

Using Mobile Technology to Enhance Pediatric Diabetes Care Management

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Abstract—Pediatric diabetes is an increasingly prevalent public health problem, especially among low-income and minority populations. In an effort to address disparities in care management among inner-city adolescents with diabetes, the Visiting Nurse Service of New York developed a two-year intervention program that combines structured education and lifestyle visits by a diabetes educator with a mobile technology application. This paper provides an overview of the program and describes the design of an evaluation study to assess outcomes among clients who complete the program. The evaluation study employs data collected through the mobile technology devices and a clinical website portal where the diabetes educator records demographic information, clinical characteristics, and service utilization.

Keywords—mobile technology; home health care; pediatric diabetes; evaluation

I. INTRODUCTION

An increasing number of children are diagnosed with diabetes each year [1]. This trend is especially notable in low-income and

minority populations, among whom hospitalization rates for adverse diabetic events are very high [2]. In an effort to address disparities in effective diabetes self-management, the Visiting Nurse Service of New York (VNSNY), the largest not-for-profit home health care agency in the United States, developed a home-based care management program for inner-city adolescents with diabetes. The program focuses on behavior modification and is facilitated by trained clinicians educated in diabetes care management. The program is enhanced by a mobile technology application and clinical website developed to provide feedback to patients and clinicians. This paper provides an overview of the program and information about the mobile technology application, and presents preliminary data from an evaluation designed to monitor program activities and assess outcomes among patients who complete the two-year program.

II. PROGRAM OVERVIEW

The Diabetes Care Management (DCM) program targets inner city adolescents with

uncontrolled diabetes for a comprehensive intervention. On a pilot basis, approximately 50 patients will be recruited from two local health care providers that specialize in treating pediatric diabetes. The program enrolls adolescents 11-17 years old who are residents of the Bronx or Upper Manhattan and have Type 1 diabetes with an HbA1c level greater than 8.0% in the past six months. Patients are ineligible if they do not speak English or Spanish, are pregnant, show signs of or are being treated for substance abuse, are under mental health care for psychosis or schizophrenia, or live in an unsafe home environment.

Patients enrolled in the DCM program receive home visits provided by a Certified Diabetes Educator (CDE). The CDE assesses patients' clinical stability and acuity (e.g., blood glucose), describes the program to patients and attains their informed consent, conducts clinical and environmental assessments, and provides structured education to patients about their diabetes. The CDE or Care Manager (a social worker trained in behavioral management) also visits patients to counsel them and their family on making sustainable lifestyle changes. These visits are made to patients in their homes 12 times during the first year, and are followed by 12 phone calls over the course of the second year.

III. USING MOBILE TECHNOLOGY TO ENHANCE PEDIATRIC DIABETES CARE

The DCM program utilizes a cell phone-based diabetes management software system and a web-based clinical portal. These tools, designed by WellDocTM Communications [3], provide an interactive platform for patients and providers to receive real-time diabetes management information. During the DCM program development phase, this mobile application was customized for a pediatric population.

Patients enrolled in the program receive a Blackberry cell-phone equipped with the WellDocTM diabetes software. The phone includes a plan with phone services and

unlimited text messaging. Patients receive individual instruction on how to use the phone and features of the application.

IV. PROGRAM EVALUATION AIMS

An evaluation is underway to understand challenges to implementing program elements and to provide an initial assessment of the impact of the program on clinical and behavioral outcomes. The evaluation has two primary aims. The first aim includes monitoring the process of providing care and instruction to patients who enroll in the program and summarizing the performance of key program activities and outputs (e.g., the number of visits and phone calls to patients among each type of care provider, program attrition, usage of the mobile technology application, achievement of targeted program objectives). The second aim involves assessing the impact of program participation on clinical and behavioral outcomes (e.g. A1c, diabetes knowledge and self-care activities).

V. DATA AND MEASURES

Data collected from the mobile diabetes application is stored in a central database maintained by WellDocTM. The database also includes demographic, behavioral, and clinical information entered into the web-based clinician portal. The complete database is then transmitted to VNSNY in a secure format on a monthly basis and transformed on-site for statistical analysis.

Demographic measures that are collected at baseline include age, sex, race/ethnicity, language, and level of education. Clinical measures that are collected at baseline and at three month intervals include A1c, hospitalizations and emergency visits, and hypoglycemic and hyperglycemic events. Behavioral measures collected at baseline and at six-month intervals include patient self-care practices, willingness to change [4], diabetes knowledge [5], quality of life [6], and depression [7].

VI. PATIENT DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

The program has enrolled approximately 30 patients between February and September 2010. The demographic and clinical characteristics of patients who are currently enrolled in the program are presented in Table 1. The average baseline A1c of patients currently enrolled in the program is 11.6, which is substantially higher than the target recommended by the American Diabetes Association ($A1c < 7.0\%$) [8].

TABLE I. DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

<i>Variable</i>	<i>Mean/Percent</i>
<i>Sex</i>	
Male	45.1
Female	54.8
<i>Age (SD)</i>	14.1 (2.0)
$11 \leq \text{Age} < 13$	26.6
$13 \leq \text{Age} < 15$	23.3
$15 \leq \text{Age} \leq 17$	50.0
<i>Race/Ethnicity</i>	
Hispanic	82.7
African American	13.7
Other	3.4
<i>Geographic Area</i>	
Bronx	74.1
Manhattan	22.5
Yonkers	3.2
<i>Baseline A1c Level (SD)</i>	11.6 (1.9)

Table 2 presents results from preliminary analyses of data collected from the mobile phone application. On average, patients have submitted 2.9 blood glucose entries per week and 1.2 carbohydrate entries per week since they began using the mobile application.

TABLE II. UTILIZATION OF MOBILE APPLICATION

<i>Variable</i>	<i>Mean (SD)</i>
<i>Average Number Entries Per Week</i>	
Blood Glucose	2.9 (4.5)
Carbohydrates	1.2 (3.1)

VII. SUMMARY

The DCM program aims to improve self-care management among inner city adolescents with diabetes through a combination of mobile technology and structured clinical education and support. The use of the WellDocTM application and clinical website portal has enabled VNSNY to gather a broad range of data on patients for program evaluation purposes. When completed, the evaluation will produce useful information for program stakeholders and provide an initial assessment of the program's clinical effectiveness. An analysis of the evaluation data will also indicate whether the mobile application is a popular mechanism for sending and receiving diabetes-related information and feedback to a pediatric population.

REFERENCES

- [1] SEARCH for Diabetes in Youth Study Group. The burden of diabetes mellitus among US youth: prevalence estimates from the SEARCH for Diabetes in Youth Study. *Pediatrics* 2006;118:1510-8.
- [2] Strategies for reducing morbidity and mortality from diabetes through health-care system interventions and diabetes self-management education in community settings. A report on recommendations of the Task Force on Community Preventive Services. *MMWR Recomm Rep* 2001;50:1-15.
- [3] Quinn C.C., Clough S.S., Minor J.M., Lender, D., Okafor, M.C., and Gruber-Baldini, A. WellDocTM Mobile diabetes management randomized controlled trial: Change in clinical and behavioral outcomes and patient and physician satisfaction. *Diabetes Technology & Therapeutics* 2008; 10:160-168.
- [4] Peterson K.A. and Hughes M. Readiness to change and clinical success in a diabetes educational program. *J Am Board Fam Pract* 2002;15:266-71.
- [5] Dunn S.M., Bryson J.M., Hoskins P.L., Alford, J.B., Handelsman D.J., and Turtle J.R. Development of the

diabetes knowledge (DKN) scales: forms DKNA, DKNB, and DKNC. *Diabetes Care* 1984;7:36-41.

- [6] Ingersoll G.M. and Marrero D.G.. A modified quality-of-life measure for youths: psychometric properties. *Diabetes Educ* 1991;17:114-8.
- [7] Kroenke K., Spitzer R.L., and Williams, J.B.. The PHQ-9: Validity of a brief depression severity measure. *J Gen Intern Med* 2001; 16:606-613.
- [8] American Diabetes Association. Standards of medical care in diabetes—2010. *Diabetes Care* 2010; 33:S11-S61.