

# A Tertiary Care–Primary Care Partnership Model for Medically Complex and Fragile Children and Youth With Special Health Care Needs

John B. Gordon, MD; Holly H. Colby, RN, MS; Tera Bartelt, BSN; Debra Jablonski, RN; Mary L. Krauthoef, BSN; Peter Havens, MD

**Objective:** To evaluate the impact of a tertiary care center special needs program that partners with families and primary care physicians to ensure seamless inpatient and outpatient care and assist in providing medical homes.

**Design:** Up to 3 years of preenrollment and postenrollment data were compared for patients in the special needs program from July 1, 2002, through June 30, 2005.

**Setting:** A tertiary care center pediatric hospital and medical school serving urban and rural patients.

**Participants:** A total of 227 of 230 medically complex and fragile children and youth with special needs who had a wide range of chronic disorders and were enrolled in the special needs program.

**Interventions:** Care coordination provided by a special needs program pediatric nurse case manager with or without a special needs program physician.

**Main Outcome Measures:** Preenrollment and postenrollment tertiary care center resource utilization, charges, and payments.

**Results:** A statistically significant decrease was found in the number of hospitalizations, number of hospital days, and tertiary care center charges and payments, and an increase was found in the use of outpatient services. Aggregate data revealed a decrease in hospital days from 7926 to 3831, an increase in clinic visits from 3150 to 5420, and a decrease in tertiary care center payments of \$10.7 million. The special needs program budget for fiscal year 2005 had a deficit of \$400 000.

**Conclusion:** This tertiary care–primary care partnership model improved health care and reduced costs with relatively modest institutional support.

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**C**HILDREN AND YOUTH WITH special health care needs (CYSHCN) are defined as having or being at increased risk for having a chronic physical, developmental, behavioral, or emotional condition that requires health and related services of a type or amount beyond that required by children generally.<sup>1</sup> According to this definition, 12% to 18% of the US pediatric population can be classified as CYSHCN.<sup>2,3</sup> A

*See also pages 930, 933, and 1003*

small and growing subset of CYSHCN are medically fragile with complex chronic conditions that involve several organ systems and require multiple specialists, technological supports, and community services. Medically complex and fragile CYSHCN are frequently hospitalized and

incur high costs.<sup>4-8</sup> Their families must access and negotiate the maze of medical and community services that are often uncoordinated, episodic, fragmented, or unavailable.<sup>3,7,9-11</sup> The lack of care coordination and communication among health care professionals contributes to duplicative and inadequate health care, patient and family dissatisfaction and stress, decreased safety, and increased cost.<sup>7,8,11-13</sup> Families of medically complex and fragile CYSHCN want physicians who can provide a single point of contact and are willing to partner with them in comprehensively addressing the needs of their children.<sup>7,12,13</sup>

The American Academy of Pediatrics and the Maternal Child Health Bureau have sought to address the needs of CYSHCN through the medical home: a concept of accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally effective health care provided by primary care physicians

**Author Affiliations:**  
Department of Pediatrics,  
Medical College of Wisconsin  
(Drs Gordon and Havens),  
Children's Research Institute  
(Drs Gordon and Havens and  
Mss Colby, Bartelt, Jablonski,  
and Krauthoef), and  
the Special Needs Program  
of the Children's Hospital of  
Wisconsin (Dr Gordon and  
Mss Colby, Bartelt, Jablonski,  
and Krauthoef), Milwaukee.

(PCPs).<sup>14,15</sup> All CYSHCN deserve a medical home, but medically complex and fragile CYSHCN *require* medical homes. However, barriers such as limited familiarity with unusual disorders and their therapies, incomplete knowledge of available community resources, distance from tertiary care centers, poor reimbursement for care coordination, and insufficient time make it difficult for PCPs alone to provide medical homes for medically complex and fragile CYSHCN.<sup>11,15-19</sup> Recognizing this, the Children's Hospital of Wisconsin (CHW) and the Medical College of Wisconsin (MCW) established a special needs program (SNP) to partner with families and PCPs in ensuring seamless inpatient and outpatient care for this population. Unlike disease-specific programs<sup>20</sup> or hospital-based ambulatory and inpatient services for CYSHCN,<sup>21,22</sup> the SNP was developed as a tertiary care–primary care partnership model based on the premise that each child would have a community PCP and the SNP would assist the PCP in ensuring that medically complex and fragile CYSHCN had medical homes. This article addresses the structure, function, impact, and challenges of the SNP.

## METHODS

### CONTEXT

This study was approved by the CHW institutional review board. Data from existing CHW and MCW databases were analyzed and reported without patient identifiers. The CHW is a 236-bed, tertiary care pediatric hospital in Milwaukee, Wisconsin. It is the largest pediatric teaching hospital in the state and serves children from Wisconsin, northern Illinois, and elsewhere. More than 90% of medical and surgical specialists who provide care at the CHW are academic faculty at the MCW.

### SNP ENROLLMENT AND INTERVENTIONS

The first patients enrolled in the SNP came from a small nurse case management program and a nascent special needs clinic that were combined in July 2002 to form the SNP. Subsequently, patients were referred from multiple sources (eg, nurses, PCPs, specialists, community agencies, and families themselves) and examined weekly at intake rounds attended by SNP personnel, a social worker, a parent advocate, and professionals from other services or specialties as needed. Initially, enrollment criteria were subjective. By 2004, formal complexity and fragility enrollment criteria were developed. Major complexity criteria were the need for 5 or more specialists and involvement of 3 or more organ systems. Major fragility criteria were 2 or more admissions and 10 or more hospital days or 10 or more clinic visits in the year before enrollment. Minor complexity criteria included unknown or uncertain disease, living more than 25 miles from the tertiary care center, having a PCP who did not admit the child to the CHW, and major socioeconomic factors (eg, language or cultural differences, divorce, or major transitions). Minor fragility criteria included 1 or more admissions and 5 or more hospital days or 5 or more clinic visits in the year before enrollment, anticipated frequent tertiary care center use based on predicted disease trajectory, and technology or home nursing dependence. Patients were eligible for enrollment if they met both major fragility and complexity criteria or if they met multiple minor criteria. Patients were excluded from enrollment if another care coordination program met their needs or if the family or PCP did not want the SNP's services.

The SNP was structured as a 2-tiered program with approximately 30% of patients assigned an SNP pediatric nurse case manager and an SNP physician (PNCM-MD group) and 70% assigned only an SNP PNCM who worked directly with the PCP and often another tertiary care center specialist involved in the care of the child (PNCM group). Patients assigned to the PNCM-MD group generally required more frequent and longer hospitalizations and had uncertain or disputed diagnoses. The PNCMs were available weekdays from 8 AM until 6 PM and served as a single point of contact at the CHW for patients and families, PCPs, and community resources. They prepared a plan of care, facilitated communication among specialists and PCPs, and attended appointments, often advocating for the child and family (particularly during the first months after enrollment). They also worked with community agencies (eg, nursing and durable medical equipment companies) and insurers to make sure that the children had all needed services. The PNCMs occasionally made home visits, attended appointments at PCPs' offices, and attended school meetings. Finally, they provided psychosocial support and care coordination education for the patients and caregivers. The PNCMs generally spent 10 to 20 hours per patient during the first month after enrollment and 2 to 6 hours per month thereafter. The average PNCM case-load was 30 to 35 patients.

The SNP physicians were available 24 hours a day, 7 days a week. On patient enrollment, they performed a detailed history and physical examination, reviewed the medical record, and synthesized the child's many problems in a comprehensive clinical care coordination summary. The summaries were reviewed with and then provided to the family, PCP, and specialists. The SNP physicians frequently arbitrated among competing diagnoses and therapies. They saw patients electively in the clinic and urgently in the emergency department and occasionally made home visits or held joint appointments in the PCPs' office. They facilitated admissions by reviewing the patient's case in detail with the admitting team and coordinated care during the hospital stay by attending rounds with the primary team and communicating with specialists. Rarely, patients were admitted to the SNP service itself. During hospitalizations, SNP physicians remained in close contact with the PCPs, thus providing them with a tertiary care center presence. The SNP physicians generally spent 8 to 20 hours initially assessing and synthesizing the child's condition and preparing the clinical care coordination summary. Subsequently, they spent 2 to 4 hours per month depending on the level of medical complexity and fragility of the patient. The average SNP physician had 25 to 30 patients.

Patients were discharged from the SNP when they graduated (ie, the family and PCP believed that they could ensure care coordination without the SNP) or at death. Other patients were discharged because they moved away, withdrew, or were dismissed from the program because the family failed to communicate with the PNCM for more than 6 months despite 3 telephone calls and 3 letters offering assistance.

### DATA COLLECTION AND ANALYSIS

Census data were collected for all patients enrolled in the SNP from July 1, 2002, through December 31, 2005. Complete demographic data, patient characteristics, and CHW and MCW resource utilization, charges, and payment data were collected for patients in the SNP at some point from July 1, 2002, through June 30, 2005. Data on tertiary care center resource utilization (number and length of hospital admissions and number of clinic, short-stay, and ED visits), charges, and payments were collected for up to 3 years before and after enrollment in the SNP.

The preenrollment period was defined as the number of days between the date of enrollment and the date of birth or onset of disease leading to enrollment in the SNP. The postenrollment period was defined as the number of days between enrollment and the date of death, discharge, or September 30, 2005 (the last date of data collection).

Data were compared in 2 ways: equal preenrollment and postenrollment periods and total normalized preenrollment and postenrollment periods. For the equal preenrollment and postenrollment analyses, the duration of the comparison period was dictated by the lesser of the preenrollment or postenrollment time. For example, if a child was 3 years of age and had been enrolled in the SNP since 2 years of age, and the age at onset of illness was birth, then data were compared for the shorter postenrollment time (365 days). For the normalized total preenrollment and postenrollment analyses, data were normalized by dividing them by the number of preenrollment or postenrollment days. Thus, in this example, the preenrollment data would have been divided by  $2 \times 365$  days and the postenrollment data by 365 days. Data were initially analyzed using a paired *t* test but were not normally distributed, so the Wilcoxon signed rank test was used to determine differences between medians. Differences were considered statistically significant at  $P < .05$ , and all results are presented as both median and mean  $\pm$  SD.

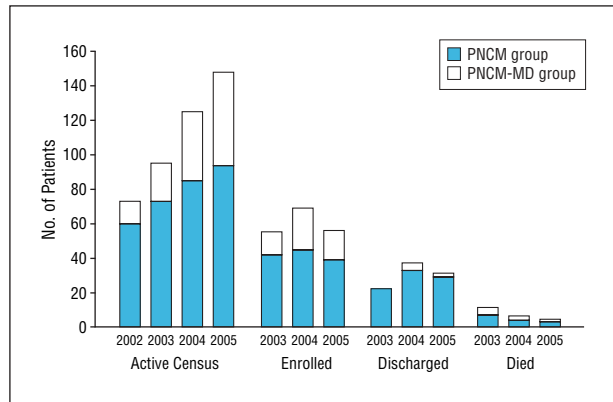
### SNP REIMBURSEMENT AND EXPENSES

The SNP physician services were billed using time-based evaluation and management *Current Procedural Terminology* codes when more than 50% of time was spent in counseling and coordination. Data on charges and payments, location of services, and payer type were collected and analyzed for fiscal years 2003, 2004, and 2005. The PNCM care coordination services were reimbursed by 1 private insurer at a rate of \$60 per hour and by a Wisconsin Medicaid waiver program at \$42 per hour.

Expenses of the SNP were related overwhelmingly to salaries, with only a small budget for supplies. In 2002, clinical services were provided by 2 PNCMs, a part-time advanced practice nurse, and 1 part-time physician. By 2005, there were 3 PNCMs, 2 part-time physicians (1 of whom was the medical director), and a part-time advanced practice nurse who provided care coordination and was the program manager. Support personnel included a part-time administrative assistant and a program coordinator who assisted with data collection.

## RESULTS

Data were available for 227 of the 230 patients in the SNP at some point from July 1, 2002, through June 30, 2005. Fifty-seven of the patients were in the PNCM-MD group and 170 in the PNCM group. Active census of the SNP has grown steadily since 2002 (**Figure 1**) because the number of newly enrolled patients exceeded the number of discharges and deaths each year. These were 136 to 149 patients referred each year with an enrollment rate of approximately 30%. Relatively few deaths and discharges occurred (Figure 1). Most discharges occurred when patients graduated, but 27 patients were dismissed or withdrew from the SNP. Patients in the PNCM-MD group were significantly younger and had more specialists at enrollment than those in the PNCM group (**Table 1**). The racial/ethnic distribution of all SNP patients mirrored that of the population served by the CHW. Only 8 (14%) of patients in the PNCM-MD group and 74 (44%) of patients in the PNCM group were admitted to the CHW by their PCP. Most



**Figure 1.** Growth of the special needs program. PNCM indicates pediatric nurse case manager; PNCM-MD, pediatric nurse case manager and physician.

**Table 1. Patient Demographics and Characteristics**

Demographic or Characteristic	PNCM-MD Group (n=57)	PNCM Group (n=170)
Age at enrollment, mean $\pm$ SD (median), y	4.2 $\pm$ 5.3 (1.6)	5.0 $\pm$ 5.3 (2.6)
Male/female, No. (%)	28 (49)/29 (51)	99 (58)/71 (42)
Race, No. (%)		
White	41 (72)	128 (75)
Black	8 (14)	28 (16)
Hispanic	6 (11)	14 (8)
Other	2 (4)	6 (4)
No. of specialists, mean $\pm$ SD (median)	8.3 $\pm$ 2.4 (8)	7.2 $\pm$ 2.9 (7)
Patient lives >25 miles from CHW, No. (%)	31 (54)	96 (56)
PCP admits patient to CHW, No. (%)	8 (14)	74 (44)
Private primary insurance, No. (%) at enrollment/at time of study	42 (74)/28 (49)	111 (65)/93 (55)

Abbreviations: CHW, Children's Hospital of Wisconsin; PCP, primary care physician; PNCM, pediatric nurse case manager; PNCM-MD, pediatric nurse case manager and physician.

patients had private primary insurance at enrollment, but this proportion decreased over time.

In the PNCM-MD group, 56 (98%) of patients met major complexity criteria and 51 (89%) met major fragility criteria for enrollment in the SNP (**Table 2**). In the PNCM group, 145 (85%) of patients met major complexity criteria and 132 (78%) met major fragility criteria. Fifteen PNCM patients (9%) did not meet major or minor complexity criteria, and 19 patients (11%) did not meet major or minor fragility criteria. The organ systems that most frequently contributed to the patients' complexity and fragility were similar in the PNCM and PNCM-MD groups (**Figure 2A**), as was the distribution of major specialties serving 20% or more of the patients (Figure 2B). An additional 17 specialties served 1 or more patients. Significant motor, speech, and cognitive delays were noted in more than 158 SNP patients (70%), and virtually all were delayed in at least 1 area. More than 136 patients (60%) were fed by enteral tubes or total parenteral nutrition. Only 24 patients had tracheostomies and 5 received long-term ventilatory support, reflecting the fact

**Table 2. Number of Special Needs Program Patients Who Met Enrollment Criteria**

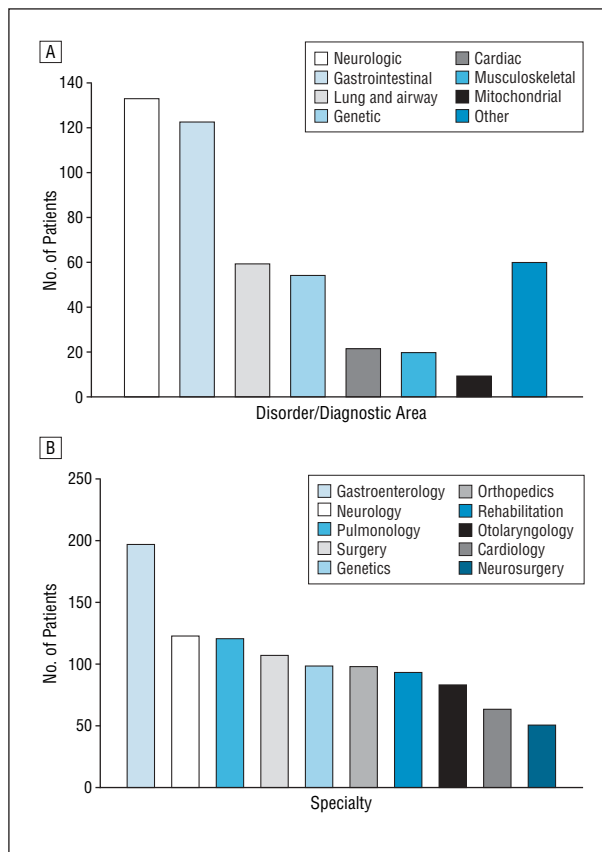
Criteria	PNCM-MD Group (n=57)	PNCM Group (n=170)
<b>Complexity Criteria</b>		
Major ( $\geq 5$ specialists and $\geq 3$ organ systems involved)	56	145
Minor (disease uncertain or unknown, PCP did not admit child to the CHW, socioeconomic factors, or distance $> 25$ miles to CHW)	1	10
None	0	15
<b>Fragility Criteria</b>		
Major ( $\geq 2$ admissions and $\geq 10$ hospital days or $\geq 10$ clinic visits in prior year)	51	132
Minor ( $\geq 1$ admission, $\geq 5$ days hospitalized, and $\geq 5$ clinic visits in prior year, anticipated frequent use of CHW based on predicted disease trajectory, or technology dependence/home nursing)	4	19
None	2	19
<b>Exclusion Criteria</b>		
Other care coordination service meets patient needs, family does not want services of SNP, or PCP does not want services of SNP	0	0

Abbreviations: CHW, Children's Hospital of Wisconsin; PCP, primary care physician; PNCM, pediatric nurse case manager; PNCM-MD, pediatric nurse case manager and physician; SNP, special needs program.

that the CHW also had an active tracheostomy and ventilator program that met care coordination needs.

#### TERTIARY CARE CENTER RESOURCE UTILIZATION, CHARGES, AND PAYMENTS

Comparison of data during equal preenrollment and postenrollment periods in the PNCM-MD group showed a significant decrease in the number of inpatient admissions and hospital days per patient after enrollment (**Figure 3A**). There was also a significant increase in clinic and emergency department visits per patient, whereas short-stay visits ( $< 23$ -hour admissions) did not change (**Figure 3A**). The shift from inpatient to outpatient services was accompanied by a significant decrease in CHW and MCW charges and a decrease in CHW payments (**Figure 3B**). Similar results were seen when total data normalized to the number of preenrollment days and postenrollment days were compared (**Table 3**). The mean  $\pm$  SD number of preenrollment and postenrollment days for the PNCM-MD group was  $647 \pm 401$  and  $530 \pm 327$ , respectively. The mean  $\pm$  SD number of preenrollment and postenrollment days for the PNCM group was  $675 \pm 434$  and  $504 \pm 371$ , respectively. Equal preenrollment and postenrollment data (**Figure 4A** and **B**) and total normalized data (**Table 3**) for the PNCM group followed a pattern similar to that of the PNCM-MD group, although the magnitude of the changes was smaller. Aggregate data for equal preenrollment and postenrollment periods for all patients (**Table 4**) showed a striking decrease in hospital days and an increase in clinic

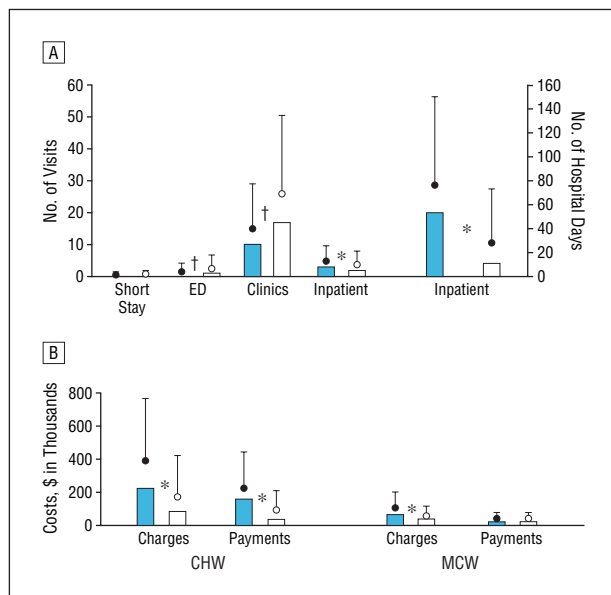


**Figure 2.** Major disorders and diagnostic areas (A) and specialties (B) serving patients in the special needs program.

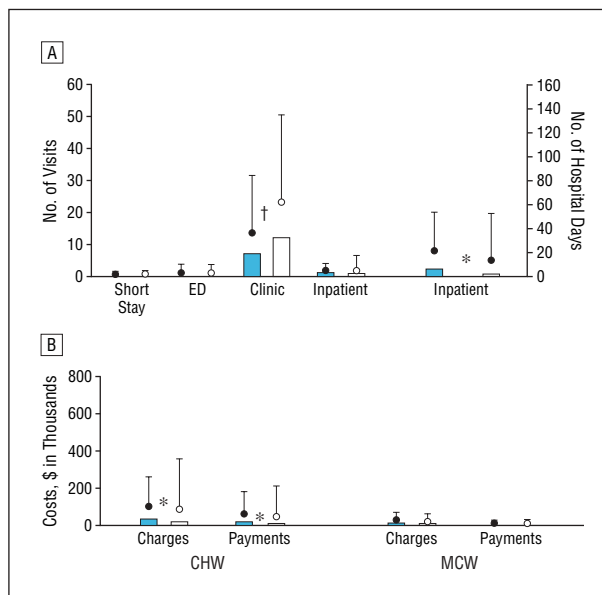
visits. These findings were accompanied by a decrease in tertiary care center payments to the CHW and MCW of \$10.7 million (**Table 4**).

#### SNP REIMBURSEMENT AND COSTS

The SNP physician billing increased as the program grew (**Figure 5A**). The mean reimbursement rate was 45.5%, reflecting a 68.3% payment rate for private insurers and a 26.7% rate for public insurers. Most services were provided for inpatients. Non-face-to-face time spent preparing detailed clinical summaries was billed at a rate of \$250 per hour using *Current Procedural Terminology* code 99499 (medical services, other) and was reimbursed at a rate of approximately 60% by both public and private insurers. Other non-face-to-face time (eg, writing letters of medical necessity, telephone consultation with families and PCPs, discussions with specialists and community resources, and renewing of prescriptions) amounted to an average of 1 hour per month per patient but was neither billed nor reimbursed. The PNCM reimbursement (**Figure 5B**) for targeted case management from Medicaid approached \$40 000 per year (65% of charges). Only a few patients were insured by the 1 private payer who reimbursed 100% of charges for nurse care coordination. To illustrate the costs of this tertiary care coordination program, the SNP budget for fiscal year 2005 is outlined in **Table 5**. The SNP deficit was almost \$400 000 in fiscal year 2005.



**Figure 3.** Mean  $\pm$  SD (circles) and median (bars) resource utilization and financial data per patient during equal preenrollment and postenrollment periods for the pediatric nurse case manager and physician group ( $n=57$ ). The mean  $\pm$  SD comparison period was  $369 \pm 279$  days (median, 302 days). A, Number of visits and hospital days. B, Costs. \*Statistically significant decrease after enrollment. †Statistically significant increase ( $P < .05$ ). Closed bars and circles indicate preenrollment data; open bars and circles, postenrollment data. CHW indicates Children's Hospital of Wisconsin; ED, emergency department; and MCW, Medical College of Wisconsin.



**Figure 4.** Mean  $\pm$  SD (circles) and median (bars) resource utilization and financial data per patient during equal preenrollment and postenrollment periods for the pediatric nurse case manager group ( $n=170$ ). The mean  $\pm$  SD comparison period was  $403 \pm 358$  days (median, 252 days). A, Number of visits and hospital days; B, costs. \*Statistically significant decrease after enrollment. †Statistically significant increase ( $P < .05$ ). Closed bars and circles indicate preenrollment data; open bars and circles, postenrollment data. CHW indicates Children's Hospital of Wisconsin; ED, emergency department; and MCW, Medical College of Wisconsin.

**Table 3. Median Resource Use and Charges per Patient per Day in the Preenrollment and Postenrollment Periods<sup>a</sup>**

Variable	PNCM-MD Group ( $n=57$ )		P Value	PNCM Group ( $n=170$ )		P Value
	Preenrollment	Postenrollment		Preenrollment	Postenrollment	
Hospital admissions	0.01	0.006	.003	0.003	0.002	.02
Hospitalized days	0.17	0.03	<.001	0.02	0.007	<.001
Clinic visits	0.04	0.07	<.001	0.02	0.05	<.001
ED visits	0.001	0.002	.01	0	0	.66
Short-stay visits	0	0.001	.02	0	0.001	<.001
CHW charges, \$	803	199	<.001	92	73	.002
CHW payments, \$	494	98	<.001	53	31	<.001
MCW charges, \$	193	157	.78	23	55	.004
MCW payments, \$	43	38	.16	8	14	.09

Abbreviations: CHW, Children's Hospital of Wisconsin; ED, emergency department; MCW, Medical College of Wisconsin; PNCM, pediatric nurse case manager; PNCM-MD, pediatric nurse case manager and physician.

<sup>a</sup> Data are given as median per patient per day before or after enrollment unless otherwise indicated.

## COMMENT

The goal of the SNP was to partner with families and PCPs to ensure seamless inpatient and outpatient care and facilitate provision of medical homes for medically complex and fragile CYSHCN. Our tertiary care–primary care partnership model has grown steadily since its inception (Figure 1). Patients in the SNP include a diverse mixture of urban, suburban, and rural children who range in age from infancy to young adulthood (Table 1) and have a wide range of conditions and specialists (Table 1 and Figure 2A and B).

One of the first difficulties facing the SNP was the lack of formal criteria for enrollment in the program. The all-inclusive definition of CYSHCN in general was too broad,<sup>1</sup>

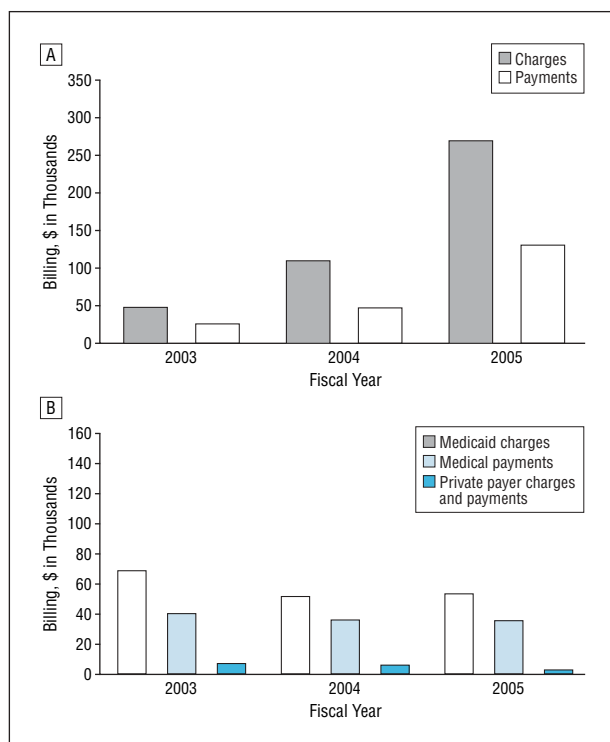
as was the 1987 definition equating medical fragility with reliance on technology and/or home nursing to survive or maintain health.<sup>4</sup> Given the limited personnel in the SNP, it was essential that the enrollment criteria identify children in most need of tertiary care center care coordination. In 2002, more than 1600 patients were actively followed up by 3 or more specialists at the CHW, but only 200 received follow-up by 5 or more specialists. Therefore, a requirement of 5 or more specialists was adopted as one of the major complexity criteria. In addition, involvement of 3 or more organ systems was required because we thought that most disease-specific programs could coordinate care for patients with fewer organ systems involved. The fragility criteria were similarly designed to iden-

**Table 4. Aggregate Resource Utilization and Tertiary Care Center Charges and Payments During Equal Preenrollment and Postenrollment Periods for All 227 Special Needs Program Patients**

Variable	Comparison Period <sup>a</sup>	
	Preenrollment	Postenrollment
Admissions, No.	572	518
Hospitalized days, No.	7926	3831
Clinic visits, No.	3150	5420
ED visits, No.	279	320
Short-stay visits, No.	121	172
CHW charges, \$ in millions	39.1	24.4
CHW payments, \$ in millions	23.4	13.0
MCW charges, \$ in millions	10.4	6.9
MCW payments, \$ in millions	4.2	3.9

Abbreviations: CHW, Children's Hospital of Wisconsin; ED, emergency department; MCW, Medical College of Wisconsin.

<sup>a</sup> The comparison period lasted a mean  $\pm$  SD of 394  $\pm$  339 days (median, 270 days).



**Figure 5.** Reimbursement for care coordination by the special needs program. A, Physician billing by fiscal year. B, Pediatric nurse case manager billing by fiscal year.

tify patients with significant care coordination needs that were not likely to be met by other programs. A small percentage of patients enrolled before formal criteria were established in 2004 failed to meet the major complexity and fragility criteria (Table 2), and a few patients enrolled since then met only minor criteria. This finding likely reflects the insensitivity of the major criteria to the needs of some patients, families, and PCPs and indicates the need for refinement of the enrollment criteria.

The decision by the SNP to partner with PCPs rather than attempt to provide primary care at the CHW was

**Table 5. Special Needs Program Fiscal Year 2005 Budget**

Budget Item	Cost or Earnings, \$
<b>Expenses</b>	
Salaries	
Physicians (2 part-time care coordinators; 1 also functioned as medical director)	265 000
Nurses (1 advanced practice nurse who also functioned as program manager and 3 pediatric nurse case managers)	302 000
Administration (1 part-time administrative assistant and 1 full-time program coordinator)	78 000
Supplies	20 000
<b>Total Expenses</b>	<b>665 000</b>
<b>Income</b>	
Clinical earnings	
Physicians	130 000
Nurses	36 000
Other	
Title V grant	14 000
Medical director stipend from CHW	90 000
<b>Total Income</b>	<b>270 000</b>
<b>Special Needs Program Deficit</b>	
Net deficit	395 000

Abbreviation: CHW, Children's Hospital of Wisconsin.

based on several considerations. Many PCPs who admitted their patients to the CHW were ready and willing to provide medical homes for medically complex and fragile CYSHCN if they had assistance with care coordination. Thus, we believed that the capacity of the SNP would be maximized by restricting the role of the SNP physicians to tertiary care center care coordination. In addition, almost half of the patients followed up in the SNP lived far from the CHW, making it impractical for them to receive their primary care at the CHW. Similar considerations led to the establishment of a 2-tiered program in which some patients were followed up by a PNCM and others by a PNCM and SNP physician. Many families and PCPs found that a PNCM who provided care coordination was all that was required to ensure medical homes. Requiring that all patients be followed up by an SNP physician when willing PCPs and other specialists were available seemed duplicative and limited the ability of the SNP physicians to care for those patients who would benefit most from their involvement.

Children and youth with special health care needs use more resources and have greater costs than healthy children.<sup>6,20,22</sup> Medically complex and fragile CYSHCN in the SNP consumed an extraordinary proportion of resources before enrollment (Figures 3 and 4 and Table 3). In the PNCM-MD group, a striking decrease was seen in the number of hospitalizations, number of hospital days, and tertiary center charges and payments after enrollment (Figure 3 and Table 3). A similar but smaller change was seen in the PNCM group (Figure 4 and Table 3), likely reflecting the lesser complexity and fragility of the PNCM group before enrollment (Tables 1 and 2). It is also possible that involvement of the SNP physician contributed to the differences between the groups, but this seems un-

likely because the PCPs and PNCMs could request the assistance of the SNP physicians if they believed that the child's condition warranted it. Indeed, 3 patients initially enrolled in the PNCM group were transferred to the PNCM-MD group.

Aggregate data for equal preenrollment and postenrollment periods (Table 4) allow ready assessment of SNP return on investment. The relatively small investment by the MCW and CHW (less than \$400 000 per year; Table 5) was associated with a more than 50% decrease in hospital days and a \$10.7 million decrease in tertiary care center payments (Table 4). The lack of a control group makes it impossible to state that the postenrollment changes were solely due to the SNP. It is certainly possible that some of the changes may have occurred simply with time. However, prior studies<sup>20-22</sup> have found that care coordination reduced costs and hospitalizations in other complex populations. Moreover, the types of conditions, the patients' medical complexity and fragility, and the magnitude of the changes in resource utilization, charges, and payments found in this study all suggest that this new tertiary care–primary care partnership model was effective in improving patient health and reducing costs.

We believe that the key interventions by the SNP were (1) partnering with the family and PCP, (2) familiarity with the child's condition, (3) close involvement during hospitalizations, and (4) proactive outpatient care. The partnership allowed the SNP to focus on care coordination, the PCP on primary care, and the family on their goals for the child. Good communication among the partners kept everyone informed. Familiarity with the patients' conditions was achieved in large part by preparing and maintaining clinical care coordination summaries. Although they required considerable time and effort, they provided families and PCPs with a detailed record of prior illnesses, testing, medications, and approaches to problems that likely reduced redundant testing and unnecessary or previously failed therapies. The SNP physicians saw patients in the emergency department and were frequently able to arrange for home care rather than admission. When a patient was admitted, the SNP reduced time spent by nurses and residents and likely reduced errors. Active SNP involvement on rounds also contributed to shorter stays and lower costs, since the SNP physician could report on prior approaches and coordinate care among specialists. Finally, increased clinic visits reflected both increased time out of the hospital and the proactive work of the SNP in referring patients to necessary specialists or services.

We did not formally investigate the impact of the SNP on quality of life or satisfaction. However, anecdotal reports by patients and families indicated a high level of satisfaction with the SNP. Families were particularly happy to have a single point of access to tertiary care center staff and resources. The PCPs also appreciated having a single, reliable source of coordination and communication with the tertiary care center. Their satisfaction was perhaps best illustrated by our observation that once one PCP's patient was enrolled, multiple referrals from the same practice generally followed. Specialists also appreciated the time saving afforded by the detailed clinical summaries

and the reduced time spent coordinating care of medically complex patients.

When the SNP was founded, the CHW and MCW made it explicitly clear that their financial support was limited and that further growth would require additional funding streams. Poor reimbursement has traditionally been a major barrier to care coordination.<sup>11,15</sup> We used time-based *Current Procedural Terminology* codes to charge for SNP physician services when more than 50% of time was spent in coordination and counseling (Figure 5). The reimbursement exceeded expectations and in 2005 covered almost 50% of the salaries and benefits of the SNP physicians (Table 5). However, PNCM care coordination was less well reimbursed (Figure 5) and covered less than 1 PNCM salary (Table 5). The other costs of the program led to a net deficit of close to \$400 000.

There are several limitations to our data. First, we did not randomize enrollment in the SNP and have not been able to identify a valid concurrent control group. Therefore, we chose to compare preenrollment and postenrollment data as the best alternative approach. Second, resource utilization, charges, and payments were measured from a single tertiary care center. However, this is unlikely to alter the results, since more than 95% of patients enrolled in the SNP received all of their tertiary care at the CHW and 90% of specialist care was provided by the MCW faculty. Finally, we did not have access to the outpatient costs of community resources, home care, durable medical equipment, and pharmaceuticals. Although the decrease in hospitalizations almost surely led to an increase in outpatient costs, it is unlikely that it approached the cost savings attributable to decreased hospitalizations.

This article presents the structure, impact, and challenges of the SNP, a new tertiary care–primary care partnership model designed to facilitate provision of medical homes for medically complex and fragile CYSHCN. Improvements in enrollment criteria, criteria for SNP physician involvement, and discharge criteria and tools are essential. To sustain growth of the SNP, it will be necessary to increase both the PNCM and physician cadre. This in turn will require continued reimbursement for face-to-face clinical services and new funding streams to pay for the non–face-to-face services that are not adequately reimbursed. The return on investment demonstrated by this study should provide some incentive for private and public payers to support this or similar models. Replicating the model in other tertiary care institutions will almost certainly require modifications because of institutional practices and reimbursement mechanisms. However, we encourage such attempts because the population of medically complex and fragile CYSHCN will continue to grow and our data suggest that the model can be developed and tested with modest institutional support.

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**Correspondence:** John B. Gordon, MD, Special Needs Program, Children's Hospital of Wisconsin, Mail Stop C350, 9000 W Wisconsin Ave, Milwaukee, WI 53226 (jgordon@mcw.edu).

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the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Gordon, Colby, Jablonski, Krauthoefer, and Havens. *Acquisition of data:* Gordon, Bartelt, Jablonski, and Krauthoefer. *Analysis and interpretation of data:* Gordon and Havens. *Drafting of the manuscript:* Gordon and Krauthoefer. *Critical revision of the manuscript for important intellectual content:* Colby, Bartelt, Jablonski, and Havens. *Statistical analysis:* Gordon and Havens. *Administrative, technical, and material support:* Colby, Bartelt, Jablonski, and Krauthoefer.

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