

Decreasing Emergency Department Visits for Children With Epilepsy

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Abstract

Background and Objectives

Epilepsy and seizures represent a frequent cause of emergency department (ED) visits for patients. By implementing quality improvement (QI) methodology, we planned to decrease ED visits for children and adolescents with epilepsy.

Methods

In 2016, a multidisciplinary team was created to implement QI methodology to address ED visits for patients with epilepsy. Based on previous successes, further ED visit reduction was deemed possible. Our aim statement was to decrease the number of ED visits, per 1000 established patients with epilepsy, from 13.03 to 11.6, by December 2019 and sustain for 1 year.

Results

We successfully decreased ED visits for seizure-related care in patients with epilepsy from 13.03% to 10.2% per 1,000 patients, which resulted in a centerline shift.

Discussion

Using QI methodology, we improved the outcome measure of decreasing ED visits for children with epilepsy. Implementations of these interventions can be considered at other institutions that may lead to similar results.



Epilepsy and seizures represent a frequent cause of emergency department (ED) visits for patients.¹ Epilepsy or seizure care remains the most common neurologic condition that presents to an ED, with the majority of patients with an ED visit being less than 5 years of age.²⁻⁶ In previous reports, seizure-related ED visits were frequently felt unnecessary by the patient, caregiver, or provider, with many of these visits being considered preventable.^{1,7-9} ED visits lead to a high cost to the health care system^{1,6,7,10-12} in claims data; however, this cost may not capture the full financial burden and social impact of ED visits for seizure care.¹³

Available Knowledge

Studies have evaluated risk factors for ED use in patients with epilepsy, which consist of prior excessive ED utilization for seizure and nonseizure care, lower socioeconomic status, inadequate dosing or lack of seizure rescue medication, limited knowledge about seizure and

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epilepsy care, and poor daily adherence to antiseizure medication use.^{1-3,8,9,11,14-22} Interventions to address these factors have been implemented with some success in reducing ED visits for patients with epilepsy.⁸⁻¹¹ However, the published use of quality improvement (QI) methodology to decrease ED utilization is limited.

Rationale

In 2016, we convened a multidisciplinary team to implement QI methodology to address ED visits and unplanned hospitalizations with success reported.^{8,9} The results have been sustained. However, further ED visit reduction was considered achievable based on our understanding of the epilepsy population and successful interventions implemented by others in recent years,^{1,14,22,23} specifically related to outpatient clinic visits and family education. A review was published detailing interventions that have been successful in decreasing ED visits. Specifically, development of care pathways, review of care received for patients with epilepsy, and improved education contributed to these decreases.¹ A separate study evaluating adults with epilepsy determined education and access to medical records for emergency medical services as it relates to seizure care, and treatment was helpful in contributing to decreased ED visits.²⁴ In our previous work, we used QI methodology and interventions to decrease ED visits.^{8,9} Specifically, interventions to improve access to outpatient care to address barriers around education, parental stress, and understanding on appropriate use of the ED were found most successful. Therefore, we felt that further decreases could be seen by adapting similar approaches using these themes to decrease ED visits for children and adolescents with epilepsy.

Specific Aim

Our aim statement was to decrease the number of ED visits from 13.03 to 11.6 per 1000 established patients with epilepsy by December 2019 and to sustain for 1 year. Based on our previous success^{8,9} and after brainstorming sessions with the team, the new goal was established.

Methods

Context

Nationwide Children's Hospital (NCH) is a free-standing pediatric hospital with 427 licensed beds and an ED with 62 beds, in Columbus, OH. NCH served approximately 3800 unique patients with epilepsy at the onset of the project time period and 3670 by December 2019. The insurance status was similar in our epilepsy population (Table).

Patients with epilepsy are seen by pediatric neurology providers consisting of physicians and advance practice providers. A multidisciplinary team developed a key driver diagram (Figure 1) using the Institute for Healthcare Improvement model.²⁵ The Standards for Quality Improvement Reporting Excellence

Revised guidelines were used to prepare the article.²⁶ We used the rolling average from 2015 as our baseline, as we implemented interventions starting in early 2016.

Interventions

Interventions around each key driver were developed and implemented sequentially over the subsequent 12 months. Six major interventions (Figure 1) included (1) in-clinic pharmacist support; (2) care coordination for high-risk Medicaid patients; (3) weekly huddle to discuss established patients with epilepsy with ED visits presenting with seizures; (4) correcting low-dose rescue medication prescriptions; (5) proactive approach to school form and seizure action plan (SAP) completion; and (6) nursing provision of enhanced and/or patient-specific education with teach back during clinic appointments. The team consisted of an epileptologist, epilepsy advanced practice provider, nurses, care coordinators, social workers, a QI specialist, administrative assistant, and an ED physician.

Study of the Interventions

Interventions were implemented sequentially over time to evaluate their impact on our outcome measure of total ED visits. A Plan Do Study Act (PDSA) cycle was implemented for each intervention with analysis of expected-to-actual performance. We did not limit our interventions to a subset of our epilepsy population. Interventions were made available to all patients with epilepsy seen at NCH with the exception of care coordination. Care coordination was available for Medicaid patients, but not all Medicaid patients were enrolled into this program. They were enrolled only if a referral was placed.

A clinical pharmacist focused in neurology was assigned to the outpatient neurology clinic and was present during clinic hours 5 days a week starting in January 2016. This pharmacist assisted in SAP completion,²² daily antiseizure medication side effect management, dose checking for rescue medication, and education on administering seizure rescue medications. The pharmacist was available if needed for all patients with epilepsy.

Furthermore, we implemented care coordination for patients who were at high risk for ED utilization based on previous published studies^{2,3} or if psychosocial barriers were identified during outpatient clinic visits on chart review. A care coordinator could be assigned if a medical provider felt that the patient had a complex epilepsy case, psychosocial factors existed, or if other medical comorbidities existed warranting coordination of outpatient visits with multiple care providers. The care coordinators are typically nurses, social workers, and a quality outreach coordinator to help families navigate the medical system. A patient can be enrolled into care coordination if they belong to 1 of the 5 managed Medicaid programs in Ohio and lives in Central/Southeast Ohio. Such patients are managed by Partners for Kids,²⁷ a pediatric accountable care organization affiliated with NCH.

Table Insurance Status for the Epilepsy Population

Category	Patients	%
Government	1,862	51
Nongovernment	1,694	46
Self-pay	114	3
Grand total	3,670	

An intervention was a weekly huddle where the project team met and reviewed a list of all patients who presented to the ED for that week. The objective of the review was to seek the root cause of the visit and to determine individualized actions to prevent future ED visits. These opportunities consisted of implementing previously successful interventions based on our original reported QI project, such as using the urgent epilepsy clinic for immediate epilepsy care needs and to reinforce epilepsy education; prescribing a properly dosed rescue seizure medication; or having social work address barriers to care.^{8,9} The team-based review process occurred weekly and took 30 minutes to complete.

Another new intervention was using a clinical pharmacist to evaluate all rescue medication prescriptions for appropriate dosing. If dosing improvements were identified, feedback was given to the provider to clarify the reason for the low dose or to correct the dose. This essential intervention was based on previous work demonstrating lack of or a low-dose rescue medication to be a variable for excessive ED use for children with epilepsy.¹⁹

Our fifth intervention was proactively managing SAPs and school forms. At NCH, an SAP²² was designed and implemented with similar principles of an asthma action plan.²⁸ A lack of access to these forms represents a barrier in the school system or patients with epilepsy.²⁹ Locally, this issue has resulted in children being restricted from school attendance, if the school does not have a seizure rescue medication or the forms required to authorize their use. Many schools would not allow use of a rescue medication without an SAP. Therefore, we proactively completed school SAPs and ensured that patients had a seizure rescue medication available for the school. During clinic visits in the summer period, an emphasis was made to remind parents to provide the schools forms or complete them online, as many schools transport children via ambulance to a hospital if forms and rescue medication were not present.

Our sixth and last intervention focused on education. As inconsistency and at times lack of education on epilepsy and seizure emergency care were identified as factors in ED utilization based on previous studies,¹ clinic nursing staff provided enhanced education addressing this gap. The education was focused around the importance of adherence to daily medication and what to do when a child is having a prolonged seizure. The SAP was reviewed, seizure rescue medication

administration was demonstrated, and a teach back of rescue medication administration was performed by family members.³⁰ Clinic flow was adapted to allow nursing more time to discharge all patients with epilepsy and provide the enhanced education. Scripting and education on the teach-back process were provided to each clinic nurse.

Measures

The primary outcome measure chosen for the project was ED visits with a primary or secondary diagnosis of seizures or epilepsy as the reason for presenting to the ED in established patients with epilepsy. We evaluated all ED visits for patients with epilepsy if they were cared for by any neurology provider.

Patients with epilepsy were identified by using *International Classification of Diseases Ninth Revision and Tenth Revision* codes. To define a patient as being established at NCH, we used patients with a completed office visit within a rolling 13 months who had a primary or secondary diagnosis of epilepsy (345.xx or G40.xxx). Current procedural terminology codes were used to identify the completed office visit. We evaluated all established patients with epilepsy seen by any neurology provider. We used an operational definition of patients with epilepsy seen by a neurology provider within the last 13 months. We used the first day of each month and looked back at the 13 months prior to see whether a completed office visit occurred in a neurology clinic. We wanted to only capture our actual patient population and not patients who seek or transferred care elsewhere.

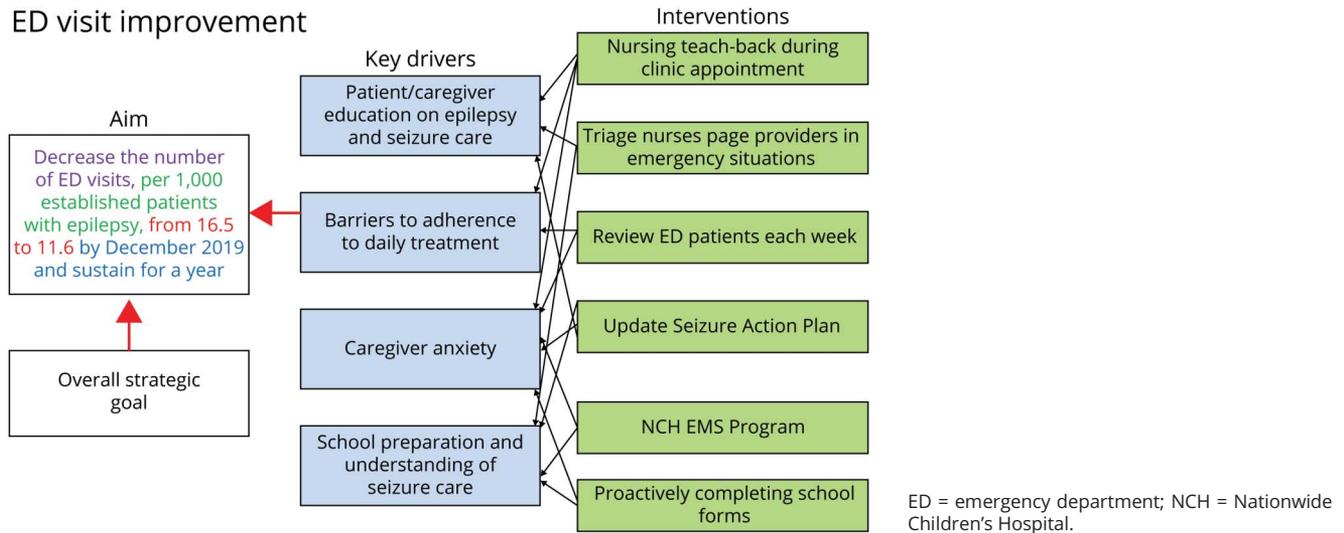
Baseline ED visits were measured over a retrospective period of 12 months in 2015, and this average was used as an extension from our previous QI project.⁸ The reduction percentage chosen for the project was based on our previous success and team consensus. For balancing measures, we focused on mortality and hospital readmissions.^{7,8}

The team developed key drivers using several techniques such as an affinity diagram from multiple brainstorming sessions led by the QI specialist. The key drivers for the project included Patient/Caregiver Education on Epilepsy and Seizure Care, Adherence to Daily Treatment, Caregiver Anxiety, and School Preparation and Understanding of Seizure Care (Figure 1).

Analysis

Using the American Society for Quality (ASQ) criteria,³¹ we observed a shift in data when 8 consecutive data points below our baseline were achieved.³² By using ASQ criteria, we limited possible bias in our data interpretation. Our primary data source was extracted from our electronic health record system. Centerline shifts using QI methodology do not occur after 1 month, and ASQ rules must be followed. We study the control charts and variation over time, and then, we shifted the centerline after following the ASQ rules. Two separate analysts performed an independent review and validation to verify accuracy of our data queries. Control charts (a

Figure 1 Key Driver Diagram



Statistical Process Control tool)³² were used to monitor the outcome metrics: monthly baseline ED visits with the interventions recorded as implemented over time (Figure 2). We used ED visits per 1,000 patients to account for the fluctuation and growth of the epilepsy population cared for at NCH with data reflected in a statistical process control U chart.

The U chart displays the number of random events occurring during an opportunity window as measured by months. A Poisson statistical distribution assumed by the U chart is typically well suited for representing such events with use of the 2-sample Poisson rate test.

Standard Protocol Approvals, Registrations, and Patient Consents

Our project was approved by the Chief Medical Officer at NCH as a QI project. Updates were provided monthly via written reports and presented quarterly to the QI administration team consisting of the Division Chief of Neurology, Director of Quality Improvement for the hospital, and Chief Medical Officer at NCH. Institutional review board approval at our institution is not required, nor is a letter of exemption needed to perform QI.

Data Availability

Any anonymized data not published in this article can be shared by request from any qualified investigator.

Results

Forty-eight months after our project initiation, ED visits for seizure-related care in patients with epilepsy decreased from 13.03% to 10.2% per 1,000 patients, surpassing our goal and resulting in a baseline shift of our data. As of November 2020,

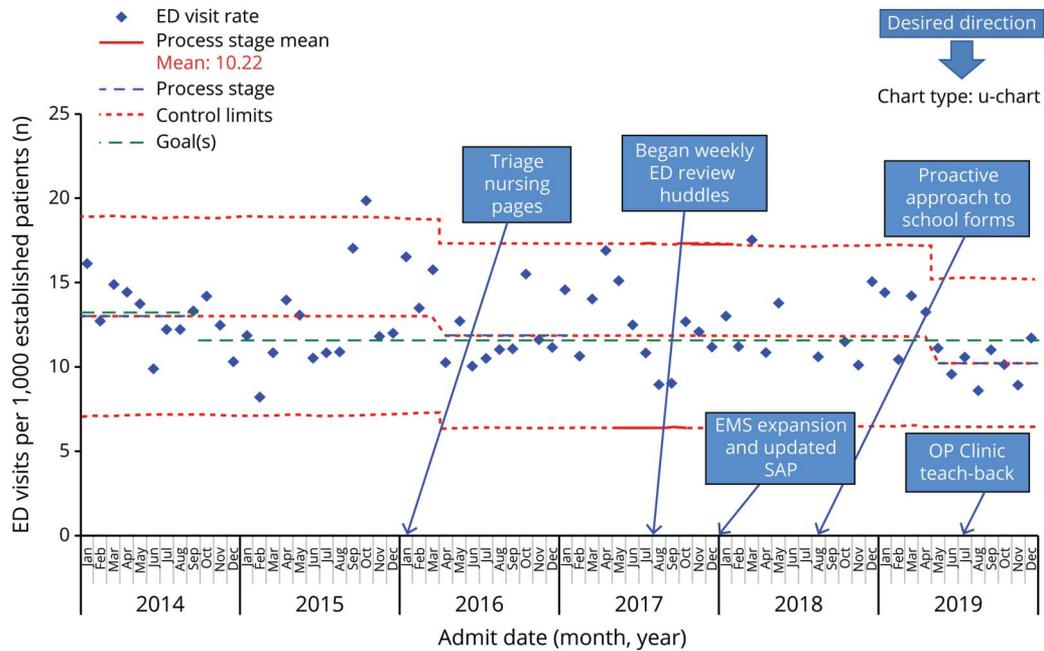
we have sustained our baseline. In terms of the balancing measure of mortality, no change was noted.

An interim analysis of the weekly review of 604 ED visits from October 2017 to March 2019 showed that 31% of ED visits were related to a need for additional seizure education, 27% resulted from caregiver anxiety, and 13% resulted from patients coming directly from schools.

We phased in our interventions over time starting in January 2016 with the last one in July 2019 (Figure 2). In January 2016, we implemented a neurology-trained clinical pharmacist to our outpatient clinics. Initially, the pharmacist was available 1 day a week as a PDSA cycle, which was successful and then rolled out to 5 days per week. In January 2017, we were able to embed care coordinators within our outpatient clinic, which allowed for direct patient care for those in need. Starting in August 2017, we began our weekly review of all established patients with epilepsy who presented to the ED for a seizure-related cause to identify opportunities to prevent future visits. In January 2018, our clinical pharmacist and other care team members started to review all low-dose rescue medication prescriptions with feedback and correction given to the prescribing provider. Our proactive approach to our SAP completion before the start of school began in the summer of 2018. Our last intervention was implemented in July 2019, which involved having our clinical nurses provide enhanced seizure education on how to administer a rescue medication for seizures and a review of the SAP.

As time progressed after our first intervention, we were able to maintain our baseline without special cause variation noted with exceptions in March 2018 and September 2018. A detailed review of these months was performed. During March 2018, many patients tested positive for influenza A/B and presented

Figure 2 U Chart With ED Visit Reduction



ED = emergency department; SAP = seizure action plan.

with breakthrough seizures in the setting of this febrile illness. In September 2018, special cause variation was noted below our lower control limits. Analysis for possible explanation did not yield any specific reason behind this finding. We noted 9 months of ED visits below our baseline consistently starting in May 2019 to December 2019 resulting in a baseline shift.

Evaluation of special cause variation in March 2018 revealed a high number of patients with epilepsy who presented with increased seizures in the setting of an influenza A or B infection.

Discussion

Using QI methodology, we were able to reduce ED visits for established patients of NCH from 13.03% to 10.2% per 1000 patients over an 8-month time period. A strength of this project was the weekly reviews of all patients presenting to the ED for seizure-related care, which enabled timely identification and addressing of active issues at the root cause of the ED visit. In addition, adapting the clinic flow to maximize the visit with enhanced nursing education and pharmacist input helped families and patients with epilepsy in the outpatient care setting.

It was difficult to associate any specific intervention with an improved outcome as our results were likely due to multiple interventions implemented over time. We used previous literature in our rationale and intervention selection.^{1,7,8,14,33-36}

A major difference from prior reports is that our interventions were implemented in a pediatric population as opposed to an adult population of patients with epilepsy. As similar to our SAP

intervention, investigators in the United Kingdom adopted first aid training for adult patients who frequently presented to the ED.³⁴ Participants reported increased confidence with managing seizures after the education.³⁴ The study presented improvements in health complications and outcomes such as quality of life in the adult population with high-risk epilepsy after the use of self-management interventions in a remote setting.³³ The intervention allowed the nurse or peer educator to reinforce important material in order for the patients to better understand and independently manage their epilepsy and comorbidities.³³ With continuous staff education on seizure management, patients and their families were able to reduce seizure complications and improve mental health. These findings are comparable to the SAP and nurse teach-back interventions that we implemented. A separate study in the United Kingdom conducted thematic analysis and found interventions incorporating education, care pathways, specialist review, and education for ambulance staff for acute seizure care and when transportation to a hospital for evaluation is warranted.¹ As in our study, multiple interventions were considered, and evidence showed that these interventions decreased ED visits.

Not all ED visits are preventable, and some need to occur. We recognize that many of our interventions require supplemental staffing that may not be present at other institutions. However, the resources used in our project were recommended by the Institute of Medicine on their report of what comprehensive epilepsy care should look like³⁷ and what has been previously used outside the United States.¹ Nursing currently exists in many epilepsy programs, and they are a great source of education for patients and caregivers with

TAKE-HOME POINTS

- ED visits for seizures in patients with epilepsy contribute to unplanned health care utilization.
- Many ED visits for seizures may be preventable.
- Quality improvement methodology can be successful to decrease ED visits in patients with epilepsy.

epilepsy. Time needed to perform the education may be an issue for busy practices with limited nursing availability. As with many QI projects, external unknown factors may have contributed to the success of our project. In addition, our results may not be extractable to other regions of the United States. We recognize that there is a cost to additional resources in salary, etc., which may be a barrier to other practices. However, these costs and time issues are balanced with savings to families and the overall health care system. Often in QI projects, it is difficult to assess which portion of the population benefits from each intervention. The hope is to create system wide improvement that will eventually benefit all. A further limitation is we do not have data on if patients in our established epilepsy population presented to an outside hospital ED. However, we are the only free-standing children's hospital for the majority of our patients.

Implementing QI methodology can decrease ED utilization for patients with epilepsy. This particular outcome measure is of great importance due to the financial implications¹¹ and burden to patients and caregivers.⁷ Previous work has demonstrated sustainability of our improvements.⁸ The interventions implemented do not require major changes to current epilepsy practices and can be used in other centers. The impact to patient care is great and an example of value-based care. Further work is needed to demonstrate whether these interventions can be implemented successfully in other settings of the United States. In addition, other projects targeting adult patients with epilepsy may be helpful as we did not evaluate adults with epilepsy. Many of our interventions are targeted to caregivers as they provide the care for a child with epilepsy. As outcome measures become increasingly used in health care for reimbursement purposes, QI projects like this one will become increasingly useful.

Study Funding

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Disclosure

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