ARTICLE

ONLINE FIRST

Medical Home Access and Health Care Use and Expenditures Among Children With Special Health Care Needs

Melissa A. Romaire, PhD, MPH; Janice F. Bell, PhD, MPH, MN; David C. Grossman, MD, MPH

Objective: To test associations between having a medical home and health services use and expenditures among US children with special health care needs (CSHCN).

Design: Cross-sectional analysis.

Setting: The 2003-2008 Medical Expenditure Panel Surveys.

Participants: A total of 9816 CSHCN up to 17 years, including 1056 with a functional or sensory limitation and 8760 without a limitation.

Main Exposure: Parent or caregiver report of CSHCN having a medical home.

Main Outcome Measures: We examined CSHCN's annual use of outpatient, inpatient, emergency department, and dental visits, and annual outpatient, inpatient, emergency department, prescription medication, dental, and other health care expenditures.

Results: CSHCN with a medical home had 14% more dental visits compared with CSHCN without a medical home (incidence rate ratio [IRR], 1.14; 95% CI, 1.03-1.25); this finding is significant for CSHCN without limitations but not for those with limitations. The medical home was associated with greater odds of incurring total, outpatient, prescription medication, and dental expenditures (odds ratio range, 1.25-1.92). Among CSHCN with a limitation, children with a medical home had lower annual inpatient expenditures compared with those without a medical home (mean, –$968; 95% CI, –$121 to –$1928), and among CSHCN without a limitation, children with a medical home had higher annual prescription medication expenditures compared with those without a medical home (mean, $87; 95% CI, $22-$153).

Conclusions: There were few differences in annual health services use and expenditures between CSHCN with and without a medical home. However, the medical home may be associated with lower inpatient expenditures and higher prescription medication expenditures within subgroups of CSHCN.

Arch Pediatr Adolesc Med. 2012;166(4):323-330.
Published online December 5, 2011.
doi:10.1001/archpediatrics.2011.1154

Author Affiliations:
Department of Health Services, School of Public Health (Drs Romaire, Bell, and Grossman), and Department of Pediatrics (Dr Grossman), University of Washington, and Group Health Research Institute (Dr Grossman), Seattle.

CHILDREN AND ADOLESCENTS are generally healthy. However, children and youth with special health care needs (CSHCN) require more resources and have 3 times the health care expenditures as other children.[1] At the same time, CSHCN and their families are often challenged by poor care coordination, increased financial burden due to medical illness, unmet health needs, poor health outcomes, and dissatisfaction with health care received.[1-5]

The pediatric, family-centered medical home model of primary care has gained momentum as an approach to redress the fragmented, uncoordinated, reactive, and health care provider–centric system of care for CSHCN.[6] The goal of the medical home is to provide preventive, acute, and chronic care management within a community-based system of services. Expectations under this model are that CSHCN will realize more appropriate health service use; improved health, well-being, and functionality; less unmet need for care; greater child and family satisfaction; and lower medical expenditures through the provision of accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally effective health care.[7,8]

Evidence among CSHCN suggests that having a medical home may be associated with service utilization, such as reduced hospitalizations or emergency department use.[7,9-12] Questions remain as to whether these changes in utilization are substantial enough to modify health care expenditures at the population level.[7]

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

Usual Source of Care
Is there a particular doctor's office, clinic, health center, or other place that the individual usually goes to if he/she is sick or needs advice about his/her health?
Is the individual's provider a person, facility, or person in a facility?

Accessible
Does the provider have office hours at night or on the weekend?
Any difficulty accessing care after hours?
Any difficulty getting to care?
Any difficulty accessing provider by phone?

Family Centered
Provider listened to the parent.
Provider spent enough time with the child and parent.
Provider seeks the parent's advice when deciding treatments.
Provider shows respect for treatments other doctors may give.
Provider asks the parent to help make decisions.
Provider explains options to the parent.
Provider explain things in a way the parent can understand.

Comprehensive
Did the child need to see a specialist?
If needed a specialist, any problems accessing a specialist?
Did the child have an illness, injury, or condition that needed care right away from a clinic, emergency room, or doctor's office?
If needed care right away, how often was care received as soon as wanted?
Were there any appointments made to see a doctor or other health provider for routine health care?
If appointments were made for routine care, how often was an appointment secured as soon as wanted?
Did the parent or a doctor believe the person needed any care, tests or treatment?
If needed care or treatment, any problems receiving care?

Compassionate
Provider shows respect for what the parent has to say.

Figure. The Medical Expenditure Panel (MEPS) survey items, by medical home domain. Survey items can be found in MEPS' Access to Care and Child Health and Preventive Care supplements.[22]

Some, but not all,[13-15] studies suggest that coordinated and/or comprehensive models of care delivery may be associated with fewer hospital costs and charges,[16,17] out-of-pocket expenditures,[18] and total health care expenditures.[19] These studies have been limited to clinic-based, low-income, or condition-specific populations; have focused on limited categories of expenditures; and have used inconsistent and limited definitions of the medical home.[13-16,18,19]

In this study, we addressed several limitations of prior research by testing associations between having a medical home and health service use and expenditures in a nationally representative population of CSHCN. We examined summary measures of annual health care use and expenditures, as well as measures within several domains, specifically, outpatient, inpatient, emergency department, and other health services, including dental and prescription medication use. We hypothesized that CSHCN with a medical home would have greater outpatient, dental, and prescription medication use and expenditures and lower inpatient and emergency department use and expenditures.

METHODS

STUDY POPULATION AND DATA SOURCE

This study was a cross-sectional analysis of the 2003-2008 Medical Expenditure Panel Surveys (MEPS). Through in-person interviews, the MEPS collects data on the type and frequency of health care use and related expenditures of noninstitutionalized US civilian families and individuals. The MEPS also assesses individuals' experiences with health care received and other variables essential for measuring the pediatric medical home from a parent or caregiver's perspective.[20,21] The study sample included 9816 CSHCN up to age 17 years, identified with a validated screening tool.[22,23] The screening tool does not capture specific diseases. Instead, it assesses the extent to which a child has a health or behavioral condition expected to last at least 12 months that limits the child in some way or requires the use of medication, additional health and/or education services, special therapies, or counseling.[23] With this approach, a wide range of medical and behavioral conditions is captured. Finally, infants younger than 30 days old were excluded under the assumption that the infant was not immediately exposed to a medical home after birth and that costs incurred during this time were independent of having a medical home.

MAIN EXPOSURE

The independent variable was the parent or caregiver report of the child having a medical home, operationalized as a binary indicator. Details on the medical home measure can be found elsewhere.[24] Briefly, 22 survey items were assigned to 5 of the 7 American Academy of Pediatrics' (AAP) recommended components of the medical home: accessible, comprehensive, family-centered, compassionate, and culturally effective care. Because there were no survey items aligning with the AAP's definition of continuous and coordinated care, they could not be measured. The **Figure** describes the survey items. To have a medical home, the child must have a usual source of care that is a person or place and have positive care experiences reflecting accessible, comprehensive, family-centered, compassionate, and culturally effective care.

OUTCOME MEASURES

Our first set of dependent variables included measures of children's health care use reported by the survey respondent in the household component of the MEPS: outpatient visits (preventive and acute) in an office or outpatient department, inpatient admissions, emergency department visits, and dental visits. The annual number of visits or admissions in each service category was calculated for each child. Preventive visits included general check-ups, well-child examinations, or visits for immunizations, and acute visits were considered all other outpatient visits.[25] Inpatient admissions for ambulatory care–sensitive (ACS) conditions were also examined. The ACS admissions are hospitalizations related to conditions for which quality outpatient care expected in a medical home could potentially prevent the need for the admission. The ACS conditions were identified in the MEPS' Inpatient Event file using a 3-digit code mapped to the condition's *International Classification of Diseases, Ninth Revision, Clinical Modification* code.[26] The ACS hospitalizations included those for asthma; diabetes mellitus; gastroenteritis; perforated appendix; urinary tract infection; dehydration; anemia; failure to thrive; immunization-related preventable conditions; seizure; severe ear, nose, and throat infection; tuberculosis; chronic obstructive pulmonary disease; bacterial pneumonia; cellulitis; hypoglycemia; pelvic inflammatory disease; dental conditions; and congestive heart failure.[27]

Annual health care expenditures included expenditures in the following service areas: outpatient, inpatient, emergency department, prescription medication, dental, "other" health care, and total health care. Outpatient expenditures included expenditures for office- and outpatient department–based visits for primary, specialty, and ancillary care. Inpatient expenditures included those related to overnight hospital stays, admis-

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

sions for which no overnight stay occurred, and emergency department visits directly preceding an inpatient admission.[22] "Other" health care expenditures included those for vision aids, medical supplies and equipment, and home health. Dental expenditures included those for generalist and specialist dental services, and prescription medication expenditures included initial purchases and refills in a given year. Total annual health care expenditures summed all health care expenditures incurred for the year.[22] Expenditures comprised household- and medical provider–reported expended payments, not charges.[22] Expenditures for 2003-2007 were inflated to 2008 dollars using the Personal Health Care Expenditures Price Index.[28]

STATISTICAL ANALYSIS

Multivariate regression analysis was used to assess the independent effect of the medical home on visits and expenditures, controlling for a child's propensity to have a medical home. This is an observational analysis. Therefore, characteristics of the family may facilitate the decision to have a medical home or to use health services. To address this potential bias, propensity scores were used to balance known child and family characteristics between CSHCN with and without a medical home.[29,30] Logistic regression was used to determine the child's probability of having a medical home (ie, the propensity score) conditional on the following predictors: (1) child age, sex, race/ethnicity, geographic region of residence, insurance status, presence of a functional or physical limitation, language spoken at home, parent/caregiver report of child health status; (2) maternal education, self-reported health status, presence of a usual source of care, employment status, age, and insurance status; and (3) family size and income.

Because annual outpatient, inpatient, emergency department, and dental visits are nonnegative counts, we used negative binomial regressions to assess the effect of having a medical home on visits.[31] For expenditures within each service category, we used a 2-part model. Part 1 modeled the probability of incurring any expenditures using multivariate logistic regression, and part 2 modeled mean expenditures, given expenditures occurred, using a generalized linear model with a log link and gamma family.[32-34] Generalized linear models account for the characteristically right-skewed distribution of the expenditure data. Part 1 and part 2 of the model were combined to calculate the estimated difference in mean expenditures between CSHCN with and without a medical home, and 95% CIs around this estimated difference were bootstrapped with 1000 repetitions.[31] In all negative binomial models and in each part of the 2-part expenditure models, the propensity score was included as a continuous variable along with the independent variable, medical home. The year the survey was conducted was also included as a covariate in the regression models to address possible temporal trends (eg, increasing expenditures) over the 6-year study period.

We also conducted an exploratory analysis by stratifying the sample by the presence of functional or sensory limitations as a proxy measure for complexity of the special health care need. The population of CSHCN is heterogeneous and inclusive of a broad range of health conditions. Aggregate analyses might mask differential measures of effect between those with and those without more limiting or severe conditions. In the MEPS, if the survey respondent indicated the child had any limitations in his or her activities of daily living, movement, ability to function in school, or if the child had a visual or hearing impairment, the child was considered to have a functional or sensory limitation (hereafter, limitation).[22] We used Stata survey routines (version 11.1; StataCorp LP, College Station, Texas) to account for the MEPS' survey design.[22]

Table 1. Select Sociodemographic Characteristics for Children With Special Healthcare Needs (CSHCN), Up to Age 17 Years, by Medical Home Status[a]

Characteristic	Total Sample (9816)	Has a Medical Home[b] Yes (4210)	Has a Medical Home[b] No (5606)
Reports a medical home	46.7		
Age, y			
0-5	19.6	20.2	19.0
6-11	38.0	37.2	38.6
12-17	42.5	42.6	42.3
Sex			
Female	42.7	41.7	43.5
Race/ethnicity			
White, non-Hispanic	64.6	68.7	61.0
Black, non-Hispanic	15.8	15.0	16.6
Other, non-Hispanic	5.7	4.9	6.4
Hispanic	13.9	11.5	16.0
Language spoken at home			
English	93.5	95.2	92.1
Spanish	5.1	3.8	6.2
Other	1.4	1.0	1.8
Insurance			
Any private	64.4	71.2	58.5
Public only	31.7	25.8	36.9
Uninsured full year	3.9	3.0	4.7
Family income, % of FPL			
<100	18.4	14.2	22.0
100-199	19.2	17.7	20.6
200-399	32.1	32.8	31.4
≥400	30.3	35.3	26.0
Parent report of child health status			
Excellent/very good	67.2	71.2	63.7
Good	25.5	23.3	27.4
Fair/poor	7.3	5.4	8.9
Has a functional or sensory limitation	9.7	7.7	11.5
Maternal education			
No high school	10.9	7.9	13.5
High school/GED	52.2	50.5	53.7
Some college or college	28.5	32.1	25.3
Postcollege	8.5	9.6	7.6
Resides in a metropolitan area	83.3	84.9	81.8
Geographic region			
Northeast	18.7	22.1	15.8
Midwest	23.3	26.1	20.7
South	38.7	35.6	41.3
West	19.4	16.2	22.2

Abbreviations: FPL, federal poverty level; GED, general education development.
[a] Data are given as percentages.
[b] The distributions of all sociodemographic characteristics significantly differed at $P < .05$ between CSHCN with and without a medical home, with the exception of age and sex.

RESULTS

Select sociodemographic characteristics of the 9816 CSHCN are shown in **Table 1**. An estimated 65% were white, non-Hispanic, and 62% resided in families earning more than 200% of the federal poverty level. Only 4% of CSHCN were uninsured, and 10% had a limitation. An estimated 47% of CSHCN had a medical home, although only 37% of CSHCN with a limitation had a medical home (**Table 2**). Eighty-four percent of CSHCN met either 5 or 6 criteria

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

Table 2. Proportion of Children With Special Health Care Needs (CSHCN) With a Medical Home, by Medical Home Criteria and Number of Criteria Met[a]

Criteria[b]	CSHCN (9816)	Children With FSL (1056)	Children With No FSL (8760)
Usual source of care	94.8	94.3	94.9
Accessible	63.7	56.2	64.5
Family-centered	83.7	81.3	83.9
Comprehensive	86.9	76.4	88.1
Compassionate	94.9	91.4	95.3
Culturally effective	99.9	99.9	99.9
Reports a medical home	46.7	36.9	47.8
No. of medical home criteria met among CSHCN reporting a medical home			
1	0	0	0
2	1.5	2.6	1.4
3	3.6	6.3	3.3
4	11.1	16.8	10.5
5	37.2	37.5	37.1
6	46.7	36.9	47.8

Abbreviation: FSL, functional or sensory limitation.
[a] Data are given as percentages.
[b] Having a usual source of care is not one of the established domains of the medical home, but it is an essential criteria for determining if a child has a medical home.

for having a medical home. CSHCN with a limitation were less likely to receive accessible, family-centered, comprehensive, and compassionate care compared with CSHCN without a limitation.

HEALTH SERVICE USE

On average, during the study period, 88% of CSHCN had at least 1 outpatient visit, 53% had at least 1 preventive care visit, 77% had at least 1 acute care visit, 5% had at least 1 inpatient admission, 1% had at least 1 ACS inpatient admission, 19% had at least 1 emergency department visit, and 57% had at least 1 dental visit on annual basis. In propensity score–adjusted analyses, CSHCN with a medical home had 14% more dental visits compared with CSHCN without a medical home (incidence rate ratio [IRR], 1.14; 95% CI, 1.03-1.25) (**Table 3**). There was no evidence that having a medical home was associated with outpatient visits (preventive and acute), inpatient admissions, emergency department visits, and ACS inpatient admissions (IRR, 0.97; 95% CI, 0.61-1.54). In stratified analyses, there was a significant, positive association between having a medical home and dental visits for CSHCN without a limitation but not for CSHCN with a limitation (Table 3). No other differences were noted within stratified groups.

HEALTH CARE EXPENDITURES

Almost all CSHCN (96%) incurred annual health care expenditures. Outpatient and prescription medication expenditures were the most prevalent, with 87% and 83% of CSHCN incurring them, respectively (**Table 4**). In propensity score–adjusted analyses for part 1 of the 2-part model, CSHCN with a medical home had higher odds of incurring certain expenditures (total OR, 1.92 [95% CI, 1.45-2.53]; outpatient OR, 1.41 [95% CI, 1.22-1.63]; prescription medication OR, 1.32 [95% CI, 1.15-1.51]; and dental OR, 1.25 [95% CI, 1.10-1.41]) compared with CSHCN without a medical home (**Table 5**). Among CSHCN who incurred service-specific expenditures (ie, part 2 of the 2-part model), there was no evidence that having a medical home was associated with annual expenditures for any service category. When the 2 parts of the model were combined to assess the difference in mean expenditures between CSHCN with and without a medical home, there were no significant differences between the 2 groups in the total sample. The same patterns held in analyses stratified by limitation, with several exceptions. Among CSHCN with a limitation, there was no evidence that children with a medical home were more likely to incur prescription medication expenditures compared with those without a medical home. Furthermore, among CSHCN with a limitation, children with a medical home had lower inpatient expenditures (mean, $968; 95% CI, –$121 to –$1928) compared with those without a medical home when the 2 parts of the 2-part model were combined (Table 5). Among CSHCN without a limitation, children with a medical home had higher prescription medication expenditures (mean, $87; 95% CI, $22 to $153) compared with those without a medical home (Table 5).

COMMENT

Results from this study suggest few significant differences in health service use and annual mean expenditures between CSHCN with and without a medical home. The findings do not support our hypotheses that CSHCN with a medical home might have more outpatient medical care visits, fewer inpatient admissions, and fewer emergency department visits. Prior studies of medical home demonstration projects for CSHCN do show reductions in emergency department and/or inpatient use. This may be attributable to the focused efforts of motivated primary care providers and medical systems targeting specific groups of CSHCN for integration of medical home processes into their care delivery.[9,10,15,35] Not all medical care is avoidable; and in a population-based survey of CSHCN with heterogeneous conditions, there are difficulties in teasing out the areas of medical care for which CSHCN will be amenable to change under the influence of high-quality primary care. We attempted to address this issue, in part, through our examination of ACS hospitalizations, but our findings yielded no significant association between these hospitalizations and having a medical home. This may be due to insufficient power; few CSHCN experience these hospitalizations.

We did find a greater incidence of dental visits in the total sample of CSHCN with a medical home and, commensurate with this, greater odds of incurring dental expenditures. Our results align with research finding a positive relationship between the presence of a basic source of usual medical care and dental use for CSHCN.[36,37] Families of CSHCN report unmet needs for dental care, and facilitating dental access may be less

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

Table 3. Number of Annual Visits and Adjusted Incidence Rate Ratios (IRRs) (95% CIs) of the Medical Home Variable

Variable	All CSHCN (9816)		Children With Limitation (1056)		Children With No Limitation (8760)	
	Mean (Range), No.	IRR (95% CI)[a]	Mean (Range), No.	IRR (95% CI)[a]	Mean (Range), No.	IRR (95% CI)[a]
Outpatient visits	6.4 (0-262)	1.00 (0.92-1.10)	11.3 (0-262)	1.06 (0.84-1.34)	5.9 (0-224)	0.99 (0.91-1.09)
Preventive visits	1.2 (0-56)	1.06 (0.94-1.20)	1.2 (0-34)	1.16 (0.87-1.54)	1.2 (0-56)	1.05 (0.93-1.19)
Acute visits	5.2 (0-261)	0.99 (0.89-1.10)	10.0 (0-261)	1.05 (0.82-1.36)	4.7 (0-213)	0.98 (0.88-1.09)
Inpatient admissions	0.06 (0-10)	1.07 (0.81-1.43)	0.2 (0-4)	0.75 (0.36-1.56)	0.1 (0-10)	1.15 (0.85-1.55)
Emergency department visits	0.2 (0-11)	0.96 (0.85-1.08)	0.3 (0-11)	1.05 (0.72-1.54)	0.2 (0-10)	0.94 (0.83-1.07)
Dental visits	1.5 (0-19)	1.14 (1.03-1.25)[b]	1.3 (0-19)	1.25 (0.97-1.62)	1.5 (0-18)	1.13 (1.02-1.24)[b]

Abbreviation: CSHCN, children with special health care needs.
[a] Models were adjusted for the propensity score and year the survey was administered.
[b] $P < .01$.

Table 4. Description of Annual Healthcare Use and Expenditures for Children With Special Healthcare Needs (CSHCN)[a]

Variable	All CSHCN			Children With Limitation			Children With No Limitation		
	Total Sample (9816)	Has a Medical Home: Yes (4210)	Has a Medical Home: No (5606)	Total Sample (1056)	Has a Medical Home: Yes (348)	Has a Medical Home: No (708)	Total Sample (8760)	Has a Medical Home: Yes (3862)	Has a Medical Home: No (4898)
Total									
Incurring exp[b]	96.1	97.7	94.8	96.0	98.4	94.6	96.2	97.7	94.8
Annual exp among CSHCN incurring exp[c]	3332	3361	3306	7992	7408	8347	2832	3023	2652
	(140)	(221)	(161)	(752)	(1092)	(961)	(126)	(219)	(121)
Outpatient									
Incurring exp[b]	87.0	89.8	84.5	88.7	92.4	86.8	86.8	89.6	84.3
Annual exp among CSHCN incurring exp[c]	1150	1119	1179	2442	2246	2564	1008	1023	994
	(48)	(63)	(58)	(263)	(299)	(329)	(42)	(63)	(44)
Inpatient									
Incurring exp	4.8	4.4	5.1	10.9	7.6	12.8	4.1	4.1	4.1
Annual exp among CSHCN incurring exp[c]	14 025	16 257	12 339	12 650	11 484	13 058	14 415	16 989	12 049
	(1710)	(3408)	(1578)	(1792)	(3382)	(2125)	(2120)	(3876)	(1958)
Emergency department									
Incurring exp[b]	16.9	15.9	17.8	20.2	19.8	20.5	16.5	15.6	17.4
Annual exp among CSHCN incurring exp[c]	713	752	682	774	1 025	632	705	723	690
	(32)	(43)	(44)	(86)	(180)	(76)	(34)	(44)	(49)
Prescription medication									
Incurring expenditures[d]	83.2	86.1	80.7	80.6	81.8	80.0	83.5	86.5	80.8
Annual expenditures among CSHCN incurring expenditures[c]	939	943	935	2545	2673	2469	772	807	738
	(54)	(75)	(72)	(500)	(921)	(567)	(23)	(34)	(27)
Dental									
Incurring exp[b]	54.8	59.7	50.4	53.8	62.6	48.7	54.8	59.5	50.6
Annual exp among CSHCN incurring exp[c]	731	744	718	776	736	806	726	744	707
	(33)	(43)	(47)	(84)	(109)	(116)	(34)	(46)	(51)
Other[e]									
Incurring exp	18.2	17.9	18.6	32.8	31.9	33.3	16.7	16.8	16.7
Annual exp among CSHCN incurring exp[c]	1267	1063	1440	4508	4574	4471	585	510	653
	(173)	(205)	(262)	(859)	(1275)	(1164)	(80)	(120)	(104)

Abbreviation: Exp, expenditures.
[a] Incurring expenditures are given as percentages; annual expenditures are given as mean (SD) dollars.
[b] In bivariate associations, the percentage of all CSHCN, CSHCN with a limitation, and CSHCN without a limitation incurring any expenditures differed significantly at $P < .05$ for children with and those without a medical home.
[c] Among CSHCN who incurred expenditures, there were no significant differences in annual expenditures between children with and those without a medical home.
[d] In bivariate associations, the percentage of all CSHCN and CSHCN without limitation incurring expenditures differed significantly at $P < .05$ for children with and those without a medical home.
[e] Other expenditures include expenditures for vision aids, medical supplies and equipment, and home health.

challenging for a medical home given the greater prevalence of dental care providers compared with pediatric medical specialty providers.[38-41]

We also found positive associations between having a medical home and the odds of incurring total, outpatient, and prescription medication expenditures. The outpatient and prescription medication findings contribute to the increased odds of incurring total expenditures. Although we found greater odds of incurring certain expenditures in the total sample of CSHCN, mean expen-

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

Table 5. Results of the 2-Part Expenditure Model (Part 1, Adjusted Odds Ratio [95% CI] and Part 2, Adjusted β [95% CI] for the Medical Home Variable) and Difference in Expenditures[a]

Type of Expenditure	All CSHCN			Children With Limitation			Children With No Limitation		
	Part 1	Part 2	Difference[b]	Part 1	Part 2	Difference[b]	Part 1	Part 2	Difference[b]
Total	1.92 (1.45 to 2.53)[c]	0.06 (−0.09 to 0.21)	272 (−193 to 797)	3.13 (1.54 to 6.39)[d]	−0.23 (−0.53 to 0.07)	−1359 (−3463 to 804)	1.84 (1.37 to 2.47)[c]	0.13 (−0.04 to 0.29)	417 (−6 to 925)
Outpatient	1.41 (1.22 to 1.63)[c]	−0.08 (−0.20 to 0.04)	−34 (−155 to 96)	1.73 (1.02 to 2.91)[d]	−0.19 (−0.50 to 0.12)	−269 (−989 to 473)	1.39 (1.19 to 1.61)[c]	−0.06 (−0.18 to 0.05)	−14 (−114 to 83)
Inpatient	1.02 (0.81 to 1.29)	0.27 (−0.20 to 0.73)	222 (−208 to 632)	0.60 (0.33 to 1.09)	−0.38 (−1.02 to 0.26)	−968 (−1928 to −121)	1.16 (0.89 to 1.51)	0.34 (−0.17 to 0.85)	322 (−103 to 750)
ED	0.94 (0.82 to 1.07)	0.05 (−0.11 to 0.21)	−0.36 (−26 to 24)	0.95 (0.63 to 1.43)	0.33 (−0.10 to 0.76)	43 (−41 to 140)	0.93 (0.82 to 1.07)	0.02 (−0.16 to 0.20)	−4 (−28 to 21)
PM	1.32 (1.15 to 1.51)[c]	0.05 (−0.17 to 0.26)	74 (−87 to 230)	1.08 (0.70 to 1.68)	−0.07 (−0.68 to 0.53)	−104 (−1125 to 984)	1.35 (1.16 to 1.56)[c]	0.09 (−0.01 to 0.18)	87 (22 to 153)
Dental	1.25 (1.10 to 1.41)[c]	−0.001 (−0.18 to 0.18)	37 (−32 to 101)	1.52 (1.12 to 2.06)[d]	−0.28 (−0.65 to 0.10)	−37 (−210 to 155)	1.22 (1.08 to 1.39)[d]	0.02 (−0.17 to 0.21)	41 (−30 to 113)
Other	0.97 (0.86 to 1.10)	−0.12 (−0.60 to 0.35)	−38 (−153 to 80)	0.9 (0.64 to 1.36)	0.09 (−0.58 to 0.76)	59 (−868 to 918)	0.98 (0.85 to 1.13)	−0.13 (−0.62 to 0.35)	−15 (−62 to 37)

Abbreviations: ED, emergency department; PM, prescription medication.

[a] Part 1 and part 2 models were adjusted for the medical home propensity score and year the survey was administered. Part 1 data are given as odds ratios (95% CIs); part 2 data are given as β values (95% CIs); differences are given as dollars.

[b] Difference = estimated expenditures for CSHCN with a medical home − estimated expenditures for CSHCN without a medical home. The difference and its 95% CI are calculated by combining parts 1 and 2 of the 2-part model and bootstrapping using 1000 repetitions. This process can result in significant findings even when a covariate's point estimates derived from the separate components of the 2-part model might be nonsignificant.

[c] $P < .001$.

[d] $P < .05$.

ditures did not differ between children with and without a medical home (ie, results from the part 2 of the 2-part model and its combination with part 1). This suggests that any increase in the odds of incurring expenditures is not commensurate with greater annual expenditures for CSHCN with a medical home. Other studies suggest that reductions in total and hospital costs are possible under CSHCN-focused demonstration projects providing comprehensive, coordinated models of care.[16,17,19] Furthermore, an accessible, comprehensive, and satisfactory usual source of care may be associated with higher total, physician, emergency department, and pharmacy expenditures among CSHCN in national survey data.[42] Differences in methodological approaches (ie, family-reported expenditures in the MEPS vs targeted demonstration projects designed to reduce expenditures in very specific CSHCN populations) and conceptualizations of the delivery system under study (ie, medical home vs usual source of care) could explain the differences between our results and prior research.

Our exploratory analysis suggested similar expenditure findings between CSHCN with and those without a limitation, with 2 exceptions. First, among CSHCN with a limitation, children with a medical home had lower average inpatient expenditures than those without a medical home, which is consistent with published findings from clinic-based demonstration projects.[17,19] Second, among CSHCN without a limitation, children with a medical home had higher average prescription medication expenditures than those without a medical home. CSHCN with greater severity have more complex needs that an accessible, comprehensive source of care may be better positioned to address, resulting in demonstrable changes in outcomes, as the inpatient expenditures findings might suggest. However, the very nature of their medical complexity may increase the number of health care providers affiliated with the medical home, presenting additional challenges to fostering meaningful parent–health care provider relationships and to establishing the effective collaboration between health care providers that is needed to best meet the needs of the child. Ultimately, these challenges could hinder the ability to effect clinically meaningful changes in outcomes. Our findings that accessible care and comprehensive care are less likely to be met for CSHCN with a limitation reinforce the notion that the delivery of quality health care for children with medically complex needs is challenging. Additional investigation is warranted to understand the salient domains of the medical home within subgroups of CSHCN and how these domains may differentially influence health service use and expenditures.

There are several considerations in interpreting our results. First, parent/caregiver report was used to operationalize the medical home as a binary measure, which was unable to capture all 7 domains of the medical home. Neither the parent/family perspective nor a binary measure was the only way to conceptualize the medical home.[21,43] A parent/caregiver-reported measure captures families' perceptions of the quality of their care as it relates to the principles underlying the medical home, but it cannot explicate whether actual care processes were used in conjunction with these principles. Future research should compare patterns of health service use and expenditures between children who have a perceived medical home and children receiving care in a medical practice engaged in all the activities indicative of a medical home. Second, with parent/caregiver-reported outcomes, there may be overreporting or underreporting of visits and expenditures, particularly for frequent outcomes, like outpatient care. Recall of more salient out-

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

comes, such as inpatient or emergency department use, may be more reliable.[44] Third, this is a cross-sectional, observational study; causal inferences cannot be made. We applied propensity scores to address potential selection bias in having a medical home, but propensity scores do not address all family experiences or beliefs that may confound the relationship between having a medical home and service use and expenditures.

In conclusion, this study focused on patterns of health care use and expenditures as a first step in understanding the fiscal implications of the medical home for CSHCN at the population level. However, frequencies of outpatient, inpatient, and emergency department visits reveal little about the content and appropriateness of the care delivered. The value of the pediatric medical home may lie less in its cost-saving capabilities than in its ability to deliver higher quality and more appropriate care at stable costs. The next steps in pediatric medical home research should investigate this quality-to-cost proposition in the context of achieving a high-value health system for children.

Accepted for Publication: October 6, 2011.
Published Online: December 5, 2011. doi:10.1001/archpediatrics.2011.1154
Correspondence: Melissa A. Romaire, PhD, MPH, Department of Health Services, School of Public Health, University of Washington, 1959 NE Pacific St, PO Box 357660, Seattle, WA 98195-7660 (mromaire@u.washington.edu).
Author Contributions: Dr Romaire had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Bell, Grossman, and Romaire. *Acquisition of data:* Romaire. *Analysis and interpretation of data:* Bell, Grossman, and Romaire. *Drafting of the manuscript:* Bell and Romaire. *Critical revision of the manuscript for important intellectual content:* Bell, Grossman, and Romaire. *Statistical analysis:* Bell and Romaire. *Study supervision:* Bell and Grossman.
Financial Disclosure: None reported.
Funding/Support: Dr Romaire received funding for this work from the Agency for Healthcare Research and Quality (2 T32 HS013853-06).
Additional Contributions: Ruth Etzioni, PhD, provided invaluable statistical technical assistance.

REFERENCES

1. Newacheck PW, Kim SE. A national profile of health care utilization and expenditures for children with special health care needs. *Arch Pediatr Adolesc Med*. 2005;159(1):10-17.
2. Mayer ML, Skinner AC, Slifkin RT; National Survey of Children With Special Health Care Needs. Unmet need for routine and specialty care: data from the National Survey of Children With Special Health Care Needs. *Pediatrics*. 2004;113(2):e109-e115.
3. Warfield ME, Gulley S. Unmet need and problems accessing specialty medical and related services among children with special health care needs. *Matern Child Health J*. 2006;10(2):201-216.
4. Newacheck PW, Strickland B, Shonkoff JP, et al. An epidemiologic profile of children with special health care needs. *Pediatrics*. 1998;102(1, pt 1):117-123.
5. Newacheck PW, McManus M, Fox HB, Hung YY, Halfon N. Access to health care for children with special health care needs. *Pediatrics*. 2000;105(4, pt 1):760-766.
6. Cooley WC. Redefining primary pediatric care for children with special health care needs: the primary care medical home. *Curr Opin Pediatr*. 2004;16(6):689-692.
7. Homer CJ, Klatka K, Romm D, et al. A review of the evidence for the medical home for children with special health care needs. *Pediatrics*. 2008;122(4):e922-e937.
8. Medical Home Initiatives for Children With Special Needs Project Advisory Committee; American Academy of Pediatrics. The medical home. *Pediatrics*. 2002;110(1, pt 1):184-186.
9. Rankin KM, Cooper A, Sanabria K, Binns HJ, Onufer C. Illinois medical home project: pilot intervention and evaluation. *Am J Med Qual*. 2009;24(4):302-309.
10. Cooley WC, McAllister JW, Sherrieb K, Kuhlthau K. Improved outcomes associated with medical home implementation in pediatric primary care. *Pediatrics*. 2009;124(1):358-364.
11. Raphael JL, Zhang Y, Liu H, Tapia CD, Giardino AP. Association of medical home care and disparities in emergency care utilization among children with special health care needs. *Acad Pediatr*. 2009;9(4):242-248.
12. McAllister JW, Sherrieb K, Cooley WC. Improvement in the family-centered medical home enhances outcomes for children and youth with special healthcare needs. *J Ambul Care Manage*. 2009;32(3):188-196.
13. Berman S, Rannie M, Moore L, Elias E, Dryer LJ, Jones MD Jr. Utilization and costs for children who have special health care needs and are enrolled in a hospital-based comprehensive primary care clinic. *Pediatrics*. 2005;115(6):e637-e642.
14. Damiano PC, Momany ET, Tyler MC, Penziner AJ, Lobas JG. Cost of outpatient medical care for children and youth with special health care needs: investigating the impact of the medical home. *Pediatrics*. 2006;118(4):e1187-e1194.
15. Domino ME, Humble C, Lawrence WW Jr, Wegner S. Enhancing the medical homes model for children with asthma. *Med Care*. 2009;47(11):1113-1120.
16. Liptak GS, Burns CM, Davidson PW, McAnarney ER. Effects of providing comprehensive ambulatory services to children with chronic conditions. *Arch Pediatr Adolesc Med*. 1998;152(10):1003-1008.
17. Gordon JB, Colby HH, Bartelt T, Jablonski D, Krauthoefer ML, Havens P. A tertiary care-primary care partnership model for medically complex and fragile children and youth with special health care needs. *Arch Pediatr Adolesc Med*. 2007;161(10):937-944.
18. Kogan MD, Strickland BB, Blumberg SJ, Singh GK, Perrin JM, van Dyck PC. A national profile of the health care experiences and family impact of autism spectrum disorder among children in the United States, 2005-2006. *Pediatrics*. 2008;122(6):e1149-e1158.
19. Casey PH, Lyle RE, Bird TM, et al. Effect of hospital-based comprehensive care clinic on health costs for Medicaid-insured medically complex children. *Arch Pediatr Adolesc Med*. 2011;165(5):392-398.
20. Agency for Healthcare Research and Quality. *The CAHPS Connection*. Rockville, MD: Agency for Healthcare Research and Quality; 2009. Pub No. 09-CAHPS003-EF.
21. Bethell CD, Read D, Brockwood K; American Academy of Pediatrics. Using existing population-based data sets to measure the American Academy of Pediatrics definition of medical home for all children and children with special health care needs. *Pediatrics*. 2004;113(5)(suppl):1529-1537.
22. Agency for Healthcare Quality and Research. *MEPS HC-105: 2006 Full Year Consolidated Data File*. Rockville, MD: Agency for Healthcare Research and Quality; 2007.
23. 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.
24. Romaire MA, Bell JF. The medical home, preventive care screenings, and counseling for children: evidence from the Medical Expenditure Panel Survey. *Acad Pediatr*. 2010;10(5):338-345.
25. Irwin CE Jr, Adams SH, Park MJ, Newacheck PW. Preventive care for adolescents: few get visits and fewer get services. *Pediatrics*. 2009;123(4):e565-e572.
26. Agency for Healthcare Quality and Research. *MEPS HC-110D: 2007 Hospital Inpatient Stays*. Rockville, MD: Agency for Healthcare Research and Quality; 2009.
27. Using administrative data to monitor access, identify disparities, and assess performance of the safety net. Agency for Healthcare Research and Quality Web site. http://archive.ahrq.gov/data/safetynet/billings.htm. Accessed October 15, 2010.
28. Using appropriate price indices for expenditure comparisons. http://www.meps.ahrq.gov/mepsweb/about_meps/Price_Index.shtml. Accessed October 2, 2009.
29. D'Agostino RB Jr. Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Stat Med*. 1998;17(19):2265-2281.
30. Posner M, Ash A, Freund K, Moskowitz M, Schwartz M. Comparing standard regression, propensity score matching, and instrumental variables methods for determining the influence of mammography on stage of diagnosis. *Health Serv Outcomes Res Methodol*. 2001;2:279-290.
31. Afifi AA, Kotlerman JB, Ettner SL, Cowan M. Methods for improving regression analysis for skewed continuous or counted responses. *Annu Rev Public Health*. 2007;28:95-111.

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016

32. Diehr P, Yanez D, Ash A, Hornbrook M, Lin DY. Methods for analyzing health care utilization and costs. *Annu Rev Public Health*. 1999;20:125-144.
33. Buntin MB, Zaslavsky AM. Too much ado about two-part models and transformation? comparing methods of modeling Medicare expenditures. *J Health Econ*. 2004;23(3):525-542.
34. Manning WG, Mullahy J. Estimating log models: to transform or not to transform? *J Health Econ*. 2001;20(4):461-494.
35. Klitzner TS, Rabbitt LA, Chang RK. Benefits of care coordination for children with complex disease: a pilot medical home project in a resident teaching clinic. *J Pediatr*. 2010;156(6):1006-1010.
36. Iida H, Lewis C, Zhou C, Novak L, Grembowski D. Dental care needs, use and expenditures among U.S. children with and without special health care needs. *J Am Dent Assoc*. 2010;141(1):79-88.
37. Beil H, Mayer M, Rozier RG. Dental care utilization and expenditures in children with special health care needs. *J Am Dent Assoc*. 2009;140(9):1147-1155.
38. Lewis C, Robertson AS, Phelps S. Unmet dental care needs among children with special health care needs: implications for the medical home. *Pediatrics*. 2005; 116(3):e426-e431.
39. Van Cleave J, Davis MM. Preventive care utilization among children with and without special health care needs: associations with unmet need. *Ambul Pediatr*. 2008; 8(5):305-311.
40. Mertz E, Mouradian WE. Addressing children's oral health in the new millennium: trends in the dental workforce. *Acad Pediatr*. 2009;9(6):433-439.
41. Rosen D. Sustaining excellence in pediatric care. *Arch Pediatr Adolesc Med*. 2011; 165(5):388-391.
42. Liu CL, Zaslavsky AM, Ganz ML, Perrin J, Gortmaker S, McCormick MC. The financial implications of availability and quality of a usual source of care for children with special health care needs. *Matern Child Health J*. 2008;12(2):243-259.
43. Vest JR, Bolin JN, Miller TR, Gamm LD, Siegrist TE, Martinez LE. Medical homes: "where you stand on definitions depends on where you sit." *Med Care Res Rev*. 2010;67(4):393-411.
44. D'Souza-Vazirani D, Minkovitz CS, Strobino DM. Validity of maternal report of acute health care use for children younger than 3 years. *Arch Pediatr Adolesc Med*. 2005;159(2):167-172.

©2012 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 07/30/2016