RESEARCH ARTICLE

Ambulatory quality, special health care needs, and emergency department or hospital use for US children

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Abstract

Objective: This study examined family-reported ambulatory care quality and its association with emergency department and hospital utilization, and how these relationships differed across levels of medical complexity.

Data sources: The 2006-2013 Medical Expenditure Panel Survey (MEPS).

Study Design: Secondary analysis of MEPS data. Variables fitting the National Quality Measures Clearinghouse clinical quality measures domain framework were selected. Exploratory factor analysis grouped ambulatory quality into 12 access, experience, or process measures. Weighted negative binomial regression stratified by health status identified associations between ambulatory quality and ED visits or hospitalizations.

Data Collection: 41,497 children ≤18 years were included. The 5-item special health care needs (SHCN) screener categorized health status as complex, less complex, or no SHCN.

Principal Findings: Weighted SHCN proportions were 1.6 Percent complex, 18.2 Percent less complex, and 80.0 Percent no SHCN. Mean ED visits were 130 and 335 visits/1000 children/year for no/complex SHCN, respectively. Mean hospitalizations were 20 and 175 hospitalizations/1000 children/year for no/complex SHCN, respectively. ED visits were associated with 8 of 12 quality measures for no/less complex SHCN. For example, usually/always receiving needed care right away was associated with 22 Percent lower ED visit rate (95% CI 0.64-0.96). Hospitalizations were associated with 4 of 12 quality measures for less complex SHCN. In complex SHCN, associations between ambulatory quality and ED/hospital use were weak and inconsistent.

Conclusions: Ambulatory quality may best predict ED and hospital use for children with no or less complex SHCN. Whether and how ambulatory care predicts emergency and hospital care in complex SHCN remains an important question.

KEYWORDS

ambulatory care, emergency service, hospitalization, quality of health care

1 | INTRODUCTION

Over \$20B are spent annually on non-neonatal and nonmaternal hospitalizations for US children.¹ Hospital and emergency department (ED) visits are measures of health and chronic disease control.² Reducing hospital and ED use is a family-centered goal³ and can lower health care spending.⁴ Although evidence is still emerging, higher quality ambulatory care, such as continuity and preventive care adherence, may lower hospital and ED use.⁵⁻⁷ For example, continuity is likely driven by the ease with which families can connect to the right provider at the right time. In fact, a study on asthma hospitalizations observed lack of contact (phone or clinic) with the ambulatory physician before the hospitalization was the greatest preventable risk factor for admission.⁸ Some specific illnesses, *for example*, pneumonia or asthma, may be particularly “sensitive” to ambulatory care.^{9,10}

These relationships are not always straightforward; inconsistent or paradoxical relationships could exist. While population-based pediatric studies have identified associations between receipt of family-centered care, shared decision making, and fewer unmet needs,¹¹ changes in ED and hospital use have been harder to identify.¹² Moreover, a recent study of respiratory hospitalizations observed unexpectedly higher odds of repeat ED visits when perceived access was higher, and no associations were observed between perceived access and rehospitalization.¹³

A key unknown is whether and how ambulatory care quality predicts ED and hospital utilization in children by underlying chronic illness. Recent research suggests that hospitalizations may have very different relationships with ambulatory care quality based on health status—stronger relationships for children with less complex chronic illness and weaker relationships for children with more complex illness.¹⁴ Expanded research on this topic could have policy implications and inform the implementation of ambulatory care strategies to prevent avoidable ED or hospital visits across health systems.

Our primary objective was to identify associations between parent-reported ambulatory care quality and pediatric ED or hospital visits. Our secondary objective was to evaluate how these relationships vary among children with: complex special health care needs (SHCN), less complex SHCN, and no SHCN. We hypothesized that ambulatory quality would better predict hospital and ED visits for children with less complexity. Understanding the ambulatory care elements associated with fewer ED or hospital visits while accounting for a child's underlying health status may facilitate more appropriately tailored system-level ambulatory interventions to achieve these outcomes. This study serves as a step toward developing tools to precisely identify children at risk for ED or hospital visits and eventually reducing that risk.

2 | METHODS

2.1 | Study design, data source, and population

A nationally representative cohort of children ≤18 years was created from 2006 to 2013 Medical Expenditure Panel Survey (MEPS) data.

What this Study Adds

- High-quality ambulatory care aims to prevent emergency department and hospital use, though the evidence base is small particularly in pediatrics. Few studies have evaluated whether underlying health status moderates associations between ambulatory quality and emergency department or hospital use.
- In this nationally representative cohort study, emergency department visits and hospitalizations for children with no complex special health needs were associated with 8 of 12 and 4 of 12 ambulatory quality measures, respectively. Associations were strongest for children with less complex special health care needs. Almost no associations were observed for children with medical complexity.

MEPS is a prospective, publicly available, nationally representative survey of the US noninstitutionalized population.¹⁵ Household participants are drawn from a subsample of those enrolled in the National Health Interview Survey during the previous year. Sample weights are provided by MEPS, with oversampling for policy-relevant subpopulations (nonwhite race/ethnicity, lower income).¹⁵ Data about each person in the household are collected using five computer-assisted, in-person interview rounds spanning a two-year period.¹⁶ The survey is conducted annually using an overlapping panel design in which a new two-year panel begins every calendar year. The household survey includes demographics, health status, medical events (eg, outpatient, ED, inpatient), health insurance, employment, access to and satisfaction with care, opinions about medical care, health behaviors, and preferences. Response rates for household files ranged from 52.8 to 59.3 Percent over the study years.

2.2 | Health status

We defined health status using the children with SHCN screener^{17,18} completed by all household caregivers in MEPS in the second of the five rounds of data collection. Children are defined as having SHCN based on experiencing one or more of five health consequences attributable to a medical/behavioral condition lasting, or expected to last, for at least 12 months. The five health consequences include the following: functional limitations, need for prescription medication, medical/behavioral services, specialized therapies, and treatment or counseling for a developmental or behavioral problem. Adapting prior approaches,¹⁹⁻²¹ we used the 5-item screener to categorize the health status of participating children into three groups: (a) complex SHCN (positive screener, positive medical/behavioral care item, and at least 3 of 4 remaining items); (b) less complex SHCN (positive screener, but not meeting complex criteria); or (c) no SHCN (negative screener).

TABLE 1 Ambulatory care quality measures included from the medical expenditure panel survey

Domain	Label	Measure definition/Survey question
Access	Usual source for care	A usual source for care is person you can go to for new and ongoing health problems, preventive care, and referrals to other health professionals
	Care when needed	In the last 12 mo, when you needed care right away, how often did you get care as soon as you thought you needed (Usually/Always vs Never/Sometimes)?
	Appointments when needed	In the last 12 mo, not counting times you needed health care right away, how often did you get an appointment for health care as soon as you thought you needed (Usually/Always vs Never/Sometimes)?
	Difficulty contacting during business hours	How difficult is it to contact your usual source for care during regular business hours over the telephone about a health problem (Very/somewhat difficult, Not too difficult, or Not at all difficult)?
	Difficulty contacting after-hours	How difficult it to contact your usual source for care after their regular hours in case of urgent medical needs (Very/somewhat difficult, Not too difficult, or Not at all difficult)?
	Distance to usual source of care	How long does it usually take you to get to your usual source for care (<15, 15-30, 31-60 min, or >60 min)?
	Usual source has after-hours clinic	Does the usual source of care have office hours at night or on weekends?
Experience	Providers...	In the last 12 mo, how often did your doctors or other health providers...(Never, Sometimes, Usually, or Always)
	...listen carefully ^a	...listen carefully to you?
	...explain things in a way that was easy to understand ^a	...explain things in a way that was easy to understand?
	...show respect for what you have to say ^a	...show respect for what you had to say?
	...spend enough time with your child ^a	...spend enough time with your child?
	Overall rating of care	Using any number from 0 to 10, where 0 if the worst health care possible and 10 is the best health care possible, what number would you use to rate all of your child's health care in the last 12 mo?
Process	Help make treatment decisions	If there were a choice between treatments, how often would your usual source for care ask you to help make the decision (Always vs not always)?
	Explain all options	Does your usual source for care present and explain all options to you (Yes/No)?
	Screening...	When was the last time... (within the past year, past 2 y or >2 y)
	...recent height measurement ^b	...height was measured
	...recent weight measurement ^b	...weight was measured
	...recent blood pressure measurement ^b	...blood pressure was measured
	...recent advice about passive smoke exposure ^b	...advice was given about how smoking in the house can be bad for your child's health?

^aPatient-Centered Communication Scale.^bTimely Routine Screening Scale.

Children whose health status could not be characterized due to missing screener responses ($n = 103$ [0.2 Percent]) were excluded from this study.

2.3 | Ambulatory care quality measures

Research team members reviewed MEPS to select variables relevant to all health status groups, used consistently over the study years, and fitting the National Quality Measures Clearinghouse measure domain framework.²² This framework categorizes clinical quality measures into access, experience, process, structure, and

outcome domains. Outcomes in this study, described below, include ED visits and hospitalizations. Because structure variables were limited within MEPS, this domain was not included in analyses. We grouped variables into access, experience, and process domains by consensus through research team discussion (Table 1). The earliest available ambulatory care quality data were used in this study—typically from the second of the five rounds of data collection. For the typical respondent, round two was approximately six months following enrollment, with families reporting on ambulatory care over the prior 12 months. Outcome counts (ED and hospital visits) were aggregated over the full two-year panel from data collected at each of the five rounds.

TABLE 2 Characteristics of US children in the medical expenditure panel survey according to health status category

	No SHCN (n = 33,836)	Less complex SHCN (n = 7,024)	Complex SHCN (n = 637)
Age, mean (SD)	8.2 (5.3)	10.0 (4.7)	9.3 (4.5)
Gender, n (%) [†]			
Female	17,176 (50.9)	2,952 (41.8)	208 (34.1)
Race/Ethnicity, n (%)			
White, non-Hispanic	10,505 (53.1)	2,863 (62.2)	271 (62.4)
Black, non-Hispanic	6,688 (13.7)	1,851 (15.8)	140 (14.0)
Hispanic	13,492 (24.3)	1,794 (15.1)	164 (15.5)
Other	3,151 (8.9)	516 (6.9)	62 (8.1)
Payer, n (%)			
Any private	14,798 (59.3)	3,165 (60.8)	224 (47.4)
Public only	16,379 (33.8)	3,610 (35.6)	402 (50.6)
None	2,659 (7.0)	249 (3.6)	11 (2.0)
Primary language, n (%)			
English	20,932 (72.3)	5,398 (80.4)	464 (80.2)
Household Income, n (%)			
≤100% FPL	11 000 (21.5)	2301 (20.9)	227 (26.0)
101%-125% FPL	2739 (6.0)	539 (5.9)	65 (8.7)
126%-200% FPL	6315 (16.6)	1228 (14.9)	118 (18.6)
201%-400% FPL	8548 (31.4)	1751 (30.5)	142 (26.7)
>400% FPL	5234 (24.6)	1205 (27.8)	85 (20.0)
CSHCN Screener, n (%)			
Prescription medication		5097 (75.1)	524 (83.2)
Medical/Behavioral services		2542 (35.7)	637 (100.0)
Functional limitations		1275 (16.5)	547 (86.7)
Specialized therapies		1051 (13.9)	497 (77.6)
Counseling		1873 (25.0)	557 (87.9)
ED visit no., mean per 1000 children per year (SD)	130 (315)	220 (455)	335 (625)
ED visits, n (%)			
0	27 388 (81.0)	4974 (72.2)	402 (64.4)
1	4687 (14.1)	1339 (18.3)	137 (20.8)
2+	1761 (4.9)	711 (9.5)	98 (14.8)
Hospitalization no., mean per 1000 children per year (SD)	20 (110)	50 (230)	175 (545)
Hospitalizations, n (%)			
0	32,660 (96.5)	6,499 (92.9)	524 (82.6)
1	1,065 (3.2)	405 (5.3)	74 (10.5)
2+	111 (0.3)	120 (1.7)	39 (6.9)

Note: n indicates the unweighted number of subjects in the sample with nonmissing information, % indicates population-weighted percentage.

Abbreviations: CSHCN, Children with Special Health Care Needs; ED, Emergency Department; FPL, Federal Poverty Line; SHCN, Special Health Care Needs.

Access measures first identified the presence of a usual source of care, which could be a general or subspecialty provider. This measure was adapted from the Healthy People 2020 leading health indicator, "Usual Primary Care Provider,"²³ and defined as a person managing preventive care, new and ongoing health problems, and referrals to other health professionals. Families then reported on receipt of care, communication, appointments when needed, and

distance (<15, 15-30, 31-60, >60 minutes) from the usual source of care. Experience measures included providers listening carefully, explaining things in a way that was easy to understand, showing respect for what parents had to say, spending enough time with the child, and overall rating of all health care (0-10). Process measures included asking parents to help make treatment decisions (proxy for shared decision making), explaining all options, having

recent height, weight, and blood pressure measurement, and advice about passive smoke exposure.

With the exception of distance to care, the included measures are frequently used indicators of ambulatory care quality in pediatrics. The measures were derived from the validated Clinician and Group Consumer Assessment of Health Care Providers and Systems surveys, endorsed by the National Quality Forum, recommended by the American Academy of Pediatrics guidelines for health supervision,²⁴ used in broad evaluations of pediatric health care quality,²⁵ or rated valid and feasible to measure for children with medical complexity.²⁶

2.4 | Exploratory factor analysis

We applied exploratory factory analysis (EFA) to combine and reduce ambulatory measures in each domain to a feasible, meaningful set of measures. We used Mplus (version 8.0) to conduct weighted EFA, as has previously been done with MEPS.¹¹ We created three separate models—one for ambulatory care access, one for process, and one for experience. The number of factors retained was determined using the Guttman-Kaiser criterion^{27,28} and by evaluating scree plots. In cases where the EFA solution for a domain produced multiple factors, each factor was interpreted for substantive meaning and then defined according to factor loadings. Sufficiently correlated items (Cronbach's alpha > 0.7) in each domain were included in subsequent analyses as continuous scales (composite scores calculated as the sum of an individual's response to each variable within the scale).

2.4.1 | Access

None of the access quality measures evaluated in EFA were sufficiently correlated to create scales. All seven access measures were included as independent predictors in subsequent analyses.

2.4.2 | Experience

Among the five measures in the experience domain, EFA identified a group of four well-correlated items (Cronbach α = 0.88): Providers listened carefully to you, providers explained things in a way that was easy to understand, providers showed respect for what you had to say, and providers spent enough time with your child. Each item was scored from 1 (never) to 4 (always), resulting in a range of scale scores from 4 to 16 (higher is better). We labeled this scale "patient-centered communication." The experience domain was therefore comprised of two measures in subsequent analyses: patient-centered communication and the fifth measure, overall rating of health care.

2.4.3 | Process

Among the six measures in the process domain, EFA identified a group of four well-correlated items (Cronbach α = 0.85): height, weight, and BP measurement, and advice about passive smoke exposure. Each item was scored 1 (≤ 1 year), 2 (1-2 years), or 3 (> 2 years), resulting in a range of scale scores from 4 to 12 (lower is better). We labeled this scale "timely routine screening." The process domain was therefore comprised of three measures in subsequent analyses: timely routine screening and the two other measures, asking parents to help make treatment decisions (proxy for shared decision making), explaining all options.

2.5 | Outcomes and covariates

Primary outcomes were the counts of ED visits and hospitalizations reported during the two-year panel period. Covariates included child age, gender, race/ethnicity, primary language (English, non-English), household income (≤ 100 , 101-125, 126-200, 201-400, 400 Percent federal poverty line), insurance (any private, public only, none), and panel number (earliest panel as reference).

2.6 | Statistical analysis

This analysis of prospectively collected data was conducted with SAS version 9.4. (SAS Institute) using survey procedures to account for complex survey design and weights provided by MEPS. Following descriptive statistical summaries of key variables, weighted negative binomial regression stratified by health status and adjusted for all covariates identified associations between each ambulatory care quality measure or EFA-derived scale score and numbers of ED visits or hospitalizations. Poisson models were not used because outcomes demonstrated over-dispersion. Additionally, all children were assumed to be at risk for ED or hospital visits; therefore, counts were not considered zero-inflated.²⁹ Results were summarized as incident rate ratios (IRR), where an IRR < 1 indicated that better quality was associated with fewer ED visits or hospitalizations. P value $\leq .05$ was considered statistically significant. This secondary analysis of publicly available data was exempt from IRB review.

3 | RESULTS

3.1 | Population

We identified 41,497 children (weighted N = 74,351,514), 80.0 Percent (N = 59,588,690) of whom had no SHCN, 18.2 Percent (N = 13,583,125) had less complex SHCN, and 1.6 Percent (N = 1,179,699) had complex SHCN. Table 2 summarizes demographic characteristics by underlying health status category. Children with

complex SHCN were older and, more commonly, non-Hispanic white, publicly insured, lower income, and in an English-speaking household. The two most common positive screener responses for children with less complex SHCN were need for prescription medications (75.1 Percent) and medical/behavioral services (35.7 Percent). All screener items were reported frequently among children with complex SHCN (need for specialized therapies [77.6 Percent] was least common).

3.2 | Ambulatory care quality

Almost all children had a usual source for care, and nearly 50 Percent lived within 15 minutes from their usual source (Figure 1). Although more than 90 Percent reported getting care or appointments right away when needed, only about 60 Percent reported having no difficulty contacting their usual source for care during the day and even fewer (about 40 Percent) reported no difficulty after hours. Experience measures were generally positive. Mean patient-centered communication scale scores (max = 16) ranged from mean (SD) 14.2 (2.4) for complex SHCN to 15.0 (0.9) for no SHCN. Overall rating of care (max = 10) ranged from mean (SD) 8.2 (1.8) for complex SHCN to 9.0 (1.3) for no SHCN. Process measures were also generally positive. Timely receipt of care scale scores (lower is better,

best = 4) ranged from mean (SD) 4.4 (0.8) for complex SHCN to 5.0 (1.7) for no SHCN.

3.3 | ED visits and ambulatory quality

Mean ED visits per 1000 children per year were 130 (no SHCN), 220 (less complex SHCN), and 335 (complex SHCN) (Table 2). Children with no SHCN or less complex SHCN had similar associations between ambulatory quality measures and ED visits (Figure 2 and Appendix S1): Five of the seven access measures, both of the experience measures, and one of the three process measures were associated with fewer ED visits. Effect sizes ranged from IRR 0.73 to 0.97. As an example, children with less complex SHCN who reported "receiving needed care right away" had over 20 Percent fewer ED visits (IRR 0.78 [95% CI 0.64-0.96]). None of the 12 ambulatory measures were associated with ED visits for children with complex SHCN.

3.4 | Hospitalizations and ambulatory quality

Mean hospitalizations per 1000 children per year were 20 (no SHCN), 50 (less complex SHCN), and 175 (complex SHCN). For children with no SHCN, patient-centered communication was the only measure

FIGURE 1 Categorical Ambulatory Access and Process Measures by Health Status Category in US Children. SHCN indicates Special Health Care Needs. Shown are the weighted percent distributions of categorical ambulatory quality measures, stratified by health status category. Experience and process measures that were continuous (ie, patient-centered communication, timely routine screening, and overall rating of care) are reported in Results

associated with fewer hospitalizations. Most associations between ambulatory quality measures and hospitalizations were among children with less complex SHCN (Figure 3 and Appendix S1). For example, three of the access measures and one process measure (timely routine screening) were associated with hospitalizations. Effect sizes ranged from IRR 0.70 to 1.30. Dose-response relationships were not observed for categorical measures of difficulty contacting the usual source for care. For children with complex SHCN, two access measures (having usual source for care and living within 15 minutes from usual source) were associated with fewer hospitalizations.

4 | DISCUSSION

This nationally representative study identified associations between ambulatory care quality and ED visits or hospitalizations among US children. The breadth of ambulatory care domains and comparison across health status groups distinguishes this from previous studies.^{12,30,31} Results were consistent with our hypothesis that broad domains of ambulatory care quality are associated with ED visits for children with no/less complex SHCN and hospitalizations for children with less complex SHCN. However, our findings raise questions about the extent to which such domains predict ED and hospital use for children with more complex health conditions.

Our study extends the relatively limited body of evidence linking pediatric ambulatory care quality and ED or hospital use. A more

complete understanding of the relationships between ambulatory care, ED and hospital use, and the influence of SHCN are worthy pursuits since important policy-relevant unknowns remain. We suspect that for children with the most complex SHCN, changing common access measures may not be sufficient to reduce ED or hospital use. More likely, these children require greater integration of care, a concept encompassing highly patient-centered and coordinated care across providers and community resources.³² More integrated care has improved utilization in some studies,³³ but integration is challenging to measure and operationalize.^{34,35} Future population-based surveys would be strengthened by adding recently developed ambulatory quality measures for children with medical complexity that target care coordination and integration.³⁶⁻³⁹ Incorporating these constructs in analyses may uncover meaningful associations between ambulatory care and ED or hospital use for these children.

It is also possible that ambulatory care quality might actually be a relatively weak driver of ED and hospital use when compared to other factors. In our prior qualitative work with families of children with medical complexity,³ we found that family decisions to seek acute care were expressed as a balance among three concepts—ambulatory care, disease severity/susceptibility, and family capacity/resources—however, the relative weights of any of these are unknown. When compared to disease severity or family capacity, ambulatory care quality may simply play a more limited role for children with complex SHCN. While rapidly emerging ambulatory “complex care” models have been associated with lower utilization and

FIGURE 2 Associations between Ambulatory Access, Experience, and Process Measures and Emergency Department Visits by Health Status Category in US Children. IRR, Incident Rate Ratio. Shown are weighted negative binomial regressions of emergency department visits on ambulatory measures, stratified by health status and adjusted for age, gender, primary language, race/ethnicity, income, insurance, and panel number. IRR (95% CI) < 1 indicates better quality is associated with fewer emergency department visits. Asterisks indicate $P < .05$. IRR estimates and 95% CI are available in the Appendix S1.

FIGURE 3 Associations between ambulatory access, experience, and process measures and hospitalizations by health status category in US children. IRR, Incident Rate Ratio. Shown are weighted multivariate negative binomial regressions of hospitalizations on ambulatory measures, stratified by health status and adjusted for age, gender, primary language, race/ethnicity, income, insurance, and panel number. IRR (95% CI) < 1 indicates better quality is associated with fewer hospitalizations. Asterisks indicate $P < .05$. IRR estimates and 95% CI are available in the Appendix S1

better access, experience, and process,⁴⁰ it would be useful to study whether the mechanism is through improvements in family capacity and resources versus higher ambulatory care quality.

Using this study's results to guide interventions to reduce hospital and ED visits is the long-term goal of this line of research. Since most of the identified access and process measures from this study are potentially modifiable, opportunities exist to test whether targeted health system-level interventions to improve performance on these measures lead to lower ED and hospital use, and determining whether such interventions are cost-effective. While some experience measures were associated with utilization, relationships were inconsistent and small in magnitude suggesting interventions targeting this construct might less effectively prevent ED or hospital use. Focusing initially on children with no or less complex SHCN and on variables with larger effect sizes, for example, reducing difficulty contacting the usual source of care after hours, might be efficient and effective strategies. Interventional research will also need to account for the dynamic nature of the primary care environment for children. For example, a recent study of US children observed that from 2003 to 2012, primary care access and continuity measures improved while family-centeredness and comprehensiveness decreased,⁴¹ and these changes were not uniform across the population.

Although lists of conditions for which high-quality outpatient care may prevent hospitalization—"ambulatory care-sensitive conditions" (ACSC)⁴²⁻⁴⁴—could represent a reasonable focus for initial interventional research, more work is needed first. The actual

preventability of ACSC hospitalizations and the specific ambulatory care elements that influence them are not well understood in pediatrics. For example, physicians and parents have had discrepant opinions of the preventability of ACSC hospitalizations.⁴⁵ In a 10-state Medicaid analysis, outpatient visits the week before hospitalization were uncommon, only occurring <1/3rd of the time, and were actually more common in children with ACSC hospitalizations.⁴⁶ Our findings combined with previous research¹⁴ also beg the question whether children with different underlying health status might even have distinct ACSCs. Such a scenario could have important policy implications since ACSCs are used as indicators of care quality across populations and health systems. A follow-up study evaluating associations between this study's measures and ACSC hospitalizations as the outcome would be a helpful step to further explore these questions.

This study has several limitations. As an observational study, we cannot draw conclusions about causal relationships between ambulatory care quality and ED or hospital visits. Although MEPS respondents were enrolled for two years, assessment of quality and health care use was largely cross-sectional. Longitudinal studies are needed to understand these presumably dynamic relationships. It is possible that the study was underpowered to detect some associations, particularly for children with complex SHCN. It is difficult to validate parent-reported ambulatory measures with currently available data; however, we used measures that have been included in a number of prior studies. In particular, these ambulatory quality measures may

have less reliability and validity in these SHCN subpopulations. As with other datasets, MEPS allows parents to self-identify their usual source for care, which could be a generalist or specialist. How the inclusion of different types of primary care providers impacts evaluations of care quality is not well understood. The dataset included limited information about reasons for ED and hospital visits. We were limited to ambulatory measures within MEPS that our team identified and may have excluded important quality metrics or confounders. The small number of disease-specific ambulatory quality measures for the many pediatric chronic and complex conditions is an additional barrier to investigating ambulatory care processes and health care outcomes at the population level.

Despite these limitations, this study has important implications. Most notably, the quality of ambulatory care experienced by US children and their families is associated with ED and hospital visits, particularly among children with less complex SHCN. Rigorous interventional research should explore whether deliberate and scalable strategies to improve ambulatory access, experience, or process can prevent ED and hospital use. Determining whether general interventions can improve these measures, or whether children with specific chronic or complex conditions will require unique approaches are important targets for future study. Finally, the children with the highest rates of ED and hospital use—children with complex SHCN—need reliable and valid predictors to inform future population-level interventions.

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CONFLICT OF INTEREST

The authors have no conflicts of interest relevant to this article to disclose.

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REFERENCES

1. Witt WP, Weiss AJ, Elixhauser A. Overview of Hospital Stays for Children in the United States, 2012. HCUP Statistical Brief #187. December 2014. Rockville, MD: Agency for Healthcare Research and Quality (US); 2006. <http://www.hcupus.ahrq.gov/reports/statbriefs/sb187-Hospital-Stays-Children-2012.pdf>
2. House SA, Coon ER, Schroeder AR, Ralston SL. Categorization of national pediatric quality measures. *Pediatrics*. 2017;139(4):e20163269.
3. Nelson BB, Collier RJ, Saenz AA, et al. How avoidable are hospitalizations for children with medical complexity? Understanding parent perspectives. *Academic Pediatrics*. 2016;16:579-586.
4. Berry JG, Hall M, Neff J, et al. Children with medical complexity and Medicaid: spending and cost savings. *Health Aff (Millwood)*. 2014;33(12):2199-2206.
5. Christakis DA, Mell L, Koepsell TD, Zimmerman FJ, Connell FA. Association of lower continuity of care with greater risk of emergency department use and hospitalization in children. *Pediatrics*. 2001;107(3):524-529.
6. Tom JO, Tseng CW, Davis J, Solomon C, Zhou C, Mangione-Smith R. Missed well-child care visits, low continuity of care, and risk of ambulatory care-sensitive hospitalizations in young children. *Arch Pediatr Adolesc Med*. 2010;164(11):1052-1058.
7. Arthur KC, Mangione-Smith R, Burkhart Q, et al. Quality of care for children with medical complexity: an analysis of continuity of care as a potential quality indicator. *Acad Pediatr*. 2018;18(6):669-676.
8. Flores G, Abreu M, Tomany-Korman S, Meurer J. Keeping children with asthma out of hospitals: parents' and physicians' perspectives on how pediatric asthma hospitalizations can be prevented. *Pediatrics*. 2005;116(4):957-965.
9. Parker JD, Schoendorf KC. Variation in hospital discharges for ambulatory care-sensitive conditions among children. *Pediatrics*. 2000;106(4 Suppl):942-948.
10. Jaeger MW, Ambadwar PB, King AJ, Onukwube JI, Robbins JM. Emergency care of children with ambulatory care sensitive conditions in the United States. *J Emerg Med*. 2015;49(5):729-739.
11. Lindly OJ, Geldhof GJ, Acocck AC, Sakuma KK, Zuckerman KE, Thorburn S. Family-centered care measurement and associations with unmet health care need among US children. *Acad Pediatr*. 2017;17(6):656-664.
12. Lindly OJ, Zuckerman KE, Mistry KB. Clarifying the predictive value of family-centered care and shared decision making for pediatric healthcare outcomes using the medical expenditure panel survey. *Health Serv Res*. 2017;52(1):313-345.
13. Kenyon CC, Gruschow SM, Haaland WL, et al. Perceived access to outpatient care and hospital reutilization following acute respiratory illnesses. *Acad Pediatr*. 2019;19(4):370-377.
14. Collier RJ, Kelly MM, Ehlenbach ML, Goyette E, Warner G, Chung PJ. Hospitalizations for ambulatory care-sensitive conditions among children with chronic and complex diseases. *J Pediatr*. 2018;194:218-224.
15. Cohen JW, Cohen SB, Banthin JS. The medical expenditure panel survey: a national information resource to support healthcare cost research and inform policy and practice. *Med Care*. 2009;47(7 Suppl 1):S44-50.
16. Agency for Healthcare Research and Quality. MEPS-HC Panel Design and Collection Process. https://meps.ahrq.gov/mepsweb/survey_comp/hc_data_collection.jsp. Accessed January 24, 2020
17. Bethell CD, Read D, Stein RE, Blumberg SJ, Wells N, Newacheck PW. Identifying children with special health care needs: development and evaluation of a short screening instrument. *Ambul Pediatr*. 2002;2(1):38-48.
18. Blumberg SJ, Olson L, Frankel M, et al. Design and operation of the National Survey of Children with Special Health Care Needs, 2001. *Vital Health Stat*. 2003(41):1-136.

19. Kuo DZ, Goudie A, Cohen E, et al. Inequities in health care needs for children with medical complexity. *Health Aff (Millwood)*. 2014;33(12):2190-2198.
20. Kuo DZ, Cohen E, Agrawal R, Berry JG, Casey PH. A national profile of caregiver challenges among more medically complex children with special health care needs. *Arch Pediatr Adolesc Med*. 2011;165(11):1020-1026.
21. Bramlett MD, Read D, Bethell C, Blumberg SJ. Differentiating subgroups of children with special health care needs by health status and complexity of health care needs. *Matern Child Health J*. 2009;13(2):151-163.
22. National Quality Measures Clearinghouse (NQMC). Domain Framework. Agency for Healthcare Research and Quality (AHRQ). <https://www.qualitymeasures.ahrq.gov/help-and-about/summaries/domain-framework>. Accessed December 20, 2016
23. Office of Disease Prevention and Health Promotion. Healthy People 2020. AHS-3. Increase the proportion of persons with a usual primary care provider. https://www.healthypeople.gov/node/3970/data_details. Accessed February 1, 2020
24. Hagan JF, Shaw JS, Duncan PM. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, 4th edn. Elk Grove Village, IL: Bright Futures/American Academy of Pediatrics; 2017.
25. Mangione-Smith R, DeCristofaro AH, Setodji CM, et al. The quality of ambulatory care delivered to children in the United States. *N Engl J Med*. 2007;357(15):1515-1523.
26. Chen AY, Schragger SM, Mangione-Smith R. Quality measures for primary care of complex pediatric patients. *Pediatrics*. 2012;129(3):433-445.
27. Guttman L. Some necessary conditions for common-factor analysis. *Psychometrika*. 1954;19(2):149-161.
28. Kaiser HF. The application of electronic-computers to factor-analysis. *Educ Psychol Meas*. 1960;20(1):141-151.
29. Pittman B, Buta E, Krishnan-Sarin S, O'Malley SS, Liss T, Gueorguieva R. Models for analyzing zero-inflated and overdispersed count data: An application to cigarette and marijuana use. *Nicotine Tob Res*. 2018. <https://doi.org/10.1093/ntr/nty072>
30. Raphael JL, Mei M, Brousseau DC, Giordano TP. Associations between quality of primary care and health care use among children with special health care needs. *Arch Pediatr Adolesc Med*. 2011;165(5):399-404.
31. Brousseau DC, Hoffmann RG, Nattinger AB, Flores G, Zhang Y, Gorelick M. Quality of primary care and subsequent pediatric emergency department utilization. *Pediatrics*. 2007;119(6):1131-1138.
32. Singer SJ, Burgers J, Friedberg M, Rosenthal MB, Leape L, Schneider E. Defining and measuring integrated patient care: promoting the next frontier in health care delivery. *Med Care Res Rev*. 2011;68(1):112-127.
33. Cohen E, Lacombe-Duncan A, Spalding K, et al. Integrated complex care coordination for children with medical complexity: a mixed-methods evaluation of tertiary care-community collaboration. *BMC Health Serv Res*. 2012;12:366.
34. Cohen E, Collier RJ. Evaluating Integrated Care for Children: A Clarion Call or a Call for Clarity? *Pediatrics*. 2020;145:e20193282.
35. Wolfe I, Satherley RM, Scotney E, Newham J, Lingam R. Integrated care models and child health: a meta-analysis. *Pediatrics*. 2020;145:e20183747.
36. Gidengil C, Parast L, Burkhart Q, et al. Development and implementation of the family experiences with coordination of care survey quality measures. *Acad Pediatr*. 2017;17(8):863-870.
37. Parast L, Burkhart Q, Gidengil C, et al. Validation of new care coordination quality measures for children with medical complexity. *Acad Pediatr*. 2018;18(5):581-588.
38. Antonelli RC, Stille CJ, Antonelli DM. Care coordination for children and youth with special health care needs: a descriptive, multisite study of activities, personnel costs, and outcomes. *Pediatrics*. 2008;122(1):e209-e216.
39. Ziniel SI, Rosenberg HN, Bach AM, Singer SJ, Antonelli RC. Validation of a parent-reported experience measure of integrated care. *Pediatrics*. 2016;138(6):e20160676.
40. Cohen E, Berry JG, Sanders L, Schor EL, Wise PH. Status Complexus? The emergence of pediatric complex care. *Pediatrics*. 2018;141(Suppl 3):S202-S211.
41. Stevens GD, Kim AY. National Trends in Indicators of a Medical Home for Children. *Matern Child Health J*. 2016;20(3):730-739.
42. Billings J, Zeitel L, Lukomnik J, Carey TS, Blank AE, Newman L. Impact of socioeconomic status on hospital use in New York City. *Health Aff (Millwood)*. 1993;12(1):162-173.
43. McDonald K, Romano P, Davies S, et al. *Technical Report: Measures of Pediatric Health Care Quality Based on Hospital Administrative Data: The Pediatric Quality Indicators*. Rockville, MD: AHRQ; 2006.
44. Sanderson C, Dixon J. Conditions for which onset or hospital admission is potentially preventable by timely and effective ambulatory care. *J Health Serv Res Policy*. 2000;5(4):222-230.
45. Flores G, Abreu M, Chaisson CE, Sun D. Keeping children out of hospitals: parents' and physicians' perspectives on how pediatric hospitalizations for ambulatory care-sensitive conditions can be avoided. *Pediatrics*. 2003;112(5):1021-1030.
46. deJong NA, Richardson T, Chandler N, Steiner MJ, Hall M, Berry J. Outpatient visits before ambulatory care-sensitive hospitalization of children receiving medicaid. *Acad Pediatr*. 2018;18(4):390-396.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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