CLINICAL PRACTICE

The effectiveness of diabetes education in rural clinical practice

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ABSTRACT

Objective: Type 2 Diabetes affects approximately 10% of the population in the United States. Diabetes is associated with acute and long-term complications are more severe. Studies are providing a correlation between better self-care actions and a reduction of undesired diabetes outcomes. The purpose of this study was to evaluate the implementation of a diabetes self-management education (DSME) program on glycemic control that was expected to improve staff knowledge and diabetes outcomes.
Methods: This study conducted a quality improvement design. Providers and nursing staff in three primary care clinics were recruited. Diabetes Knowledge Test (DKT) and HbA1c were measured pre and post intervention.
Results: Data from 15 staff participants were analyzed. The mean score for the pre-test was 81% while the mean score for the post-test was 87%. A paired t-test revealed $t = 1.533$, df = 3.998 and $p = .160$. The HbA1c percentage mean over 6 months decreased by 0.02% and subsequently in 3 months by 0.17%. The Friedman rank sum test was used to compare the differences, $\chi^2(2) = 14.79$, $p < .001$. Post-hoc analysis identified a statistical significance in the HbA1c from implementation to post implementation.
Conclusions: There was an increase in the percent score in the provider and nursing staff knowledge after implementation of the DSME program. A decrease in percent change of the HbA1c was identified over the three- month implementation period. This study demonstrated that the implementation of a DSME program may contribute to improved glycemic control.

Key Words: Type 2 Diabetes, Self-care management, Diabetes education

1. INTRODUCTION

Diabetes mellitus is the most commonly diagnosed endocrine disease.[1] Type 2 Diabetes is characterized by insulin resistance and/or relative insulin deficiency.[2] The International Diabetes Federation reported in 2015, globally, there were 415 million adults with a diagnosis of Type 2 Diabetes and that number is expected to grow to 640 million by 2040. People who have knowledge regarding the disease and adequate self-care are expected to have better glycemic control and a decreased risk for complications.[1]

Diabetes is a chronic condition whose prevalence is increas-

ing worldwide. In North America alone, occurrence of this condition has "reached 10.2%, and is estimated to reach 12.1% by 2030".[3] In the year 2013, diabetes caused 5.1 million deaths.[4] Type 2 Diabetes is a complex condition requiring continuous patient involvement and management by a healthcare professional team in clinical settings. Treatment for this condition has been centered on medication management to control blood glucose levels and minimize risks. However, in recent studies, optimization of glycemic control and prevention of long-term complications have been driven by self-care actions. Self-care has been defined as "conscious,

educated, and targeted measures performed by individuals in order to live and supply, maintain, and improve their and their families' health".[1] The purpose of self-care management is to prevent acute and chronic complications such as, visual impairment and, physical limitations.[5] Self-care management differs from the usual treatment as it allows patients to have the knowledge regarding their condition and emphasizes their role in disease management and treatment.[1]

In Louisiana, approximately 11.8 percent of the adult population has diabetes, and has been identified as the seventh leading cause of death amongst those living in Louisiana.[6] The purpose of this study was to increase self-management of care in persons with Type 2 Diabetes in rural Louisiana. The aim was to improve staff knowledge of Type 2 Diabetes disease management and patient's glycated hemoglobin (HbA1C) test values by implementing Diabetes Self-Management Education (DSME). Upon completion of this program, the staff implemented the DSME program within the community health clinics using the resource materials according to an established protocol. This project investigated the feasibility of implementing a DSME program to increase staff knowledge while promoting self-care management in improving patients' diabetes metabolic control.

2. METHODS

2.1 Study design

The study design used for this project was a quality improvement program to analyze practice performance with an emphasis on improvement of patient metabolic outcomes.[7] This study was in alignment with a quality improvement program since its purpose was to increase self-management of care in patients with Type 2 Diabetes to improve HbA1c test values.[8]

2.2 Setting

The study was conducted at community health clinics in rural Louisiana with high prevalence of diabetes. Overtime, the clinics developed and expanded to provide affordable and convenient care to the people of these communities with primary health care services.

2.3 Sample

A convenience sampling method was utilized to identify employed staff in the clinics. The sample size of 22 participants consisted of providers, nursing staff and the diabetes educator. Those employees 18 years or older were given the opportunity to participate in the study, which was voluntary. The staff education was conducted in a group setting.

The second group of participants included a convenience sample of 233 patients. Inclusion criteria for patient outcome data were age 18 years or older, newly diagnosed and established persons with Type 2 Diabetes within the clinics from visit dates February 2017 to November 2017 as requested by the facilities. Exclusion criteria included those persons diagnosed with Type 1or Type 2 Diabetes with a comorbidity of congestive heart failure stage IV, end stage renal disease, and/or terminally ill. All persons in both sample groups were English speaking.

2.4 Procedures

Recruitment considered all staff members of the Community Health Center clinics who were providers, nursing staff and diabetes educators. Flyers as well as word of mouth were used to recruit staff participation. The staff education dates were derived from staff feedback based on the most efficient day and time for each facility. Once a date was established, it was communicated to the staff members who volunteered to participate.

The clinics received the same educational material even though it was presented on different days. Staff education was a 60-minute program. The agenda included an introduction about the project, completion of informed consent, the demographic survey, and the Diabetes Knowledge Test (DKT). Subsequently, the DSME program was discussed and adopted as a new protocol implemented for diabetes education for staff and persons with diabetes.

In order to improve self-management care, a DSME program was introduced consisting of core information to be reviewed by the providers and nursing staff in the primary care clinics. The DSME program was supported by the American Diabetes Association, which is where the resource material was extracted. The DSME program addressed the disease process, nutrition, physical activity, self-monitoring, medication adherence, foot care, complications, follow-up needs, and motivational interviewing techniques. The education was provided in lecture form while using available educational tools such as the Living Well with Diabetes booklet[8] as a guide to address all desired topics. The initiation of the DSME protocol for new and/or established patients with a diagnosis of Type 2 Diabetes was documented in the electronic health record (EHR) and supported by the staff. The staff was audited regarding adherence to the DSME protocol twice a week for one month, weekly for one month and every other week for one month. A checklist was used to make sure providers and nursing staff were utilizing the information provided during the DSME program.

2.5 Ethical considerations

The institutional review board (IRB) approved the study and participant recruitment. Informed consent was received from all participants after an explanation of the study. Participants were given a code number that was linked to their surveys. The code did not consist of no identifiers. The participant list was secured in a locked file cabinet and destroyed after data analysis was completed.

2.6 Instrumentations

The outcomes measured were staff knowledge of diabetes by utilization of the Diabetes Knowledge Test (DKT) and the patients' HbA1c percentages. Staff demographics were collected to include age, gender, ethnicity, education, employment status, job position, years in healthcare, years in the network, years in community, and personal experience with diabetes.

The DKT was reviewed to ensure current diabetes self-management education standards. Current practices were consistent with what was being presented in the survey.[9] The DKT consisted of 23 questions, which referred to diabetes knowledge and health behaviors in certain situations. The questions were related to food choices, laboratory testing, effects of diabetes, symptoms, risk factors, insulin use and general diabetes. Each question was multiple-choice with one correct answer. The reading level of this knowledge test was on a fourth grade reading level.

The Cronbach's coefficient alpha was .77 with supported reliability and validity.[9]

Each clinic had an individual lab contracted to collect blood specimen as the providers' ordered. HbA1c aggregate lab values were retrieved from the electronic health records. These measurements were evaluated 6 months prior to implementation, at initiation of the program and three months post intervention for analyzing the data. This data measurement revealed how controlled the patient's blood glucoses pre and post interventions. Storage for this data required a password to be accessed. The facilitator was the only person with access to this computer and information. At the completion of the study, all data information was destroyed.

2.7 Data analysis

The data from the demographic survey were analyzed using descriptive statistical methods supported by two statistical computer programs. Microsoft Excel was utilized to input data. The statistical results were calculated using Statistical Package for Social Sciences (SPSS). The descriptive analysis included frequency and percentages for demographics and test scores. The test scores were reviewed pre- and post-intervention. The difference in the means pre- and post-test

were analyzed with the use of a paired sample t-test. If the assumptions of the paired t-test were not met, the nonparametric equivalent of Wilcoxon Signed Rank Test would be used. The patient's HbA1c test values were compared at six months pre-intervention, at implementation and three months post-intervention using a repeated measures ANOVA; however, if the assumptions for the repeated measures ANOVA were not met the nonparametric alternative of a Friedman Rank Sum Test would be utilized. The independent variable was the implementation of a diabetes self-management protocol. This protocol consisted of an diabetes educational program, completion of diabetes knowledge test, and review of HbA1c test values. The dependent variables were the providers, nursing staff's diabetes knowledge and the patients' HbA1c test values at three measurement intervals.

3. RESULTS

3.1 Quantitative findings

The following staff test results from the Diabetes Knowledge Test (DKT) displayed below reflect pre-intervention results versus post-intervention results. The first two columns identified the question number and a small description of the question. The table was divided by frequencies and percent correct pre-intervention and post-intervention answers. The pre-intervention score of 80% increased to 87% after three months (see Table 1).

3.2 *T*-test results

The Diabetic Knowledge Test provides a quick and low-cost method of assessing a patient's or a population's general knowledge of diabetes and diabetes self-care. There is no stated normal scoring system of the DKT. A paired t-test was conducted to determine if the mean of staff post-intervention DKT scores were significantly different from pre-intervention DKT scores. The assumptions for the paired t-test were met. In utilizing the DKT for pre and post interventions, the scores were compared for improvement in knowledge. The results of the paired t-test test were $t = -1.533$, df = 3.998, and $p = .160$. The results were not statistically significant.

3.3 Glycated hemoglobin HbA1c descriptive statistics

In regard to the HbA1c results, the study compared results from 6 months prior to intervention, at implementation, 3 months post, November 2017. Six months prior to implementation, there were 190 HbA1c results that were extracted for data collection. The most common HbA1c 6 months prior to intervention was 5.5% (n = 23, 10%). The minimum HbA1c was 4.6%; however, the maximum was 13.4%. The mean was 5.94%. At implementation, there were 233 HbA1c results that were acquired for data collection. The most fre-

quently observed HbA1c in August was 5.60% (n = 32, 14%). The minimum HbA1c was 4.9%; however, the maximum was 11.9%. The mean was 5.93%. Post implementation there were 189 HbA1c lab results that were obtained for data collection and the most frequently observed was 5.40% (n

= 26, 11%). The minimum HbA1c was 4.3%; however, the maximum was 13.1%. The mean was 5.76%. The HbA1c percentage mean from February to August decreased by 0.02 and from August to November by 0.17 (see Table 2).

Table 1. DKT staff results pre/post intervention

Question		Pre-Intervention		Post-Intervention	
#	Description	Frequency	Percent Correct	Frequency	Percent Correct
1	Diabetes diet	14	93.3%	14	93.3%
2	Item highest in carbohydrate	11	73.3%	13	86.7%
3	Item highest in fat	8	53.3%	7	46.7%
4	"free food"	11	73.3%	12	80%
5	A1c measurement	14	93.3%	14	93.3%
6	Method of home glucose testing	15	100%	14	93.3%
7	Effects of unsweetened juice	9	60%	10	66.7%
8	Treatment for low blood glucose	10	66.7%	11	73.3%
9	Effect of exercise on blood glucose	13	86.7%	13	86.7%
10	Effect of infection on blood glucose	13	86.7%	13	86.7%
11	Foot care	13	86.7%	15	100%
12	Low-fat diet	14	93.3%	15	100%
13	Numbness and tingling symptoms	14	93.3%	15	100%
14	Not associated with diabetes	15	100%	15	100%
15	Signs of ketoacidosis	6	40%	11	73.3%
16	Effects of sickness	11	73.3%	12	80%
17	Rapid-acting insulin	13	86.7%	14	93.3%
18	Meal-time insulin use	9	60%	12	80%
19	Action to take with low glucose	14	93.3%	15	100%
20	Reason for low glucose	14	93.3%	15	100%
21	Morning insulin	12	80%	14	93.3%
22	Cause of high blood glucose	13	86.7%	14	93.3%
23	Cause of low blood glucose	12	80%	13	86.7%
Total score			81%		87%

Table 2. Glycated hemoglobin (HbA1c) results

	February	August	November
n	190	233	189
Mean	5.94%	5.93%	5.76%
Min	4.6%	4.9%	4.3%
Max	13.4%	11.9%	13.1%

The nursing staff and providers results revealed improvement in knowledge after DSME program implementation; however, the analyses were not statistically significant. The staff sample size was small. A decrease in the average patient HbA1c percentages from implementation to three months post implementation was statistically significant.

4. DISCUSSION

The findings of this study shine light on the current standards of practice for persons with Type 2 Diabetes. Practice could be improved by having the entire staff become engaged in promoting patient diabetes management rather than one educator. Advanced practice nurse's engagement in this study helped the nursing staff to become aware of the patients' needs. The staff was able to examine over a short period of time how patients' results could improve by implementing an evidence-based program. Utilizing a DSME program to review core information with all staff members allowed for a more standard process to educate patients regarding diabetes self-management.

Persons with diabetes are encouraged to comply with deci-

sions made in conjunction with their health care providers as well as self-management of the condition.[10] Providers in these clinics were responsible to closely follow these patients and motivate them to self-manage their chronic condition. As a new standardized protocol for providers, patients were more likely to have uniformed instructions resulting in better understanding of their diabetes self care management and glycemic control.

There were improvements that could be made in the study to enhance outcomes. The design of the study was appropriate; however, a longitudinal study could potentially better demonstrate the program impact. The time of the study was limited to a three-month period, in comparison to other studies that were conducted over one to three years.[11, 12] Perhaps it would be better to also measure patient knowledge using the Diabetes Knowledge Test (DKT). A measure of patient self-management behaviors would be beneficial in conjunction with HbA1c values. A recommendation to ensure a larger sample size would have been to include clinics. As each clinic has one physician, one nurse practitioner and an abundance of medical assistants, the test scores were more of a reflection of the nursing staff (MAs) instead of the providers.

In order to sustain the project, new hires will be exposed to the diabetic self-management education (DSME) program during their facility orientation. A diabetes management competency for the staff will be included in annual training. In the electronic medical record, the information will be embedded to make sure all topics have been discussed. Providers and nursing staff were not expected to discuss all of the core information in one visit; however, there should be a time frame established based on the frequency of patient visits and glycemic control. Currently, these clinics have HEDIS measures to meet, which are marked with a check once completed. The information technology (IT) department can alter the electronic system to complete a check mark once all core information has been discussed.

This project can be used in the outpatient settings, as well as the inpatient arena. This study can impact diabetes care in all levels of healthcare. Evidence-based protocols can be developed for clinic settings to address the need for change and improve diabetes care. Although this quality improvement project contained a small sample of educators, it can be replicated in larger primary care clinics and endocrinol-ogy clinics. This quality improvement project focused on persons with Type 2 Diabetes; however, diabetes focused clinics may want to include persons with Type 1 Diabetes and Pre-diabetes.

As this research study was intense, it was with great hope that standardized diabetes education would be utilized throughout the network by all providers for new and established patients with diabetes. It is with hopes that the results of this project have integrated new protocols regarding persons with diabetes, their care, education, and overall management.

Limitations
There were two key limitations in this study: a small sample size and the duration of the study. The sample size for healthcare providers was limited. There were more medical assistants in ratio to nurses and health care providers. Medical assistants normally do not learn core information regarding diabetes self-management or patient education principles. Secondly, the study was conducted over a 3-month period in comparison to other studies. Both limitations reduce the generalizability of the findings in this study. The intent of this study was to improve staff knowledge of Type 2 Diabetes disease management and patient's HbA1C test values by implementing DSME. While the study had limitations, the ultimate goal of the study was achieved.

5. CONCLUSION
The nursing staff and providers who completed the Diabetes Knowledge Test (DKT) demonstrated an increase in knowledge regarding general diabetes information and medication management. The aggregated HbA1c data demonstrated clinical and statistical significance from implementation to three months post-intervention. This study had similar conclusions as previous research studies identified in the literature. A similar longitudinal design with a larger sample size has been recommended. Health care provider education serves as a foundation for maintaining and improving the health and well-being of persons with diabetes. This is a unique opportunity to learn, offer new perspectives, seek alternative strategies, share creativity, and work together to evolve optimal learning strategies in serving the diabetes population.

CONFLICTS OF INTEREST DISCLOSURE
The authors declare that there is no conflict of interest.

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