Quality of care provided to diabetic patients attending primary health care centers in National Guard in Makkah Region, Saudi Arabia

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ABSTRACT

Background: Diabetes is a costly and serious health problem that is increasing markedly. The quality of care is a major issue among diabetic patients. This study aims to assess the quality of care provided to diabetic patients using the American Diabetes Association (ADA) indicators. Methods: This was a cross-sectional study conducted using a retrospective chart review. The population was adult diabetic patients (type 2) who had attended the National Guard’s primary healthcare centers, Makkah region, Saudi Arabia, from January 1, 2017, to December 31, 2018. Results: We studied 400 adult diabetic patients aged 30–97 years with a mean age of 58.25 (SD = 11.9). The length of time with diabetes ranged from 1 to 42 years with a mean of 9.66 years (SD = 7.6). Among all the primary healthcare centers (PHCs), specialized polyclinic (SPC) had the highest number of patient visits. Furthermore, the SPC had the highest number of patients with complications; the primary healthcare center with the fewest complications was Iskan-Jeddah. The results show that the control of hemoglobin A1C (HbA1C) was better in 2018 than in 2017. Conclusion: There is improved and adequate care provided to patients among the assessed primary healthcare centers in the Makkah region. Nevertheless, there remains a need for interventions to maintain comprehensive data on diabetes performance. Monitoring and proper education on diabetic care to patients are suggested to achieve better control of diabetes and delay the occurrence of complications.

Keywords: Diabetes, primary healthcare centers, quality of care provided to diabetic patients

Introduction

Diabetes mellitus (DM) is a chronic condition reflected by increased glucose levels because the body cannot produce sufficient insulin or use insulin efficiently. According to the International Diabetes Federation (IDF), there are approximately 425 million people who live with diabetes worldwide. This is 8.8% of the adult population among 20–79-year-olds. This rises to 451 million cases aged 18–99 years. If these trends continue, there will be 693 million diabetics in 2045. Diabetes is an epidemic that causes high rates of morbidity and mortality in Saudi Arabia. According to the World Health Organization (WHO), Saudi Arabia has the second-highest rate of diabetes cases in the Middle East (seventh globally). Around 7 million people live with diabetes and 3 million live with...
Based on a nationwide study, we estimated that the total prevalence of diabetes in Saudi Arabia is 23.7%. The highest prevalence was found in the northern and eastern regions at 27.9 and 26.4%, respectively. The prevalence in the western, central, and southern regions was 24.7, 23.7, and 18.2%, respectively. Another study in Jeddah by Alqurashi et al. (2011) showed an even higher prevalence of diabetes at 30%.

Family physicians play a key role in diabetic care and management. This permits the patients to attain more control and avoid the development or worsening of diabetes. However, the quality of care provided to diabetic patients is a major issue both for the physicians and patients. This paved the way for the American Diabetes Association (ADA) to establish standards to measure the quality of care for diabetic patients.

The ADA’s “Standards of Medical Care in Diabetes,” is also referred to as the Standards of Care and is envisioned to give the patients, clinicians, payers, researchers, and others the components and mechanisms of diabetes care, tools to assess the quality of care, and general treatment goals. The Standards of Care recommendations are not intended to impede clinical judgment and must be applied in the context of excellent clinical care with variations for individual preferences, other patient factors, and comorbidities.

Several previous studies by Al-Arfaj in 2006, Al-Khaldi in 2014, and Guzu et al. in 2012 have assessed the quality of care for diabetic patients in the primary care settings in Saudi Arabia, but little is known about the quality of care provided to the diabetic patients at the level of primary healthcare centers in the Makkah region in Saudi Arabia. Poor care quality may be seen due to inadequate adherence to practice recommendations despite the availability of many updated practice guidelines.

**Objectives**

This study assesses the quality of care provided to diabetic patients at the primary healthcare centers of the National Guard in Makkah using the ADA indicators. Moreover, we further compare these care metrics between the primary healthcare centers (PHCs) in the region. Accordingly, suggestions on the quality-of-care improvement can be provided to the authorities if needed. To our knowledge, this study is the first of its kind in the region.

**Subjects and Methods**

**Study design**

This was a cross-sectional descriptive study using a retrospective chart review. The study was conducted at four PHCs of the National Guard in the Makkah region, Saudi Arabia. These centers provide preventive and curative services, and one of the most important services is the Chronic Diseases Clinics that provides care and treatment for diabetics. These clinics include Iskan PHC at King Faisal Residential City in Jeddah, the Specialized Poly Clinic (SPC) PHC in Jeddah, Bahra PHC, and Iskan PHC at King Khalid Residential City in Taif.

**Study population and sampling technique**

Four hundred adult diabetics patients (type 2) who had attended the PHCs of the Ministry of National Guard-Health Affairs in the Makkah region, Saudi Arabia, were included from January 1, 2017, to December 31, 2018. The inclusion criteria included adult patients aged ≥18 years who had been diagnosed with type 2 diabetes. The patients should have been on oral hypoglycemic agents or insulin therapy and a regular follow-up for at least two visits per year during the study period. The adults with gestational diabetes mellitus (GDM) were excluded.

The patients were selected from four PHCs using a systematic random sampling technique with equal allocation. The records were entered into a spreadsheet for random sampling technique; 100 files were selected from each center.

All the diabetics who fulfilled the inclusion criteria were enrolled. All the patients signed an informed consent form for participation indicating their right to refuse or withdraw without cause or consequences. Their confidentiality was maintained and ensured.

**Research instrument and data collection**

A questionnaire was generated and reviewed thoroughly by two expert endocrinologists, and a pilot test was performed on the records of 40 patients to assess the validity and reliability of this tool using the aforementioned sampling technique. The questionnaire included basic demographic and clinical information of the patients such as age, gender, duration of diabetes, nationality, marital status, educational level, occupation, treating physician characteristics, management in other departments, and smoking habits. The indicators of glycemic control, metabolic profile control, and those relevant to the detection and management of diabetes complications were also collected. The process and outcomes of the services provided by the PHCs under study were evaluated by the standard process and the outcomes indicators as demonstrated by the ADA. These included 18 process indicators and 10 outcome indicators.

The process indicators included the measurements of hemoglobin A1C (HbA1C) at least twice annually as well as the assessment of blood pressure, weight, and body mass index on each routine visit. The following assessments should have been performed once per year: low-density lipoprotein, albumin-to-creatinine ratio, serum creatinine, a dental visit, and screening for depression. On an annual basis, the patients should have been referred for eye examination and foot examination. They should have received effective diabetes education, an educational booklet for self-monitoring of blood glucose, dietary advice, and exercise instructions at least once annually. We also anticipated that the diabetic patients might have received the influenza vaccine and monitoring of vitamin B12 for the patients on metformin. Pneumococcal vaccination should have been given.

For the anticipated outcome indicators, the HbA1C goal was assumed to be less than 7% and a less stringent A1C goal (<8%)
was set for the diabetic patients with a history of severe hypoglycemia, limited life expectancy, higher comorbidities, and advanced micro- or macro-vascular complications. For the blood pressure, the expected target was <140/90 mmHg among the patients with a low risk of cardiovascular disease and <130/80 mmHg among those with a high risk of cardiovascular disease. For low-density lipoprotein (LDL), the goal was assumed to be <100 mg/dL with moderate cardiovascular risk and below 70 mg/dL in those with a high cardiovascular risk. Other outcome indicators included the proportion of diabetic patients with no micro-complications (microalbuminuria, retinopathy [non-proliferative or proliferative], and neuropathy), no macro-complications (coronary artery disease, peripheral arterial disease, and stroke/transient ischemic attack), and no diabetic foot. The body mass index target was assumed to be between >18.5 and <25 kg/m².

Data analysis
The data was analyzed using the IBM SPSS version 23 (IBM Corp., Armonk, NY). A simple descriptive statistic was used for categorical (frequencies and percentages) and continuous variables (mean and standard deviations). The correlation between the categorical variables was assessed via a Chi-square test. For continuous variables with more than two groups, a one-way analysis of variance (ANOVA) test was used followed by the least significant differences (LSD) for post hoc comparisons of significantly different outcomes. These tests were performed based on normal distribution. Alternatively, the Games Howell testing was used for multiple groups with unequal variances. The criteria for rejecting the null hypothesis were at the standard P value of <0.05.

Ethical considerations
The study’s protocol was approved by the Institutional Review Board of King Abdullah International Medical Research Center. For the data collection phase, all participants signed a consent form attached to the data collection sheet, which specifically explained the nature and the aim of the study as well as the confidentiality of their data and personal information.

Results
Characteristics of the study population
The records of 400 patients with T2DM were analyzed. The patient records were equally extracted across the four PHCs under study (n = 100 in each PHC). [Table 1] shows that the participants’ ages ranged from 30 to 97 years with a mean value of 58.25 (SD = 11.9). Of the included patients, 193 (48.3%) were females; most of them (91.5%) were married. A large proportion of the patients had no documented data regarding their educational levels (90.5%), occupation (76.3%), and smoking habits (65.5%). The remaining records with the available data are listed in [Table 1].

On average, the patients were diagnosed with diabetes for 9.66 (SD = 7.6) years with a range of 1–42 years. The duration between the last two visits to the PHCs ranged between 1 and 11 months with a mean duration of 2.84 (SD = 1.8). The other additional data regarding the clinical information and medical history of the included patients in 2017 and 2018 are shown in [Table 2].

Characteristics of attending physicians of the respondents
The information on the highest academic degrees of the doctors who had checked the patients in 2017 and 2018 was also gathered to determine if the patients were given expert opinions. In 2017, the patients were mostly checked by staff physicians (80.2%), followed by family medicine residents (43.9%) and associate consultants in family medicine (43%). In 2018, the staff physicians, family medicine consultants, and family medicine residents treated the patients (80.3, 52.3, and 40.3%, respectively).

Level of HbA1c of the patients: As an outcome
The ranges of HbA1c among the patients with diabetes in different PHCs differed between 2017 and 2018 [Table 3]. Of the whole population, 324 and 334 had HbA1c of <7% in 2017 and 2018, respectively. In 2017, prediabetes (HbA1c of 7–9%) was prevalent among 53 patients in 2017 and 35 patients in 2018. For patients with HbA1c >9%, there were 11 patients in 2017 and 13 in 2018.

Among the four centers, Iskan-Jeddah, Iskan-Taif, and Bahrah showed an increasing trend in the patients with HbA1c <7%; all the centers had a declining trend of patients with HbA1c 7–9%. Interestingly, HbA1c control relatively improved with time considering the greater proportion of the patients with HbA1c <7% in 2018 versus 2017. This indicates that there was a high control for both years and a positive response among the patients with diabetes. Furthermore, based on the results of the
statistical analysis, the level of HbA1C was significantly different at $P < 0.05$ between 2017 and 2018 among the different PHCs.

**Comparison of the patients’ medical history from different PHCs**

The ANOVA results showed significant differences in the means of the process indicators performed at different PHCs. For example, SPC reported a significantly higher number of visits, the number of physicians who checked the patients, the number of BMI checkups during routine visits, and the frequency of documented diabetes education and dietary advice on routine visits ($P < 0.0001$ for all the parameters); these findings were consistent in 2017 and 2018. In addition, in 2017, the mean number of blood pressure measurements was significantly higher in SPC compared to other PHCCs ($P = 0.001$). However, the mean number of HbA1c tests and dental visits was significantly higher in Iskan-Jeddah than in the other centers ($P < 0.0001$ for all the parameters, [Table 4]).

Based on the Chi-square test, there were significant differences among the PHCCs in terms of providing self-monitoring blood glucose booklets ($P$-value $<0.001$), performing albumin-to-creatinine ratio tests ($P$-value $<0.001$), performing serum creatinine tests ($P$-value $<0.001$), referral for eye exam ($P$-value $<0.001$), performing foot examinations ($P$-value $<0.001$), and giving the influenza and pneumococcal vaccines ($P$-value $<0.001$). Furthermore, significant differences were reported for patients with

| Demographics $n=400$ | Min | Max | Mean | Median | SD |
|----------------------|-----|-----|------|--------|----|
| Age (by years)       | 30  | 97  | 58.25| 57.00  | 11.9 |
| How long has the patient been diagnosed with diabetes? (in years) | 1   | 42  | 9.66 | 8.00   | 7.6 |
| Duration between the last two visits (in months) | 1   | 11  | 2.84 | 3.00   | 1.8 |

| The primary healthcare center that patient is the following in | Frequency | Percent | Valid percent | Cumulative percent |
|-------------------------------------------------------------|-----------|---------|---------------|--------------------|
| SPC                                                          | 100       | 25.0    | 25.0          | 25.0               |
| Bahra                                                        | 100       | 25.0    | 25.0          | 50.0               |
| Iskan-Jeddah                                                | 100       | 25.0    | 25.0          | 75.0               |
| Iskan-Taif                                                  | 100       | 25.0    | 25.0          | 100.0              |
| Gender                                                      |           |         |               |                    |
| Male                                                        | 207       | 51.8    | 51.8          | 51.8               |
| Female                                                      | 193       | 48.3    | 48.3          | 100.0              |
| Nationality                                                 |           |         |               |                    |
| Saudi                                                       | 400       | 100.0   | 100.0         | 100.0              |
| Marital status                                              |           |         |               |                    |
| Married                                                     | 366       | 91.5    |               | 91.5               |
| Unmarried                                                   | 34        | 8.5     | 8.5           | 100.0              |
| Educational level                                           |           |         |               |                    |
| Unknown (not documented)                                    | 362       | 90.5    | 90.5          | 90.5               |
| Illiterate                                                  | 10        | 2.5     | 2.5           | 93.0               |
| Primary                                                     | 9         | 2.3     | 2.3           | 95.3               |
| Secondary                                                   | 14        | 3.5     | 3.5           | 98.8               |
| Unmarried Person                                            | 5         | 1.3     | 1.3           | 100.0              |
| Occupation of the patient                                   |           |         |               |                    |
| Not documented                                              | 305       | 76.3    | 76.3          | 76.3               |
| Homemaker                                                   | 46        | 11.5    | 11.5          | 87.8               |
| Military                                                    | 27        | 6.8     | 6.8           | 94.5               |
| Professional                                                | 5         | 1.3     | 1.3           | 95.8               |
| Retired                                                     | 17        | 4.3     | 4.3           | 100.0              |
| Smoking habits of the patient                               |           |         |               |                    |
| Unknown (not documented)                                    | 262       | 65.5    | 65.5          | 65.5               |
| Non-Smoker                                                  | 93        | 23.3    | 23.3          | 88.8               |
| Smoker                                                      | 45        | 11.3    | 11.3          | 100.0              |
| How long has the patient been diagnosed with diabetes? (in years) |           |         |               |                    |
| Not documented                                              | 111       | 27.8    | 27.8          | 27.8               |
| 1-5 years                                                   | 120       | 30.0    | 30.0          | 57.8               |
| 6-10 years                                                  | 81        | 20.3    | 20.3          | 78.0               |
| >10 years                                                   | 88        | 22.0    | 22.0          | 100.0              |
| Type of diabetes                                            |           |         |               |                    |
| DM type 2                                                    | 400       | 100.0   | 100.0         | 100.0              |

**Table 1: Demographic characteristics of the participants ($n=400$)**

| Demographics       | Min | Max | Mean | Median | SD |
|--------------------|-----|-----|------|--------|----|
| Age (by years)     | 30  | 97  | 58.25| 57.00  | 11.9|
| How long has the patient been diagnosed with diabetes? (in years) | 1   | 42  | 9.66 | 8.00   | 7.6 |
| Duration between the last two visits (in months) | 1   | 11  | 2.84 | 3.00   | 1.8 |

In SPC compared to other PHCCs ($P = 0.001$). However, the mean number of HbA1c tests and dental visits was significantly higher in Iskan-Jeddah than in the other centers ($P < 0.0001$ for all the parameters).
hypertension (P-value <0.001), lipid disorders (P-value <0.001), diabetic kidney disorder (P-value <0.001), diabetic retinopathy (P-value <0.001), and diabetic foot (P-value <0.001, [Table 4]).

**Discussion**

The findings revealed slight differences in the indicators of quality of care in 2017 and 2018: the number of visits, number of doctors who saw the patients, number of HbA1c tests, levels of HbA1c (four readings), levels of diastolic and systolic blood pressure (three readings), levels of LDL, and number of times body mass index were checked. The dental visits and screening for depression were also analyzed. The means of the variables in 2017 were slightly higher than those in 2018 except for the first and second readings of systolic blood pressure, the fourth reading of HbA1c testing, and the number of screening tests for depression in 2018.

The process of care for the HbA1c levels consistently improved from the first to the third reading between 2017 and 2018. Of note, the mean HbA1c levels in our analysis (8.09–8.32 in 2017...
and 7.87–8.34 in 2018) were low compared to the mean value indicated in a previous study by Guzu et al. (9.4%). However, our mean values were comparable to the value reported for the diabetic patients in a rural health clinic in Montana (7.43%) and community health centers in Chicago (8.6%). On the national level, Alfadda et al. showed better indicators of HbA1c control in a PHCC in Riyadh (with the mean values ranging between 7.65 and 7.84%). The difference in the HbA1c values suggests an improved quality of care provided to diabetic patients and higher adherence levels to the guidelines of HbA1c in the PHCC. Based on these findings, we showed enhanced compliance rates to receiving care among diabetic patients and a better-quality systematic approach in monitoring and controlling the HbA1c rates. In contrast, Guzu et al. reported a low control of HbA1c relative to the HbA1c target of <7%. Similarly, Babwah et al. reported uncontrolled diabetes among 9.44% of the patients attending a Trinidadian health center. However, the mean level of HbA1c was 6.9% in an early study. Furthermore, a previous study showed comparable results to our findings with a mean HbA1c level of 6.9%. Overall, effective diabetes supervision was demonstrated with a comprehensive system of care. Our patients obtained key care procedures and had steady HbA1c measurements. The follow-ups of laboratory investigations, increased number of staff physicians, and ongoing diabetic education should be continued.

Regarding blood pressure control, our findings showed that the most recent reading of the mean systolic blood pressure as well as all the readings of diastolic blood pressure in 2018 improved versus those in 2017. Furthermore, more than 50% of the diabetic patients in the SPCs showed an improved BP (<130 mmHg for the systolic blood pressure, 80 mmHg for the diastolic blood pressure). In our study, the blood pressure control in 2018 was generally better than a previous study by Grant et al. in which 46.3% had improved PB. The dental visits decreased in 2018 versus 2017, and depression screening increased in 2018.

The number of diabetic patients with a history of hypertension and/or lipid disorders is greater than in those who did not. The results also showed that the frequencies of patients with a history of diabetic kidney disease, diabetic retinopathy, and diabetic foot are lower than those of their counterparts with no comorbidities.

### Table 3: Patients’ level of hemoglobin A1C and healthcare centers

| Variables            | Year | Total | SPC | Bahra | Iskan-Jeddah | Iskan-Taif |
|----------------------|------|-------|-----|-------|--------------|------------|
| Level of hemoglobin A1C |      |       |     |       |              |            |
| <7                   | 2017 | 324   | 85  | 84    | 71           | 84         |
|                     | 2018 | 334   | 84  | 85    | 77           | 88         |
| 7-9                  | 2017 | 53    | 9   | 9     | 27           | 8          |
|                     | 2018 | 35    | 8   | 6     | 16           | 5          |
| >9                   | 2017 | 11    | 3   | 2     | 1            | 5          |
|                     | 2018 | 13    | 2   | 4     | 6            | 1          |
| P                    | 2017 |       |     |       | 0.001a       |            |
|                     | 2018 |       |     |       | 0.037a       |            |

*Significant using the Chi-square test @<0.5 level*
| Variables | Year | Total | Primary Healthcare Center | Iskan-Taif |
|-----------|------|-------|---------------------------|------------|
|           |      |       | SPC | Bahra | Iskan-Jeddah | |
| How many visits (number)? | 2017 | 400 | 9.76±5.7 | 6.05±2.7 | 4.86±1.8 | 5.98±3.9 | <0.001^a |
| | 2018 | 400 | 8.52±4.9 | 5.32±2.8 | 5.03±2.1 | 5.71±3.7 | <0.001^a |
| How many doctors had seen the patient in the primary healthcare center (number) | 2017 | 400 | 6.06±5.2 | 3.80±1.5 | 3.61±1.4 | 3.96±1.9 | <0.001^a |
| | 2018 | 400 | 5.39±2.7 | 3.72±1.9 | 3.91±1.5 | 3.84±2.0 | <0.001^a |
| How many times was hemoglobin A1C tested? | 2017 | 400 | 2.01±1.0 | 1.99±1.1 | 2.62±1.2 | 2.12±1.0 | <0.001^a |
| | 2018 | 400 | 2.02±1.0 | 1.99±1.1 | 2.60±1.2 | 1.92±0.9 | <0.001^a |
| How many times was blood pressure measured at a routine primary health care center visit? | 2017 | 400 | 5.36±2.6 | 4.51±2.5 | 4.09±1.4 | 4.46±2.2 | 0.001^a |
| | 2018 | 400 | 4.74±2.5 | 3.87±2.5 | 4.17±1.9 | 4.23±2.3 | 0.063 |
| How many times was the body mass index checked during routine visit (number) | 2017 | 400 | 5.37±2.6 | 3.60±2.1 | 3.92±1.4 | 4.37±2.3 | <0.001^a |
| | 2018 | 400 | 4.79±2.5 | 2.92±1.9 | 4.12±1.9 | 4.20±2.3 | <0.001^a |
| How many dental visits (number)? | 2017 | 400 | 0.69±0.9 | 0.21±0.6 | 0.78±1.7 | 0.23±0.7 | <0.001^a |
| | 2018 | 400 | 0.47±0.8 | 0.24±0.7 | 0.92±2.2 | 0.11±0.5 | <0.001^a |
| How many screenings for depression (number)? | 2017 | 400 | 0.06±0.2 | 0.05±0.3 | 0.08±0.3 | 0.03±0.2 | 0.587 |
| | 2018 | 400 | 0.11±0.3 | 0.14±0.8 | 0.10±0.5 | 0.05±0.4 | 0.697 |
| How many regular follow‑ups with an ophthalmologist? | 2017 | 400 | 1.53±1.5 | 1.35±1.9 | 1.08±1.2 | 1.16±1.8 | 0.203 |
| | 2018 | 400 | 31.39±6.2 | 31.93±6.6 | 32.12±5.9 | 32.13±5.7 | 0.807 |
| How much was the patient’s body mass index during the last visit? | 2017 | 400 | 4.93±2.5 | 1.06±1.4 | 3.75±2.4 | 3.08±2.5 | <0.001^a |
| | 2018 | 400 | 4.62±2.2 | 2.98±2.0 | 2.60±1.9 | 3.31±2.3 | <0.001^a |
| Documentation of diabetes education at routine diabetes visits? | 2017 | 400 | 2.33±1.4 | 2.68±1.9 | 2.17±2.0 | 2.34±1.7 | 0.230 |
| | 2018 | 400 | 294 | 26 (22.6%) | 56 (19.0%) | 74 (25.2%) | 87 (29.6%) | <0.01^b |
| Documentation of the Self‑Monitoring of Blood Glucose booklet given? | 2017 | 61 | 19 (31.1%) | 21 (34.4%) | 13 (21.3%) | 8 (13.1%) | |
| | 2018 | 45 | 4 (8.9%) | 23 (51.1%) | 13 (28.9%) | 5 (11.1%) | |
| Does the patient have a history of hypertension? | 2017 | 93 | 30 (32.3%) | 2 (2.2%) | 48 (51.6%) | 13 (14.0%) | <0.001^a |
| | 2018 | 258 | 68 (26.4%) | 61 (23.6%) | 51 (19.8%) | 78 (30.2%) | |
| Does patient have history of any lipid disorders? | 2017 | 49 | 2 (4.1%) | 37 (75.5%) | 1 (2.0%) | 9 (18.4%) | |
| | 2018 | 31 | 6 (19.4%) | 0 (0.0%) | 17 (54.8%) | 8 (25.8%) | <0.001^a |
| Does the patient have a history of diabetic kidney disease? | 2017 | 335 | 94 (28.1%) | 79 (23.6%) | 82 (24.5%) | 80 (23.9%) | |
| | 2018 | 34 | 0 (0.0%) | 21 (61.8%) | 1 (2.9%) | 12 (35.3%) | |
| How many times coronary risk profile tested? | 2017 | 7 | 1 (14.3%) | 1 (14.3%) | 2 (28.6%) | 3 (42.9%) | 0.101 |
| | 2018 | 75 | 17 (22.7%) | 25 (33.3%) | 10 (13.3%) | 23 (30.7%) | |
| How many times was the albumin‑to‑creatinine ratio tested? | 2017 | 170 | 56 (32.9%) | 36 (21.2%) | 30 (17.6%) | 48 (28.2%) | |
| | 2018 | 198 | 44 (22.2%) | 47 (23.7%) | 64 (32.3%) | 43 (21.7%) | |
| How many times was the serum creatinine tested? | 2017 | 6 | 0 (0.0%) | 2 (33.3%) | 0 (0.0%) | 4 (66.7%) | <0.001^c |
| | 2018 | 119 | 50 (42.0%) | 24 (20.2%) | 14 (11.8%) | 31 (26.1%) | |
| How many times was the retinopathy tested? | 2017 | 275 | 50 (18.2%) | 74 (26.9%) | 86 (31.3%) | 65 (23.6%) | |
| | 2018 | 175 | 62 (35.4%) | 31 (17.7%) | 54 (30.9%) | 28 (16.0%) | <0.001^a |
| How many times was there a referral for an eye exam? | 2017 | 157 | 2 (1.3%) | 59 (37.6%) | 40 (25.5%) | 56 (35.7%) | |
| | 2018 | 196 | 26 (13.3%) | 58 (29.6%) | 45 (23.0%) | 67 (34.2%) | <0.001^a |
| Does the patient have a history of diabetic foot? | 2017 | 172 | 71 (41.3%) | 38 (22.1%) | 31 (18.0%) | 32 (18.6%) | |
| | 2018 | 32 | 3 (9.4%) | 4 (12.5%) | 24 (75.0%) | 1 (3.1%) | |
| How many times was the foot examination tested? | 2017 | 244 | 43 (17.6%) | 82 (33.6%) | 37 (15.2%) | 82 (33.6%) | |
| | 2018 | 258 | 49 (19.0%) | 82 (31.8%) | 45 (17.4%) | 82 (31.8%) | <0.001^a |

*Contd...*
Among the PHCCs in our analysis, SPC had the highest number of visits for the patients with follow-up for diabetes care. They also had the most doctors who had seen the patients and the number of times that the body mass index (BMI) was checked. However, SPC reported the greatest number of patients with complications. For diabetes kidney diseases, diabetes retinopathy and diabetes foot complications [Figures 1, 2 and 3]. The patients in Iskan-Jeddah had the lowest number of complications. Interestingly, the SPC had the most frequent diabetes education and dietary advice. Bahra had the least diabetes education and Iskan-Jeddah had the least documentation of dietary advice. These results show that the PHCs in the Makkah region have regular and adequate patient monitoring. Thus, the patients were generally at a lower risk of developing life-threatening complications. Iskan Jeddah was the highest in doing diabetic foot examination in 2017/2018 [Figure 4] while bahra clinics was the highest in providing influenza vaccination [Figure 5].

**Conclusion**

In conclusion, this study indicates improved and adequate care in primary healthcare centers in the Makkah region. There were slight temporal improvements in HbA1c, diastolic and systolic blood pressure, and LDL. The rates on the annual checkups and examinations were high and comprehensive.

Nevertheless, there remains a need for interventions to maintain comprehensive data on diabetes performance. Improvements in suitable measures to assess the quality of care should be done. Continuous monitoring and proper education on diabetic care to the patients are suggested to achieve better control on diabetes and delay the occurrence of complications. Enhanced screening and measurements will be a gateway to underscore the need to monitor individuals, and consequently, improve the control rates. Future studies remain essential for more concise and concrete findings to enhance the performance of PHCCs. It is also necessary to assure that more important data be collected to compare the quality of care provided to diabetics at PHCCs. Finally, this study will help Family Medicine physicians by highlighting the areas that need to be improved when it comes to the quality of care provided to diabetic patients.

**Authors contributions**

AMA and FMF: contribute to the conception, design of the work, and revising it critically for important intellectual content

OSB, SAA and SSA contribute to the acquisition, analysis, interpretation of data and drafting the work

All authors approved the final version of this manuscript to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed

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**Table 4: Contd...**

| Variables | Year | Total | Primary Healthcare Center | P |
|-----------|------|-------|---------------------------|---|
|           |      | SPC   | Bahra                     | Iskan-Jeddah | Iskan-Taif |
| Was the influenza vaccine given in 2017/2018? | Not given in 2017 or 2018 | 344 | 77 (22.4%) | 82 (23.8%) | 90 (26.2%) | 95 (27.6%) | 0.001b |
|           | Given either in 2017 or 2018    | 47  | 21 (44.7%) | 12 (25.5%) | 9 (19.1%) | 5 (10.6%) |         |
| Was the pneumococcal vaccine given to the patient? | Not given in 2017 or 2018 | 364 | 83 (22.8%) | 87 (23.9%) | 96 (26.4%) | 98 (26.9%) | <0.001b |
|           | Given either 2017 or 2018        | 36  | 17 (47.2%) | 13 (36.1%) | 4 (11.1%) | 2 (5.6%) |         |
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