Profile of Medical Charges for Children by Health Status Group and Severity Level in a Washington State Health Plan

John M. Neff, Virginia L. Sharp, John Muldoon, Jeff Graham, and Kristin Myers

Objective. To identify children and evaluate patterns of charges for pediatric medical care, by overall health status, severity of illness, and categories of medical service.

Data Sources. Enrollment, claims, and charges data from a Washington State health plan. The study population includes all children ages 0 to 18 years during calendar year 1999.

Study Design. Children were classified into clinically defined health status groups and severity levels using Clinical Risk Groups (CRGs). Health plan charges were analyzed according to core health status group, severity level, and category of service.

Data Collection. The three secondary data sources were obtained electronically from the health plan and cleaned for unique members and data quality before analysis.

Principal Findings. Children classified as healthy (85.2 percent) had mean and median annual charges of \$485 and \$191. Children with one or more chronic conditions (9.5 percent) had mean and median charges increasing by status and severity group from \$2,303 to \$76,143 and from \$1,151 to \$19,456, and accounted for 45.2 percent of all charges. Distribution of charges varied across health status groups. Healthy children had 70.6 percent of their charges in outpatient and physician services. Children classified in the complex, catastrophic, and malignancy groups had 67 percent of their charges in inpatient encounters. Children with chronic conditions accounted for 31.8 percent of all physician, 41.8 percent of outpatient, 47.7 percent of pharmacy, 60.7 percent of inpatient, and 75.8 percent of all other charges.

Conclusions. Children with chronic conditions account for a disproportionately high percentage of children's health expenditures. They account for different percentages of expenses for different medical services. These percentages vary according to health status and severity. This analysis can be used to identify and track groups of children for various purposes.

Key Words. Children, chronic illnesses, administrative data, charges, special health care needs

There is considerable evidence that costs of care vary widely across medical conditions and general health status, and children with certain conditions generate higher medical costs than the average pediatric population (Newacheck and Halfon 1998). There is limited information, however, concerning

how these costs vary by health status group or by severity levels within these groups. Health plans also are limited in their ability to identify children with special health care needs for care management strategies. As we enter another time of double-digit health care inflation, there will certainly be efforts to reduce and control costs. An ability to understand and track the costs of specific components of care across pediatric populations will help provide a basis for developing rational care management strategies for cost controls and improved outcomes.

There is relatively little information published on medical care costs for children. Ireys et al. (1997) analyzed health care costs for children in a Washington State Medicaid database for 1992. They analyzed the costs of care for certain children with special health care needs (CSHCN) sentinel conditions according to various cost categories, such as hospital, pharmaceutical, inpatient, and physician services, and compared costs by category and with the entire group of enrolled children. In general, all of the condition-based groups they identified were more costly than the entire population. Certain groups, such as those with malignancies, were very costly on an individual basis, but collectively, children with respiratory conditions generated higher overall costs. They also showed that the distribution of costs across cost categories varied considerably for different conditions. Using the same data, Andrews et al. (1997), identified certain very costly conditions that might be used for carve outs and tracking. McCormick et al. (2001), using data from the Medical Expenditure Panel Survey (MEPS) analyzed expenditures for all health care services from any sources during 1996 for children, 0–17 years old. In this study, average annual expenditures for a child with any medical expenses (85.4 percent of the children) were \$1,019, and 10

This work has been supported by a grant from the Maternal and Child Health Bureau (GH93MC00061), and by a research license from 3M Health Information Systems Corporation to test CRGs on pediatric populations. The article is based on a presentation at the Third Annual Meeting of Child Health Services Researchers, Atlanta, Georgia, June 2001 (<http://academyhealth.org/childhealth/program.htm>).

Address correspondence to John M. Neff, M.D., Center for Children with Special Needs, Children's Hospital and Regional Medical Center, Seattle, WA. Dr. Neff is also with the Department of Pediatrics, University of Washington School of Medicine, Seattle. Virginia L. Sharp, M.A., is with the Center for Children with Special Needs, Children's Hospital and Regional Medical Center, Seattle. John Muldoon, M.H.A., is with the National Association of Children's Hospitals and Related Institutions, Alexandria, Virginia. Jeff Graham, M.D., is a Health Care Consultant, Bellingham, Washington. Kristin Myers is with Regence Blue Shield, Burlington, Washington.

percent of the most expensive children accounted for 69 percent of the total dollars spent on all forms of children's health care. Maynard et al. (2000), with 1994 data from a sample of 67,432 Washington State commercially insured children 2–17 years old, analyzed medical health care plan utilization and health care charges data. They determined that the average per-member, per-year charge was \$499. There is some literature on the differential costs between children who have chronic conditions and those who do not. Silber, Gleeson, and Huaqin (1999) described the influence of chronic diseases on resource utilization for common pediatric conditions, and showed that length of inpatient stay and total inpatient charges are higher for common pediatric conditions when the child also has a chronic condition.

Several studies have focused on the costs of caring for children with specific chronic health conditions. Guevara et al. 2001, and Chan, Zhan, and Homer 2002, analyzed health service utilization and costs for children with attention deficit hyperactivity disorder, while Lozano et al. 1997 focused on utilization and costs of care for children with asthma. Ringel and Sturm (2001) estimated mental health expenditures for children in 1998. Neff et al. (2001) analyzed the overall costs for the Washington State SSI population in 1992 by broadly defined severity groups, and Kuhlthau et al. (1998), analyzed the costs for SSI enrollees in four states. Neither Neff nor Kuhlthau analyzed the specific components of those costs. A four-state analysis of Medicaid enrollees by the Center for Health Care Strategies (CHCS) demonstrated that children without chronic conditions had average total Medicaid expenses of \$37 a month (\$444 a year) in comparison to children with chronic or disabling conditions who had average expenditures of \$240 per month (\$2,880 a year) (Center for Health Care Strategies 2000). None of these studies classified all children by a comprehensive classification of health status groupings and severity, and none except the CHCS study, compared the groups they identified to a control group of predominantly healthy children. In addition, the papers by Ireys, Anderson, Neff, Kulthau, and CHCS studied only Medicaid populations.

Recently, 3M Health Services Information Systems and the National Association of Children's Hospitals and Related Institutions (NACHRI) have developed software, Clinical Risk Groups (CRGs), which classifies each individual into a health status group and a severity level, using administrative data (Averill et al. 1999). This software has been developed for risk-adjustment purposes and for tracking subpopulations. A team at NACHRI, with extensive pediatrician input, developed the components of the CRGs that relate to children (Muldoon, Neff, and Gay 1997). The availability of this software now allows for analyses of health care utilization and costs by health status

groups at various levels of aggregation, severity level, or a combination of the two.

Clinical risk groups have been used to identify and classify children in a medium-sized comprehensive health plan in Washington State (Neff et al. 2002). In this study, CRGs seemed to perform well at identifying children who have chronic health conditions that require interaction with the health care system, such as children with malignancies, cystic fibrosis, diabetes, and attention deficit disorders. It performed reasonably well in identifying children with asthma and behavioral problems, but did not perform well in identifying children with conditions that did not require interactions with the health care system, or had conditions that often are not identified in administrative data, such as those with developmental delay or learning disorders. In this single health plan, covering a mixed, small urban/rural population, 9.5 percent of the children were identified as having chronic conditions. The average numbers of unique medical care encounters per child increased by chronic condition complexity (i.e., health status group) and by severity level. It is, therefore, reasonable to expect that CRGs should perform well in identifying patterns of charges for similarly defined health status groups.

The purpose of this article is to demonstrate a replicable methodology for stratifying children in a health plan according to health status groups and severity levels and for evaluating patterns of charges and types of medical care services.

METHODS

Clinical Risk Groups

Clinical risk groups (CRGs) is a classification system that uses administrative data to group patient populations into a set of predefined health status groups and severity levels. It is a system that has been developed both for risk adjustment and care management. Clinical risk groups can be used for adults and children alike to categorize each individual in a nonduplicative fashion into a core health status and severity group. The system's development, methodology, and testing have been described elsewhere (Muldoon, Neff, and Gay 1997). Clinical risk groups, using administrative claims data, classify each individual into one of nine core health status groups: (1) healthy; (2) significant acute; (3) minor chronic; (4) two or more minor chronic conditions in more than one body system; (5) moderate chronic; (6) dominant chronic;

(7) multiple significant chronic conditions (two or more moderate or dominant chronic conditions that occur in more than one body system); (8) metastatic malignancies; and (9) catastrophic conditions. Within each core health status group the individual is assigned to a specific severity level.

The core health status groups are described as follows: *Significant acute conditions* are those conditions that place an individual at risk for developing a chronic condition. Examples include head injury with coma, failure to thrive, prenatal drug or alcohol exposure, meningitis, and prematurity greater than 1,000 g. *Minor chronic conditions* are usually less serious and nonprogressive, have limited interactions with other body systems, and usually can be managed with few complications. Examples include attention deficit hyperactive disorder, minor depression, thyroid disorders, and certain self-limiting musculoskeletal conditions. *Moderate chronic conditions* are highly variable but can be complicated and require extensive care and sometimes lead to individual debility and death. Examples include asthma, epilepsy, scoliosis, conduct disorders, and major depression. *Dominant chronic conditions* are those that are either progressive or serious, permanent, often with multiple body systems involved, often requiring extensive treatment, and often ultimately leading to debility and death. Examples include diabetes, sickle cell disease, and schizophrenia. *Metastatic and dominant malignancies* are those malignancies that have a very difficult progression or are fundamentally systemic. Examples in this group are brain tumors and leukemia. *Catastrophic conditions* are those chronic conditions that are expected to be life-long, often progressive, and require extensive services. Examples in this group are spina bifida and cystic fibrosis.

Study Population

Northwest Washington Medical Bureau (NWMB) was a health insurance plan operating in northwestern Washington State. It served primarily four counties: Skagit, Whatcom, Island, and San Juan. The plan had contractual arrangements with virtually all of the practitioners in the region. In 1999, NWMB insured 46,600 children, ages 0 to 18, representing about 45 percent of the population in this age group in the four-county region. The NWMB offered a variety of business lines to companies and individuals in their service territory. The 1999 population of insured children was covered as follows: Medicaid capitated managed care (37 percent), Medicaid fee-for-service (0.9 percent), non-Medicaid capitated managed care (17 percent), and non-Medicaid fee for service (45 percent). All providers were required to submit claims to NWMB

for all services provided, regardless of the type of health plan—capitated or fee-for-service—covering the patient’s medical care. The NWMB merged with Regence BlueShield in 2001.

Claims Data and Analysis of Data

Eligibility and paid claims files for all children born on or after January 1, 1982, were obtained from NWMB on a strictly confidential basis with unique identifiers assigned and personally identifiable information removed. The initial enrollment file indicated a total enrollment of 48,013 children, 11,408 of whom were covered by more than one health insurance policy, that is, were included multiple times in the enrollment file. Unique patient identifiers, independent of parent’s membership, were created for all children, so that those covered by multiple policies were represented by a single unique identifier. These “unique” children were then screened for eligibility. Children older than one year of age were required to be enrolled for at least six months during calendar year 1999. Children born during 1999 had to be enrolled for at least three months. After cleaning for multiple coverage and eligibility requirements, the resultant population for analysis included 34,544 unique children (48,013 total enrollees minus 11,408 with multiple coverage minus 3,061 not meeting eligibility requirements). Children covered by NWMB were enrolled in several different types of medical insurance lines of business, including fee-for-service, preferred provider plans, and Medicaid.

Clinical risk group classification requires creation of two related data files—a patient eligibility file and a claims data file. The patient eligibility file, containing a unique patient identifier, date of birth, gender, and period of eligibility, was created from the NWMB eligibility data for CRG analysis. The paid claims file for all children’s claims processed through NWMB during calendar year 1999 contained 310,679 records. Of these, 293,626 were for the 34,544 eligible children identified above. After recoding to meet CRG specifications, a claims file was created containing a unique patient identifier, date of service, site of service, provider type, diagnosis (ICD-9-CM) codes, procedure codes and type (ICD-9-CM, CPT, HCPCS), and principal diagnosis flag (code to indicate primary diagnosis for each claim). These two files, the patient eligibility file and the claims file, were analyzed using *3M Clinical Risk Grouping Software, Windows NT* version 1.0. The CRG software produces a number of different output records. The grouping results provide four distinct levels of CRG grouping aggregation. For the purposes of this

paper, classification results are reported at the highest level of aggregation, Aggregated Clinical Risk Group 3, which identifies core health status group and severity level only. The CRG software also generates as output information on how each claims record was used, all diagnostic categories identified for each patient (both for Major Diagnostic Categories and Episode Diagnostic Categories), counts of records per patient, and several different error records (i.e., medical code errors, missing data).

A third data file containing NWMB charges data for each claim record was also created. Regardless of type of health policy through which the claim was processed, the NWMB charge data represents each provider's "usual and customary" charge for each service submitted for payment, without regard to ultimate payment status or patient's copay requirement or deductible status. The NWMB analytics staff cleaned the charges file to insure that claims processed multiple times were represented only once in the charges database. Services provided to NWMB pediatric patients for whom claims were not submitted to NWMB for payment (e.g., for children covered by multiple medical insurance companies), are not included in this claims database.

Charges were classified into discrete categories representing broad types of services based on NWMB provider type and service site codes. Prescription charges were obtained in a separate file from NWMB analytics staff, and appended to the other charges data. For the purposes of this analysis, we initially created the same eight service categories as those developed by Ireys et al. (1997) in their analysis of selected chronic sentinel conditions. These categories have been aggregated for this paper into five categories of charges: (1) *inpatient charges*, including all facility, provider, and other charges associated with hospitalizations (does not include residential treatment facilities); (2) *physician and other provider charges* includes all charges associated with the NWMB physician provider type code (other than those associated with inpatient hospitalizations) and allied health professionals (other than inpatient, home health, and outpatient service sites); (3) *outpatient services* other than physician and other provider charges (including emergency room charges); (4) *pharmacy charges* encompass all charges included in the separate pharmacy data file; (5) *other charges* includes all other services, including home health, DME, skilled nursing, hospice, and so on. The resultant charges data file contained 366,769 records distributed as follows: inpatient = 13,564; physician and other providers = 235,451; outpatient = 23,505; pharmacy = 89,893; other = 4,356. Each record contained a unique patient identifier, category of service code, and dollar value of charges.

RESULTS

The CRG classification results for all eligible NWMB children are summarized in Table 1. Note that for the purposes of this presentation, the nine CRG core health status groups were aggregated into the following six groups: (1) Healthy, including children with no encounters; (2) Significant acute; (3) Single and multiple minor chronic; (4) Dominant and moderate chronic conditions; (5) Catastrophic and multiple significant chronic conditions; and (6) Metastatic malignancies. The multiple significant chronic condition group has been combined with the catastrophic group because of the small numbers in each group and the similarity of their financial profile. Eighty-five percent of the children are classified as healthy, 5.2 percent have significant acute conditions, and 9.6 percent have one or more chronic health conditions. Of those children identified with chronic health conditions, 4.6 percent had single or multiple minor chronic conditions, 4.9 percent had single or multiple moderate and dominant chronic conditions, and less than 1.0 percent were classified into the two most complex status groups.

Table 2 summarizes the distribution of total charges by aggregated CRG health status group. The calendar year 1999 mean and median charges for all eligible children were \$989 and \$254, respectively. When analyzed by health status groups, a striking pattern emerges. The mean and median charges for healthy children are \$485 and \$191, while for all children with chronic conditions the charges are \$4,694 and \$1,503, approximately a ten-fold difference. Within the chronic category, as medical complexity increases, both

Table 1: CRG Classification of NWMB CY99 Medical Billing Data for Eligible Members Ages 0–17 Years

CRG Core Health Status Groups	Level of Severity				Totals	
	0	1	2	3–6	N	%
Healthy children	29,446				29,446	85.2
Significant acute	1,807				1,807	5.2
Single and multiple minor chronic		1,397	167	21	1,585	4.6
Single dominant/moderate chronic		1,010	435	101	1,546	4.5
Catastrophic and multiple significant chronic		76	27	40	143	0.4
Malignancies		1	11	5	17	<0.1
Totals by level of severity	31,253	2,484	640	167	34,544	100.0

Note that the Healthy category includes 6,773 eligible children with *no* encounters during calendar year 1999. Pearson chi-square significant at $p < .001$ for distribution.

Table 2: Mean, Median, Total Charges by CRG Core Health Status Group

<i>CRG Core Health Status Group</i>	<i>N</i>	<i>Mean</i>	<i>Median</i>	<i>Total Charges</i>
Healthy children	29,446	\$485	\$191	\$14,289,341
Significant acute	1,807	\$2,443	\$1,015	\$4,414,381
Single and multiple minor chronic	1,585	\$2,303	\$1,151	\$3,650,854
Single dominant/moderate chronic	1,546	\$4,294	\$1,783	\$6,638,977
Catastrophic and multiple significant chronic*	143	\$27,030	\$7,011	\$3,865,275
Malignancies (metastatic)	17	\$76,143	\$19,456	\$1,294,435
All Children	34,544	\$989	\$254	\$34,153,264
Chronically ill children	3,291	\$4,694	\$1,503	\$15,449,542

*Multiple significant chronic is defined as two or more dominant or moderate CRGs, or one dominant CRG and one moderate chronic CRG.

mean and median charges increase. Children with the most complex chronic conditions, those classified in the metastatic malignancy CRG status group, averaged more than \$75,000 in billed charges to their health plan during a single calendar year (median charges slightly less than \$20,000). The 160 children who make up the combined group of multiple significant chronic, catastrophic, and malignancies accounted for \$5.2 million in total health plan charges during calendar year 1999.

Table 3 summarizes the distribution of total charges across core health status groups and severity levels. Note that within each health status group (except malignancies), both mean and median total charges increase very substantially as severity increases. Median charges generally double from one severity level to the next.

Table 4 summarizes the percent distribution of charges for core health status group by category of service. Charges for the combined service categories of physicians and other providers and outpatient services account for 70.6 percent of the total charges for the healthy group, 45.3 percent of total charges for the dominant/moderate chronic status group, and only 22.7 percent for the combined group of multiple significant chronic, catastrophic, and malignancies. In contrast, inpatient charges account for 67.0 percent of total charges for the combined group of multiple significant chronic, catastrophic, and malignancies groups combined, 39.1 percent of total charges for the dominant/moderate chronic status group, and only 19.9 percent of the healthy group's total charges. Across all of the status groups, pharmacy charges represent only between 4 and 13 percent of total charges.

Table 5 summarizes the distribution of patients, encounters, and charges across CRG health-status groups. Note that the 9.5 percent of all children who

Table 3: Mean and Median Charges by CRG Core Health Status Group and Severity Level

CRG Core Health Status Group		Severity 0	Severity 1	Severity 2	Severity 3–6
Healthy children	Mean	\$485			
	Median	\$191			
Significant acute	Mean	\$2,443			
	Median	\$1,014			
Single and multiple minor chronic	Mean		\$1,753	\$5,230	\$15,614
	Median		\$1,070	\$2,022	\$3,429
Single dominant/moderate chronic	Mean		\$2,652	\$4,657	\$19,159
	Median		\$1,364	\$2,700	\$6,329
Catastrophic and multiple significant chronic	Mean		\$6,791	\$20,682	\$69,768
	Median		\$3,746	\$8,396	\$25,273
Malignancies (metastatic)	Mean		\$14,793	\$88,463	\$61,309
	Median		[n = 1]	\$17,458	\$20,392

Analysis of variance on total charges significant at > .01 for this stratification.

Table 4: Percent Distribution of Charges for CRG Core Health Status Group by Category of Service

Category of Service	Healthy Children	Significant Acute	Single and Multiple Minor Chronic	Single Dominant/Moderate Chronic	Catastrophic and Multiple Significant Chronic and Malignancies
	(Σ = \$14.3 M)	(Σ = \$4.4 M)	(Σ = \$3.7 M)	(Σ = \$6.6 M)	(Σ = \$5.2 M)
Inpatient charges	19.9%	36.5%	22.5%	39.1%	67.0%
Physicians and other providers	57.2%	41.0%	47.6%	33.8%	12.9%
Outpatient charges	13.4%	14.6%	15.6%	11.5%	9.8%
Pharmacy charges	8.5%	5.6%	13.1%	10.2%	3.6%
All other charges (includes DME, nursing, home health, miscellaneous)	1.0%	2.2%	1.2%	5.4%	6.6%
All Categories of Service	100.0%	100.0%	100.0%	100.0%	100.0%
% of total charges, all children	41.8%	12.9%	10.7%	19.4%	15.1%

Table 5: Percent Distribution of Patients, Encounters, and Charges by CRG Core Health Status Groups

<i>CRG Core Health Status Group</i>	<i>Patients</i>	<i>Encounters</i>	<i>Charges</i>
	(<i>n</i> = 34,544)	(<i>n</i> = 172,266)	(<i>n</i> = \$34.1 M)
Healthy children	85.2%	59.0%	41.2%
Significant acute	5.2%	12.3%	12.9%
Single and multiple minor chronic	4.6%	10.8%	10.7%
Dominant/moderate chronic	4.5%	14.1%	19.4%
Catastrophic and multiple significant chronic	0.4%	3.1%	11.3%
Malignancies (metastatic)	< 0.1%	0.7%	3.8%
All children	100.0%	100.0%	100.0%
All chronically ill children	9.5%	28.7%	45.2%

Table 6: Percent Distribution of Charges for Category of Medical Service by CRG Core Health Status Groups

<i>CRG Core Health Status Group</i>	<i>Inpatient Charges</i>	<i>Physicians and Other Providers</i>	<i>Outpatient Charges</i>	<i>Pharmacy Charges</i>	<i>All Other Charges</i>
	(\$11.3 M)	(\$14.6 M)	(\$4.4 M)	(\$2.8 M)	(\$1.0 M)
Healthy children	25.1%	55.9%	43.5%	43.4%	14.1%
Significant acute	14.2%	12.4%	14.7%	8.9%	10.1%
Single and multiple minor chronic	7.2%	11.9%	12.9%	17.1%	4.4%
Single dominant/moderate chronic	22.9%	15.3%	17.4%	24.0%	36.6%
Catastrophic and multiple significant chronic	24.0%	3.6%	5.4%	5.1%	24.2%
Malignancies (metastatic)	6.6%	0.9%	6.1%	1.6%	10.6%
All children	100.0%	100.0%	100.0%	100.0%	100.0%
All chronically ill children	60.7%	31.8%	41.8%	47.7%	75.8%

are classified as having a chronic condition account for 28.7 percent of all encounters and 45.2 percent of all charges. The approximately .5 percent of all children identified in the most complex status groups (multiple significant chronic, catastrophic, and malignancies) account for 15 percent of total medical service charges.

Table 6 summarizes the distribution of charges by category of medical service by CRG core health-status group. This shows that the children classified as healthy, 85.2 percent of all children, account for 55.9 percent of all charges for physicians and other providers and a smaller proportion of other

medical charges, especially inpatient. In contrast, those children classified with one or more chronic conditions, 9.5 percent of all children, account for 60.7 percent of all inpatient charges, and 75.8 percent of all other medical service charges, which include durable medical equipment and home health services.

DISCUSSION

As seen in this 1999 case study, the pattern of pediatric medical charges is strikingly different across health status and severity groups. Four distinct observations emerge from this analysis. *First*, the health-related charges that are generated by healthy children are relatively small, less than \$500 per child per year. This finding is consistent with the average Medicaid child's expenditures of \$444 per year reported by CHCS (2000). Healthy children make up about 85 percent of the pediatric population, and, in general, are relatively inexpensive to care for. *Second*, while the cost of care may be low for children in general, those with chronic conditions significantly influence the overall cost of care for all children. Children who are classified as having a chronic condition of any kind represent only about 10 percent of the population, yet account for nearly 50 percent of total medical service charges. *Third*, the distribution of charges by category of service is distinctly different for the healthy group compared to the other health status groups. More than two-thirds of total charges for care consumed by healthy children are for physician, other provider, and outpatient related services, while between 40 percent and 67 percent of total charges consumed by children with the most complex chronic conditions are for inpatient care. Pharmacy charges also vary by health status groups, but make up a relatively small proportion of pediatric medical service costs, between 4 percent and 13 percent of total charges. *Fourth*, the distribution of charges among health status groups is very different depending on the category of charges. Approximately 60 percent of all physician, other provider, and outpatient services are for those children classified as healthy, while more than 60 percent of all inpatient charges and 75 percent of all other charges are for those in the chronic condition health status groups.

Implications from these observations are as follows:

1. Office related charges and expenses could be influenced significantly by the composition of the pediatric patients treated in that office. This is especially true in an environment where the office contracts for a significant number of children who are covered under prepaid

capitation arrangements, or in a contract that reimburses physician visits at a level calculated for care of healthy children. If the office has a high percentage of patients with chronic health conditions, especially those at high complexity or severity levels, and there is not reimbursement recognition of the high cost of care they receive, there may not be sufficient resources in that practice to support the services these children need.

2. Case management services should be designed to meet the specific needs of children in the different health status groups. The basic management efforts for this population, to decrease the use of high-cost hospital services and improve health status, may require careful long term coordination of care, identification of community services, and access to appropriate specialty services. The CRG methodology can be used for identifying children for care management and is more inclusive than often-used categorical models because it identifies groups of children who can be expected to be high users of health care resources—not just those with specific conditions. It can identify children in categories that can be expected to generate high future medical costs, rather than waiting until after those charges have occurred. Clinical risk groups are a methodology that is easier and less expensive for health plans to use than other survey-based methodologies.
3. It might be possible to rearrange services in a more cost effective way. As an example, the service category “other,” which includes home care and nursing services, represents only 6.6 percent of the charges of the most complex health status group, while inpatient charges that are the highest and most costly service that these children receive, represent 67 percent of all charges for the group. These data suggest that it might be wise to explore the possibility of increasing home services for patients in the most complex health status groups in order to decrease inpatient services.
4. Pharmaceutical charges represent 8.2 percent of all medical charges incurred by children. This has been the cost category that has been identified as a major cause of health care inflation. In this analysis, pharmaceutical costs do not predominate and certainly represent a relatively low expenditure for children in all of the health status groups. Repeating this type of analysis with additional years of data will allow for tracking of costs by category of service, health status group, and age groups. It should be possible to analyze the

inflationary trends in drugs as compared to the other medical service cost categories.

There are certain limitations to this analysis. First, we use charges as a measure of costs. Charges are not an absolute measure of costs and there are very uneven reimbursement patterns. Physician reimbursements in fee-for-service contracts often are below charges. In capitated arrangements, both the charges and the reimbursements are often below costs and not risk-adjusted for severity of conditions. Outpatient reimbursement patterns vary widely depending on: site of service, specialty, and the procedures performed, and are often below both costs and charges. Inpatient and pharmacy reimbursements are generally provided at a higher percentage of charges than are provided for outpatient and physician charges. They do not necessarily reflect costs, but only historical reimbursement patterns. There also are costs of care incurred that are not reflected in health-plan-generated charges data. These include out of pocket expenses, copays, lifetime or annual limits and deductions, and services that are received outside of the plan. These out of plan expenses are generally far greater for children with chronic conditions than for those who are healthy, since many children receive care through school and public health programs. If these expenses could be incorporated into the analysis, as is provided in the analysis of the MEPS data by McCormick et al. (2001), the discrepancy between the cost of care for children with chronic conditions and those without would be even greater.

There are other limitations inherent in the analysis of any cost data derived from administrative data. Charges for services provided to children who do not use the NWMB health plan's services, or who use direct services outside of the health plan, will not be included. In Washington State, examples of these services include those provided by the state through a system of neuromuscular development centers, through the school systems, and separately funded mental health centers for children with developmental disabilities, learning disorders, or mental health conditions. In addition, only children who meet the eligibility requirements were included in the analysis, missing the recently born or children with special needs who have been enrolled in the plan for less than a year. In general, administrative data underidentify children with chronic conditions, a situation we have explained in a preceding article (Neff et al. 2002). For all of these reasons, this current analysis will underestimate the true health care costs for the pediatric population as a whole, and especially for children with chronic health conditions. Finally, the NWMB service territory may not be representative of

other geographic areas. The NWMB service area encompasses several small and mid-sized urban centers and a large rural area. A more metropolitan population may well have more chronically ill children, and health plans in these areas will have a different and possibly higher-cost profile.

The strengths of this analysis are that it provides an analysis of charges in a health plan and demonstrates how these charges can be evaluated and tracked over time. This is one of the first studies to look specifically at the distribution of charges by health status comparing children with chronic conditions to healthy children. This study can be replicated consistently in other regions and in other population groups. Clinical risk group software, which has been developed for children as well as adults, can be used to compare costs across all ages, as well as across health status and severity groups. Recently, Ireys et al. (2002) demonstrated the use of CRGs for identifying prevalence rates and patterns of service use and cost for 261,000 children in a commercial health care plan and confirmed the feasibility of identifying children with special health care needs using CRG stratification.

From this study we can conclude that there are very different patterns of medical service charges for children as a function primarily of chronic condition status. These costs are significantly higher for the chronically ill, who represent less than 10 percent of the pediatric population, and in this analysis accounted for nearly 50 percent of total health plan charges. Children identified and stratified according to these categories can be grouped for care management strategies and can be tracked to determine patterns of utilization and cost of services. This identification and tracking can extend into the adult age range using the same methodology.

ACKNOWLEDGMENTS

Special thanks to Tracy Fitzgibbon from the Northwest Washington Medical Bureau, Nanci Larter Villareale and Patty Centioli of the Center for Children with Special Needs, Jan Hicks-Thomson from the Department of Health, Washington State, and Jim Gay, M.D., from Vanderbilt University School of Medicine.

REFERENCES

- Andrews, J. S., G. F. Anderson, C. Han, and J. M. Neff. 1997. "Pediatric Carve Outs: The Use of Disease Specific Conditions as Risk Adjusters in Capitated Payment Systems." *Archives of Pediatric and Adolescent Medicine* 151 (3): 236–42.

- Averill, R. F., N. I. Goldfield, J. Eisenhandler, J. S. Hughes, B. V. Shafir, D. E. Gannon, L. W. Gregg, F. A. Bagadia, B. A. Steinbeck, N. Ranade, S. A. Meskin, A. Y. Weiner, J. H. Muldoon, J. M. Neff, J. C. Gay, and L. J. Turner. 1999. "Development and Evaluation of Clinical Risk Groups (CRGs)." *Final Report to the National Institutes of Standards and Technology, U.S. Department of Commerce*. Wallingford, CT: 3M Health Information Systems.
- Center for Health Care Strategies. 2000. *The Faces of Medicaid: The Complexities of Care for People with Chronic Illnesses and Disabilities*. Princeton, NJ: Center for Health Care Strategies.
- Chan, E., C. Zhan, and J. Homer. 2002. "Health Care Use and Costs for Children with Attention-Deficit/Hyperactivity Disorder." *Archives of Pediatrics and Adolescent Medicine* 156 (5): 504-11.
- Guevara, J., P. Lozano, T. Wickizer, L. Mell, and H. Gephart. 2001. "Utilization and Cost of Health Care Services for Children with Attention-Deficit/Hyperactivity Disorder." *Pediatrics* 108 (1): 71-8.
- Ireys, H. T., G. F. Anderson, T. J. Shaffer, and J. M. Neff. 1997. "Expenditures for Care of Children with Chronic Illnesses Enrolled in the Washington State Medicaid Program, Fiscal Year 1993." *Pediatrics* 100 (2, part 1): 97-204.
- Ireys, H. T., J. Humensky, E. Peterson, S. Wickstrom, B. Manda, and P. Rheault. 2002. "Children with Special Health Care Needs in Commercial Managed Care: Patterns of Service Use and Cost." Available at <http://www.mathematica-mpr.com/PDFs/childrenspecial.pdf> [accessed on December 10, 2002].
- Kuhlthau, K., J. M. Perrin, S. L. Ettner, T. J. McLaughlin, and S. L. Gortmaker. 1998. "High-Expenditure Children with Supplemental Security Income." *Pediatrics* 102 (3, part 1): 610-5.
- Lozano, P., P. Fishman, M. VonKorff, and J. Hecht. 1997. "Health Care Utilization and Cost among Children with Asthma who were Enrolled in a Health Maintenance Organization." *Pediatrics* 99 (6): 757-64.
- Maynard, C., S. Ramsey, T. Wickizer, and D. Conrad. 2000. "Healthcare Charges and Use in Commercially Insured Children Enrolled in Managed Care Health Plans in Washington State." *Maternal and Child Health Journal* 4 (1): 29-38.
- McCormick, M., R. Weinick, A. Elixhauser, M. Stagnitti, J. Thompson, and L. Simpson. 2001. "Annual Report on Access to and Utilization of Health Care for Children and Youth in the United States—2000." *Ambulatory Pediatrics* 1 (1): 3-15.
- Muldoon, J. H., J. M. Neff, and J. C. Gay. 1997. "Profiling the Health Service Needs of Populations Using Diagnosis-Based Classification Systems." *Journal of Ambulatory Care Management* 20 (3): 1-18.
- Neff, J. M., J. H. Muldoon, J. C. Gay, and G. F. Anderson. 2001. "Profile of the SSI Population in Washington State Medicaid Program with a Diagnosis-Based Classification System." *Journal of Cost and Quality* 7: 11-36.
- Neff, J. M., V. L. Sharp, J. Muldoon, J. Graham, J. Popalisky, and J. C. Gay. 2002. "Identifying and Classifying Children with Chronic Conditions Using Administrative Data with the Clinical Risk Group Classification System." *Ambulatory Pediatrics* 2 (4): 71-9.

- Newacheck, P. W., and N. Halfon. 1998. "Prevalence and Impact of Disabling Chronic Conditions in Childhood." *American Journal of Public Health* 88 (4): 610–7.
- Ringel, J., and R. Sturm. 2001. "National Estimates of Mental Health Utilization and Expenditures for Children in 1998." *Journal of Behavioral Health and Research* 28 (3): 319–33.
- Silber, J. H., S. P. Gleeson, and Z. Huaqing. 1999. "The Influence of Chronic Disease on Resource Utilization in Common Acute Pediatric Conditions: Financial Concerns for Children's Hospitals." *Archives of Pediatric and Adolescent Medicine* 153 (2): 169–79.
- 3M Health Information Systems. 2001. *3M Clinical Risk Grouping Software Installation and User Manual*. Murray, UT: 3M Health Information Systems.