Dubai Diabetes and Endocrinology Journal
Volume 32, Issue no. 1, DOI 10.18502/ddej.v32i1.21067
Production and Hosting by KnE Publishing

KNE Publishing

Research Article

Emirates Diabetes and Endocrine Society Consensus for the Management of Type 2 Diabetes Mellitus (2026 Update)

Fatheya Al Awadi[1,2]*, Elamin Abdelgadir[1,2], Ahmed Abdul Karim Hassoun[3,4,5], Salah Abusnana[6], Bachar Afandi[7,8,9], Khaled M AlDahmani[7,8,9], Juma Alkaabi[7,8], Alaaeldin Bashier[1,2], Faten Bayado[10], Buthaina bin Belaila[11], Salem Arifi Beshyah[5,12], Huda Ezzeddin[10], Mohamed Farghaly[5,13], Muhammad Farooqi[2,14], Khadija Hafidh[2,15], Omniyat Al Hajeri[16], Abdul Jabbar[2,17], Sami Kenz[18], Hussein Saadi[19], Sara G. I. Suliman[20], George Tadros[21], Zeina Younes[14], and Mohamed Hassanein[1,2]

[1]Endocrine Department, Dubai Hospital, Dubai, United Arab Emirates
[2]Mohamed Bin Rashid University of Medicine and Health Sciences, Dubai, United Arab Emirates
[3]Fakeeh University Hospital, Dubai, United Arab Emirates
[4]Clinical Sciences, College of Medicine, University of Sharjah, United Arab Emirates
[5]Dubai Medical University, Dubai, United Arab Emirates
[6]University Hospital, Sharjah, United Arab Emirates
[7]Division of Endocrinology, Tawam Hospital, SEHA, Pure Health, Al Ain, United Arab Emirates
[8]Department of Internal Medicine, College of Medicine and Health Sciences (CMHS UAEU), Al Ain, United Arab Emirates
[9]Sheikh Tahnoon bin Mohammed Medical City, SEHA, Pure Health, Al Ain, United Arab Emirates
[10]Health Plus Diabetes and Endocrinology Center, Abu Dhabi, United Arab Emirates
[11]Ministry of Health and Prevention, Non-Communicable Disease, Dubai, United Arab Emirates
[12]NMC Royal Hospital, Mohammed Bin Zayed City, Abu Dhabi, United Arab Emirates
[13]The True Value Center, Dubai, United Arab Emirates
[14]Dubai Health Diabetes Center, Dubai Health, Dubai, United Arab Emirates
[15]Diabetes Unit, Rashid Hospital, Dubai, United Arab Emirates
[16]Abu Dhabi Public Health Center, Abu Dhabi, United Arab Emirates
[17]Department of Diabetes and Endocrinology, Medcare Hospital, Dubai, United Arab Emirates
[18]Rashid Center for Diabetes and Research, Sheikh Khalifa Medical City, Ajman, United Arab Emirates
[19]Cleveland Clinic Abu Dhabi, Abu Dhabi, United Arab Emirates
[20]Imperial College London Diabetes Center (ICLDC), Abu Dhabi, United Arab Emirates
[21]Maudsley Health, Abu Dhabi, United Arab Emirates

Corresponding Author:
Fatheya Al Awadi;
Email: ffAlawadi@dubaihealth.ae

Received: January 28, 2026
Accepted: January 30, 2026
Published: April 17, 2026

Production and Hosting by Knowledge E

Abstract

Introduction: Type 2 diabetes (T2D) is a chronic condition that causes progressive impairment of glycemic homeostasis. It affects nearly every organ of the body through microvascular and macrovascular effects, increasing the risk of morbidity and mortality. Studies also show that the younger the age of the diagnosis, the higher the relative risk of cardiovascular and all-cause mortality. The "diabetes continuum" describes progression from euglycemia through prediabetes, impaired fasting glucose (IFG), and/or impaired glucose tolerance (IGT), to overt diabetes. Early intervention can slow disease progression or even reverse prediabetes, reducing the risk of downstream complications. With the increasing global burden of T2D, ongoing research continues to refine strategies across all stages of the diabetes continuum, such as a shift from the traditional glucose-centered approach to more personalized, risk-based treatment strategies. There is growing emphasis on weight

OPEN ACCESS

How to cite this article: Al Awadi F, Abdelgadir E, Hassoun AA, Abusnana S, Afandi B, AlDahmani KM, et al. Emirates Diabetes and Endocrine Society Consensus for the Management of Type 2 Diabetes Mellitus (2026 Update). *Dubai Diabetes and Endocrinology Journal*. 2026;32(1):1–58. DOI 10.18502/ddej.v32i1.21067

management, early initiation of combination therapy rather than stepwise escalation, and prevention of target organ damage by using glucose-lowering treatments with proven cardiovascular and renal benefits.

Methods: Diabetes prevalence in the UAE is significantly higher than global estimates. The increasing burden of T2D in the UAE and the importance of early detection, effective risk-based management, and culturally sensitive patient education underscore the need for updated and locally relevant recommendations. The Emirates Diabetes and Endocrine Society (EDES) convened a panel of 23 experts to review the latest evidence and international guidelines on T2D management in adults and develop consensus recommendations tailored to the UAE healthcare context and real-world clinical practice.

Results: The panelists, through multiple rounds of discussion, developed evidence-based, consensus recommendations for the screening, diagnosis, and management of T2D. Updated tables for the initial and follow-up assessments were also included to ensure a comprehensive evaluation.

Conclusion: These T2D management recommendations provide a tailored framework to help reduce the disease burden and improve long-term health outcomes in the UAE.

Keywords: BMI, cardiometabolic risk, diabetes mellitus, insulin resistance, metabolic disorder, metabolic syndrome, nutrition, pharmacological therapy, physical activity, prevention, type 2 diabetes, prediabetes, Emirates Diabetes and Endocrine Society, UAE

1. Introduction

To ensure that the Emirates Diabetes and Endocrine Society (EDES) consensus guidelines for the management of Type 2 Diabetes (T2D), published in 2020, are in sync with the global updates, consistent with the latest evidence, and aligned with local healthcare policies, challenges, and perspectives, the EDES convened a panel of experts to review and update them. The recommendations in this 2026 EDES consensus provide evidence-based guidance for screening, diagnosis, and management of prediabetes and T2D.

2. Scope and Rationale

Given the increasing prevalence of T2D in the UAE, the recommendations have been slightly modified from the international guidelines to suit the UAE context. These modifications include earlier screening, beginning at the age of 30, an adjusted frequency of comprehensive clinical evaluations tailored to local healthcare practices, and medical nutrition therapy adapted to local food choices. The consensus

also emphasizes the implementation of a closed-loop referral pathway tailored to local healthcare systems. Additionally, a specific cardio-renal-metabolic (CRM) risk scoring has been incorporated to stratify patients for individualized pharmacological management. This CRM risk scoring aligns with the previously published EDES-Emirates Cardiac Society (ECS) cardiometabolic guidelines. These updated 2026 EDES consensus recommendations for T2D management also include algorithms and tables that busy clinicians can quickly refer to for easy application in their daily clinical practice. These should serve as a national reference to guide consistent and evidence-based care. While they provide broad guidance on T2D management in the UAE, it remains crucial to individualize treatment based on patients' clinical profiles and preferences.

3. The Impact of Diabetes in the UAE

3.1. The Increasing Prevalence of T2D

In regional epidemiological studies such as the 2017-2018 UAE National Health Survey (UAE-NHS) report, the prevalence of diabetes was found to be 11.8% among 18–69-year-old adults [1]. Data from the Dubai Household Health Surveys (DHHS), conducted in 2014/2017 and 2019, indicate that the prevalence of T2D among UAE nationals remained relatively stable at 19% and 19.3%, respectively. The prevalence in expatriates ranged from 14.7% in 2014/2017 to 12.4% in 2019 [2]. The 2014/2017 survey also identified undiagnosed diabetes in 10% of UAE nationals and 10.9% of expatriates. However, in the 2019 survey, newly diagnosed diabetes cases were reported in 3.2% of UAE nationals and 1.9% of expatriates (see Figure **1**A) [2, 3].

The overall prevalence of diabetes in Dubai, according to the 2019 DHHS survey, was 13.7% (11.5% previously known diabetes and 2.1% newly diagnosed cases) (see Figure **1**A) [2]. Stratified analysis comparing diabetes prevalence between Emiratis and other ethnic groups in the UAE expatriate community revealed higher adjusted prevalence rates among UAE nationals (21% in males, 23% in females) and Asian non-Arabs (23% in males, 20% in females) relative to other groups such as Arab non-nationals, Westerners, and Africans [4].

In the DHHS 2019 findings, a strong association between age and diabetes prevalence was consistent across all population subgroups (both Emirati and expatriate). Among individuals aged between 18 and 29 years, the prevalence was 1.4%, which increased sharply to 43.6% among those aged 60 years and above (see Figure **1**B) [2].

According to the 2017-2018 UAE-NHS Report, the prevalence of prediabetes was found to be 11.7% among 18–69-year-old adults. The prevalence rate was higher among non-Emirati males (14.1%) than among Emirati males (12.1%) [1]. According to the DHHS, the prevalence of prediabetes has shown divergent trends among UAE nationals, declining from 18.6% in the 2014/2017 survey findings to 12% in the 2019

survey findings. In contrast, among expatriates, the prevalence increased from 15.5% to 17.1% over the same period [3, 5].

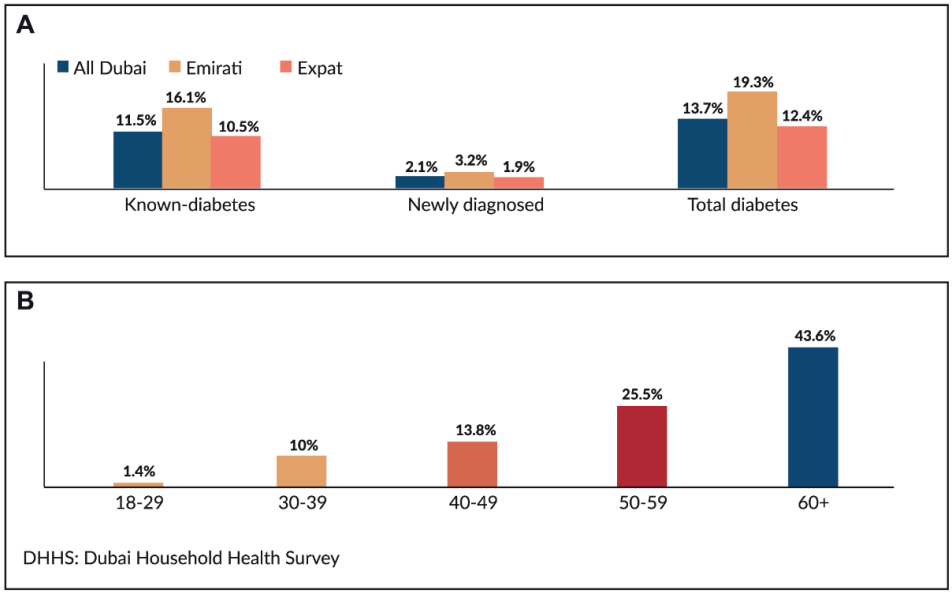


Figure 1: DHHS-2019: Total prevalence of diabetes mellitus in Dubai. (A) According to nationality and (B) According to age.

3.2. Metabolic Syndrome (MetS)

Central obesity, hypertension, dyslipidemia, and hyperglycemia were previously considered as separate clinical entities; however, they are now recognized as interrelated metabolic abnormalities that often coexist as the MetS, collectively increasing the risk of cardiovascular disease (CVD) and T2D. The criteria used for the diagnosis of MetS are shown in Figure **2** [6, 7]. MetS is often considered a "prediabetes equivalent," with insulin resistance as a shared pathophysiological link between the two conditions [8–10]. Moreover, the risk of developing T2D is approximately 5 times higher in individuals with MetS without IFG, 7 times higher in those with IFG without MetS, and 21 times higher in those with both MetS and prediabetes [7, 9].

Subgroup analysis across all World Health Organization (WHO) regions revealed that the Eastern Mediterranean Region, which includes all the Gulf Cooperation Council (GCC) countries, including the UAE, had the highest prevalence of MetS, according to both the International Diabetes Federation (IDF) and the National Cholesterol Education Program (NCEP)—Adult Treatment Panel III (ATP III) definitions (34.6% and 32.9%, respectively) [11]. Another 2020 systematic review and modeling analysis assessed 169 studies involving 550,405 children and adolescents across 44 countries from 13 regions. The study reported one of the highest prevalence rates of MetS among adolescents in the UAE (9.8%), second only to Spain (9.9%) [12].

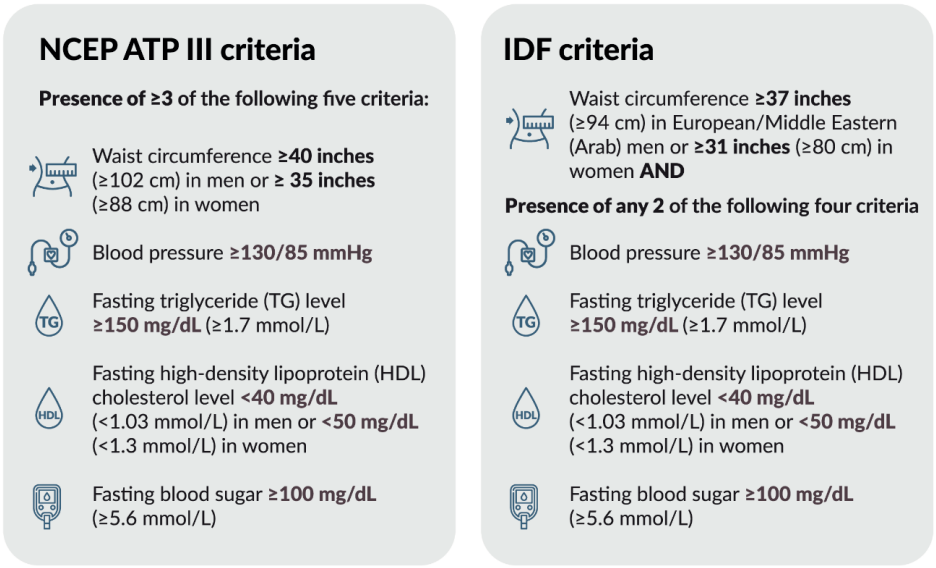


Figure 2: NCEP ATP III and IDF criteria for the diagnosis of MetS.

3.3. Obesity and T2D

Obesity, especially visceral obesity, a key component of MetS, has emerged as a major public health challenge, with a recent study reporting a prevalence of 28% in the UAE (35.8% according to ethnicity-based cut-points) and 63% of the population living with overweight and obesity [13]. The risk of developing T2D increases as body mass index (BMI) rises due to multiple interconnected mechanisms that cause changes in adipose tissue biology and pancreatic beta-cell function, contributing to insulin resistance [14].

The 2019 DHHS reported diabetes prevalence of 8.2% in individuals with normal BMI, with the rates increasing to 12.4% and 21.1% in those with overweight and obesity, respectively [2]. The 2017-2018 UAE-NHS Report revealed the prevalence of obesity and overweight in those aged between 18 and 69 years to be 27.8% and 67.9%, respectively, with the highest prevalence in the age group of 30–44 years [1].

4. Methods

The EDES convened a panel of 23 experts to review and discuss the available evidence on the management of T2D. The panelists reviewed the latest published evidence and international guidelines, reassessed the 2020 recommendations, and, through multiple rounds of discussion, drafted new and revised recommendations for the management of T2D in adults [15]. The panelists ensured the recommendations were tailored to the UAE healthcare context and aligned with real-world clinical practice in the region. This document constitutes an update of the 2020 guideline, incorporating newly available evidence and revising previous recommendations where clinically indicated.

5. Results

5.1. Diagnostic Criteria

Recommendation: The diagnostic criteria for T2D and prediabetes are shown in Table **1** [16].

Table 1: Diagnostic criteria thresholds for diabetes and prediabetes.

Diagnostic test	Prediabetes	Diabetes[5]
HbA1c[1]	5.7–6.4% (39–47 mmol/mol)	≥6.5% (≥48 mmol/mol)
FPG[2]	100–125 mg/dL (5.6–6.9 mmol/L) (IFG)	≥126 mg/dL (≥7 mmol/L)
2-h OGTT[3]	140–199 mg/dL (7.8–11.0 mmol/L) (IGT)	≥200 mg/dL (≥11.1 mmol/L)
RPG in symptomatic individuals[4]		≥200 mg/dl with hyperglycemia symptoms

HbA1c: Glycated hemoglobin; FPG: Fasting blood glucose; IFG: Impaired fasting glucose; IGT: Impaired glucose tolerance; OGTT: Oral glucose tolerance test (2-hr plasma glucose during a 75 g oral glucose tolerance test); RPG: Random plasma glucose.
[1]HbA1c may not be appropriate for the diagnosis of diabetes in conditions where red cell turnover is abnormal (see Table **2**).
[2]FPG: Fasting is defined as no caloric intake for 8–12 hr.
[3]2-h OGTT: The test should be performed as described in the World Health Organization guidelines, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. Carbohydrate restriction few days before the OGTT can falsely elevate post-challenge glucose levels, increasing the risk of a false-positive result. Intake of adequate carbohydrates (at least 150 gm/day) for 3 days before the test is recommended.
[4]RPG can only be used for the diagnosis of diabetes in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis.
[5]In the absence of unequivocal hyperglycemia, diagnosis of diabetes requires two abnormal test results either from the same test sample or from two separate test samples.

Caveats on testing:

1. HbA1c test should be performed in a laboratory using a method certified by the National Glycohemoglobin Standardization Program (NGSP), and standardized (or traceable) to the Diabetes Control and Complications Trial (DCCT) reference assay.
2. Point-of-care (POC) HbA1c assays that are approved for diagnostic purposes by NGSP or the Federal Drug Administration should only be considered in settings licensed to perform moderate-to-high complexity tests. Although some POC HbA1c assays may be certified for diagnostic testing, proficiency testing is not always mandated.
3. The HbA1c test may not be appropriate if a patient is pregnant (second and third trimesters and postpartum period, see Table **2**).
4. In cases of significant mismatch between measured HbA1c and plasma glucose levels, HbA1c assay interference should be suspected. In these cases, an assay without interference or plasma glucose criteria should be considered to diagnose diabetes accurately. Additionally, alternative clinically-approved biomarkers (e.g., fructosamine and glycated albumin) indicative of chronic hyperglycemia may be considered.

According to these diagnostic criteria, in the absence of a clear clinical presentation, i.e., classic symptoms of hyperglycemia or hyperglycemic crisis accompanied by RBG ≥200 mg/dL, the diagnosis of diabetes should be confirmed by one of the following: [16]

- Two abnormal results from the same diagnostic test with samples drawn at different time points within a clinically appropriate interval.
- Two different diagnostic tests, both showing abnormal values, either with the same sample or with samples drawn at separate time points within a clinically appropriate interval.

In cases where the results from two different diagnostic tests conflict, that is, one test result meets the diagnostic threshold for diabetes, but the other does not, the former test should be repeated after considering factors that may impact the test results (see Table **2**) [15]. The diagnosis should be confirmed if the repeated test result meets the diagnostic criteria.

Table 2: Medical conditions and drugs that can affect the accuracy of HbA1c test.

Inappropriately low HbA1c	Inappropriately high HbA1c	Either high or low HbA1c
• Acute or chronic blood loss	• Renal failure (uremia)	• Certain hemoglobinopathies
• Hemoglobinopathies: ◦ Sickle cell ◦ Thalassemia • Elliptocytosis • Blood transfusion • Hemolysis, including G6PD deficiency	• Low red cell turnover: ◦ Vitamin B12 deficiency ◦ Iron deficiency • Alcohol • Hyperbilirubinemia	• Fetal hemoglobin • Methemoglobin • Assay interference
• Drugs: ◦ Iron therapy ◦ Vitamin B12 supplements ◦ Erythropoietin ◦ Antiretrovirals, ribavirin ◦ Dapsone ◦ Aspirin (low dose) ◦ Vitamin C ◦ Vitamin E	• Drugs: ◦ High-dose aspirin ◦ Chronic opiate use	
• Chronic liver disease • Hypertriglyceridemia • Pregnancy • Reticulocytosis • Rheumatoid arthritis	• Splenectomy • Aplastic anemia • Lead poisoning	

G6PD: Glucose-6-phosphate dehydrogenase

5.2. Screening

Proactive and targeted screening facilitates early detection of prediabetes and T2D, allowing timely intervention. Once diagnosed, further screening for CRM risk and metabolic dysfunction-associated steatotic liver disease (MASLD) is equally essential, as discussed in this section.

5.2.1. Screening for T2D and prediabetes

Recommendations:

a) We recommend adopting evidence-based screening criteria, with the initiation of targeted T2D screening in asymptomatic individuals starting at age 30 [15, 16]. FPG and HbA1c tests are preferred due to convenience. OGTT may be used in specific situations (see Figure **3**) [17].

b) A risk-based screening approach is recommended (see Figure **3**) with risk factors for prediabetes and T2D outlined in Table **3** [16–18]. T2D screening in special populations requires specific considerations due to their unique risk profiles (see Table **4**) [16].

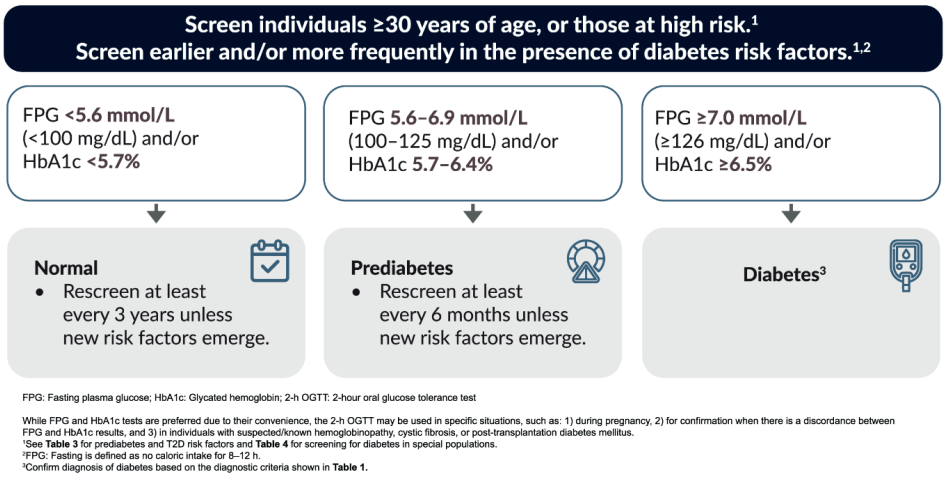


Figure 3: T2D screening algorithm.

Table 3: Prediabetes and T2D risk factors.

The risk factors for prediabetes or T2D are:
• Adults ≥30 years old[1]
• Prediabetes (HbA1c ≥5.7%, IGT or IFG on previous testing)
• Adults of any age who have overweight or obesity (BMI ≥25 kg/m^2 or ≥23 kg/m^2 for those of Asian descent) with ≥1 risk factor(s).
• First-degree relative with diabetes
• Low levels of HDL (<35 mg/dL [< 0.90 mmol/L]) and/or high TG levels (>250 mg/dL [>2.8 mmol/L])
• Hypertension (BP ≥130/80 mm Hg or on treatment for hypertension)
• Physical inactivity
• High-risk ethnic groups
• History of CVD
• PCOS
• Other conditions associated with insulin resistance (e.g., severe obesity or acanthosis nigricans)
• Obstructive sleep apnea
• History of delivery of a macrosomic infant (birth weight >4 kg)
• History of psychiatric disorders (bipolar disorder, schizophrenia, depression, mood disorders)
• History of gestational diabetes
• MASLD (previously known as NAFLD)
• Periodontal disease

BMI: Body mass index; HbA1c: Glycated hemoglobin; IGT: Impaired glucose tolerance; IFG: Impaired fasting glucose; HDL: High-density lipoprotein cholesterol; TG: Triglyceride; BP: Blood pressure; CVD: Cardiovascular disease; PCOS: Polycystic ovary syndrome; MASLD: Metabolic dysfunction-associated steatotic liver disease; NAFLD: Non-alcoholic fatty liver disease
[1]Modified from the ADA guidelines, which recommend initiating diabetes screening in asymptomatic individuals at age 35.

Table 4: T2D Screening in special populations.

• **Patients taking medications known to increase the risk of diabetes**
◦ Consider medications that increase diabetes risk (e.g., glucocorticoids and thiazide diuretics).
◦ Screen annually for diabetes and prediabetes in individuals on atypical anti-psychotic medications.
◦ For individuals starting second-generation antipsychotic medications, screen for prediabetes and diabetes at baseline, again at 12–16 weeks (or sooner, if indicated), and annually thereafter.
• **Patients with diabetes-associated end-organ damage, especially microvascular diseases (retinopathy, neuropathy, or nephropathy) or macrovascular disease (CHD, stroke, or PVD).**
• **Patients with HIV infection**
◦ Test for diabetes or prediabetes:
■ before initiating antiretroviral therapy
■ while changing antiretroviral therapy

Table 4: Continued.

- 3–6 months after initiating/changing antiretroviral therapy
- retest annually if results are normal

• **Patients with cystic fibrosis**
- Although HbA1c is not recommended for CFRD screening, a reading of ≥6.5% (≥48 mmol/mol) is consistent with a diagnosis of CFRD.
- If not already diagnosed with CFRD: Perform OGTT annually in all patients ≥10 years old.
- Consider annual monitoring for diabetes-related complications starting >5 years after CFRD diagnosis.

• **Patients after organ transplantation**
- Screen for hyperglycemia once patients are stable on an immunosuppressive regimen and acute infection has been ruled out.
- Perform OGTT to check for post-transplantation diabetes.

• **Patients with pancreatitis**
- Screen for diabetes within 3–6 months after an episode of acute pancreatitis and annually thereafter.
- Screen annually in individuals with chronic pancreatitis.

CHD: Coronary heart disease; PVD: Peripheral vascular disease; HIV: Human immunodeficiency virus; CFRD: Cystic fibrosis-related diabetes; OGTT: Oral glucose tolerance test

Several international professional societies recommend initiating diabetes screening between the ages of 35 and 40, with earlier and more frequent screening if risk factors are present [16, 17]. Due to the high burden of prediabetes and T2D in the UAE, the 2020 EDES guidelines recommended initiating T2D screening at age 30, which remains a valid approach [2, 3, 5, 15]. Early screening and a risk-based approach offer the opportunity for timely diagnosis and prevention of complications, making them cost-effective strategies.

The choice of a screening test (HbA1c, FPG, or 2-h OGTT) depends on multiple factors, including clinical context, resource availability, patient convenience, and cost. The advantages and disadvantages of the three screening tests are outlined in Table **5** [19].

Table 5: Advantages and disadvantages of diabetes screening tests.

Screening test	Advantages	Disadvantages
HbA1c	• No fasting needed • Requires standardization, which can ensure reproducibility • Preanalytical stability	• Expensive and may have limited availability in some regions • Some conditions and drugs may affect its accuracy. • Is an indirect measure of glycemia
FPG	• Single blood draw required • Easily available • More reproducible than OGTT	• Requires 8–12 hr fasting[1] • Stress and illness can affect accuracy • Preanalytical and analytical variability
2-h OGTT	• Can diagnose IGT • Can help estimate surrogate markers of insulin sensitivity, beta cell function (in relation to insulin sensitivity), and the incretin effect	• Requires 8–12 hr fasting[1] • Some people experience nausea • Time-consuming

HbA1c: Glycated hemoglobin; FPG: Fasting plasma glucose; 2-h OGTT: 2-hour oral glucose tolerance test; IGT: Impaired glucose tolerance

[1]Fasting is defined as no caloric intake for 8–12 hr.

5.2.2. Screening for cardio-renal-metabolic (CRM) risk in individuals with prediabetes and T2D

Recommendations: Screening for CRM risk is recommended in all individuals with prediabetes and T2D. CRM risk screening should include relevant investigations to identify risk factors, including assessment of BP, lipid profile, renal and liver function, smoking status, BMI, and findings from medical history/physical examination. A standard lipid panel can be used. Fasting lipid testing is generally not required, as it does not influence therapeutic decisions unless triglyceride assessment is needed (see Table **6**) [10, 16, 20].

Table 6: Cardiometabolic screening for individuals with prediabetes and T2D.

Whom to screen?
• Prediabetes • T2D
How to screen?
1. *Detailed medical history:* • Symptoms of CVD[1] • Symptoms of claudication[1] • Smoking status 2. *Physical examination:* • Full medical examination • BP • BMI • Peripheral pulses, including ABI • Retinal examination 3. *Investigations:* • Serum creatinine, eGFR, and Urine ACR • Lipid profile • CBC • HbA1c • LFT • Vitamin B12 (for those treated with metformin) • ECG and Pro-BNP (hs-CRP and hs-TnT at physician discretion)
How frequently to screen?
• For individuals with prediabetes: Every 2–3 years based on CV risk factors • For individuals with T2D: Annually[2]
Who is considered "Screen +ve"?
Those with abnormal: • Physical examination • Peripheral pulses and/or ABI • Retinal examination • Clinical investigations (ECG, Pro-BNP, serum creatinine, eGFR, and/or ACR)
For those who are Screen -ve
• Apply the CRM risk score and screen annually (or every 2 years in case of prediabetes) based on the CRM risk category

CVD: Cardiovascular disease; BP: Blood pressure; BMI: Body mass index; ABI: Ankle-brachial index; ECG: Electrocardiography; Pro-BNP: B-type natriuretic peptide; hs-CRP: high-sensitivity C-reactive protein; hs-TnT: High-sensitivity troponin T; eGFR: Estimated glomerular filtration rate; ACR: Albumin-to-creatinine ratio; CBC: Complete blood count; LFT: Liver function test; CRM: Cardio-renal-metabolic; CV: Cardiovascular

[1]Symptoms or signs of CVD or PAD or CHF: chest pain, peripheral edema, dizziness, palpitations, fatigue, effort intolerance, syncope, intermittent claudication, etc.

[2]Individuals with T2D who are at very high risk should be managed in specialist clinics and undergo screening based on their specific underlying conditions.

CRM syndrome has been defined as "a systemic disorder characterized by pathophysiological interactions among metabolic risk factors, chronic kidney disease (CKD), and the cardiovascular system leading to multiorgan dysfunction and a high rate of adverse cardiovascular outcomes." Elevated CRM risk is associated with increased morbidity and premature mortality [21]. Thus, accurate identification of the CRM risk level is necessary to ensure that high-risk individuals receive optimal treatment with CRM benefit, while avoiding overtreatment in lower-risk patients [20]. Detailed cardiometabolic guidelines, published jointly by the EDES and ECS, outline the assessment and management of cardiometabolic risk in individuals with prediabetes and T2D [20].

5.2.3. Screening for MASLD in individuals with prediabetes and T2D

Recommendation: Individuals with T2D or prediabetes, especially those with overweight or obesity, or other cardiometabolic risk factors or established CVD, must be screened for MASLD using appropriate assessment tools.

MASLD, previously called non-alcoholic fatty liver disease (NAFLD), is highly prevalent in T2D, affecting nearly 70% of individuals with T2D [22, 23]. It is diagnosed by the presence of steatotic liver disease in combination with one or more cardiometabolic risk factors (overweight or obesity, hypertension, prediabetes or T2D, elevated triglycerides, or low HDL cholesterol) and the absence of other potential causes of steatosis, such as significant alcohol consumption [24]. A bidirectional association has been observed between MASLD and T2D, with each condition influencing the development and progression of the other [22, 23]. Also, about 20–30% of MASLD cases progress to metabolic dysfunction-associated steatohepatitis (MASH), which can lead to liver cirrhosis and even hepatocellular carcinoma [25]. Identifying the extent of hepatic and extrahepatic clinical implications of MASLD is essential for comprehensive risk assessment and management of T2D.

The fibrosis-4 (FIB-4) index, calculated using age, liver enzyme levels (ALT and AST), and platelet count, is widely used to assess the extent of liver disease [24, 26]. A FIB-4 score <1.3 indicates low risk of advanced fibrosis, while a score >2.67 suggests advanced fibrosis. Additional testing for liver stiffness with vibration-controlled transient elastography (VCTE) or enhanced liver fibrosis (ELF) blood test may be required in individuals with a FIB-4 score between 1.3 and 2.67. The NAFLD fibrosis score (NFS), calculated using age, BMI, presence/absence of IFG, AST/ALT ratio, platelets, and albumin, may also be considered to assess fibrosis in certain cases [27]. Referral to a gastroenterologist specializing in hepatology or a hepatologist is recommended for individuals with a FIB-4 score >2.67 (without the need for any additional testing), and should also be considered for those with a VCTE-derived liver stiffness measurement ≥8 kPa or ELF score ≥9.8 [24, 28, 29].

5.3. Initial and Follow-up Assessment of T2D

Recommendations:

a) *Medical history, physical examination, and laboratory investigations*: A comprehensive clinical evaluation that includes all these components is recommended during the initial, interim follow-up, and annual visits (see Tables **7**, **8**, and **9**) [15, 17, 24, 30].

b) *Vaccination*: Individuals with T2D should undergo targeted infectious disease screening beyond routine protocols due to their increased risk. The recommended vaccination schedule is shown in Table **10** [31, 32]. When feasible, vaccination should be considered during periods of better glycemic control but should not be delayed if there is a risk of infection.

c) *Mental health assessment*: Mental health evaluation should be included in the initial and follow-up assessments of individuals diagnosed with prediabetes (if clinically indicated) and diabetes. It should involve a person-centered approach to identify the risk of diabetes distress, anxiety, eating disorder, depression, cognitive impairment (in older adults), self-harm, or suicide ideation, using standardized screening tools (see Table **7**).

Table 7: Comprehensive clinical evaluation in T2D—Medical history.

	Key factors to document during medical history collection	Initial visit	Interim follow-up visit	Annual follow-up visit
Diabetes	• Age of onset, duration, control, and symptoms of hyperglycemia	✓	✓	✓
	• Hypoglycemia symptoms	✓	✓	✓
	• Hospitalization	✓	✓	✓
Comorbidities	• Dyslipidemia and hypertension	✓	✓	✓
	• Neuropathy:			
	◦ Peripheral	✓	✓	✓
	◦ Autonomic and mononeuritis	✓		✓
	• Visual impairment, depression/anxiety, hemoglobinopathies, thyroid disorder, cancer, MASLD	✓		✓
	• Infections	✓	✓	✓
Lifestyle	• Smoking status and alcohol consumption	✓		✓
	• Physical activity and sedentary habits, eating habits, and sleep patterns	✓	✓	✓
Medication	• Assess for compliance and side effects	✓	✓	✓
	• Alternative therapies	✓	✓	✓
Vaccinations (Detailed list of recommended vaccines and their administration schedule is shown in Table **10**)	• Pneumococcus	✓		
	• Influenza	✓		✓
	• Hepatitis B	✓		

Table 7: Continued.

	Key factors to document during medical history collection	Initial visit	Interim follow-up visit	Annual follow-up visit
Self-care	• Glucose monitoring • Independency, personal hygiene, oral health	✓ ✓	✓	✓ ✓
Social network	• Review social background and living conditions	✓		✓
Digital technology	• Assess comfort level with digital technology	✓	✓	✓
Family history	• Enquire about the history of diabetes, genetic predisposition, renal disease, CVD, dyslipidemia, or autoimmune disorders in the family • Check for any updates in family history	✓	✓	✓
Disability assessment	• Enquire about any physical, visual, or auditory devices, cognitive status • History of fractures, amputations, or ulcers • History of foot evaluations (numbness, claudication)	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Mental health assessment	• Check for mental health symptoms with validated questionnaires and/or structured clinical interviews[1]	✓		✓

MASLD: Metabolic dysfunction-associated steatotic liver disease; DDS: Diabetes distress scale; GAD: Generalized anxiety disorder; PHQ-9: Patient health questionnarie-9

[1]Screening tools may include DDS (for diabetes-related stress), GAD scale, and PHQ-9.

Table 8: Comprehensive clinical evaluation in T2D—Components of physical examination.

Physical exam	Procedure	Initial visit	Interim follow-up visits	Annual follow-up visits
	Physical and vital assessments			
Anthropometric measures	• Height, weight, BMI[1], waist circumference, and waist-to-height ratio	✓	✓	✓
Vital signs	• BP in sitting and standing positions • Pulse rate	✓ ✓	✓ ✓	✓ ✓
	General assessments			
Skin	• Look for injection sites, evidence of lipodystrophy	✓		✓
Fundus[2]	• Fundus examination (digital exam, if available, is preferred)	✓		✓
Foot (look for evidence of neuropathy, PAD, deformity, or infection)	• Inspection (skin integrity, callous, ulcers, gangrene, and toenails) • Palpation of peripheral pulses • Vibration testing • Sensation with 10 g monofilament[3] • ABI	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Thyroid	• Thyroid palpation	✓		✓

Table 8: Continued.

Physical exam	Procedure	Initial visit	Interim follow-up visits	Annual follow-up visits
	Systemic assessments			
Cardiovascular	• Auscultation of carotid, heart, and lung bases	✓		✓
Abdomen	• Liver examination	✓		✓
Lower limbs	• Look for edema	✓		✓

ABI: Ankle brachial pressure index; BMI: Body mass index; PVD: Peripheral vascular disease
[1]Consider ethnicity-specific criteria where applicable.
[2]Refer to a specialist every 2 years if no retinopathy and more frequently as necessary.
[3]10-g monofilament test should be performed with at least one other assessment (pinprick, temperature, or vibration).

Table 9: Comprehensive clinical evaluation in T2D—Lab investigations.

Test	Initial assessment	Interim follow-up visits	Annual follow-up visits
Glycemia			
• Blood glucose levels	✓	✓	✓
• HbA1c[1]	✓	✓	✓
Lipid profile[2]			
• Total cholesterol, LDL, non-HDL cholesterol, triglycerides	✓	✓	✓
Kidney function			
• Electrolytes	✓	✓*	✓
• Serum creatinine/eGFR[3]	✓	✓*	✓
• UACR	✓	✓*	✓
Other tests			
• Liver function[3]	✓		✓
• Vitamin B12 (for those on metformin)	✓		✓
• Other vitamins	✓*		✓*
• CBC	✓		✓*
• TSH	✓		✓*
• NT-proBNP	✓		✓
• Lipoprotein(a)[4]	✓		
• ApoB[5]	✓		

HbA1c: Glycated hemoglobin; LDL: Low-density lipoproteins; HDL: High-density lipoproteins; eGFR: Estimated glomerular filtration rate; UACR: Urine albumin: creatinine ratio; CBC: Complete blood count; TSH: Thyroid-stimulating hormone; NT-proBNP: N-terminal pro b-type natriuretic peptide.
✓*To be done if clinically indicated
[1]The recommended frequency of HbA1c testing is 2–4 times per year (every 3-6 months), depending on the extent of control and overall clinical condition.
[2]The recommended frequency of lipid testing is 2–4 times per year. Testing frequency should depend on clinical factors (e.g., more frequent testing if monitoring treatment efficacy). Monitoring can be less frequent in those without dyslipidemia and who are not on lipid-lowering agents. Random lipid testing may be sufficient.
[3]eGFR and liver function tests can be done more frequently based on the condition of the patient upon initiation or dose modification of medications.
[4]A once-in-a-lifetime measurement of lipoprotein(a) is recommended to evaluate cardiovascular risk.
[5]To be done based on cardiovascular risk and repeated if clinically indicated.

5.3.1. Initial assessment of prediabetes and diabetes

The initial assessment of individuals diagnosed with prediabetes or diabetes should include identification of comorbidities, assessment of complications, evaluation of psychosocial parameters, and review of overall health status [24]. The initial assessment should begin with a thorough clinical evaluation that includes:

1) Patient history: Documenting a detailed medical history helps identify risk factors and comorbidities and gauge patients' level of disease awareness and the extent of their willingness to participate in disease management (see Table **7**) [15, 17, 24, 30, 33–35].

2) Physical examination: Conducting a thorough physical examination provides a clinical baseline for risk stratification and guides management (see Table **8**) [15, 24].

3) Laboratory investigations: These are crucial to evaluate disease severity and identify comorbidities. The list of recommended lab tests is shown in Table **9** [15, 24].

4) Additional considerations: Treatment goals must be developed collaboratively between individuals and the healthcare team, and should be personalized, achievable, and clinically feasible within the time and resource constraints of routine clinical practice [24]. Additionally, emerging non-invasive technologies like SUDOSCAN help to assess sudomotor dysfunction, which is an indicator of peripheral small fiber neuropathy in individuals with diabetes [36]. While a promising technology, there is currently limited evidence to support its widespread application.

5.3.2. Follow-up and annual assessments of T2D

Individuals with stable T2D should undergo a comprehensive assessment at least once a year to monitor their glycemic status, cardiovascular health, and metabolic control. The interim follow-up assessments can be conducted every 3-6 months, individualized based on risk factors and glycemic control [15, 24]. More frequent interim assessments (every 4-6 weeks) may be required in specific situations, such as the initiation of continuous glucose monitoring (CGM), treatment adjustments, unstable glycemia, or pregnancy. The interim and annual follow-up reassessment checklists for medical history, physical examination, and laboratory investigations are shown in Tables **7**, **8**, and **9** [15, 17, 24, 30].

5.3.3. Vaccination considerations in T2D

Individuals with T2D may be at high risk for vaccine-preventable infections such as pneumonia and influenza [37]. They are also more likely to experience poorer outcomes from infections such as hepatitis B, with an increased risk of hepatocellular carcinoma and all-cause mortality [38].

The recommended vaccines for individuals with T2D and their administration schedule are shown in Table **10** [24, 31, 32]. The vaccination schedules may need to be individualized and closely monitored (e.g., checking post-vaccination titers for hepatitis B) in those with poor glycemic control [39].

Table 10: Recommended vaccination in individuals with T2D.

Influenza inactivated/recombinant		≥19 years: 1 dose of any influenza vaccine appropriate for age and health status, to be given annually. ≥65 years: Preferred vaccines: any one of HD-IIV3, RIV3, or aIIV3* *HD-IIV3: High-dose inactivated influenza vaccine, trivalent; RIV3: Recombinant influenza vaccine, trivalent; aIIv3: Adjuvanted inactivated influenza vaccine, trivalent
LAIV3		**Precaution**: Might be indicated if the benefits outweigh the risk of adverse reaction
Td or Tdap		• Completed primary series and ◦ received at least 1 dose of Tdap at age 10 years or older: Td or Tdap every 10 years ◦ did not receive at least 1 dose of Tdap at age 10 years or older: 1 dose of Tdap followed by Td or Tdap every 10 years • Unvaccinated/incomplete primary vaccination series: Complete 3-dose primary series followed by Td or Tdap every 10 years
Pneumococcal (PPSV23, Pneumovax)		• For adults aged 19–64 years with risk factors like diabetes and all adults ≥65 years: ◦ If received PCV13: Give one dose of PPSV23 ◦ If received PCV15: Give PPSV23 after ≥1 year ◦ PPSV23 is not indicated after PCV20 ◦ Adults who received only PPSV23 may receive PCV15 or PCV20 ≥1 year after their last dose
Pneumococcal (PCV15, PCV20)		• Adults aged 19–64 years: ◦ One dose of PCV15 or PCV20 is recommended • Adults aged 19–64 years with an immunocompromising condition (e.g., chronic renal failure): ◦ One dose of PCV15 or PCV20 is recommended • Adults ≥65 years with an immunocompromising condition based on shared decision-making with their healthcare professional (HCP): ◦ One dose of PCV15 or PCV20 ◦ PPSV23 may be given following PCV15 (minimum interval of 8 weeks). PPSV23 is not indicated after PCV20)
RSV		• Not recommended for all adults, but only some adults based on either age or increased risk for or severe outcomes from disease • Conditions that increase the risk of severe RSV disease include: ◦ Diabetes complicated by CKD, neuropathy, retinopathy, or other end-organ damage ◦ Diabetes requiring treatment with insulin or SGLT2i ◦ Age 60–74 years: 1 dose recommended if unvaccinated and at an increased risk of severe RSV disease. Additional doses are not recommended.
RZV		• Not recommended for all adults, but only some adults based on either age or increased risk for or severe outcomes from disease • Age ≥50 years: 2-dose series recombinant zoster vaccine (RZV, Shingrix) 2–6 months apart (minimum interval: 4 weeks)
HepB Age <60	HepB Age ≥60	• Age 19–59 years: Recommended if there is a lack of documentation of vaccination, or lack of evidence of immunity. Complete 2-, 3-, or 4-dose series. • Age ≥60 years with diabetes: Recommended vaccination (2-, 3-, or 4-dose series) based on shared clinical decision-making

Table 10: Continued.

COVID-19, MMR, VAR	• Recommended for all adults who lack documentation of vaccination **OR** lack evidence of immunity
HPV	• Not recommended for all adults, but only some adults based on either age or increased risk for or severe outcomes from disease
HepA	• Not recommended for all adults, but only some adults based on either age or increased risk for or severe outcomes from disease • Any person who is not fully vaccinated and requests vaccination (identification of risk factor not required)
MenACWY, Men B, Hib	• No guidance/Not applicable
Mpox	• Not recommended for all adults, but only some adults based on either age or increased risk for or severe outcomes from disease
IPV	• Recommended for all adults who lack documentation of vaccination **OR** lack evidence of immunity • In cases of incomplete vaccination (self-reporting acceptable), complete 3-dose series

Recommended for all adults meeting age requirements, lacking documentation of immunization, or lacking evidence of immunity

Recommended for adults with additional risk factors or another indication

Recommended based on shared decision-making

No guidance or not applicable

Might be indicated if the benefits outweigh the risk of adverse reaction

LAIV3: Influenza vaccine (live, attenuated); Td: Tetanus and diphtheria vaccine; Tdap: Tetanus, diphtheria, and acellular pertussis vaccine; RSV: Respiratory syncytial virus vaccine; RZV: Zoster vaccine, recombinant (Shingrix); HepB: Hepatitis B vaccine; HPV: Human papillomavirus vaccine; HepA: Hepatitis A vaccine; COVID-19: Coronavirus disease vaccine; MMR: Measles, mumps, and rubella vaccine; VAR: Varicella vaccine; MenACWY: Meningococcal serogroups A, C, W, Y vaccine; Men B: Meningococcal serogroup B vaccine; Hib: *Hemophilus influenzae* type b vaccine; IPV: Poliovirus vaccine (inactivated)

5.3.4. Mental health and well-being assessment

The diagnosis of diabetes can induce diabetes distress, leading to difficulty accepting the diagnosis, poor treatment adherence, fear of future complications, and feelings of anger or sadness due to dietary restrictions [17]. Addressing these behavioral barriers is essential to improving outcomes. Also, unlike diabetes distress, which may improve with targeted diabetes self-management education and support (DSMES), clinical depression, characterized by persistent sadness, loss of interest, and functional impairment beyond diabetes-related concerns, warrants psychological or pharmacological intervention [40–42].

Psychiatric disorders like major depressive disorder (MDD), bipolar and related disorders, schizophrenia spectrum disorders, anxiety disorders, and eating disorders increase the risk of T2D development. In some cases, the relationship may be bidirectional [17, 43–45]. T2D is also an established risk factor for dementia and mild cognitive impairment [17]. The financial burden of diabetes also adds to the psychological

distress of individuals with T2D [17]. Referral to a specialist may be considered when clinically indicated for additional evaluation and timely intervention.

5.4. Patient Referral Pathway

Recommendation: We recommend implementing a robust electronic medical records (EMR) system to facilitate patient data sharing, streamline multidisciplinary care, prevent treatment duplication, and optimize overall T2D management [46]. Also, adopting a closed-loop referral pathway that is not only initiated but also tracked by the primary care physicians (PCPs) (see Figure **4**) is recommended [47].

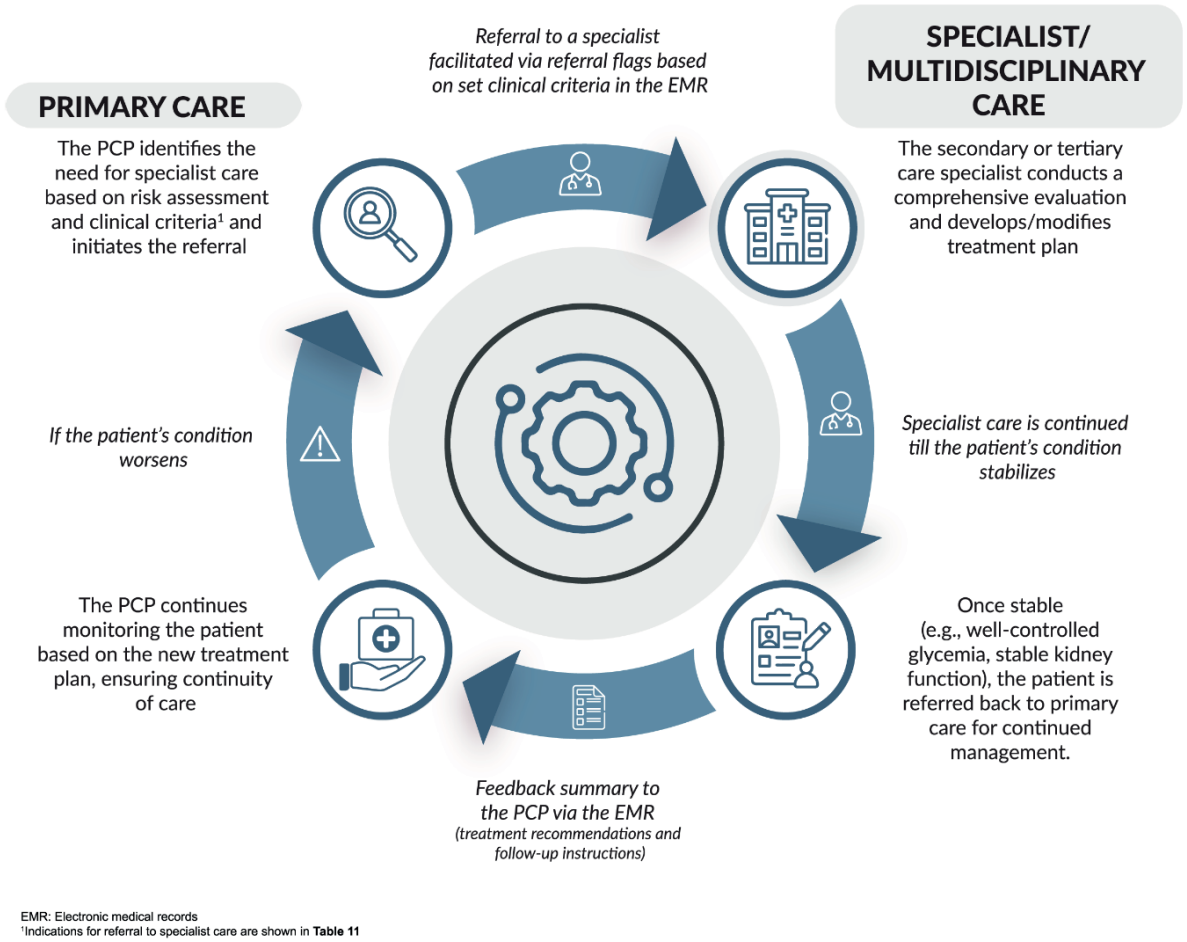


Figure 4: EMR-integrated closed-loop referral pathway.

Timely referrals from primary care to appropriate specialists are essential for multidisciplinary care and early detection of complications (see Table **11**) [17, 24, 48, 49].

A closed-loop referral pathway can ensure that patients complete the specialist consultation and that their clinical status, with relevant findings and recommendations, is communicated back to the PCP through EMR. Continued specialist care may be warranted in some patients (see Figure **4**) [47].

Table 11: Indications for patient referral.

Indication	Details and rationale
Inadequate glycemic control despite optimized therapy	• Refer if glycemic targets are not met after 3–6 months of lifestyle and pharmacologic optimization. • Consider referral for evaluation of secondary causes, psychosocial barriers, or intensification needs (e.g., insulin).
Development of microvascular or macrovascular complications	• Prompt referral to a specialist (e.g., nephrologist for eGFR decline/albuminuria, ophthalmologist for retinopathy, neurologist for neuropathy, or cardiologist for CVD) is indicated should any of these complications arise. ◦ Early detection and co-management improve outcomes.
Need for advanced therapies	• Complex cases requiring initiation of basal-bolus insulin, GLP-1 RA, dual GIP/GLP-1 RA, or SGLT2i, with renal/cardiac indications, may warrant endocrinology and cardiology referral. • Education for self-injection, titration, or pump therapy may require DSMES and multidisciplinary input.
Presence of hypoglycemia unawareness or severe episodes	• Refer when there is recurrent severe hypoglycemia, particularly in the elderly, those on insulin, or with cognitive decline. ◦ CGM or behavioral evaluation may be needed.
Diagnostic uncertainty or atypical presentation	• Refer for diagnostic clarification in atypical cases (e.g., monogenic diabetes or pancreatic disorders). ◦ Specialized testing and long-term care planning may be required.
Psychosocial, cognitive, or adherence issues	• Complex patients with diabetes distress, depression, low health literacy, or poor adherence benefit from psychologist, social worker, or DSMES referrals. ◦ Multidisciplinary support enhances outcomes.

eGFR: Estimated glomerular filtration rate; CVD: Cardiovascular disease; GLP-1 RA: Glucagon-like peptide-1 receptor agonist; GIP: Glucose-dependent insulinotropic polypeptide; SGLT2i: Sodium-glucose cotransporter-2 inhibitor; DSMES: Diabetes self-management education and support

5.5. Management of Prediabetes

Early intervention in prediabetes, primarily through lifestyle modifications, can prevent progression to T2D and, in some cases, increase the likelihood of the reversal of disease [50]. It can also improve other health parameters associated with MASLD, renal disease, and CVD. Weight management in those with overweight or obesity, along with increased physical activity and a healthy diet, can support glycemic control and enhance quality of life, altering the course of the diabetes continuum [10]. Pharmacotherapy may be required in some individuals with prediabetes, especially those at high risk for developing T2D. The prediabetes management algorithm is shown in Figure **5**.

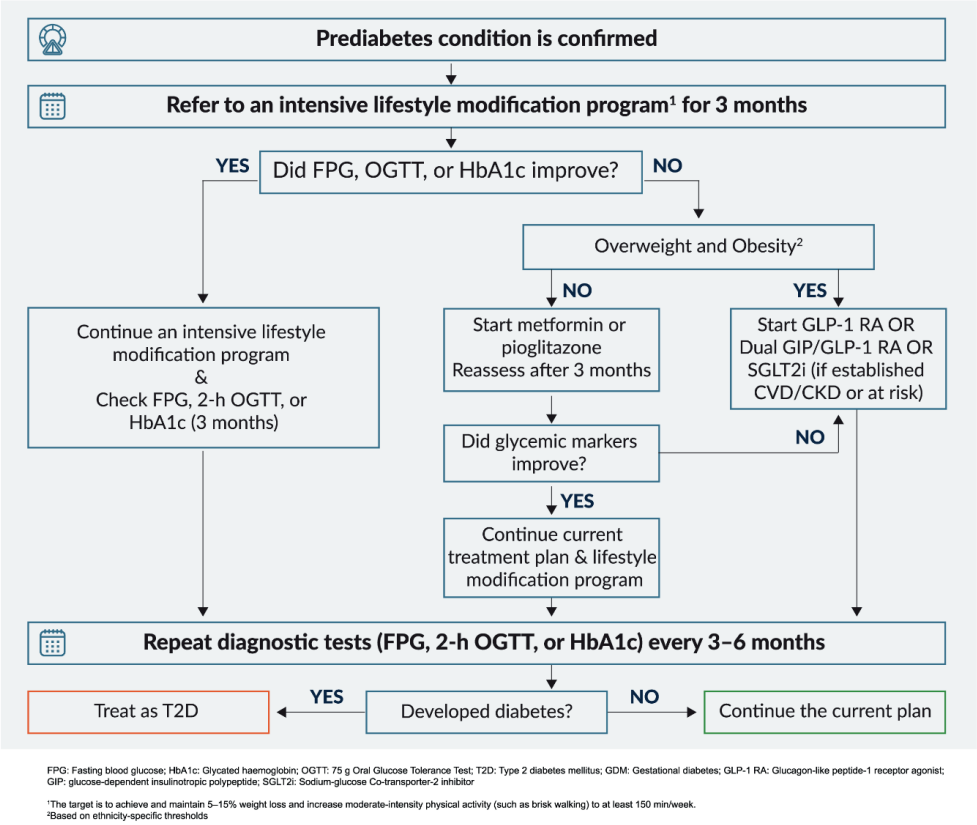


Figure 5: Management of prediabetes.

5.5.1. Prediabetes: Lifestyle interventions and pharmacotherapy

Recommendations:

a) Intensive lifestyle interventions, including dietary changes and regular physical activity, are recommended [17, 42, 51–60]. Please refer to the *Management of hyperglycemia: Lifestyle interventions* section for additional details on specific diet and exercise recommendations.

b) Metformin or pioglitazone may be considered for the prevention of T2D in select individuals when lifestyle intervention alone is insufficient. Decisions should be individualized based on risk factors and a careful evaluation of potential benefits and risks.

c) In individuals with prediabetes and overweight/obesity and established CVD/CKD or those at risk, early intervention with a glucagon-like peptide-1 receptor agonist (GLP-1 RA), dual glucose-dependent insulinotropic polypeptide (GIP)/GLP-1 RA, or sodium-glucose cotransporter-2 inhibitor (SGLT2i) is advisable for managing prediabetes/obesity as well as for reducing CVD risk (see Figure **5**) [10, 51, 61].

While the FDA has not approved any medications specifically for the prevention of T2D, it is crucial to assess the risks and benefits of pharmacotherapy in individuals with prediabetes and to consider individualized treatment goals, cost, and the burden of long-term use [51].

5.5.1.1. Metformin

The Diabetes Prevention Program (DPP) showed that, compared to a placebo, lifestyle intervention and metformin reduced the risk of T2D by 58% and 31%, respectively, over an average follow-up period of 2.8 years [62]. Over the long-term DPP Outcomes Study (DPPOS), the difference in T2D incidence rates between the two groups diminished.

An analysis using HbA1c as the diagnostic criterion found that metformin and lifestyle intervention reduced the risk of T2D by 44% and 49%, respectively, during the DPP and by 38% and 29%, respectively, over the extended follow-up period [63]. Compared to placebo, the lifestyle intervention was found to be cost-effective, and metformin was found to be marginally cost-saving over 10 years [64]. However, the DPP identified specific subgroups (with elevated FPG and HbA1c, and a history of GDM) in which metformin was especially beneficial in achieving desired glycemic goals [51, 65, 66].

Current evidence suggests that in the long-term: 1) lifestyle intervention alone or with metformin can delay progression to T2D in select individuals, 2) although delayed, progression to T2D is likely to occur (15-year DPPOS study), highlighting the need for improved prevention, and 3) individuals who do not develop T2D have a lower prevalence of microvascular complications, underscoring the importance of prevention. T2D prevention strategies should be individualized, with lifestyle intervention as the cornerstone. Metformin can be considered in select cases when lifestyle changes alone do not help achieve desired outcomes [62, 65, 67, 68].

5.5.1.2. Pioglitazone

In the Insulin Resistance Intervention after Stroke (IRIS) trial, pioglitazone was shown to reduce the risk of stroke and myocardial infarction in individuals with insulin resistance but no diabetes (nearly 65% had prediabetes; HbA1c $\geq$5.7%) and a history of ischemic stroke or transient ischemic attack. It also reduced the risk of progression to T2D, but increased the risk of weight gain, edema, and fracture. Given the elevated cardiovascular risk associated with prediabetes, pioglitazone may be considered in select high-risk individuals to prevent progression to T2D [10, 51, 69].

5.5.1.3. GLP-1 RAs, dual GIP/GLP-1RA, and SGLT2is

In individuals with overweight/obesity and prediabetes, GLP-1RAs, or dual GIP/GLP-1 RA, may be considered if lifestyle measures are insufficient, and weight loss is a goal for T2D prevention [10, 70]. SGLT2is may be considered in those with CVD or CKD (established disease or at-risk), or heart failure [71–74].

5.6. Management of Hyperglycemia

T2D management requires a holistic approach that integrates glycemic control with structured education, regular monitoring, and personalized care. Lifestyle factors such as sleep quality, diet, physical activity, and smoking influence T2D management. They should be considered while deciding the optimal treatment strategy. Pharmacotherapy should be individualized, goal-oriented, and person-centered.

5.6.1. Monitoring and education

Effective management of hyperglycemia requires a combination of appropriate monitoring strategies and patient education. Evidence-based, structured education should be designed to equip individuals with knowledge, skills, and confidence to manage their condition effectively and make informed decisions.

5.6.1.1. Importance, timing, and frequency of monitoring

Recommendations:

a) Glycemic monitoring using HbA1c testing, self-monitoring of blood glucose (SMBG), and CGM or flash glucose monitoring (FGM) is recommended. The monitoring frequency and optimal target ranges for these tests are shown in Tables **12** and **13** [17, 48, 59, 75–80].

b) Ketone testing may be recommended if clinically indicated. The reference ranges may vary depending on individual clinical profiles and should be interpreted accordingly.

Table 12: Recommendations and optimal targets for glucose monitoring and ketone testing.

	Recommendations	**Optimal targets**
HbA1c[1]	• Monitor every 3–6 months	• <6.5% (<48 mmol/mol) for most patients (may be reported as eAG <8.6 mmol/L [<154 mg/dL])
SMBG	• Recommended in individuals who: ◦ Are on insulin and SU therapy (due to hypoglycemia risk) ◦ Need monitoring of hypoglycemia/hyperglycemia due to intercurrent illness ◦ Need monitoring during preconception and pregnancy management (for those with established diabetes or GDM) ◦ Need monitoring due to changes in management or lifestyle, or in situations (specific conditions or medications, such as corticosteroids) where HbA1c may not accurately reflect glycemic patterns ◦ Have poorly controlled T2D and need monitoring to aid compliance with medication and diet • May be considered in others on a case-by-case basis • Monitoring frequency should be personalized[2] • Additional guidance on BGM in different populations is outlined in Table **13**	• Fasting/preprandial: 4.4–7.2 mmol/L (80–130 mg/dL) • Postprandial: <10 mmol/L (<180 mg/dL)[3]

Table 12: Continued.

	Recommendations	Optimal targets
CGM[4] or FGM	• Recommended in all insulin-treated individuals with T2D, particularly those with: ◦ Recurrent or severe hypoglycemia ◦ Hypoglycemia unawareness ◦ Glycemic variability ◦ Difficulty achieving HbA1c targets ◦ High-risk profiles (e.g., during pregnancy, elderly, those with complex treatment regimens) • May be considered in others on a case-by-case basis	Glucose CV: ≤36% TAR >250 mg/dL (>13.9 mmol/L): Most adults <5%, Older adults <10% TAR 181–250 mg/dL (10.1–13.9 mmol/L)[5]: <25%, <50% TIR 70–180 mg/dL (3.9–10.0 mmol/L): >70%, >50% TBR 54–69 mg/dL (3.0–3.8 mmol/L)[6]: <4%, <1% TBR <54 mg/dL (<3.0 mmol/L): <1%
Ketone testing	• Recommended during acute illness episodes accompanied by elevated blood glucose, when preprandial glucose levels are consistently >14 mmol/L, or when symptoms of DKA are present (nausea, vomiting, or abdominal discomfort)	• Blood ketone levels <0.6 mmol/L (6 mg/dL) • Levels >1.5 mmol/L (15 mg/dL) warrant prompt medical consultation

HbA1c: Glycated hemoglobin, SU: Sulfonylurea; GDM: Gestational diabetes mellitus; CGM: Continuous glucose monitoring; FGM: Flash glucose monitoring; T2D: Type 2 diabetes; DKA: Diabetic ketoacidosis; SMBG: Self-monitoring of blood glucose; eAG: Estimated average glucose; BGM: Blood glucose monitoring; TAR: Time above range; TIR: Time in range; TBR: Time below range; CV: Coefficient of variation

[1]Personalize frequency and target recommendations (e.g., more frequently in the elderly). Fructosamine may be used as an alternative marker of glycemic control when HbA1c cannot be measured accurately.

[2]Factors influencing monitoring frequency include type of therapy, extent of glycemic control, comfort level with SMBG devices, risk of hypoglycemia, hypoglycemia unawareness, or acute illness.

[3]Postprandial readings must be taken 1–2 hr after beginning a meal.

[4]CGM metrics interpretation: TAR >250 mg/dL (% of time in level 2 hyperglycemia); TAR 181–250 mg/dL (% of time in level 1 hyperglycemia); TIR 70–180 mg/dL (% of time in range); TBR 54–69 mg/dL (% of time in level 1 hypoglycemia); TBR <54 mg/dL (% of time in level 2 hypoglycemia); Targets to be individualized based on the clinical profile; lower CV targets (<33%) may be preferred for individuals on insulin or sulfonylurea treatment.

[5]Goals for combined levels 1 and 2 hyperglycemia

[6]Goals for combined levels 1 and 2 hypoglycemia

Table 13: Guidance on BGM in different populations.

- **People on MDI, insulin pump therapy, or those with hypoglycemia unawareness:**
  - CGM is recommended
  - If CGM is unavailable: BGM should be used at least four or more times per day
    - before meals/snacks
    - at bedtime
    - occasionally postprandially
    - before/after exercise
    - when hypoglycemia or hyperglycemia is suspected
    - before driving
- **People on basal insulin only:**
  - Daily fasting BGM is recommended to guide insulin titration
  - Additional checks may be needed in cases of hypoglycemia, illness, or medication changes

Table 13: Continued.

• **People not on insulin (T2D patients on oral therapy/non-insulin injectables):** ◦ Routine BGM is not generally recommended unless: ■ Experiencing hypoglycemia or unexplained glucose variability ■ Adjusting lifestyle or medications ■ Assessing the accuracy of HbA1C or intercurrent illness
• **Pregnant women and older adults:** ◦ Frequency of BGM should be individualized, with heightened monitoring in pregnancy or if hypoglycemia risk is

MDI: Multiple daily injections; CGM: Continuous glucose monitoring; BGM: Blood glucose monitoring; T2D: Type 2 diabetes; HbA1c: Glycated hemoglobin

Glucose monitoring helps achieve and maintain optimal glycemic control, detect hyperglycemia and hypoglycemia, evaluate treatment efficacy, and guide treatment modifications [17]. Ketone testing may be required on an as-needed basis in specific individuals with T2D, such as those on insulin or SGLT2is. Educating these individuals to recognize the signs of diabetic ketoacidosis, providing a structured "sick-day" protocol, and training them in accurate ketone measurement and prompt self-management are essential steps to prevent complications [17, 75].

HbA1c: Point-of-care (POC) HbA1c testing offers an opportunity for timely treatment adjustments [15, 81]. However, caution must be exercised with POC HbA1c testing due to the variable accuracy of some devices and the absence of mandated proficiency testing in certain settings. Therapeutic decisions based on POC results may require validation with additional glycemic assessments, such as CGM, BGM, or laboratory-based HbA1c measurement [15, 82].

SMBG: To be effective, SMBG should follow a structured approach, where individuals are guided on when to take glucose measurements (see Tables **12** and **13**), how to document and interpret the findings, and how to use them to optimize self-management (how to modify treatment based on SMBG results) [17].

CGM: Clinical trial data support the benefits of CGM in individuals with T2D who are not on insulin therapy, including lower HbA1c levels, increased time-in-range, reduced time-below and above range, and increased patient satisfaction [78, 83]. However, it should not be considered as a replacement for SMBG. Some real-time CGM devices still require SMBG readings to calibrate sensors or to confirm glucose values before making treatment adjustments or treating suspected hypoglycemia. Additionally, SMBG may be needed when glucose alerts or CGM readings do not match symptoms [17].

FGM: Unlike CGM, FGM is a pre-calibrated device that does not require SMBG for calibration. Newer generation devices can download data and send alerts directly to a Bluetooth-connected phone [84–86].

While CGM and FGM devices provide more detailed, continuous glycemic data than SMBG, studies have shown only modest differences in clinical outcomes between these methods. Therefore, the choice of method should be based on individual preferences and clinical needs [59].

5.6.1.2. Diabetes self-management education and support (DSMES)

Recommendations:

a) Details of the recommended DSMES program are outlined in Table **14** [15, 87, 88]. Utilizing telehealth and digital platforms for DSMES can help tailor care to individual needs and overcome access challenges [42].

b) DSMES should not be a one-time intervention, but an ongoing process delivered at regular intervals to support sustained self-management. The educational program may be offered annually or individualized by the treating physicians (e.g., more frequently in individuals not meeting treatment goals) [17, 42].

c) DSMES should be delivered by a multidisciplinary team comprising specialist nurses, registered dietitians, pharmacists, social workers, certified health education specialists, exercise physiologists, certified (or appropriately trained) diabetes specialist nurses, and other diabetes care coordinators [42]. These specialists should obtain a formal education certificate in diabetes education to ensure standardized support for individuals with diabetes.

Table 14: Structured education program for diabetes self-management.

When should the program be offered?	Aims of the program	Curriculum Contents
• At the time of diagnosis • Annually thereafter, for reinforcement and review • When complicating factors occur • During care transition • At intensification of treatment (e.g., introduction of injectable therapy, change from basal to intensive insulin) • Before Ramadan fasting • Before Hajj	**The program should:** • Be individualized, i.e., suits the needs of the person • Have a structured curriculum, i.e.: ◦ Evidence-based and uses resources efficiently ◦ Accompanied by supporting materials (leaflets) • Should be objective-driven • Enable individuals and their family members/caregivers to gain confidence, knowledge, and skills for effective self-management • Be quality-assured and reviewed by qualified, independent assessors to ensure its objectives are met, its delivery is consistent, and its outcomes are regularly evaluated • Be tailored to the cultural and language needs of the local population • Be inclusive and adapted to meet the needs of individuals with disabilities, impairments, or sensory loss	• Diabetes pathophysiology and treatment options • Healthy eating • Physical activity • Medication and its usage • Monitoring and using patient-generated health data • Preventing, detecting, and treating acute and chronic complications of diabetes • Coping with psychosocial issues and concerns • Problem-solving strategies • Social aspects such as fasting, driving, and travelling for individuals on insulin

Studies have shown that structured self-management education programs improve glycemic outcomes by reducing HbA1c levels, cardiovascular risk factors, and diabetes-related complications [17, 89].

5.6.1.3. Lipodystrophy

Recommendations: Individuals with T2D on insulin therapy should be trained on proper injection technique. Regular injection site checks by HCPs and structured education for individuals with T2D are recommended (see Table **15**) [90–93].

Table 15: Recommendations to reduce the risk of lipohypertrophy (LH).

Injection technique training
Individuals with T2D on insulin therapy should be trained/informed to: • Select appropriate injection sites • Follow structured injection/infusion site rotation ◦ Maintain a minimum distance of 1 cm between 2 successive injections • Avoid injecting into areas with LH • Use a fresh needle each time to avoid skin trauma and reduce the risk of infections • Use the most appropriate needle size • Avoid injecting cold insulin • Avoid injecting through clothing, as it may hinder proper injection site inspection • Avoid massaging the skin immediately after injection. However, a gentle massage before or between injections may help reduce discomfort
Injection site inspection by HCPs
• HCPs should conduct periodic injection site inspections during initial and annual comprehensive clinical evaluations as a part of the physical examination • Individuals should also be encouraged to routinely examine their injection sites and report any abnormalities
Structured education
• Structured education programs emphasizing proper injection techniques should be implemented, as they can decrease LH occurrence and reduce glycemic variability.

T2D: Type 2 diabetes; HCP: Healthcare professionals

Lipohypertrophy (LH), a form of lipodystrophy, is a common complication of insulin therapy in individuals with diabetes, resulting from the accumulation of subcutaneous adipose tissue at injection sites due to repeated insulin administration in the same area and needle reuse [91, 93]. These fatty lumps can interfere with insulin absorption, leading to glycemic variability and hypoglycemia [92].

In a meta-analysis (26 studies, 12,493 participants), the pooled prevalence of LH was 38%, with a higher prevalence in T2D (49%) compared to T1D (34%) [94]. The high prevalence of LH in insulin-treated T2D individuals underscores the need for increased HCP awareness and routine palpation of injection sites for early detection. Trained HCPs may be more likely to detect smaller (<4 cm) LH lesions compared to those without training [91].

Lipoatrophy (LA), another form of lipodystrophy, involves localized loss of subcutaneous fat at insulin injection sites. Its prevalence has reduced with the use of recombinant human insulin and insulin analogs. However, occasional cases have been reported in individuals with T2D on insulin therapy, warranting physician vigilance [95–97].

5.6.2. Lifestyle interventions

5.6.2.1. Sleep hygiene promotion

Recommendations:

a) We recommend an initial and annual assessment of sleep quality and patterns in individuals with prediabetes and T2D. A symptom-based questionnaire (e.g., loud snoring, excessive daytime sleepiness, etc.) or the STOP-Bang questionnaire may be used for obstructive sleep apnea (OSA) screening [10, 98, 99].

b) Individuals experiencing sleep disruptions should be counseled on limiting electronic device use before bedtime, reducing nighttime light exposure, avoiding caffeine, and engaging in regular physical activity to improve sleep quality. They should also be evaluated for underlying depression.

c) Referral to sleep medicine specialists should be considered when clinically indicated.

The duration of sleep is a crucial lifestyle factor, as important as diet and exercise, that influences T2D development and progression. Studies show that the risk of T2D is low when sleep duration is 7 to 8 hr [100, 101]. Poor sleep quality, evening chronotype, and excessive daytime napping (>30 min) can also increase the risk of T2D by 7-20% [101]. A cross-sectional analysis of data from the UAE Healthy Future Study (UAEHFS) confirmed the correlation between OSA risk and T2D, revealing an overall high-risk OSA prevalence of 16.58% and an intermediate-risk prevalence of 7.6% among the study participants. The prevalence was higher in men (26.46%) than in women (4.1%) [102]. Multiple studies have confirmed the link between sleep disturbances and depression in individuals with T2D [103–107]. Thus, all major international guidelines now emphasize the importance of sleep and the need for evaluating sleep patterns during routine T2D assessments [10, 17, 48, 51].

5.6.2.2. Medical nutrition therapy

Recommendations:

a) Individuals with T2D should be referred to a registered dietitian specializing in diabetes care to ensure they receive personalized MNT. Assessment for disordered eating behaviors by experienced HCPs is recommended. Those experiencing rapid weight loss should be screened for malnutrition and sarcopenia using a screening tool like MUST [108].

b) HCPs should routinely ask individuals with T2D about their participation in religious fasting and accommodate their preferences with proper guidance before special seasons like Hajj and Ramadan.

Medical nutrition therapy (MNT) is an effective intervention in the management of T2D that helps in improving glycemic control, supports weight management, and reduces cardiovascular risk factors [109]. When delivered by a registered dietitian, individualized MNT has been associated with HbA1c reductions ranging from 0.3% to 2.0% in people with T2D [42, 48, 110].

The goals of MNT and a summary of all the dietary recommendations are outlined in Tables **16** and **17** [42, 48, 52, 109, 111].

Table 16: Medical nutrition therapy (MNT) goals for people with T2D.

Promote healthy eating patterns 
Encourage diverse, nutrient-dense foods in appropriate portion sizes to support overall health. The goal is to help individuals with diabetes: • Achieve and maintain a healthy body weight • Meet personalized targets for glycemic control, blood pressure, and lipid profiles • Delay or prevent diabetes-related complications
Individualized Nutrition Guidance 
Address nutritional needs based on cultural traditions, food preferences,health literacy and readiness to change.
Preserve/Maintain the Pleasure of Eating 
Deliver food guidance in a respectful, non-restrictive manner, limiting or avoiding certain foods only when strongly supported by scientific evidence.
Empower with Practical Tools 
Equip individuals with diabetes with the skills to adopt long-term, health-promoting eating habits, focusing on overall patterns rather than individual macronutrients, micronutrients, or single foods.

Table 17: Summary of dietary recommendations.

Promote dietitian-led individualized MNT 	• Refer people with diabetes to a dietitian experienced and skilled in providing diabetes-specific MNT. • Involve locally trained dietitians in the care team to tailor advice to traditional Emirati diets.
Promote healthy evidence-based dietary patterns 	• Individualized meal plans that focus on diet quality, while accounting for patients' current eating patterns, metabolic goals, and cultural and religious preferences, are recommended. • Focus should be on whole, nutrient-dense foods while minimizing processed foods, added sugars, sugary beverages, refined grains, and red/processed meats
Avoid promoting micronutrients and supplements for diabetes management 	• Routine antioxidant or herbal supplements are not recommended due to a lack of consistent evidence. • Vitamin D supplementation, if not deficient, is not recommended. • Periodic vitamin B12 testing is recommended for those on long-term metformin therapy, particularly if presenting with anemia or neuropathy.
Avoid excess alcohol intake 	• Advise individuals on insulin or insulin secretagogues about the risk of hypoglycemia from alcohol. • Alcohol consumption should be limited or avoided, and glucose monitoring before and after drinking is recommended. • Patients who do not consume alcohol should not be encouraged to start.
Limit sodium and high salt foods 	• Individuals should be encouraged to reduce salt usage during cooking or at the table • Recommend a daily sodium intake of <2300 mg, with further reductions. • Emphasize reducing intake of processed and ultra-processed foods as the primary strategy. • Promote the use of potassium-enriched salt substitutes in appropriate populations to reduce stroke and cardiovascular risk.

Table 17: Continued.

Recommend water versus other drinks	• Water should be the primary beverage of choice over nutritive and non-nutritive sweetened (NNS) beverages. • NNS may be used in moderation to reduce intake of added sugars and total calories.
Screen and monitor patients on GLP-1 RAs and dual GIP/GLP-1 RAs	• An individualized nutrition and physical activity regimen focused on adequate protein intake, regular resistance training, and monitoring body composition changes throughout treatment is essential to minimize muscle mass loss.
Carbohydrates	• Emphasis on ◦ consumption of high-quality, nutrient-dense, and minimally processed sources of carbohydrates that are rich in fiber ◦ carbohydrate quality, not quantity ◦ whole grains, vegetables, legumes, fruits, and low-fat dairy (or fortified non-dairy alternatives) • Limit consumption of refined grains, sweetened beverages, and sugar-dense snacks • Educate on the use of low GI foods (carrots, green peas, oats, apples, berries, etc.) to improve glycemic control • For those on fixed insulin doses, advise a consistent carbohydrate pattern in timing and portion size. • Incorporate culturally appropriate dietary adjustments while ensuring they are accounted for in the total daily carbohydrate intake: ◦ Moderate portion control of dates and honey ◦ Healthier alternatives for Karak tea (unsweetened, low-fat fresh milk)/Limiting intake to occasional small servings
Proteins	• Protein intake targets should be tailored to individual dietary patterns and clinical goals. • Recommend a protein intake of 0.8–1.5 g/kg/day, individualized according to patient needs • Ensure adequate protein intake (quantity and quality) for patients on GLP-1 RAs and dual GIP/GLP-1 RA, especially those at risk of sarcopenia
Fats	• Prioritize unsaturated fats (e.g., olive oil, nuts, seeds, fatty fish) and limit intake of foods high in saturated fat • When reducing saturated fat, replace it with unsaturated fats, not refined carbohydrates • Adherence to general population guidelines on saturated fat, cholesterol, and *trans*-fat intake is recommended

MNT: Medical nutrition therapy; NNS: Non-nutritive sweetener; GLP-1 RA: Glucagon-like peptide receptor agonist; GIP: Glucose-dependent insulinotropic polypeptide; GI: Glycemic index

Carbohydrates

Recommendation: While monitoring carbohydrate consumption is crucial for glycemic management, evidence on the optimal intake remains inconclusive. Replace sugar-sweetened beverages and processed foods with healthier and more nutrient-dense food options to improve overall nutritional status (See Table **17**) [42].

Monitoring carbohydrate intake is crucial in achieving glycemic goals in T2D patients. Improving carbohydrate quality by incorporating low GI foods has been shown to support better glycemic control [59]. A systematic review of 54 RCTs involving adults and children with IGT, T1D, or T2D, demonstrated a

modest but statistically significant reduction in HbA1c of 0.19% (2 mmol/mol) with a low-GI diet compared to other dietary approaches [59, 112].

Proteins

Recommendations*:* Protein consumption above or below the general population recommendations (0.8–1.5 g/kg/day or 15–20% of total calories) has not been shown to provide additional benefits in individuals with T2D [42]. Also, protein restriction below the recommended allowance is not advised for individuals with CKD [42]. HCPs should monitor the quantity and quality of protein intake and the potential reduction in lean body mass in individuals taking GLP-1 RAs or dual GIP/GLP-1 RA for weight loss (see Table **17**) [113]. Recommended protein sources include legumes, soy products, nuts and seeds, fish, seafood, poultry, and low-fat dairy. Consumption of processed meats should be limited due to the risk of CVD [42].

In CKD, lowering protein intake beyond the general dietary recommendation (0.8 g/kg/day) does not improve glycemic control, cardiovascular risk markers, or slow the decline in estimated glomerular filtration rate (eGFR). Moreover, it may increase the risk of malnutrition [113]. While GLP-1 RAs can lead to significant weight loss, they also lead to reduction in muscle mass. Studies indicate that 15–40% of the lost weight may be from lean body mass [114].

An individualized nutrition and physical activity regimen that includes adequate protein intake, regular resistance training, and monitoring of body composition changes throughout treatment can help minimize muscle-mass loss [114]. By inducing greater diet-induced thermogenesis than carbohydrates or fats, high-protein diets can increase energy expenditure and help preserve resting energy expenditure by preventing loss of fat-free mass. Thus, while long-term studies are warranted, a high-protein diet may be an effective weight-loss strategy that minimizes a decrease in fat-free mass [115]. Also, when combined with resistance training, dietary protein intake can enhance muscle protein synthesis. However, improvements in muscle strength are typically observed only when protein intake is accompanied by exercise [116].

Fats

Recommendations: The percentage of total calories from saturated fats should be limited, and trans fats should be avoided altogether. To support cardiovascular and glycemic health, saturated fat intake should be replaced with unsaturated fats (rather than refined carbohydrates) (see Table **17**) [42].

When considering metabolic goals and CVD risk, the type of dietary fats consumed is more important than the total amount of fat intake.

Sodium, alcohol, and non-nutritive sweeteners

Recommendations: Replacing regular salt with alternatives that have lower sodium and higher potassium levels can be considered [117]. As the long-term effects of alcohol consumption in individuals with T2D are unknown, they must be advised to limit alcohol consumption. Individuals with obesity and T2D may use a variety of no-calorie or low-calorie sweetened products to help reduce sugar intake without feeling deprived (see Table **17**) [42].

- **Sodium:** Intake recommendations for sodium should balance palatability with clinical relevance [42]. Replacing regular salt with alternatives that have lower sodium and higher potassium levels has been shown to significantly reduce the risk of stroke, CVD, and all-cause mortality in diabetes patients with high CV risk [117].
- **Alcohol:** Risks associated with alcohol consumption include immediate or delayed hypoglycemia (especially in those using insulin or insulin secretagogues) as well as weight gain and hyperglycemia in cases of excessive intake [42].
- **Non-nutritive sweeteners (NNS):** In moderate amounts, NNS may be a suitable alternative to nutritive sweeteners (sugar, honey, or agave syrup) for individuals with T2D who regularly consume sugar-sweetened products (such as regular sodas, juices, and other items sweetened with cane sugar or high-fructose corn syrup). NNS generally does not impact blood glucose levels and can help reduce total calorie and carbohydrate intake, provided the reduction is not offset by increased consumption from other sources [42].

Nutrition counseling for individuals with T2D on insulin therapy

Comprehensive counseling on matching insulin with carbohydrate intake is essential for individuals with T2D who use insulin (see Table **18**) [42, 118, 119].

Table 18: Key nutrition counseling points for individuals with T2D.

Nutritional aspects to emphasize in T2D 
• Understanding insulin-to-carbohydrate ratios (especially for those with variable carbohydrate intake and meal schedules) is essential. ◦ This allows individuals to adjust their insulin doses from meal to meal, thereby improving glycemic control.
• When meals are high in fat and/or protein, standard carbohydrate counting alone is insufficient in controlling postprandial glycemic excursions. The protein and fat content of meals can affect the timing and magnitude of peak blood glucose levels and the overall duration of postprandial hyperglycemia. ◦ Dietary fat and protein intake should be considered in insulin dosing and meal planning.
• Although additional insulin dosing based on fat and protein content of meals may lower postprandial glucose levels 3 and 4 hr after meals and improve time in range (TIR) on CGM, late-onset hypoglycemia may be experienced (particularly with higher insulin doses). ◦ Individualized insulin dosing adjustments and careful monitoring are crucial.
• Insulin dosing should be guided by structured glucose monitoring or CGM to enable appropriate dose adjustments.
• For individuals on insulin pump therapy: ◦ Utilizing the split bolus feature (where part of the bolus is delivered immediately and the rest is extended over time) can enhance postprandial glycemic control following high-fat and/or high-protein mixed meals.
• For individuals on a fixed daily insulin regimen: ◦ Meal planning should prioritize consistent carbohydrate intake (timing and quantity) to align with the expected insulin action and minimize glycemic variability.

Additional considerations for specific populations and situations

Recommendations*:*

a) Identifying potential effects of treatment on appetite or calorie intake is essential [109]. To mitigate risks of malnutrition and sarcopenia, registered dietitians should emphasize resistance training, adequate protein intake, hydration, and fiber consumption, and encourage whole-food-based healthy eating patterns [109, 120, 121].

b) To prevent complications during religious fasting, people with T2D should receive individualized guidance on fluid intake and meal composition, with an emphasis on adequate hydration, fiber-rich foods, and complex carbohydrates instead of sugary foods [122–124].

c) During Hajj, individuals with T2D should receive comprehensive guidance on nutrition, hydration, medication management, and strategies for preventing and addressing hyperglycemia and hypoglycemia [125].

- **Disordered eating behaviors:** There is a bidirectional relationship between eating disorders and T2D, with each being a risk factor for the other [126]. Binge eating disorder (BED; excessive food intake followed by a loss of control) is most commonly reported, but often remains undiagnosed [109, 127, 128]. Additionally, individuals with insulin-requiring diabetes may exhibit insulin omission, also known as diabulimia. It involves intentionally skipping insulin doses to induce weight loss [42, 129]. Other eating disorders include anorexia nervosa and bulimia nervosa, which are more prevalent in females than males [130]. Risk factors associated with eating disorders in T2D include high BMI, body dissatisfaction, inadequate coping strategies, and depression [129].

- **Malnutrition and sarcopenia:** The increasing prevalence of overweight and obesity has led to a double burden of malnutrition, where undernutrition and obesity coexist, causing nutritional imbalances and increasing the risk of sarcopenia [131]. In individuals with diabetes, insulin resistance and oxidative stress can increase the risk of sarcopenia. A systematic meta-analysis (12,237 participants) found the prevalence of sarcopenia in T2D patients to be 18%. The risk of sarcopenia in diabetes was associated with age, BMI, HbA1c, duration of diabetes, high-sensitivity C-reactive protein (hs-CRP), diabetic nephropathy, and visceral fat area [132]. The use of GLP-1 RA and dual GIP/GLP-1 RA has been associated with an increased risk of malnutrition and sarcopenia, especially in individuals with liver, kidney, or cardiac conditions [42, 121].

- **Religious fasting:** Fasting for religious reasons is a common practice across various faiths, with differences in duration and frequency. It leads to altered eating patterns, with post-fast meals often high in carbohydrates, fats, and added sugars. Thus, in individuals with T2D, fasting increases the risk of hypoglycemia, hyperglycemia, and dehydration. Detailed guidance on religious fasting is available in the IDF-DaR (Diabetes and Ramadan) guidelines [133].

- **Muslim pilgrimage:** Hajj is one of the five central pillars of Islam. It is accompanied by substantial shifts in sleep patterns, nutrition, physical activity, meal patterns, and food quality, while excessive heat may affect insulin absorption [134].

5.6.2.3. Exercise

Recommendations: Physical activity recommendations for individuals with T2D are outlined in Table **19** [15, 42, 48, 117]. Barriers such as extreme weather, cultural norms, lack of access to safe facilities, or gender-specific limitations should also be considered. In the UAE, indoor walking and physician-supervised programs are feasible alternatives [15, 59, 117]. A multidisciplinary team approach involving physicians, diabetes educators, physiotherapists, and behavioral counselors can improve program adherence and outcomes.

Table 19: Summary of physical activity recommendations in prediabetes and diabetes, including special populations.

• Aim for at least 150 min per week of moderate-intensity aerobic activity, spread over at least 3 days per week.
• Avoid more than 2 consecutive days without physical activity.
• For fit individuals, 75 min of high-intensity interval training (HIIT) per week may be substituted.
• Post-meal walking and cumulative activities throughout the day are encouraged.
• Include resistance exercises 2–3 times per week on non-consecutive days.
• Focus on major muscle groups to improve glucose control, strength, and metabolism.
• Avoid prolonged sitting; break up sedentary time every 30 min with light activity.
• Even small increases in daily step count (e.g., +500 steps/day) can improve health outcomes.
• Account for local barriers such as heat or limited safe spaces.
• Promote indoor options, culturally acceptable routines, and personalized plans.
Special populations
◦ **People with prediabetes** ■ Structured physical activity is a cornerstone of prevention. ■ Lifestyle programs can significantly reduce progression to diabetes.
◦ **Youth** ■ Engage in ≥60 min/day of moderate to vigorous activity. ■ Include strengthening exercises at least 3 days/week. ■ Limit screen time to <2 hr/day.
◦ **Older adults** ■ Add balance and flexibility exercises like yoga to reduce fall risk. ■ Tailor activity to individual health status and functional ability.
◦ **People with cardiovascular risk** ■ May require pre-exercise assessment before starting moderate or vigorous programs. ■ Begin with low-impact, supervised activity if necessary.

Regular exercise improves glycemic control. Aerobic and resistance training can reduce HbA1c levels by approximately 0.3-0.7% in individuals with T2D, regardless of weight loss [42, 48, 135]. Exercise enhances insulin sensitivity, facilitates glucose uptake in muscles, and helps preserve pancreatic beta-cell function, which is particularly important in prediabetes [17, 136]. Physical activity also supports weight loss and weight maintenance, two crucial strategies for reducing the risk of T2D [17, 59]. In individuals with cardiovascular risk, exercise improves endothelial function, lipid profiles, and blood pressure and reduces overall CVD risk [117]. Moreover, it contributes to psychological well-being and better physical function, especially in older adults [15, 42].

5.6.2.4. Smoking cessation

Recommendations:

a) The following interventions should be accessible to all adults who smoke:

- Behavioral interventions: Behavioral support and very brief advice
- Regulatory licensed products: Nicotine replacement therapy, bupropion, and varenicline

b) All patients, regardless of associated morbidity, should be screened for cigarette, electronic cigarette, or shisha use to prevent CVD and associated complications.

c) Brief counseling on the importance of smoking cessation should be provided to all individuals with CVD risk factors to reduce smoking prevalence and associated CVD events in the UAE [42].

Smoking poses a significant public health challenge in the UAE. Based on the *Weqaya* (a population screening program) study of cardiovascular risk factor prevalence rates, smoking prevalence in Abu Dhabi was 26% in males and 0.8% in females [137]. According to the 2017–2018 UAE-NHS, overall smoking prevalence in the UAE among adults was found to be 9.1%, with rates of 15.7% in males and 2.4% in females. The prevalence was higher in Emirati males (20.5%) than in non-Emirati males (14.9%) (see Figure **6**) [1]. It increases the risk of developing T2D and accelerates the progression of microvascular and macrovascular complications [42].

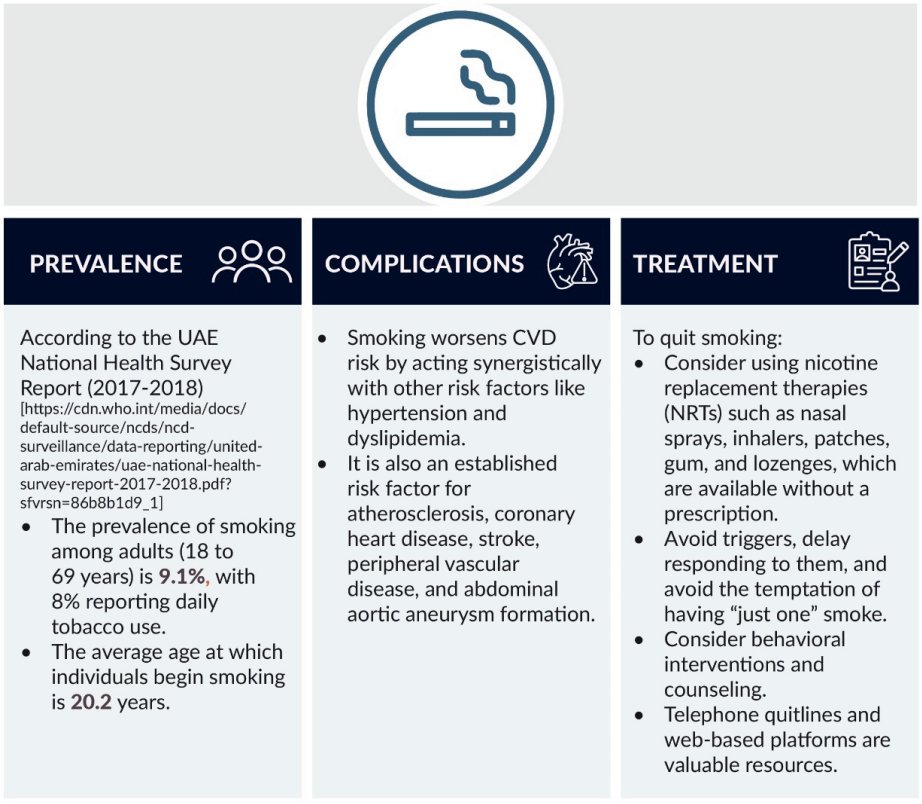


Figure 6: Smoking: A snapshot of prevalence, complications, and cessation strategies.

One in four CVD-related deaths may be attributed to smoking, making it a major but also a modifiable risk factor for CVD. Passive smoke exposure increases the risk for CVD by 25–30%. However, smoking cessation can reduce the risk of coronary heart disease by 50% in 3-6 years of quitting [138]. The complications associated with smoking are shown in Figure **6**, [138, 139]. Moreover, electronic cigarettes (e-cigarettes) and shisha (or hookah) smoking, a common practice in the Middle East, are also associated with health risks and have been linked to CVD [140, 141].

Measures like accessibility to telephone quitlines and web-based online platforms can provide the necessary resources to help individuals quit smoking and sustain long-term cessation [42].

5.6.3. Focus on obesity and overweight management and intermittent fasting

5.6.3.1. Focus on obesity and overweight

Recommendations: Individuals with obesity and T2D should be treated with respect and without judgment. Eating disorders should be assessed and managed appropriately. Some diabetes management medications result in weight gain and should be avoided, if possible, in individuals with obesity and T2D. Obesity management with lifestyle intervention, pharmacotherapy, or bariatric surgery should be individualized based on clinical profiles [61, 142].

Obesity management is crucial to prevent the progression of prediabetes to diabetes [143]. The goal of weight loss should be to achieve remission of prediabetes rather than just delay its progression to T2D. Remission is associated with greater health benefits, like improvements in renal function and microvascular health [144, 145].

The findings of the DIADEM-I trial, which included individuals (18–50 years) with T2D (duration $\leq$3 years) and BMI $\geq$27 kg/m^2 from the MENA region, showed that significant weight loss with intensive lifestyle intervention was associated with remission of T2D in 60% of the participants [146]. Additional guidance on obesity management is available in the UAE National Guidelines for Weight Management and Prevention of Adulthood Obesity [147].

5.6.3.2. Intermittent fasting

Recommendations: We recommend considering individual preferences and conducting a thorough risk assessment before implementing a weight-loss strategy such as intermittent fasting (IF). Certain therapies may increase the risk of hypoglycemia during prolonged fasting, necessitating regular monitoring. Before initiating IF, individuals with T2D should be counseled on the risks, potential benefits, and practical aspects of the strategy.

IF involves alternating periods of regular food intake with periods of calorie restriction or fasting. The most common non-religious methods of IF involve alternate day fasting (alternating days of normal eating with fasting or low-calorie intake of about 500 kcal for women and 600 kcal for men), time-restricted eating (food intake confined to 4–10 hr per day with water (or non-caloric drinks, like plain tea or coffee)-only fasting for the remaining 14–20 hr), and the 5:2 diet (5 days of regular food intake and 2 non-consecutive days of calorie restriction/fasting). Consumption of water is allowed during the fasting periods [42, 148]. Unlike these forms of IF, religious fasting during Ramadan involves refraining from all food, drink, and water from sunrise to sunset.

In terms of weight loss, data from several systematic reviews and meta-analyses suggest similar benefits of IF and continuous energy restriction diets [42, 149–151]. Additional long-term studies are needed to ascertain the comparative effectiveness of the two strategies.

5.6.4. Pharmacotherapy

Comprehensive pharmacological management of T2D should be individualized, considering efficacy, safety, adherence, comorbidities, and benefits beyond glycemic control to improve overall health outcomes. The management strategy should align with published international guidelines on T2D management as well as the EDES/ECS cardiometabolic guidelines [10, 17, 20, 92, 117].

5.6.4.1. Treatment in individuals with biopsy-confirmed MASH or those at high risk for liver fibrosis

Semaglutide (2.4 mg once weekly) has been shown to improve liver histology results in individuals with MASH (moderate or advanced liver fibrosis). It should be considered a first-line treatment option in these individuals [152]. Resmetirom, a selective thyroid hormone receptor-β agonist, has been approved by the FDA for the treatment of MASH (moderate or advanced fibrosis) and should be prescribed under the guidance of a specialist. Additionally, a dual GIP/GLP-1 RA or pioglitazone may be considered for glycemic management in these individuals, given their potential benefits in MASH [92].

5.6.4.2. CRM risk-based T2D treatment

Recommendations: We recommend a risk-based approach to pharmacotherapy selection in individuals with T2D. Treatment should be selected based on efficacy on cardiovascular, renal, and glycemic outcomes; risk of hypoglycemia; impact on weight; and cost.

Cardiorenal complications such as atherosclerotic cardiovascular disease (ASCVD), heart failure, and CKD contribute to early morbidity and mortality in T2D [153]. Cardiovascular outcomes trials, conducted following the 2008 FDA guidance to assess the cardiovascular safety of glucose-lowering agents, have revealed not only glycemic benefits but also cardiovascular and renal protection with drug classes such as GLP-1 RAs and SGLT2is [154]. The trial findings have thus led to a paradigm shift in T2D management, expanding the focus from a purely glucocentric management to a more holistic and integrated approach that prioritizes CRM risk reduction [154, 155].

The easy-to-follow treatment algorithms for different risk categories (CRM risk score of 1 [low CV risk] to 4 [very high risk]) can be used to guide treatment selection (see Figures **7**–**10**) [20, 92, 117, 156–158]. Steps to initiate or intensify insulin treatment are shown in Figure **11**. A brief overview of the routes of administration and efficacies of different classes of antihyperglycemic medications on glycemic control, weight, cardiovascular outcomes, kidney function, and MASH is shown in Figure **12** [10, 61, 92, 152, 159–164].

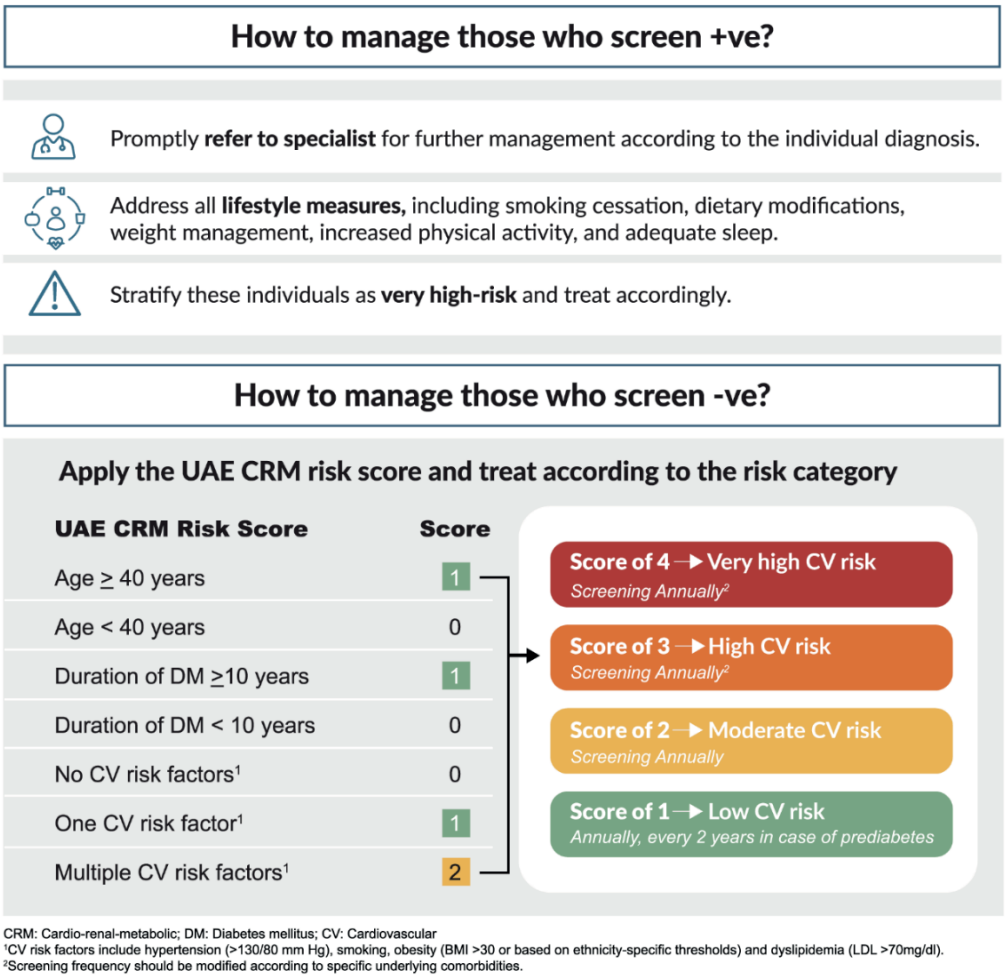
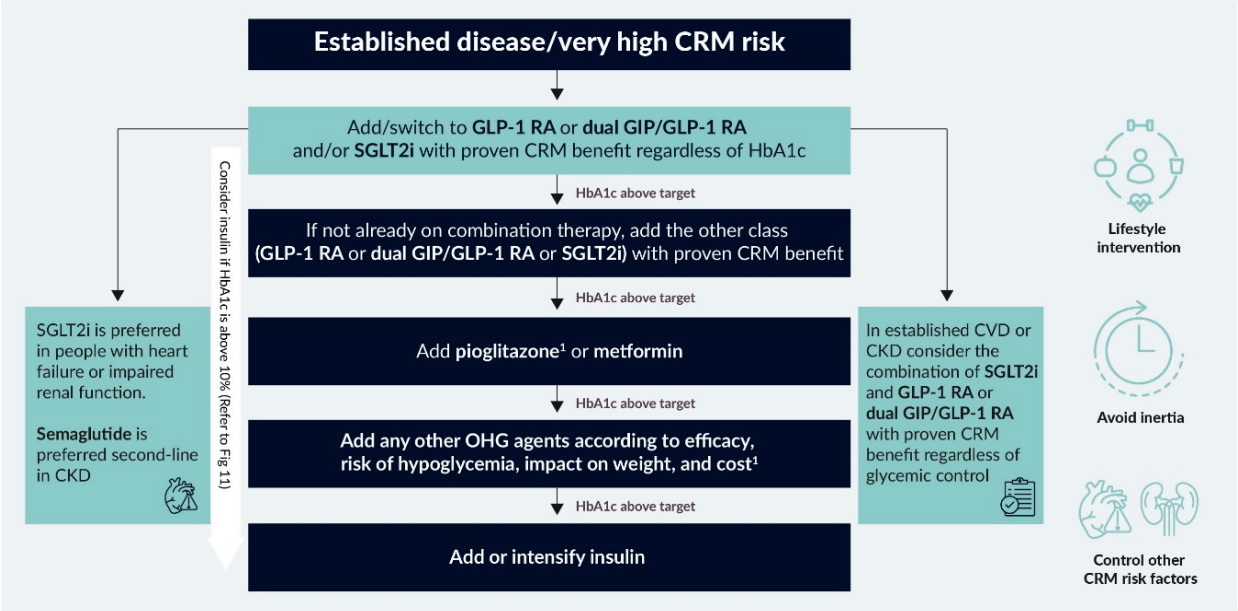
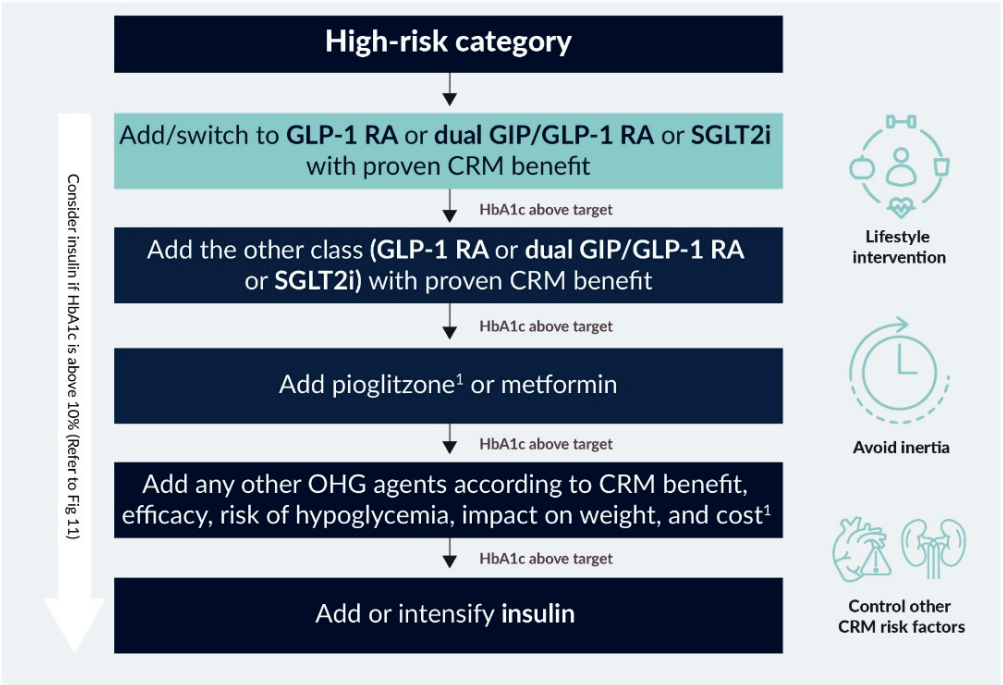


Figure 7: Management based on CRM risk screening.



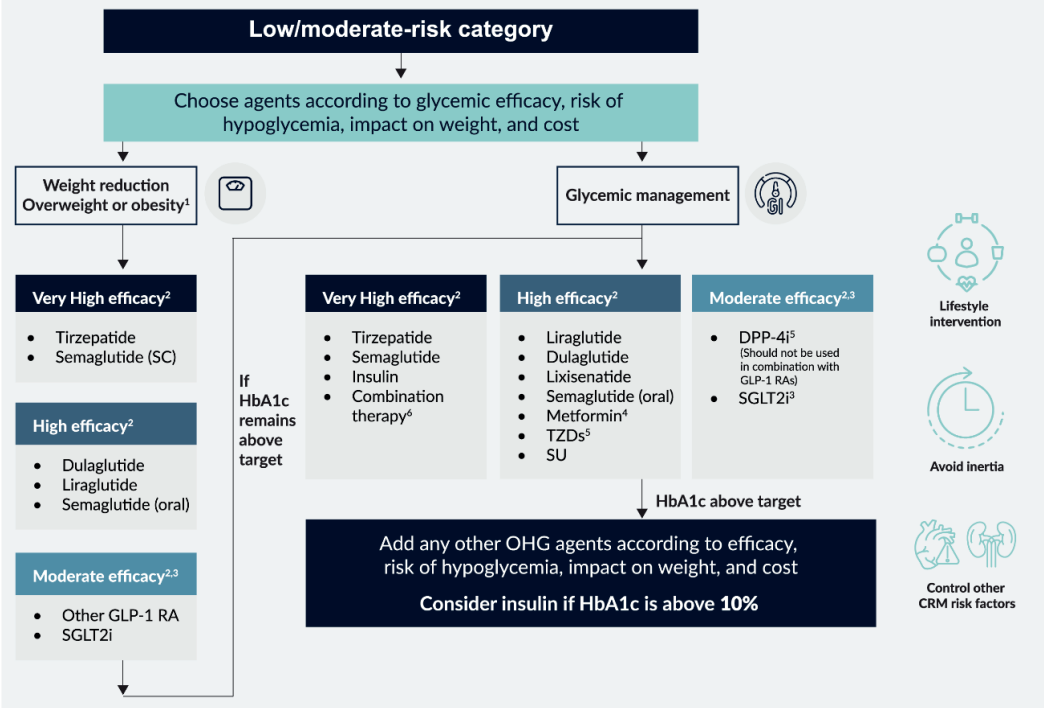
GLP-1 RA: Glucagon-like peptide-1 receptor agonist; GIP: Glucose-dependent insulinotropic polypeptide; HbA1c: Glycated hemoglobin; SGLT2i: Sodium–glucose Cotransporter-2 inhibitor; CRM: Cardio-renal-metabolic; OHG agents: Oral hypoglycemic agents; CVD: Cardiovascular disease; CKD: Chronic kidney disease; MASLD: Metabolic dysfunction-associated steatotic liver disease; ASCVD: Atherosclerotic cardiovascular disease
[1]Pioglitazone is preferred in patients with MASLD. Avoid pioglitazone, saxagliptin, and alogliptin in congestive heart failure.

Figure 8: Treatment algorithm for individuals with T2D and established disease/very high CRM risk.



GLP-1 RA: Glucagon-like peptide-1 receptor agonists; GIP: Glucose-dependent insulinotropic polypeptide; HbA1c: Glycated hemoglobin; SGLT2i: Sodium–glucose Cotransporter-2 inhibitor; CRM: Cardio-renal-metabolic; OHG agents: Oral hypoglycemic agents; DPP-4i: Dipeptidyl peptidase-4 inhibitor; TZDs: Thiazolidinediones; SU: Sulfonylurea; MASLD: Metabolic dysfunction-associated steatotic liver disease
[1]Metformin, DPP-4is, TZDs, or SU can be considered based on the factors listed. DPP-4is should not be used in combination with GLP-1 RAs. Pioglitazone is preferred in patients with MASLD. Avoid pioglitazone, saxagliptin, and alogliptin in congestive heart failure.

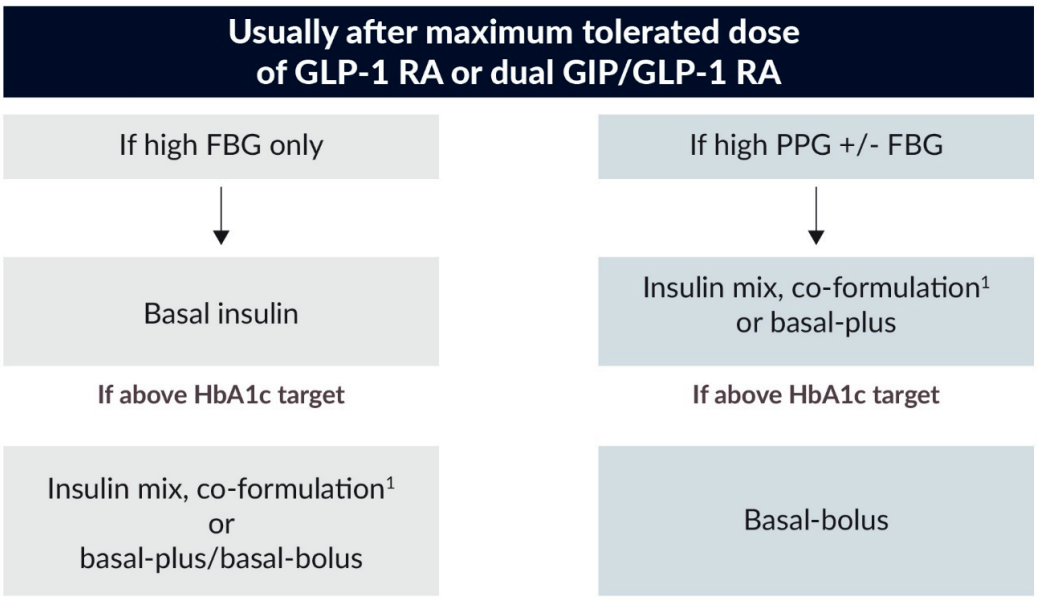
Figure 9: Treatment algorithm for individuals with T2D and high CRM risk.



DPP-4i: Dipeptidyl peptidase-4 inhibitor; GLP-1 RA: Glucagon-like peptide-1 receptor agonist; HbA1c: Glycated hemoglobin; SGLT2i: Sodium–glucose Cotransporter-2 inhibitor; SU: Sulfonylurea; TZDs: Thiazolidinediones; OHG agents: Oral hypoglycemic agents; MASLD: Metabolic dysfunction-associated steatotic liver disease; CRM: Cardio-renal-metabolic; SC: Subcutaneous

[1]Based on ethnicity-specific thresholds
[2]GLP-1 RA can be used in patients with eGFR >30 mL/min/1.73 m²; dulaglutide can be used up to eGFR >15mL/min/ 1.73 m². Avoid semaglutide in patients with retinopathy.
[3]SGLT2i is the preferred option in people with heart failure or impaired renal function. SGLT2i can be used in eGFR >45 mL/min/1.73 m². Avoid using SGLT2i in patients with aortic stenosis and eGFR <45ml/min/1.73 m².
[4]Metformin (where eGFR >30 mL/min/1.73 m²) and pioglitazone are safe in CKD, and can be used interchangeably.
[5]Pioglitazone is preferred in patients with MASLD. Avoid pioglitazone, saxagliptin and alogliptin in congestive heart failure.
[6]Combination therapy includes both oral-oral and oral-injectable regimens.

Figure 10: Treatment algorithm for individuals with T2D and low/moderate CRM risk.



GLP-1 RA: Glucagon-like peptide receptor agonist-1; GIP: Glucose-dependent insulinotropic polypeptide; FBG: Fasting blood glucose; PPG: Postprandial glucose; HbA1c: Glycated hemoglobin
[1]Co-formulation: Insulin plus GLP-1 RA

Figure 11: Insulin initiation or intensification in individuals with T2D.

Drug class[1]	Glucose-lowering efficacy	Effect on				
	Hypoglycemia risk	Weight	MACE	HF	CKD progression	MASH
Metformin (oral)	+++ / No risk	Potential modest loss?	Potential benefit?	Neutral	Neutral	Neutral
SGLT2i (oral)	++ to +++ / No risk	Intermediate loss	Canagliflozin Empagliflozin	Canagliflozin Empagliflozin Dapagliflozin Ertugliflozin	Canagliflozin Empagliflozin Dapagliflozin	Unknown
GLP-1 RA (oral and SC)	+++ to ++++ / No risk	Intermediate to very high loss	Dulaglutide Liraglutide Semaglutide (SC) / Exenatide (qw)	Semaglutide (2.4 mg/week) in obesity-related HFpEF and T2D	Albumin-driven endpoints: Dulaglutide Liraglutide Semaglutide (SC) CKD progression: Semaglutide (SC)	Semaglutide (2.4 mg/week) in MASH with moderate-to-advanced fibrosis
Dual GIP/GLP-1 RA (SC)	++++ / No risk	Very high loss	Based on the SURPASS-CVOT trial	Tirzepatide (15 mg/week) in HFpEF and obesity	Being studied	Potential benefit?
DPP-4i (oral)	++ / No risk	Neutral	Neutral	Neutral / Potential risk? Saxagliptin	Neutral	Unknown
TZD (oral)	+++ / No risk	Gain	Potential benefit?	Increased risk	Neutral	Potential benefit?
SU (2nd gen) (oral)	+++ / Moderate to severe risk	Gain	Neutral	Neutral	Neutral	Unknown
Insulin and its analogs	+++ to ++++ / Moderate to severe risk	Gain	Neutral	Neutral	Neutral	Unknown

Benefit
Potential benefit
Adverse effects
Potential adverse effects
Under investigation/unknown
Neutral effect

Glucose-lowering efficacy
\+ Low
++ Intermediate
+++ High
++++ Very high

Adapted from the American Diabetes Association (ADA) Standards of Care in Diabetes—2025 (ElSayed NA, McCoy RG, Aleppo G, et al. 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes—2025. Diabetes Care. 2025;48(Supplement_1):S181-S206. doi:10.2337/dc25-S009) with modifications to reflect local clinical practice standards.
SGLT2i: Sodium-glucose Cotransporter-2 inhibitor; GLP-1 RA: Glucagon-like peptide-1 receptor agonist; GIP: Glucose-dependent insulinotropic polypeptide; DPP-4i: Dipeptidyl peptidase-4 inhibitors; TZD: Thiazolidinedione; SU: Sulfonylurea; SC: Subcutaneous; MACE: Major adverse cardiovascular events; HF: Heart failure; CKD: Chronic kidney disease; MASH: Metabolic dysfunction-associated steatohepatitis; HFpEF: Heart failure with preserved ejection fraction

[1]Please refer to the respective drug labels for detailed information on dosing, contraindications, and side effects.

Figure 12: Overview of the routes of administration and efficacies of different classes of antihyperglycemic therapies.

5.7. Integrating Technology into T2D Management

Recommendations: Diabetes technology should be individualized, evidence-based, and integrated within a system of education and expert oversight. The focus must remain on meaningful clinical outcomes rather than embracing the newest tools (see Table **20**) [17, 48, 78–80].

Table 20: General principles for glucose monitoring and device use.

Blood glucose monitoring 
• BGM use must be structured and actionable • Patients and clinicians should be trained to interpret and respond to BGM data • BGM accuracy may vary between meters; only regulatory-approved devices with verified accuracy should be used
Continuous glucose monitoring 
• Device choice should be based on patient needs, preferences, and ability to use the technology • Structured education and periodic evaluation of data use are essential • Professional judgment must over-ride automated recommendations in complex or unclear scenarios
Insulin pumps and automated insulin delivery systems 
• **Criteria for prescribing insulin pumps and AID systems:** ◦ Insulin-requiring T2D with evidence of clinical insulin deficiency and poor control on conventional therapy ◦ Frequent hypoglycemia despite optimized MDI therapy ◦ High glycemic variability or significant fear of hypoglycemia ◦ Patients with erratic schedules or complex dosing needs • **Training and support requirements:** ◦ Comprehensive patient training covering device operation, troubleshooting, infusion set/CGM site management, and data interpretation ◦ Structured onboarding with return demonstration of skills ◦ Ongoing access to a multidisciplinary diabetes care team (educators, nurses, endocrinologists, pharmacists) ◦ Access to follow-up support (in-person or remote) for dose adjustments and system troubleshooting • **Prescribing center prerequisites:** ◦ Demonstrated experience and infrastructure to support diabetes technology (minimum number of trained staff and devices managed annually) ◦ Availability of certified diabetes educators and endocrinologists with up-to-date training in pump and AID systems ◦ Capacity for data analysis and structured follow-up visits ◦ Access to emergency protocols for technical failures (e.g., pump malfunction, infusion site issues) ◦ Ongoing patient tracking to evaluate outcomes and safety
General recommendations regarding diabetes technology 
• Prioritize technology that has proven clinical benefit, safety, and user-centered design • Avoid promoting commercially driven solutions without medical oversight • Ensure human oversight in decision-making is supported by technology • Balance cost containment with investment in proven, complication-preventing interventions

BGM: Blood glucose monitoring; T2D: Type 2 diabetes; MDI: Multiple daily injections; CGM: Continuous glucose monitoring; AID: Automated insulin delivery

Diabetes technology includes devices, software, and digital platforms that assist individuals in diabetes self-management by: 1) enabling glycemic assessment through BGM or CGM; 2) facilitating insulin delivery using syringes, pens, patches, or pumps; and 3) providing educational resources [78].

5.7.1. Blood glucose monitoring and continuous glucose monitoring

The glucose monitoring devices must be FDA/ISO-approved, and patients must be trained on their correct use and troubleshooting procedures [78]. Detailed guidance on BGM and CGM has been provided in the *Management of Hyperglycemia: Monitoring and Education section.*

5.7.2. Insulin delivery technologies

5.7.2.1. Syringes and pens

Traditional methods remain relevant, with insulin pens generally preferred due to convenience and dosing accuracy. Connected insulin pens can support better adherence, but they are not widely accessible or uniformly regulated [165, 166].

5.7.2.2. Insulin pumps and automated insulin delivery systems

Automated insulin delivery (AID) systems allow real-time modulation of insulin delivery and have shown significant benefits in individuals with T1D. Evidence for their use in T2D is also gradually emerging [78].

5.7.3. Digital tools and apps

While numerous diabetes management apps exist, most lack regulatory oversight and clinical validation. Such apps should not be recommended unless they are medically reviewed and approved by regulatory authorities. Human expert oversight remains essential to guide clinical decision-making.

6. Discussion

Obesity and T2D are growing concerns in the UAE, highlighting the need for primary prevention strategies targeting individuals at-risk. Promoting healthy diets and increased physical activity levels, as well as screening for risk factors, through sustainable healthcare programs can be facilitated by academia-government partnerships. While developing these programs, it is crucial to acknowledge cost and feasibility constraints and utilize technology for effective patient engagement, information dissemination, and data analysis [167].

A combination of mandates, economic incentives, marketing regulations, and restrictions on unhealthy food availability through government-initiated public health policies can help improve dietary habits at the population level [168]. Initiatives, such as MOHAP's nationwide diabetes screening campaign, launched in October 2023, aim to support the national goal of reducing T2D prevalence while enhancing public

awareness [169]. Additional programs, including a mobile application designed by MOHAP, have already been implemented to educate the public on T2D prevention [170]. The EDES also organizes programs that raise public awareness about diabetes through educational campaigns and materials like videos and leaflets, provides HCPs with evidence-based scientific content, and offers a platform for professional development and networking by organizing scientific meetings [171].

7. Conclusion

Sustained implementation of efforts by government bodies and professional societies is crucial. Enhancing public health strategies and ensuring insurers and healthcare payers accept these recommendations can strengthen diabetes prevention efforts at the population level in the UAE. In conjunction with these primary prevention initiatives, the T2D management recommendations outlined in this consensus can provide a comprehensive framework for reducing the T2D burden and enhancing long-term health outcomes in the UAE.

Acknowledgments

Dr. Preeti Nerurkar from Medcytes, Dubai, provided medical writing and editorial support for the manuscript. The authors would like to acknowledge the leadership role of the Emirates Diabetes Society in convening the expert group.

Disclosure Statement

The author(s) declare that there is no conflict of interest.

Funding

Eli Lilly Dubai provided an unrestricted grant for the medical writing and publication charges. All authors volunteered, and no direct compensation was applicable to any of them for their contribution to this work. Eli Lilly did not participate in any of the meetings or the drafting of the manuscript.

Author Contributions

All authors contributed to the manuscript by drafting and developing their assigned sections, and reviewing the entire manuscript for its intellectual content and accuracy. All the authors reviewed and approved the final version of the manuscript. The corresponding author takes primary responsibility for communication with the journal during submission, peer review, and publication.

Ethical Approval

This work represents the development of clinical guidelines based on published evidence and expert consensus and did not involve the conduct of new studies in human participants or animals. Ethical approval was therefore not required.

Informed Consent Statement

This guideline document did not involve the conduct of any studies with human participants. Informed consent was not applicable.

Artificial Intelligence (AI) Disclosure Statement

AI-Unassisted work.

Data Sharing Statement

All data sets are included in the published article.

References

[1] UAE Ministry of Health and Prevention. UAE National Health Survey Report 2017–2018 [Internet]. 2019 [cited 2025 Apr 22]. Available from: https://cdn.who.int/media/docs/default-source/ncds/ncd-surveillance/data-reporting/united-arab-emirates/uae-national-health-survey-report-2017-2018.pdf?sfvrsn=86b8b1d9_1

[2] Al Awadi F, Hassanein M, Hussain HY, Mohammed H, Ibrahim G, Khater A, et al. Prevalence of diabetes and associated health risk factors among adults in Dubai, United Arab Emirates: Results from Dubai Household Survey 2019. Dubai Diabetes Endocrinol J. 2020;26(4):164–173.

[3] Alawadi F, Hassanein M, Suliman E, Hussain HY, Mamdouh H, Ibrahim G, et al. The prevalence of diabetes and pre-diabetes among the Dubai population: Findings from Dubai Household Health Surveys, 2014 and 2017. Dubai Diabetes Endocrinol J. 2020;26(2):78–84.

[4] Hamoudi R, Saheb Sharif-Askari N, Saheb Sharif-Askari F, Abusnana S, Aljaibeji H, Taneera J, et al. Prediabetes and diabetes prevalence and risk factors comparison between ethnic groups in the United Arab Emirates. Sci Rep. 2019 Nov;9(1):17437.

[5] Hassanein MM, Alawadi FF, Mamdouh H, Hussain HY, Khater A, Ibrahim G, et al. Prevalence of prediabetes among adult population of Dubai, the United Arab Emirates: Findings from Dubai Household Survey, 2019. Dubai Diabetes Endocrinol J. 2024 Sep;30(1–2):3–18.

[6] Alberti KG, Zimmet P, Shaw J. Metabolic syndrome—a new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabet Med. 2006 May;23(5):469–480.

[7] Lorenzo C, Williams K, Hunt KJ, Haffner SM. The National Cholesterol Education Program - Adult Treatment Panel III, International Diabetes Federation, and World Health Organization definitions of the metabolic syndrome as predictors of incident cardiovascular disease and diabetes. Diabetes Care. 2007 Jan;30(1):8–13.

[8] Bianchi C, Miccoli R, Bonadonna RC, Giorgino F, Frontoni S, Faloia E, et al.; GENFIEV Investigators. Metabolic syndrome in subjects at high risk for type 2 diabetes: the genetic, physiopathology and evolution of type 2 diabetes (GENFIEV) study. Nutr Metab Cardiovasc Dis. 2011 Sep;21(9):699–705.

[9] Grundy SM. Pre-diabetes, metabolic syndrome, and cardiovascular risk. J Am Coll Cardiol. 2012 Feb;59(7):635–643.

[10] Samson SL, Vellanki P, Blonde L, Christofides EA, Galindo RJ, Hirsch IB, et al. American Association of Clinical Endocrinology Consensus Statement: Comprehensive Type 2 Diabetes Management Algorithm - 2023 Update. Endocr Pract. 2023 May;29(5):305–340.

[11] Noubiap JJ, Nansseu JR, Lontchi-Yimagou E, Nkeck JR, Nyaga UF, Ngouo AT, et al. Geographic distribution of metabolic syndrome and its components in the general adult population: A meta-analysis of global data from 28 million individuals. Diabetes Res Clin Pract. 2022 Jun;188:109924.

[12] Noubiap JJ, Nansseu JR, Lontchi-Yimagou E, Nkeck JR, Nyaga UF, Ngouo AT, et al. Global, regional, and country estimates of metabolic syndrome burden in children and adolescents in 2020: a systematic review and modelling analysis. Lancet Child Adolesc Health. 2022 Mar;6(3):158–170.

[13] Abdelgadir E, Rashid F, Bashier A, Zidan M, McGowan B, Alawadi F. Prevalence of overweight and obesity in adults from the Middle East: A large-scale population-based study. Diabetes Obes Metab. 2025 Jul;27(7):3676–3685.

[14] Klein S, Gastaldelli A, Yki-Järvinen H, Scherer PE. Why does obesity cause diabetes? Cell Metab. 2022 Jan;34(1):11–20.

[15] Alawadi F, Abusnana S, Afandi B, Aldahmani KM, Alhajeri O, Aljaberi K, et al. Emirates Diabetes Society Consensus Guidelines for the Management of Type 2 Diabetes Mellitus – 2020. Dubai Diabetes Endocrinol J. 2020;26(1):1–20.

[16] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 2. Diagnosis and Classification of Diabetes: Standards of Care in Diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S27–S49.

[17] Diabetes Canada. Diabetes Canada: Clinical Practice Guidelines. 2018. [cited 2025 May 6]. Available from: https://guidelines.diabetes.ca/cpg

[18] Centers for Disease Control and Prevention. Diabetes Risk Factors [Internet]. 2024 [cited 2025 Jun 17]. Available from: https://www.cdc.gov/diabetes/risk-factors/index.html

[19] Garonzi C, Maguolo A, Maffeis C. Pros and cons of current diagnostic tools for risk-based screening of prediabetes and Type 2 diabetes in children and adolescents with overweight or obesity. Horm Res Paediatr. 2023;96(4):356–365.

[20] Hassanein M, Sabbour H, Al Awadi F, Abusnana S, Afandi B, Al Kaabi J, et al. Cardiometabolic guidelines: Cardiovascular risk assessment and management in patients with dysglycemia. Dubai Diabetes Endocrinol J. 2023;29(2):67–88.

[21] Ndumele CE, Neeland IJ, Tuttle KR, Chow SL, Mathew RO, Khan SS, et al.; American Heart Association. A synopsis of the evidence for the science and clinical management of cardiovascular-kidney-metabolic (CKM) syndrome: A scientific statement from the American Heart Association. Circulation. 2023 Nov;148(20):1636–1664.

[22] Leith D, Lin YY, Brennan P. Metabolic dysfunction-associated steatotic liver disease and type 2 diabetes: A deadly synergy. TouchREV Endocrinol. 2024 Oct;20(2):5–9.

[23] Cusi K, Abdelmalek MF, Apovian CM, Balapattabi K, Bannuru RR, Barb D, et al. Metabolic dysfunction-associated steatotic liver disease (MASLD) in people with diabetes: The need for screening and early intervention. A Consensus Report of the American Diabetes Association. Diabetes Care. 2025 Jul;48(7):1057–1082.

[24] ElSayed NA, McCoy RG, Aleppo G, Bajaj M, Balapattabi K, Beverly EA, et al.; American Diabetes Association Professional Practice Committee. 4. Comprehensive medical evaluation and assessment of comorbidities: standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S59–85.

[25] Yanai H, Adachi H, Hakoshima M, Iida S, Katsuyama H. Metabolic-dysfunction-associated steatotic liver disease-its pathophysiology, association with atherosclerosis and cardiovascular disease, and treatments. Int J Mol Sci. 2023 Oct;24(20):15473.

[26] Blanco-Grau A, Gabriel-Medina P, Rodriguez-Algarra F, Villena Y, Lopez-Martínez R, Augustín S, et al. Assessing liver fibrosis using the FIB4 Index in the community setting. Diagnostics (Basel). 2021 Nov;11(12):2236.

[27] Tacke F, Horn P, Wai-Sun Wong V, Ratziu V, Bugianesi E, Francque S, et al.; European Association for the Study of the Liver (EASL); European Association for the Study of Diabetes (EASD); European Association for the Study of Obesity (EASO). EASL-EASD-EASO Clinical Practice Guidelines on the Management of metabolic dysfunction-associated steatotic liver disease (MASLD). J Hepatol. 2024 Sep;81(3):492–542.

[28] Health Technology Wales (HTW). ELF test (Enhanced Liver Fibrosis) [Internet]. [cited 2025 Jul 22]. Available from: https://healthtechnology.wales/about

[29] National Institute for Health and Care Excellence (NICE). Cirrhosis in over 16s: assessment and management [Internet]. [cited 2025 Jul 22]. Available from: https://www.nice.org.uk/guidance/ng50/chapter/Recommendations

[30] International Diabetes Federation (IDF). Managing older people with type 2 diabetes: global guideline [Internet]. 2013 [cited 2025 Jun 24]. Available from: https://idf.org/media/uploads/2023/05/attachments-48.pdf

[31] The Centers for Disease Control (CDC). Vaccines and immunization: Recommended adult immunization schedule (2025) [Internet]. 2025 [cited 2025 Jun 21]. Available from: https://www.cdc.gov/vaccines/hcp/imz-schedules/downloads/adult/adult-combined-schedule.pdf

[32] American Diabetes Association (ADA). Protect people with diabetes with the recommended vaccines [Internet]. 2025 [cited 2025 Aug 19]. Available from: https://professional.diabetes.org/sites/dpro/files/2025-03/sri-protectpeoplewithdiabetes-pro-3-11-25.pdf

[33] Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006 May;166(10):1092–1097.

[34] Polonsky WH, Fisher L, Earles J, Dudl RJ, Lees J, Mullan J, et al. Assessing psychosocial distress in diabetes: development of the diabetes distress scale. Diabetes Care. 2005 Mar;28(3):626–631.

[35] Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001 Sep;16(9):606–613.

[36] Selvarajah D, Cash T, Davies J, Sankar A, Rao G, Grieg M, et al. SUDOSCAN: A simple, rapid, and objective method with potential for screening for diabetic peripheral neuropathy. PLoS One. 2015 Oct;10(10):e0138224.

[37] Holt RI, Cockram CS, Ma RC, Luk AO. Diabetes and infection: review of the epidemiology, mechanisms and principles of treatment. Diabetologia. 2024 Jul;67(7):1168–1180.

[38] Liu X, Wang X. The prognosis of patients with co-morbid diabetes and hepatitis B and strategies for improving outcome. Am J Med Sci. 2025 May;369(5):638–641.

[39] Mojaddidi MA, Aboonq M, Alqahtani SA. Glycemic control and vaccine response: the role of mucosal immunity after vaccination in diabetic patients. Front Immunol. 2025 May;16:1577523.

[40] Kreider KE. Diabetes distress or major depressive disorder? A practical approach to diagnosing and treating psychological comorbidities of diabetes. Diabetes Ther. 2017 Feb;8(1):1–7.

[41] Zu W, Zhang S, Du L, Huang X, Nie W, Wang L. The effectiveness of psychological interventions on diabetes distress and glycemic level in adults with type 2 diabetes: a systematic review and meta-analysis. BMC Psychiatry. 2024 Oct;24(1):660.

[42] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 5. Facilitating positive health behaviors and well-being to improve health outcomes: Standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S86–S127.

[43] Breznoscakova D, Pallayova M. Bipolar disorder and type 2 diabetes mellitus: A bidirectional relationship. Eur J Psychiatry. 2022 Jul;36(3):152–162.

[44] Beverly EA, Gonzalez JS. The interconnected complexity of diabetes and depression. Diabetes Spectr. 2025 Feb;38(1):23–31.

[45] Mizuki Y, Sakamoto S, Okahisa Y, Yada Y, Hashimoto N, Takaki M, et al. Mechanisms underlying the comorbidity of schizophrenia and type 2 diabetes mellitus. Int J Neuropsychopharmacol. 2021 May;24(5):367–382.

[46] Sonmez A, Sabbour H, Echtay A, Rahmah AM, Alhozali AM, Al Sabaan FS, et al. Current gaps in management and timely referral of cardiorenal complications among people with type 2 diabetes mellitus in the Middle East and African countries: expert recommendations. J Diabetes. 2022 May;14(5):315–333.

[47] Patel MP, Schettini P, O'Leary CP, Bosworth HB, Anderson JB, Shah KP. Closing the referral loop: an analysis of primary care referrals to specialists in a large health system. J Gen Intern Med. 2018 May;33(5):715–721.

[48] Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, et al. Management of hyperglycemia in type 2 diabetes, 2022. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care. 2022 Nov;45(11):2753–2786.

[49] International Diabetes Federation (IDF). IDF clinical practice recommendations for managing type 2 diabetes in primary care [Internet]. 2017 [cited 2025 Jun 8]. Available from: https://idf.org/media/uploads/2023/05/attachments-63.pdf

[50] Galaviz KI, Weber MB, Suvada K, Gujral UP, Wei J, Merchant R, et al. Interventions for reversing prediabetes: A systematic review and meta-analysis. Am J Prev Med. 2022 Apr;62(4):614–625.

[51] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 3. Prevention or delay of diabetes and associated comorbidities: Standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S50–S58.

[52] Minari TP, Manzano CF, Tácito LH, Yugar LB, Sedenho-Prado LG, Rubio TA, et al. The impact of a nutritional intervention on glycemic control and cardiovascular risk markers in type 2 diabetes. Nutrients. 2024 May;16(9):1378.

[53] Campbell TM, Campbell EK, Attia J, Ventura K, Mathews T, Chhabra KH, et al. The acute effects of a DASH diet and whole food, plant-based diet on insulin requirements and related

cardiometabolic markers in individuals with insulin-treated type 2 diabetes. Diabetes Res Clin Pract. 2023 Aug;202:110814.

[54] Campbell AP. DASH eating plan: An eating pattern for diabetes management. Diabetes Spectr. 2017 May;30(2):76–81.

[55] Li G, Zhang P, Wang J, An Y, Gong Q, Gregg EW, et al. Cardiovascular mortality, all-cause mortality, and diabetes incidence after lifestyle intervention for people with impaired glucose tolerance in the Da Qing Diabetes Prevention Study: a 23-year follow-up study. Lancet Diabetes Endocrinol. 2014 Jun;2(6):474–480.

[56] Qian X, Wang J, Gong Q, An Y, Feng X, He S, et al. Non-diabetes status after diagnosis of impaired glucose tolerance and risk of long-term death and vascular complications: A post hoc analysis of the Da Qing Diabetes Prevention Outcome Study. PLoS Med. 2024 Jul;21(7):e1004419.

[57] Saito T, Watanabe M, Nishida J, Izumi T, Omura M, Takagi T, et al.; Zensharen Study for Prevention of Lifestyle Diseases Group. Lifestyle modification and prevention of type 2 diabetes in overweight Japanese with impaired fasting glucose levels: a randomized controlled trial. Arch Intern Med. 2011 Aug;171(15):1352–1360.

[58] Smith AD, Crippa A, Woodcock J, Brage S. Physical activity and incident type 2 diabetes mellitus: a systematic review and dose-response meta-analysis of prospective cohort studies. Diabetologia. 2016 Dec;59(12):2527–2545.

[59] IDF. 2025. [cited 2025 May 8]. IDF global clinical practice recommendations for managing type 2 diabetes. Available from: https://idf.org/media/uploads/2025/05/IDF_Rec_2025.pdf

[60] Esposito K, Maiorino MI, Ciotola M, Di Palo C, Scognamiglio P, Gicchino M, et al. Effects of a Mediterranean-style diet on the need for antihyperglycemic drug therapy in patients with newly diagnosed type 2 diabetes: a randomized trial. Ann Intern Med. 2009 Sep;151(5):306–314.

[61] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 8. Obesity and weight management for the prevention and treatment of type 2 diabetes: standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S167–S180.

[62] Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, Brenneman AT, et al.; Diabetes Prevention Program Research Group. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. Lancet. 2009 Nov;374(9702):1677–1686.

[63] Diabetes Prevention Program Research Group. HbA1c as a predictor of diabetes and as an outcome in the diabetes prevention program: a randomized clinical trial. Diabetes Care. 2015 Jan;38(1):51–58.

[64] Diabetes Prevention Program Research Group. The 10-year cost-effectiveness of lifestyle intervention or metformin for diabetes prevention: an intent-to-treat analysis of the DPP/DPPOS. Diabetes Care. 2012 Apr;35(4):723–730.

[65] Diabetes Prevention Program Research Group. Long-term effects of lifestyle intervention or metformin on diabetes development and microvascular complications over 15-year follow-up: the Diabetes Prevention Program Outcomes Study. Lancet Diabetes Endocrinol. 2015 Nov;3(11):866–875.

[66] The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Diabetes Prevention Program (DPP) [Internet]. 2021 [cited 2025 May 16]. Available from: https://www.niddk.nih.gov/about-niddk/research-areas/diabetes/diabetes-prevention-program-dpp

[67] Zhang L, Zhang Y, Shen S, Wang X, Dong L, Li Q, et al.; China Diabetes Prevention Program Study Group. Safety and effectiveness of metformin plus lifestyle intervention compared with lifestyle intervention alone in preventing progression to diabetes in a Chinese population with impaired glucose regulation: a multicenter, open-label, randomised controlled trial. Lancet Diabetes Endocrinol. 2023 Aug;11(8):567–577.

[68] Amer BE, Abdelgalil MS, Hamad AA, Abdelsayed K, Elaraby A, Abozaid AM, et al. Metformin plus lifestyle interventions versus lifestyle interventions alone for the delay or prevention of type 2 diabetes in individuals with prediabetes: a meta-analysis of randomized controlled trials. Diabetol Metab Syndr. 2024 Nov;16(1):273.

[69] Kernan WN, Viscoli CM, Furie KL, Young LH, Inzucchi SE, Gorman M, et al.; IRIS Trial Investigators. Pioglitazone after ischemic stroke or transient ischemic attack. N Engl J Med. 2016 Apr;374(14):1321–1331.

[70] Jastreboff AM, Aronne LJ, Ahmad NN, Wharton S, Connery L, Alves B, et al.; SURMOUNT-1 Investigators. Tirzepatide once weekly for the treatment of obesity. N Engl J Med. 2022 Jul;387(3):205–216.

[71] Mori Y, Duru OK, Tuttle KR, Fukuma S, Taura D, Harada N, et al. Sodium-glucose cotransporter 2 inhibitors and new-onset type 2 diabetes in adults with prediabetes: systematic review and meta-analysis of randomized controlled trials. J Clin Endocrinol Metab. 2022 Dec;108(1):221–231.

[72] Biswas K, Reddy VB, Seshadri K, Kapoor N, Dharmalingam M, Anthuvan T. Position of SGLT2i in prediabetes: a systematic review of literature. J Diabetol. 2025 Apr;16(2):102–114.

[73] Henney AE, Riley DR, Heague M, Hydes TJ, Anson M, Alam U, et al. Sodium-glucose cotransporter 2 inhibitors reduce the risk of incident type 2 diabetes in people with heart failure without diabetes: an analysis of real-world, cohort data. Diabetes Obes Metab. 2024 Oct;26(10):4665–4673.

[74] Adrita S, Bacsa J. A systematic review of sodium-glucose cotransporter-2 (SGLT2) inhibitors in the management of heart failure: A comprehensive analysis of cardiovascular outcomes, hospitalizations, and quality of life. Cureus. 2025 Jun;17(6):e86784.

[75] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 6. Glycemic goals and hypoglycemia: standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S128–S145.

[76] Sakane N. Innovations and applications of ketone body monitoring in diabetes care. Diabetol Int. 2024 May;15(3):370–378.

[77] Czupryniak L, Barkai L, Bolgarska S, Bronisz A, Broz J, Cypryk K, et al. Self-monitoring of blood glucose in diabetes: from evidence to clinical reality in Central and Eastern Europe—recommendations from the international Central-Eastern European expert group. Diabetes Technol Ther. 2014 Jul;16(7):460–475.

[78] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 7. Diabetes technology: standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S146–S166.

[79] ElSayed NA, Aleppo G, Bannuru RR, Bruemmer D, Collins BS, Ekhlaspour L, et al.; American Diabetes Association Professional Practice Committee. 7. Diabetes technology: standards of care in diabetes-2024. Diabetes Care. 2024 Jan;47 Suppl 1:S126–S144.

[80] NICE guideline Reference number:NG28. Type 2 diabetes in adults: management [Internet]. 2022 [cited 2025 May 11]. Available from: https://www.nice.org.uk/guidance/ng28

[81] Arnold WD, Kupfer K, Little RR, Amar M, Horowitz B, Godbole N, et al. Accuracy and precision of a point-of-care HbA1c test. J Diabetes Sci Technol. 2020 Sep;14(5):883–889.

[82] Sacks DB, Kirkman MS, Little RR. Point-of-care HbA1c in clinical practice: caveats and considerations for optimal use. Diabetes Care. 2024 Jul;47(7):1104–1110.

[83] Ferreira RO, Trevisan T, Pasqualotto E, Chavez MP, Marques BF, Lamounier RN, et al. Continuous glucose monitoring systems in noninsulin-treated people with type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. Diabetes Technol Ther. 2024 Apr;26(4):252–262.

[84] Crabtree TS, Choudhary P, Kar P, Wilmot EG. Flash glucose monitoring: the story so far and the journey ahead. BMJ Innov. 2023 Jan;9(1):27–31.

[85] Garg SK, Akturk HK. Flash glucose monitoring: the future is here. Diabetes Technol Ther. 2017 May;19 S2:S1–S3.

[86] Diez Alvarez S, Fellas A, Santos D, Sculley D, Wynne K, Acharya S, et al. The clinical impact of flash glucose monitoring-a digital health app and smartwatch technology in patients with type 2 diabetes: scoping review. JMIR Diabetes. 2023 Mar;8:e42389.

[87] National Institute for Health and Care Excellence (NICE). Type 2 diabetes in adults: quality statement 2 - Structured education programme [Internet]. 2023 [cited 2025 Jun 12]. Available from: https://www.nice.org.uk/guidance/qs209/chapter/Quality-statement-2-Structured-education-programme

[88] Gad H, Al-Muhannadi H, Purra H, Mussleman P, Malik RA. The effect of Ramadan focused education on patients with type 2 diabetes: A systematic review and meta-analysis. Diabetes Res Clin Pract. 2020 Apr;162:108122.

[89] Worswick J, Wayne SC, Bennett R, Fiander M, Mayhew A, Weir MC, et al. Improving quality of care for persons with diabetes: an overview of systematic reviews - what does the evidence tell us? Syst Rev. 2013 May;2(1):26.

[90] Gentile S, Guarino G, Della Corte T, Marino G, Satta E, Pasquarella M, et al.; AMD-OSDI Study Group on Injection Technique, Nefrocenter Research and Nyx Start-Up. Role of structured education in reducing lypodistrophy and its metabolic complications in insulin-treated people with type 2 diabetes: a randomized multicenter case-control study. Diabetes Ther. 2021 May;12(5):1379–1398.

[91] Tian T, Aaron RE, Huang J, Yeung AM, Svensson J, Gentile S, et al. Lipohypertrophy and insulin: an update from the diabetes technology society. J Diabetes Sci Technol. 2023 Nov;17(6):1711–1721.

[92] ElSayed NA, McCoy RG, Aleppo G, Bajaj M, Balapattabi K, Beverly EA, et al.; American Diabetes Association Professional Practice Committee. 9. Pharmacologic approaches to glycemic treatment: standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S181–S206.

[93] Mader JK, Fornengo R, Hassoun A, Heinemann L, Kulzer B, Monica M, et al. Risk factors for lipohypertrophy in people with insulin-treated diabetes: a systematic meta-analysis. J Diabetes Sci Technol. 2025 Mar;19322968251325569.

[94] Deng N, Zhang X, Zhao F, Wang Y, He H. Prevalence of lipohypertrophy in insulin-treated diabetes patients: A systematic review and meta-analysis. J Diabetes Investig. 2017 Sep;9(3):536–543.

[95] Singha A, Bhattarcharjee R, Ghosh S, Chakrabarti SK, Baidya A, Chowdhury S. Concurrence of lipoatrophy and lipohypertrophy in children with type 1 diabetes using recombinant human insulin: two case reports. Clin Diabetes. 2016 Jan;34(1):51–53.

[96] Turk Wensveen T, Fučkar Čupić D, Jurišić Eržen D, Polić B, Wensveen FM. Severe lipoatrophy in a patient with type 2 diabetes in response to human insulin analogs glargine and degludec: possible involvement of CD4 T cell-mediated tissue remodeling. Diabetes Care. 2020 Feb;43(2):494–496.

[97] Thewjitcharoen Y, Prasartkaew H, Tongsumrit P, Wongjom S, Boonchoo C, Butadej S, et al. Prevalence, risk factors, and clinical characteristics of lipodystrophy in insulin-treated patients with diabetes: an old problem in a new era of modern insulin. Diabetes Metab Syndr Obes. 2020 Nov;13:4609–4620.

[98] Chung F, Abdullah HR, Liao P. STOP-Bang Questionnaire: a practical approach to screen for obstructive sleep apnea. Chest. 2016 Mar;149(3):631–638.

[99] Slowik J, Sankari A, Collen J. Obstructive sleep apnea [Internet]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [cited 2025 Jun 11]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459252/

[100] Lu H, Yang Q, Tian F, Lyu Y, He H, Xin X, et al. A meta-analysis of a cohort study on the association between sleep duration and type 2 diabetes mellitus. J Diabetes Res. 2021 Mar;2021:8861038.

[101] Liu H, Zhu H, Lu Q, Ye W, Huang T, Li Y, et al. Sleep features and the risk of type 2 diabetes mellitus: a systematic review and meta-analysis. Ann Med. 2025 Dec;57(1):2447422.

[102] Taimah M, Ahmad A, Al-Houqani M, Al Junaibi A, Idaghdour Y, Abdulle A, et al. Association between obstructive sleep apnea risk and type 2 diabetes among Emirati adults: results from the UAE healthy future study. Front Endocrinol (Lausanne). 2024 Jul;15:1395886.

[103] Sokoty L, Eshaghi M, Farezi M, Mirshafiyi P, Darabian S. Relationship between sleep quality and depression in people with type 2 diabetes. J Diabetes Metab Disord. 2023 Nov;23(1):765–772.

[104] Al Faker M, Wacquier B, Willame H, Point C, Dosogne M, Loas G, et al. The association between type 2 diabetes and major depression in apnoeic individuals. Sleep Biol Rhythms. 2022 Jan;20(2):219–228.

[105] Bhar D, Bagepally BS, Rakesh B. Association between chronotype and cardio-vascular disease risk factors: a systematic review and meta-analysis. Clin Epidemiol Glob Health. 2022 Jul;16:101108.

[106] Jeon B, Luyster FS, Sereika SM, DiNardo MM, Callan JA, Chasens ER. Comorbid obstructive sleep apnea and insomnia and its associations with mood and diabetes-related distress in type 2 diabetes mellitus. J Clin Sleep Med. 2022 Apr;18(4):1103–1111.

[107] Laverty B, Puthezhath Jayanandan S, Smyth S. Understanding the relationship between sleep and quality of life in type 2 diabetes: a systematic review of the literature. J Health Psychol. 2023 Jul;28(8):693–710.

[108] BAPEN. (The British Association for Parenteral and Enteral Nutrition). Introducing 'MUST' - Malnutrition Universal Screening Tool [Internet]. 2025 [cited 2025 May 11]. Available from: https://www.bapen.org.uk/must-and-self-screening/introducing-must/

[109] ElSayed NA, Aleppo G, Bannuru RR, Beverly EA, Bruemmer D, Collins BS, et al.; American Diabetes Association Professional Practice Committee. 5. Facilitating positive health behaviors and well-being to improve health outcomes: standards of care in diabetes-2024. Diabetes Care. 2024 Jan;47 Suppl 1:S77–S110.

[110] Franz MJ, MacLeod J, Evert A, Brown C, Gradwell E, Handu D, et al. Academy of nutrition and dietetics nutrition practice guideline for type 1 and type 2 diabetes in adults: systematic review of evidence for medical nutrition therapy effectiveness and recommendations for integration into the nutrition care process. J Acad Nutr Diet. 2017 Oct;117(10):1659–1679.

[111] Diabetes Canada. 2025. [cited 2025 Nov 1]. The glycemic index guide. Available from: https://www.diabetes.ca/DiabetesCanadaWebsite/media/Managing-My-Diabetes/Tools%20and%20Resources/glycemic-index-food-guide.pdf?ext=.pdf

[112] Zafar MI, Mills KE, Zheng J, Regmi A, Hu SQ, Gou L, et al. Low-glycemic index diets as an intervention for diabetes: a systematic review and meta-analysis. Am J Clin Nutr. 2019 Oct;110(4):891–902.

[113] Christensen S, Robinson K, Thomas S, Williams DR. Dietary intake by patients taking GLP-1 and dual GIP/GLP-1 receptor agonists: a narrative review and discussion of research needs. Obes Pillars. 2024 Jul;11:100121.

[114] Memel Z, Gold SL, Pearlman M, Muratore A, Martindale R. Impact of GLP- 1 Receptor agonist therapy in patients high risk for sarcopenia. Curr Nutr Rep. 2025 Apr;14(1):63.

[115] Moon J, Koh G. Clinical evidence and mechanisms of high-protein diet-induced weight loss. J Obes Metab Syndr. 2020 Sep;29(3):166–173.

[116] Harper ME, Dent RR, McPherson R. High-quality weight loss in obesity: importance of skeletal muscle. Diabetes. 2025 Dec;74(12):2191–2198.

[117] Marx N, Federici M, Schütt K, Müller-Wieland D, Ajjan RA, Antunes MJ, et al.; ESC Scientific Document Group. 2023 ESC Guidelines for the management of cardiovascular disease in patients with diabetes. Eur Heart J. 2023 Oct;44(39):4043–4140.

[118] Abdou M, Hafez MH, Anwar GM, Fahmy WA, Abd Alfattah NM, Salem RI, et al. Effect of high protein and fat diet on postprandial blood glucose levels in children and adolescents with type 1 diabetes in Cairo, Egypt. Diabetes Metab Syndr. 2021;15(1):7–12.

[119] Frohock AM, Oke J, Yaliwal C, Edge J, Besser RE. Additional insulin dosing for fat and protein in children with type 1 diabetes using multiple daily injections. Pediatr Diabetes. 2022 Sep;23(6):742–748.

[120] Locatelli JC, Costa JG, Haynes A, Naylor LH, Fegan PG, Yeap BB, et al. Incretin-based weight loss pharmacotherapy: can resistance exercise optimize changes in body composition? Diabetes Care. 2024 Oct;47(10):1718–1730.

[121] Neeland IJ, Linge J, Birkenfeld AL. Changes in lean body mass with glucagon-like peptide-1-based therapies and mitigation strategies. Diabetes Obes Metab. 2024 Sep;26(S4 Suppl 4):16–27.

[122] Alfadhli EM, Alharbi TS, Alrotoie AM, Aljohani AA, Qari AS, Alsubhi BA, et al. Validity of the International Diabetes Federation risk stratification score of Ramadan fasting in individuals with diabetes mellitus. Saudi Med J. 2024 Jan;45(1):86–92.

[123] Hassanein M, Hussein Z, Shaltout I, Wan Seman WJ, Tong CV, Mohd Noor N, et al. The DAR 2020 Global survey: Ramadan fasting during COVID 19 pandemic and the impact of older age on fasting among adults with type 2 diabetes. Diabetes Res Clin Pract. 2021 Mar;173:108674.

[124] Mohammed N, Buckley A, Siddiqui M, Al Ahmed S, Afandi B, Hassanein M, et al. Validation of the new IDF-DAR risk assessment tool for Ramadan fasting in patients with diabetes. Diabetes Metab Syndr. 2023 Apr;17(4):102754.

[125] Ibrahim M, Ba-Essa E, Alarouj M, Annabi F, Armstrong DG, Bennakhi A, et al. Recommendations for management of diabetes and its complications during Hajj (Muslim Pilgrimage) - 2024 update. Diabetes Res Clin Pract. 2024 Jun;212:111647.

[126] Dziewa M, Bańka B, Herbet M, Piątkowska-Chmiel I. Eating disorders and diabetes: facing the dual challenge. Nutrients. 2023;15(18):3955.

[127] Papelbaum M, Appolinário JC, Moreira RO, Ellinger VC, Kupfer R, Coutinho WF. Prevalence of eating disorders and psychiatric comorbidity in a clinical sample of type 2 diabetes mellitus patients. Rev Bras Psiquiatr. 2005 Jun;27(2):135–138.

[128] Yahya AS, Khawaja S, Williams PS, Naguib M. Binge eating disorder and type 2 diabetes: epidemiology and treatment approaches. Prog Neurol Psychiatry. 2022 Apr;26(2):33–37.

[129] Niemelä PE, Leppänen HA, Voutilainen A, Möykkynen EM, Virtanen KA, Ruusunen AA, et al. Prevalence of eating disorder symptoms in people with insulin-dependent-diabetes: A systematic review and meta-analysis. Eat Behav. 2024 Apr;53:101863.

[130] Dziewa M, Bańka B, Herbet M, Piątkowska-Chmiel I. Eating disorders and diabetes: facing the dual challenge. Nutrients. 2023 Sep;15(18):3955.

[131] Barazzoni R, Gortan Cappellari G. Double burden of malnutrition in persons with obesity. Rev Endocr Metab Disord. 2020 Sep;21(3):307–313.

[132] Feng L, Gao Q, Hu K, Wu M, Wang Z, Chen F, et al. Prevalence and risk factors of sarcopenia in patients with diabetes: a meta-analysis. J Clin Endocrinol Metab. 2022 Apr;107(5):1470–1483.

[133] Hassanein M, Afandi B, Yakoob Ahmedani M, Mohammad Alamoudi R, Alawadi F, Bajaj HS, et al. Diabetes and Ramadan: practical guidelines 2021. Diabetes Res Clin Pract. 2022 Mar;185:109185.

[134] Alsafadi H, Goodwin W, Syed A. Diabetes care during Hajj. Clin Med (Lond). 2011 Jun;11(3):218–221.

[135] Michielsen M, Yagiz J, Hanssens M, Claes J, Geuns L, Gojevic T, et al. The effect of exercise characteristics on HbA1c and other cardiovascular risk factors in adults with type 2 diabetes: a systematic review and meta-analysis of randomised controlled trials. Cardiovasc Diabetol. 2025;25(1):30.

[136] Kirwan JP, Sacks J, Nieuwoudt S. The essential role of exercise in the management of type 2 diabetes. Cleve Clin J Med. 2017 Jul;84(7 Suppl 1):S15–S21.

[137] Hajat C, Harrison O, Al Siksek Z. Weqaya: a population-wide cardiovascular screening program in Abu Dhabi, United Arab Emirates. Am J Public Health. 2012 May;102(5):909–914.

[138] The Centers for Disease Control (CDC). Health effects of cigarettes: cardiovascular disease. [cited 2025 May 9]; Available from: https://www.cdc.gov/tobacco/about/cigarettes-and-cardiovascular-disease.html

[139] Primatesta P, Falaschetti E, Gupta S, Marmot MG, Poulter NR. Association between smoking and blood pressure: evidence from the health survey for England. Hypertension. 2001 Feb;37(2):187–193.

[140] Masaki K, Taketa RM, Nakama MK, Kawamoto CT, Pokhrel P. Relationships between depressive symptoms, anxiety, impulsivity and cigarette and e-cigarette use among young adults. Hawaii J Health Soc Welf. 2022 Mar;81(3):51–57.

[141] Espinoza-Derout J, Shao XM, Lao CJ, Hasan KM, Rivera JC, Jordan MC, et al. Electronic cigarette use and the risk of cardiovascular diseases. Front Cardiovasc Med. 2022 Apr;9:879726.

[142] Rothberg AE, Ard JD, Gudzune KA, Herman WH. Obesity management for the treatment of type 2 diabetes [Internet]. 2024 [cited 2025 Jul 8]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK603314/

[143] Bramante CT, Lee CJ, Gudzune KA. Treatment of obesity in patients with diabetes. Diabetes Spectr. 2017 Nov;30(4):237–243.

[144] Sandforth A, von Schwartzenberg RJ, Arreola EV, Hanson RL, Sancar G, Katzenstein S, et al. Mechanisms of weight loss-induced remission in people with prediabetes: a post-hoc analysis of the randomised, controlled, multicentre prediabetes lifestyle intervention study (PLIS). Lancet Diabetes Endocrinol. 2023 Nov;11(11):798–810.

[145] Jumpertz von Schwartzenberg R, Vazquez Arreola E, Sandforth A, Hanson RL, Birkenfeld AL. Role of weight loss-induced prediabetes remission in the prevention of type 2 diabetes: time to improve diabetes prevention. Diabetologia. 2024 Aug;67(8):1714–1718.

[146] Taheri S, Zaghloul H, Chagoury O, Elhadad S, Ahmed SH, El Khatib N, et al. Effect of intensive lifestyle intervention on bodyweight and glycaemia in early type 2 diabetes (DIADEM-I): an open-label, parallel-group, randomised controlled trial. Lancet Diabetes Endocrinol. 2020 Jun;8(6):477–489.

[147] UAE Ministry of Health & Prevention. National Clinical Guidelines for Weight Management and Prevention of Adulthood Obesity. 2025. [cited 2026 Feb 20]. Available from: https://mohap.gov.ae/documents/d/guest/national-clinical-guidelines-for-weight-management-and-prevention-of-adulthood-obesity

[148] Small S, Iglesies-Grau J, Gariepy C, Wilkinson M, Taub P, Kirkham A. Time-restricted eating: a novel dietary strategy for cardiac rehabilitation. Can J Cardiol. 2023 Nov;39(11 11S):S384–S394.

[149] Semnani-Azad Z, Khan TA, Chiavaroli L, Chen V, Bhatt HA, Chen A, et al. Intermittent fasting strategies and their effects on body weight and other cardiometabolic risk factors: systematic review and network meta-analysis of randomised clinical trials. BMJ. 2025 Jun;389:e082007.

[150] Schroor MM, Joris PJ, Plat J, Mensink RP. Effects of intermittent energy restriction compared with those of continuous energy restriction on body composition and cardiometabolic risk markers - a systematic review and meta-analysis of randomized controlled trials in adults. Adv Nutr. 2024 Jan;15(1):100130.

[151] Wang J, Wang F, Chen H, Liu L, Zhang S, Luo W, et al. Comparison of the effects of intermittent energy restriction and continuous energy restriction among adults with overweight or obesity: an overview of systematic reviews and meta-analyses. Nutrients. 2022 May;14(11):2315.

[152] Sanyal AJ, Newsome PN, Kliers I, Østergaard LH, Long MT, Kjær MS, et al.; ESSENCE Study Group. Phase 3 trial of semaglutide in metabolic dysfunction-associated steatohepatitis. N Engl J Med. 2025 Jun;392(21):2089–2099.

[153] Colagiuri S, Ceriello A; IDF Technical Working Group. 6. Cardio-renal protection in type 2 diabetes. Diabetes Res Clin Pract. 2025 Apr;222 Suppl 1:112150.

[154] Schnell O, Almandoz J, Anderson L, Barnard-Kelly K, Battelino T, Blüher M, et al. CVOT summit report 2024: new cardiovascular, kidney, and metabolic outcomes. Cardiovasc Diabetol. 2025 May;24(1):187.

[155] Davies MJ, Drexel H, Jornayvaz FR, Pataky Z, Seferović PM, Wanner C. Cardiovascular outcomes trials: a paradigm shift in the current management of type 2 diabetes. Cardiovasc Diabetol. 2022 Aug;21(1):144.

[156] Cosentino F, Grant PJ, Aboyans V, Bailey CJ, Ceriello A, Delgado V, et al.; ESC Scientific Document Group. 2019 ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed in collaboration with the EASD. Eur Heart J. 2020 Jan;41(2):255–323.

[157] ElSayed NA, McCoy RG, Aleppo G, Balapattabi K, Beverly EA, Briggs Early K, et al.; American Diabetes Association Professional Practice Committee. 10. Cardiovascular disease and risk management: standards of care in diabetes-2025. Diabetes Care. 2025 Jan;48(Suppl 1):S207–S238.

[158] Perkovic V, Tuttle KR, Rossing P, Mahaffey KW, Mann JF, Bakris G, et al.; FLOW Trial Committees and Investigators. Effects of semaglutide on chronic kidney disease in patients with type 2 diabetes. N Engl J Med. 2024 Jul;391(2):109–121.

[159] Kasina S. Baradhi. KM. Dipeptidyl peptidase IV (DPP IV) inhibitors. [Internet]. 2023 [cited 2025 May 14]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK542331/

[160] Kosiborod MN, Abildstrøm SZ, Borlaug BA, Butler J, Rasmussen S, Davies M, et al.; STEP-HFpEF Trial Committees and Investigators. Semaglutide in patients with heart failure with preserved ejection fraction and obesity. N Engl J Med. 2023 Sep;389(12):1069–1084.

[161] Zile MR, Borlaug BA, Kramer CM, Baum SJ, Litwin SE, Menon V, et al.; SUMMIT Trial Study Group. Effects of tirzepatide on the clinical trajectory of patients with heart failure, preserved ejection fraction, and obesity. Circulation. 2025 Mar;151(10):656–668.

[162] Fadini GP. Can dual incretin receptor agonists exert better cardiovascular protection than selective GLP-1 receptor agonists? Highlights from SURPASS-CVOT. Diabetes Ther. 2025 Oct;16(10):1893–1898.

[163] US Food and Drug Administration (FDA). FDA approves treatment for serious liver disease known as 'MASH' [Internet]. 2025 [cited 2025 Oct 14]. Available from: https://www.fda.gov/drugs/news-events-human-drugs/fda-approves-treatment-serious-liver-disease-known-mash

[164] SURPASS-CVOT scientific disclosure, oral presentation at EASD Congress Vienna, Austria, on 18th September 2025.

[165] Tejera-Pérez C, Chico A, Azriel-Mira S, Lardiés-Sánchez B, Gomez-Peralta F, Jesús AF, et al.; Área de Diabetes-SEEN. Connected insulin pens and caps: an expert's recommendation from the Area of Diabetes of the Spanish Endocrinology and Nutrition Society (SEEN). Diabetes Ther. 2023 Jul;14(7):1077–1091.

[166] Lingen K, Pikounis T, Bellini N, Isaacs D. Advantages and disadvantages of connected insulin pens in diabetes management. Endocr Connect. 2023 Sep;12(11):e230108.

[167] Yi SS, Chamany S, Thorpe L. Academic and government partnerships to address diabetes in the USA: a narrative review. Curr Diab Rep. 2017 Sep;17(9):75.

[168] Gorski MT, Roberto CA. Public health policies to encourage healthy eating habits: recent perspectives. J Healthc Leadersh. 2015 Sep;7(Sep):81–90.

[169] UAE Ministry of Health & Prevention. MoHAP launches first nationwide diabetes screening campaign [Internet]. 2023 [cited 2025 Aug 14]. Available from: https://mohap.gov.ae/en/w/mohap-launches-first-nationwide-diabetes-screening-campaign

[170] UAE Ministry of Health & Prevention. Ministry of Health and Prevention launches Mobile App for diabetes [Internet]. 2020 [cited 2025 Aug 14]. Available from: https://mohap.gov.ae/en/w/ministry-of-health-and-prevention-launches-mobile-app-for-diabetes?p_l_back_url=%2Fen%2Fsearch%3Fq%3Ddiabetes&p_l_back_url_title=Search+results

[171] Emirates Diabetes and Endocrine Society [Internet]. [cited 2025 Sep 12]. Available from: https://www.emiratesdiabetessociety.org/