Improved availability and quality of care with epilepsy nurse practitioners

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Abstract

Background: This study investigated the quality of care delivered by nurse practitioner (NP)–physician teams employed to expand clinic appointment availability for patients with epilepsy. **Methods:** We performed a retrospective observational cohort study of patients with epilepsy presenting to the Penn Epilepsy Center for a new patient appointment in 2014. During this time, patients were seen either by an NP–physician team care model or a more traditional physician-only care model. These care models were compared with regard to adherence to the 2014 American Academy of Neurology epilepsy quality measures at the initial visit. Clinical outcomes of seizure frequency, presentations to the Emergency Department, injury, and death were assessed over the subsequent year. **Results:** A total of 169 patients were identified by our inclusion and exclusion criteria: 65 patients in the NP–physician team care model cohort and 104 patients in the physician-only care model cohort. The NP–physician team care model saw, on average, 3 more patients per clinic session. There were no meaningful differences between these cohorts in baseline characteristics. The NP–physician team care model showed equivalent adherence to the physician-only care model for the epilepsy quality measures, with superior adherence to the counseling measures of querying for side effects, provision of personalized epilepsy safety education, and screening for behavioral health disorders. The 2 care models performed similarly in all clinical outcomes. **Conclusions:** An NP–physician team care model employed to increase availability of care could also improve quality of care delivered. *Neurol Clin Pract* 2017;7:109–117

Access to expert care is an important determinant of health for patients with epilepsy.^{1–4} Yet of the 1% of adults in the United States who have epilepsy requiring management, the 2010 National Health Interview Survey estimated only half had seen a neurologist in the prior year.⁵ The Affordable Care Act has addressed the

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accessibility of care by increasing medical insurance coverage for patients.^{6,7} However, the availability of care remains a challenge and the current deficit of neurologists is estimated to nearly double by 2025.^{6,8,9} While it is evident that we will need to accommodate rising demand for specialized care, research is lacking regarding which care models yield the best outcomes for patients with epilepsy.¹⁰

Epilepsy centers are increasingly employing multidisciplinary teams as a means to extend the availability of neurologic outpatient services.² Nurse practitioners (NPs) offer a particular skill set of clinical expertise and counseling that is pertinent to epilepsy care^{1,11–16}; however, the result of their addition has not yet been well-characterized. Although epilepsy nurse specialists are used in the United Kingdom, a systematic review did not find strong evidence of benefit in clinical outcomes or patient satisfaction.¹⁷ A 2016 Cochrane review concluded that epilepsy specialist NPs may improve the knowledge, compliance, and quality of life of patients with epilepsy.¹⁰

The goal of this study was to investigate the quality of care delivered to patients with epilepsy by a multidisciplinary care model that includes an NP compared to a more traditional physician-only care model.

METHODS

Study design

We performed a retrospective observational cohort study of patients with epilepsy presenting to the Penn Epilepsy Center for a new patient appointment from January to December 2014. In this time period, 2 care models were employed simultaneously: a particular clinic session was planned as either (1) the physician working alone (physician-only care model) or (2) an NP and physician working together with both providers seeing each new patient (NP–physician team care model). For both types of clinic sessions, all patients were placed on the physician's schedule. The scheduling template for an NP–physician team clinic session included 2 additional new patient appointment slots. The type of clinic session scheduled on a given day was determined by NP availability; overall, there were fewer NP–physician team clinic sessions scheduled than physician-only clinic sessions. Patients were not clinically triaged to a particular clinic session, but rather were scheduled for a particular clinic session by appointment availability and a patient's preference for time and date. All physicians and NPs included in this study were epilepsy specialists. The physicians all completed epilepsy fellowships and saw primarily epilepsy patients in their practice. The epilepsy NPs completed a several-month orientation to epilepsy outpatient care by physician epileptologists, attended surgical and medical management case conferences each week, and saw exclusively epilepsy patients in their practice.

Study population

Patients were identified from our electronic medical record, EPIC, with the assistance of the Penn Data Analytics Center. Inclusion criteria included (1) a new patient visit at the Penn Epilepsy Center at the Hospital of the University of Pennsylvania during 2014, (2) age >17 years, (3) a diagnosis of seizure assigned to the initial visit defined by ICD-9 345.xx or 780.39, and (4) at least one follow-up appointment within 12 months. Patients were excluded if they were not found to have active epilepsy, defined as experiencing ≥ 1 seizure in the last year or currently taking an antiepileptic medication. As the final diagnosis was not known at the time of the new patient appointment, patients eventually diagnosed in the follow-up period with psychogenic nonepileptic seizures (PNES) were included in the study population. If the new patient visit encounter only included documentation in the electronic medical record by a physician, then the patient was assigned to the physician-only care model; if the new patient visit encounter included both documentation by a physician and documentation by a NP, then the patient was assigned to the NP–physician team care model.

Table 1 American Academy of Neurology 2014 updated quality measures¹

Measure	Working definition of adherence
1A: Seizure frequency	Documentation of the number of seizures in the preceding 6 months
1B: Seizure intervention	For all patients with seizure frequency >0: Documentation of counseling on medication adherence, offering an increase in antiepileptic medication dose, offering a new antiepileptic medication, offering up titration of vagal nerve stimulation, or initiating evaluation for epilepsy surgery
2: Etiology, seizure type, or epilepsy syndrome	Documentation of etiology, documentation of seizure type, or appropriate testing ordered if etiology unknown
3: Querying and intervention for side effects of antiseizure therapy	For all patients currently taking an antiepileptic medication: Documentation of query of side effects or offer of intervention for side effects
4: Personalized epilepsy safety issue and education provided	Documentation of discussion of injury prevention, potential seizure precipitants, or driving issues
5: Screening for psychiatric or behavioral health disorders	Documentation of a screen for depression, anxiety, or psychosis
6: Counseling for women of childbearing potential with epilepsy	For all women of childbearing potential: Documentation of recommendation of folic acid, discussion of appropriate contraception, discussion of pregnancy planning and potential antiepileptic medication teratogenicity, or discussion of breastfeeding
7: Referral to comprehensive epilepsy center	Not assessed as our center is a comprehensive epilepsy center

Data abstraction

All encounters for a particular patient were reviewed for the study period, which began at the initial new patient visit and concluded after 12 months. The encounters reviewed included all office visits, all telephone calls, and all secure e-mail messaging through the electronic medical record to the epilepsy clinic. Formal chart review was performed using a standardized RedCap template to extract data from EPIC into a RedCap database.¹⁸ Data extraction was performed in full by the primary investigator and a random 10% sample of charts underwent independent review by a research assistant who was blinded to the study questions to assess reliability of data abstraction. Comparison between abstractors showed 100% agreement regarding adherence to the primary measures.

Measures

Demographic and clinical data Data regarding age, sex, race, type of insurance, and etiology of epilepsy were collected for each patient. Disease severity was evaluated by considering the presence of convulsive seizures, the presence of drug resistance at the initial new patient visit (defined as more than 2 medication trials without resolution of seizures), duration of epilepsy, and neurologic and psychiatric comorbidities.

Quality of care Adherence to the 2014 American Academy of Neurology epilepsy quality measures in the initial new patient visit was assessed for each patient (table 1). Appropriate numerators, denominators, and denominator exceptions were considered for each epilepsy quality measure.¹

Clinical outcomes To assess the clinical status of patients during the study period, data were abstracted regarding (1) unplanned presentations to the emergency department (ED) for seizures, (2) injuries from seizures, (3) sudden unexplained death in epilepsy or other cause of death, and (4) unimproved seizure frequency. Unimproved seizure frequency was defined as a <50% reduction in seizure frequency (number of seizures in the preceding 6 months)

For each patient, the number of visits and the number of telephone calls and e-mail messages were quantified to assess outpatient care utilization.

from the initial visit to the last follow-up visit within the study period. Patients who were found to be experiencing PNES or who were seizure-free at the initial visit were not included in the analysis of seizure frequency improvement.

Care utilization For each patient, the number of visits and the number of telephone calls and e-mail messages were quantified to assess outpatient care utilization. Telephone calls and e-mail messages were combined in analysis as the epilepsy clinic responds similarly to these 2 forms of patient communication. Diagnostic workup and treatment escalation were measured by admission to the Epilepsy Monitoring Unit (EMU), the number of antiepileptic drug changes or titrations, presentation in epilepsy surgical conference, and completion of epilepsy surgery.

Data analysis

Statistical analysis was performed with Stata version 14.0. Differences between the 2 care model cohorts in demographic attributes, clinical characteristics, adherence to the epilepsy quality measures, clinical outcomes, and care utilization were assessed using the χ^2 test, Fisher exact test, and Wilcoxon rank sum test as appropriate based on variable attributes and distribution. Adherence to each quality measure was assessed as the proportion of patients who met an individual measure at their initial visit (table 1 regarding working definitions). Clinical outcomes were assessed as the proportion of patients who met each outcome during the study period. Significance was defined as $p \leq 0.05$.

Standard protocol approvals, registrations, and patient consents

The University of Pennsylvania's institutional review board approved this study. Informed consent was waived for this study.

RESULTS

We identified 176 patients who met the inclusion criteria. Upon chart review, 7 of these patients were excluded (<1 seizure in the last year and not currently taking an antiepileptic medication), resulting in a total of 169 patients. The median age of the population was 37 years (interquartile range [IQR] 24–53) and 46% of the population were female. Thirty-three percent of the population were nonwhite and 17% had public insurance. Convulsive seizures were a seizure type for 72% of the population and the median duration of epilepsy was 10 years (IQR 2–22). This sample appears representative of the epilepsy population at large, with drug-resistant disease present in 40% of the study population.²

Sixty-five patients were seen by the NP–physician team care model and 104 patients were seen in the physician-only care model. Six of the 9 physicians included in this study employed both types of clinic sessions, the NP–physician team care model and the physician-only care model; the remaining 3 physicians exclusively saw patients in the physician-only care model. Two NPs participated in the NP–physician team care model. While the scheduling template for an NP–physician team clinic session included 2 additional new patient appointment slots, this differed from actual clinic attendance; the NP–physician team care model completed a median of 8 patient visits (IQR 7–9) per clinic session, as compared to the physician-only team care model, which completed a median of 5 patient visits (IQR 3–6) per clinic session. While the NP–physician team care model saw more patients per clinic session, there

Table 2 Demographic and clinical characteristics at baseline

	All patients, n = 169	NP-physician team, n = 65	Physician-only, n = 104	p Value
Age at new patient visit, y, median (IQR)	37 (24-53)	40 (29-55)	34 (22-51)	0.05 ^a
Female, n (%)	77 (46)	32 (49)	45 (43)	0.45 ^b
Race, nonwhite, ^c n (%)	52/157 (33)	15/62 (24)	37/95 (39)	0.06 ^b
Type of insurance, public, n (%)	28 (17)	14 (22)	14 (13)	0.17 ^b
Etiology, suspected, n (%)				
Partial	119 (70)	50 (77)	69 (66)	
Generalized	18 (11)	6 (9)	12 (12)	
Unknown	32 (19)	9 (14)	23 (22)	
Convulsive seizures, n (%)	122 (72)	44 (68)	78 (75)	0.30 ^b
Drug-resistant, n (%)	67 (40)	21 (32)	46 (44)	0.12 ^b
Duration of epilepsy, y, median (IQR)	10 (2-22)	11 (1-24)	8.5 (2-20)	0.86 ^a
Neurologic and psychiatric comorbidities, median (IQR)	1 (0-2)	1 (0-2)	1 (0-2)	0.63 ^a
PNES diagnosed during the study period, n (%)	9 (5)	4 (6)	5 (5)	0.73 ^d
Length of time from initial visit to final follow-up visit, d, median (IQR)	255 (159-336)	267 (162-349)	246.5 (144-313)	0.26 ^a

Abbreviations: IQR = interquartile range; NP = nurse practitioners; PNES = psychogenic nonepileptic seizures.

^aWilcoxon rank sum.

^b χ^2 test.

^cRace not known for every patient.

^dFisher exact test.

were fewer total patients in this cohort compared to the physician-only cohort because fewer NP-physician team clinics were scheduled and exclusion criteria refined the patient sample.

The only difference observed between the patients in the 2 care models with regard to demographic characteristics was in age (table 2). Disease severity was not significantly different between these 2 cohorts and there were no significant differences in the number of neurologic

Table 3 Adherence to the epilepsy quality measures

	NP-physician team, % (n)	Physician-only, % (n)	p Value
Documentation of seizure frequency	98 (64/65)	93 (97/104)	0.16 ^a
Offering an intervention for seizures	100 (56/56)	96 (92/96)	0.30 ^a
Documentation of etiology or semiology	100 (65/65)	99 (103/104)	1.00 ^a
Querying for side effects	94 (51/54)	70 (62/89)	<0.001 ^a
Personalized epilepsy safety education	69 (45/65)	49 (51/104)	0.01 ^b
Screening for behavioral health disorders	100 (65/65)	90 (94/104)	<0.01 ^a
Counseling women of childbearing potential	87 (13/15)	57 (16/28)	0.09 ^a

Abbreviation: NP = nurse practitioners.

^aFisher exact test.

^b χ^2 test.

Table 4 Clinical outcomes

	NP-physician team, % (n)	Physician-only, % (n)	p Value
Unimproved seizure frequency	64 (34/53)	55 (51/92)	0.31 ^a
Presentation to the ED	22 (14/65)	15 (16/104)	0.31 ^a
Injury from seizure	2 (1/65)	7 (7/104)	0.16 ^b
Death	0 (0/65)	0 (0/104)	

Abbreviations: ED = emergency department; NP = nurse practitioners.
^a χ^2 test.
^bFisher exact test.

and psychological comorbidities. There was no difference between the 2 cohorts in the number of patients who were found by the end of the study period to have a diagnosis of PNES. In addition, the median length of time between the initial new patient visit and the last follow-up visit in the study period was similar for the 2 groups of patients.

Adherence to the objective epilepsy quality measures of documentation of seizure frequency, offering an intervention for seizures, and documentation of etiology or semiology were not associated to the care model (table 3). The NP-physician team care model outperformed the physician-only care model in the counseling measures of querying for side effects (94% vs 70%, $p < 0.001$), personalized epilepsy safety education (69% vs 49%, $p = 0.01$), and screening for behavioral health disorders (100% vs 90%, $p < 0.01$). Counseling for women of childbearing potential was not associated to the care model. In a secondary analysis within the NP-physician team care model, no association was observed between care provider (NPs vs physicians) and adherence to the epilepsy safety counseling measures (58% vs 51%, $p = 0.38$).

There were no associations between the care model and the clinical outcomes of unimproved seizure frequency, presentation to the ED, injury from seizure, or death (table 4).

The 2 cohorts of patients experienced similar care utilization as measured by number of follow-up appointments and phone calls/e-mails during the 1-year study period (table 5).

Table 5 Care utilization over 12 months

	NP-physician team, n = 65	Physician-only, n = 104	p Value
No. of in-person encounters in follow-up period, median (IQR)	2 (1-3)	2 (1-3)	0.40 ^a
No. of telephone and e-mail encounters in follow-up period, median (IQR)	5 (2-10)	6 (3-12.5)	0.28 ^a
Antiepileptic medication titrations, median (IQR)	1 (0-3)	1 (0-3)	0.76 ^a
Admission to the epilepsy monitoring unit, n (%)	14 (22)	25 (24)	0.71 ^b
Presentation in surgical conference, n (%)	7 (11)	6 (6)	0.24 ^b
Epilepsy surgery completed, n (%)	4 (6)	5 (5)	0.73 ^c

Abbreviations: IQR = interquartile range; NP = nurse practitioners.
^aWilcoxon rank sum.
^b χ^2 test.
^cFisher exact test.

Diagnostic investigation and treatment escalation during the study period were also similar for the 2 cohorts of patients, with no significant differences in number of antiepileptic drug changes or titrations, admission to the EMU, presentation in surgical conference, or completion of epilepsy surgery.

DISCUSSION

This study examined care delivered to patients with epilepsy by an NP–physician team care model that, on average, saw 3 more patients per clinic session compared to a physician-only care model. The 2 cohorts were similar except for a difference in age; this difference is unlikely to affect the study outcomes. We found both care models exceeded 90% adherence for the objective quality measures of documentation of seizure frequency, offering an intervention to reduce seizures, and documenting or ordering testing for seizure etiology. However, adherence was less dependable for the counseling measures in both care models, which is consistent with prior studies.^{11–14,16,19,20} Overall, adherence to the quality measures within both care models was superior to previously published studies, which is likely related to 2 points: there has been more time for the diffusion and implementation of these epilepsy quality measures and all the care providers in this study were epilepsy specialists.

We found greater association of adherence to the counseling quality measures of querying for side effects, personalized epilepsy safety education, and screening for behavioral health to the NP–physician team care model compared to the physician-only care model. Improved performance by nonphysician providers has been noted previously in a study that showed higher adherence by advanced practice providers compared to physicians in documentation of etiology and the counseling measures of querying about side effects and counseling for women of childbearing potential.¹² We found that at least some types of counseling during a patient encounter within the NP–physician team care model were just as likely to be documented by the physician as documented by the NP. This finding suggests 2 desirable effects of a multidisciplinary approach to patient care. This first is that redundancy alone likely improves adherence to quality measures; that is, in the NP–physician team care model, a new patient is seen by 2 care providers. The second is that with an NP completing the majority of the initial information gathering, medication reconciliation, medication prescribing, and ordering of studies, the physician is granted an opportunity to consider subtleties of clinical practice as well as time to counsel patients.

While physicians and patients alike may approach a nontraditional model of care delivery with some trepidation, our study shows no association of clinical outcomes, diagnostic investigation, or treatment escalation to the care model. Furthermore, although we did not observe improved clinical outcomes with greater adherence to the epilepsy quality measures, prior studies have seen such a relationship. Documentation of seizure frequency has been shown to be correlated with epilepsy-related adverse hospitalizations.¹⁶ A study that examined adherence to the quality measures during clinic visits demonstrated significantly higher mean adherence to quality measures within the group of patients achieving seizure control over 3 years compared to the group of patients with uncontrolled seizures.¹¹ With a longer follow-up period, the improved safety counseling provided by the NP–physician team care model may decrease mortality and morbidity. Furthermore, greater recognition of behavioral and psychiatric comorbidities may improve quality of life.

There are several limitations to this study. There are likely unmeasured differences between new patients seen by the NP–physician team care model and the physician-only care model; however, as cohort assignment was largely determined by the patient's preferences for time and date, this should introduce only minimal bias. As a retrospective chart review, this study uses documentation of adherence to quality measures as a surrogate for true adherence to quality measures, thus there may be some discrepancy between documentation and reality; however, identical abstraction of data was employed for both cohorts. While presentations to outside hospitals are typically captured in telephone calls to a primary neurologist or in subsequent visits, we may fail to capture

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care that was provided at other institutions; again, this limitation should equally affect both cohorts. Finally, our sample size may have limited our ability to demonstrate statistically significant differences between study groups. A noninferiority study would have been another possible design; however, a noninferiority limit was not defined prior to study initiation.

Increasing the availability of specialist care is critical to improving the health of patients with epilepsy and multidisciplinary teams provide one means to do so. Investigation regarding which particular subgroups could benefit most from a care model that employs NPs will be important in future studies. There is evidence that epilepsy specialist nurses provide less costly consultation than physicians¹⁷ and that epilepsy specialist NPs can considerably reduce the primary care costs associated with patients with epilepsy.¹⁰ Our next step will be a cost-efficiency analysis of the NP–physician care team model to determine if this model provides good value and should be adopted more widely.

While further research is needed regarding which care models provide the best outcomes for patients with epilepsy, this study suggests that employment of a NP–physician team can increase availability of care without compromising quality of care. Our findings are relevant and applicable given the current environment of an unmet demand for neurologic specialist services. Physicians, NPs, and patients should be encouraged that successful expansion of epilepsy care is within reach.

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AUTHOR CONTRIBUTIONS

Chloe E. Hill: study concept and design, data acquisition, analysis and interpretation of data, drafting and revising of manuscript for intellectual content. Bethany Thomas: study design, interpretation of data. Kimberly Sansalone: study design, data acquisition. Kathryn A. Davis: study concept and design, revising of manuscript. Judy A. Shea: study design, data interpretation, revising of manuscript. Brian Litt: study concept and design, interpretation of data, revising of manuscript. Nabila Dahodwala: study design, analysis and interpretation of data, revising of manuscript for intellectual content.

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