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Case Report

Use of tracking test results via health electronic record (HER) to engage patients in diabetes self-management

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- Diabetes self-management
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Abstract

Diabetes self-management is essential for diabetes management. Many factors influence patients' engagement in diabetes self-management. These factors include intrinsic or extrinsic factors that may be modified by external stimulation or assistance such as knowledge gain, provider's support, and mutual goal setting.

Objective of this quality improvement project utilized the visual display of hemoglobin A1c trend on the electronic medical record to initiate provider-patient interaction based on the Chronic Care Model.

Setting: The Diabetes Clinic of a community health center in Honolulu, Hawaii. Majority of patients were the Asian and the Pacific Islander immigrants.

Method: This quality improvement project was guided with the Chronic Care Model. The provider displayed A1c trend generated from the HER in front of patients, followed with discussion of meaning of A1c and its impact on health outcomes. The provider engaged patient in developing mutual goals in diabetes self-management. The project was evaluated by comparing the laboratory results at pre- and post- intervention in one group of patients.

Result: Paired t-test showed significant reduction in A1c level at 3-month and 6-month follow ups, compared with A1c at the baseline.

Conclusion: The reduction in A1c levels showed in this study indicates that the chronic care model is effective in reducing A1c level through initiating provider and patient interaction.

Abbreviations: HER - electronic medical record; **A1c** - hemoglobin A1c

INTRODUCTION

Diabetes self-management plays an essential role for improving type 2 diabetics' outcomes. Uncontrolled diabetes has been associated with diabetes induced medical complications including blindness, cardiovascular events, chronic kidney disease, neuropathy, and depression [1]. Culture influences diabetes self-management [2,3]. The Filipino Americans in Hawaii perceive rice as a significant source of energy and served at every meal. Chinese Americans maintain the use of herbs and traditional diet.

Health care providers and researchers have tried to develop innovative strategies to improve diabetes self-management. Strategies include diet-related knowledge classes [4], medication regimen adherence [5-7], lifestyle interventions [4,8], equity in access and quality of primary care [9], patient-provider collaborative, medication-planning [10], hospital-based telephone coaching [11], semi-structured interviewing [12], and integration of patients' healthcare needs in person-centered models [13].

Research has revealed that the use of modern technology in diabetes self-management has focused on patients receiving information about continuous glucose monitoring devices, electronic insulin pens, insulin pumps, glucose meters, and mobile diabetes applications [14]. Low technological knowledge and higher age are barriers for patient's ability and willingness to learn new skills for use of these modern technologies [15].

Our previous publication [16] identified the glycemic relapse in uninsured Asian-Americans and Pacific Islanders with diabetes. Health literacy has been associated with self-efficacy, self-care activities, and health-related quality of life in patients with type 2 diabetes [16,17].

Since June 15, 2015, our diabetes team initiated a quality improvement project that included providing each client with a picture of a graph which provided a visual cue of their own A1c trends. The aim was to engage patients so as to increase their

understanding of the significance of maintaining their A1c at less than 7%, accompanied by the development of mutual goals for diabetes self-management. This quality improvement project was not disclosed to other providers of the health center. The purpose of this study was to minimize the impact of health literacy among the Asians and Pacific Islanders on the diabetes self-management via use of visual display on HER.

This retrospective study project focused on differences in health outcomes (e.g., changes in BMI, A1c, Triglyceride/HDL ratio, LDL, the number of cardiovascular events and the changes in the Tri /HDL ratio) during the year of visual cues, compared with the prior year of routine care.

The key questions asked were:

1. What are the changes in health outcomes during the year of visual cue implementation? Are there significant differences in the health outcome changes between the year of visual cue implementation (June 2015 – June 2016) and the year of routine care (June 2014 - June 2015).

2. What is the relationship between individual characteristics (gender, age, ethnicity) and the medical insurance status and health outcomes (e.g., A1c, BMI, Tri/HDL ratio at the baseline? What is the association between the Tri/HDL ratio and the number of coronary artery diseases (CAD) at the baseline?

CASE PRESENTATION

This was a retrospective longitudinal study which included pre-and then post visual cues data for A1c trends for a cohort of patients with Type 2 Diabetes Mellitus who were patients at the Diabetes Clinic of a community health center for a continuous period of twenty-four months. Patient charts were reviewed by 3, 6, 9, 12- months from the initial visit. Patients with gestational diabetes, anemia, or receiving dialysis therapy were excluded. The pre-intervention period was June 15, 2014-June 14, 2015. Beginning with visits on or after June 15, 2015, the same patients were provided with a visual graph of their A1c laboratory results. At the conclusion of the 24-month period, chart reviews were conducted to collect pre-and post-intervention data which included: ethnicity, gender, age, medical insurance status, coronary arterial disease (CAD) events (e.g., chest pain, heart disease, MI,), body mass index (BMI), and laboratory results for A1c, low density lipo-protein (LDL), and Triglyceride-HDL (Tri/HDL) ratio obtained between June 15, 2014 and June 15, 2016.

SETTING

The diabetes clinic is recognized by the American Diabetes Association. The diabetes team at the diabetes clinic of the Kalihi Palama Health Center at Honolulu, Hawaii includes one nurse practitioner, one registered dietician (RD) who is a certified diabetes educator (CDE), one registered nurse (RN), and one medical assistant (MA). Patients receive group education from the RD/CDE, individual medical visit with the nurse practitioner, goal setting discussion with the RN, and blood drawn by the MA in a large room that was partitioned into four areas. Community Health Workers (CHW) of the health center assist in interpretation as needed.

PARTICIPANTS

All clients who were enrolled during the time period of the study (N= 176) seen at the diabetes clinic between June 15, 2015 and June 15, 2016 were included in the chart review. The patients' ages ranged from 25 years old to 87 years old, 80% were uninsured, and included a wide variety of race/ethnicity groups (Caucasian, Chinese, Chuukese, Filipino, Hawaiian, Hispanic, Japanese, Korean, Marshallese, Vietnamese and other Pacific Islanders).

THEORETICAL FRAMEWORK

Multiple factors influence self-management behaviors of chronic illnesses (Figure 1). The diabetes team chose the Chronic Care Model (http://www.improvingchroniccare.org/index.php?p=The_Chronic_CareModel&s=2) to guide the evaluation of the visual cues to engage diabetic patients with their own diabetes self-management program. The diabetes team revised this conceptual model based on study purpose and population. The Chronic Care Model composed of 'Community Resource & Policies related to self-management support', 'Organization of Health Care related to delivery system, decision support, and clinical information system', 'Informed, Activated Patient', and 'Prepared, Proactive Practice Team'. These components together improve outcomes. Our clinic is a community health center that provides translated patient education materials, cooking demonstration, diabetes classes, organized exercise program, and nutrition consultation in group (at waiting room) or individually. The diabetes clinic is recognized by the American Diabetes Association. The diabetes team coached patients to develop their own small goals like taking their medication as directed, Self-Monitored Blood Glucose (SMBG) as directed, meal plan, and regular physical activity. The diabetes team met monthly to evaluate the program. One patient representative attended the meetings. Our intent is to inform and activate patients via visual display to promote productive interactions that enhance the impact of community resources and organization of health care on the patient outcomes.

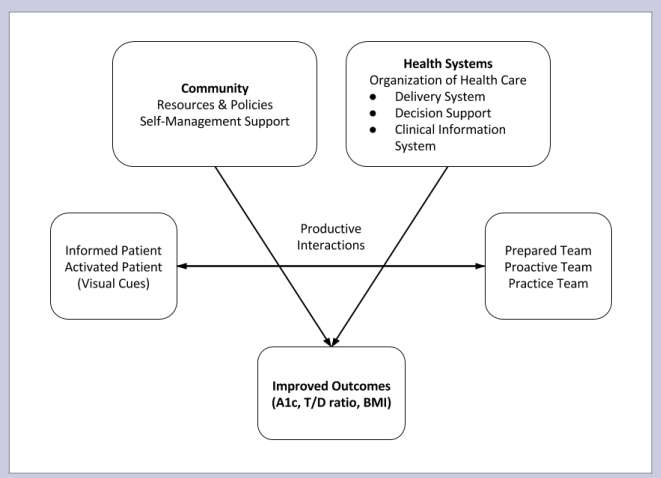

Figure 1: Illustrates the adaptation of the Chronic Care Model for this project

STUDY PROCEDURE

The RN in the diabetes team retrieved pertinent data from the HER. The nurse practitioner utilized the SPSS version 23 to analyze data. The diabetes team discussed the results of the statistical analyses and disseminated their findings based on the proposed conceptual model.

DATA ANALYSES

The analysis plan was to examine the influence of A1c levels and the Tri/HDL ratio at baseline on the reduction in A1c levels. Descriptive statistics were used to describe the sample. Paired sample t-tests were used to examine the changes in A1c, BMI, and Tri/HDL ratio; linear regression was computed to examine the level of impact for each variable of individual characteristics, the medical insurance status, BMI, and Tri/HDL ratio on the A1c level and correlation between the Tri/HDL ratio and the number of cardiovascular events was analyzed. In addition, cases were categorized into two groups, with Tri/HDL ratio equal or greater than four as the dividing criteria. Correlation between the Tri/HDL ratio and the number of cardiovascular events were computed for two subgroups. Chi-square test was used to analyze the effects of 2 x 2 factors (e.g. Tri/HDL ratio and BMI) on the number of cardiovascular events.

RESULTS

One hundred seventy-six clients met the inclusion criteria, 110 were female and 66 were male, ages ranged from 26 to 83 years (M=58.1, SD=9.9), 39.8% were uninsured, and 15 different ethnicities (Table 1).

Results of paired samples t-test was shown in Table 2. Paired sample t-test indicated the mean differences in A1c between the baseline and follow-ups, compared those between baseline and interval points prior to the baseline. Results showed the statistically significant paired differences in A1c between baseline and 3-month follow-up; baseline and 6-month follow-up (=0.001); baseline and 9-month follow-up (p=0.048). In other words, A1c levels significantly reduced. In contrast, A1c at baseline increased, compared with A1c levels at 12-month prior (p = 0.029). Mean differences in A1c changes between baseline and follow-ups were -0.5953% for 3-month, -0.4955%, -0.2870% for 9-month, and – 0.3068 % at 12-month. Mean differences between baseline and 12-month prior to the baseline was 0.304%.

111 of these 176 patients had A1c equal or greater than 8% at baseline. They were 67 females and 44 males. These 111 patients aged from 26 years old to 80 years old (M=56.76, SD=9.88). Mean differences in A1c among these patients were presented in Table 3. On the other hand, patients with A1c levels less than 8% at baseline did not have significant reduction in A1c levels after intervention.

Significant negative correlation (p=0.01) between age and A1c level was shown in Table 4. There was significant negative correlation (p=0.05) between age and ethnicity code. There was no correlation among BMI, TD/HDL ratio, and A1c. Linear regression showed the combination of ethnicity code, TRI/HDL ratio, BMI, and age counted for 3.9% of predicting A1c level at baseline and 1.1% of predicting changes in A1c level at 3-month follow-up.

Table 1. Sample Description: Ethnicity, Gender and Insurance

		Frequency	Percent	Valid Percent	Cumulative Percent
Ethnicity	Caucasian	4	2.3	2.3	2.3
	Chinese	15	8.5	8.5	10.8
	Chuukese	53	30.1	30.1	40.9
	Filipino	42	23.9	23.9	64.8
	Japanese	4	2.3	2.3	67
	Korean	13	7.4	7.4	74.4
	Laotian	1	0.6	0.6	75
	Marshallese	20	11.4	11.4	86.4
	Native Hawaiian	2	1.1	1.1	87.5
	Other	1	0.6	0.6	88.1
	Pohnpeian	1	0.6	0.6	88.6
	Samoan	5	2.8	2.8	91.5
	Spanish	4	2.3	2.3	93.8
	Tongan	7	4	4	97.7
	Vietnamese	4	2.3	2.3	100
	Total	176	100	100	
Gender	Female	110	62.5	62.5	62.5
	Male	66	37.5	37.5	100
Insurance	Without	70	39.8	39.8	39.8
	With	106	60.2	60.2	100

Table 2: Paired samples t-test (N = 176 patients)

Change in A1c levels between two interval points	Paired Differences					t	df	Sig(2 tailed)
	Mean	Std Deviation	Std Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
12 m F/U -- Baseline	-.3068	1.5478	0.1899	-0.6654	0.0518	-1.705	73	.092
9 m F/U -- Baseline	-.2870	1.2560	0.1431	-0.5721	-0.0019	-2.005	76	.048
6 m F/U – Baseline	-.4955	1.4189	0.1504	-0.7944	-0.1966	-3.295	88	.001
3 m F/U – Baseline	-.5953	1.4968	0.1447	-0.8822	-0.3085	-4.114	106	.000
Baseline – 3 months prior	.2230	1.4022	0.1503	-0.0759	0.5218	1.483	86	.142
Baseline – 6 months prior	.3034	1.4202	0.1515	0.0042	0.6025	2.015	88	.047
Baseline – 9 months prior	.2545	1.2709	0.1355	-0.0147	0.5238	1.879	87	.064
Baseline – 12-month prior to the baseline	.3040	1.8128	0.1378	0.0320	0.5761	2.206	172	.029

• F/U = Follow-up visit

Table 3: Paired t-test for patients with A1c equal and greater than 8% (N=111)

Change in A1c levels between two interval points	Paired Differences					t	df	Sig (2 tailed)
	Mean	Std Deviation	Std Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
12 m F/U - Baseline	-.8293	1.5413	0.241	-1.3158	-0.3428	-3.445	40	.001
9 m F/U - Baseline	-.6674	1.4261	0.218	-1.1063	-0.2286	-3.069	42	.004
6 m F/U - Baseline	-.9157	1.7248	0.242	-1.4008	-0.4306	-3.791	50	.000
3 m F/U - Baseline	-.9197	1.7119	0.203	-1.9249	-0.5145	-4.527	70	.000
Baseline – 3-month prior	.6434	1.5767	0.217	0.2088	1.0780	2.971	52	.004
Baseline – 6-month prior	.5772	1.6138	0.2138	0.1490	1.0054	2.700	56	.009
Baseline – 9-month prior	.4925	1.4805	0.2034	0.0844	0.9005	2.422	52	.019
Baseline – 12-month prior to baseline	.6229	2.1180	0.2029	0.2208	1.0251	3.071	108	.003

Table 4: Correlations

		Age	A1c	Eth_code	BMI	T/D
Age	Pearson Correlation	1	-.241**	-.164*	-0.133	.061
	Sig. (2-tailed)		.001	.031	0.085	.473
	N	176	176	174	169	142
A1c	Pearson Correlation	-.241**	1	.050	-0.013	.081
	Sig. (2-tailed)	0.001		.511	0.867	.337
	N	176	176	174	169	142
Eth_code	Pearson Correlation	-.164*	.050	1	0.143	.050
	Sig. (2-tailed)	.031	.511		0.065	.554
	N	174	174	174	167	140
BMI	Pearson Correlation	-.133	-.013	.143	1	.044
	Sig. (2-tailed)	.085	.867	.065		.603
	N	169	169	167	169	140
T/D	Pearson Correlation	.061	.081	.050	0.044	1
	Sig. (2-tailed)	.473	.337	.554	0.603	
	N	142	142	140	140	142

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Fifty-two patients had episode of CAD. Five of these 52 patients had 4 different types of CAD (chest pain, coronary arteriosclerosis, coronary artery bypass surgery, and stent placement). There was no significant correlation between number of CAD and TRI/HDL ratio with entire 176 patients or the follow subgroups: a) BMI <30 kg/m2 and TRI/HDL ratio < 4, b) BMI <30 kg/m2 and TRI/HDL ratio > 4, c) BMI >30 kg/m2 and TRI/HDL ratio < 4, and d) BMI>30 kg/m2 and TRI/HDL ratio >4.

DISCUSSION

Findings indicated that use of tracking test results via HER improved health outcome evidenced by significantly decreased mean differences in A1c levels at 3-month and 6-month follow ups. The mean differences at 9 month follow up were not significant. The phenomena might lead to glycemia relapse [16]. There were no significant mean differences of A1c between at 3-month, 6-month, 9-month prior to the baseline and the A1c at 12-month prior to the baseline. For subgroup with A1c equal to or great than 8% at baseline, the mean differences significantly decreased at 3-month (-.9197%), 6-month (-.9157%), 9-month (-.6674%), and 12-month follow up (-.8293%). The mean differences in A1c (.6229) at baseline was significantly increased than that at 12months prior to the baseline. In summary, displaying patient's A1c trend on the HER facilitated interactions between the provider and the patient. Through the interaction and visual display, the provider explained the importance of controlling A1c less than 7%. In addition, the provider pointed out the lowest level of A1c on the display, followed with asking patient and his or her family to talk about what they can do to decrease A1c level again. Patients expressed that they decreased portion of foods when they attended social gathering. They also increased frequency and length of walking.

Finding indicated negative association between A1c levels and age at baseline. It implied that patients with higher age had lower A1c levels. Correlations between changes in A1c and age were not significant at 3-month or 6-month follow up. It implied that age was not a factor of A1c improvement in these 176 patients who were motivated with tracking A1c results via HER. Possible explanation for the negative correlation between age and A1c at the 3-month, 6-month follow-up is that younger patients have changed their lifestyle after reviewed A1c display with their providers. Literature indicates that age was a predictor of diabetes self-management [18]. Lower diabetes self-management was reported by the younger patients.

Linear regression results indicated that BMI, age, TRI/HDL ratio at baseline and ethnicity are weak predictors for A1c changes. Use of tracking test results via HER to engage patients may play a role to promote patients' outcome expectations and outcome expectancy that had significant relationship with the self-care score in 384 patients [19].

LIMITATION

There was no comparison or control group in which patients would receive a standard method. Findings of this quality improvement project only indicated the effective of the Chronic Care Model in initiating provider-patient interaction, leading to the reduction in A1c levels. Findings did not indicate the effectiveness of the use of visual display of A1c trend on the reductions in A1c.

CONCLUSION

The reduction in A1c levels showed in this study indicates that the chronic care model is effective in reducing A1c level through initiating provider and patient interaction. However, the study was a quality improvement project, not a research project. There was no comparison group. Further study with 2 arms, one arm to engage patients using the current method and the other to engage patients using a standard method, is needed to examine the effectiveness of intervention on the reduction in A1c.

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DISCLOSURE

There was no financial interest or conflict of interest in producing this report.

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