



# Managing type 2 diabetes mellitus: Role of family physicians in successful treatment goal achievement

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## ABSTRACT

**Introduction:** It is important to emphasize that for most patients with type 2 diabetes mellitus (T2DM), an integrated approach to managing risk factors or the simultaneous modification of all increased risk factors is needed to help reduce the risk of cardiovascular events. Achieving an optimal level of glycated hemoglobin (HbA1c), blood pressure (BP) and LDL cholesterol (LDL) in patients softens macro- and microvascular complications, which is the main goal of treatment in the treatment of type 2 diabetes. This study was aimed at determining the proportion of patients with type 2 diabetes and the aforementioned variable conditions that achieve the triple goals of vascular treatment, based on current practical recommendations.

**Methods:** A questionnaire was distributed to adult patients with T2DM and dyslipidemia at primary care clinics in Ukraine. The demographic and clinical data for these patients with both T2DM and dyslipidemia were compared with laboratory data and treatment data obtained from their medical records. The pooled data was then analyzed to determine the proportion of patients who achieved the triple treatment goals, and logistic regression analysis was used to identify the factors associated with this outcome.

**Results:** 715 eligible patients were recruited [58.9% women] with an average age of 59.8 years. Of these patients, 71.2% achieved LDL-C  $\leq$  2.6 mmol / L, 70.1% had BP <140/90 mm Hg, and 41.2% reached HbA1c <6.5%. Overall, 23.1% achieved the triple goal of treating glycemia, blood pressure and LDL control. The main determinants were the number of diabetic drugs and the intensity of statin therapy.

**Conclusion:** Eight out of ten patients with diabetes mellitus could not achieve the simultaneous goals of treating glycemia, blood pressure and LDL, putting them at risk for vascular complications. Primary health care professionals can reduce these risks by optimizing therapeutic treatment to maximize glycemia, dyslipidemia, and blood pressure control.

**Keywords:** type 2 diabetes mellitus, glycemia, dyslipidemia, blood pressure, primary care

## INTRODUCTION

Type 2 diabetes mellitus (T2DM) is often a progressive disease that begins with impaired glucose tolerance and can progress to insulin resistance with an accumulation of complications over time. T2DM is associated with microvascular complications such as retinopathy, neuropathy and nephropathy (1, 2). In addition, people with type 2 diabetes have an increased risk of developing a number of cardiovascular diseases (CVD), such as peripheral artery disease, ischemic stroke, angina, myocardial infarction, and heart failure. In addition, diabetes is considered a risk factor for cardiovascular mortality (3).

Cardiovascular diseases are currently the main cause of premature death of patients with type 2 diabetes and lead to significant costs for the care of patients. Dyslipidemia, high blood pressure (BP), hyperglycemia, and an unhealthy lifestyle all contribute to the risk of cardiovascular diseases, and management options for all these areas are considered in national and international guidelines. With regard to diabetes, the decision about which patients have a sufficient cardiovascular risk to justify treatment is not based on a formal risk assessment, since most of the recommendations briefly describing the admission of patients with diabetes already have a high enough risk to to justify full-scale preventive interventions for cardiovascular diseases (4, 5).

Thus, the 2013 ESC Guidelines on Diabetes, Pre-Diabetes and Cardiovascular Diseases emphasize the importance of managing diabetes patients in accordance with evidence-based target approaches adapted to the needs of a particular patient (6). The guidelines of the Joint European Society for the Prevention of Cardiovascular Diseases in 2016

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recommended that patients with diabetes and at least one other risk factor for CVDs or target organ damage be considered very high. All other patients with type 2 diabetes should be considered as having a high risk (7).

The management of patients with type 2 diabetes is aimed at reducing the risk of both macro- and microvascular complications. Numerous and consistent evidence suggests that the risk of these vascular complications can be reduced by achieving optimal control over their hyperglycemia, blood pressure and LDL cholesterol levels (8, 9). These vascular risks can be reduced by pharmacological intervention, lifestyle changes and patient adherence to therapy.

However, achieving simultaneous control of glycemia, blood pressure and LDL-C in patients with type 2 diabetes is a difficult task. It is extremely important to determine the proportion and baseline characteristics of the population of patients with type 2 diabetes who do not achieve the triple goals of treatment. The size of this risk group will determine the amount of medical resources needed to manage them (10).

Consequently, this study was aimed at determining the proportion of patients with type 2 diabetes who failed to achieve the triple treatment goals for concomitant control of blood glucose, blood pressure and LDL cholesterol (LDL-C). The secondary goal was to identify modifiable factors associated with triple treatment goals' achievement.

## **MATERIALS AND METHODS**

The study included 715 patients with type 2 diabetes and dyslipidemia between the ages of 35 and 75 years. This study was prospective, conducted in primary health care centers in Kharkiv (clinical bases of the Kharkiv Medical Academy of Postgraduate Education) in the period from August 2016 to September 2018.

The study was conducted in accordance with international standards of bioethics (Council of the European Convention on Human Rights and Biomedicine) and the recommendations of the Committee on Bioethics of the Ministry of Health of Ukraine. All patients signed an informed consent to participate in the study. This study was approved by the Ethics Commission of the Kharkiv Medical Academy of Postgraduate Education of the Ministry of Health of Ukraine (Kharkiv, UA).

Patients who met the criteria for the inclusion of T2DM with a diagnosis of a doctor and dyslipidemia were interviewed by trained research assistants to complete the examination. This questionnaire contains data related to demographic and clinical profiles, laboratory tests and information about the personal lifestyle of patients with dyslipidemia.

The study included patients who found it difficult to communicate in local primary languages and dialects or who could not give informed consent due to cognitive, auditory, and / or visual impairment.

### **Definition of Treatment Goals**

Clinical information, including laboratory tests, such as lipid profiles (total cholesterol, HDL-C, triglycerides (TG) and LDL-C), BP values, HbA1c, and drug prescriptions, were obtained from their medical records. The questionnaire for patients with dyslipidemia covered self-esteem of compliance with prescribed drugs and perceptions related to their understanding and attitude to lifestyle changes and pharmacological treatment. This article is devoted to the influence of modifiable factors, mainly pharmacological, on the achievement of triple treatment goals among patients with type 2 diabetes and dyslipidemia.

The goal of treatment for T2DM is normoglycemia, defined as HbA1c  $\leq$  6.5%, in accordance with the recommendation of the American Diabetes Association (ADA). Following the recommendations of the European Society of Hypertension [ESH] / European Society of Cardiology [ESC] 2013 for the treatment of hypertension, the goal of blood pressure for patients with type 2 diabetes is defined as <140/90 mmHg. The goals of LDL-C treatment for high-risk groups, including patients with type 2 diabetes, are <2.6 mmol / L (<100 mg / dL). Statin therapy intensity, classified as low, medium or high, is based on the 2013 ACC / AHA recommendations for primary and secondary prevention of cardiovascular events.

### **Statistical Analysis**

The analysis was performed using the simultaneous goals of triple treatment with certain levels of glycated hemoglobin (HbA1c), LDL-C and BP as the main result. To assess the difference between those who have well controlled glycated hemoglobin and those who do not have it, the chi-square test or Fisher's exact test was used to test independence for categorical responses. Continuous variables were tested using independent t-tests and the Mann-Whitney U-test.

The adjusted odds ratios (ORs) and the corresponding 95% confidence intervals (CI) were calculated using logistic regression in which all potentially significant factors were entered. The data was coded and analyzed using IBM SPSS Statistical Software 22.0. For all tests performed, a p-value less than 0.05 was considered statistically significant.

**Table 1:** Demographic profiles of patients with T2DM in association with their glycemia, blood pressure, and LDL-cholesterol controls

	Total	Glycated hemoglobin <sup>1</sup> , BP <sup>2</sup> and LDL <sup>3</sup> goals not achieved	Glycated hemoglobin <sup>1</sup> , BP <sup>2</sup> and LDL <sup>3</sup> goals achieved	p-value
<b>Demographic profile</b>	715 (100.0)	550 (76.9)	165 (23.1)	
<i>Gender</i>				0.30
Female	421 (58.9)	332 (78.9)	89 (21.1)	
Male	294 (41.1)	218 (74.1)	76 (25.9)	
<i>Age (years)</i>				<0.01
<60	347 (48.5)	292 (84.1)	55 (15.9)	
≥60	368 (51.5)	258 (70.1)	110 (29.9)	
<i>Employment status</i>				0.70
Employed	350 (49.0)	272 (77.7)	78 (22.3)	
Unemployed	365 (51.0)	278 (76.2)	87 (23.8)	
<i>BMI<sup>4</sup></i>				0.65
Below 23	82 (11.5)	62 (75.6)	20 (24.4)	
23 and above	633 (88.5)	488 (77.1)	145 (22.9)	
<b>Lifestyle habits</b>				
<i>Current smoker</i>				0.92
Yes	38 (5.3)	29 (76.3)	9 (23.7)	
No	677 (94.7)	521 (77.0)	156 (23.0)	
<b>Comorbidities</b>				
<i>Hypertension</i>				0.90
Yes	612 (85.6)	470 (76.8)	142 (23.2)	
No	103 (14.4)	80 (77.7)	23 (22.3)	
<i>Coronary artery disease</i>				0.60
Yes	172 (24.1)	136 (79.1)	36 (20.9)	
No	543 (75.9)	414 (76.2)	129 (23.8)	
<i>Cerebral vascular disease / Stroke / TIA</i>				0.55
Yes	158 (22.1)	125 (79.1)	33 (20.9)	
No	557 (77.9)	425 (76.3)	132 (23.7)	
<i>Renal disease</i>				<0.01
Yes	79 (11.0)	73 (92.4)	6 (7.6)	
No	636 (89.0)	477 (75)	159 (25)	
<i>Peripheral vascular disease</i>				<0.05
Yes	8 (1.1)	7 (87.5)	1 (12.5)	
No	707 (98.9)	543 (76.8)	164 (23.2)	
<b>Duration of comorbidities</b>				
Duration of Type 2 Diabetes, median (IQR)	7 (4-12)	7 (4-12)	5.5 (3-10)	<0.01
Duration of Hypertension, median (IQR)	8 (4-12)	8.5 (4-11)	8 (4-12)	0.92
Duration of Dyslipidemia, median (IQR)	8 (4.5-12)	8 (4-12)	8 (5-11)	0.62
<b>Medication</b>				
Number of diabetic medications, median (IQR)	2 (1-2)	2 (1-3)	1 (1-2)	<0.01
Number of anti-hypertensive medications, median (IQR)	2 (1-3)	2 (1-3)	2 (1-3)	0.25
Number of lipid-lowering medications, median (IQR)	1 (1-1)	1 (1-1)	1 (1-1)	0.68
<i>Diabetic medication type</i>				<0.01
Non on diabetic medication	82 (11.5)	43 (52.4)	39 (47.6)	
Oral	564 (78.9)	442 (78.4)	122 (21.6)	
Insulin	11 (1.5)	9 (81.8)	2 (18.2)	
Combination (oral and insulin)	58 (8.1)	56 (96.6)	2 (3.4)	
<b>Statin Intensity<sup>5</sup></b>				<0.01
Low	186 (26)	128 (68.8)	58 (31.2)	
Moderate	392 (54.8)	310 (79.1)	82 (20.9)	
High	137 (19.2)	108 (78.8)	29 (21.2)	

1 Glycated hemoglobin: Goals not achieved: HbA1c≥6.5; Goals achieved: HbA1c < 6.5

2 Blood pressure: aged 60 years or older < 150/90mmHg; aged below 60 years < 140/90mmHg; Patients with diabetes <140/90mmHg

3 LDL-C: For high risk group, goals achieved refers to LDL≤ 2.6mmol/L (100 mg/dL), Goals not achieved refers to LDL>2.6mmol/L (100 mg/dL).

4 BMI value of 23 and above indicates unhealthy weight range

5 Statin Intensity: Adopted from the 2013 American College of Cardiology and American Heart Association (ACC/AHA) Blood Cholesterol Guideline

From the point of view of the measurements used for BP, HbA1c and LDL-C, the current BP readings were performed twice, with an interval of 15 minutes between two measurements, and the average of the two readings was used as a parameter BP. The most recent laboratory results (HbA1c and lipid profile), as well as data on prescribed drugs were obtained from medical records.

## RESULTS

The study population consisted of a total of 715 patients (421 women and 294 men) with an average age of 59.8 years. **Table 1** shows the demographic characteristics of the patients included in the analysis. A total of 76.9% of patients

**Table 2:** Factors influencing glycosylated hemoglobin, blood pressure, and LDL-C goal achievement using logistic regression in patients with T2DM and dyslipidemia

	OR (95% CI)	p-value
<b>Age (years)</b>		
<60	1	-
≥60	1.56 (0.98, 1.6)	0.09
<b>Renal disease</b>		
No	1	-
Yes	0.44 (0.18, 1.15)	0.10
Duration of T2DM	0.96 (0.95, 1.07)	0.54
Number of diabetic medications	0.55 (0.38, 0.75)	<0.01
<b>Diabetic medication type</b>		
Combination (oral and insulin)	1	-
Not on diabetic medication	2.71 (0.65, 12.05)	0.08
Oral hypoglycemic agent only	2.35 (0.78, 7.34)	0.16
Insulin only	2.61 (0.38, 19.76)	0.41
<b>Statin intensity</b>		
Low	1	-
Moderate	0.60 (0.38, 0.92)	0.03
High	0.49 (0.22, 0.99)	0.04

with diabetes mellitus and dyslipidemia could not achieve the simultaneous goals of treating HbA1c, blood pressure and LDL-C.

Demographic variables, such as gender, education, and employment status, were not associated with achieving the triple goal. A significant proportion of patients aged 60 years and older (29.9%) achieved better simultaneous control over the three treatment goals than patients from younger age groups and other ethnic groups. As many as 88.5% of the study population had a body mass index of 23 or higher, however, the levels of control with three goals were the same for groups with overweight and with overweight. The majority of patients with T2DM and other concomitant diseases did not achieve the concomitant treatment goals, and the association was significant among patients with renal insufficiency (92.4%) (**Table 1**).

The patients in this study took an average of 2 drugs related to diabetes, while the average duration of T2D was 8 years. Those who could not achieve triple control, probably consumed more diabetic drugs and had a longer duration of type 2 diabetes. The highest percentage (47.6%) of simultaneous control was observed among patients who were not prescribed any medication for diabetes. Those who took oral hypoglycemic drugs or insulin were more likely to achieve simultaneous treatment goals than those who received the combined treatment ( $p < 0.01$ ) (**Table 1**).

In our study, 71.2% and 70.1% of patients achieved the treatment goals for LDL-C and BP, respectively. Among the three goals, glycemic control was the least satisfactory - 41.2%. Dual achievement of HbA1c and BP goals was recorded for 27.5%, 34% achieved HbA1c and LDL-C goals, while combined BP and LDL-C goals corresponded to 53%. Simultaneous control of blood glucose, blood pressure, and lipids in the blood was noted in 23.1% of patients.

**Table 2** shows the results of the analysis of the logistic regression of factors associated with the achievement of the goals of triple treatment. Patients treated with moderate statins (OR=0.60, 95% CI 0.38-0.92,  $p=0.03$ ) to high intensity (OR=0.49, CI 95% 0.22-0.99,  $p = 0.04$ ), are less likely to achieve simultaneous treatment goals compared to low intensity.

## DISCUSSION

Younger patients were less likely to achieve triple treatment goals than those who were 60 years or older. This finding is consistent with data from an earlier study, which postulated that younger adult patients may have less motivation to manage their diabetic conditions, since they may be busy with their work and therefore have less time to comply with the requirements of a healthy lifestyle and treatment. Based on their lifespan, they will be more susceptible to vascular complications due to an earlier onset of the disease and a longer period of time during which these adverse events may develop (11, 12).

It was reported that young people with type 2 diabetes felt that modern diabetes education programs were not specifically targeted at their age group in several areas. They would appreciate clear and concise information given their time constraints. They wanted support from their families and peers, since community acceptance was associated with a positive impact on their life experiences with their health (13, 14).

One out of five patients (21.8%) in this study achieved the triple goal of treatment. Patients' achievement of triple goals was largely related to their therapy, including the number of antidiabetic drugs and the intensity of their statin regimen. This requires that doctors regularly check and adjust the dosages of these medicines, which can be associated

with a large expenditure of time and resources. Most of their patients with chronic diseases receive support for the self-control of their diseases, and high-risk patients have the opportunity to combine self-management and professional help.

Fewer drugs and shorter duration of T2DM were significant factors in the triple control. Increasing the number of drugs may be necessary to optimize control as the disease progresses, but this may adversely increase the risk of poor drug compliance and side effects (15). Thus, the progression of the disease is associated with a growing problem in terms of achieving triple goals.

Finding a good balance of risk-benefit is important when choosing the intensity of a HbA1c reduction strategy. The rationale for a good risk-benefit ratio for diabetes changes from "Treat to target" to "Treat to benefit", and should be based on an assessment of effectiveness and commitment, safety and balance between positive effects on the risk of deterioration and mortality from cardiovascular diseases.

Unlike most studies that report the results associated with individual glycemic control, this article discusses three quality indicators for people with type 2 diabetes (16). Simultaneous achievement of the triple goal is a more comprehensive mitigation measure to reduce the risk of both macro- and microvascular complications. The results of this article provide baseline data to initiate qualitative improvement initiatives in order to raise the proportion of patients with type 2 diabetes who achieve this goal (17).

The study did not include other potential factors that could impede the achievement of triple treatment goals, such as the physical activity of patients; social habits such as drinking; the condition of the thyroid gland and possible renal failure; genetics and local hormonal reactions of the intestines to diet and medications; and the intervention of intestinal microbiomes.

## CONCLUSION

Simultaneous control of glycemia, hypertension and dyslipidemia was achieved 23.1% of the studied population with type 2 diabetes. Younger patients under the age of 60 are less likely to achieve the triple goal of treatment. The number of diabetic drugs and the intensity of statin treatment were significant factors associated with the successful triple treatment goal achievement.

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