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EMR Adaptations to Support the Identification and Risk Stratification of Children with Special Health Care Needs in the Medical Home

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Abstract

Introduction Children with special health care needs (CSHCN) are a high risk population with complex medical issues and needs. It is challenging to care for them in a busy, pediatric practice without understanding how many exist and how best to allocate resources. EMRs can be adapted to develop registries and stratify patients to promote population health management. *Methods* Adaptations were made to the EMR in September 2013 to capture CSHCN and the associated risk level during well-child visits prospectively. All physicians were trained on the definition of CSHCN and on risk stratification levels 1, 2, 3A and 3B. An analysis using one-way ANOVA for children ages 0–21, seen between September 1, 2011 and August 31, 2015, who were identified and stratified after September 2013, was conducted to determine utilization patterns on hospital admissions, emergency department (ED), subspecialty, and primary care visits. *Results* A total of 4687 CSHCN were identified during the study period. Of the CSHCN, 45% were Level 1, 41% Level 2, 7% 3A and 7% 3B. There were significant differences in utilization across the tiers of CSHCN with the highest level of stratification (3B) demonstrating the most hospital admissions and primary care visits. Level 3B and level 3A (unstable) had significantly more ED visits. Additionally, as tiers increased from level 1 to 3B there was an increase in subspecialty provider utilization ($p < 0.0001$). *Discussion* The EMR adaptations developed for CSHCN identified the expected number of CSHCN and predicted utilization patterns across primary, subspecialty, ED and in-patient care.

Keywords Children with special health care needs · Risk stratification · Medical homes · Utilization

Significance

The triple aim sets forth goals to improve the patient experience, the health of populations and reduce costs. A foundational element to achieve this aim for CSHCN requires approaches to systematically identify and stratify them in the primary care environment. This study highlights a feasible and effective approach implementing adaptations in the EMR that supports the medical home transformation efforts which are essential to alignment with evolving payment models opportunities.

Introduction

Children with special health care needs encompass an important subset of the population cared for by pediatricians in medical homes. They are defined by the Maternal and Child Health Bureau as "those who have or are at increased risk for chronic physical, developmental, behavioral, or emotional conditions and who also require health and health related services of a type or amount beyond that required by children generally." (McPherson et al. 1998) Nationally, estimates show that they make up about 20% of children in pediatric practices. (Strickland et al. 2009) Despite being only about 20% of the pediatric population, they account for approximately 70% of the healthcare dollars spent for all children. (Newacheck and Kim 2005) With scientific

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advancements, they are also a growing population and providing them with needed care has resulted in increased costs to the healthcare system (Perrin et al. 2007).

Healthcare reform has afforded new opportunities to enhance and improve care management for special populations (Jackson et al. 2013; Rittenhouseet al. 2009). The Patient Centered Medical Home model is one that promotes the use of disease registries often based on ICD-10 codes to identify and better manage populations (Bojadzievski and Gabbay 2011). In pediatrics, however, the diverse population of CSHCN is not easily identified or stratified into registries, as the population is not identified under one ICD code but rather can collectively encompass multiple codes. Traditional methods based on ICD 10 codes rarely, if ever, capture the complexity of the child's condition, their risk of utilization, social determinants of health and have limited application in medical homes (Leininger et al. 2015). Patterns have been studied and evaluated, however, the majority of these studies are from hospital data and few, if any are from primary care settings (Cohen et al. 2012; Davis et al. 2015; Kuo et al. 2015; Simon et al. 2010).

This study seeks to understand the impact of introducing EMR adaptations to support the identification and risk-stratification of CSHCN given the limitations of an ICD-10 based approach, and to assess the utilization patterns for the population studied. We developed a simple stratification model for CSHCN based on the Maternal and Child Health Bureau definition of CSHCN that was physician-driven and easily incorporated into the EMR utilizing an adapted version of the CSHCN screener© (Bethell et al. 2002a, b; Bramlett et al. 2014). This approach, unlike others, did not burden families with additional survey instruments and was integrated into the academic practice setting workflow in the EMR. We conducted a retrospective analysis of records at our institution to assess the impact of the EMR adaptations in identifying and stratifying the population of CSHCN and in the stratification, predicting utilization patterns in primary care, subspecialty, ED and in-patient care.

Methods

Setting

This study was conducted in four urban pediatric academic medical homes of the Ambulatory Care Network of New-York Presbyterian Hospital. The four practices are staffed by university faculty and are the setting for outpatient pediatric training of 75 residents. The patient population is predominantly of Hispanic origin and insured by Medicaid or Child Health Plus. The overall number of pediatric patients across the four medical homes is approximately 20,000. The study was approved by the institutional review board of Columbia University Irving Medical Center and determined to be exempt from informed consent.

Study Design

The EMR was adapted to capture the designation of CSHCN as an observation in the ambulatory pediatric notes section developed for CSHCN, and populated a patient registry of all CSHCN as of September 2013 and through August 31, 2015. A retrospective analysis was conducted of healthcare system utilization among a cohort of children between 0 and 21 years of age designated as CSHCN in the EMR by the physician as of August 31, 2015. Utilization data at our medical center was obtained for hospitalizations, ED visits, primary care visits and subspecialty visits by patient and by level of stratification from September 1, 2011 through August 31, 2015.

Intervention

Beginning September 2013, a section for CSHCN was integrated into all pediatric outpatient primary care notes in the EMR. Children were defined as CSHCN if they met the CSHCN screener criteria added into a "CSHCN" section for new patient notes and follow-up notes. This section included the following:

1. The definition of a CSHCN simplified from the CSHCN screener©:
    a. Does the child have a physical, emotional, behavioral, or developmental condition that is expected to last more than 1 year?
    b. Does the child take daily, prescribed medicine, other than vitamins?
    c. Is the child unable to do things most children of the same age can do?
    d. Does the child need or receive early intervention services, special education, therapy such as physical, occupational, speech or counseling?
2. The stratification model for all children who meet the definition of CSHCN:
    a. Level 1: meets the definition of CSHCN and is stable with no subspecialists
    b. Level 2: Stable condition with 1–3 subspecialists involved in care
    c. Level 3A: Unstable medical condition or social instability with 0–3 subspecialists involved in care.

Social instability as defined by acute issues such as active domestic violence, homelessness, acute maternal depression or open child welfare services case that were identified through practice screening surveys families complete as part of the well-child visit or the social history obtained during the visit.

d. Level 3B: Has 4 or more subspecialists involved in care OR has 2 or more life sustaining devices (tracheostomy, feeding tubes, home vent, BIPAP/CPAP)

The administration of the CSHCN screener questions was modified for this intervention based on physicians' knowledge and in an effort to simplify the stratification process. This modification eliminated the need for families to complete a cumbersome screener during the visit, already burdened in our setting by a complicated registration process and inefficient ancillary workflows. By embedding this identification and stratification process into the standard documentation of all pediatric well visits, the physicians were successfully engaged. Physicians were asked to select a CSHCN level at each visit and the observations in the note were built to copy forward the next time a follow up note was documented. This approach was implemented as in the vast majority of cases the stratification level would not change in subsequent visits. CSHCN patients were identified in notes if they met at least one of the criteria for the definition of CSHCN and then stratified based on the above levels. In preparation for this request for stratification, all physicians and house staff were educated on the definition of CSHCN, importance of stratification and its overall purpose to provide targeted outreach in the medical home environment through a one-hour conference in person during a faculty meeting or morning report, respectively. Overall, approximately 100 physicians received the education, as they were the only providers able to stratify patients through the EMR.

All analyses were conducted using IBM SPSS Statistics 23. First, descriptive statistics of the patients with a recorded CSHCN level were investigated with regard to demographic variables. Next, the mean number of primary care visits was compared in relation to the last CSHCN level that was recorded as of August 2015 using one-way analysis of variance. Further post-hoc analysis was done using Tukey's honest significant difference test to investigate whether the means at each CSHCN level were significantly different from each other. This analysis further clarified what CSHCN levels accounted for any differences found in the one-way analysis of variance. Similar analyses were done for specialty care visits, emergency department visits, and inpatient visits.

Results

The adaptations to the EMR resulted in the identification of the population (n = 4687) described in Table 1. This sample size was composed of all of the CSHCN stratified at the four practices as of August 2015. Fifty-four percent of the CSHCN were male with a mean age of 8.3 years. Of the populations 45% were Level 1, 41% were Level 2, 7% were 3A and 7% were 3B. 95% of the children studied were insured by New York State Medicaid or Child Health Plus (CHIP). The distribution of the population ranged from 40 to 14.9% across the four practices.

Table 2 shows the results of one-way analyses of variance analyses for the mean number of healthcare visits based on CSHCN level. Significant differences ($p < 0.0001$) among these mean visit numbers for all visit types (primary care visits, subspecialty visits, ED visits, and inpatient visits) were identified. The children with the highest frequency of medical home visits for primary care were the Level 3B with 6.0 mean visits, although this frequency was not significantly higher than the 3A level based on Tukey HSD with a mean of 5.6 visits ($p = 0.44$). The highest utilizers of the ED were the Level 3A CSHCN (unstable patients) with 4.2

Table 1 Study population

Variable	Result
Total number	4687
CSHCN level	
1	2129 (45.4%)
2	1900 (40.5%)
3A	316 (6.7%)
3B	342 (7.3%)
Age (year)	
Mean (SD)	8.3 (5.2)
Gender	
Female	2151 (45.9%)
Male	2536 (54.1%)
Site	
Practice A	1874 (40.0%)
Practice B	795 (17%)
Practice C	697 (14.9%)
Practice D	1321 (28.2%)
Insurance	
Fee for service medicaid	277 (6%)
Managed care medicaid	3831 (82%)
Child health plus	131 (3%)
Medicare	3 (< 1%)
Commercial	277 (6%)
Self-pay	89 (2%)
Other	5 (< 1%)

Table 2 Differences in number of visits based on CSHCN level

Visit type	CSHCN level	Mean number of visits	Standard deviation	ANOVA F	ANOVA P-value
Primary care visits	1	4.3	2.8		
	2	5.0	3.6		
	3A	5.6	3.9		
	3B	6.0	3.9	40.8	< 0.0001
Subspecialty care visits	1	2.4	5.0		
	2	6.2	9.3		
	3A	11.5	14.7		
	3B	17.2	17.0	319.0	< 0.0001
Emergency department visits	1	2.5	3.3		
	2	3.2	4.1		
	3A	4.2	5.1		
	3B	4.1	4.7	33.2	< 0.0001
Inpatient visits	1	0.4	0.7		
	2	0.8	2.1		
	3A	1.5	3.2		
	3B	3.7	4.6	259.4	< 0.0001

mean visits, although this frequency was not significantly more than the mean number of visits for 3B patients with a mean of 4.1 visits ($p = 0.99$). The children with the highest frequency of admissions were the Level 3B with 3.7 mean admissions and these differences in admissions were significant across all levels of CSHCN by Tukey HSD ($p < 0.0001$). Subspecialist utilization was highest for the Level 3B children with a mean of 17.2 visits and differences in utilizations were significant across all levels of CSHCN ($p < 0.0001$).

Discussion

This study demonstrates that the adaptations in the EMR implemented to identify and stratify a population of CSHCN in medical homes were feasible and effective in predicting utilization patterns relative to risk level. This simple, physician-driven risk stratification model is one of the first in this area of research implemented in an academic practice through EMR adaptations. The approach of educating physicians on the definition of CSHCN and adapting the provider notes in the EMR to capture the level of complexity yielded an identification of 4687 CSHCN. The four practices have approximately 20,000 pediatric patients, which results in the identification of about 22% of patients identified as CSHCN. This finding is in alignment with national rates of CSHCN at general practices, which is estimated to be around 20% (Newacheck and Kim 2005). One practice located closest geographically to the children's hospital identified 40% CSCHN and is historically perceived by the in-patient teams as the main outpatient site resulting in a high number of referrals of complex patients to that location.

The challenge of systematically identifying CSHCN has been long-standing and for the most part, in-patient hospital or health insurance focused (Leininger et al. 2015; Simon et al. 2014). This approach has resulted in CSHCN models or studies that inform quality improvement programs from a predominantly hospital utilization perspective. Some work has been done and focused more on the most medically complex and further defining them by considering domains such as needs, chronic conditions, functional limitations and healthcare utilization (Cohen et.al. 2011). Our model adds the critical element of identifying all CSHCN from the medical home setting, through the EMR, and supporting the stratification of the population including medical complexity and social stability. This stratification serves to promote care management and align with potential health care reform opportunities such as NCQA Patient Centered Care Recognition.

Specifically knowing who comprises the broad population of CSHCN beyond patients with the traditional diagnoses of asthma and depression to include children with neurodevelopmental conditions, genetic and metabolic conditions and high-risk social circumstances is essential. Furthermore, determining their different levels of complexity enables medical homes to outreach with care managers, callbacks for appointments, vaccination outreach, and community-linkages to support programs. These CSHCN have been challenging to identify systematically and this model "brings them to the surface" enabling the outreach to be implemented. The traditional models to identify CSHCN

have focused on retrieving ICD codes from databases. (Simon et al. 2014) This approach has successfully identified medically complex children, with strong sensitivity and specificity but it has limitations when considering implementation at the medical home level in terms of practicality, feasibility and the ability to work with claims data in smaller practice settings with limited resources. Additionally, it does not address the importance of accounting for social determinants of health.

In order to assess if the stratification of levels in the EMR was an accurate reflection of the actual utilization of the CSHCN we reviewed the utilization patterns retrospectively. As expected, the Level 3A CSHCN, defined as "unstable" by the methodology, had the highest number of ED visits. This study did not find that the most medically complex (level 3B) were drivers of ED utilization, which is similar to, patterns and cost of this population previously noted (Cohen et.al 2011). The analysis also did not demonstrate a significant difference in ED utilization between the level 3A and the level 3B CSHCN, a finding which warrants further study, however, it gives insight into the concept of high ED utilizers in the pediatric medical home. This general approach however provides a framework for medical homes to understand the populations at risk of ED utilization, which is essential in any care management strategy, and can inform outreach with social work support, nurse care management or community health workers to decrease preventable ED utilization.

The most medically complex children (Level 3B), as expected, were found to be the highest utilizers of primary care, subspecialty care and in-patient hospital visits. Few, if any studies have been able to demonstrate these findings from the medical home perspective, which is involved in coordinating, care across those three settings (Simon et al. 2010; Cohen et al. 2011). By targeting this subset of patients, systems can be implemented to target reductions in length of stay of in-patient admissions, decrease preventable ED visits and hospitalizations and to improve patient and family experience in the medical home and ensure subspecialty integration to the overall patient experience. Knowing the scope of the CSHCN population informs many down-stream decisions as systems consider accountable care organizations and medical home expansion efforts to improve the quality of care and reduce costs (Peter et al 2011; Kelleher et al. 2015; Payne and Christensen 2016).

We note several limitations to this study for consideration. Firstly, we did not conduct a validation of the selection of the level of complexity in the study population and recognize that the identification was entirely at the discretion of the physician. The possibility exists that patients identified as 3B or other levels were not accurately defined per the criteria or were entirely missed from the classification. Subsequent studies are warranted to evaluate the validity of the identification and stratification. Additionally, utilization by the study patients outside of the children's hospital system was not obtained and some likely experienced utilization outside of the medical center at both hospital and outpatient settings, which may have affected the findings. Additionally, we did not evaluate the fluctuation of levels by patient over time in this early study and did not determine the impact of chronic disease progression on the findings.

Conclusions

These adaptations to the EMR identified CSHCN as expected and predicted their utilization patterns for primary and subspecialty care, and for hospital and ED care. Children with the highest level of complexity, level 3B, had the highest utilization in primary care, subspecialty care and of overall hospital admissions. Those children identified as "unstable"—level 3A had the highest frequency of ED utilization reflecting their acute needs. These enhancements strengthen the medical home by aiding in the identification of high-risk populations and establishing a functional registry for medical home teams to utilize in care management strategies.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflicts of interest to disclose.

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