Comparison of diabetes control among type 2 diabetes mellitus patients treated in the primary health care clinics and diabetes center in King Saud University Hospitals

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Abstract

Context: Diabetes mellitus is prevalent in 23.7% of adults in Saudi Arabia. But there is a lack of diabetes control to recommended targets.

Aim: This study compares diabetes mellitus patients at diabetes center in two different settings.

Settings and design: The study was conducted at King Abdulaziz University Hospital (KAUH) and primary care clinic in King Khalid University Hospital (KKUH).

Methods and Materials: A retrospective cohort of 306 type 2 diabetes mellitus patients, who underwent treatment from January 2009 till December 2012, was analyzed.

Statistical Analysis: Student's t-test and chi-square test were performed on data on demography, biochemistry and duration of diabetes to compare different variables. Multivariate logistic regression analysis was used to control confounders.

Results: Patients with glycemic control was 20.9%. Control of total cholesterol level was found in 81%, LDL in 53.6%, HDL in 54.3% of males and 68.4% females, systolic blood pressure in 28.4% and diastolic blood pressure in 72%. Controlled patients at KKUH vs. KAUH for different parameters were: glycosylated hemoglobin (HbA_1C) ≤ 7 [29.9% vs. 11.8%; p = 0.0001], LDL ≤ 2.6 mmol/L [46.8% vs. 60.5%; p = 0.0165], HDL

in males ≥ 1.03 mmol/L [35.4% vs. 58.4%; *p* = 0.0034], HDL in females ≥ 1.29 mmol/L [20.7% vs. 40%; *p* = 0.0237].

Conclusions: Diabetes patients at KKUH had better glycemic control, while hypercholesterolemia was controlled better at KAUH, with no difference regarding blood pressure management. However, diabetes control is still unsatisfactory at both centers, and needs more effective management.

Keywords: Diabetes mellitus type 2, Glycosylated hemoglobin, Specialized clinics

Key Messages: Diabetes patients at primary healthcare clinics at KKUH had better glycemic control while hypercholesterolemia was controlled better at KAUH. However, diabetes control is still unsatisfactory at both centers.

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Introduction

Diabetes mellitus, one of the most common diseases worldwide, is caused by sedentary lifestyles in most nations.[1] According to the World Health Organization (WHO) estimation, there will be more than 366 million patients with diabetes by 2030.

The most recent prevalence of diabetes worldwide is around 10%. However, the Arab region appears to have a higher prevalence of diabetes than the global average, with Saudi Arabia having prevalence around 24%.[2–5] Diabetes is known to be associated with long term damage, dysfunction and failure of different organs, especially the eyes, kidneys, nerves, heart and blood vessels.[6] Proper management of diabetes to the recommended targets for blood sugar, blood pressure and cholesterol level can delay these complications.[7–11] Management of diabetes is largely dependent on the quality of care due to difference in patients' severity, physician specialty, physician training, and access to care. There is a debate over the quality of care received by patients with diabetes for better disease control. Some studies suggested that patients with diabetes in the diabetes clinic receive better quality of diabetes care by physicians than the patients in the general clinics[12,13]; although, some studies found no difference in the outcomes irrespective of primary care or specialized clinics.[14–16] This controversy has prompted us to undertake this retrospective study to investigate whether the degree of diabetes management is dependent on the care provided. It would be interesting to investigate the quality of care at King Saud University Hospitals (KSUH), where diabetes is managed at the diabetes center at King Abdulaziz University Hospital (KAUH) and at the primary care clinics at King Khalid University Hospital (KKUH). The aim of this retrospective study was to assess the type of care provided to the patients

with diabetes at KAUH and KKUH. Our objective was to determine the overall percentage of patients with controlled diabetes followed at KSUH and also to compare the percentages of patients with controlled diabetes followed by KAUH, specialized center with respect to patients who were followed at KKUH, a primary care center.

Materials and methods

Study Design

A retrospective cohort design was adapted for this study. Patients with diabetes in KKUH and KAUH were identified and the data were extracted from medical records (between January 2009 and December 2012) to analyze the extent of disease control. All patients with diabetes aged 40 years and above were included in the study. The patients with the following conditions were excluded: type 1 diabetes, type 2 diabetes with irregular follow-up (missed two or more visits), secondary diabetes (like taking steroids), undergoing intensive insulin therapy or insulin pump.

Sample Size and Technique

The prevalence of patients with controlled diabetes at the primary care settings and specialized clinics were found to be 30–50% and >60%, respectively in some studies.[17–21] The sample size was estimated to compare between the difference and level of diabetes control in KSUH patients. The estimated population to be controlled were around 40% in KKUH (P1) and around 60% in KAUH (P2) with a 95% level of

confidence (α error = 5%) and a study power of 80% (β error = 20%). Using the equation for difference between two proportions, we obtained the estimated sample size as 115 patients for each group. The sample size was increased to 154 and 152 for KKUH and KAUH, respectively. Therefore, a total of 306 type 2 diabetes mellitus (DM) patients' medical records were examined. A systematic random sampling technique was used, where every third medical record was taken from the list provided by the medical record department.

Data Collection

A structured abstraction sheet was developed by the researcher (Supplementary file: Appendix I). The abstraction sheet was validated by an expert in community medicine and pilot tested. It included the following items: Demographic data (age, gender, marital status and education level), anthropometry (height, weight and body mass index (BMI)), duration of diabetes, compliance with treatment plan (medications, diet and exercise), glycosylated hemoglobin (HbA1C) for each visit, lipid profile for each visit, measured blood pressure for each visit, continuity of care (number of visits per year), follow-up with the ophthalmologist and dietitian, complications.

Outcome Definitions

The level of diabetes control is defined according to the American Diabetes Association (ADA) criteria, which includes the followings: HbA1C ≤ 7%, total cholesterol ≤ 5.17 mmol/L, LDL-cholesterol ≤ 2.6 mmol/L, triglycerides ≤ 1.7mmol/L, HDL-cholesterol in males ≥ 1.03 mmol/L, HDL-cholesterol in females ≥ 1.29 mmol/L, systolic blood pressure (SBP) ≤ 130 mmHg, diastolic blood pressure (DBP) ≤ 80 mmHg.

Confounders

Possible confounders that might affect the study include patients' compliance with treatment regimen and dietary advice, physical inactivity, abnormal BMI. These were controlled by multivariate analysis.

Statistical Analyses

The extracted data were coded and entered into a Microsoft Excel spreadsheet. The statistical software SPSS version 17.0 was used to analyze the data. Comparison of the mean level of HbA1C, triglycerides, total cholesterol, HDL-cholesterol, LDL-cholesterol and blood pressure between both groups (KAUH and KKUH) were done by using the student t-test, while association of diabetes control according to the center in which the patients were followed were done by using chi-square test. Multivariate logistic regression analysis was used to control the confounders. All *p*-values were two tailed, and a value of less than or equal to 0.05 was considered as significant.

Results

Patient Demographics

Among 306 patients, 152 (49.7%) were from KAUH diabetes center and 154 (50.3%) were from KKUH primary health care center. The population consisted of 56.5% of males and 43.5% of females. The majority of patients were between 50–60 years with a mean of 56.54 ± 8.34. The mean duration of diabetes was 13.38 ± 6.70 years; 44.4% had diabetes >15 years. The mean BMI was 31.43 ± 6.01 Kg/m2 with only 11% of patients having normal body weight, while 29.4% were over-weight and 59.6% were

obese. One-third of the patient population was illiterate, while 29% had high education above secondary school. The complete socio-demographic characteristics of the patient population are presented in Table 1.

Table 1: Patients' Sociodemographic Characteristics

Sociodemographic	Hospital				*p*-Value
	KAUH		KKUH		
	No (152)	%	No (154)	%	
Gender					
Female	75	49.3	58	37.7	0.039
Male	77	50.7	96	62.3	
Age Group					
40–<50	34	22.4	29	18.8	0.043
50–<60	70	46.1	55	35.7	
60–70	48	31.6	70	45.5	
Duration of diabetes					
<5 yrs	11	7.2	10	6.5	0.732
5–<10	32	21.1	38	24.7	
10–<15	43	28.3	36	23.4	
15+	66	43.4	70	45.5	
BMI					
18.5–24.9	24	15.8	12	7.8	0.095
25–29.9	42	27.6	54	35.1	

30–34.9	43	28.3	47	30.5	
35–39.9	26	17.1	31	20.1	
40+	17	11.2	10	6.5	
Smoking Status					
Smoker	4	2.6	18	11.7	0.003
Non-smoker	148	97.4	136	88.3	
Nationality					
Non-Saudi	7	4.6	11	7.1	0.346
Saudi	145	95.4	143	92.9	
Marital status					
Married	134	88.2	135	87.7	0.393
Widow	17	11.2	17	11.0	
Divorced	0	0.0	2	1.3	
Single	1	0.7	0	0.0	
Education level	53	34.9	57	37.0	0.868
Illiterate	21	13.8	24	15.6	
Primary	4	2.6	7	4.5	
Intermediate	27	17.8	24	15.6	
Secondary	11	7.2	8	5.2	
Diploma					
University	36	23.7	34	22.1	

Assessment of Glycemic Control

Patients with diabetes with oral hypoglycemics represented 53.6% of total population. Patients taking insulin alone represented 11.4%, while those on combined treatment represented 35%. Table 2 provides the list of medications; it is evident that patients at the diabetes center are more medicated. Patients who were compliant with their medication regimen (i.e., those who take all medications prescribed by their physicians) represented 80.7%.

Table 2: Patients' Medications

Medication	No	Hospital				*p*-Value
		KAUH		KKUH		
		No (152)	%	No (154)	%	
Biguanide	266	135	88.8	131	85.1	0.330
Sulfonylurea	137	54	35.5	83	53.9	0.001
Alpha glucosidase inhibitors	26	9	5.9	17	11.0	0.108
Thiazolidinedines	44	32	21.1	12	7.8	0.001
Dipeptidyl peptidase 4 inhibitors	20	18	11.8	2	1.3	<0.001
Meglitinides	5	5	3.3	0	0.0	0.029
Mixtard insulin	115	62	40.8	53	34.4	0.250
Basal insulin	26	21	13.8	5	3.2	0.001
Short acting insulin	4	3	2.0	1	0.6	0.369
Rapid acting insulin	5	5	3.3	0	0.0	0.029
ACEI	125	34	22.4	91	59.1	<0.0001

ARB	100	61	40.1	39	25.3	0.006
Thiazid diuretics	87	47	30.9	40	26.0	0.337
Loop diuretics	32	17	11.2	15	9.7	0.680
Beta blockers	77	39	25.7	38	24.7	0.843
Calcium channel blockers	65	30	19.7	35	22.7	0.523
Methyldopa	3	3	2.0	0	0.0	0.121
Statins	237	117	77	120	77.9	0.843
Fibric acid derivatives	8	5	3.3	3	1.9	0.500
Ezetimibe	6	6	3.9	0	0.0	0.014
Aspirin	206	114	75	92	59.7	0.004
Clopidogrel	14	7	4.6	7	4.5	0.980
Warfarin	1	1	0.7	0	0.0	0.497
Nitrates	10	6	3.9	4	2.6	0.540
Digoxin	2	2	1.3	0	0.0	0.246
Thyroxin	35	30	20.4	4	2.6	<0.0001

The mean HbA1C for the entire patient population was 8.5 ± 1.51 [Table 3].

Table 4 shows the difference in HbA1C [8.06 ± 1.44 (KKUH) vs. 8.94 ± 1.54 (KAUH); $p < 0.0001$) between the patients with diabetes treated in the two centers.

Table 5 reveals that only 20.9% of the total sample had HbA1C <7, while the percent of patients with controlled blood sugar were 29.9% at the primary care (KKUH) vs. 11.8% at the diabetes center (KAUH) (p = 0.0001).

Table 3: Mean of studied variables

Characteristics	Hospital				Total	
	KAUH		KKUH			
	No	Mean ± SD	No	Mean ± SD	No	Mean ± SD
Age	152	55.35 ± 7.85	154	57.70 ± 8.66	306	56.54 ± 8.34
Duration of diabetes	152	13.41 ± 7.02	154	13.38 ± 6.70	306	13.38 ± 6.70
BMI	152	31.52 ± 6.60	154	31.34 ± 5.39	306	31.43 ± 6.01
Number of Visits	152	9.68 ± 3.84	154	6.22 ± 1.42	306	7.94 ± 3.37
HbA1c	152	8.94 ± 1.45	154	8.06 ± 1.44	306	8.50 ± 1.51
SBP	152	135.79 ± 12.2	154	136.14 ± 12	306	135.96 ± 13.04
DBP	152	75.51 ± 7.12	154	76.15 ± 7.59	306	75.83 ± 7.36
TG	152	1.65 ± 0.81	154	1.75 ± 1.17	306	1.70 ± 1.01
Cholesterol	152	4.32 ± 0.90	154	4.40 ± 1.05	306	4.36 ± 0.98
HDL	152	1.17 ± 0.32	154	1.00 ± 0.25	306	1.09 ± 0.30
LDL	152	2.42 ± 0.82	154	2.67 ± 0.85	306	2.55 ± 0.84

Table 4: Results of Student t-test comparing the means

Characteristics	HOSPITAL				t-test	*p*-Value	95% C.I
	KAUH		KKUH				
	No	Mean ± SD	No	Mean ± SD			
HbA1c	152	8.94 ± 1.45	154	8.06 ± 1.44	5.3265	<0.0001	0.5549 to 1.2051
Triglycerides	152	1.65 ± 0.81	154	1.75 ± 1.17	0.8682	0.3860	−0.327 to 0.1267
Cholesterol	152	4.32 ± 0.90	154	4.40 ± 1.05	0.7152	0.4751	−0.300 to 0.1401
LDL	152	2.42 ± 0.82	154	2.67 ± 0.85	2.6179	0.0093	−0.438 to −0.062
HDL	152	1.17 ± 0.32	154	1.00 ± 0.25	5.1823	<0.0001	0.1054 to 0.2346
SBP	152	135.79 ± 12.92	154	136.14 ± 13.20	0.1205	0.9041	−3.119 to 2.7587
DBP	152	75.51 ± 7.12	154	76.15 ± 7.59	0.7605	0.4475	−2.296 to 1.0160

Table 5: Assessment of the level of diabetes control by Chi-square Test

Characteristics	No	Hospital				95% C .I	*p*-Value
		KAUH		KKUH			
		No (152)	%	No (154)	%		
HgbA1c in two groups							
≤7	64	18	11.8	46	29.9	0.32	0.000
>7	242	134	88.2	108	70.1	(0.17–	1
						0.60)	
TG in two groups in mmol/L							
≤1.7	183	93	61.2	90	58.4	1.12	0.642
>1.7	123	59	38.8	64	41.6	(0.69–	5
						1.82)	
Cholesterol in two groups in mmol/L	248	132	86.8	116	75.3	2.16	0.012
≤5.17	58	20	13.2	38	24.7	(1.15–	8
>5.17						4.10)	
LDL in two groups mmol/L							
≤2.60	164	92	60.5	72	46.8	1.75	0.016
>2.60	142	60	39.5	82	53.2	(1.08–	5
						2.82)	

HDL IN TWO GROUPS (Male) mmol/L							
≤1.03	94	32	41.6	62	64.6	0.39	0.003
>1.03	79	45	58.4	34	35.4	(0.20–0.76)	4
HDL IN TWO GROUPS (Female) mmol/L							
<1.29	91	45	60.0	46	79.3	0.39	0.023
≥1.29	42	30	40.0	12	20.7	(0.17–0.92)	7
DBP IN TWO GROUPS (mmHg)	220	112	73.7	108	70.1	1.19	0.526
≤80	86	40	26.3	46	29.9	(0.70–2.03)	1
>80							
SBP IN TWO GROUPS (mmHg)	87	44	28.9	43	27.9	1.05	0.899
<130	219	108	71.1	111	72.1	(0.62–1.78)	4
>130							

Assessment of Hypercholesterolemia Control

The patients on antilipidemic drugs were 82%, while those using HMG-CoAreductase inhibitors (statins) and fibricacid derivatives were 77.45% and ~3%, respectively. Only

six patients were on ezetimibe at the diabetes center (KAUH). Table 3 represents the lipid profiles of total sample with means 4.36 ± 0.98 mmol/L, 1.7 ± 1.01 mmol/L, 1.09 ± 0.3 mmol/L and 2.55 ± 0.84 mmol/L, respectively, for cholesterol, triglycerides, HDL and LDL. Table 4 shows significant difference in the level of LDL and HDL [LDL: 2.42 ± 0.82 mmol/L (KAUH) vs. 2.67 ± 0.85 mmol/L (KKUH); $p < 0.0001$ and HDL 1.17 ± 0.32 mmol/L (KAUH) vs. 1 ± 0.25 mmol/L (KKUH); $p < 0.0001$) between the patient population of two centers. However, no statistically significant difference was found for triglycerides in patients treated in the two different centers. Following are the overall percentage of patients with controlled lipid profile: 81% with controlled total cholesterol; 53.6% with controlled LDL-cholesterol; 45.7% males with controlled HDL-cholesterol while 31.6% females with controlled HDL-cholesterol; 60% with controlled triglycerides level. We also compared the percentage with respect to controlled targets between the patients treated in KKUH and KAUH, respectively: Cholesterol ≤5.17 mmol/L, 75.3% vs. 86.8% ($p = 0.0128$); triglycerides ≤1.7 mmol/L, 58.4% vs. 61.2% ($p = 0.6425$); LDL ≤2.6 mmol/L, 46.8% vs. 60.5%, ($p = 0.0165$); HDL inmales ≥1.03 mmol/L, 35.4% vs. 58.4% ($p = 0.0034$); HDL in females ≥1.29 mmol/L, 20.7% vs. 40% ($p = 0.0237$) [Table 5].

Assessment of Hypertension Control

The mean blood pressure of the total population was 135.96 ± 13.04 mmHg and 75.83 ± 7.36 mmHg, respectively for systolic and diastolic blood pressure [Table 3].

The majority of patients were on at least two antihypertensive medications. Percentage of patients taking ACEI was 59% at KKUH vs. 22.4% at KAUH ($p < 0.0001$), while 25.3% at KKUH were on ARBs vs. 40% at KAUH ($p = 0.006$). The percentage of overall

population achieving the target systolic (≤130 mmHg) and diastolic (≤80 mmHg) blood pressures were 28.4% and 72%, respectively.

The comparison of percentage of controlled targets between the two centers (KKUH vs. KAUH) are shown in Table 5: Systolic 27.9% vs. 28.9%, (p = 0.8994) and diastolic 70.1% vs. 73.7% (p = 0.5261).

Assessment of Care Provided and Complications

Regarding the regular follow-up for patients in the clinics, the mean visits during the four years period of the study in two centers (KKUH vs. KAUH), were 6.22 ± 1.42 vs. 9.68 ± 3.84 suggesting three and four visits per year at KKUH and KAUH, respectively. These numbers are not enough for controlling disease in population with diabetes. According to the guidelines of ADA, the annual screening for micro albuminuria is done using urine albumin and creatinine ratio. This test was not available in KKUH at the time of data collection. However, the 24 hours urinary collection for proteinuria was performed to 68.9% of the patients at KKUH; while it was performed to only 20.4% patients followed at KAUH. This suggests that the physicians at the diabetes center, KAUH were relying more on the Glumerular Filtration Rate (GFR). The annual eye examination of all the patients from KAUH had been referred to the ophthalmologic clinic with regular follow-up, while 95.3% patients of KKUH were referred to the ophthalmologist. We also investigated the complications arising from diabetes, especially macrovascular complications for the study cohort, and found ischemic heart disease, chronic kidney disease, cerebrovascular accident, peripheral arterial disease in 9.7%, 8.3%, 1.7% and 1% patients, respectively. Multivariate analysis was performed to control the

confounders, and the adjusted odd ratios (ORs) were calculated. The calculated ORs are statistically significant for HbA1C with $p = 0.001$ (OR = 4.368 [1.847–10.334]) and HDL-Cholesterol with $p < 0.0001$ (OR = 4.1 [1.959–8.58], while no statistical significance is observed for the other outcomes.

Discussion

We performed a comparative study of diabetes control between patients followed in KKUH and KAUH. Overall 21% of total study population achieved the recommended target of HbA1C, while the overall percentages of patients reaching the optimal goal for total cholesterol, LDL-cholesterol, triglycerides level were 81, 53.6 and 60, respectively. Percentages of patients reaching the optimal goal for HDL-cholesterol were 45.7 in male and 31.6 in female. Only 28.4% achieved target SBP, while DBP was controlled to optimal target by 72% of patient population. The level of control in our patients is at par with the global average of patients with diabetes who reached the recommended targets. A survey conducted by WHO in seven countries for assessing the level of disease control in patients with diabetes with respect to recommended target, found that only a small fraction of individuals with diabetes met the recommended treatment targets. Comparison of the rates of diabetes control between patients treated in specialized diabetes clinics and primary care sitting is a difficult task, because of the variability of severity of diabetes, the facilities provided, limitation of time and different definitions of controlled diabetes according to the co-morbidities of patients. Nevertheless, the current percentage of glycemic control at KKUH had improved slightly to 30% compared to 25% in 2006.[20] Similar studies have been conducted in different

countries for comparing the level of disease control in patients with diabetes between the primary care clinics and the specialized clinics. All of these studies revealed that patients followed up in a primary care set up had better control of their blood sugar level. Aria *et al*.[16] conducted a study in Japan to determine the status of diabetes care by general practitioners and diabetes specialist. They found that the mean HbA1C level for all patients treated by general practitioners was significantly lower than for those treated by the diabetes specialists (6.8 ± 1.2% vs. 7.0 ± 1.2%, $p = 0.0002$).[16] Another study[22] conducted in Malaysia revealed that the average of HbA1C was 7.4 at the primary care clinics, whereas average of HbA1C in the tertiary hospital was between 8.6 and 9.1. Level of difficulty in controlling a disease depends on the severity of a disease, e.g., controlling the disease in patients with insulin-dependent diabetes is more difficult due to severity of the disease. Patients with type 2 diabetes when finally receiving insulin means that the disease has progressed to more severe stages.[10] In our study population, almost 47% were using insulin, while 53% were on oral hypoglycemic agents alone. At KAUH more than half of the patients (54%) and two-fifth at KKUH were on insulin (40%), and the difference in the percentages were significant ($p = 0.0165$). The patients at KAUH used more oral hypoglycemic agents than those at KKUH suggesting that the patients at the diabetes center somewhat had more severe diabetes or the physicians are treating the disease more aggressively. Hypercholesterolemia occurs as a result of metabolic derangement in type 2 diabetes mellitus patients basically due to insulin resistance leading to defect in lipid handling. Insulin resistance, relative insulin deficiency, and obesity are associated with hypertriglyceridemia, low serum HDL cholesterol concentrations, and occasionally with high serum LDL

cholesterol and lipoprotein (a) values. The very high risk of atherogenicity is associated with the small dense LDL particles, which are known for aggressive lowering of LDL-C to therapeutic targets, more among patients with diabetes, and this pattern of lipid abnormalities can be detected before the onset of overt hyperglycemia.[22] The National Cholesterol Education Program (NCEP) advice physicians to consider new and more intensive options for patients at high and moderately high risk of heart attack. However, these options include setting lower treatment goals since diabetes is a cardiovascular risk equivalent.[23] We found that hypercholesterolemia management at both centers was better than managing hyperglycemia as evident from the percentages of patients with controlled targets. The difference between the two groups regarding the level of control might be related to the type of medication they use, as most of the patients at KAUH were on atorvastatin, while those at KKUH were on simvastatin. Our findings are in agreement with the studies[24-26] done to compare the outcomes between atorvastatin and simvastatin. It has been reported that the prevalence of hypertension in patients with diabetes varies from 39–46%. The prevalence in patients with controlled SBP <130 mmHg was 14.4% while with controlled DBP <85 mmHg was 16%.[27] The benefits of tight blood pressure control in patients with diabetes exceed the benefits of tight glycemic control. It not only extends to the prevention of macro-vascular disease, but also the prevention of micro-vascular complications. We found that the management of hypertension at both centers were suboptimal with the percent of patients achieved the target goal at KAUH were around 29% and at KKUH around 28% for the systolic blood pressure, while for diastolic blood pressure around 74% and 70%, respectively, despite the aggressive management at both centers with the recommended antihypertensive

medications. Hyperglycemia and elevated HbA1C are correlated with increased arterial intima-medial thickness and arterial stiffness, which could reduce the efficacy of antihypertensive drugs. Finally, hyperglycemia is associated with vascular smooth muscle dysfunction in animals and humans, providing another potential mechanism for resistance of antihypertensive therapy.[28] The management of diabetes and its complications is challenging. For a variety of reasons, some people with diabetes and their health care providers do not achieve the desired goals of treatment. Rethinking the treatment regimen may require assessment of the barriers hindering the disease control such as health literacy, diabetes stress, demands of competency and responsibility of health care providers and patients themselves. Diabetes care is mainly based on self-management by the patient. Quest for improving glycemic control mainly depends on willing cooperation by the patient irrespective of the technical expertise applied. This, in turn, depends on the patients' awareness and understanding of the risks of diabetes and the potential benefit of glycemic control. Self-care practices (as mentioned above) in diabetes are crucial to keep the illness under control and as much as 95% of the self-care is usually provided by the patients or their families. Self-care not only involves just merely completing these activities, but also considering the interrelationships amongst them and implementing appropriate changes in the daily plan when necessary. In order to perform effective self-care, the patient needs physical skills, cognitive function and an awareness of how psychological factors affect self-care.[7] The percentage of patients with good glycemic control is 20.9%, still low, and this disease is growing in our community and we are still not achieving the desired goals in a good number of patients with diabetes. We need to change the system of care, rather than the magnitude of

facilities. The most successful practices have an institutional priority for providing high quality of care.[29] Changes that have been shown to increase quality of diabetes care include basic care on evidence based guidelines.[30] Expanding the role of teams and staff,[31] redesigning the process of care,[32,33] activating and educating patients,[34,35] and identifying and/or developing and engaging community resources and public policy that support healthy lifestyle would have considerable effect on the disease control. The quality of diabetes care delivered to patients fall below the expectations of practice guidelines and clinical trial evidences. Studies in many jurisdictions with varying health care systems have shown that recommended processes of care provided less often than they should; hence, outcomes of care are inadequate. Many studies comparing care between specialists and generalists have found that specialists are more likely to implement processes of care. However, this provides little insight into improving quality of care, as the difference between specialists and generalists in these studies is small compared to the overall deficiency in quality. Therefore, future research should instead focus on ways to implement high quality care, regardless of specialty.[14]

Delimitation vs. Limitations

The delimitations in our study include the following points: (i) using a three years follow-up data, not a single point to estimate diabetes control, (ii) collecting both patients and management data that can affect diabetes control, and (iii) matching the patients from the two clinics based on demographics to limit their confounding effects. However, our study faced few challenges, which were potential weakness of our study, and we acknowledge those limitations. Firstly, we used a retrospective cohort design, which is

liable to selection bias. Since all the data were extracted from a single health care facility we cannot generalize our findings. Lastly, we also acknowledge the possibility of referral bias in our study.

Conclusions

The overall percent of patients who achieved the recommended targets were unsatisfactory compared to only 21% achieving the recommended glycemic target. The rate of glycemic control in this study was significantly different when compared between the two centers, the primary care center and the diabetes center (29.9% vs. 11.8%; p = 0.0001). The rate of hypercholesterolemia control was also significantly different. However, after multivariate analysis only there was significance for glycemic control and HDL-cholesterol. Based on our findings we recommend more effective management for patients with uncontrolled diabetes. Change of medications, doses and frequent follow-up are essential to improve the disease control. In this regard, a prospective study examining both patients and physicians for causes of uncontrolled diabetes as well as adherence to guidelines (physicians) and medications (patients), in future, may be effective in reducing the risk of bias as well as ascertaining adherence, which cannot be examined from patients' charts.

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