019. Variables that were significant at the $P < 0.10$ in the univariate models were included in the multivariable logistic regression models. Backward elimination was then performed to find a reduced model that best explained the data; this involved including all variables at the univariate level that were significant at the $P \leq 0.10$ level and then reducing the multivariate model one variable at a time by the least significant until only the variables associated at the $P < 0.05$ level were included. All statistical tests were two-sided and performed in SAS 9.4 Copyright (c) 2000-2002, Intel Corporation.

Results

Overall data

Between March 26 and June 1, 2019, there were 5662 completed conventional clinic visits compared with 4099 completed telemedicine visits in 2020. Of these, 317 patients in 2019 (5.6%) and 173 patients in 2020 (4.2%) were seen in the ED or admitted within eight weeks after their clinic visit. The mean age of the patients was eight years.

There was no difference between the two groups in average age at time of visit, state of residence, or payor type (Table). In addition, there was no difference between the groups in clinical complexity (greater than one diagnosis) and proportion of patients with new medications prescribed, new tests ordered, or for whom a close follow-up was recommended. There was a higher likelihood for a planned admission or surgery in 2019 (68 of 317 = 21%) versus 2020 (27 of 173 = 15.6%) ($P = 0.003$). Additionally, there was a greater likelihood of a patient having called within one week of an ED visit or admission in 2020 compared with 2019 (27% vs 16% $P = 0.01$). Of those who were later seen in ED or hospitalized, a greater number of patients in 2019 had a new diagnosis made (18.5% vs 28% $P = 0.03$). A greater proportion of patients who complained about worsening symptoms at the time of clinic visit presented to the ED or were admitted in 2019 compared with 2020 (61% vs 38%, $P < 0.0001$).

Time to ED visit and inpatient admission

The average time to an ED visit in 2019 versus 2020 was 23 vs 33 days ($P < 0.001$), whereas that for admissions was 28 vs 31 days ($P > 0.05$).

Cause-specific ED and admission rates

Sixty patients presented to the ED for the same reason as their last neurology visit in 2019 (29.7%) versus 45 (26.0%) in 2020 ($P = 0.43$). The number admitted for the same reason as their last
neurology visit in 2019 was 93 (40.3%), and in 2020, it was 42 (24.3%) \( (P = 0.0007) \).  

**Results of univariate analysis**  

*For overall visits (ED plus inpatient: planned and unplanned)*  

When comparing visits in 2020 against 2019, the factor showing the highest likelihood of subsequent ED or admission in 2019 was worsening presenting complaint \( (P < 0.0001) \) or new diagnosis \( (P = 0.02) \). Significant factors for ED or admission in 2020 included provider specialty \( (P = 0.003 \text{ if seen by an epilepsy specialist}) \) or diagnosis code of seizures/spells \( (P = 0.004) \). Patients calling after their appointment with concerns were 1.9 times more likely to be seen in ED or admitted within seven days of the call in 2020 compared with 2019 \( (P = 0.01) \).  

**Results of multivariate analysis**  

Patients calling after a telemedicine appointment in 2020 were 2.6 times more likely to be admitted within one week of the call \( (P = 0.0009) \). Patients were also more likely to be admitted or present to the ED if they had been seen for epilepsy \( (P = 0.01) \). Patients with new or worsening complaints at the time of the clinic visit were less likely to be hospitalized in 2020 compared with 2019 \( \text{odds ratio 0.4; } P = 0.01 \). When comparing patients seen in specialty clinics other than epilepsy with those seen in general clinic, once again they were more likely to be seen in ED or admission in 2020 \( \text{odds ratio 3.7; } P = 0.001 \).  

**Discussion**  

We undertook this project to assess the factors associated with ED admission or hospitalization after a telemedicine visit due to our desire for quality improvement after launching telemedicine on a large scale in 2020.  

Telemedicine refers to a telecommunication-based remote evaluation of a patient. It is a health care delivery method that improves access to care and is almost universally associated with patient satisfaction.\(^1\,2\) Our hospital first implemented telemedicine in 2008 using a hub-and-spoke model, wherein a patient went to a local outreach clinic (spoke) near their home and connected to our hospital (hub) to see a practitioner. In the neurology section, we launched home-based telemedicine for epilepsy and movement disorders in 2012. Because of our hospital’s earlier experience with telemedicine, with the commencement of the pandemic, we were able to successfully convert our outpatient practice almost entirely to home-based telemedicine. We did this in a systematic manner by creating triage guidelines and implementing division-wide teaching sessions. We found guidelines similar to ours in later publications that discuss how to successfully implement and operationalize telemedicine clinics during COVID-19.\(^3\,5\) Telemedicine is now endorsed and established as a part of regular outpatient neurology practice.\(^6\)  

Standard practices of examination through telemedicine and treatment for various neurological conditions have been published.\(^7, 8\) We saw telemedicine as the silver lining of a disrupted health care during the pandemic,\(^10\) whereas others are not as convinced of its safety and advocate caution.\(^11\) We previously studied the overall safety and quality of telemedicine visits using SPROUT (Supporting Pediatric Research and Outcomes Using Telemedicine) guidelines.\(^12\) Our previously published data\(^13\) suggest that telemedicine is a safe and high-quality option for the vast majority of pediatric neurology patients, with a low cause-specific readmission rate: less than 2.5% within four weeks of a telemedicine visit.\(^15\)  

**What did we find in our study?**  

Overall decrease in ED visits, inpatient admissions, and elective procedures  

The complexity of patients that we see and that need admissions did not change; there was no difference in the

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**TABLE.**  

Demographic Variables of Our Cohort  

| Variables                                      | 2020 \( (n = 173) \) | 2019 \( (n = 317) \) | Total \( (n = 490) \) |
|------------------------------------------------|----------------------|----------------------|----------------------|
| Age at visit (S.D. years)                      | 8.8 (6.5)            | 8.7 (6.1)            | 8.7 (6.1)            |
| Payor                                         |                      |                      |                      |
| 1 Medicaid                                    | 83 (48.0%)           | 144 (45.4%)          | 227 (46.3%)          |
| 0 Other                                       | 90 (52.0%)           | 173 (54.6%)          | 263 (53.7%)          |
| Patient state                                 |                      |                      |                      |
| Colorado                                      | 168 (97.1%)          | 304 (95.9%)          | 472 (96.3%)          |
| Other                                         | 5 (2.9%)             | 13 (4.1%)            | 18 (3.7%)            |
| Greater than 1 diagnosis                      |                      |                      |                      |
| Yes                                           | 86 (49.7%)           | 157 (49.5%)          | 243 (49.6%)          |
| No                                            | 87 (50.3%)           | 160 (50.5%)          | 247 (50.4%)          |
| Close follow-up recommended                   |                      |                      |                      |
| Yes                                           | 21 (12.1%)           | 28 (8.9%)            | 49 (10.0%)           |
| No                                            | 152 (87.9%)          | 288 (91.1%)          | 440 (90.0%)          |
| New tests ordered                             |                      |                      |                      |
| Yes                                           | 73 (42.2%)           | 124 (39.1%)          | 197 (40.2%)          |
| No                                            | 100 (57.8%)          | 193 (60.9%)          | 293 (59.8%)          |
| New medications prescribed                   |                      |                      |                      |
| Yes                                           | 56 (32.4%)           | 128 (40.4%)          | 184 (37.6%)          |
| No                                            | 117 (67.6%)          | 189 (59.6%)          | 306 (62.4%)          |
| Mean days to ED visit (S.D.: days)\(^*\)       | 32.6 (21.4)          | 23.4 (15.3)          | 27.0 (18.5)          |
| Mean days to admit (S.D.: days)\(^*\)         | 30.6 (27.1)          | 28.1 (22.4)          | 29.1 (32.2)          |
| Planned surgery\(^*\)                         |                      |                      |                      |
| Yes                                           | 27 (15.6%)           | 68 (29.3%)           | 95 (19.4%)           |
| No                                            | 146 (84.4%)          | 164 (70.7%)          | 310 (80.6%)          |

Abbreviation:  

ED = Emergency department  

\(^*\) Used Satterthwaite correction.  

\(^1\) Comparison between groups \( P < 0.0001 \).  

\(^2\) Comparison between groups \( P = 0.0031 \).
proportion of patients with greater than one diagnosis admitted in 2019 or 2020. However, we saw overall reduced numbers of patients in the ED and hospital in 2020 versus 2019 (173 vs 317) within eight weeks of their neurology visit. Elective or planned admissions were seen in a significantly lower proportion of patients in 2020 versus 2019 (30% vs 16%) (P = 0.003). Some of this was due to complete closure of our hospital for nonurgent elective procedures and hence would be an expected finding. This trend has been reflected worldwide, as evidenced by a recent survey through the International League Against Epilepsy showing that patients with epilepsy are less likely to undergo elective electroencephalograms and more likely to experience delayed epilepsy surgery.

If a patient complained of worsening neurological symptoms at the time of clinic visit in 2020, the odds of their presenting to the ED or for hospital admission was only 0.4 compared with 2019. In addition, the average number of days to ED presentation was almost 10 days more in 2020 than in 2019. Westgard et al. reported an overall reduction in ED visits by up to 50%, with disproportionate increase in hospitalization. Westgard et al. showed that the average number of days to ED presentation was around 5%. We believe that this was the case due to our experience with telemedicine, large infrastructural support for telemedicine at our institution, and a planned launch of telemedicine. We maintained vigilance to opportunities for quality improvement (we started with a set of guidelines for patients to be seen via telemedicine but changed these as we went along after the first admission). Future development of checklists to be used for symptom-specific or systems-based history and physical examination could further reduce cognitive errors during a telemedicine visit.

Telemedicine was launched as a crisis standard-of-care practice in many hospitals and has allowed patients with chronic conditions to maintain continuity of care with their providers. We believe that it is important to establish “telemedicine standards” that can be applied across specialties and hospitals with varying past experience with telemedicine and nonuniform infrastructural capacity. Establishing universally applicable and acceptable telemedicine standards for various specialties will allow further improvement in quality of care delivered to patients. It will be important to maintain the investments made into telemedicine during this current pandemic to allow its use in the future.

Conclusions

Although postpandemic numbers of telemedicine visits are likely to decrease, the use of telemedicine is likely to remain as a complementary method for seeing patients in addition to in-person visits. Adverse events experienced by two of our patients, one infant with hydrocephalus and a teenager with weakness, prompted this project to assess factors associated with ED/inpatient hospitalization after a telemedicine visit. However, our study shows that, at least in our hospital, such cases are rare and not the norm. Our article contributes to the literature on safety and quality of telemedicine informing the practicing neurologist. Rates of admission to the hospital or ED, in 2019 or 2020 (prepandemic and during pandemic), were not different and both around 5%. We believe that this was the case due to our experience with telemedicine, large infrastructural support for telemedicine at our institution, and a planned launch of telemedicine. We maintained vigilance to opportunities for quality improvement (we started with a set of guidelines for patients to be seen via telemedicine but changed these as we went along after the first admission). Future development of checklists to be used for symptom-specific or systems-based history and physical examination could further reduce cognitive errors during a telemedicine visit.

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Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pediatra/neurol.2021.06.005.

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