Clinical outcomes of a diabetes education program for patients with diabetes mellitus in the Micronesian community in Hawaii

Mok Thoong Chong

School of Pharmacy, American University of Health Sciences, Signal Hill, California, USA

ABSTRACT

Objective: Hawaii has diverse population made up of a cultural mix of different races. Due to different cultural and social influences and language barrier, many of the under-served population who migrated to Hawaii and having diabetes mellitus may be susceptible to long-term complications due to uncontrolled hyperglycemia and medication nonadherence. The purpose of this study was to evaluate the impact of a diabetes education program on the clinical outcomes in patients with diabetes mellitus in the Micronesian community of Hawaii.

Methods: This study included patients over age 18 years, with a diagnosis of type 2 diabetes mellitus. The diabetes education program was customized for its weekly classes to fit to the under-served population. Data were collected on participants on the 1st day and then 6 months after attending the education program. Data on primary and secondary endpoints were collected and analyzed.

Findings: The mean glycosylated hemoglobin A1c, fasting blood glucose, and triglyceride levels of participants fell significantly from baseline after attending the diabetes education program for 6 months. No significant changes were observed in other secondary outcomes during the study time period.

Conclusion: Based on our findings, the diabetes education program that was tailored to the Micronesian population was successful in achieving glycemic goals, enhancing medication adherence, improving clinical outcomes, and also preventing long-term complications among its participants.

Keywords: Clinical outcomes; diabetes education program; Micronesian; Ohana; type 2 diabetes

INTRODUCTION

An estimated 29.1 million Americans have diabetes mellitus, accounting for 9.3% of the United States population based on the 2014 National Diabetes Statistics Report.[1] In 2012, the total cost for treating diabetes in the United States was estimated of $245 billion,[1] where majority of it were spent on the treatment of long-term complication.[2] Poor glycemic control manifested in costly and lifelong morbidities, which could have been managed by healthy eating, regular physical activity, and treatment with medication lowering blood glucose levels.[3] Improving glycemic control in patients with type 2 diabetes mellitus can prevent or delay the onset, or slow the progression of microvascular and some macrovascular complications.[4-7] The American Diabetes Association (ADA) has stated that long-term
The maintenance of glycosylated hemoglobin (HbA1c) levels of ≤6.5% is an important indicator of blood glucose control and would not categorized as having high risk for diabetes. Hawaii is known as the melting pot of the Asia-Pacific region based on the diversity of its people. Under the Compact of Free Association Act with the United States, the Micronesian had access to many US programs and services including health care. In addition, many groups of people throughout the Asia-Pacific region have immigrated to Hawaii for more opportunities or a better life. When newcomers arrive to Hawaii, often times they are not assimilated to the American culture, eating habits to adopt a much healthier and different life style. Moreover, these people may not be accustomed to what known as “Western Medicine” as they are accustomed to the use of traditional medicine depending on individual culture, background, and belief.

Some Micronesian patients with diabetes mellitus living in Hawaii do not store their medications properly due to the lack of knowledge and education on medication use. Continuous medication nonadherence along with comorbid conditions makes many Micronesian patients susceptible to the long-term complications as a result of uncontrolled hyperglycemia. Unknowingly, many Micronesian patients associate these long-term complications with the clinical actions or side effects due to the “Western Medicine” treatment plan. These misconceptions influence many of them to opt out of treatment in fear that they will develop these long-term complications, thus creating another barrier for effective management of their diabetic condition. Couple with other barriers such as language, social influence, low-health literacy, high-sugar food intake, and different life style, the Micronesian population has higher prevalence of diabetes. In order to prevent further long-term complications, to improve medication adherence, and to optimize drug therapy in such patients, a tailored diabetes education program was launched. In a case report by Chong, it was demonstrated that such specially tailored type of diabetes education program could help to improve clinical outcomes in a Micronesian patient with uncontrolled hyperglycemia. The objective of this study was to evaluate the feasibility and the effectiveness of a diabetes education program on the clinical outcomes of Micronesian patients with diabetes mellitus.

**METHODS**

Hilo Bay Clinic, an only Federally Qualified Health Center in Hilo, provides primary care services to a large population in Hilo and surrounding areas, serving about 45,000 people. As the only safety-net health care provider in the area, Hilo Bay Clinic provides primary care, children and women services, preventive care, and dental services through the federally qualified 340B subsidized healthcare plan that reaches out to low-income people and also the uninsured. In 2006, Hilo Bay Clinic initiated a diabetes education program to meet the needs and demands of the Micronesian population in Hawaii to self-manage their disease condition. This modified diabetes education program is known as the “Ohana Diabetes Education Program” [Table 1]. The word “Ohana” in Hawaiian language means “family,” and thus promotes a very friendly and family-like environment to help educate and support the patients in understanding and managing their diabetes. In 2009, an ambulatory care pharmacist was added to the interprofessional team to provide medication therapy and monitoring patients’ clinical outcome.

Patients visited this clinic were enrolled in the diabetes education program from July 1, 2010 to January 1, 2012 over a 18 months period. Patients were considered eligible to participate in this program, if 18 years of age and above, had type 2 diabetes mellitus, or had multiple chronic conditions, or were on multiple medications, or were recently diagnosed with diabetes mellitus. Patients were excluded if found not willing to comply with medication adherence, not residing in Hawaii or considered difficult in keeping up with their regular clinic visit. A total of thirty individuals participated in this diabetes education program. The study was approved by the University of Hawaii Institutional Review Board. The diabetes education program was advertised throughout the local community and by word-of-mouth by the participants.

The program was organized on two separate days. Classes on Wednesdays were primarily targeted to the Marshallese patients, whereas classes on Thursdays were scheduled for the Chuukese as they were all Hawaii residents that came from the Micronesian Islands. The customized weekly diabetes education classes were administered by a dietitian and an advanced nurse practitioner in a group setting based on ADA standard guidelines as shown in Table 1. Classes included learning about the disease progression, healthy eating and living, physical activity or exercise, medication therapy and monitoring, management of acute and long-term complication, preventive care, and goal settings. Blood glucose level and blood pressure were recorded during each class. Each class had an interpreter who spoke either Marshallese or Chuukese language to facilitate participants’ learning, enhance adherence,
and improve dialog. This program also helped to develop an “Ohana” atmosphere by creating a successful care and learning environment to build trust and lasting patient-provider partnership. Following the classes, patients with abnormal laboratory values would meet with the interdisciplinary team consisted of an advanced nurse practitioner, pharmacist, dietitian, and interpreter. This team would provide appropriate counseling, referral to specialists, and medication management to the patients through an interdisciplinary approach as a normal clinic visit. During this time, the pharmacist was able to recommend drug therapy by initiating, modifying, or discontinuing medication. This collaborative practice, automatically enabled patients’ follow-up visit in an easy and very friendly and familiar manner. In addition to the weekly classes, monthly community outreach events were held by the interdisciplinary team outside the clinic to reach out to the larger community. These social events were held in the park or on the beach or in a community center.

Participants’ data were collected at the 1st day of their visit or enrollment as a baseline and then 6 months later during the class. Data on primary and secondary endpoints were collected and analyzed, which was not limited to glycosylated HbA1c, fasting blood glucose (FBG) level, blood pressure, lipid panel only. Continuous variables were analyzed using Student’s t-test. A \( P \leq 0.05 \) was considered statistically significant.

**RESULTS**

A total of thirty Micronesian individuals participated in the “Ohana” diabetes education program at Hilo Bay Clinic. Participants’ demographic characteristics and medical conditions were presented in Table 2. It is obvious from this table that majority of the patients had 2 or more conditions namely diabetes, and/or hypertension, and/or dyslipidemia. Both, male and female were equal in number with a mean age of 56 years (+/- 8.1). The mean weight of patients was

**Table 1: Classes included in “Ohana” diabetes education program**

| Class   | Title of the class                                       | Purposes of the class taught in “Ohana” diabetes education program                                                                                  |
|---------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Class 1 | Diabetes disease process                                 | Describe the definition, signs, symptoms, pathophysiology and treatments                                                                            |
| Class 2 | The basics of eating                                     | Describe how food groups can impact blood glucose and reasons for meal planning                                                                    |
| Class 3 | Physical activity and exercise                           | Describe the effects of physical activity in blood glucose, and help create individual exercise program for preventing complications               |
| Class 4 | Medication                                               | Describe the purpose, action, use, side effects and administration of medication and insulin used to treat diabetes                                 |
| Class 5 | Monitoring your diabetes                                 | Improve patient and family knowledge about the purposes of blood glucose self-management and monitoring, how to record blood glucose readings and to understand the results |
| Class 6 | Prevent, detect and treat acute complication and personal health habits | Describe how to incorporate good health habits (foot and skin care, dental care, recognizing and preventing infections) into daily living |
| Class 7 | Managing blood glucose                                   | Describe the management of blood glucose during hypo-or hyperglycemia, ketones and ketosis, and managing sick days                                    |
| Class 8 | Long-term complications                                  | Describe the various chronic complications and associated symptoms, ways to monitor and prevent complications                                     |
| Class 9 | Goal setting and problem solving                          | Describe effective ways to set and carry out goals for better self-management of diabetes                                                            |

**Table 2: Patients’ characteristics, medical conditions and comorbidities[22]**

| Patients’ characteristics | Micronesian patients (n=30) |
|---------------------------|-------------------------------|
| Demographic characteristics |                               |
| Age (years)               | 56±8.1                        |
| Male                      | 14 (46)                       |
| Female                    | 16 (54)                       |
| Weight (pounds)           | 180±38.3                      |
| BMI                       | 32.1±5.7                      |
| Number of patients using tobacco | 5 (16)                       |
| Medical conditions        |                               |
| Diabetes mellitus         | 30 (100)                      |
| Cardiovascular diseasea   | 21 (70)                       |
| Dyslipidemia              | 22 (73)                       |
| Stroke                    | 2 (6)                         |
| Pulmonary diseaseb        | 7 (23)                        |
| Malignancy                | 4 (13)                        |
| Depression                | 1 (3)                         |
| Seizures                  | 4 (13)                        |
| Gastrointestinal diseasec | 3 (10)                        |
| Comorbiditiesd            |                               |
| 0 comorbidity             | 3 (10)                        |
| 1 comorbidity             | 7 (23)                        |
| 2 comorbidities           | 11 (36)                       |
| 3 comorbidities           | 9 (30)                        |

Data are expressed either as mean±SD or n (%). aCardiovascular disease includes=Hypertension, myocardial infarction, angina pectoris, and heart failure, bPulmonary disease includes=Asthma, chronic obstructive pulmonary disease, and emphysema, cGastrointestinal disease includes=Pepitic ulcer, gastric reflux, duodenal ulcer, and diarrhea, dComorbidities include=Diabetes mellitus, hypertension, and dyslipidemia. SD=Standard deviation, BMI=Body mass index

[22] Chong: Clinical outcomes of a diabetes education program
180 pounds with an average body mass index of 32.1 suggesting that most patients were obese. Five (16%) patients were tobacco users; however, seven (23%) of participants had pulmonary diseases. Few patients also had gastrointestinal diseases and seizures.

Ninety percent of patients enrolled in the program were taking low-dose aspirin. Most patients were also prescribed with either an angiotensin converting enzymes (ACEs) inhibitor or angiotensin receptor blockers (ARBs) and a lipid-lowering agent. About one-third of the patients were treated with long-acting insulin injection. During this diabetes education program, all patients received both flu and pneumonia vaccines.

The HbA1c levels improved significantly from baseline to 6 months among participant who attended the diabetes education program [Table 3]. The mean reduction in HbA1c levels was 1.2% over a 6-month period from 9.56% to 8.36% (P < 0.05). Similarly, mean FBG levels decreased from 264 to 194 mg/dl, and this reduction was statistically significant (P < 0.05). Mean triglyceride (TG) levels showed significant decrease from 154 to 129 mg/dl at 6 months period (P < 0.05). However, no significant changes were observed in other secondary outcomes such as total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), and blood pressure during the study period.

**DISCUSSION**

The objective of this study was to understand how appropriately “Ohana” diabetes education program helped to optimize drug therapy in Micronesian patients for preventing long-term complications due to their uncontrolled hyperglycemia. In this program, patients had the opportunity to attend educational classes on a weekly basis as compared to most national programs that met monthly or quarterly for a limited and specific time. By meeting on a continual basis, the patients had access to continuity of health care and were able to adhere to their treatment plan through attending the weekly diabetes education session with monitoring and evaluation of progress by interdisciplinary team approach. In this way, patients could avoid missing doses because of running out of medication, which was a common occurrence among the Micronesian patients. Second, this study could remove the cultural, social, and other potential barriers to improve medication adherence. With continuous improvement in clinical outcomes, long-term complications, morbidity, and mortality can be prevented in patients with diabetes mellitus.

In this study, it was found that majority of the medical conditions were not being treated or patients had no knowledge of their conditions. Most of the patients were nonadherence to medication therapy, and they were not aware of the proper use of medication prior to enrolling into the program during initial assessment at enrollment. Patients enrolled in the program were either had diabetes and/or hypertension, and/or dyslipidemia, with few patients also having gastrointestinal diseases and seizure disorder.

The “Ohana” diabetes education program demonstrated how to improve clinical outcomes for patients with diabetes. Patients seemed to be able to accept medical treatment better as compared to prior enrollment to the program. From Table 4, it was through the diabetes education program that 90% of the patients enrolled were eventually taking low-dose aspirin, with either an ACE inhibitor or an ARB (angiotensin II blocker) blocker and also a lipid-lowering agent. It was realized that if a patient was treated with insulin injection was considered to be “having terminal condition of the disease” by the Micronesian patients, although one-third of the patients in the program were treated with long-acting insulin injection. Proper education on the use and beneficial effects of insulin injection is primary to the overall effect on disease management.

### Table 3: Primary and secondary end points on day 1 and six months later

| Primary or secondary end points | Day 1 on enrollment | 6 months after enrollment | P       |
|--------------------------------|---------------------|--------------------------|---------|
| **Primary end points**         |                     |                          |         |
| HbA1c (%)                      | 9.56±1.96           | 8.36±1.74                | <0.05   |
| **Secondary end points**       |                     |                          |         |
| FBG (mg/dl)                    | 264.62±124.41       | 194.62±89.44             | <0.05   |
| TG (mg/dl)                     | 154.36±72.1         | 128.10±58.44             | <0.05   |
| TC (mg/dl)                     | 179.56±32.14        | 170.10±32.97             | NS      |
| LDL (mg/dl)                    | 108.83±28.16        | 103.43±26.73             | NS      |
| HDL (mg/dl)                    | 40.26±8.04          | 40.26±9.67               | NS      |
| Systolic BP (mmHg)             | 128.56±15.82        | 132.36±24.81             | NS      |
| Diastolic BP (mmHg)            | 74.74±10.08         | 76.00±9.67               | NS      |

Data are expressed as either mean±SD. HbA1c=Hemoglobin A1c, FBG=Fasting blood glucose level, TG=Triglyceride, TC=Total cholesterol, LDL=Low density lipoprotein, HDL=High density lipoprotein, SD=Standard deviation, NS=Not significant, BP=Blood pressure

### Table 4: Medication initiated during “Ohana” diabetes education program

| Types of medication taken by the patients during the program | Micronesian patients (n=30) |
|--------------------------------------------------------------|-----------------------------|
| Aspirin (81 mg)                                              | 27 (90)                     |
| ACE/ARB                                                     | 20 (67)                     |
| Lipid-lowering drugs*                                        | 22 (73)                     |
| Insulin injection                                           | 9 (30)                      |
| Flu vaccination                                              | 30 (100)                    |
| Pneumococcal vaccination                                    | 30 (100)                    |

Data are expressed as n (%).*Lipid-lowering drugs include: Statins, fibrates, niacin, nicotinic acids, bile acid resins, fish oil preparations, ACEI=Angiotensin converting enzyme inhibitors; ARB=Angiotensin-II receptor blockers
disposal of insulin injection was taught during the weekly classes by the interdisciplinary team members. All patients attending classes received both flu and pneumonia vaccinations, which was the another benefit of this education program.

Based on our findings, the Micronesian patients with type 2 diabetes who attended the “Ohana” diabetes education program demonstrated improved HbA\textsubscript{ic}, FBG, and TG levels over a 6-month period. The mean HbA\textsubscript{ic} for the patients was 8.36% [Table 3] after attending the program for 6 months, which was still considered high based on the ADA guidelines. Most of the Micronesian patients had HbA\textsubscript{ic} on an average 10% and above before arriving in Hawaii due to uncontrolled hyperglycemia.

Reduction in HbA\textsubscript{ic} by 1.2% in the first 6 months was considered statistically significant achievement for these patients due to long-term complications associated with uncontrolled hyperglycemia as demonstrated by UK Prospective Diabetes Studies. The objective of this “Ohana” diabetes education program in its unique setting was to dissipate the stress, cultural, and social differences that the Micronesian patients may experience when coming into a new and unfamiliar healthcare environment. This program served as a bridge to enable such patients to build trust and feel comfortable with the healthcare providers as a result of meeting one-on-one to receive individualized care within a group environment. This diabetes education program in turn had provided ample opportunity and easy accessibility to health care to the Micronesian patients for immediate and consistent changes toward healthy living. It is yet to known, if this program eventually will be used as a model to enhance medication adherence and impart patient education; thus improving the quality of life, reducing healthcare cost, and preventing further progression of short- and long-term complications associated with chronic diseases such as diabetes.

Sample size of thirty could be a limitation of this study. However, continuous efforts are being made to promote awareness among Micronesian community for preventing chronic diseases. We have simultaneously initiated a mobile health screening project, as a community outreach program, especially tailored to the Marshallese population. This Marshallese Mobile Screening Clinic Project (MMSCP) was initiated by a team of three pharmacy students and a faculty member at the University of Hawaiii, Daniel K. Inouye College of Pharmacy. The team members traveled to churches and community events to offer health screening and education to the Marshallese people. Screening on HbA\textsubscript{ic}, blood pressure, and cholesterol level was conducted during this community outreach events, and the test results were interpreted to the participants. If participants were identified to have shown with abnormal screening results, they were referred and encouraged to attend the “Ohana” diabetes education program at Hilo Bay Clinic as described earlier. Chong et al. in their study reported 59% of the participants actually enrolled in the diabetes education program at Hilo Bay Clinic upon referral from the health screening events with one-half of the participants were older than 40 years of age. This study also revealed that this MMSCP project in fact helped to prevent the progression of long-term complications due to uncontrolled hyperglycemia among the Marshallese people. It was believed that such health screening events would help to increase the sample size for future study. Another limitation of the study was to have a more effective control group in the study design. In this study, the
patients served as their own control as they were subjected to intervention by the interdisciplinary team after their baseline measurement at the time of study enrollment. Our future plan is to design a study comparing two groups, one group receiving the “Ohana” diabetes education, whereas the other group subjected to regular clinic visit. Third, the study period of 6-month was too short to elucidate long-term effect on clinical and patient outcomes, which could be addressed in our future study.

In short, the “Ohana” diabetes education program was vital success for helping Micronesian patients to achieve their glycemic goals and to prevent long-term complications that was due to chronic disease such as diabetes mellitus.

AUTHORS’ CONTRIBUTION

Dr. Mok Thoong Chong contributed to this study.

Acknowledgments

The author would like to thank Dr. Danita D. Henley who was a Pharm.D student at the University of Hawaii, Daniel K. Inouye College of Pharmacy, Charlotte Grimm, APRN, Keola Downing, Ph.D, and Richard Agenten, RN from Hilo Bay clinic for their help and contribution during the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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