Original Article

Individualized A1C Targets versus A1C <7% as a Key Performance Indicator: Lessons Learned from a Tertiary Diabetes Center in Thailand

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Background: Shortcomings of one-size-fits-all dichotomous A1C target had been addressed in various diabetes guidelines. However, performance measurement data are very limited to document the impact of A1C goal achievement through individualized A1C targets.

Objective: To compare the rate of goal achievement with individualized A1C targets versus A1C of less than 7% from the database of annually audited medical records.

Materials and Methods: One thousand two hundred randomly selected type 2 diabetes patients medical records at Theptarin Hospital, a multidisciplinary based diabetes center in Bangkok, were audited between 2015 and 2017 and the rates of goal achievement with individualized A1C targets versus A1C below 7% were examined.

Results: During the present study period, 1,200 medical records were reviewed (female 50.5%, mean age 65.1±12.8 years, duration of diabetes 14.1±10.0 years). The average A1C was 7.1±1.2% and 51.6 % of the patients had an A1C of less than 7%. While 51.6% of the patients achieved an A1C level of less than 7%, 58.3% of the patients achieved the individualized A1C goal. The patients who failed to achieve the individualized goal showed higher rate of insulin usage in comparison to those who achieved the goal.

Conclusion: The application of individualized A1C targets resulted in an achievement rate that was 6.7% higher in comparison to a target A1C level of less than 7%. These results highlight that physicians should document an individualized glycemic treatment goal and periodic evaluation should be done to prevent over-treatment or under-treatment in diversified diabetic patients.

Keywords: Individualized A1C, Targets, Key performance, Indicator, Thailand

Received 23 Jul 2019 | Revised 9 Jan 2020 | Accepted 15 Jan 2020

J Med Assoc Thai 2020;103(3):232-9
Website: http://www.jmatonline.com

Diabetes is a lifelong and progressive disease that requires multiple medications and lifestyle changes. Simultaneous treatment of blood glucose, blood pressure (BP), lipid, and other co-morbid conditions is common and necessary to prevent diabetic and cardiovascular complications. Sometimes, these aggressive treatments lead to polypharmacy, high cost, and side effects that might place a major burden on the patients and their families. Individuals with diabetes and their families need to be fully engaged in strategies for the treatment of diabetes. Therefore, various guidelines from professional organizations emphasized individualized care[1-4]; however, there is lack of data on how to implement guideline at the individual patient level[5,6].

Advance in the treatments of diabetes and associated cardiovascular diseases extend life expectancy of elderly patients with diabetes. It is expected that the proportion of Thailand's aging population (age 60 and over) will reach 20% in 2021[7] and this trend of aging population also will

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How to cite this article: Nakasatien S, Thewjitcharoen Y, Butadej S, Chotwanvirat P, Kittipoom W, Krittiyawong S, et al. Individualized A1C Targets versus A1C <7% as a Key Performance Indicator: Lessons Learned from a Tertiary Diabetes Center in Thailand. J Med Assoc Thai 2020; 103:232-9.

affect all sectors in the authors' society including patients with diabetes. A single target of glycated hemoglobin (A1C) may not be suitable for all patients with type 2 diabetes mellitus (T2DM) in different health conditions and socio-economic statuses. Both under and over-treatment must be considered when treating those patients. Tight intensive glycemic control in uncomplicated T2DM confers long-term benefit while higher A1C target is appropriated in those who have established macrovascular complications or have high risk for hypoglycemia, have a long duration of diabetes, and have a limited life expectancy[8-10]. Personalized care is needed due to the increased number of medications that have differing glucose-lowering efficacies, weight effects, risk of hypoglycemia, costs, and cardiovascular benefits[11].

Despite the abundance of pharmacological treatment options, real-world data show that the proportion of patients with A1C levels at 7.0% or greater is unacceptably high in both developed and developing countries and has shown no signs of improvement over the past 10 to 20 years[12-15]. While performance measurement through audit, feedback, and profiling are important factors contributing to improvement in the outcome of diabetes care[16], the impact of A1C goal achievement through individualized A1C targets is not completely understood.

To address this issue, the aim of the present study was to utilize the past three years audit data base in a multidisciplinary based diabetes center treated by diabetologists to shed light on the distribution pattern of various individualized A1C target values. The clinical characteristics and rate of goal achievement with individualized A1C targets were also examined to understand factors that might affect decisions of treating diabetologists in reclassify patients from uncontrolled to controlled diabetes by tailored glycemic targets.

Materials and Methods

A retrospective analysis of 1,200 randomly selected patients with T2DM medical records were audited in 2015 to 2017 as a part of annual quality improvement program at Theptarin Hospital, a multidisciplinary based diabetes center in Bangkok with over 2,000 registered DM patients. A systematic sampling strategy was done on 13 diabetologists at Theptarin Hospital and included 400 medical records in each year. The most recent data on patient characteristics related to quality measures were collected (age, sex, body mass index [BMI], BP, A1C, low-density lipoprotein level [LDL], and recorded individualized A1C target). The presence of micro- and macro-vascular diseases were also extracted from the clinical database. Individualized A1C target values were established in each patient by shared decision-making approach[17] based on the position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)[1]. Data collection sheet was designed to be filled-out by treating diabetologists for self-audit process.

The rates of goal achievement with individualized A1C targets versus A1C of less than 7% were compared. The clinical characteristics of patients who achieved individualized A1C targets but A1C of 7% or more were compared and analyzed with those who achieved A1C of less than 7%. The present retrospective study was approved by the Ethics Board Committee of Theptarin Hospital (No.08/2018).

Statistical analysis

Continuous variables were presented as mean ± standard deviation (SD) or median (interquartile range), and categorical variables were presented as proportions. Comparisons between the two groups were done using unpaired Student's t-test for continuous data. A p-value of less than or equal to 0.05 was considered statistically significant. All statistical analyses were conducted using the IBM SPSS Statistics software, version 22.0 (IBM Corp., Armonk, NY, USA).

Results

During the study period, 1,200 medical records were reviewed (female 50.5%, mean age 65.1±12.8 years, duration of diabetes 14.1±10.0 years). Average A1C was 7.1±1.2%, and 51.6% of the patients had an A1C of less than 7%. Overall, the chart audit revealed that 37.2% and 77.8% of patients were at the recommended target for BP 130 over 80 and 140 over 90 mmHg, respectively, while 63.1% were at the recommended target for LDL (LDL less than 100 mg/dL). The details of patient characteristics and treatment in each audited year are shown in Table 1.

Using the recommendation from ADA/EASD consensus, a less stringent target A1C of 7.5% to 9.0% applied to 27.6% of the study population, while the conventional target of less than 7% applied to 60.7%. The distribution of documented individualized A1C target values in all audited patients is shown in Figure 1.

Table 1. Demographic data, pattern of diabetes treatment, and diabetic complications in randomly selected patients for annual medical records audit

	Total patients (n=1,200)	Year; n (%)		
	n (%)	2015 (n=400)	2016 (n=400)	2017 (n=400)
Age (years); mean±SD	65.1±12.8	64.8±13.3	66.0±12.5	64.4±12.7
Sex: female	606 (50.5)	198 (49.5)	199 (49.8)	209 (52.3)
Duration of DM (years); mean±SD	14.1±10.0	13.8±10.5	14.8±9.7	13.8±9.8
Follow-up time (years); mean±SD	9.7±7.9	9.7±8.1	10.6±7.7	8.7±7.7
BMI (kg/m^2); mean±SD	26.6±4.6	26.4±4.8	26.5±4.6	26.9±4.3
Co-morbidities				
Coronary arterial disease	100 (8.3)	25 (6.3)	41 (10.3)	33 (8.3)
Stroke	70 (5.8)	24 (6.0)	23 (5.8)	23 (5.8)
Peripheral arterial disease	108 (9.0)	41 (10.3)	31 (7.8)	36 (9.0)
Chronic kidney disease	366 (30.5)	113 (28.3)	136 (34.0)	117 (29.3)
Cancer	61 (5.1)	19 (4.8)	26 (6.5)	16 (4.0)
Dementia	16 (1.3)	2 (0.5)	12 (3.0)	2 (0.5)
A1C (%NGSP); mean±SD	7.1±1.2	7.1±1.2	7.1±1.2	7.2±1.3
Systolic BP (mmHg); mean±SD	129±14	129±14	129±15	129±14
Diastolic BP (mmHg); mean±SD	72±10	72±11	72±11	72±10
LDL (mg/dL); mean±SD	95±30	94±27	97±28	95±35
Diabetic retinopathy (%)*	30.1	32.3	30.0	28.2
Pattern of diabetes treatment				
Diet control alone	55 (4.6)	27 (6.8)	12 (3.0)	16 (4.0)
OHA	890 (74.2)	299 (74.8)	295 (73.8)	296 (74.0)
Insulin and OHA	200 (16.7)	62 (15.5)	73 (18.3)	65 (16.3)
Insulin therapy	55 (4.6)	12 (3.0)	20 (5.0)	23 (5.8)

SD=standard deviation; DM=diabetes mellitus; BMI=body mass index; BP=blood pressure; LDL=low-density lipoprotein level; OHA=oral hypoglycemic agents

* Data were available in 656/1,200 (54.7%) of patients

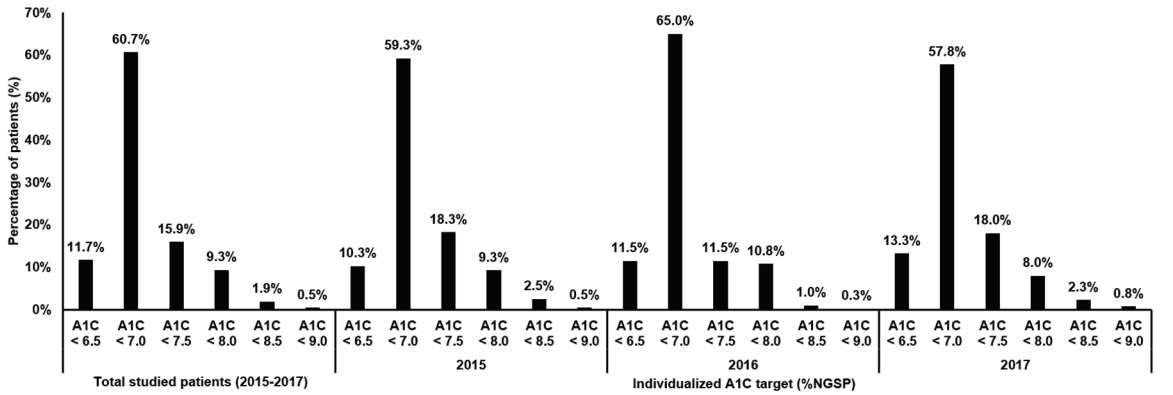

Figure 1. The distribution of documented individualized A1C target values in each audit year and overall (2015 to 2017).

Individualization of glycemic targets increased the number of patients considered adequately controlled from 51.6% to 58.3% (6.7% higher achievement rate). When analyzed in each audit year, the increased achievement rate varied from 5.0% to 7.8% as revealed in Figure 2.

Table 2. Comparison between characteristic of patients who could achieve individualized A1C targets and patients who could not achieve individualized A1C targets

	Achieved individualized A1C target (n=699) n (%)	Non-achieved individualized A1C target (n=501) n (%)	p-value
Age (years); mean±SD	66.2±13.0	63.4±12.4	<0.001
Sex: female (%)	50.5	50.5	1.000
Duration of DM (years); mean±SD	13.1±10.1	15.6±9.6	<0.001
BMI (kg/m^2); mean±SD	26.1±4.2	27.4±5.0	<0.001
Co-morbidities			
Coronary arterial disease	56 (8.0)	44 (8.8)	0.679
Stroke	44 (6.3)	26 (5.2)	0.421
Peripheral arterial disease	66 (9.4)	42 (8.4)	0.527
Chronic kidney disease	215 (30.8)	151 (30.1)	0.834
Cancer	41 (5.9)	20 (4.0)	0.145
Dementia	9 (1.3)	7 (1.4)	0.870
Rate of insulin usage (%)	81 (11.6)	174 (34.7)	<0.001

SD=standard deviation; DM=diabetes mellitus; BMI=body mass index

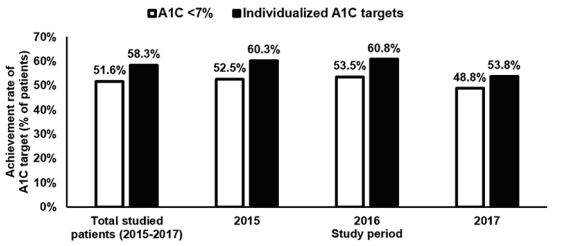

Figure 2. The annual and overall comparison of goal achievement with A1C <7.0% versus individualized A1C targets.

The comparison between characteristics of patients who could achieve individualized A1C targets and patients who could not achieve individualized A1C targets is shown in Table 2. The patients who failed to achieve the individualized goal showed younger age, slightly longer duration of diabetes, more obese, and higher rate of insulin usage in comparison to those who achieved the goal.

The clinical characteristics of patients who achieved individualized A1C targets, but A1C of 7% or more were compared and analyzed with those who achieved A1C of less than 7%. When compared with fixed target A1C at less than 7.0%, patients who achieved individualized A1C targets, but A1C of 7.0% or more were older with longer duration of diabetes, and higher rate of insulin usage as shown in Table 3.

Discussion

The shortcomings of one-size-fits-all dichotomous A1C target have been addressed in various diabetes guidelines. However, information on the impact of A1C goal achievement through individualized A1C targets in different populations is scarce, especially in Asian countries. Despite the increasing availability of many new pharmacological treatment options, the proportion of patients with A1C levels of 7.0% or more is unacceptably high in both developed and developing countries[12,14]. Previous studies from Thailand revealed that only less than one-third of the patients could achieve optimal glycemic control with A1C levels of less than 7.0%[18-20].

In the present study, the authors found only about half of the patients adequately controlled their blood sugar if the A1C target of less than 7% was applied, compared with almost 60% if using individualized glycemic targets. This finding suggested that a substantial proportion of patients might be misclassified as not achieving target when they were below an appropriate individualized target especially in elderly patients with long duration of diabetes and patients who were treated with insulin. Therefore, a documented individualized glycemic target in each patient should be recorded and incorporated into performance measurement data to demonstrate outcomes of diabetes treatments. Comprehensive diabetes care required multi-faceted treatment strategies targeting hyperglycemia, hypertension, and hyperlipidemia. Therefore, achievement of triple-goal without side effects from medications should be the goal of diabetes care[21]. In the real-world data, only

Table 3. Comparison between clinical characteristic of patients who achieved individualized A1C targets but A1C ≥7% and those who achieved A1C <7%

	Achieved A1C <7.0% (n=619) n (%)	Achieved individualized A1C targets but A1C ≥7% (n=107) n (%)	p-value
Age (years); mean±SD	64.7±13.4	71.5±11.1	<0.001
Sex: female (%)	50.7	47.7	0.558
Duration of DM (years); mean±SD	11.7±9.7	19.4±10.0	<0.001
BMI (kg/m^2); mean±SD	26.1±4.2	26.3±4.4	0.723
Co-morbidities			
Coronary arterial disease	43 (6.9)	12 (11.2)	0.123
Stroke	35 (5.7)	9 (8.4)	0.270
Peripheral arterial disease	51 (8.2)	16 (15.0)	0.101
Chronic kidney disease	175 (31.5)	41 (39.8)	0.117
Cancer	32 (5.2)	9 (8.4)	0.180
Dementia	8 (1.3)	1 (0.9)	0.757
A1C (%NGSP); mean±SD	6.3±0.5	7.4±0.5	<0.001
Systolic BP (mmHg); mean±SD	128±13	129±15	0.814
Diastolic BP (mmHg); mean±SD	72±11	70±11	0.198
LDL (mg/dL); mean±SD	97±31	87±25	0.001
Pattern of diabetes treatment			<0.001
Diet control alone	44 (7.1)	3 (2.8)	
OHA	522 (84.3)	76 (71.0)	
Insulin and OHA	36 (5.8)	20 (18.7)	
Insulin therapy	17 (2.7)	8 (7.5)	

SD=standard deviation; DM=diabetes mellitus; BMI=body mass index; BP=blood pressure; LDL=low-density lipoprotein level; OHA=oral hypoglycemic agents

a small proportion of patients with diabetes (less than one-fourth) are meeting all three goals[13,22]. A systematic review of strategies for improving guideline adherence included continuous education, clinical reminder systems, ongoing audit and feedback, and benchmarking with other institutes[23]. The present study finding supported that in using the personalized approach for glycemic control, physicians need to consider factors with respect to individual patient such as side effects from treatments, cost, and patient's attitude.

The balance between clinical inertia and overly aggressive treatment intensification remains a valid concern especially for specific subpopulations of vulnerable patients with diabetes[24-26]. The number of drugs approved to treat diabetes is also increasing rapidly and there are now 11 categories of diabetes medications. The authors' previous study showed that extreme elderly patients (those in their mid-80s upwards) still received treatments that are too "aggressive"[27]. Other studies also showed similar findings in overtreatment of diabetes in extremely aged patients or so-called "oldest old" patients[28]. The unintended consequences of guideline-derived quality measurement are well-described when practicing clinicians focus on achieving the performance measure rather than what might be best for the needs of the individual patient[29-31]. Not only increasing economic cost of diabetes care, the hazards of over-treatment also include adverse drug events and the potential increase in mortality as shown in clinical trials from the last decade.

Even though relaxing the A1C targets for patients with diabetes could result in an increase of achievement rate of annual performance measure, it would be emphasized that this should not lead to complacency or reinforce clinical inertia for timely advancement of therapy since almost half of patients still failed to meet the required targets[32]. The present study is in agreement with previous published studies all over the world that achievement of glycemic control, BP, and lipid targets in diabetes is markedly suboptimal. Diabetes management requires patients' engagement and substantial patient-executed diabetes

self-management[33]. Quality improvement efforts supported by data along with periodic evaluation should be performed continuously to deliver the best care[34].

Several limitations of the present study should be noted. First, the authors' diabetes center composed of experienced diabetologists in a private setting so it might not extend these finding into different healthcare settings. Second, the records of the annual individualized A1C targets had been extracted from the medical records in the year of audit, detailing strategies for individualization of glycemic targets including psychosocial and economic contexts were lacking. Third, the sample size of audited medical records in each year was still relatively small and might not be representative of treated patients at the authors' hospital. Forth, there were no complete data on complexity of patients' co-morbidities incorporated into the analysis. Strengths of the present study included the systemic random samplings of audited medical records from every diabetologists and all clinical information were collected from on-going annual audits, which had been set as a part of quality improvement program. In addition, this is the first study from a multidisciplinary based diabetes center in Bangkok, so the effect of multidisciplinary approach could be demonstrated and compared with other studies from Western countries.

Conclusion

The present study highlights that physicians should document an individualized glycemic treatment goal and periodic evaluation should be done based on the updating individualized A1C goals to prevent over- or under-treatment in patients with T2DM. Efforts are needed to translate the knowledge already gained from clinical trials into individual patients seen in real-life setting. Further large-scale studies should focus on further examination of the reasons for the factors related to individualized glycemic treatment goal and exploration of the reasons for suboptimal attainment of the three key treatment targets in T2DM patients.

What is already known on this topic?

Various guidelines from the professional organizations emphasized individualized care. A single target of glycated hemoglobin (A1C) may not be suitable for all patients with T2DM in different health conditions and socio-economic statuses. Previous studies from Thailand revealed that only less than one-third of patients could achieve optimal glycemic control with A1C levels of less than 7.0%

What this study adds?

This study found that, by using the recommendation from ADA/EASD consensus, a less stringent target A1C of 7.5% to 9.0% applied to 27.6% of this study population, while the conventional target of less than 7% applied to 60.7%. Individualization of glycemic targets increased the number of patients who are considered adequately controlled from 51.6% to 58.3% (6.7% higher achievement rate). When compared with fixed target A1C at less than 7.0%, patients who achieved individualized A1C targets but A1C of 7.0% or more showed more advanced age, longer duration of diabetes, and higher rate of insulin usage.

Acknowledgement

The authors would like to express their gratitude to Dr. Tinapa Himathongkam for her generous advice and English editing. The authors are also grateful to the contributing staffs from the Diabetes and Thyroid Center, Theptarin Hospital for all their supports and helps.

Parts of this manuscript had previously been presented as a poster at the 19th ASEAN Federation of Endocrine Societies Congress (AFES) meeting, Yangon, Myanmar, 9 to 12 November 2017.

Conflicts of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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