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Type 2 Diabetes Mellitus

Methodological recommendations for medical students
Adapted from
American Diabetes Association Guideline

Uzhhorod-2024

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These methodological recommendations include information about prevention, screening and management of Type 2 Diabetes Mellitus. The aim of manual is to provide help for medical students of IV, V and VI courses in preparation for practical classes, improvement of their knowledge and skills in management of patients with type 2 DM.

The methodological recommendations are composed according to medical student's educational qualification characteristics and professional training programs.

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** Evidence-grading system:

Level evidence	Description
A	Clear evidence from well-conducted, generalizable randomized controlled trials that are adequately powered
B	Supportive evidence from well-conducted cohort studies
C	Supportive evidence from poorly controlled or uncontrolled studies
E	Expert consensus or clinical experience

1. Diabetes mellitus (DM)* – is a metabolic disorder of multiple etiologies, characterized by chronic hyperglycemia with disturbance in metabolism of carbohydrates, proteins and fats as a result of defects in insulin secretion, action or both.

* Defined by WHO

Classification of DM:

Diabetes can be classified into the following general categories:

1. Type 1 diabetes (T1DM)-due to autoimmune b-cell destruction, usually leading to absolute insulin deficiency

2. Type 2 diabetes (T2 DM)- due to a progressive loss of b-cell insulin secretion frequently on the background of insulin resistance

3. Gestational diabetes mellitus (GDM) (diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation)

4. Specific types of diabetes due to other causes, e.g., monogenic diabetes syndromes (such as neonatal diabetes and maturity-onset diabetes of the young [MODY]), diseases of the exocrine pancreas (such as cystic fibrosis), and drug- or chemical-induced diabetes (such as with glucocorticoid use, in the treatment of HIV/AIDS, or after organ transplantation)

2. Etiology and risk factors of DM 2 :

The origin and etiology of DM can vary greatly, but it is proved that DM 2 is associated with resistance of tissues to insulin and accompanied by risk factors.

Etiology:

- Genetic defects of β-cell function, defects of insulin action
- Pancreatic diseases (e.g. pancreatitis, pancreatectomy, neoplastic disease, cystic fibrosis, haemochromatosis)
- Excess endogenous production of hormonal antagonists to insulin (e.g. Growth hormone – acromegaly, Glucocorticoids – Cushing's syndrome, Glucagon – glucagonoma, Catecholamines – pheochromocytoma, Thyroid hormones – thyrotoxicosis)
- Drug-induced (e.g. corticosteroids, thiazide diuretics)
- Associated with genetic syndromes (e.g. Down's syndrome, Klinefelter's syndrome, Turner's syndrome)

Risk factors:

- ✓ Obesity, physical inactivity
- ✓ Family history of DM in relatives of the1 st line
- ✓ Ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
- ✓ Cardio-vascular factors (arterial hypertension, hyperlipidemia)
- ✓ History of gestational diabetes
- ✓ Polycystic ovary syndrome

3. Prevention or delay of DM 2

Lifestyle behavior change for diabetes prevention recommendations:

Refer adults with overweight or obesity at high risk of type 2 diabetes to an intensive lifestyle behavior change program to achieve and maintain a weight reduction of at least 7% of initial body weight through healthy reduced-calorie diet and ≥150 min/week of moderate intensity physical activity. (A).

Pharmacologic interventions:

Metformin for the prevention of type 2 diabetes should be considered in adults at high risk of type 2 diabetes, as typified by the DPP, especially those aged 25–59 years with BMI ≥35 kg/m2, higher fasting plasma glucose (e.g., ≥110 mg/dL [≥6 mmol/L]), and higher A1C (e.g.,≥6.0%[≥42 mmol/mol]), and in individuals with prior gestational diabetes mellitus. A

Long-term use of metformin may be associated with vitamin B12 deficiency; consider periodic assessment of vitamin B12 level in metformin-treated individuals, especially in those with anemia or peripheral neuropathy. B

4. Symptoms of DM 2:

- ➢ Polydipsia (↑ thirst), dry mouth
- ➢ Polyuria (↑urination), nocturia
- ➢ Polyphagia (↑hunger)
- ➢ Fatigue
- ➢ Sudden weight loss
- ➢ Blurring of vision
- ➢ ↑Frequency of infections (ex., genital candidiasis)

- Poor wound's healing
- Numbness , tingling of hands or feet

5. Screening of DM 2

5.1 *Criteria for screening for diabetes or prediabetes in asymptomatic adults (B)**:

1. Testing should be considered in **overweight or obese** (BMI 25 kg/m^2 or 23 kg/m^2 in Asian Americans) **adults** who have **<u>one or more</u>** of the following **<u>risk factors</u> (B)**:

- A1C 5.7% (39 mmol/mol), IGT, or IFG on previous testing
- first-degree relative with diabetes
- high-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American,Pacific Islander)
- women who were diagnosed with GDM
- history of cardio-vascular diseases
- hypertension (BP ≥130/80 mmHg or on therapy for hypertension)
- HDL cholesterol level <35 mg/dL (0.90 mmol/L) and/or a triglyceride level >250 mg/dL(2.82 mmol/L)
- women with polycystic ovary syndrome
- physical inactivity
- other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans).

2. For all patients, testing should begin at age 35 years (B).
It is recommended that people at high risk for Type 2 DM receive appropriate lifestyle counseling to reduce their risk of developing DM (A).

* Recommendations of American Diabetes Association

5.2 Frequency of screening

If results are normal, testing should be repeated at a minimum of **3-year intervals** (C), with consideration of more frequent testing depending on initial results (e.g., those with pre-diabetes should be tested yearly) and risk status.

5.3 Screening methods of DM 2 (B):

1. Fasting plasma glucose (FPG) - (fasting is defined as no caloric intake for at least 8 h)
2.Oral glucose tolerance test (OGTT) – (test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water)
3. HbA1c (glycated hemoglobin) -reflects amount of glucose attached to Hgb of RBC and indicates overall glucose control over previous 90 – 120 days)

All these methods are equally appropriate (B)

5.4 Ranges of <u>venous plasma g</u>lucose for the diagnosis of Diabetes Mellitus[1]

Method	Normal range	Pre-Diabetes	Diabetes Mellitus
FPG	3.3-5.5 mmol/l (59-100mg/dl)	5.6 - 6.9 mmol/l (100.1-125/dl)	≥ 7.0 mmol/l (126mg/dl)
OGTT	<7.8 mmol/l (140 mg/dl)	7.8- 11.0 mmol/l (140-199 mg/dl)	≥11.1 mmol/l (≥200 mg/dl)
HbA1c	≤ 5.6%	5.7% - 6.4%	≥6.5% 6.5-6.9 %-well compensated DM 7.0-7.4% sub-compensated DM ≥7.5 %- decompensated DM

[1] ADA –American Diabetes Association

5.5 *Criteria for diagnosing of Diabetes Mellitus:

- ✓ *a* ***<u>fasting plasma glucose*</u>*** *concentration* ***<u>≥ 7.0 mmol/l</u>*** ***<u>(126 mg/dL)</u>***.

Fasting is defined as no caloric intake for at least 8 h.

OR

- ✓ ***<u>2 hours postprandial glucose</u>*** *concentration* ***<u>≥11.1 mmol/l</u>*** ***<u>(200 mg/dL)</u>*** ***during <u>oral glucose tolerance test</u>*** *(OGTT)**. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.* **

OR

- ✓ ***HbA1C <u>≥</u> 6.5%*** (48 mmol/mol)

OR

- ✓ *In a patient with* ***classic symptoms of hyperglycemia*** *(e.g.polyuria,polydipsia) or hyperglycemic crisis****, a random plasma glucose ≥ 11.1 mmol/L (200 mg/dL).*** Random is any time of the day without regard to time since previous meal.

With no symptoms diagnosis should not be based on a single glucose determination. At least one additional glucose test result on another day with a value in the diabetic range is essential, either fasting from a random sample or from the two hour post glucose load. If the fasting random values are not diagnostic the two hour value should be used.

Unless there is a clear clinical diagnosis (e.g., patient in a hyperglycemic crisis or with classic symptoms of hyperglycemia and a random plasma glucose ≥ 11.1 mmol/L (200 mg/dL), diagnosis requires two abnormal test results, either from the same sample or in two separate test samples. If using two separate test samples, it is recommended that the second test, which may either be a repeat of the initial test or a different test, be performed without delay.

*Recommendations of ADA 2024

6. Treatment of Type 2 DM

Management and treatment of DM 2 includes such components as:

6.1. Diet (low carbohydrate diet with reduction of saturated fat, trans fat and cholesterol intake) focusing on weight loss (if indicated);

Diet is a basic part of management and treatment of diabetes mellitus !!!

Topic	Recommendations
Effectiveness of nutrition therapy	An individualized medical nutrition therapy program as needed to achieve treatment goals, provided by a registered dietitian nutritionist (RD/RDN), preferably one who has comprehensive knowledge and experience in diabetes care, is recommended for all people with type 1 or type 2 diabetes, prediabetes, and gestational diabetes mellitus. A Because diabetes medical nutrition therapy can result in cost savings B and improved outcomes (e.g., A1C reduction, reduced weight, decrease in cholesterol) A, medical nutrition therapy should be adequately reimbursed by insurance and other payers. E

Energy balance	For all patients with overweight or obesity, lifestyle modification to achieve and maintain a minimum weight loss of 5% is recommended for all patients with diabetes and prediabetes. A
Eating patterns and macronutrient distribution	There is no single ideal dietary distribution of calories among carbohydrates, fats, and proteins for people with diabetes; therefore, meal plans should be individualized while keeping total calorie and metabolic goals in mind. E A variety of eating patterns can be considered for the management of type 2 diabetes and to prevent diabetes in individuals with prediabetes. B
Carbohydrates	Carbohydrate intake should emphasize nutrient-dense carbohydrate sources that are high in fiber and minimally processed. Eating plans should emphasize nonstarchy vegetables, minimal added sugars, fruits, whole grains, as well as dairy products. B Reducing overall carbohydrate intake for individuals with diabetes has demonstrated the most evidence for improving glycemia and may be applied in a variety of eating patterns that meet individual needs and preferences. B For people with diabetes who are prescribed a flexible insulin therapy program, education on how to use carbohydrate counting A and on dosing for fat and protein content B should be used to determine mealtime insulin dosing. For adults using fixed insulin doses, consistent pattern of carbohydrate intake with respect to time and amount, while considering the insulin action time, can result in improved glycemia and reduce the risk for hypoglycemia. B People with diabetes and those at risk are advised to replace sugar-sweetened beverages (including fruit juices) with water as much as possible in order to control glycemia and weight and reduce their risk for cardiovascular disease and fatty liver B and shouldminimize the consumption of foods with added sugar that have the capacity to displace healthier, more nutrient-dense food choices. A
Protein	In individuals with type 2 diabetes, ingested protein appears to increase insulin response without increasing plasma glucose concentrations. Therefore, carbohydrate sources high in protein should be avoided when trying to treat or prevent hypoglycemia. B
Dietary fat	An eating plan emphasizing elements of a Mediterranean-style eating pattern rich in monounsaturated and polyunsaturated fats may be considered to improve glucose metabolism and lower cardiovascular disease risk. B Eating foods rich in long-chain n-3 fatty acids, such as fatty fish (EPA and DHA) and nuts and seeds (ALA), is recommended to prevent or treat cardiovascular disease. B
Micronutrients and herbal supplements	There is no clear evidence that dietary supplementation with vitamins, minerals (such as chromium and vitamin D), herbs, or spices (such as cinnamon or aloe vera) can improve outcomes in

	people with diabetes who do not have underlying deficiencies, and they are not generally recommended for glycemic control. C
Alcohol	5.22 Adults with diabetes who drink alcohol should do so in moderation (no more than one drink per day for adult women and no more than two drinks per day for adult men). C Educating people with diabetes about the signs, symptoms, and self-management of delayed hypoglycemia after drinking alcohol, especially when using insulin or insulin secretagogues, is recommended. The importance of glucose monitoring after drinking alcoholic beverages to reduce hypoglycemia risk should be emphasized. B
Sodium	As for the general population, people with diabetes and prediabetes should limit sodium consumption to 2,300 mg/day. B
Nonnutritive sweeteners	The use of nonnutritive sweeteners may have the potential to reduce overall calorie and carbohydrate intake if substituted for caloric (sugar) sweeteners and without compensation by intake of additional calories from other food sources. For those who consume sugarsweetened beverages regularly, a low-calorie or nonnutritive-sweetened beverage may serve as a short-term replacement strategy, but overall, people are encouraged to decrease both sweetened and nonnutritive-sweetened beverages and use other alternatives, with an emphasis on water intake. B

6.2. Physical activity (aerobic exercises 30-45 min/5 days a week);

Most adults with type 2 diabetes should engage in 150 min or more of moderate to vigorous-intensity aerobic activity per week, spread over at least 3 days/week, with no more than 2 consecutive days without activity (B).
Shorter durations (minimum 75min/week) of vigorous-intensity or interval training may be sufficient for younger and more physically fit individuals.
Diet, physical activity, and behavioral therapy designed to achieve and maintain ≥5% weight loss is recommended for most patients with type 2 diabetes who have overweight or obesity and are ready to achieve weight loss. Greater benefits in control of diabetes and cardiovascular risk may be gained from even greater weight loss. B

6.3. Smoking cessation: tobacco and e-cigarettes

Advise all patients not to use cigarettes and other tobacco products or e-cigarettes.
After identification of tobacco or e-cigarette use, include smoking cessation counseling and other forms of treatment as a routine component of diabetes care (A)

Address smoking cessation as part of diabetes education programs for those in need (B)

6.4. Psychosocial issues

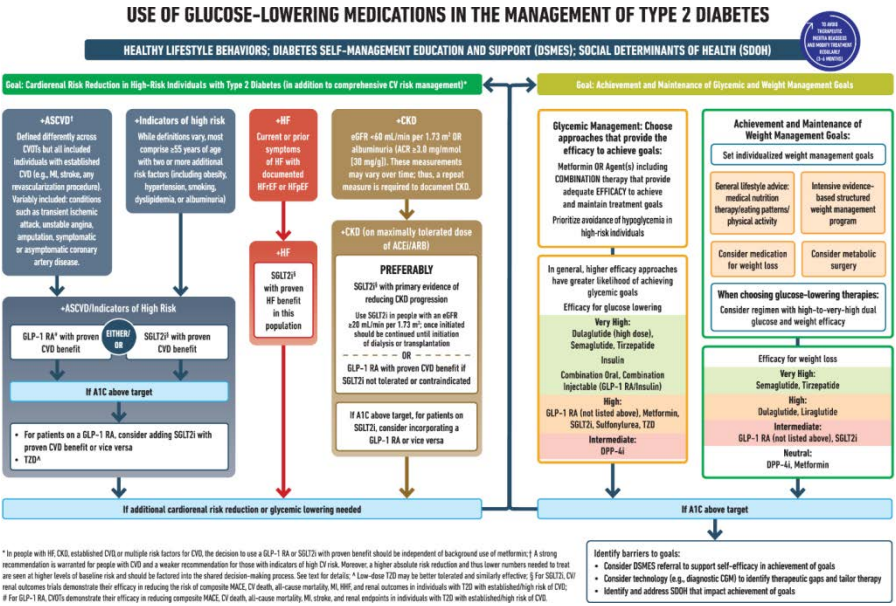
Psychosocial care should be integrated with a collaborative, patient-centered approach and provided to all people with diabetes, with the goals of optimizing health outcomes and health-related quality of life. (A)

Providers should consider assessment for symptoms of diabetes distress, depression, anxiety, disordered eating, and cognitive capacities using appropriate standardized and validated tool sat the initial visit, at periodic intervals, and when there is a change in disease, treatment, or life circumstance. Including caregivers and family members in this assessment is recommended. B

Consider screening older adults (aged ≥65 years) with diabetes for cognitive impairment and depression. (B)

6.5. Pharmacological treatment

6.5.1 ADA 2024 algorithm of treatment of DM 2



6.5.2. Medications for lowering glucose, summary of characteristics

	Efficacy[1]	Hypoglycemia	Weight change[2]	CV effects		Renal effects		Oral/SQ	Cost	Clinical considerations
				Effect on MACE	HF	Progression of DKD	Dosing/use considerations*			
Metformin	High	No	Neutral (potential for modest loss)	Potential benefit	Neutral	Neutral	• Contraindicated with eGFR <30 mL/min per 1.73 m²	Oral	Low	• GI side effects common; to mitigate GI side effects, consider slow dose titration, extended release formulations, and administration with food • Potential for vitamin B12 deficiency; monitor at regular intervals
SGLT2 inhibitors	Intermediate to high	No	Loss (intermediate)	Benefit: canagliflozin, empagliflozin	Benefit: canagliflozin, dapagliflozin, empagliflozin, ertugliflozin	Benefit: canagliflozin, dapagliflozin, empagliflozin	• See labels for renal dose considerations of individual agents • Glucose-lowering effect is lower for SGLT2 inhibitors at lower eGFR	Oral	High	• DKA risk, rare in T2DM: discontinue, evaluate, and treat promptly if suspected; be aware of predisposing risk factors and clinical presentation (including euglycemic DKA); discontinue before scheduled surgery (e.g., 3–4 days), during critical illness, or during prolonged fasting to mitigate potential risk • Increased risk of genital mycotic infections • Necrotizing fasciitis of the perineum (Fournier gangrene), rare reports: institute prompt treatment if suspected • Attention to volume status, blood pressure; adjust other volume- contracting agents as applicable
GLP-1 RAs	High to very high	No	Loss (intermediate to very high)	Benefit: dulaglutide, liraglutide, semaglutide (SQ) Neutral: exenatide once weekly, lixisenatide	Neutral	Benefit for renal endpoints in LYDUs, driven by albuminuria outcomes: dulaglutide, liraglutide, semaglutide (SQ)	• See labels for renal dose considerations of individual agents • No dose adjustment for dulaglutide, liraglutide, semaglutide • Monitor renal function when initiating or escalating doses in patients with renal impairment reporting severe adverse GI reactions	SQ; oral (semaglutide)	High	• Risk of thyroid C-cell tumors in rodents; human relevance not determined (liraglutide, dulaglutide, exenatide extended release, semaglutide) • Counsel patients on potential for GI side effects and their typically temporary nature; provide guidance on dietary modifications to mitigate GI side effects (reduction in meal size, mindful eating practices [e.g., stop eating once full], decreasing intake of high-fat or spicy food); consider slower dose titration for patients experiencing GI challenges • Counsel patients about potential for ileus • Pancreatitis has been reported in clinical trials but causality has not been established. Discontinue if pancreatitis is suspected • Evaluate for gallbladder disease if cholelithiasis or cholecystitis is suspected
Dual GIP and GLP-1 RA	Very high	No	Loss (very high)	Under investigation	Under investigation	Under investigation	• See label for renal dose considerations • No dose adjustment • Monitor renal function when initiating or escalating doses in patients with renal impairment reporting severe adverse GI reactions	SQ	High	• Risk of thyroid C-cell tumors in rodents; human relevance not determined • Counsel patients on potential for GI side effects and their typically temporary nature; provide guidance on dietary modifications to mitigate GI side effects (reduction in meal size, mindful eating practices [e.g., stop eating once full], decreasing intake of high-fat or spicy food); consider slower dose titration for patients experiencing GI challenges • Not recommended for individuals with history of gastroparesis • Pancreatitis has been reported in clinical trials but causality has not been established. Discontinue if pancreatitis is suspected • Evaluate for gallbladder disease if cholelithiasis or cholecystitis is suspected
DPP-4 inhibitors	Intermediate	No	Neutral	Neutral	Neutral (potential risk, saxagliptin)	Neutral	• Renal dose adjustment required (sitagliptin, saxagliptin, alogliptin); can be used in renal impairment • No dose adjustment required for linagliptin	Oral	High	• Pancreatitis has been reported in clinical trials but causality has not been established. Discontinue if pancreatitis is suspected • Joint pain • Bullous pemphigoid (postmarketing); discontinue if suspected
Thiazolidinediones	High	No	Gain	Potential benefit: pioglitazone	Increased risk	Neutral	• No dose adjustment required • Generally not recommended in renal impairment due to potential for fluid retention	Oral	Low	• Congestive HF (pioglitazone, rosiglitazone) • Fluid retention (edema, heart failure) • Benefit in NASH • Risk of bone fractures • Weight gain: consider lower doses to mitigate weight gain and edema
Sulfonylureas (2nd generation)	High	Yes	Gain	Neutral	Neutral	Neutral	• Glyburide generally not recommended in chronic kidney disease • Glipizide and glimepiride: initiate conservatively to avoid hypoglycemia	Oral	Low	• FDA Special Warning on increased risk of CV mortality based on studies of an older sulfonylurea (tolbutamide); glimepride shown to be CV safe (see text) • Use with caution in persons at risk for hypoglycemia
Insulin Human	High to very high	Yes	Gain	Neutral	Neutral	Neutral	• Lower insulin doses required with a decrease in eGFR; titrate per clinical response	SQ; inhaled	Low (SQ)	• Injection site reactions • Higher risk of hypoglycemia with human insulin (NPH or premixed formulations) vs. analogs
Analogs								SQ	High	

6.5.3 Approach to individualization of glycemic targets

- An A1C goal for many nonpregnant adults of <7% (53 mmol/mol) without significant hypoglycemia is appropriate. A

- On the basis of provider judgment and patient preference, achievement of lower A1C levels than the goal of 7% may be acceptable, and even

beneficial, if it can be achieved safely without significant hypoglycemia or other adverse effects of treatment. C

- Less stringent A1C goals (such as <8% [64 mmol/mol]) may be appropriate for patients with limited life expectancy, or where the harms of treatment are greater than the benefits. B

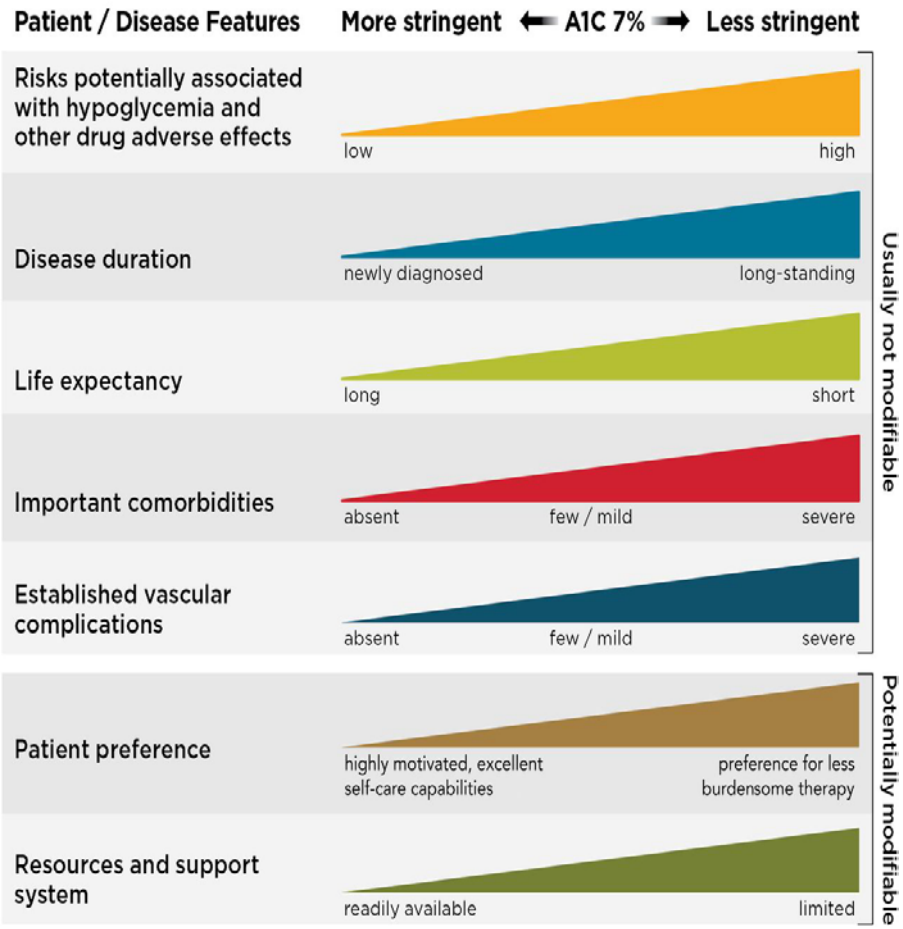
For many people with diabetes, glucose monitoring, either using BGM by capillary (finger-stick) devices or CGM in addition to regular A1C testing, is key for achieving glycemic goals.

Glycemic goals and management should be individualized and not one size fits all. Numerous factors must be considered when setting a glycemic goal. The ADA proposes general goals that are appropriate for many people but emphasizes the importance of individualization based on key patient characteristics. Glycemic goals must be individualized in the context of shared decision-making to address individual needs and preferences and consider characteristics that influence risks and benefits of therapy; this approach may optimize engagement and self-efficacy.

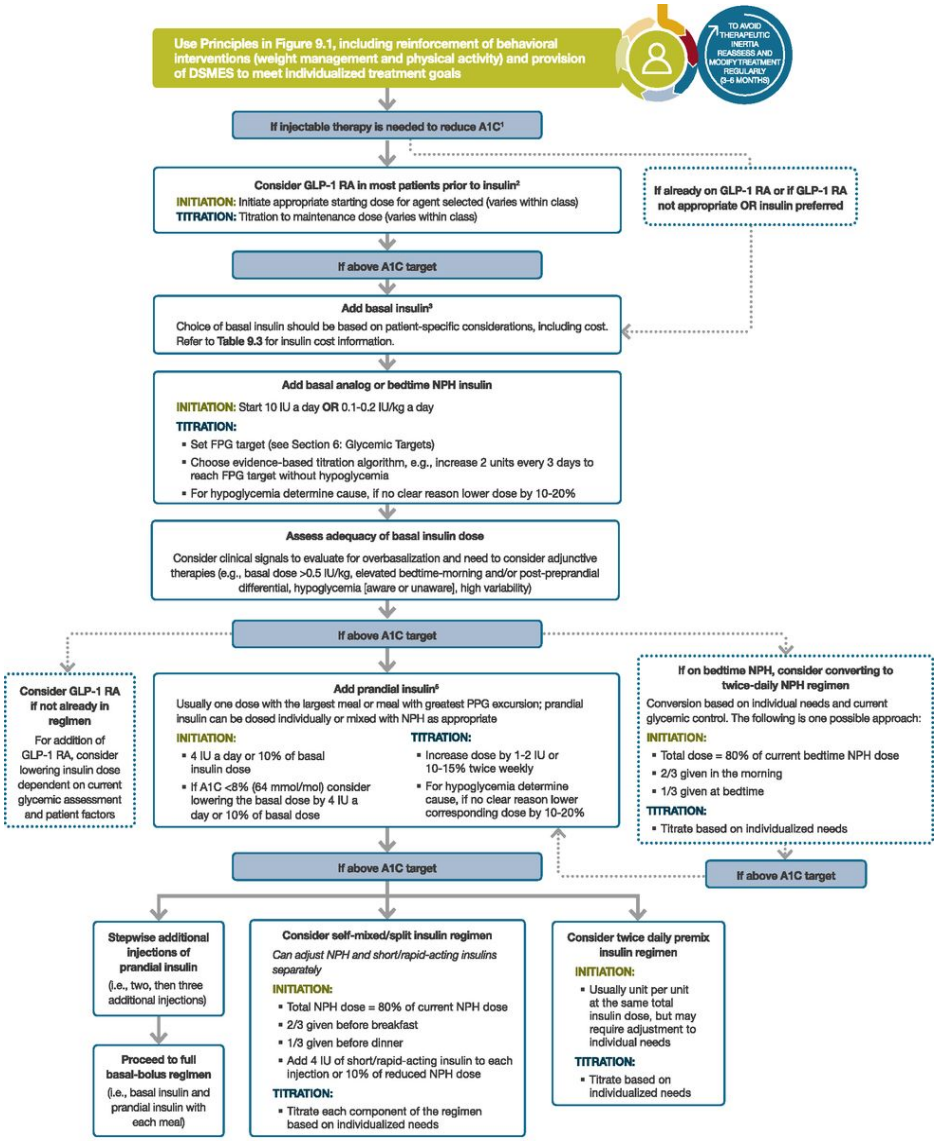
Summary of glycemic targets recommendations for nonpregnant adults with diabetes are presented below:

Preprandial capillary plasma glucose	4.4-7.2 mmol/l (80-130 mg/dl)
2 hours postprandial capillary plasma glucose	<10.0 mmol/l (<180 mg/dl)
HbA1c	<7.0 % (<53 mmol/mol)

Approach to Individualization of Glycemic Targets



6.5.4 Combination injectable therapy for DM2*



1. Consider insulin as the first injectable if evidence of ongoing catabolism, symptoms of hyperglycemia are present, when A1C levels (>10% [86 mmol/mol]) or blood glucose levels (≥300 mg/dL [16.7 mmol/L]) are very high, or a diagnosis of type 1 diabetes is a possibility.
2. When selecting GLP-1 RA, consider: patient preference, A1C lowering, weight-lowering effect, or frequency of injection. If CVD, consider GLP-1 RA with proven CVD benefit. Oral or injectable GLP-1 RA are appropriate.
3. For patients on GLP-1 RA and basal insulin combination, consider use of a fixed-ratio combination product (iDegLira or iGlarLixi).
4. Consider switching from evening NPH to a basal analog if the patient develops hypoglycemia and/or frequently forgets to administer NPH in the evening and would be better managed with an AM dose of a long-acting basal insulin.
5. If adding prandial insulin to NPH, consider initiation of a self-mixed or premixed insulin regimen to decrease the number of injections required.

* by American Diabetes Association

6.5.5 Self-monitoring of blood glucose

People who are on insulin using self-monitoring of blood glucose should be encouraged to test when appropriate based on their insulin regimen. This may include testing when fasting, prior to meals and snacks, at bedtime, prior to exercise, when low blood glucose is suspected, after treating low blood glucose until they are normoglycemic, and prior to and while performing critical tasks such as driving. B

When prescribing continuous glucose monitoring (CGM) devices, robust diabetes education, training, and support are required for optimal CGM device implementation and ongoing use. People using CGM devices need to have the ability to perform self-monitoring of blood glucose in order to calibrate their monitor and/or verify readings if discordant from their symptoms. B

6.5.6 Hypoglycemia

Hypoglycemia is the major limiting factor in the glycemic management of type 1 and type 2 diabetes.

Classification of hypoglycemia

	Glycemic criteria/description
Level 1	Glucose, <3.9 mmol/L (70 mg/dL) and > 3.0 mmol/L (54 mg/dL)
Level 2	Glucose, <3.0 mmol/L (54 mg/dL)
Level 3	Altered mental and/or physical status requiring assistance for treatment of hypoglycemia

6.5.7 Management of hypoglycemia

Occurrence and risk for hypoglycemia should be reviewed at every encounter and investigated as indicated (C). Glucose (approximately 15–20 g) is the preferred treatment for the conscious individual with blood glucose,70mg/dL (3.9mmol/L], although any form of carbohydrate that contains glucose may be used.

Fifteen minutes after treatment, if self-monitoring of blood glucose (SMBG) shows continued hypoglycemia, the treatment should be repeated. Once the SMBG or glucose pattern is trending up, the individual should consume a meal or snack to prevent recurrence of hypoglycemia. B

Glucagon should be prescribed for all individuals at increased risk of level 2 or 3 hypoglycemia so that it is available should it be needed. Caregivers, school personnel, or family members of these individuals should know where it is and when and how to administer it

7. Management of chronic complications of DM 2

Classification of chronic complications of DM		
Microvascular:		**Macrovascular:**
-Retinopathy **-Nephropathy** **-Neuropathy**		**-Cardiovascular diseases** (arterial hypertension, dyslipidemia, coronary heart disease) **-Cerebrovascular diseases** (TIA, stroke) **-Diabetic foot**

Chronic complications of DM2	**Screening of chronic cmplications** (method of screening/frequency of examination)	**Management and treatment**
7.1 Glucose control	**Method**: ***1)HbA1C*** **Frequency:** if HbA1c less than 7.0% **every 6 months** if HbA1c more than 7.0% **every 3 months** It is recommended to apply tight glucose control, targeting a near-normal HbA1c (<7.0% or <53mmol/mol) to decrease microvascular complications in Type 2 DM (A) ***2) Preprandial capillary plasma glucose*** 4.4–7.2 mmol/L (80–130 mg/dL) ***3) Peak postprandial capillary***	1. **Diet** (low carbohydrate diet with reduction of saturated fat, trans fat and cholesterol intake) **Diet is a basic part of management and treatment of diabetes mellitus !!!** 2. **Physical activity** (aerobic exercises 30-45 min/5 days a week) 3. **Pharmacological treatment (antihyperglycemic drugs)**

	plasma glucose less than 10.0 mmol/L (180 mg/dL)	
7.2 Diabetic retinopathy	**Method**: dilated retinal examination **Frequency**: at least **annually** by an ophthalmologist or optometrist (B). *If retinopathy is progressing or sight-threatening, then examinations will be required more frequently. B*	**1.Glucose control -** to reduce the risk or slow the progression of diabetic retinopathy(A) **2.Blood pressure control -** (ACE inhibitors or ARBs)(A) **3.Lipid control** –(statin therapy: atorvastatin, rosuvastatin) **4.Smoking cessation** **5.Laser photocoagulation therapy**- is indicated to reduce the risk of vision loss in patients with high-risk proliferative diabetic retinopathy and, in some cases, severe nonproliferative diabetic retinopathy (A) **6.Antivascular endothelial growth factor (anti-VEGF) agents** - provide more effective treatment regimen for central involved diabetic macular edema.
7.3 Diabetic nephropathy	**Method**: - **urinary albumin** (e.g., spot urinary albumin–to– creatinine ratio) and estimated -**glomerular filtration rate** **Frequency**: at least **once a year** *Frequency of visits, and referral to nephrology according to glomerular filtration rate (GFR) and albuminuria see Appendix Table 1*	**1.Glucose control** -to reduce the risk or slow the progression of chronic kidney disease (A) *For patients with type 2 diabetes and diabetic kidney disease, consider use of a sodium–glucose cotransporter 2 inhibitor in patients with an estimated glomerular filtration rate >30 mL/min/1.73 m2 and urinary albumin >300 mg/g creatinine. A* *In patients with type 2 diabetes and diabetic kidney disease, consider use of sodium–glucose cotransporter 2 inhibitors*

		additionally for cardiovascular risk reduction when estimated glomerular filtration rate and urinary albumin creatinine are $30 mL/min/1.73 m2 or .300 mg/g, respectively. A *In patients with chronic kidney disease who are at increased risk for cardiovascular events, use of a glucagon-like peptide 1 receptor agonist reduces renal end point, primarily albuminuria, progression of albuminuria, and cardiovascular events. A* **2.Blood pressure control** - (ACE inhibitors or ARBs)(A)
7.4 Peripheral diabetic neuropathy	**Method**: -**temperature or pinprick sensation** (small-fiber function) and -**vibration sensation** using a 128-Hz **tuning fork** (for large-fiber function). All patients should have annual **10-g monofilament** testing to identify feet at risk for ulceration and amputation (B) **Frequency** : at least **annually** (B)	**1.Diet and physical activity** **2.Glucose control -** to slow the progression of neuropathy in patients with type 2 diabetes (B) **3.Pain management** – anticonvulsants (**pregabalin** 25-300 mg) or antidepressants (**duloxetine** 20-40 mg) are recommended as initial pharmacological treatment for neuropathic pain in diabetes (A)
7.5 Diabetic foot	**Method:** - **inspection of the skin, assessment of foot deformities, neurological assessment** (10-g monofilament testing with at least one other assessment: pinprick, temperature, vibration, or ankle reflexes), and **vascular assessment** including pulses in the legs and feet (B) **Frequency:** all patients with diabetes should have their feet inspected at every visit (C)	**1.Diet and physical activity** **2.Glucose control** **3.Foot care** -provide general preventive foot self-care education to all patients with diabetes (B) Patient should : • Check and wash feet daily with warm water and soap

		• Dry feet well after, especially between toes • Keep toe nails short • Always wear socks ,never walk barefoot indoors or outdoors • Look inside shoes before putting them on • Break in new shoes gradually
7.6 Cardio-and cerebro-vascular complications (macrovascular)	**Method/frequency**: **1)Blood pressure** should be **measured** at **every** routine **visit** (A) **Goals of BP -** ≤140/90 mmHg (A); -130/80 mmHg (may be appropriate for individuals at high risk of cardiovascular diseases) **2) lipid profile of blood / yearly** **Target lipid values:** Total cholesterol < 4.5 mmol/l (<175 mg/dl), LDL <1.8 mmol/l (<70 mg/dl)-*high risk patients*, <1.4 mmol/l (<55 mg/dl)-*very high risk patients* HDL > 1.0 mmol/l (>40 mg/dl) for men, > 1.3 mmol/l (>50 mg/dl) for women TG < 1.7 mmol/l (<66 mg/dl)	**1.Diet and physical activity** **2.Glucose control** **3.Blood pressure control** – (drug classes demonstrated reduction of cardiovascular events in patients with DM) ➢ ACE inhibitors (lisinopril,ramipril) ➢ Angiotensin receptor blockers (ARBs)-losartan, valsartan ➢ Thiazide-like diuretics (indapamide) , ➢ Dihydropyridine calcium channel blockers (amlodipine). *Multiple-drug therapy is generally required to achieve blood pressure targets (but not a combination of ACE inhibitors and angiotensin receptor blockers). A* *Patients with blood pressure ≥160/ 100 mmHg should, in addition to lifestyle therapy, have prompt initiation and timely titration of two drugs or a single-pill combination of drugs demonstrated to reduce cardiovascular events in patients with diabetes. A*

		Patients with hypertension who are not meeting blood pressure targets on three classes of antihypertensive medications (including a diuretic) should be considered for mineralocorticoid receptor antagonist therapy. B **4.Lipid control** -statin therapy (atorvastatin, rosuvastatin)-for patients of all ages with diabetes and atherosclerotic cardiovascular disease *For patients with diabetes aged 40–75 years without atherosclerotic cardiovascular disease, use moderate-intensity statin therapy (see Appendix Table 2) in addition to lifestyle therapy. A* *In patients with diabetes at higher risk, especially those with multiple atherosclerotic cardiovascular disease risk factors or aged 50–70 years, it is reasonable to use high-intensity statin therapy (see Table 2 below). B* **5.Antiplatelet therapy**-consider **aspirin** therapy **(75–162 mg/day)** as a secondary prevention strategy in those with diabetes and a history of atherosclerotic cardiovascular disease(A) For patients with atherosclerotic cardiovascular disease and documented aspirin allergy, **clopidogrel (75 mg/day)** should be used (B)

8. Appendix

Table 1. Risk of chronic kidney disease (CKD) progression, frequency of visits, and referral to nephrology according to glomerular filtration rate (GFR) and albuminuria

CKD is classified based on: • Cause (C) • GFR (G) • Albuminuria (A)				Albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30-299 mg/g 3-29 mg/mmol	≥300 mg/g ≥30 mg/mmol
GFR categories (mL/min/1.73m²) Description and range	G1	Normal to high	≥90	1 If CKD	Treat 1	Refer* 2
	G2	Mildly decreased	60-89	1 If CKD	Treat 1	Refer* 2
	G3a	Mildly to moderately decreased	45-59	Treat 1	Treat 2	Refer 3
	G3b	Moderately to severely decreased	30-44	Treat 2	Treat 3	Refer 3
	G4	Severely decreased	15-29	Refer* 3	Refer* 3	Refer 4+
	G5	Kidney failure	<15	Refer 4+	Refer 4+	Refer 4+

Table 2. High-intensity and moderate-intensity statin therapy*

High-intensity statin therapy (lowers LDL cholesterol by ≥50%)	Moderate-intensity statin therapy (lowers LDL cholesterol by 30–49%)
Atorvastatin 40–80 mg	Atorvastatin 10–20 mg
Rosuvastatin 20–40 mg	Rosuvastatin 5–10 mg
	Simvastatin 20–40 mg
	Pravastatin 40–80 mg

9.For notes

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Medical Faculty №2
Department of Internal Medicine

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Type 2 Diabetes Mellitus

Methodological recommendations for medical students
Adapted from
American Diabetes Association Guideline

Uzhhorod-2024

Type 2 Diabetes Mellitus. Methodological recommendations for medical students/comp. I.V.Shushman, M.I.Tovt-Korshynska. – Uzhhorod, 2024.-24p.

These methodological recommendations include information about prevention, screening and management of Type 2 Diabetes Mellitus. The aim of manual is to provide help for medical students IV, V and VI courses in preparation for practical classes, improvement of their knowledge and skills in management of patients with type 2 DM.

The manual is composed according to medical student's educational qualification characteristics and professional training programs.

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