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Adherence to Guidelines and Its Effect on Glycemic Control During the Management of Type 2 Diabetes in Turkey: The ADMIRE Study

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Additional information is available at the end of the chapter

1. Introduction

Type 2 diabetes is a progressive chronic disease that causes serious complications and decreases the life expectancy. According to 1997-98 population-based survey (TURDEP-I), the prevalence of diabetes was 7.2% in adult population of Turkey [1]. The second survey which was recently completed (TURDEP-II), indicated that the prevalence of diabetes increased by 90% within last 12 years and reached to 13.7% (undiagnosed 7.5%), which means that almost 6.5 million adults have diabetes in Turkey [2].

Intensive control of glycemia and cardiovascular risk factors can significantly reduce the rate of acute and chronic complications, and increase the life expectancy and quality of life in patients with diabetes [3–6]. Early diagnosis, correct and intensive antidiabetes treatment, and effective follow-up were recommended to decrease the risk of complications [7]. Despite extensive evidence of benefits of tight glycemic control, large proportions of people with diabetes do not achieve target glycemic control.

The use of clinical guidelines is the best strategy for the effective control of diabetes. There are multiple diabetes practice guidelines based on published data or derived from expert consensus and provide specific recommendations to diagnose diabetes and to achieve and maintain glycemic control. Previous studies reported non-adherence to evidence-based guidelines, which was based on physician factors, patient factors, and organizational factors [8–11].

The national guidelines have particular importance to address local requirements. Therefore, Diabetes Study Group of The Society of Endocrinology and Metabolism of Turkey (SEMT) developed 'Clinical Practice Guidelines for Diagnosis, Treatment, and Follow-up of Diabetes and Its Complications' in 2006, which are reviewed and updated

biannually [12–14]. In comparison with 'American Diabetes Association (ADA) Clinical Practice Recommendations', the SEMT guidelines include more detailed information on diagnosis and follow-up of diabetes and its complications in addition to general information on diabetes. Furthermore, diabetes management on special and co-morbid conditions such as pregnancy, surgery, travel, vaccination, hypertension, hyperlipidemia, coronary artery disease was explained in detail in the SEMT guidelines. While target glycated hemoglobin A1c (A1C) is ≤6.5% in the SEMT guidelines, it is <7% in ADA guidelines [15]. The treatment algorithm in the SEMT guidelines has also some differences than that of ADA/European Association for the Study of Diabetes (EASD) guidelines [16]: initially lifestyle modification + MET treatment; if A1C target is not reached in 2-3 months, other oral antidiabetics for A1C <8.5% or insulin treatment for A1C >8.5%; if initial A1C >10%, insulin or combination regimens are suggested from the beginning. If target A1C is not still obtained, basal-bolus insulin is started and MET treatment is retained if possible.

The perception and use of SEMT guidelines by physicians in Turkey, however, are unknown.

Therefore, we aimed to determine the physicians' adherence to the SEMT diabetes guidelines in a study entitled "Adherence of physicians to guidelines for the management of type 2 diabetes: The ADMIRE study". The main objectives of the ADMIRE study were to evaluate physicians' adherence to SEMT diabetes guidelines, to determine the factors affecting physicians' adherence, to evaluate the impact of physicians' adherence to guidelines on glycemic control in diabetes mellitus, and to prospectively evaluate the impact of education of physicians on the adherence to guidelines.

2. Patients and methods

2.1. Study design

2.1.1. Retrospective phase

This was a patient-based, multi-centre, and non-interventional study. The study was composed of two phases: a retrospective phase and a prospective phase.

For the retrospective phase, 200 Internal Medicine or Family Medicine physicians who involved in medical care of patients with type 2 diabetes were randomly selected to represent all geographical regions and hospital types. Of these physicians, 180 agreed to participate in the ADMIRE Study Group. The medical records of 1,790 patients with type 2 diabetes (mean age, 58.7±10.9 years; female, 61.7%; duration of diabetes, 7.7±7.5 years, mean body mass index [BMI], 30.1±5.6 kg/m²; chronic complications, 58.6%) followed by 180 physicians during last 12 months were reviewed to determine whether the patients were followed and treated according to SEMT guidelines. The number of visits was at least 4 for 1,149 (64.2%) patients.

The effects of following patient- and physician-related factors on adherence to guidelines were analyzed using data from retrospective phase: patients' age, gender, diabetes duration,

BMI, presence and number of chronic complications, physicians' specialty, and type of institution were considered as variables affecting guideline adherence.

2.1.2. Prospective phase

In this phase, physicians were educated on the basis of data obtained from retrospective phase. Before the education, 883 type 2 diabetes patients (female, 61.7%; mean age, 55.3±10.4 years, duration of diabetes, 7.1±6.9 years, BMI, 30.4±5.4 kg/m²) who were under control by study physicians were included in the study during two months of recruitment period. These patients were followed up for four months including initial and control visits. Afterwards, recruitment of patients was stopped and physicians received education. The educations included one-day comprehensive training course with case presentations and distribution of a DVD and booklets on several complications of diabetes mellitus. Along with a hard copy of SEMT diabetes guidelines, and online access to education materials for three months. After the education of physicians, 1,613 type 2 diabetes patients (female 58.7%, mean age, 56.7±10.8 years, duration of diabetes, 7.3±6.3 years, BMI, 30.3±5.3 kg/m²) who were under control by study physicians were included in the study during two months and then were followed up for four months with a control visit. Total duration of prospective phase was 15 months.

The change in adherence of physicians to SEMT guidelines and glycemic control with education of physicians was evaluated. Furthermore, the effect of education on the rate of patients with regard to physicians' adherence to guidelines for treatment of diabetes was determined.

2.2. Parameters for adherence to guidelines

Adherence to SEMT guidelines was assessed in three domains of medical history, physical examination, and laboratory evaluations; each domain was scored on a 10-point scale (0 for non-adherence, 10 for full adherence). The score for adherence to guidelines for overall diagnosis and follow-up procedures was calculated by multiplying the arithmetic mean of the adherence scores for medical history, physical examination, and laboratory evaluation by 10, and changed between 0 and 100.

2.3. Glycemic control parameters

The relation between the degree of adherence to SEMT guidelines and glycemic control of patients was evaluated. The glycemic control parameters were A1C ≤6.5% (≤48 mmol/mol), fasting blood glucose (FBG) levels 70–120 mg/dL, and 2-hour postprandial blood glucose (PPBG) levels <140 mg/dL.

2.4. Statistical analyses

Study data was summarized with descriptive statistics (number, percentages, mean, standard deviation). Spearman's simple correlation coefficient (*r*) was calculated for the

correlation of between degree of adherence to guidelines and the levels of A1C, FBG, and PPBG. Student t test and analysis of variance (ANOVA) followed by post-hoc Tukey test were used to compare continuous data of two and three groups, respectively. Chi-square test or Mantel-Haenszel chi-square test was used for comparison of discrete data between groups. Statistical level of significance was defined as p<0.05.

3. Results

3.1. Physicians' adherence to guidelines on retrospective phase

Evaluation of physicians' adherence to SEMT guidelines regarding medical history, physical examination, and laboratory evaluation showed that diagnosis and follow-up procedures were >75% compliant with SEMT guidelines for 869 patients (48.5%) (Table 1). Full physicians' adherence to medical history, physical examination, and laboratory aspects of SEMT guidelines were met in 68.6%, 8.3%, and 19.2% of the patients, respectively. The mean adherence scores for medical history, physical examination, and laboratory aspects of SEMT guidelines were 8.83±2.21, 5.86±2.98, and 6.29±2.68, respectively.

Physicians were adherent to guidelines in 565 patients (54.2%) for antidiabetic treatment. They applied insufficient treatment for 468 patients (44.9%) and unnecessarily aggressive treatment for 10 patients (1.0%). Management was adherent to guidelines in 859 patients (79.2%) for antihypertensive treatment, and in 578 patients (76.0%) for antilipid treatment approaches (Figure 1).

3.2. Factors affecting physicians' adherence on retrospective phase

Patients' age, gender, diabetes duration, BMI, presence and number of chronic complications were patient-related factors; type of institution and specialty were physician-related factors whose effects on scores for adherence to guidelines were studied. For older patients and males, physicians' adherence to guidelines was higher for laboratory evaluations. All aspects of guideline adherence were poor in patients with short duration (<5 years) of diabetes and in the absence of chronic complications. Furthermore, physicians in state institutions and family practitioners had lower adherence scores for physical examination and laboratory evaluation (Table 2).

3.3. Impact of adherence to guidelines on glycemic control on retrospective phase

Degree of overall adherence for diagnosis and follow-up procedures to guidelines did not correlate with glycemic control parameters except a negative correlation with FBG levels in visit 2. However, there was a weak inverse correlation between physical examination adherence score and A1C (r=-0.058, p=0.045), FBG (r=-0.049, p=0.050), and PPBG (r=-0.073, p=0.030) levels in visit 1. There was also negative correlation between adherence to guidelines for laboratory evaluation and FBG in visit 1 (r=-0.051, p=0.039) and visit 2 (r=-0.093, p=0.001) and between adherence to guidelines for medical history and FBG in visit 2 (r=-0.073, p=0.008) and A1C in visit 3 (r=-0.097, p=0.007) (Table 3).

	n	%
Medical history[a]		
0	39	2.2
2	30	1.7
4	65	3.6
6	111	6.2
8	317	17.7
10	1,228	68.6
Mean score	8.83±2.21	
Physical examinations[b]		
0	134	7.5
1	80	4.5
2	89	5.0
3	112	6.3
4	135	7.5
5	177	9.9
6	189	10.6
7	220	12.3
8	232	13.0
9	273	15.3
10	149	8.3
Mean score	5.86±2.98	
Laboratory evaluation[c]		
0	146	8.2
3.3	254	14.2
6.7	1,046	58.4
10	344	19.2
Mean score	6.29±2.68	
Overall diagnosis and follow-up procedures[d]		
<50	283	15.8
50-75	638	35.6
>75	869	48.5
Mean score	69.94±20.27	

[a] Adherence to guidelines was evaluated on a 10-point scale with 2-point for each of five items (diabetes symptoms, acute complications, chronic complications, cardiovascular risk factors, family history) that should be questioned for medical history.

[b] Adherence to guidelines was evaluated on a 10-point scale with 1 or 0 point respectively for performing or not performing each of the following 10 physical examination items: height, weight, waist circumference, blood pressure and heart rate measurements; thyroid, abdominal, neurological, foot and fundus examination.

[c] Adherence to guidelines was evaluated on a 10-point scale with 3.33 points for each of three laboratory tests (lipid profile, creatinine, and urinalysis).

[d] Adherence to guidelines for overall diagnosis and follow-up procedures was evaluated on a 100-point scale, it was obtained by multiplying the mean of adherence scores for medical history, physical examination, and laboratory evaluation by 10.

Table 1. Physicians' adherence to SEMT guidelines regarding medical history, physical examination, and laboratory evaluation. Data are given as number of patients and % or mean±standard deviation of score.
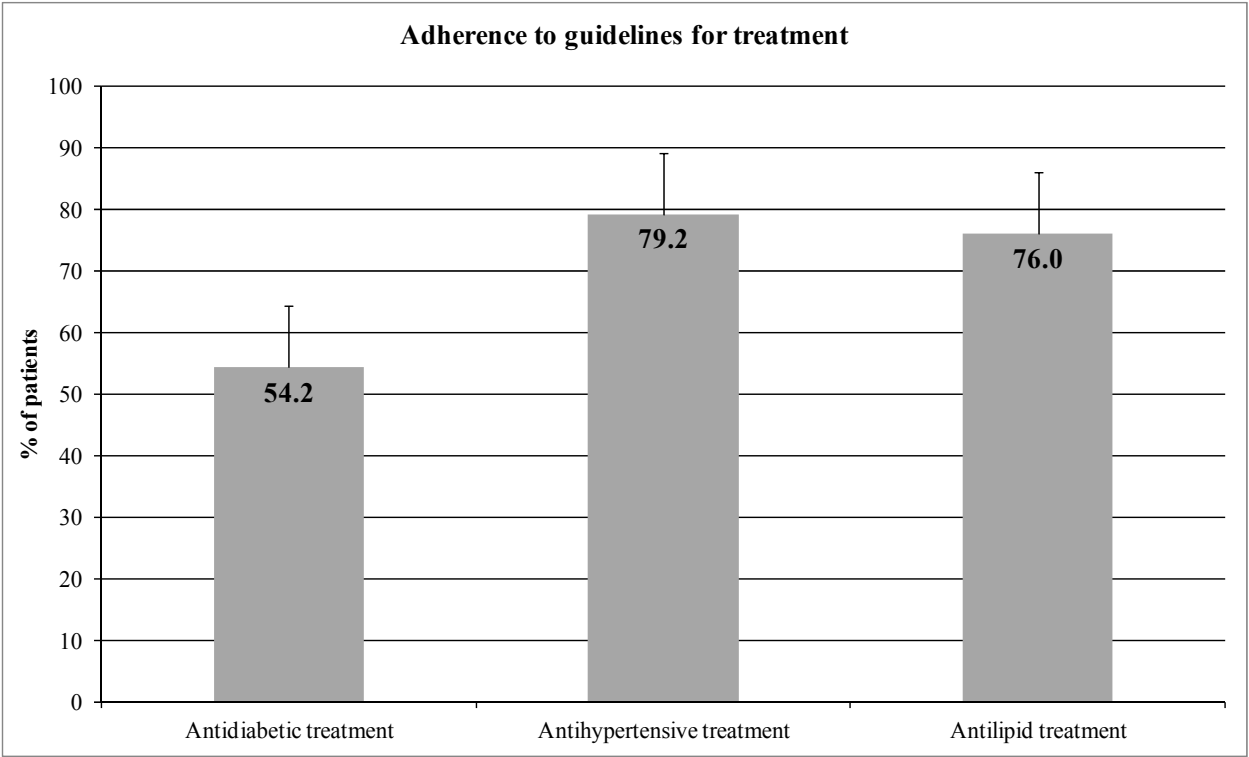
Figure 1. Physicians were adherent to guidelines for treatment.

			Scores for adherence to SEMT guidelines			
			Medical history	Physical examinations	Laboratory evaluation	Overall diagnosis and follow-up procedures
Patient-related factors						
Age (years)	<40		9.4±1.5	5.7±3.0	6.4±2.9	71.4±20.0
	40-49		8.8±2.2	5.6±3.0	6.2±2.8[a]	68.9±21.1
	50-59		8.8±2.2	5.8±3.1	6.6±2.8	70.8±21.6
	60-69		8.9±2.1	6.0±3.0	6.8±2.7	72.2±21.0
	≥70		8.7±2.4	6.0±2.8	6.9±2.6	72.1±20.3
		p	0.322	0.515	*0.020*	0.272
Gender	Male		8.9±2.2	5.9±3.0	6.8±2.7	72.1±20.8
	Female		8.8±2.2	5.8±3.0	6.5±2.8	70.6±21.0
		p	0.469	0.666	*0.021*	0.139
Diabetes duration (years)	0-5		8.7±2.3[b]	5.4±3.0[c]	6.3±2.9[c]	68.1±22.0[c]
	6-10		9.0±1.9	6.2±2.9	6.9± 2.6	74.0±19.3
	11-15		8.9±2.1	6.5±2.8	7.4±2.6	75.9±19.6

		Scores for adherence to SEMT guidelines			
		Medical history	Physical examinations	Laboratory evaluation	Overall diagnosis and follow-up procedures
Patient-related factors					
	16-20	9.4±1.2	6.7±2.9	7.3±2.7	78.2±19.1
	>20	8.9±2.1	6.5±2.8	7.3±2.5	75.6±18.9
	p	*0.003*	*<0.001*	*<0.001*	*<0.001*
Body mass index (kg/m^2)	<25	9.3±1.7	7.8±1.9	7.3±2.1	81.3±13.8
	25-26	9.5±1.5	8.0±1.8	7.5±2.2	83.6±13.4
	27-29	9.3±1.6	7.9±1.9	7.4±2.5	82.1±15.3
	30-39	9.5±1.3	8.0±1.7	7.3±2.4	82.7±13.6
	≥40	9.6±0.9	8.2±1.7	7.4±2.2	84.2±11.2
	p	0.278	0.635	0.922	0.619
Chronic complications (number of systems involved)	None	9.4±1.4[d]	5.9±2.9[e]	6.6±2.7[e]	72.9±18.2[e]
	1 system	9.1±1.8	6.2±2.9	6.8±2.8	73.8±19.1[e]
	2 systems	9.4±1.2	6.4±2.8	6.9±2.7	75.8±17.2
	>2 systems	9.4±1.2	6.6±2.8	7.4±2.5	77.6±17.4
	p	*0.020*	*0.007*	*0.001*	*0.003*
History of chronic complications	Yes	9.3±1.5	6.3±2.8	7.0±2.7	75.4±18.2
	No	9.4±1.4	5.9±2.9	6.6±2.7	72.9±18.2
	p	0.096	*0.002*	*0.002*	*0.008*
Physician-related factors					
Type of institution	State	8.7±1.9	5.5±2.6[g]	6.4±2.3[g]	68.7±18.7
	Private	9.1±1.5	6.4±2.4	6.7±2.3	73.9±17.7
	University	8.8±1.6	7.5±2.4	8.2±2.0	81.8±18.8
	p	0.550	*0.008*	*0.041*	*0.035*
Specialty	Family practice	9.0±1.4	5.1±2.5[h]	5.7±2.1[h]	65.9±16.1[h]
	Internal medicine	8.7±1.9	5.7±2.5	6.7±2.4	70.2±19.6[h]
	Endocrinology	9.6±1.8	7.9±1.7	7.9±1.4	84.5±8.7
	p	0.096	*<0.001*	*0.003*	*0.002*

[a] p<0.05 versus 60-69 years and ≥70 years of age; [b] p<0.05 versus 16-20 years diabetes duration; [c] p<0.05 versus all other diabetes duration groups; [d] p<0.05 versus 1 system involvement; [e] p<0.05 versus >2 systems involvement; [g] p<0.05 versus university; [h] p<0.05 versus endocrinology.

Table 2. Effect of patient- and physician-related factors on scores for adherence to guidelines. Data are given as mean±standard deviation of score.

Adherence to guidelines		Visit 1			Visit 2			Visit 3			Visit 4		
		A1C level	FBG level	PPBG level	A1C level	FBG level	PPBG level	A1C level	FBG level	PPBG level	A1C level	FBG level	PPBG level
Medical history	r	-0.023	0.024	-0.003	-0.043	-0.073	-0.046	-0.097	-0.026	-0.054	-0.059	0.016	-0.040
	p	0.428	0.326	0.918	0.209	*0.008*	0.197	*0.007*	0.385	0.159	0.137	0.635	0.342
Physical examination	r	-0.058	-0.049	-0.073	-0.019	-0.044	-0.064	-0.062	-0.042	-0.042	-0.036	0.012	0.042
	p	*0.045*	*0.050*	*0.030*	0.585	0.111	0.073	0.086	0.163	0.281	0.360	0.731	0.318
Laboratory evaluation	r	-0.017	-0.051	-0.033	0.024	-0.093	-0.027	0.028	-0.024	-0.006	0.077	0.040	0.111
	p	0.571	*0.039*	0.323	0.477	*0.001*	0.442	0.441	0.425	0.878	0.051	0.239	*0.008*
Overall diagnosis and follow-up	r	-0.046	-0.039	-0.053	-0.013	-0.091	-0.062	-0.053	-0.043	-0.036	-0.001	0.030	0.063
	p	0.116	0.118	0.111	0.702	*0.001*	0.080	0.144	0.152	0.350	0.983	0.372	0.131

A1C: Glycated hemoglobin A1c; FBG: Fasting blood glucose, PPBG: 2-hour postprandial blood glucose.

Table 3. Correlation coefficients (Spearman's r) between degree of adherence to SEMT guidelines and the levels of A1C, FBG, and PPBG

The minimum levels of A1C, FBG, and PPBG were significantly associated with the degree of general adherence to guidelines (p<0.05, Table 4). The minimum levels of A1C, FBG, and PPBG were significantly lower in >75% adherence to SEMT guidelines.

	Adherence to SEMT guidelines			p
	<50	50–75	>75	
A1C (%)				
Minimum	7.8±1.9	7.6±1.8	7.4±1.8	**0.021**
Maximum	8.7±2.1	8.7±2.0	8.8±2.1	0.315
FBG (mg/dL)				
Minimum	154.0±61.7	149.71±62.2	139.8±51.2	**<0.001**
Maximum	202.2±82.4	212.8±86.0	207.6±83.7	0.232
PPBG (mg/dL)				
Minimum	201.3±89.1	195.9±69.6	180.9±69.9	**0.001**
Maximum	248.9±93.8	246.7±87.9	250.6±90.6	0.809

A1C: Glycated hemoglobin A_{1c}; FBG: Fasting blood glucose, PPBG: 2-hour postprandial blood glucose.

Data are given as mean±standard deviation.

Table 4. The relation between the degree of adherence to SEMT guidelines for overall diagnosis and follow-up procedures and minimum and maximum levels of A1C, FBG, and PPBG during previous year

3.4. Impact of education of physicians prospectively on the adherence to guidelines

After the education of physicians, adherence scores to SEMT guidelines significantly increased for medical history, physical examination, and overall diagnosis and follow-up procedures (p<0.001), however, adherence score decreased significantly for laboratory evaluation (p<0.001) (Table 5). This might be caused due to the time limit between visits. Patients may not have yet their laboratory control or could not provide test results to their physicians.

The percentage of patients whose physicians comply with guidelines for antidiabetic (p<0.001), antihypertensive (p<0.001) and antilipid (p=0.002) treatment were increased significantly with the education (Table 6).

However, rate of patients under glycemic control was similar before and after the education of physicians. Furthermore the level of adherence to SEMT guidelines for overall diagnosis and follow-up procedures had no effect on glycemic control before or after the education, except that significantly more patients whose physician adhere to guidelines >75% had FBG <120 mg/dL in control visit before education (p<0.013) (Table 7).

	Before education		After education		p
	n	%	*n*	%	
Medical history[a]					**<0.001**
0	35	4.0	141	8.7	
2	109	12.3	51	3.2	
4	160	18.1	0	0.0	
6	106	12.0	0	0.0	
8	116	13.1	54	3.3	
10	359	40.6	1,370	84.8	
Mean score	6.79±3.24		8.81±3.08		**<0.001**
Physical examinations[b]					**<0.001**
0	14	1.6	122	7.5	
1	21	2.4	1	0.1	
2	20	2.3	7	0.4	
3	112	12.7	12	0.7	
4	417	47.1	50	3.1	
5	147	16.6	351	21.7	
6	36	4.1	194	12.0	
7	6	0.7	22	7.5	
8	23	2.6	41	2.5	
9	14	1.6	167	10.3	
10	75	8.5	549	34.0	
Mean score	4.65±2.12		7.02±2.95		**<0.001**
Laboratory evaluation[c]					**<0.001**
0	58	6.6	235	14.5	
3.3	93	10.5	171	10.6	
6.7	473	53.4	859	53.2	
10	261	29.5	351	21.7	
Mean score	6.86±2.71		6.07±3.11		**<0.001**
Overall diagnosis and follow-up procedures[d]					**<0.001**
<50	225	25.4	203	12.6	
50-75	481	54.4	416	25.7	
>75	179	20.2	997	61.7	
Mean score	61.03±17.36		72.99±25.30		**<0.001**

[a] Adherence to guidelines was evaluated on a 10-point scale with 2-point for each of five items (diabetes symptoms, acute complications, chronic complications, cardiovascular risk factors, family history) that should be questioned for medical history.

[b] Adherence to guidelines was evaluated on a 10-point scale with 1 or 0 point respectively for performing or not performing each of the following 10 physical examination items: height, weight, waist circumference, blood presssure and heart rate measurements; tyroid, abdominal, neurological, foot and fundus examination.

[c] Adherence to guidelines was evaluated on a 10-point scale with 3.33 points for each of three laboratory tests (lipid profile, creatinine, and urinalysis).

[d] Adherence to guidelines for overall diagnosis and follow-up procedures was evaluated on a 100-point scale, it was obtained by multiplying the mean of adherence scores for medical history, physical examination, and laboratory evaluation by 10.

Table 5. Physicians' adherence to SEMT guidelines during prospective phase of the study before and after education of physicians on guidelines. Data are given as number of patients and % or mean±standard deviation of score.

Adherence to guidelines	Before education		After education		p
	n	%	n	%	
Antidiabetic treatment					
Incompliant	283	40.0	440	32.5	**<0.001**
Insufficient treatment	253	35.7	301	22.2	
Unnecessary treatment	30	4.2	139	10.3	
Compliant	425	60.0	914	67.5	
Antihypertensive treatment					
Incompliant	181	21.4	183	12.7	**<0.001**
Compliant	664	78.6	1,253	87.3	
Antilipid treatment					
Incompliant	100	13.6	118	9.2	**0.002**
Compliant	634	86.4	1,170	90.8	

Table 6. Number and percentage of patients in terms of physicians' adherence to SEMT guidelines for treatment of diabetes patients during prospective phase of the study before and after education of physicians on guidelines

Beside this, A1C of the patients followed up after the education significantly decreased at control visit compared to baseline. Similarly the percentage of the patients at target A1C significantly increased at control visit compared to baseline, after the education.

4. Discussion and conclusion

The use of diabetes guidelines meeting national requirements is the most effective way to improve quality in practice; however, they must be effectively disseminated and implemented to obtain this goal. On the other hand, national studies mostly reported suboptimal level of physicians' adherence to the guidelines [10, 11, 17, 18]. Similarly, we found that only for half of the diabetes patients, diagnosis and follow-up procedures were >75% compliant with current SEMT guidelines; and for 54.2% patients, antidiabetic treatment were adherent to guidelines.

Lack of knowledge, reluctance to change practice, clinical inertia, time constraints, difficulties with referral systems, patient nonadherence for various reasons and deficiencies in healthcare system are some of the barriers affecting physicians' adherence to guidelines [19–21]. Among these factors, clinical inertia is defined as "recognizing the problem but failure to act" by health care professionals in primary care [22–29]. The key issues in the

	Before education						After education					
	A1C (≤%6.5)		FBG (<120 mg/dL)		PPBG (<140 mg/dL)		A1C (≤%6.5)		FBG (<120 mg/dL)		PPBG (<140 mg/dL)	
	First visit	Control visit	First visit	Control visit	First visit	Control visit	First visit	Control visit	First visit	Control visit	First visit	Control visit
Adherence to SEMT guidelines for overall diagnosis and follow-up procedures												
<50	30 (15.3)	28 (19.6)	30 (16.4)	25 (21.7)	11 (9.1)	15 (22.4)	57 (28.4)	17 (30.4)	12 (23.1)	9 (45.0)	8 (21.1)	7 (36.8)
50-75	80 (17.8)	90 (23.6)	83 (17.7)	117 (32.2)	46 (13.7)	52 (18.6)	81 (20.0)	64 (28.1)	67 (18.7)	50 (27.2)	19 (8.0)	20 (15.9)
>75	30 (16.9)	39 (23.9)	32 (18.0)	57 (36.3)	20 (12.7)	29 (21.2)	191 (19.5)	182 (28.2)	206 (21.4)	203 (31.9)	105 (13.9)	100 (20.0)
Total	140 (17.0)	157 (22.9)	145 (17.5)	199 (31.3)	77 (12.6)	96 (19.9)	329 (20.8)	263 (28.3)	285 (20.7)	262 (31.2)	132 (12.8)	127 (19.7)
p	0.674	0.381	0.691	*0.013*	0.416	0.988	*0.016*	0.821	0.546	0.778	0.364	0.742

A1C: Glycated hemoglobin A_{1c}; FBG: Fasting blood glucose, PPBG: 2-hour postprandial blood glucose.

Table 7. The rate of patients under glycemic control before and after the education of physicians on guidelines on glycemic control with respect to adherence to SEMT guidelines. Data are given as number of patients (%).

	Before		After	
	Baseline	Control	Baseline	Control
A1C (%)	8.68	7.98	8.39	7.69
FPG (mg/dL)	190.9	158.2	178.4	150.1
PPG (mg/dL)	247.9	200.9	240.2	199.5
Patients on target A1C (≤6.5%) (%)	17.0	22.9	20.8	28.3
Patients on target FBG (<120 mg/dL) (%)	17.5	31.3	20.7	31.2

Table 8. Glycemic control before and after the education.

management of people with type 2 diabetes include early detection of problems, realistic goal setting, improved patient adherence, better knowledge and understanding of pharmaco-therapeutic treatment options and prompt intervention. Clinical inertia is due to at least three problems: overestimation of care provided; use of "soft" reasons to avoid intensification of therapy; and lack of education, training, and practice organization aimed at achieving therapeutic goals. Health care professionals must need to overcome clinical inertia and need to intensify therapy in an appropriate and timely manner. Using guidelines in the management of diabetes patients and continuous education of diabetes care providers are effective ways to overcome clinical inertia [24, 29]. In a 3-year trial on 345 internal medicine residents, feedback on performance given to medical resident primary care providers improved provider behaviour and lowered A1C levels [27]. We think that lower adherence of guidelines by the physicians who provide care for younger (<50 year old) patients, males, and patients with short duration (<5 years) of diabetes and patients without complications in the ADMIRE study might be linked to clinical inertia in this group of patients.

Furthermore characteristics of patients and physicians can also influence clinical decision making and guideline adherence. McKinlay et al. showed that adherence to guidelines varied according to patients' age and gender and physicians' years of experience [30]. We also found that guideline adherence was influenced by patient-related factors such as gender, diabetes duration, and comorbid conditions. Unfortunately, new onset diabetes patients were less likely to receive best practice. Physician specialty and institution type were also contributing factors for guideline adherence; family practitioners and physicians in state institutions had lower adherence scores.

Although overall adherence for diagnosis and follow-up procedures to guidelines did not affect the glycemic control, weak inverse correlations were noted between physical examination, laboratory evaluation and medical history adherence scores and the levels of

A1C, FBG, and PPBG in some visits. Even if the correlation coefficients were too low to speak about, glycemic control is better maintained with increasing adherence to guidelines. Yet, the minimum levels of A1C, FBG, and PPBG were significantly lower with the increasing degree of general adherence to guidelines. On the other hand, poorer adherence scores for laboratory evaluation in our study may be because of the short duration following the educational session. Due to non-interventional design of the study, we think that some of the patients could not be able to come to a control visit or might have missed their appointment.

In a controlled study, Gerstein et al. [31] evaluated the effect of a national continuing medical education (CME) program designed to improve family physicians' implementation of diabetes-specific clinical practice guidelines. They found that compared to controls, participants who attended CME programs had improved their attitude, and knowledge. Moreover self-reported practice pattern of physicians regarding diabetes after one month but not after one year was also improved. Thus the education of physicians is effective to disseminate practice guidelines, but needs to be repeated periodically. We also hypothesized that specific training of physicians on SEMT guidelines would increase the adherence and improve patient outcomes. We provide to participating physicians one-day educational session along with a DVD and a hard copy of the guidelines. Adherence to SEMT guidelines significantly increased for overall diagnosis and follow-up procedures with the education. Compliance to guidelines for treatment of diabetes patients was also increased after education of physicians. However, glycemic control of patients was similar before and after the education, which may be due to relatively short duration (four months) of follow-up of patients.

The major limitation of this study is that the effect of other factors on the adherence to guidelines such as patient nonadherence to appointments, failure to comply with requested laboratory evaluations or system-related factors could not be eliminated. However, this study has particular importance in terms of type 2 diabetes knowledge: it showed that local guidelines are crucial to improve the clinical care of patients and to increase life-expectancy and quality of life of patients. However, continuous education of physicians on these guidelines should be recognized as a necessity rather than an individual optional behaviour. For example setting regulations to physicians to receive CME periodically on a compulsory manner may be beneficial.

4.1. Conclusions and recommendations

The following conclusions and recommendations were inferred from the ADMIRE study:

1. The physician adherence to diabetes guidelines is suboptimal in Turkey.
2. Patients with old age, established disease and multiple chronic complications received better care which is in compliance with guidelines.
3. Patients with short duration of diabetes, younger age, no complication, and males received less attention, this may be attributed to clinical inertia of care providers.

4. Specialists and physicians practicing in university settings followed guidelines better than family practitioners and physicians practicing in state institutions.

5. Glycemic control is better maintained with increasing physicians' adherence to guidelines.

6. Education of physicians on SEMT guidelines significantly increased their adherence to guidelines.

7. A better glycemic control is provided, unnecessary treatment is decreased and more rational treatment preferences are observed, after education.

As a conclusion, the educational programs targeted towards family practitioners and state institutions, may improve guideline adherence and patients' outcome. These programs should emphasize the preventive aspect of diabetes management rather than symptom-based treatment approach, Better adherence to diabetes guidelines provide better glycemic control and, thus lower the number of chronic complications and slow the natural course (progression) of the disease.

Appendix

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Original article:

1. Satman İ, İmamoğlu Ş, Yılmaz C, ADMIRE Study Group. Adherence of physicians to SEMT guidelines for the management of type 2 diabetes in Turkey: ADMIRE study. Turk J Endocrin Metab (Turk JEM) 2010; 14: 66-72.

Presentations:

2. Satman I, Imamoglu S, Yilmaz C, Ozkaya RD, Ozdemir O. Adherence of internists and family physicians to SEMT guidelines for type 2 diabetes mellitus in Turkey. 11th ECE 2009, 25-29 April 2009, Istanbul, Turkey, Poster No. 295.

3. Satman I, Yilmaz C, Imamoglu S. Interrelationship among chronic complications, adherence of guidelines and degree of metabolic control in type 2 DM patients in Turkey. 91th Annual Meeting ENDO 09, 10-13 June 2009, Washington DC, USA, Poster No. 515.

4. Satman I, Imamoglu S, Yilmaz C. Relationship between adherence of physicians and the degree of glycaemic control in type 2 DNM patients in Turkey. 69th Scientific Session of ADA, 5-9 June 2009, New Orleans, USA, Poster No. 900.

5. Satman I, Imamoglu S, Yilmaz C and ADMIRE Study Group. Factors related with the adherence of physicians to diabetes guidelines in type 2 DM patients in Turkey. ECE 2011, 30 April-04 May 2011, Rotterdam, The Netherlands, Poster No. 672.

6. Satman I, Imamoglu S, Yilmaz C. Impact of adherence to guidelines on glycemic control and chronic complications in Turkey. 71st Scientific Session of ADA, 24-28 June 2011, New Orleans, USA, Poster No. 1189-P.

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9. Satman I, Imamoglu S, Yilmaz C and ADMIRE Study Group. Comparison of the Methods for Evaluation of Adherence to Type 2 DM Guidelines: Retrospective Chart Review vs. Prospective Patient Follow-up. World Diabetes Congress (WDC), IDF 2011, 4-8 December 2011, Dubai.

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