Factors that Predict Frequency of Emergency Department Utilization in Children With Diabetes-Related Complaints

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Objectives: The primary purpose of the study was to determine the factors that are associated with repeat emergency department (ED) visits in children with diabetes.

Methods: Emergency department charts and billing data for children up to 18 years of age presenting to the ED with diabetic diagnoses over a 4-year period were reviewed.

Results: The overall rate of repeat visits to the ED was 0.24 visits per person-year of follow-up time. In univariate analyses, there were statistically significant effects of age, insurance category, sex, type of practice, and income.

In a multivariate analysis, there was a significant interaction of insurance category and age. Revisit rate ratios for children older than 6 years were higher for those with Medicaid compared with those with commercial insurance. Diabetic boys were less likely to revisit the ED than were girls.

Conclusions: Type of insurance was associated with repeated visits to the ED in children with diabetes. Other contributing factors included age group and sex.

Key Words: diabetes, insurance types, revisit rate
(Pediatr Emer Care 2012;28: 00–00)

Diabetic children are more likely to have emergency department (ED) visits than those without chronic conditions, regardless of their insurance status.1–5 As a result of higher rates of service utilization by children with diabetes, their medical care involves higher costs compared with the care of children without chronic conditions.1–3,6,7 Some of the risk factors associated with higher rates of ED use in diabetic children, other than having a chronic medical condition, are age less than 1 year, being nonwhite Hispanic or African American, receiving Supplemental Security Income, living in urban areas, and Medicaid enrollment.2,4,8 None of these studies addressed repeated visits by children with diabetes in the pediatric emergency department or the reason for visits. In addition, none examined visits for new-onset versus established diabetes.

Among diabetic children, those insured by Medicaid appear to be at higher risk for ED utilization, developing diabetic ketoacidosis (DKA), and having limited access to or limited compliance with necessary medical care such as measurement of glycosylated hemoglobin level and ophthalmologic treatment than those who are commercially insured.2,3,9,10 However, little information exists regarding the demographic characteristics that are associated with ED visits in diabetic children, the risk factors for repeat visits to the ED, and the reasons for increased ED utilization by diabetic children. Also, to date, none have explored the types of medical care that diabetic children receive in the prehospital setting and in the ED.

METHODS

Study Design and Setting

After approval by our hospital’s Committee on the Protection of Human Subjects in Research, we performed a retrospective cohort review of patient medical records from October 1, 2001, through September 30, 2004, of all Hasbro Children’s Hospital Emergency Department (HCH ED) visits by patients younger than 18 years with diabetes-specific primary, secondary, or tertiary International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes: 250.0–250.9 and 251.0. The HCH ED is an urban ED located at a tertiary care children’s hospital in Providence, RI. The HCH ED receives more than 43,000 visits annually and is a regional referral center for subspecialty care for Rhode Island and Southeastern Massachusetts.

Data Source

Sources of information included ED physician and nursing records, emergency medical service run sheets, and HCH electronic medical records. Information from the billing database was cross-referenced with information from the ED charts to verify the identity of children. Income levels were derived using zip codes and US census data.

A research assistant blinded to the hypotheses performed data abstraction after a formal training session and supervised practice abstraction of a subset of charts before actual data collection. Data abstraction was conducted using a data collection template with a pre-established schema for prioritization of data sources. Information from physician documentation took priority over the information on the emergency medical service note and the triage note. Once data abstraction was completed, the primary investigator rechecked the data, and every chart was reexamined and cross-checked with the extracted data for accuracy. If there was a discrepancy from the primary data during reexamination, they were reviewed through discussion between the principal investigator and the research assistant.

Inclusion and Exclusion Criteria

Visits were included in the study if a diabetes-specific diagnosis (ICD-9 codes 250–250.9 and 251.0, including diabetes without complication and DKA) appeared at least once as the patient’s primary, secondary, or tertiary diagnosis (ICD-9 code). Children with types 1 and 2 diabetes mellitus were included.
Objectives

The primary objective of the study was to determine whether type of insurance is associated with frequency of repeat ED visits in children with diabetes-related complaints. In addition, we also investigated the contribution of other variables to repeated ED visits in children with diabetes-related complaints, including sex, age, primary diagnosis in the ED, regular source of medical care, triage levels, and income levels, and the statistical interaction of each variable with type of insurance.

Study Variables

International Classification of Diseases, Ninth Revision codes were grouped further by categorizing codes into 1 of 3 categories: “diabetes-specific,” “diabetes-related,” or “diabetes-unrelated.” Diabetes-specific diagnoses included those that were clearly the direct result of the child’s diabetes or its treatment and included such diagnoses as DKA and hypoglycemia. The “diabetes-related” category included diagnoses for which the patient’s presenting symptoms, such as vomiting and abdominal pain, were determined to be secondary to their diabetes. All other diagnoses, such as otitis media or migraine, were included in the “diabetes-unrelated” category. The proportion of each category classified as primary, secondary, and tertiary ICD-9 diagnoses in each group was calculated. In addition to the analysis of all patients combined, a separate analysis was performed of ED visit information for children presenting with new-onset diabetes.

Additional patient characteristics collected included age, sex, medical insurance status, city of residence, zip code, and regular source of medical care. The study population was divided into commercially insured and Medicaid-insured according to insurance status at the first visit during the study period. The Medicaid-insured grouping included Rhode Island’s Medicaid Managed Care Program (RIteCare), Medicaid Massachusetts, and all fee-for-service Medicaid. For all patients, the median family income and per-capita income were estimated using zip codes and the 2000 census data. Primary care providers (PCPs), as recorded in ED records, were cross-referenced with the HCH directory of physicians at the Brown Medical School and affiliated hospitals, as well as with the Rhode Island and Massachusetts Medical Board’s listing of licensed physicians. Primary care providers practicing at community health centers and hospital-based clinics were grouped into a single (Health Center) category.

Statistical Analysis

Data were analyzed using the SAS statistical package (version 9.1.2; SAS Institute, Cary, NC). The probability value for statistical significance was set at an α level of 0.05. Descriptive statistics were calculated for demographic variables. The values for age, insurance category, type of practice category, triage category, and income category were defined as the value at the time of the initial visit; χ² and Fisher exact tests were used to compare the categorical variables by insurance category, and a t test was used to compare mean ages for the 2 insurance categories. Children were grouped into 3 categories according to their ages: 5 years or younger, 6 to 12 years of age, and 13 years or older.

Revisit rates were calculated as the number of visits after the initial visit divided by the time period from the initial visit until the end of the data collection period on September 30, 2004. Poisson regression was used to test differences among revisit rates for univariate and multivariate analyses. For the multivariate analysis, a backward selection process was used, and terms were retained in the model if P < 0.05.

RESULTS

Sample Characteristics

Twenty visits (5.0%) were excluded because ED charts could not be located. Of these patients, 11 were commercially insured, and 9 were Medicaid-insured. Two additional visits were excluded for being inappropriately coded with diabetes diagnoses; another was excluded because of a data error in the record number, and 7 other visits were excluded because insurance documentation was missing. The remaining 372 patient visits were included in the analysis (92.5%).

The sample included 267 children who had at least 1 visit to the ED during the study period, with a total of 372 visits. Among those 267 children, there were 181 commercially insured children and 86 Medicaid-insured children. Sex (54% boys for...
commercially insured children and 51% boys for Medicaid-insured children) and mean ages (9.3 years for commercially insured children and 9.4 years for Medicaid-insured children) at the time of the initial visit were similar for the 2 groups.

A total of 60.8% of all diabetes-related visits to the ED during the study period were made by commercially insured children. In contrast, the overall HCH ED patient population had approximately an equal distribution between commercially insured and Medicaid-insured children during the study period.

Number of ED Revisits

There were 105 revisits to the ED after the initial visit during an average follow-up time of 19.8 months from the time of the initial visit until the end of the study. Of the 181 commercially insured children, 45 had ED revisits, and of the 86 Medicaid-insured children, 60 had ED revisits.

The overall rate of revisits to the ED was 0.24 visits per person-year of follow-up time. In univariate analyses, age group, insurance category, sex, source of medical care, and income were significantly associated with the revisit rate (Table 1).

In the multivariate analysis, there was a statistically significant interaction between insurance category and age. Therefore, the interaction term was retained in the model, and revisit rate ratios for insurance category were estimated for each age category (Table 2). Income and source of medical care were not significantly associated with the ED revisit rates in the multivariate analysis.

Study Variables

Diagnosis

A diabetes-specific ICD-9 diagnosis was the primary diagnosis for the majority of the visits: 80.8% of the visits by the commercially insured group and 78.5% of the visits by the Medicaid-insured group (Table 3). There was no difference in the number of visits related to hypoglycemia between the commercially insured and the Medicaid group (10.2% vs 11.0%, not statistically significant [NS]). Similarly, the percentage of visits due to DKA by the commercially insured children was similar to that of Medicaid-insured children (27.4% vs 32.2%, NS). Among children with a diagnosis of DKA, commercially insured children were more likely to have a PCP recorded (93.5%) compared with the Medicaid-insured children (80.9%, P < 0.05%).

Regular Source of Medical Care

Among commercially insured patients, a PCP was identified in the ED chart for 95.1% of the visits versus 89.0% among the Medicaid-insured (P < 0.05). Children in the commercially insured group were less likely to have PCPs at a community health center or hospital-based clinic (8.0%) compared with those in the Medicaid-insured group (54.6%, P < 0.05).

Triage Codes, Glucose Levels, and Treatment Before and During ED Visit

There were no differences between the 2 insurance groups with regard to triage level, percentage of patients with measured prehospital and ED glucose levels, percentage with glucose levels greater than 200 mg/dL before the ED visit and during the ED visit, or percentage with treatment before the ED visit and in the ED, except intravenous line (IV) placement (Table 4).

New-Onset Diabetes

After analysis of all 267 children was completed, visits related to new-onset diabetes were characterized separately (Table 5). A greater percentage of boys (56%) were diagnosed

<table>
<thead>
<tr>
<th>TABLE 2. Multivariate Revisit Rate Ratios Per Person-Year of Follow-Up Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comparison</strong></td>
</tr>
<tr>
<td>Aged 0–5 y: Medicaid compared with commercial insurance</td>
</tr>
<tr>
<td>Aged 6–12 y: Medicaid compared with commercial insurance</td>
</tr>
<tr>
<td>Aged 13–17 y: Medicaid compared with commercial insurance</td>
</tr>
<tr>
<td>Male compared with female</td>
</tr>
<tr>
<td>Not recorded practice type compared with private practice</td>
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<tr>
<td>Public practice compared with private practice</td>
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</table>

CI indicates confidence interval.

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<tr>
<th>TABLE 3. Categories of ICD-9 Codes for ED Visits in the Commercially and Medicaid Insured Diabetic Children*</th>
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<table>
<thead>
<tr>
<th>Commercial</th>
<th>Medicaid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary, %</td>
<td>Secondary, %</td>
</tr>
<tr>
<td>Diabetes specific</td>
<td>80.8</td>
</tr>
<tr>
<td>Diabetes related</td>
<td>9.6</td>
</tr>
<tr>
<td>Unrelated to diabetes</td>
<td>9.6</td>
</tr>
<tr>
<td>Not documented</td>
<td>0</td>
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*Sums may not total 100% because of rounding. |
with new-onset diabetes during the study period compared with girls (44%). In the commercially insured group, 102 (56.4%) of the patients were presenting for new-onset diabetes at the time of the initial visit, whereas in the Medicaid-insured group, 32 (37.1%) of the patients were presenting with new-onset diabetes ($P < 0.05$). Sex, age group, and insurance category were all significantly associated with repeat visits for those with a new-onset diabetes-related visit during the study period ($P < 0.05$). Females were more likely to have repeat visits compared with males by Poisson regression ($0.36$ repeat visits per person-year vs $0.14$ repeat visits per person-year, $P < 0.05$). Multivariate analysis revealed that sex and insurance status were still statistically significant factors with revisit rate ratios of $0.16$ ($P < 0.05$) for males compared with females ($P < 0.05$) and $2.52$ for Medicaid compared with commercial insurance (Table 6). Age group was also a significant factor, with revisit rate ratios of $0.31$ for the 6- to 12-year group, and $1.37$ for the group older than 13 years compared with the group younger than 6 years ($P < 0.05$, Table 6). The interaction between age and insurance category was not tested because of sparse data in some cells.

With regard to treatment received by those with new-onset diabetes, commercially insured patients were less likely to have received any treatment before the ED visit (2.0% vs 12.5%, $P < 0.05$; Table 4). Most of the new-onset visits among both insurance groups involved some treatment in the ED (commercial 100% vs Medicaid 96.9%, NS). Again, these were most commonly IV placement and insulin.

### DISCUSSION

We analyzed ED visits for diabetic complaints in commercially insured and Medicaid-insured children to determine whether type of insurance is related to increased frequency of revisits to the ED. Medicaid-insured children experienced a higher frequency of repeat visits during the study period compared with commercially insured children. Although our data do not offer an explanation for this observation, one possibility is that Medicaid-insured patients were sicker than commercially insured patients. However, there were no differences between the 2 insurance groups in glucose levels, acuity (triage) scores, or care given before or during the ED visit. Another alternative is that the difference between groups in revisit rates was the result in differences in access to care. It is well established that those with public insurance are more likely to have lower income levels, be from racial minority groups and be from single-parent households and households of parents with a high school education or less. Multivariate analysis revealed that sex and insurance status were still statistically significant factors with revisit rate ratios of $0.16$ ($P < 0.05$) for males compared with females ($P < 0.05$) and $2.52$ for Medicaid compared with commercial insurance (Table 6). Age group was also a significant factor, with revisit rate ratios of $0.31$ for the 6- to 12-year group, and $1.37$ for the group older than 13 years compared with the group younger than 6 years ($P < 0.05$, Table 6). The interaction between age and insurance category was not tested because of sparse data in some cells.

With regard to treatment received by those with new-onset diabetes, commercially insured patients were less likely to have received any treatment before the ED visit (2.0% vs 12.5%, $P < 0.05$; Table 4). Most of the new-onset visits among both insurance groups involved some treatment in the ED (commercial 100% vs Medicaid 96.9%, NS). Again, these were most commonly IV placement and insulin.

### TABLE 5. Demographics, Admission Rates, and Treatment for the Commercially and Medicaid-Insured Children With New-Onset Diabetes*

<table>
<thead>
<tr>
<th></th>
<th>Commercial</th>
<th>Medicaid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients*</td>
<td>56.4</td>
<td>37.2</td>
</tr>
<tr>
<td>With DKA</td>
<td>22.5</td>
<td>25.0</td>
</tr>
<tr>
<td>Age mean, y</td>
<td>8.5</td>
<td>8.1</td>
</tr>
<tr>
<td>Admitted</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>21.6</td>
<td>21.9</td>
</tr>
<tr>
<td>Treatment pre-ED*</td>
<td>2.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Insulin†</td>
<td>1.0</td>
<td>12.5</td>
</tr>
<tr>
<td>IV</td>
<td>1.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Treatment in ED</td>
<td>100.0</td>
<td>96.9</td>
</tr>
<tr>
<td>Insulin†</td>
<td>89.2</td>
<td>90.6</td>
</tr>
<tr>
<td>IV</td>
<td>88.2</td>
<td>81.2</td>
</tr>
</tbody>
</table>

*Including only visits with new-onset diagnosis.
†$P < 0.05$.
‡Percentage of all patients in each group (unless otherwise specified): commercially insured 102 of 181 and Medicaid 32 of 86.

### TABLE 6. Multivariate Revisit Rate Ratios Per Person-Year of Follow-up Time for New-Onset Diabetes*

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Rate Ratio (95% CI)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicaid (compared with commercial insurance)</td>
<td>2.52 (1.26–5.03)</td>
<td>0.009</td>
</tr>
<tr>
<td>Aged 6–12 y (compared with aged 0–5 y)</td>
<td>0.31 (0.11–0.85)</td>
<td>0.02</td>
</tr>
<tr>
<td>Aged 13–17 y (compared with aged 0–5 y)</td>
<td>1.37 (0.65–2.88)</td>
<td>0.41</td>
</tr>
<tr>
<td>Male (compared with female)</td>
<td>0.16 (0.07–0.38)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* $P < 0.05$.

CI indicates confidence interval.
DKA tend to have a higher rate of depression.\textsuperscript{31,33} It is also possible that the increased frequency of visits by girls may partly be related to the more frequent occurrence of hypoglycemia in women. Diabetic women of all ages appear to have higher ED visits rates related to hypoglycemia.\textsuperscript{32} Similarly, increased ED visits by women related to hypoglycemia may have physiologic explanations such as changes in sensitivity to insulin during menstruation.\textsuperscript{33} Ovarian autoantibodies may be linked to menstrual irregularities in girls with diabetes, and menstrual cycle irregularities may be associated with poor diabetic control.\textsuperscript{34–36} Additional studies will be required to sort these questions out more fully.

Per-capita income, triage category, and type of primary care practice were not associated with revisit rate when we adjusted for age, sex, and insurance types. A previous Canadian study suggested that children from lower socioeconomic areas had a higher rate of ED visits.\textsuperscript{37} The lack of statistical significance in the association of per-capita income with revisit rate in our study may be the result of the comparative insensitivity of using census information to derive per-capita income, as we used the census data instead of the actual income of the individual patient's family. It is also possible that the lack of statistical significance in our study may be related to the small sample size.

It is notable that the distribution of type of insurance coverage in our overall ED population (equal distribution between commercially insured and Medicaid-insured) was similar to that of the population living in proximity to HCH, whereas the insurance coverage distribution in our study population (a higher proportion of commercially insured) was similar to the overall pediatric population of Rhode Island and Southeastern Massachusetts (ie, the catchment area of our ED for subspecialty complaints). To explore this observation, we examined the distribution of cities of residency and determined the proportion of patients with commercial insurance and Medicaid for our study sample and for the overall HCH ED patient population. The proportion of commercially insured children (60.8\%) in this study was similar to that of all Rhode Island children (62.0\% in 2003).\textsuperscript{29} Also, similar to the proportion of Medicaid-insured children in our study (39.2\%), approximately a third of Rhode Island children were insured by Medicaid\textsuperscript{28} (in 2002). Thus, our diabetic sample appears to be more representative, from a health insurance perspective, of the entire state, whereas our ED population appears to be more local. This could be explained by proximity, because a higher proportion of children in Providence (the site of the HCH ED and the most populous city in Rhode Island) were insured by Medicaid (in 2003).\textsuperscript{29} In fact, Medicaid-insured children in the overall HCH ED population originated from a much less broad geographic distribution (23 localities) compared with the commercially insured children (32 localities). It may be that children with chronic diseases use the hospital where they receive care for their chronic disease for all of their medical care, whereas children without chronic diseases use the hospital or other medical facility closest to their homes.

It is important to note that the findings of this study may not apply to some states whose rate of uninsured children is much higher (the rate in our ED was <4\% at the time of the study) because we have eliminated uninsured patients from the analysis.

CONCLUSIONS

Several differences exist in the ED presentation and care of children with diabetes based on type of medical insurance. Among those is a higher rate of ED revisits by Medicaid-insured diabetic children older than 6 years. In addition, overall, girls were more likely to have more frequent revisits. Further work is needed to identify explanations for these differences and to determine whether they represent disparities in care.

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