



# Glycemic Control in Patients with Diabetes across Primary and Tertiary Government Health Sectors in the Emirate of Dubai, United Arab Emirates: A Five-Year Pattern

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## ABSTRACT

**Objectives:** In the UAE, the comparative prevalence of diabetes is reported as 18.98%, but there are very few studies evaluating glycemic control. Attaining the optimum glycemic control has been a global challenge over the years. However, there is a trend of global improvement with the availability of newer options of antidiabetic medications, increasing numbers of physicians, and patient awareness. Our primary aim was to assess the level of glycemic control across Dubai Health Authority points of care over the past five years. Additionally, we aimed to compare the differences in glycemic control between primary and tertiary centers, between nationalities, and type I and II diabetes. **Methods:** We conducted a retrospective analysis of the electronic medical records of all patients who attended primary and tertiary care centers within the Dubai Health Authority between 2012 and 2016. All patients with any type of diabetes were included in this assessment. **Results:** A total of 26447 patients were included in the study; of these, 73.8% (n = 19508) were UAE nationals while the other nationalities accounted for 26.2% (n = 6939) of patients. The overall mean glycated hemoglobin (HbA<sub>1c</sub>) levels from 2012 to 2016 was 7.76%. Patients attending primary care clinics had a mean HbA<sub>1c</sub> of 7.64% compared to 7.68% for the tertiary care cohort. Out of the total population, 37.7% achieved HbA<sub>1c</sub> < 7%. Over 40% of the patients attending primary care centers achieved HbA<sub>1c</sub> < 7% compared to 34.9% of those who attended tertiary care centers. **Conclusions:** Optimum glycemic target was achieved by less than 40% of patients. Glycemic control is still below the desired levels. However, there has been a trend of improvement in the last few years and we are achieving the international average targets. Further collaborative actions from clinical, educational, and strategic sectors are needed to improve our goals further.

**D**iabetes mellitus is one of the fastest growing non-communicable diseases globally. The Middle East is one of the regions with the highest diabetes indices.<sup>1</sup> Of the top 20 countries with highest prevalence of diabetes, seven are from the Middle East and North Africa region. The prevalence of type II diabetes in patients aged 20–79 years in the UAE is estimated to be 17.3%.<sup>1</sup> The mean healthcare expenditure per person with diabetes per year in the UAE is more than \$5000 USD.<sup>1</sup> Moreover, the economic burden of diabetes is expected to increase

with development of diabetes complications. Data from the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) demonstrated that the incidence of diabetic complications is directly related to glycemic control. Furthermore, preliminary WESDR health outcomes data suggest that higher levels of glycemia are related to a decreasing quality of life.<sup>2</sup>

Previous studies have provided evidence of the power of good glycemic control to restrict the microvascular and macrovascular complications of diabetes.<sup>3,4</sup> The results of the Diabetes Control

and Complications Trial showed that intensive insulin therapy and improved glycemic control reduced diabetic complications in people with type I diabetes.<sup>5</sup> Results of the U.K. Prospective Diabetes Study and the Kumamoto trial also support the relationship between glycemic control and diabetic complications in individuals with type II diabetes.<sup>6,7</sup> Despite that, between 40% and 60% of patients worldwide still have poorly controlled diabetes.<sup>8-11</sup>

Attaining the benchmark of the American Diabetes Association ( $HbA_{1c} < 7\%$ ) has always been a global challenge.<sup>9,12,13</sup> Given the propagated cost of treating diabetes and its complications, very few countries have managed to report a positive trend in diabetes control.<sup>9,12,13</sup>

Despite the high prevalence of diabetes in the UAE, very few studies have evaluated diabetes control patterns over the last few years.<sup>14-18</sup> In the UAE, all national citizens and expatriates (the majority of whom have health insurance) receive free medical treatment; a fact that raises the expectations of having a high percentage of patients with controlled diabetes status.

This study was conducted in Dubai Health Authority (DHA), the main governmental health sector in the emirate of Dubai in the UAE. DHA has 13 primary care centers that manage patients with diabetes, in addition there are three hospitals with specialized tertiary diabetes care departments.

Our primary aim was to assess the level of glycemic control across DHA points of care over the past five years (2012–2016). Additionally, we aimed to compare the differences in glycemic control between primary and tertiary centers, between nationalities, and different types of diabetes.

## METHODS

We conducted a retrospective analysis of the electronic medical records of all patients who attended the DHA primary and tertiary care centers from 2012 to 2016.

We analyzed all patients with an International Classification of Diseases (ICD) coding of type I and II diabetes, with or without complications. Since the data was retrospectively collected, we randomly selected any glycated hemoglobin ( $HbA_{1c}$ ) available during the fourth quarter in each year, which may arguably reflect the glycemic control of that particular year.

Patients were categorized based on their  $HbA_{1c}$  into three groups: controlled ( $< 7\%$ ), uncontrolled (7–9%), and poorly controlled ( $> 9\%$ ) diabetes. Different levels of glycemic control were compared between the primary and tertiary services, UAE nationals versus expatriates, and type I versus type II diabetes. Moreover, those who were coded to have advanced cardiovascular or renal complications were categorized (as per American Diabetes Association recommendations) into less tight  $HbA_{1c}$  cutoffs (7–7.5, 7.5–8, and  $> 8\%$ ). The different  $HbA_{1c}$  categories were then compared between primary and tertiary care centers, and UAE nationals and expatriates.

Data was statistically described as mean and standard deviation, median and range, or frequencies (number of cases), and percentages as appropriate. Comparison of numerical variables between the study groups was made using Student *t*-test for independent samples in comparing two groups and one-way analysis of variance (ANOVA) test with post-hoc multiple two-group comparisons for comparing more than two groups. Within-group comparison between the different years was made using the repeated measures ANOVA test. For comparing categorical data, the Chi-square test was performed.

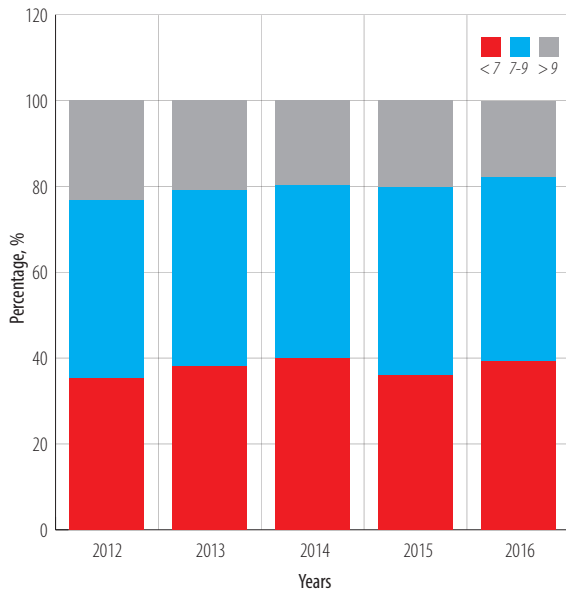
## RESULTS

We reviewed 26 447 patients 73.8% ( $n = 19 508$ ) were UAE nationals while the other nationalities accounted for 26.2% ( $n = 6939$ ). The population was not equally distributed in gender with 51.7% females ( $n = 13 682$ ) and 48.3% males ( $n = 12 765$ ) [Table 1]. The overall mean  $HbA_{1c}$  (across the DHA

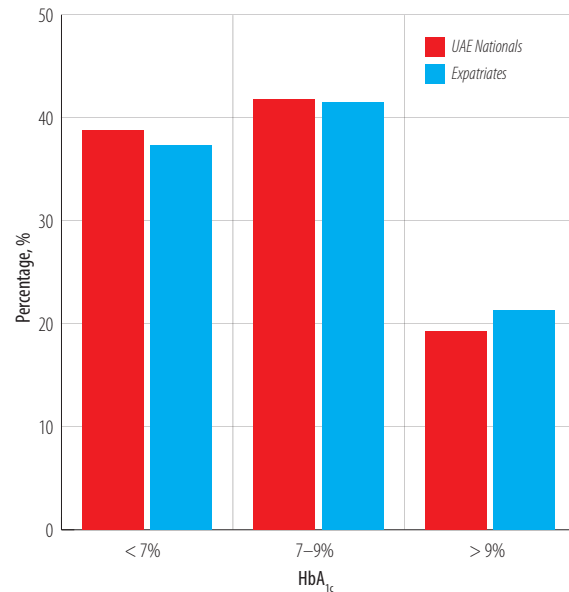
**Table 1:** Demographic distribution of the study population.

Category	Frequency, n	Percentage, %
Males	12 765	48.3
Females	13 682	51.7
UAE nationals	19 508	73.8
Expatriates	6939	26.2
T1DM	2625	9.9
T2DM	23 822	90.1
Tertiary care	10 967	41.5
Primary care	15 480	58.5

UAE: United Arab Emirates; T1DM: type I diabetes mellitus; T2DM: type II diabetes mellitus.



**Figure 1:** Proportions of glycated hemoglobin (HbA<sub>1c</sub>) levels from 2012 to 2016.



**Figure 2:** Mean glycated hemoglobin (HbA<sub>1c</sub>) levels between UAE nationals and expatriates.

clinics) from 2012 to 2016 was 7.76%. Mean HbA<sub>1c</sub> among males was 7.68%, while in females, it was 7.78% ( $p = 0.046$ ). Patients attending primary care clinics had a mean HbA<sub>1c</sub> of 7.64% compared to 7.68% for the tertiary care cohort. In our population, 37.7% achieved HbA<sub>1c</sub> < 7%, while the majority (42.0%) had HbA<sub>1c</sub> of 7–9%, and 20.3% had HbA<sub>1c</sub> > 9% [Figure 1].

Upon comparing primary versus tertiary care patients with HbA<sub>1c</sub> levels < 7, there were 40.8% and 34.9%, respectively [Table 2]. More than one-third of primary care patients (39.7%) had a mean HbA<sub>1c</sub> of 7–9%, compared to 44.4% in tertiary care.

Interestingly, both primary and tertiary care patients had a comparable percentage of HbA<sub>1c</sub> > 9% which was 19.5% and 20.8%, respectively [Table 2].

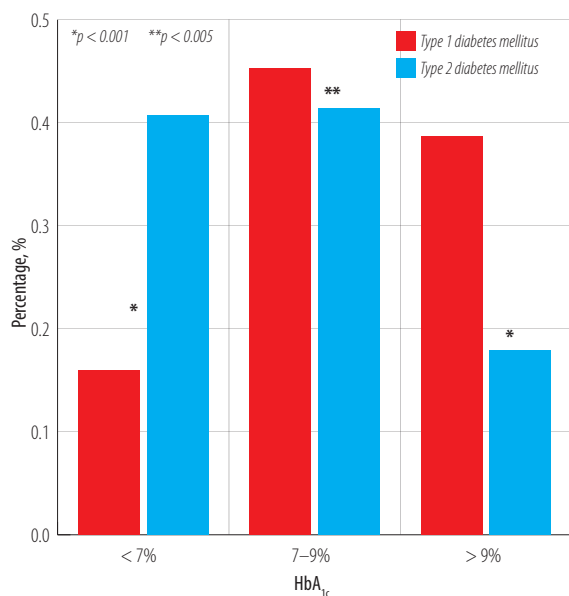
UAE nationals had significantly higher mean HbA<sub>1c</sub> levels (7.84) compared to expatriates (7.65). Of the UAE nationals only 38.8% had HbA<sub>1c</sub> < 7% compared to 37.3% of expatriates [Figure 2].

Patients with type II diabetes had better glycemic control (HbA<sub>1c</sub> < 7%) than patients with type I diabetes; 16.0 and 40.7%, respectively [Figure 3]. Moreover, about 40.0% of patients aged 20–40 years and > 65 years achieved HbA<sub>1c</sub> < 7% in both groups [Figure 4].

**Table 2:** Mean HbA<sub>1c</sub> levels across the study duration and the percentages of HbA<sub>1c</sub> according to health care center type.

Health center type	Mean HbA <sub>1c</sub> /year				
	2016	2015	2014	2013	2012
Overall	7.653	7.803	7.723	7.769	7.899
Primary care	7.639	7.780	7.714	7.609	7.775
Tertiary care	7.671	7.831	7.732	7.968	8.093
<i>p</i> -value	0.370	0.170	0.660	< 0.001	< 0.001
Health center type	HbA <sub>1c</sub> level, %				
	Mean HbA <sub>1c</sub>	< 7%	7–9%	> 9%	
Total	7.76	37.7	42.0	20.3	
Tertiary care	7.68	34.9	44.4	20.8	
Primary care	7.64	40.8	39.7	19.5	

HbA<sub>1c</sub>: glycated hemoglobin.



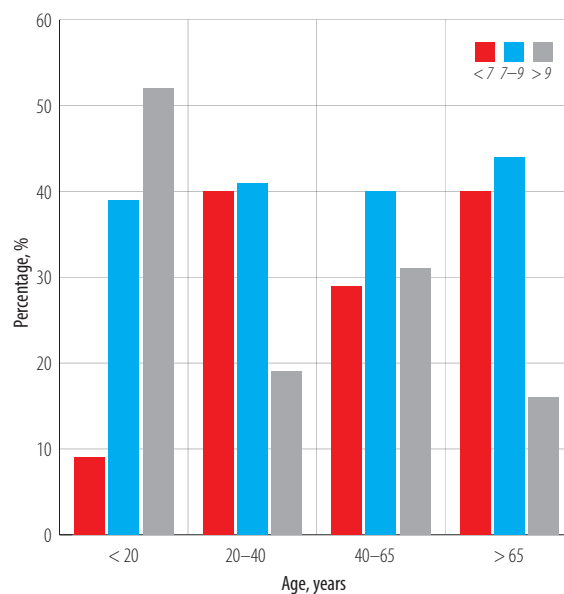
**Figure 3:** Comparison of glycated hemoglobin (HbA<sub>1c</sub>) levels between patients with type I and type II diabetes.

## DISCUSSION

Achievement of glycemic control targets is the mainstay of diabetes management. This has been supported by numerous studies looking at the advantages of improved glycemic control in reducing complications related to diabetes.<sup>2-7</sup>

International guidelines such as the American Diabetes Association Standards of Medical Care<sup>19</sup> and the European Association for the Study of Diabetes joint care statement<sup>20</sup> have devised evidence-based recommendations on target diabetes glycemic control variables, allowing physicians across general practice and specialist centers to benchmark their practice. This was shown to be successful in improving overall critical quality indicators including HbA<sub>1c</sub> levels, blood pressure, and low-density lipoprotein at the primary care level in the OPTIMISE randomized, controlled trial.<sup>21</sup>

Globally, however, it is very difficult to achieve the appropriate level of HbA<sub>1c</sub> (<7%) as per international guidelines. A recent meta-analysis that included 24 studies reporting on over 350 000 patients with diabetes from 20 countries, reported a pooled HbA<sub>1c</sub> target achievement rate of 42.8% (95% confidence interval CI: 38.1-47.5%) with a higher proportion of patients achieving the target in Europe and North America compared to the rest of the world.<sup>22</sup> Our study shows that we are slightly below the average achievement internationally, with our percentage



**Figure 4:** Categories of glycated hemoglobin (HbA<sub>1c</sub>) levels according to age.

of patients on target at 37.7% on average over five years with an improving trend. The achievement of target HbA<sub>1c</sub> in patients with type II diabetes alone is 40.7%. However, we have the highest percentage of patients achieving target levels in the Middle East region, compared to Saudi Arabia (24.2%), Palestine (29.1%), Kuwait (19.2%), and Qatar (22.3%) although the number of patients included in these cross-sectional studies was significantly smaller, ranging from 305 to 652 patients.<sup>23-26</sup> We are also the first to describe the trend in glycemic control over five consecutive years, with an overall trend towards improvement in the percentage of patients achieving target HbA<sub>1c</sub> from 35.2% in 2012 to 39.2% in 2016 ( $p < 0.001$ ). This improvement could be attributed to improved physician awareness, standardization of services, and the availability of new therapies (such as the sodium glucose cotransporter inhibitor class of diabetes therapy), and improved glucometers including flash glucose monitoring. Most of these advances have occurred in tertiary care centers, which have also shown a more substantial trend towards improvement of glycemic control in patients over the years.

It is interesting to note that a larger percentage of patients attending primary care for follow-up of diabetes had achieved the target HbA<sub>1c</sub> value of <7% compared to their counterparts attending tertiary care centers, with a total of 40.8% of the former group at target, compared to 34.9% of the latter.

A possible explanation for this observation is that primary care centers tend to look after patients in the early phase of diabetes and those who are well controlled, while patients with type I diabetes and those with more complicated type II diabetes cases would be referred to specialist centers whereby an overall poorer glycemic profile could be expected at baseline. This is evident with the larger percentage of patients with an HbA<sub>1c</sub> of 7–9% at tertiary referral centers (44.4%), compared to 39.7% with a similar HbA<sub>1c</sub> level in primary care. A smaller, retrospective study done in the UAE at a tertiary referral center in Al Ain, reported a similar achievement rate of < 7% HbA<sub>1c</sub> with 38% of patients on target.<sup>14</sup> Another study reported achievement of target HbA<sub>1c</sub> in only 23% of surveyed patients at a Dubai Hospital.<sup>18</sup>

A significant discrepancy was noted in the level of glycemic control achieved by patients aged 40–65 years, with only 29.0% being on target compared to those aged 20–40 and > 65 years with the number on target in both these groups being 40.0%. Of note, adolescents (< 20 years) generally had poor glycemic control with only 9% achieving target levels. It is worth mentioning that only 16% of patients with type 1 diabetes achieved the HbA<sub>1c</sub> target. There was no difference between the UAE nationals and expatriates in terms of the HbA<sub>1c</sub> control.

The retrospective nature of this study gives rise to some limitations. Reliance on the ICD coding alone may have veiled patients with diabetes who were coded under other diseases (missed cases). On the other hand, those who were identified on the basis of the ICD code are confirmed cases of diabetes, thus strengthening the validity of the study. As this was a large group inclusive of type I and type II patients of all ages and with any possible complications, the overall percentage of patients described achieving glycemic targets is affected by various variables, which may not reflect any one specific group. However, the breakdown of patients by age, nationality and diabetes type helps alleviate some of those issues.

## CONCLUSIONS

To date, this is the largest study in the region evaluating the glycemic control of patients with diabetes. The optimum glycemic target was achieved by < 40% of patients. Glycemic control is still below the desired levels. However, there has been a trend

of improvement in the last few years and we are achieving the international average target. Prompt and sustainable educational activities are needed to improve these goals. Further collaborative actions from clinical, educational, and strategic sectors are needed.

### Disclosure

The authors declared no conflicts of interest. No funding was received for this study.

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