Effect of Hospital-Based Comprehensive Care Clinic on Health Costs for Medicaid-Insured Medically Complex Children

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Objective: To evaluate the effect on all state Medicaid costs of a children’s hospital-based multidisciplinary clinic that provides comprehensive and coordinated care for medically complex children.

Design: Before-after intervention study. Patients’ health care costs for up to 1 year before enrollment in the clinic were compared with patients’ health care costs for up to 1 year after enrollment in the clinic. Patients were enrolled in our study from August 2006 to May 2008.

Setting: Tertiary care children’s hospital in a rural state.

Participants: A total of 225 medically complex children who had at least 2 chronic medical conditions and who were followed up by at least 2 pediatric subspecialists.

Intervention: Multidisciplinary teams ensure that each patient receives all the necessary medical, nutritional, and developmental care and that there is improved coordination of care with primary care providers, subspecialists, hospitalists, and community-based services.

Main Outcome Measures: Using Arkansas Medicaid claims data, we examined the medical costs for all outpatient, inpatient, emergency department, and prescription drug claims. Costs were calculated on a per month per patient basis and summarized for annual costs.

Results: The mean annual cost per patient per month decreased by $1766 for inpatient care ($1766, P < .001) and by $6.00 for emergency department care ($6.00, P < .001). Although the cost per patient per month for outpatient claims ($6.00, P < .05) and prescriptions ($6.00, P < .001) increased, the overall cost to Medicaid per patient per month decreased by $1179 ($1179, P < .001).

Conclusions: This hospital-based multidisciplinary clinic resulted in a significant decrease in total Medicaid costs for medically complex children.

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IMPROVEMENTS IN SURGICAL, GENERAL medical, and intensive care have increased the survival of low-birth-weight children born preterm with various congenital anomalies. As a result, an increasing number of children with multiple chronic conditions now live at home. Many such children have an associated chronic neurodevelopmental disability and are in need of assistance with special medical equipment (such as tracheostomy and gastrostomy tubes). These medically complex children (MCC) have the most medically complex conditions of children with special health care needs (CSHCN). Although CSHCN experience more hospital admissions and outpatient visits compared with healthy children, MCC may require even more hospitalizations and physician visits. Although the health care needs of CSHCN often are not met, an even higher number of unmet needs, both within the health care system and with community-based services.

Primary care providers often acknowledge a lack of comfort, time, and resources in treating and coordinating the care of MCC. Tertiary care subspecialists provide quality, organ system–focused care; however, the coordination and the integration of an overall care plan are not typical, and communication among specialists and primary care providers is sometimes not optimal. As a result, care may be ineffective or duplicated, potentially resulting in increased resource utilization and poorer outcomes. Some children’s hospitals have begun to develop special programs dedicated to better serving MCC. Some programs provide continuity of care during hospitalizations, whereas others assist in care coordination in ambulatory settings.
Recognizing the increasing number of MCC and their need for comprehensive and coordinated care, Arkansas Children’s Hospital (ACH) initiated a medical home program for MCC. It was hypothesized that this program would result in fewer acute hospitalizations and emergency department visits, resulting in reduced overall costs of medical care.

**METHODS**

**SETTING**

Arkansas is a primarily rural state with approximately 2.8 million citizens and 699,000 children 18 years of age or younger. Arkansas Children’s Hospital is the only tertiary care hospital in the state that provides subspecialty care and surgical care for children. The vast majority of children in Arkansas requiring subspecialty care receive their care at ACH.

**INTERVENTION**

The goals of the medical home program are to ensure that each child receives all the necessary medical, nutritional, and developmental and/or therapeutic care and to improve the coordination of care for all physicians and other providers at ACH and in the communities. Arkansas Medicaid requires all Medicaid-eligible children to have a primary care provider to act as a referral gatekeeper. The children continue seeing their community-based primary care provider as well as all needed pediatric subspecialists. The program is outpatient-based, with coordination with inpatient services during hospitalization. The clinic staff includes pediatricians (neonatologist, developmental pediatricians, hospitalists, and general pediatricians), nurses, nutritionists, social workers, speech pathologists, and child psychologists. At least 1 person from each discipline is present for each clinic visit; this way, the continuity of care by the clinic team is ensured. The frequency of visits is determined by clinical need. Each patient is assigned a nurse coordinator who meets with the child and family in the clinic. The nurse is available for telephone consultation during daytime hours to assist with concerns of any type, including appointment coordination, clinical decision making, and acute care issues. The clinic team ensures that the needed community-based services are provided and that communications with these programs and the primary care providers occur via letter, e-mail, and/or telephone.

**SUBJECTS**

Children eligible for enrollment in the medical home program are high utilizers of services at ACH who have at least 2 serious chronic conditions and were followed up by at least 2 pediatric subspecialists. Many are born with extremely low birth weight (or with congenital anomalies and/or syndromes), with chronic neurodevelopmental disability, and/or are dependent on special medical equipment (such as gastrostomy tubes). Eligible children, who live throughout the state, are referred by their primary care provider or by a pediatric subspecialist with approval by the primary care provider. All children in our study were eligible for Medicaid and were continuously enrolled from the outset of the new program beginning in August 2006 and ending May 2008. Excluded from the analyses were (1) children who had been previously followed by the codirectors of the medical home program (R.E.L. and P.H.C.) in their prior existing clinics; (2) children 90 days of age or younger, to exclude hospitalizations in neonatal intensive care units (which would have inflated the hospital costs prior to the initial Medical Home Clinic visit); and (3) children who died. There were 281 children enrolled in the clinic who met the study criteria. Matching to Medicaid claims data was accomplished for 225 children, who make up the final sample for the analyses. Matching was not successful for 36 children because of inconsistencies in the child’s name or Medicaid identification number between ACH clinical records and Medicaid files.

**DATA**

The University of Arkansas for Medical Sciences institutional review board reviewed and approved the research protocol. Our study is a retrospective cohort study of eligible enrollees in the Medical Home Clinic. Demographic and clinical data for our study came from hospital medical records. Demographic data include patients’ sex, race/ethnicity, and age at first clinic visit. Clinical data include number and type of complex chronic conditions. All cost and resource utilization data came from linking hospital data to Arkansas Medicaid data. Medicaid utilization and cost data were obtained state-wide for all (not just ACH) inpatient stays, outpatient claims (including physician visits and therapy treatment), emergency department visits, and prescription drugs. Utilization data were obtained for up to 12 months before and after the index clinic visit.

**ANALYSES**

Because of the varying ages of the enrolled children, the exclusion criteria based on age of child at enrollment, and the staggering of enrollment over time, the number of patients eligible for inclusion in our study varied across the different time frames (ie, before and after the first clinic visit). For example, because the minimum age at enrollment was 90 days, children enrolled at 15 months of age or younger could not have 12 months of preenrollment data. Similarly, children enrolled less than 12 months before the end of the data collection could not have 12 months of postenrollment data. To account for the varying number of subjects across months, all cost data were standardized on a per patient per month (PPPM) basis. Because the distribution of the PPPM utilization data was significantly positively skewed, multivariable analyses were conducted using a generalized linear model with a Gamma distribution and a log link. Multivariable analyses before and after enrollment relied on predicted pre- and post-PPPM cost values adjusted for sex, race/ethnicity, and age at index clinic visit. To gain a more detailed understanding of utilization patterns before and after enrollment in the clinic, a piecewise generalized linear model was used. Our piecewise model allowed for different slopes, or utilization trends, as well as different intercepts for pre- and postenrollment periods. All analysis was conducted using Stata/MP version 11.1 statistical software (StataCorp LP, College Station, Texas).

Demographic and selected clinical characteristics of the 225 study subjects are presented in Table 1. Sixty-two percent were male children, and 50% were white. The mean (SD) age at enrollment was 19.4 (21.3) months, and the median age was 13 months. The oldest child at enrollment was 138 months.

Before enrollment, the mean (SD) number of hospitalizations PPPM was 0.1 (0.3), and the mean (SD) number of outpatient claims PPPM was 10.3 (7.4). Of the 225 children enrolled in our study, 152 (67%) were born pre-
The clinical intervention of the ACH medical home program resulted in significantly fewer inpatient stays PPPM with significantly shorter lengths of hospital stay. This resulted in an annual savings of $1766 PPPM. The number of outpatient claims per child per month increased, but emergency department contacts decreased for the year after the first clinic visit compared with the year before the first clinic visit. The aggregate cost savings for Arkansas Medicaid, including the costs mentioned earlier as well as medications and other related expenses, was $1179 PPPM for the year after the first clinic visit.

Based on these total cost data, the predicted adjusted annual cost for a theoretical group of 225
MCC before enrollment in the Medical Home Clinic would be $12,698,100. The predicted adjusted annual cost for a theoretic group of MCC after enrollment in the Medical Home Clinic would be $9,514,800. This would result in an annual cost saving of $3,183,300 for the theoretical 225 patients, with savings of $14,148.

Table 2. Actual and Adjusted Medicaid Costs for 12 Months Before and 12 Months After Entry Into the Medical Home Clinic

<table>
<thead>
<tr>
<th>Cost, $, per Patient per Month</th>
<th>Bivariate Analysis</th>
<th>Multivariable Analysisa</th>
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<tbody>
<tr>
<td></td>
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<td>After</td>
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Abbreviation: CI, confidence interval.
aThe results of multivariable analysis were adjusted for sex, race/ethnicity, and age at entry into Medical Home Clinic by use of a generalized linear model.

Figure 1. Actual and adjusted per patient per month (PPPM) overall cost to Medicaid for 12 months before and 12 months after clinic enrollment. PPPM cost values were adjusted for sex, race/ethnicity, and age at clinic enrollment by use of a generalized linear model. The number for each month represents the number of children (ie, the sample size per month).

Figure 2. Actual and adjusted per patient per month (PPPM) inpatient cost to Medicaid for 12 months before and 12 months after clinic enrollment. PPPM cost values were adjusted for sex, race/ethnicity, and age at clinic enrollment by use of a generalized linear model. The number for each month represents the number of children (ie, the sample size per month).
proved quality of life for parents,30 improved child adjustment,31 and receipt of more community services.32 Studies of programs that targeted children with a single chronic condition like asthma or epilepsy, with short-term outcomes such as family function, satisfaction with care, and timeliness of care.27

Other studies have evaluated the number of inpatient, outpatient, and/or emergency department visits and their associated costs as an outcome of interventions targeting children with special health care needs. Broyles et al33 examined the benefits of comprehensive care programs in very low birth weight infants in a randomized controlled trial. The comprehensive care group had significantly more clinic visits and telephone conversations, with fewer life-threatening illnesses, intensive care admissions, and days in intensive care compared with the routine care group. Beckmezian et al31 compared the care provided by a typical subspecialty/house staff team with a staff-only hospitalist team. The hospitalist team demonstrated hospital stays that were shorter by 2.7 days with 29% lower costs. Much of the remaining research in this field has utilized the before-after intervention design. A comprehensive care program that served 4-year-old CSHCN, few of whom were medically complex, found no difference before and after enrollment in the number of hospitalizations or in associated costs.34

Expanded comprehensive care programs resulted in significantly shorter hospital stays,30,35 more outpatient visits,30 and decreased hospital charges compared with national data.35 Emergency department visits of MCC decreased after the integration of a comprehensive care coordination program in a resident education clinic36 and after the onset of an emergency department–based coordination program that provided 24-hour access to nurse coordinators.37 Gordon et al32 described the results before and after the implementation of a program that best resembled our ACH medical home program. They enrolled children with complex chronic conditions that involved 3 or more organ systems requiring the care of at least 5 pediatric subspecialists. Pediatric nurse case managers provided direct care but served as coordinators for all medical- and community-based needs. The hospital-based physicians saw program patients in the emergency department, sometimes during clinic visits, and they also participated in the care of hospitalized children. This program resulted in a significant decrease per patient in the number of inpatient admissions and days in the hospital, as well as a significant increase in outpatient clinic and emergency department visits. In aggregate, these changes resulted in a decrease of payment of $10.7 million to the hospital. Our results extend these findings by utilizing all aggregate state Medicaid costs, not just costs generated by one hospital.

Because we did not feel ethically comfortable designing a randomized controlled intervention trial or using a wait-list control design with these MCC, we used a before-after intervention study design to assess health costs. Although we attempted to adhere to the high standards of this type of research design, our conclusions may be limited. For example, the natural course of disease might result in improved clinical status with age, thus resulting in decreased clinical encounters of all types over time. However, we found an upward trend of hospitalizations and associated costs that decreased immediately after the implementation of our medical home program (ie, Medi-
cal Home Clinic). In addition, we controlled for age at first clinic visit in an attempt to address the concern of maturing out of a serious condition. The number of patients available for analyses each month varied depending on when they were first enrolled in our clinic and on how long they were followed up after the first clinic visit. We were not able to match 56 of our subjects to Medicaid data because of inconsistencies in identifiers in the 2 data sets. There is no reason to think that these children differed significantly from those included in the analyses, because all our patients were consecutively enrolled and met our enrollment criteria for medical complexity. In addition, they did not differ in demographic characteristics. Our results may not apply to children who are not publicly insured, and our model examines only a single program at one institution. Although it is feasible that other hospital- or Medicaid-supported initiatives occurring concomitant with ours might have influenced our results, we were aware of no such program. Finally, we do not have data that document changes in patient health status.

Our report has several strengths. Our use of Arkansas Medicaid data allowed us to determine all clinical contacts and associated costs, not just those occurring in our hospital. We were thus able to determine that decreased utilization and cost to our hospital were not offset by increased costs at other provider sites. Our analytical plan is unique in that we were able to evaluate the PPPM experience in each of our outcomes for the year before and the year after our initial clinical contact.

We acknowledge that our use of the term “medical home” differs from that used by the Academy of Pediatrics and others, which implies care provided in the primary care setting. We propose that the notion of a medical home be expanded for this subpopulation of very complex children who often challenge the time and capacity of primary care providers. The medical home is not a building or location; rather, it is the concept of comprehensive, coordinated, and accessible care that all children deserve. The expanded multidisciplinary team offers these MCC the opportunity to have the coordinated and comprehensive care often not available when their care is provided in a primary care setting supported by consultation with tertiary care providers.

In summary, the ACH medical home program resulted in significant decrease in total Medicaid costs for the MCC cared for in our clinic. The savings resulted primarily from a decrease in inpatient costs, by decreasing both the number of hospitalizations and the length of stay. Future research is needed to determine whether the coordinated and comprehensive care resulted in better patient quality of life and health status, as well as improvement in the quality of life, mental health, satisfaction with care, and general well-being of their care providers.

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REFERENCES