

Pediatric Diabetes Outpatient Center at Rhode Island Hospital: The impact of changing initial diabetes education from inpatient to outpatient

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ABSTRACT

BACKGROUND: This study compared outcomes and costs for new-onset Type 1 diabetes mellitus (T1DM) patients educated at the outpatient versus inpatient settings.

METHODS/DESIGN: Retrospective study examining the following variables: 1) hemoglobin A1c (HbA1c), 2) severe hypoglycemia, 3) admissions for diabetic ketoacidosis (DKA) or ER visits, and 4) healthcare cost.

RESULTS: 152 patients with new-onset T1DM from September 2007-August 2009. There were no differences between outpatient group (OG) and inpatient group (IG) in mean HbA1c levels at 1, 2 and 3 years post-diagnosis (OG 8%, 8.5%, 9.3%; IG 8.3%, 8.9%, 9%, $p=0.51$). Episodes of severe hypoglycemia, DKA, and ER visits were not different between the two groups. Mean total hospital costs for OG and pure OG were significantly less than IG (OG: \$2886 vs. IG: \$4925, $p<0.001$), (pure OG: \$1044 vs. IG: \$4925, $p<0.0001$).

CONCLUSION: Our study demonstrates that outpatient-based pediatric diabetes education lowers healthcare cost without compromising medical outcomes.

KEYWORDS: diabetes education, inpatient, outpatient, HbA1c

INTRODUCTION

Type 1 diabetes mellitus (T1DM) is the third most prevalent severe chronic disease of childhood in the United States.¹ Children with new-onset T1DM are traditionally hospitalized at diagnosis for patient education.^{5,6} The advantages of hospitalization include constant supervision with meal preparation, insulin administration and blood glucose monitoring.^{5,6} However, hospitalization may be traumatic for the child,⁷ costly to the healthcare system, and may trigger negative parental outcomes including increased work absenteeism, feeling of constantly being monitored and inability to care for other children.⁶

An alternative to hospitalization is outpatient education. Outpatient education enhances a family's adjustment to diabetes and improves skills in self-management.¹⁰ It has gained popularity due to its potential to reduce healthcare costs and psychosocial stress to the family.⁶

Several studies have examined the differences between inpatient and outpatient management of T1DM.^{5-7, 8-10, 12} Chase et al. noted that long-term glycemic control, as measured by HbA1c values, was not different in the two groups ($p>0.05$).⁶ Siminerio et al. did not find statistically significant differences in rates of hospital readmissions or emergency room visits for severe hypoglycemia or ketoacidosis, sharing of responsibilities or family functioning.⁵ A recent study by Tonyushkina et al. did not show any significant difference in HbA1c at 1 year and 2 years post-diagnosis ($p=0.85$ and $p=0.69$, respectively).²

Three studies compared cost-effectiveness of inpatient and outpatient care.^{3,8,12} Spaulding and Spaulding showed that the cost per patient of initiating insulin treatment in hospital was nine times the cost in a day-care program.⁸ Dougherty et al. found that increased costs of health care services with home care were largely offset by parental cost savings.¹² A study by Jasinski et al. showed that total charges per child for hospital care were 4.7 times higher among children in the inpatient group than in the outpatient group ($p<0.001$).³

In a review article comparing inpatient and outpatient management, there were no significant differences in psychosocial/behavioral variables or rates of acute diabetes complications within two years between groups.⁹ However, there are insufficient data to conclude that outpatient diabetes education is as good as, or better than, inpatient diabetes education.⁹

At Rhode Island Hospital/Hasbro Children's Hospital (RIH/HCH), an outpatient diabetes program was added for new-onset T1DM patients who are clinically stable, i.e. not in DKA (venous pH<7.3, serum $\text{HCO}_3^- < 15$ mg/L, glucose>250 mg/dL). Prior to September 2007, all children with new-onset T1DM were admitted for 3-5 days at Hasbro Children's Hospital at time of diagnosis. Families were educated on the following: 1) basic pathophysiology of DM, 2) types and action of insulin, 3) insulin administration, 4) self-monitoring of blood glucose, 5) carbohydrate counting, 6) hypoglycemia management and 7) sick-day management. They met with the certified diabetes educators and dietitian. After discharge, the diabetes team called the family for blood glucose review and insulin dose adjustments daily or every other day until their initial follow-up appointment four weeks after diagnosis.

In September 2007, we established the Pediatric Diabetes Outpatient Center of Rhode Island Hospital (PDOC), a multidisciplinary team consisting of diabetes educators, a pediatric endocrinologist, dietitian and social worker. Within 24

hours of diagnosis, families come to the PDOC for three days with each session lasting four hours/day. Similar to families educated inpatient, the diabetes team calls the families daily until follow-up four weeks after initial diabetes education.

In both inpatient and outpatient settings, families are given the Understanding Diabetes Handbook by Barbara Davis Center for Childhood Diabetes and the Calorie King book. A pediatric endocrinologist and pediatric endocrinology fellow are available 24 hours a day for diabetes-related concerns or emergencies (hyperglycemia, ketonuria and hypoglycemia). The starting insulin dose is 0.5-1 units/kg/day divided in 2-4 daily injections depending on age and type of insulin regimen. At RIH/HCH, patients at both the outpatient and inpatient centers have the same nurse-educators for the entire diabetes education period. Only the dietitian was different between the two groups. Both inpatient and outpatient dietitians, however, follow the same American Diabetes Association (ADA) guidelines for diabetes education.

The purpose of this study was to compare the effects of inpatient and outpatient initial diabetes education at RIH/HCH in clinically stable patients with new-onset T1DM. We hypothesized that there would be no significant differences in HbA1c in the first 3 years after diagnosis, frequency of severe hypoglycemia, admissions for DKA or ER visits but that outpatient education would cost significantly less.

METHODS

A retrospective chart review compared the outcomes of patients diagnosed with new onset T1DM prior to and after establishment of the PDOC in terms of: 1) HbA1c in the first 3 years after diagnosis, 2) frequency of severe hypoglycemia, 3) admissions for DKA or ER visits, and 4) diabetes education healthcare cost.

Patients with new-onset T1DM diagnosed from September 2007-August 2009 were identified by review of hospital medical records and the Pediatric Diabetes Database of the Division of Pediatric Endocrinology at RIH. Inclusion criteria for the study were: age ≥ 3 years and mild DM at presentation (venous pH > 7.3 , with trace or negative urine ketones). Exclusion criteria included: children < 3 years of age, profound developmental delay, DKA, hyperglycemia with moderate or large ketonuria, illness requiring hospitalization and significant psychosocial issues that would interfere with outpatient education (lack of transportation, severe anxiety disorder or mental health issues in the patient, parent or guardian). Patients were divided into those who received all of their education in the outpatient center (pure OG) and those who were admitted for 1 day to clear urine ketones and received most of their education in the PDOC (OG).

These patients were matched by age, sex and metabolic status to new onset T1DM patients who were admitted as inpatients from September 2004 until August 2007 (IG, historical control).

Primary clinical outcome was assessed by quarterly

measurements of glycosylated HbA1c. In inpatient setting, HbA1c was measured using the Tosoh Automated Glycohemoglobin Analyzer HLC-723G8 which uses non-porous ion-exchange high performance liquid chromatography (Tosoh Bioscience, Inc., South San Francisco, CA, USA). HbA1c values were measured quarterly in the outpatient setting using Siemens/ Bayer DCA 2000+ Analyzer (WS-DCA2000+, Bayer, Inc., Tarrytown, NY, USA). A mean HbA1c value was calculated for each subject per year of follow-up.

All inpatient and outpatient records for pediatric patients with diabetes mellitus seen by the Division of Pediatric Endocrinology at Rhode Island Hospital between September 2004 and December 2010 were reviewed. For inpatient data/ER visits, records having the ICD (International Classification of Diseases) code 250.xx (Diabetes Mellitus) were included. Admissions not related primarily to diabetes mellitus were excluded (surgical procedures, non-DM related hospitalizations, cystic fibrosis).

To obtain an estimate of the cost-effectiveness of the Outpatient Diabetes Education Center, total hospital charges for the initial admission (excluding physician fees) were averaged for patients in the IG and compared to the average of visit charges for the outpatient group.

Statistical Analysis

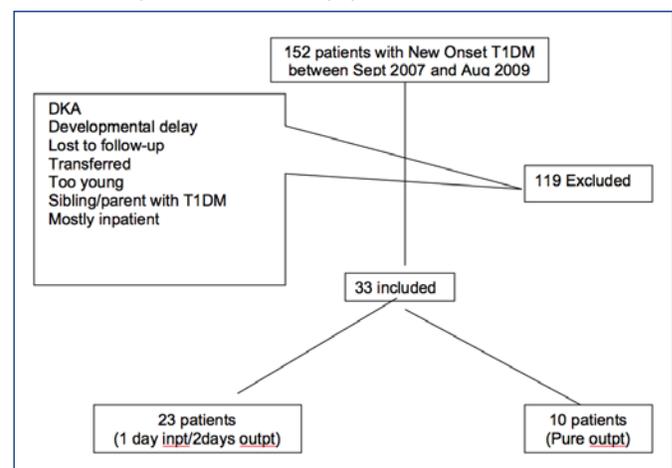
Student t-test analyses were used to test between-group differences. Wilcoxon-signed rank test and univariate analyses were used to compare hospital charges. Analyses were performed with STATA software, version 11.1.

RESULTS

Study participants

There were 152 patients with new-onset T1DM identified between September 2007 and August 2009. Thirty-three patients met our inclusion criteria for outpatient education (OG) and 119 patients were excluded (**Figure 1**). Ten patients

Figure 1. Sample size and analysis population



of the 33 had all of their education in the PDOC. Twenty-three patients had 1 day of inpatient stay to clear ketonuria but had most of their education in the PDOC. This OG group (n=33) was matched to 33 patients from the IG cohort, who received all of their education in the hospital.

Clinical and metabolic characteristics at diagnosis

The baseline clinical characteristics of the two groups showed no significant differences in age, sex, weight, height and BMI (Table 1). There were no significant differences in pH, bicarbonate, glucose and sodium levels between OG and IG (Table 2).

Metabolic outcome

There were no differences in average glycemic control (mean yearly HbA1c) 3 years post-diagnosis between OG and IG (Figure 2). Mean HbA1c were 8.03% (OG) vs. 8.3% (IG), 8.5% (OG) vs. 8.9% (IG), and 9.3% (OG) vs. 9.0% (IG) at 1, 2, 3 years, respectively.

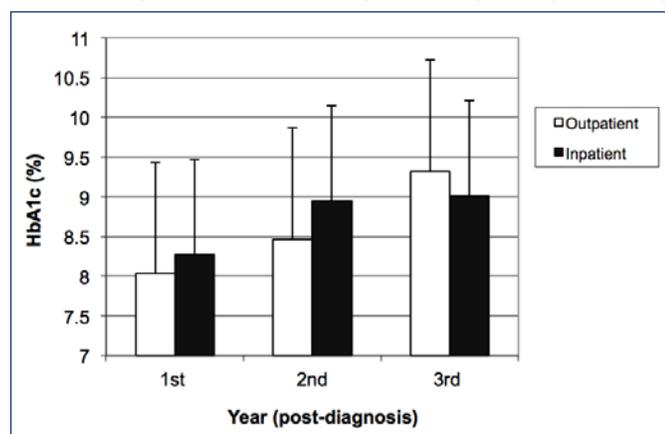
Table 1. Baseline clinical characteristics of sample population

	Outpatient	Inpatient	p-value
# of cases	33	33	
Age in years (\pm SD)	10.6 \pm 2.8	10.4 \pm 2.9	0.163
Sex (M/F)	14/19	15/18	0.062
Weight (kg)	41.6 \pm 6.8	52.9 \pm 8.9	0.16
Height (cm)	149.05 \pm 2.8	152.8 \pm 16	0.51
BMI (kg/m ²)	18.8 \pm 3.7	22.7 \pm 1.1	0.08

Table 2. Baseline metabolic characteristics of sample population.

	Outpatient	Inpatient	p-value
pH	7.4 + 0.05	7.39 + 0.03	0.49
Bicarbonate (meq/L)	23.5 + 4.9	23.7 + 3.3	0.89
Glucose (mg/dl)	458 + 142	454 + 149	0.93
Sodium (meq/L)	134 + 3.4	133 + 3.2	0.16

Figure 2. Comparison of HbA1c of Outpatient group and Inpatient group



Acute DM complications

Over the three-year period, only 1 (3%) out of 33 patients from OG had an episode of severe hypoglycemia presenting as a seizure and 1 (3%) out of 33 patients from IG was readmitted for DKA.

Hospital charges

Mean total hospital cost for OG was significantly less than IG (OG: \$2886 vs. IG: \$4925, $p < 0.001$); this difference was more pronounced when pure OG was compared to IG (pure OG: \$1044 vs. IG: \$4925, $p < 0.0001$).

DISCUSSION

This retrospective study shows that outpatient management of new onset T1DM is a safe and cost-effective alternative to inpatient management. We found that outpatient and inpatient management resulted in the same rates of metabolic outcomes and DM complications for up to three years post-diagnosis. Additionally, the mean hospital cost for pure outpatient management was \$3,881 less than the mean hospital cost for inpatient management.

A study by Jasinski et al. at Baystate Children's Hospital reported no difference in HbA1c between inpatient and outpatient groups one year from onset.³ They also found total costs at one year to be significantly less in the outpatient group than in the inpatient group. Our study expands upon their results by showing that rates of DKA and hypoglycemia are also not significantly different between the two groups. We also found that these rates remain similar up to three years post-diagnosis, showing that inpatient and outpatient management do not have significant differences in long-term metabolic outcomes.

A review by Clar et al. identified other studies comparing metabolic outcomes between inpatient and outpatient groups of new-onset T1DM patients, although there are few published studies on this topic.⁹ Chase et al. reported no significant differences in HbA1c or diabetes-related hospitalizations between the outpatient and inpatient groups after six years of follow-up.⁶ They did not include a cost analysis of the two groups. Siminerio et al. found no differences in metabolic outcomes, hospital readmissions, or overall family functioning between the two groups, but only after a five-week follow-up period.⁵ They recommended that a future study should compare long-term metabolic outcomes of the two groups. Our study showed that these same results can persist up to three years while also reducing healthcare costs.

Our results may not be applicable to all healthcare centers. Outpatient education may not be feasible in centers with insufficient outpatient diabetes staffing. Some patients may require inpatient education if they live too far from the hospital to travel there often. Additionally, due to the nature of a retrospective study, some data may be inadvertently biased or missing from the results. Any care that patients may have received outside of Rhode Island Hospital, such

as ER visits for hypoglycemia or DKA, was not included in the study. Some of the blood sugar measurements may have been missing or subjectively identified at some point over the three-year period. A follow-up study to confirm our results should use a prospective design.

CONCLUSION

Outpatient medical management and education appears to be a safe and effective alternative to hospitalization of newly diagnosed children with mild T1DM and no complicating features. As healthcare systems find more cost-effective ways of delivering care, this will justify the need for third-party payers to increase reimbursement for outpatient diabetes education.

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Disclosures

None

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