Managed Care Organizational Characteristics and Health Care Use among Children with Special Health Care Needs

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Objective. To examine the relationship between features of managed care organizations (MCOs) and health care use patterns by children.

Data Sources. Telephone survey data from 2,223 parents of children with special health care needs, MCO-administrator interview data, and health care claims data.

Study Design. Cross-sectional survey data from families about the number of consequences of their children's conditions and from MCO administrators about their plans' organizational features were used. Indices reflecting the MCO characteristics were developed using data reduction techniques. Hierarchical models were developed to examine the relationship between child sociodemographic and health characteristics and the MCO indices labeled: Pediatrician Focused (PF) Index, Specialist Focused (SF) Index, and Fee-for-Service (FFS) Index, and outpatient use rates and charges, inpatient admissions, emergency room (ER) visits, and specialty consultations.

Data Collection/Extraction Methods. The telephone and MCO-administrator survey data were linked to the enrollment and claims files.

Principal Findings. The child's age, gender, and condition consequences were consistent predictor variables related to health care use and charges. The PF Index was associated with decreased outpatient use rates and charges and decreased inpatient admissions. The SF Index was associated with increased ER visits and decreased specialty consultations, while the FFS Index was associated with increased outpatient use rates and charges.

Conclusion. After controlling for sociodemographic and health characteristics, the PF, SF, and FFS indices were significantly associated with children's health care use patterns.

Key Words. Children with special health care needs, managed care, health care use

With rising health care costs, state programs, such as Medicaid and the State Children's Health Insurance Program (SCHIP), have turned to managed care as a way to improve access to care, while controlling health care expenditures for children with special health care needs (CSHCN) (Zuckerman, Brennan, and Yermane 2002). Managed care organization (MCO) characteristics such as the composition of the provider network, provider reimbursement

strategies, and care coordination practices, among others, are likely to affect access to care and health care use for those with disabilities, including CSHCN (Hill and Wooldridge 2002; Simpson and Fraser 1999).

Understanding the influence of organizational characteristics on CSHCN's access to and use of health care services is particularly salient for this vulnerable group. These children often require an array of services that (1) place additional responsibility on the children's primary care providers (PCPs) to provide care coordination; (2) increase the importance of ensuring that an adequate number of pediatricians and pediatric subspecialists are available for them; and (3) raise questions about the best form of reimbursement for their care (Perrin et al. 1997). Currently, it is not certain how well MCOs are able to establish provider networks that meet the needs of CSHCN and how MCOs assist PCPs in coordinating care for these children. Finally, MCOs use a variety of different reimbursement methods, but little is known about the relationship between these methods and the care that CSHCN receive.

Health care service use is an indicator of children's access to health care and utilization patterns for several types of services should be assessed, including outpatient, inpatient, emergency room use, and specialty care (Ireys, Grason, and Guyer 1996). Managed care is seen as one strategy to control health care costs by promoting health care use in outpatient settings and by reducing emergency room visits and inpatient hospitalizations for all enrollees. In addition, the goal is to preserve access to needed specialty care for CSHCN.

The purpose of our study was to examine the relationship between MCOs' (1) provider network composition (number of pediatricians, family practitioners, and pediatric subspecialists), (2) strategies to coordinate or facilitate care for CSHCN, and (3) reimbursement practices on CSHCN's

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access to care, after considering important covariates in our models such as the children's sociodemographic and health characteristics and their geographic location (urban, rural). Access to care was assessed by examining (1) outpatient health care use and charges, (2) the number of inpatient admissions, (3) the number of emergency room visits, and (4) the odds of receiving a specialty consultation.

The CSHCN were enrolled in one of eight different MCOs participating in Florida's SCHIP. This study setting is important for several reasons. First, despite early Congressional and State expectations that children enrolled in SCHIP would largely be healthy, a substantial percentage of CSHCN are enrolled in this program (Stein, Shenkman, Wegener, and Silver 2003). Understanding how MCO characteristics in one large state's SCHIP initiative influence access to care for CSHCN may provide valuable information to other state programs. Second, the eight MCOs participating in Florida are diverse and represent large national plans as well as smaller more regional plans. Third, the MCOs' characteristics observed in this study are similar to those used by health plans nationally (Harvard Managed Care Industry Center Group 2002). Fourth, all of the participating MCOs are required to use the same benefit package and copayment structure, and to have board-certified PCPs, thereby allowing a greater focus on MCO characteristics of interest in this study.

BACKGROUND

Challenges exist when studying the quality of care that CSHCN receive, beginning with identifying them. Childhood chronic conditions are rare, with most occurring at a rate of less than 1 in 1,000 (Perrin 2002). Most MCOs do not have large numbers of CSHCN with the same diagnoses, with the exception of asthma or hyperactivity disorders. Yet, children with a range of special needs are enrolled in managed care settings. A substantial body of literature has demonstrated that children with diverse conditions share more commonalities when grouped according to the consequences of their conditions, such as limitations in functioning or increased use of health care services, than when grouped according to diagnoses (Stein and Jessop 1989). Therefore grouping CSHCN according to consequences of their conditions can open new avenues for examining the care that they receive.

The second major challenge in assessing the quality of care for CSHCN enrolled in managed care is characterizing the MCOs' organizational features

for analytic purposes. Increasingly, researchers are recognizing the importance of identifying MCOs' core characteristics and organizing them into domains such as contractual and financial relationships, care delivery and management practices, and others (Brach et al. 2000; Dudley et al. 2000). However, MCOs' organizational features are often confounded with one another making it difficult to isolate the effects of particular features on health care quality. Various strategies such as organizing the MCOs' features along a continuum or using data reduction techniques such as factor analysis have been recommended (Dudley et al. 2000). This study contributes to the existing, limited body of knowledge by (1) focusing on CSHCN with many different conditions, (2) examining MCOs' organizational features related to provider network composition, care coordination program characteristics, and reimbursement strategies, and (3) using data reduction techniques to meaningfully combine the MCOs' organizational features.

METHODS

Study Setting

The Florida Healthy Kids Program and eight MCOs participating in the program at the time this study began in 1999 comprised the study setting. Children between the ages of 5 and 19 years are eligible to enter along with any siblings who are between 3 and 4 years old. Families below 200 percent of the federal poverty level (FPL) are offered subsidized premiums of \$15.00 per month, regardless of the number of children enrolled. Families above 200 percent FPL can enroll their children but they must pay the full premium price of about \$85.00 per child per month.

Children cannot enroll in the Healthy Kids Program if they are Medicaid eligible. In addition, children whose parents indicate they have a special health care need on the application are screened to determine if they have a condition severe enough to meet the state Title V CSHCN Program's medical eligibility criteria. The Healthy Kids benefit package covers preventive care with no copayment, and emergency services and other outpatient, inpatient, and mental health care with minimal copayments. At the time of this study, the eight MCOs covered 24 Florida counties but there was only one MCO per county. Families could elect to enroll their children in the program, but once enrolled, the children received care through the MCO available in their county. All participating MCOs had the same subsidized premium rate, comprehensive benefit package, and copayments. In addition,

the MCOs had to ensure that their PCPs were board certified. However, the MCOs were organized differently in terms of their disease management programs, the composition of their provider networks, and their reimbursement strategies.

Data Sources

The following data sources were used: (1) person-level enrollment files for all enrollees, containing sociodemographic information about the child's age, gender, family income, and the number of months enrolled; (2) results from the telephone surveys conducted between January and July 2000 with families about the consequences their children were experiencing from their conditions; (3) person-level claims and encounter data containing Physician's Current Procedural Terminology (CPT) codes and International Classification of Diseases, 9th Revision (ICD 9-CM) codes; and (4) results from face-to-face interviews conducted with MCO administrators.

Claims and encounter data from time of the interview and for 12 months after the interview (January 1 through July 31, 2001) were used in the analysis, so that each child potentially had one full year of health care use data after the telephone survey. Some children dropped out by six months postinterview, but were retained in the analyses. The use rates for all children were adjusted for the number of months they were enrolled after the telephone survey.

Measures Used

Diagnoses Indicative of the Presence of a Special Health Care Need. CSHCN were initially identified for study participation by searching the claims/encounter data for ICD 9-CM codes that are indicative of the presence of special health care needs. The list contains 2,320 high-prevalence, low-severity conditions like asthma and low-prevalence, high-severity conditions like spina bifida and is described fully elsewhere (Shenkman et al. 2002; Youngblade, Shenkman, and Col 2002).

The Questionnaire for Identifying Children with Chronic Conditions (QuICCC). The QuICCC was administered to parents whose children had an ICD-9 code indicative of a special health care need to determine if the children were currently experiencing any health consequences from their conditions (Stein, Westbrook, and Bauman 1997). The QuICCC is designed to identify those children who have: a biological, psychological, or cognitive disorder; with a duration of at least 12 months; and consequences of the disorder such as

functional limitations, reliance on compensatory mechanisms or assistance, or service use beyond that which is considered routine.

The Managed Care Administrator Interview Guide. The Managed Care Administrator Interview Guide was used to interview managed care administrators about: (1) their ownership status (profit, not-for-profit), (2) the types of disease management programs they offered, (3) provider network characteristics (percentage of PCPs who were pediatricians or family practitioners and the number of pediatric subspecialists), (4) provider primary compensation, and (5) the use of financial incentives and penalties. All interviews were face-to-face and held with at least five different MCO administrators at each MCO. The administrators' responses were then coded and used to create the MCO predictor variables used in this study.

Place of Residence. An indicator of urban versus rural residence was generated from Rural-Urban Commuting Areas (RUCA) codes developed by the Economic Research Service/United States Department of Agriculture. These codes categorize a family's residence using their zip codes and census tract. To ensure an adequate sample size, the RUCA categories were collapsed to represent metropolitan/large town areas versus small town/rural areas. Because only one MCO was available to families in each county, the RUCA codes were used to gain some basic understanding about the influence of the MCOs' location on the study outcomes.

Sample Selection Procedures

Approval was obtained from the University of Florida, Health Sciences Center Institutional Review Board. A census of MCOs participating in the Healthy Kids Program was included in the study. The CSHCN were identified in each MCO using the following procedures. First, children with special health care needs were identified using claims and encounter data from January 1 to December 31, 1999. Eight percent or 4,678 children were identified as potentially having a special health care need based on their diagnoses as recorded in the claims data *and* were currently enrolled. Once children with eligible diagnoses were identified from the claims and encounter data, the QuICCC was used to further screen the children for condition consequences. Of the 4,678 children who had a special needs diagnosis in the claims/encounter data, 79 percent, or 3,695 of them, were located and enrolled and their parents agreed to participate in an interview. Of these, 61 percent, or 2,265 children, were identified as experiencing condition consequences and included in the study sample. Due to missing values in

some child-level variables, the final sample size was 2,223 for the four analyses about health care use, and 1,929 of them with nonzero cost were used for the analyses about outpatient charges.

Predictor Variables

Child Level-Variables. The following sociodemographic characteristics were used in this study: child age (in years), gender, the number of months enrolled, family income expressed as a percentage of the FPL (≤ 150 percent and > 150 percent), child race (white, African-American, and other), child ethnicity (Hispanic and non-Hispanic), and place of residence (metropolitan/large town areas versus small town/rural areas). The child's health was categorized according to whether they were experiencing one, two, or three condition consequences.

MCO-Level Variables. The results of the managed care administrator interviews were organized into domains. The domains, the specific organizational features contained within the domains, and the numbers of MCOs with the various features are described in Table 1. The relationships between the MCO organizational features were then explored and, as expected, they were highly correlated and therefore posed a collinearity problem for the regression models. To overcome this difficulty we used principal components and confirmatory factor analyses for binary data (Muthen 1989). Four indices were identified from the principal components analyses with three of the eigen-values explaining 69.3 percent of the total variance. A confirmatory factor analysis supported the initial results. More details about the principal components analysis can be obtained from the authors.

Index 1 contained the following organizational features: mixed model health maintenance organization; providers that are either salaried or capitated, requirements for prior authorization of specialty services, and primary care provider networks comprised of more than 41 percent family practitioners. Index 1 was named the *Utilization Management (UM) Index* because it was associated with techniques traditionally used to control health care use and charges.

Index 2 included the following features: independent practice association model, primary care provider networks comprised of more than 41 percent pediatricians, the use of both capitation and fee-for-service, and fee-for-service reimbursement for immunizations. Index 2 was named the *Pediatrician Focused (PF) Index*.

Table 1: Managed Care Organizational Features

<i>Domains and Categories</i>	<i>Operational Definition</i>	<i>Number of MCOs with the Features</i>
<i>Overall Structure</i>		
Independent practice association	1 = MCOs that contract with group or individual practices to deliver services, coded -1 if not in this category	N = 3
Mixed-model health maintenance organization	1 = MCOs that use two or more delivery systems to organize care for their enrollees, coded -1 if not in this category	N = 5
Ownership status	1 = For-profit and -1 = not-for-profit	N = 4 not-for-profit N = 4 for profit
<i>Composition of the Provider Network</i>		
Percentage of pediatricians in the primary care provider network	Median value: 41% of the network, range: 18% to 63% of network. 1 = above the median, -1 = below the median	N = 5 above the median N = 3 below the median
Percentage of family practitioners in the primary care provider network	Median value: 50% of the network, range: 25% to 79% of network. 1 = above the median, -1 = below the median	N = 5 above the median N = 3 below the median
Percentage of pediatric subspecialist in the physician specialty network	Median value: 25% of specialty network, range: 0% to 43%. 1 = above the median, -1 = below the median	N = 3 above the median N = 5 below the median
Contracts with children's hospitals for specialty inpatient care	1 = yes, -1 = no	N = 6 yes N = 2 no
<i>Strategies to Coordinate or Facilitate Care for CSHCN</i>		
Use of nurse coordinators	Nurse coordinators interact with PCPs and families of CSHCN to assist with referrals and care coordination, 1 = yes, -1 = no	N = 5 yes N = 3 no

CSHCN exempt from prior authorization	Prior authorization for specialty care and procedures not required for CSHCN, 1 = yes, -1 = no	N = 5 yes N = 3 no
<i>Reimbursement and Prior Authorization Strategies</i>		
Primary compensation:		
Capitation	Coded as 1 = yes, -1 = no for each form of primary compensation	Capitation, N = 3
Discounted fee-for-services		Discounted FFS, N = 1
Salary		Salary, N = 1
Capitation and discounted fee-for-service		Capitation plus FFS, N = 3
Financial incentives:		
Withholds for emergency room use	Coded as 1 = yes, -1 = no if a portion of the provider's payment was withheld related to enrollees' emergency room use	N = 2 yes N = 6 no
Fee-for-service payments for immunizations	Providers receive fee-for-service or "bill above" for immunizations given, 1 = yes, -1 = no	N = 5 yes N = 3 no

The MCO features in *Index 3* included: not-for-profit MCOs, specialist networks comprised of more than 25 percent pediatric subspecialists, contracting with specially designated children's hospitals for specialty care, the use of nurse coordinators to work with the PCPs and families caring for CSHCN, and exemption of CSHCN from prior authorization procedures. *Index 3* was named the *Specialist Focused (SF) Index*.

Index 4 was named the *Fee-for-Service (FFS) Index* because it characterized MCOs that paid their providers fee-for-service and did not incorporate other strategies into the care of CSHCN, such as ensuring a certain percentage of PCPs in the network. Pearson correlation coefficients between factors 1 and 2 was high and negative ($r = -0.77$), all remaining correlation coefficients among the factors ranged from -0.22 to 0.18 , thus we retained indices 2, 3, and 4 for further analyses. Further detail about the factor analyses can be obtained from the authors.

Interaction Terms between Child-Level and MCO-Level Variables. To determine if any of the MCO organizational features differentially influenced the health care use patterns, all interaction terms were considered in the models.

Outcome Variables

Five health care use variables were assessed: (1) *outpatient use rates* were calculated by counting the number of unique days on which a health care encounter occurred divided by the number of months the child was enrolled in the program; (2) *outpatient charges per month*, which were calculated using a fee database linked to all of the reported CPT codes. A logarithmic transformation was performed on the monthly charges to decrease the skewness and kurtosis; (3) *inpatient use rate per month*; (4) *the emergency room use rate per month*; and (5) the odds of a child having a *specialty consultation* during the study year.

Analytic Techniques

The unit of analysis at the individual level was the child and at the aggregate level was the MCO. Children included in the analyses ranged from 139 to 501 for the eight MCOs. Because children were nested within organizations, a hierarchical model (Goldstein 1995) with random effects was developed for each of the five outcomes.

Let Y_{ij} be an outcome for i^{th} child in the j^{th} MCO, and w_{lj} be the l^{th} index measured on the j^{th} MCO. We let x_{kij} denote the k^{th} child-level variable that

include age, gender, race, federal poverty level, number of consequences, months of enrollment, and child ethnicity. Suppose y_{ij} has mean μ_{ij} , a two-level hierarchical generalized linear model relate the means with the explanatory variables as follows:

$$g(\mu_{ij}) = \beta_{0j} + \sum_{k=1}^p \beta_{kj} x_{kij},$$

$$\beta_{kj} = \beta_k + \sum_{l=1}^q \gamma_{kl} w_{lj} + u_{kj}, k = 0, 1, \dots, p.$$

In the above model, g is called the link function. We fit the log of monthly outpatient charges with normal error and identical link. For inpatient and emergency room use rates, we used Poisson regression models with log link for the corresponding counts during the study period including the log of months of enrollment as an offset. For specialty consultation, we assumed a Bernoulli distribution and canonical logit link. Both Poisson and logistic regressions models included extra-dispersion parameter ϕ . Substituting the second equation into the first yields the following single equation for the two-level regression models:

$$g(\mu_{ij}) = (\beta_0 + u_{0j}) + \sum_{k=1}^p (\beta_k + u_{kj}) x_{kij} + \sum_{l=1}^q \gamma_{0l} w_{lj} + \sum_{k=1}^p \sum_{l=1}^q \gamma_{kl} w_{lj} x_{kij}.$$

Therefore, the components u_{0j} and u_{kj} which are assumed to have normal distribution with zero mean and variance τ_0^2 , stand for departures of the j^{th} MCO from the overall mean and slopes, β_0 and β_k respectively.

We used the *SASIML* macro GLIMMIX, an extension of the MIXED Procedure, to fit our models (Littell et al. 1996). None of those random effects (except random intercept) were significant at 0.1 levels. Based on the fitted models, we evaluated the “variance partition coefficient (VPC),” which represents the fraction of the total residual variation that is due to the MCO level (Goldstein, Browne, and Rasbash 2002). For the hierarchical normal response models with random intercept, $VPC = \tau_0^2 / (\tau_0^2 + \sigma^2)$ this is a measure of the residual correlation between responses from two children in the same MCO, which also is known in the literature as the “intra class correlation (ICC).”

For the hierarchical nonlinear models, a simulation method was applied to compute the variance partitions (Goldstein, Browne, and Rasbash 2002). To separate the contextual and compositional effects, we also provided the partitioned variance statistics and VPC for the null model with no covariates

and only a random intercept. Because the residual variances and VPC depend on the values of the covariates, or equivalently the value of linear predictor (LP), we compared the final model and the null model on the same LP. Last, we offered variance partition results based on Type I SS and Type III SS for the log of outpatient charges based on SAS's GLM procedure, which is contained in Appendix A (See online Appendices A and B at <http://www.blackwellpublishing.com/products/journals/suppmat/HESR/HESR02243/HESR02243sm.htm>.)

RESULTS

Sample Characteristics

The final study sample contained 2,223 children, and their sociodemographic and health characteristics are described in Table 2. The mean outpatient use rate was 0.97 visits per month with a standard deviation of 1.30. The log of monthly outpatient charges had a mean of 4.14 and SD of 1.39. The inpatient use rates and emergency room use rates per month were 0.02 ± 0.16 and 0.04 ± 0.09 , respectively. Finally, 14 percent of the CSHCN sample had a specialty consultation.

For each outcome, we plotted the within MCO average against the indices (Figure 1, Appendix B). The figures indicated trends in the various use categories that subsequently were supported by further analyses (described below). No obvious outliers among the five health care use outcomes studied were observed in the plots.

Results from the Hierarchical Regression Models

Outpatient Use Rates. At the individual level, all sociodemographic predictor variables except months of enrollment, child ethnicity, and place of residence were significantly related to outpatient use rates (Table 3). All effects in this section are presented in the log scale. Compared to children with three condition consequences, those with one or two consequences had use log rates that were 0.71 or 0.29 lower; respectively ($p < .01$).

Male CSHCN had higher outpatient use rates (0.23; $p < .01$) than females. Children's age was associated with increased outpatient use rates for those cared for in MCOs with the PF and SF Index characteristics (0.02, $p < .01$). However, as the FFS index increased, outpatient use rates decreased with age (-0.02 , $p < .01$). Race was significantly related to outpatient use rates with white children having higher outpatient rates (0.44; $p < .01$) than their

Table 2: Sample Characteristics

<i>MCO-Level Variables</i>	<i>Frequency/Mean $\pm$ SD</i>	<i>Percent/Range</i>
Pediatrician Focused Index (PF)	0.20 $\pm$ 2.90	– 3.8 to 3.8
Specialist Focused Index (SF)	3.3 $\pm$ 2.67	– 2.8 to 4.8
Fee-for-Service Index (FFS)	919	41%
<i>Child-Level Variables</i>		
Children age	11.8 $\pm$ 3.52	3 to 19
Gender		
Male	879	40%
Female	1,344	60%
Enrollment in months postinterview	10.7 $\pm$ 2.32	6 to 12
Race		
White	1,712	77%
African-American	284	13%
Other race	227	10%
Ethnicity		
Hispanic	546	25%
Non-Hispanic	1,677	75%
Federal Poverty Level		
Less than 150%	1,452	65%
Greater than 150%	771	35%
Results of QuICCC		
1 consequence	566	26%
2 consequences	827	37%
3 consequences	830	37%
Outpatient use rates per month	0.97 $\pm$ 1.30	0 to 13.18
Log outpatient charges per month	4.14 $\pm$ 1.39	0.15 to 9.06
Inpatient use rates per month	0.02 $\pm$ 0.16	0 to 4.25
Emergency room use rates per month	0.04 $\pm$ 0.09	0 to 1.00
Percent with a specialty consultation	304	14%
Outpatient charges per month in dollars	\$172 $\pm$ \$404	\$10 to \$8,619

African American counterparts, even after considering other covariates in the model. In addition, as the Pediatrician Focused Index increased, this racial difference became even larger. Children from families with incomes greater than 150 percent FPL had higher outpatient use rates (0.34; $p < .01$) than families with incomes less than 150 percent FPL for those in MCOs with the PF or SF Indices. However, the differences between the two poverty groups in the outpatient use rates were smaller for those enrolled in MCOs with SF or FFS index characteristics.

At the MCO level of analysis, the PF Index was significantly related to decreased outpatient use rates (-0.10 ; $p < .01$). The effect of the PF Index was greater for African American children and those of mixed racial backgrounds than for white children. The SF Index was associated with increased outpatient

Figure 1: Relationship between Outcomes and Facility Indices

use rates for children from families with incomes less than 150 percent FPL, and with decreased rates for those with incomes greater than 150 percent FPL (-0.01 ; $p < .05$). Likewise, the FFS Index was significantly and positively related to increased outpatient use rates for those with incomes below 150 percent FPL (0.44 ; $p < .01$).

Table 3: Estimates (and Standard Errors) for the Fixed Effects of the Hierarchical Models^{a,b,c}

	Monthly Outpatient Use Rates	Monthly Outpatient Charges	Monthly Inpatient Use Rates	Monthly Emergency Dept Use Rates	Had Specialty Consultation (Y/N)
Intercept	−0.75 (0.18) [†]	3.98 (0.34) [†]	−3.77 (0.67) [†]	−3.93 (0.62) [†]	−2.74 (0.69) [†]
<i>MCO-Level Main Effects:</i>					
Pediatrician Focused (PF) Index	−0.13 (0.04) [‡]	−0.10 (0.05) [*]	−0.69 (0.16) [‡]		−0.22 (0.13) [*]
Specialist Focused (SF) Index	0.04 (0.02)	0.03 (0.05)		0.23 (0.10) [†]	−0.33 (0.38)
Fee-for-Service (FFS) Index	0.44 (0.21) [†]	0.76 (0.34) [†]	−0.78 (0.54)	0.72 (0.57)	
<i>Child-Level Main Effects:</i>					
QuICCC Results 1 conditions	−0.71 (0.07) [‡]	−0.68 (0.08) [†]	−1.65 (0.36) [‡]	−0.53 (0.13) [†]	−0.88 (0.22) [‡]
QuICCC Results 2 conditions	−0.29 (0.05) [‡]	−0.32 (0.07) [‡]	−0.87 (0.24) [‡]	−0.19 (0.10) [†]	−0.46 (0.19) [†]
Male	0.23 (0.05) [‡]	0.25 (0.06) [‡]	−0.47 (0.31)	0.17 (0.10) [*]	0.42 (0.13) [‡]
Age	0.02 (0.01) [‡]	0.03 (0.01) [‡]	0.05 (0.03) [*]	0.07 (0.03) [†]	0.05 (0.03)
White Race	0.44 (0.09) [‡]	0.48 (0.14) [‡]	0.02 (0.42)		0.19 (0.37)
Mixed Race	0.50 (0.11) [‡]	0.63 (0.18) [‡]	−0.46 (0.59)		0.59 (0.50)
Federal Poverty Level (FPL) > 150%	0.34 (0.11) [‡]	0.39 (0.13) [‡]		−0.05 (0.03) [*]	0.45 (0.22) [†]
Months of Enrollment		−0.07 (0.01) [‡]		0.53 (0.22) [†]	0.10 (0.03) [‡]
Hispanic					
<i>Interaction Effects:</i>					
PF*QuICCC Results 1 conditions		0.06 (0.03) [†]			
PF*QuICCC Results 2 conditions		0.02 (0.02)			
PF*Male			0.21 (0.08) [‡]		
PF*White Race	0.04 (0.03) [†]		0.55 (0.14) [‡]		
PF*Mixed Race	−0.01 (0.04)		0.56 (0.20) [‡]		
SF*Age				−0.01 (0.01) [†]	0.02 (0.01) [†]
SF*White Race				0.15 (0.09) [*]	
SF*Mixed Race				−0.07 (0.12)	

continued

Table 3: Continued

	Monthly Outpatient Use Rates	Monthly Outpatient Charges	Monthly Inpatient Use Rates	Monthly Emergency Dept Use Rates	Had Specialty Consultation (Y/N)
SF*FPL > 150%	−0.05 (0.02) [‡]	−0.04 (0.02)*	−0.15 (0.05) [‡]		−0.16 (0.05) [‡]
SF*Hispanic					
FFS*QuICCC Results 1 conditions				0.74 (0.35) [‡]	
FFS*QuICCC Results 2 conditions				0.29 (0.35)*	
FFS*Male			1.11 (0.49) [‡]		
FFS*Age	−0.04 (0.01) [‡]	−0.04 (0.02) [‡]		−0.05 (0.03)*	
FFS*White Race		−0.18 (0.19)			
FFS*Mixed Race		−0.61 (0.26) [‡]			
FFS*FPL > 150%	−0.31 (0.12) [‡]	−0.51 (0.14) [‡]			

^aThe effects for the charges and all use rates were presented in log scale, and in logit scale for the specialty consultation.

^bBlank cells indicate that the factor was not statistically significant and was not involved in any significant two-way interactions with other main effects, at the 0.1 level.

^cP-values: [‡] $p < 0.05$; * $p < 0.01$; * $p < 0.1$. However, it should be cautious interpreting those “nonsignificant” main effects. They were not significant when other factors were at reference levels, but they were involved in some significant interactions, that is their effects depend on the levels of other factors

Table 4: Estimates (and Standard Errors) for the Random Effects and Variance Partition Coefficients (VPC) of the Hierarchical Models^{a,b,c,d,e}

	Monthly Outpatient Use Rates ^c	Monthly Outpatient Charges ^c	Monthly Inpatient Use Rates	Monthly Emergency Dept Use Rates	Had Specialty Consultation (Y/N)
<i>Final Models</i>					
Random intercept					0.19 (0.15)* 0.99 (0.03) [‡]
Extra-dispersion scale				0.36 (0.26)* 1.74 (0.05) [‡]	
<i>Linear Predictors Based on Final Models^a</i>					
MCO-level residual variance	0.02 12.51 (0.38) [‡]	0.12 (0.09) [†] 1.68 (0.05) [‡]	0.33 (0.29) 5.98 (0.18) [‡]		0.0038 0.1375 2.66%
Child-level residual variance	13.86 0.18%	3645 (0.12) 2.68% (6.67%)	0.0010 0.33%	0.0007 0.0691 0.96%	
Variance Partition Coefficient					
<i>Linear Predictors Based on Null Models^a</i>					
MCO-level residual variance	0.02 10.92 0.14%	2967 (0.12) 107756 (1.68) 2.68% (6.67%)	0.0002 0.15 0.16%	0.0006 0.0636 0.91%	0.0027 0.1157 2.25%
Child-level residual variance					
Variance Partition Coefficient					
<i>Null Models (with Random Intercept Only)</i>					
Random intercept	0.09 (0.05) [†] 14.87 (0.45) [‡]	0.11 (0.06) [†] 1.81 (0.06) [‡]	0.16 (0.16) 10.21 (0.31) [‡]	0.22 (0.15)* 1.85 (0.06) [‡]	0.10 (0.07)* 0.99 (0.03) [‡]
Extra-dispersion scale					
<i>Linear Predictors Based on Final Models</i>					
MCO-level residual variance	0.12 (0.12) 17.03 (14.69) 0.71% (0.83%)	3760 (0.11) 171844 (1.81) 2.14% (5.73%)	0.0003 0.46 0.07%	0.0003 0.0685 0.48%	0.0020 0.1366 1.46%
Child-level residual variance					
Variance Partition Coefficient					
<i>Linear Predictors Based on Null Models</i>					
MCO-level residual variance	0.08 (0.08) 13.41 (11.56) 0.56% (0.65%)	3061 (0.11) 139895 (1.81) 2.14% (5.73%)	0.0001 0.23 0.04%	0.0003 0.0631 0.45%	0.0014 0.1145 1.22%
Child-level residual variance					
Variance Partition Coefficient					

^aThe simulation method consists of three steps: (1) based on the fitted model simulate values for the MCO-level residuals; (2) for a pre-selected covariate values compute the corresponding values of the MCO-level means, and evaluate the child-level variance; (3) the VPC is then estimated.

^bThe residual variances and VPC depend on the values of the covariates, or equivalently the value of linear predictor (lp). In order to compare final models with the null models, we studied two cases: (1) lp based on the final models with covariates chosen as means or modes (i.e., PF = 0.2, SF = 3.3, FFS = 0, Age 11.8, Female, Enrollment = 10.7 months, White, Non-Hispanic, FPI less than 150%, and QulCCC results 3 consequences), and (2) lp evaluated by null models.

^cFor monthly outpatient charges, we compared THREE models: null model, final model, and a third model that included random intercept and all significant child-level variables. Results for the final model were at the top half of table. The first column at the bottom was for the null model, while the bold numbers in the second column was for the third model.

^dFor monthly outpatient charges, we presented two sets of results on residual variances and VPC. The first column was in the cost scale, while the bold numbers in the second column was for log of charges.

^eP-values: [†] $p < 0.01$; [‡] $p < 0.05$; * $p < 0.1$.

Finally, the unexplained variance at the MCO level for the log-outpatient utilization rates was $\hat{\tau}_0^2 = 0.02$, which was much smaller than $\hat{\tau}_0^2 = 0.09$ from the null model that only included the random intercept (Table 4). The extra-dispersion scale were $\hat{\phi} = 12.51$ and $\hat{\phi} = 14.87$ for the two models; respectively. Table 4 shows the final model compared to the null model on the residual variances and variance partition coefficients (VPC). The MCO residual variance had larger percentage reductions from the null model to the final model than the child level residual variance, hence the VPC also decreased.

To understand how much of the original between-MCO variation was explained by child level characteristics (i.e., compositional effects) versus by the MCO-characteristics (i.e., contextual effects), we fit a third model that included a random intercept and all significant child level variables, which yielded $\hat{\tau}_0^2 = 0.09$ and $\hat{\phi} = 12.80$. The residual variance at the individual level decreased and did not change at the MCO level when child characteristics were added (Table 4). These results suggest that the three MCO indices, not the child level characteristics, explained most of the variation between the eight organizations on outpatient use rates. One should note that the VPC was very small even in the null model, and should also be cautious about the above results because the random effects were estimated with few degrees of freedom. Similar results were obtained for the outpatient charges and are not described here.

Inpatient Use

Once again, all effects in this section are expressed in the log scale for the inpatient use rates per month. Among the child-level characteristics, family poverty level, months of enrollment, place of residence, and child ethnicity were not significantly associated with inpatient use rates. Compared to children with three consequences, those with one or two consequences had inpatient use log rates that were 1.65 or 0.78 higher; respectively ($p < .01$). Male children had inpatient use log rates that were 0.64 more than females as the FFS Index increased, but 0.47 less among MCOs with high PF and SF indices ($p < .05$). Age also was associated with inpatient use rates (0.05; $p < .10$), with older children having higher use rates. In addition, African American children and those of mixed racial backgrounds had lower inpatient use rates than whites, and the racial effect became larger as the PF Index increased ($p < .01$).

At the MCO level, the PF Index was significantly related to decreased inpatient use ($-.69, p < .01$). The magnitude of the decreased rates was larger for African American than white children with a difference of 0.55 in slope ($p < .01$). In addition, the PF Index effect on inpatient use was larger for females than males. The SF Index was not significantly related to inpatient use. The FFS Index effect was significantly different between females and males with a negative association with inpatient admissions for females, but a positive one for males, with regression coefficients of $-.078$ and 0.33 respectively ($p < .05$).

Similar to outpatient charges, the unexplained variance at the MCO level for the log of inpatient use rates was larger for the final model than the null model (0.33 and 0.16 respectively). This is likely due to the drop in the degrees of freedom and the previously stated fact that the FFS Index effect had different directions for males and females. It is also noteworthy that the between-MCO variation was not significant even in the null model. Table 4 shows that there was a reduction of more than 30 percent for the child-level residual variance from the null model to the full model. Last, the estimates of extra-dispersion scale were $\hat{\phi} = 5.98$ and $\hat{\phi} = 10.21$ for the two models.

Emergency Room Use

Once again, all effects in this section are expressed in the log scale for emergency room use rates per month. Compared to children with three condition consequences, those with one or two consequences had ER log rates that were 0.53 or 0.34; respectively ($p < .01$). Males had higher use rates (0.17; $p < .1$) than females. Age was associated with ER use (0.07; $p < .05$) with older children using the ER more. This age effect became smaller as the SF and FFS indices increased.

Hispanic children had higher ER use rates than non-Hispanics. However, the gap in ER use lessened as the SF Index increased. Children enrolled in the health insurance program for longer periods of time had decreased ER use ($-.05$; $p < .1$). Race, income, and place of residence were not significantly associated with ER use rates.

At the MCO level, the PF Index was not significantly related to ER use rates. The SF Index was associated with increased ER use (0.23; $p < .05$), but the effect was reduced as the child grew older and it was smaller for Hispanic children than for non-Hispanic children. Finally, the effect of FFS Index on ER use decreased significantly as child grew older ($-.05$; $p < .1$).

Similar to inpatient use, the MCO indices and the child-level variables did not help much in explaining the between-MCO variations in ER use rates. Once again, the unexplained variance at the MCO level for the log of the ER use rates was larger for the final model than the null model (0.22 and 0.36 respectively). Both random effects were significant at the 0.1 level, indicating that there was moderate evidence that the use rates varied between MCOs. The estimates of extra-dispersion scale were $\hat{\phi} = 1.74$ for the final model and $\hat{\phi} = 1.85$ for the null model.

Odds of Specialty Consultation

All effects in this section are presented in the scale of log odds. At the individual level, all sociodemographic predictor variables except child ethnicity and place of residence were significantly related to having a specialty consultation. Compared to children with three condition consequences, those with one or two consequences had log odds of specialty consultation that were 0.88 or 0.46 lower; respectively ($p < .01$). However, the differences observed among children with different numbers of condition consequences were smaller for the FFS Index than for the PF and SF indices ($p < .05$). Similar to the previous results, male CSHCN had higher odds of receiving a specialty consultation (0.42; $p < .01$) than females. The odds of receiving specialty care increased as children grew older (0.05; $p < .05$), and the age effect was larger for those in MCOs with SF Index characteristics. African American children had lower specialty consultation use than their white counterparts, and as the SF Index increased, this racial difference became even larger ($p < .05$). Children from families with incomes greater than 150 percent FPL had higher log odds of specialty consultation (0.45; $p < .01$) than families with incomes less than 150 percent FPL, but the effect diminished as the SF Index increased.

At the MCO level of analysis, the PF Index was not significantly related to having a specialty consultation. The SF Index was related to decreased odds of having a specialty consultation (-0.22 ; $p < .10$), and as the child grew older, the effect gradually disappeared (0.02; $p < .01$). In addition, the SF index had a bigger negative impact on specialty consultation for children from families with incomes greater than 150 percent FPL than below 150 percent FPL, with a difference of -0.16 ($p < .05$). Likewise, the effect of the FS Index on the receipt of specialty consultations was larger for African American than white children. Those children enrolled in MCOs with the FFS Index had higher odds of receiving specialty consultation. However, the association became

negative ($p < .05$) as the number of condition consequences increased from one to three.

Finally, the random effect was significant at 0.1 level for both the final model ($\hat{\tau}_0^2 = 0.19$) and the null model ($\hat{\tau}_0^2 = 0.10$), which suggested that there was moderate evidence that the odds of having specialty consultation varied between MCOs. Once again, the MCO indices and child-level variables did not help much in explaining the between-MCO variations in specialty consultation. Estimates of extra-dispersion scale were the same ($\hat{\phi} = 0.99$) for the two models.

DISCUSSION

Nationally, there is growing concern about the care that vulnerable populations such as CSHCN receive in managed care settings and an increasing emphasis on understanding how the health care delivery system can best be organized to promote access to care for those with special needs. Some MCOs have implemented various practices and policies that may be beneficial for CSHCN, such as exempting CSHCN from prior authorization procedures or ensuring an adequate number of pediatricians and pediatric subspecialists in their networks. One of the goals of managed care for publicly insured children is the promotion of health care in the outpatient setting and reduced ER use. In addition, for CSHCN, there are added goals of promoting outpatient as opposed to inpatient care and fostering access to needed specialty care.

Overall, the managed care organizational characteristics measured in this study did not have the desired effect of reducing inpatient and ER use, while promoting outpatient care and specialty consultation. Moreover, the influence of the organizational characteristics on the CSHCN's use patterns was not uniform. Children with certain socioeconomic characteristics fared differently than others within particular managed care contexts, even after considering their health status, in the models. For example, children in MCOs with the SF Index characteristics had increased ER use, although this increase was not as substantial for Hispanic children as it was for non-Hispanic children. African American children were less likely to have a specialty consultation when compared to their white counterparts, particularly when cared for in MCOs with the SF Index characteristics.

Some of the child-level variables measured in our study were more consistently related to health care use patterns. Children's health, as measured

by the number of consequences they were experiencing from their chronic conditions, their age, and their gender were consistently associated with their health care use patterns. As the number of condition consequences increased, the outpatient use rates and charges, emergency room use, and inpatient use increased.

Some sociodemographic characteristics were related to the CSHCN's health care use. Notably, African American children had lower outpatient use rates and charges than white children, even after considering their health characteristics, in the model. In addition, Hispanic children had higher ER use rates than non-Hispanic children.

Other studies have found that minority patients may be at risk for receiving less intensive services than nonminority patients (Fiscella et al. 2000). There are many factors not addressed in this study that may have contributed to the African American children's lower outpatient use rates, such as transportation barriers, communication barriers with the provider, and others (Hargraves, Cunningham, and Hughes 2001). However, our findings indicate that certain MCO characteristics may have a differential impact on African American children. African American CSHCN enrolled in MCOs using strategies generally perceived as child sensitive, such as those seen in both the Pediatrician Focused and Specialist Focused indices had less outpatient care and a smaller likelihood of receiving a specialty consultation than white children. The reasons for this finding are not clear and warrant further investigation.

Among the MCO indices, the PF Index was associated with decreased outpatient and inpatient use but had no relationship to ER use or the receipt of specialty consultation. The PF Index was associated with MCOs that used blended payment mechanisms relying on both capitation and fee-for-service payments and had more than 41 percent of their primary care networks comprised of pediatricians. In contrast, the FFS Index was associated with increased outpatient use and charges, even after considering the child's health status.

There is increasing evidence, based on economic theory that blended payment methods, such as those seen in the PF Index, may be the most optimal way to reimburse physicians (Robinson 2001). Fee-for-service may reward the provision of inappropriate services and upcoding of visits, whereas capitation may encourage inappropriate underutilization of services and dumping of high-cost patients. In contrast, blended payments incorporate the use of capitation for some specified services with fee-for-service supplements for other carved out services and, in theory,

encourage delivery of the appropriate amount of health care. The findings from our study may provide some support for the use of blended payments to reimburse providers in that children cared for under conditions using this reimbursement strategy had decreased outpatient and inpatient use rates. However, those MCOs that used blended payments also formed provider networks characterized by a substantial percentage of pediatricians, making it impossible to state which component of the index contributed to the findings.

The Specialist Focused Index was associated with increased emergency room use. It also was associated with increased outpatient use and charges, but only for those families whose incomes were below 150 percent FPL. As previously noted with the Pediatrician Focused Index, it is impossible to isolate one component of the Specialist Focused Index from the others because they are occurring simultaneously. However, the index is composed of characteristics that in isolation have been associated with increased health care charges. For example, some studies have demonstrated that when subspecialists provide primary care, at least in an adult population, health care charges are higher than when generalists are the PCPs (Greenfield et al. 1995). The reasons for the increased ER use are not clear and warrant further exploration.

Finally, the Fee-for-Service Index was associated with significantly higher outpatient use rates and charges. An abundant body of literature has demonstrated that the use of fee-for-service payments is associated with elevated health care costs (Robinson 2001). Our study findings are consistent with those seen in the literature. Despite the associations of the various MCO level indices with CSHCN's health care use patterns, the child's health status was one of the most important variables related to the children's health care use patterns. This finding suggests that providers are providing care for CSHCN based on their unique needs, without undue influence from health care system organizational factors.

While this study yields some important information about the associations between MCO organizational features and children's health care use, there are several limitations. First, we were not able to compare the children's health care use patterns to any benchmarks because few exist (Perrin et al. 2002). Therefore, while we can describe the MCO- and individual-level features associated with specific health care use categories, we do not know if the amount of use was appropriate or inappropriate based on benchmarks, nor do we know if the amount of use contributed to improved health status or complications for these children.

Second, the findings in this study were obtained with Title XXI enrollees in a state where children with conditions severe enough to meet Title V CSHCN Program medical eligibility criteria are placed in a separate network. The CSHCN with mild to moderate conditions remain in the Title XXI enrollee pool and participated in this study. It is possible that different findings could be obtained with children with more severe special needs. However, these children are experiencing consequences of their conditions and as such represent a vulnerable group that warrant special consideration.

Third, we faced the problem of categorizing the MCO organizational features in a meaningful way for analytic purposes and elected to use principal components analysis to cluster the variables together. While this strategy reflects what happens in actual practice, namely, that MCOs use a variety of practices simultaneously to deliver health care services to their enrollees, it does not allow us to pinpoint specific features that may contribute to the delivery of quality health care for CSHCN. Moreover, because the index that included strong utilization management was negatively and strongly correlated with the PF Index, one of them had to be dropped from the analysis.

Fourth, because only one MCO was available in each county and families could not choose their MCOs, it is possible that the MCO influences may be related to regional or county variations in the health care delivery system. We included a very basic measure of place of residence in our analyses to distinguish between metropolitan versus small town and rural locations for the families. The place of residence was not significantly associated with any of the CSHCN's health care use patterns. However it is possible that this measure was not sufficient to capture county or regional variations that may be important to our outcome variables. Finally, this study focuses on the organization of care at the MCO level. Understanding the organization of care at the provider level is also essential and should be addressed in future studies.

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APPENDIX B

We plotted the within MCO average of five outcomes against the Pediatrician Focused Index and Specialist Focused Index. In each panel, crosses are for Fee-for-Service (FFS) organizations and circles for non-FFS ones. From the top to bottom, the y-axes are log of monthly outpatient charges, monthly outpatient use rates, monthly inpatient use rates, emergency department use rates, and percentage of children who used specialty consultation.

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APPENDIX A : Type I and Type III Sum of Squares from the General Linear Model for the Log of Monthly Outpatient Charges^a

	Model I ^b				Model II ^b			
	Type I		Cumulative		Type I		Cumulative	
	df	SS	Type I SS	Type III SS	df	SS	Type I SS	Type III SS
<i>MCO-Level Main Effects:</i>								
Pediatrician Focused (PF) Index	1	130.5	130.5	110.7				
Specialist Focused (SF) Index	1	0.0	130.5	1.2				
Fee-for-Service (FFS) Index	1	15.6	146.1	11.2	7	232.5	232.5	85.0
MCO Plan								
<i>Child-Level Main Effects:</i>								
QuICCC Results	2	115.8	261.9	121.2	2	125.8	358.4	129.6
Male	1	28.5	290.5	26.4	1	32.8	391.1	29.1
Age	1	7.6	298.0	15.5	1	8.5	399.6	15.7
Race	2	31.1	329.1	30.7	2	28.5	428.1	24.3
Federal Poverty Level	1	0.3	329.5	19.1	1	0.3	428.4	15.5
Months of Enrollment	1	36.1	365.6	35.2	1	33.3	461.6	33.2
<i>Interaction Effects:</i>								
PF*QuICCC Results	2	11.4	376.9	9.8	2	9.4	471.0	8.0
SF*Federal Poverty Level	1	0.2	377.2	5.5	1	0.5	471.5	5.3
FFS*Age	1	8.5	385.7	8.8	1	7.8	479.2	8.1

continued

APPENDIX A: Continued

	Model I ^b			Model II ^b				
	Type I	Cumulative	Type	Type I	Cumulative	Type		
	SS	Type I SS	III SS	SS	Type I SS	III SS		
df	df	df	df	df	df	df		
FFS*Federal Poverty Level	1	31.8	417.5	31.7	1	22.8	502.1	23.5
FFS*Race	2	10.1	427.6	10.1	2	10.5	512.6	10.5
SSE (MSE)	1910	3287.1	(1.72)		1906	3202.1	(1.68)	
Corrected Total	1928		3714.7	1928		3714.7		
Percent Explained by MCO-Level Variables			3.9%			6.3%		
Percent Explained by MCO and Child-Level Variables			11.5%			13.8%		

^aType I SS, also called sequential sums of squares, are the incremental improvement in error SS as each term is added to the model sequentially. And the Type III SS, sometime referred to as partial sums of squares, which are the incremental improvement i.

^bModel I is the final model that included the three MCO indices. It was compared to model II that include dummy variables for all MCOs.