Health Care Utilization and Costs of Publicly-Insured Children with Diabetes in California

Joyce M. Lee, MD, MPH[1,2], Vandana Sundaram, MPH[3], Lee Sanders, MD[3], Lisa Chamberlain, MD[3], and Paul Wise, MD, MPH[3]

Objective To examine diabetes-related health care utilization and costs for a population-based sample of children with presumed type 1 diabetes (T1D) enrolled in the California Children's Services program.

Study design Our data source was the California Children's Services claims data for the period July 1, 2009, to June 30, 2012. We studied a sample of 652 children aged 0-21 years who were continuously enrolled for at least 365 days, had an outpatient visit for T1D, and were taking insulin.

Results Compared with the younger age groups, individuals in the 19-21 year age group had the highest rates of hospitalization, T1D-specific bed-days, and emergency department visits. The overall median cost for this population was $7654. The overall median costs per year (and proportion of total costs) were $5603 (59%) for hospitalizations, $58 (0.4%) for emergency department visits, $144 (1.3%) for outpatient utilization, $2930 (23%) for insulin, and $1579 (13%) for blood glucose monitoring supplies. For those who used them, the median cost of pumps was an additional $2162.

Conclusion Further studies are needed to provide more insight into patterns of care and adverse health outcomes for children with T1D as they transition into young adulthood. The costs of insulin, glucose monitoring supplies, and pump therapy for children with T1D is substantial and may factor into future policy considerations regarding coverage and cost-sharing with families. *(J Pediatr 2015;167:449-54)*.

Diabetes represents one of the most common chronic diseases of childhood, and its incidence is increasing in children.[1] The majority of children with diabetes have type 1 diabetes (T1D),[2] which requires intensive management, including frequent daily blood glucose monitoring and multiple daily injections of insulin (anywhere from 4 to 10 times a day). Furthermore, an increasing proportion of children are using technology, including insulin pumps and continuous glucose monitoring systems, to augment management of T1D.[3] Thus, T1D in children represents an excellent paradigm for understanding health care utilization and costs of childhood chronic disease, as well as the impact of medical technology on costs of care.

The majority of previous studies have focused almost exclusively on adults, who mostly have type 2 diabetes.[4-6] To date, only a few studies have evaluated health utilization patterns and costs of diabetes in children. Those studies focused on privately insured children[7] and on inpatient rather than outpatient care,[8] were based on small sample sizes or clinic-based samples from tertiary care,[9] or were from countries other than the US.[10,11] Other studies attributed health care costs to specific events rather than measuring claims paid out for services.[12]

Consequently, we sought to describe diabetes-related health care utilization and costs (both inpatient and outpatient) for a population-based sample of children with T1D enrolled in the California Children's Services (CCS) program, a safety net program for children with chronic diseases in the state of California. We hypothesized that health care utilization and costs would be higher for adolescents vs younger children, for minority vs white children, for urban vs rural children, and for children receiving pump therapy vs those not on pump therapy.

Methods

CCS, the California safety net Title V program established by the Social Security Act of 1935, provides coordination of care and medical coverage for children with diabetes up to 21 years of age who are enrolled in Medi-Cal (the Medicaid program in California) or Healthy Families (the State Children's Health Insurance Program in California), or who are uninsured or have private insurance if their health-related expenditures exceed a designated level, based on income.

Our data source was CCS paid claims. We used a dataset provided by the California Department of Health Care Services that included demographic

CCS	California Children's Services
ED	Emergency department
T1D	Type 1 diabetes

From the [1]Child Health Evaluation and Research Unit, Division of General Pediatrics, and [2]Division of Pediatric Endocrinology, University of Michigan, Ann Arbor, MI; and [3]Center for Policy, Outcomes and Prevention, Stanford University, Stanford, CA

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information, geographic information, diagnoses, procedures, and reimbursement information for all paid claims for every eligible child, as well as information about the CCS-eligible diagnosis and eligibility start and end dates for each child enrolled between July 1, 2009, and June 30, 2012. We identified a sample of children aged 0-21 years with a CCS-eligible diagnosis of diabetes enrolled for a continuous period of at least 365 days who had at least 1 outpatient clinic visit for diabetes (based on an *International Classification of Diseases, Ninth Revision* code of 250.xx) (n = 7993). We elected to focus on children with insulin-treated diabetes, because this would capture all children with T1D; therefore, we further narrowed the population to 7057 children who were taking insulin. We cannot exclude the possibility that the cohort may include some children with type 2 diabetes, however. Given our aim of describing both utilization and costs, we focused on children enrolled in Medicaid fee-for-service plans, because information about costs for children enrolled in managed care is incomplete; this left us with a sample of 652 children.

To identify claims/costs of insulin, blood glucose monitoring, and pump supplies, we used National Drug Codes to capture outpatient pharmacy claims and Healthcare Common Procedure Coding System codes for any insulin/supplies dispensed in clinic visits (see the **Appendices 1-4**; available at www.jpeds.com). Children were defined as being on a pump if they had at least 1 outpatient claim for a pump during the study period.

We used a descriptive-based approach to assess utilization and costs. We estimated median annualized utilization rates of bed-days and hospitalizations (diabetes-related and non–diabetes-related), and emergency department (ED) visits and outpatient visits (diabetes-related). For costs, we assessed median annualized costs for hospitalizations, ED visits, outpatient visits, insulin, testing supplies, and pumps. Costs were annualized, because children could have been enrolled for anywhere from 1 to 3 years. In sensitivity analyses, we also assessed overall expenditures (not limited to diabetes-related expenditures) for the cohort. Because we have data for the entire sample of children covered by the CCS program, we did not perform significance testing. For our analyses comparing sex, some children had both "M" and "F" coded as sex on different claims, and these children were coded as "unknown" sex.

Results

The majority of children were age 10-14 years (37%) or 15-18 years (32%), and there was a preponderance of females (**Table I**). The majority of children were either Hispanic or white and lived in urban areas. A minority of children used an insulin pump (18%) (**Table I**).

For the overall population, the median annual hospitalization rate was 0.7, the median annual bed-day rate was 2.5 days, the median annual ED visit rate was 0.7 visits, and the median annual outpatient visit rate was 2.7. **Table II** (available at www.jpeds.com) shows the annualized median inpatient and outpatient utilization rates according to demographic characteristics for the entire sample, with n representing the number of children who had a visit. Compared with the younger age groups, children in the 19- to 21-year age group had the highest rates of hospitalizations, bed-days, and ED visits. Although the median rate of hospitalization was similar in males and females, the median rate of bed-days was slightly higher in females. Compared with children of other races, blacks had higher rates of bed-days and ED visits and had lower rates of outpatient visits. Compared with rural children, urban children had higher rates of bed-days and lower rates of outpatient visits.

Table I. Demographic characteristics of children with diabetes in the CCS program for the overall population and stratified by insulin pump use

Characteristics	Overall (n = 652), n (%)	Insulin pump use: No pump (n = 534), n (%)	Insulin pump use: Pump (n = 118), n (%)
Age, y*			
0-4	36 (5.5)	26 (4.9)	10 (8.5)
5-9	126 (19.3)	97 (18.2)	29 (24.6)
10-14	239 (36.7)	199 (37.3)	40 (33.9)
15-18	206 (31.6)	172 (32.2)	34 (28.8)
19-21	45 (6.9)	40 (7.5)	5 (4.2)
Sex			
Female	274 (42)	214 (40.1)	60 (50.8)
Male	245 (37.6)	213 (39.9)	32 (27.1)
Unknown	133 (20.4)	107 (20)	26 (22)
Race/ethnicity			
White	237 (36.3)	171 (32)	66 (55.9)
Black	74 (11.4)	65 (12.2)	9 (7.6)
Hispanic	201 (30.8)	178 (33.3)	23 (19.5)
Other	120 (18.4)	105 (19.7)	15 (12.7)
Unknown	20 (3.1)	15 (2.8)	5 (4.2)
Residence county			
Rural	65 (10)	45 (8.4)	20 (16.9)
Urban	587 (90)	489 (91.6)	98 (83.1)

*Age for the unique cohort represents the age at the start of the first claim between July 1, 2009, and June 30, 2012.

For the overall population, the median (proportion of total costs) annual costs were $5603 (59%) for all hospitalizations, $58 (0.4%) for diabetes-specific ED visits, $144 (1.3%) for diabetes-specific outpatient visits, $2930 (23%) for insulin, and $1579 (13%) for blood glucose monitoring supplies. The overall total median cost for the study population was $7654. In a sensitivity analyses of overall expenditures (not limited to diabetes-related expenditures) for the cohort, the total was $11 624 per child.

Figures 1-4 (**Figure 2** available at www.jpeds.com) show breakdowns of the annualized median cost rates by age group, sex, race, and pump use. For most age groups, the costs of hospitalization were comparable with the costs of medications, supplies, and insulin pumps; however, for the 19- to 21-year age group, the costs of inpatient hospitalization was nearly double. Overall costs were higher for females compared with males, for black and Hispanic children compared with white children, and for children