Emirates Diabetes Society Consensus Guidelines for the Management of Type 2 Diabetes Mellitus – 2020

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Summary of Key Recommendations

- We recommend that the American Diabetes Association screening criteria be adopted but starting at a lower age of 30 years (section Screening)
- For persons with normal test results, repeat testing at least once every 3 years (unless conditions changed), or 6-monthly if the person is diagnosed with pre-diabetes (section Screening for T2DM or Pre-Diabetes)
- Patients with pre-diabetes should be provided with a comprehensive lifestyle modification programme that includes weight management, medical nutrition therapy, exercise and smoking cessation (section Treatment of Pre-Diabetes; Fig. 1)
- Structured education for diabetes self-management should be an integral part of diabetes care and offered to all adults diagnosed with T2DM and/or their family members or caregivers (as appropriate) (section Structured Education; Table 3)
- Patients with diabetes should be encouraged to embark on ≥150 min of moderate aerobic exercise in addition to 2–3 sessions of resistance exercise weekly (section Exercise)
- Medical nutrition therapy guidance throughout the course of a structured weight management plan is strongly recommended (section Dietary Therapy)
- We recommend risk-based pharmacotherapy for patients with diabetes (based on cardiovascular, renal, hypoglycaemia and weight risks) (section T2DM and Risk of CVD; Fig. 2–6; Appendix C)
- A comprehensive set of checklists for periodic assessment of patients with diabetes is provided (section Initial and Follow-Up Assessment of Patients with Diabetes; Appendix B)

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Abstract

Rapid urbanisation and socioeconomic development in the United Arab Emirates (UAE) have led to the widespread adoption of a sedentary lifestyle and Westernised diet in the local population and consequently a high prevalence of obesity and diabetes. In 2019, International Diabetes Federation statistics reported a diabetes prevalence rate of 16.3% for the adult population in the UAE. In view of the wealth of recent literature on diabetes care and new pharmacotherapeutics, the Emirates Diabetes Society convened a panel of experts to update existing local guidelines with international management recommendations. The goal is to improve the standard of care for people with diabetes through increased awareness of these management practices among healthcare providers licensed by national health authorities. These consensus guidelines address the screening, diagnosis and management of type 2 diabetes mellitus in adults including individuals at risk of developing the disease.

Introduction

The global prevalence of diabetes in the 20–79 years age group has tripled in the last two decades, from 151 million affected persons in 2000 to 463 million in 2019 [1]. This emerging pandemic of diabetes mellitus (DM) is an important public health issue with a huge impact on patients, health-care systems and society at large; and underscores the urgency of finding effective strategies for diabetes treatment and prevention. The United Arab Emirates (UAE) is one of the 19 countries and territories within the International Diabetes Federation (IDF) Middle East and North Africa (MENA) region. In 2019, this region had the highest relative prevalence among the IDF regions, with the UAE having a diabetes prevalence of 16.3% for adults aged 20–79 years [1]. The Emirates Diabetes Society (EDS) is the primary non-profit organisation whose main mission is the promotion of diabetes care in the public and medical community. In view of the wealth of recent literature on diabetes care and new pharmaco-therapeutics, the EDS convened a panel of experts to update local guidelines (last revised in 2009 and 2012), keeping in mind international management recommendations. The goal is to improve the standard of care for people with diabetes through increased awareness of these management practices among healthcare providers licensed by national health authorities.

These guidelines address the screening, diagnosis and management of pre-diabetes and type 2 DM (T2DM) in adults as well as individuals at risk of developing the disease. Key research findings and international guidelines on diabetes management, which were developed for populations in the Western world, are adapted for local use and presented in a user-friendly format for healthcare professionals, especially in primary and secondary care. In addition, gaps between evidence-based knowledge and clinical practices specific to the UAE community are acknowledged. These guidelines aid decision-making driven by the best available evidence at present. However, therapeutic decisions should be individualised in line with the patient's profile, cultural values and preferences, and informed by public policies and quality control activities. These guidelines were reviewed by the panel and represent its collective analysis and recommendations.

Background

The discovery of oil in the MENA region in the early 20th century precipitated the rapid urbanisation and socioeconomic development of countries in the region. This has led to the widespread adoption of a sedentary lifestyle and Westernised dietary habits by the local population and consequently, a high prevalence of obesity and diabetes. The IDF Atlas (9th edition, 2019), estimated that the UAE had a diabetes prevalence of 16.3% for the 20–79 years age group [1]. A survey of Emiratis and expatriates in 1999–2000 reported a 20.0% rate in the 20–64 years age group, using the oral glucose tolerance test (OGTT) [2]; and is similar to rates reported in neighboring MENA countries. Since then, there have been few studies on the diabetes prevalence in the UAE. The Weqaya screening programme conducted in Abu Dhabi, collected data from 50,138 participants for 2008–2010. This showed age-standardised prevalence rates of 17.6% for diabetes and 27.1% for pre-diabetes [3]. More recently, a study of UAE citizens in the Northern Emirates found that the prevalence of diabetes was 25.1% [4]. The study also identified the main risk factors for diabetes in this population, i.e. age (≥35 years), family history of diabetes, hypertension, body mass index (BMI) ≥30.0 and waist-to-hip ratio ≥0.90 for males and ≥0.85 for females. The researchers also examined the prevalence of diabetes

Table 1. Interpreting results of diagnostic tests for diabetes [6]

Diagnostic test	Diabetes	Pre-diabetes
FPG*	≥126 mg/dL (7.0 mmol/L)**	100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L) (IFG)
OGTT†	≥200 mg/dL (11.1 mmol/L)	140 mg/dL (7.8 mmol/L) to 199 mg/dL (11.0 mmol/L) (IGT)
HbA1c‡	≥6.5% (48.0 mmol/mol)	5.7–6.4% (39.0–47.0 mmol/mol)
RBG in symptomatic individuals§	≥200 mg/dL (11.1 mmol/L)	–

* FPG: Fasting is defined as no caloric intake for 8–12 h. † OGTT: The test should be performed as described in the World Health Organization guidelines [8], using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. ‡ HbA1c may not be appropriate for diagnosis of diabetes in conditions where red cell turnover is abnormal (please see Table 2). § RBG can only be used for diagnosis of diabetes in a patient with classic symptoms of hyperglycaemia or hyperglycaemic crisis. ** In the absence of unequivocal hyperglycaemia, diagnosis of diabetes requires two abnormal test results from the same sample or in two separate test samples.

FPG, fasting blood glucose; HbA1c, glycated haemoglobin; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; OGTT, 2-h fasting glucose during a 75 g oral glucose tolerance test; RBG, random blood glucose.

Caveats on testing:

1. Tests should be performed in a laboratory using method certified by the National Glycohemoglobin Standardization Program (NGSP), and standardised (or traceable) to Diabetes Control and Complications Trial (DCCT) reference assay.

2. Point-of-care (POC) HbA1c assays that are approved for diagnostic purposes by NGSP or 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 patient is pregnant (second and third trimesters and postpartum period, see also Table 2).

among expatriates living in the UAE [5]. The results were alarming: the population-adjusted prevalence rate was 19.1% (95% confidence interval, CI: 17.6–20.5%), of whom 64.2% of people found to have diabetes were previously undiagnosed; and 15.3% (95% CI: 14.0–16.7%) had impaired fasting glucose (IFG).

Diagnostic Criteria and Tools

The diagnosis of diabetes is based on internationally determined standards and is therefore not specific to a particular region. In many countries, this diagnosis uses criteria published annually by the American Diabetes Association (ADA) [6], which are similar to the IDF [7] and World Health Organization [8] criteria.

Criteria for a Diagnosis of Diabetes

For a diagnosis of diabetes, one of the following tests can be used [6]:

- Fasting plasma glucose (FPG)
- 2-h plasma glucose value during a 75 g OGTT
- Glycated haemoglobin (HbA1c)
- Random blood glucose (RBG) for symptomatic individuals.

The criteria for a diagnosis of diabetes and the interpretation of the test results are shown in Table 1.

In the absence of symptoms, a diagnosis requires two abnormal test results from the same sample or in two separate test samples. If two samples were used, the second test, which may be a repeat of the initial test or a different test, should be performed. In the event of conflicting results from the two tests, the test result that was above the diagnostic cut-off point should be repeated. The diagnosis should be made based on the confirmatory test. If the results were close to, but below the cut-off levels, we recommend repeating the test in 3–6 months while following the patient clinically during that time.

Although FPG, OGTT, HbA1c or RBG can be used for a diagnosis, they may not all be abnormal at the same time in an individual. Amongst them, the OGTT tends to diagnose more people with pre-diabetes and diabetes compared with FPG and HbA1c [9]. Although the OGTT has been used to identify persons at risk of developing T2DM in many clinical trials, the use of HbA1c or FPG testing is often more practical.

Screening

Screening for diabetes implies testing for diabetes in individuals without symptoms or who are unaware of their condition. Screening can also detect individuals at increased risk for diabetes such as IFG, impaired glucose

Table 2. Medical conditions affecting the accuracy of the HbA1c test

Inappropriately low HbA1c	Inappropriately high HbA1c	Either high or low HbA1c
Acute or chronic blood loss	Renal failure (uraemia)	Certain haemoglobinopathies
Haemoglobinopathies: – Sickle cell – Thalassaemia Elliptocytosis Blood transfusion Haemolysis, including G6PD deficiency	Low red cell turnover: Vitamin B_{12} deficiency Iron deficiency Alcohol Hyperbilirubinaemia	Foetal haemoglobin Methaemoglobin Assay interference
Drugs: – Iron therapy – Vitamin B_{12} supplements – Erythropoietin – Antiretrovirals, ribavirin – Dapsone – Aspirin (low dose) – Vitamin C – Vitamin E	Drugs: – High-dose aspirin – Chronic opiate use	
Chronic liver disease Hypertriglyceridaemia Pregnancy Reticulocytosis Rheumatoid arthritis	Splenectomy Aplastic anaemia Lead poisoning	

tolerance (IGT) or both (i.e., pre-diabetes). Early detection through targeted screening allows appropriate interventions that can delay disease onset and progression.

Data from the IDF showed that almost half of adults aged 20–79 years with IGT are aged <50 years [1]. A third (28.3%) of them are between 20 and 39 years and are therefore likely to be at risk of developing diabetes for many years. A large study of 33,327 Emirati men aged 18–29 years during the period between May 2015 and February 2017 showed that diabetes conditions already exist in this young age group: 4.7% (95% CI: 4.4–5.0) prevalence for diabetes and 41.3% (95% CI: 40.6–41.9) for IFG [10]. The ADA [6] and Canadian [11] guidelines advocate screening individuals above the age of 45 years; and at a younger age in the presence of risk factors for diabetes. The United States Preventive Services Task Force (USPSTF) recommends screening for abnormal blood glucose in adults aged 40–70 years with overweight or obesity [12]. A study of the performance of the USPSTF recommendations revealed that only half of the individuals with undiagnosed dysglycaemia were detected, and substantially less in racial/ethnic minorities [13].

The Canadian primary care system, which screens its patients as early as 40 years of age, found that useful in detecting unrecognised diabetes.

Recommendation: We recommend that the ADA screening criteria [6] be adopted but starting at *a lower age of 30 years.*

Screening Tests

HbA1c is the preferred screening test. It is convenient as it does not require the patient to fast and is not affected by illness or stress at the time of testing. For healthy individuals, a study comparing persons of Swedish and Middle Eastern ancestry found minor differences in the sensitivity and specificity of using a HbA1c of ≥6.5% for the presence of T2DM [15]. However, HbA1c has a relatively high cost and its accuracy can be affected by a number of medical conditions (Table 2), e.g. sickle cell trait, which may limit its use as a screening test [16].

Screening for T2DM or Pre-Diabetes

For asymptomatic adults, consider using an assessment of risk factors or validated questionnaire-based tools, e.g. ADA Diabetes Risk Test [6], to determine need

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for diagnostic testing. The risk factors for T2DM or pre-diabetes (modified from the ADA guidelines [6]) are:

- *Adults ≥30 years old*
- Adults of any age who are overweight or obese (BMI ≥25 or ≥23 kg/m² for those of Asian descent) with ≥1 additional risk factor as listed below:
  - First-degree relative with diabetes
  - Pre-diabetes, i.e. HbA1c ≥5.7%, IGT or IFG on previous testing
  - Low levels of high-density lipoprotein cholesterol (<35 mg/dL [<0.90 mmol/L]) and/or high triglyceride (TG) levels (>250 mg/dL [>1.70 mmol/L])
  - Hypertension (blood pressure ≥140/90 mm Hg or on treatment for hypertension)
  - Physical inactivity
  - High-risk ethnic groups
  - History of cardiovascular disease (CVD)
  - Polycystic ovary syndrome
  - History of gestational diabetes
  - Other conditions associated with insulin resistance, e.g. severe obesity or acanthosis nigricans

Recommendation: For persons with normal test results, repeat testing at least once every 3 years (unless conditions changed), and for persons diagnosed with pre-diabetes repeat testing in 6 months.

Please refer to Appendix A for screening for T2DM in special populations [6].

Management of Pre-Diabetes

The goals of diabetes prevention are:
- Delaying the onset of diabetes
- Preserving beta cell function
- Preventing or delaying microvascular and cardiovascular complications

As a therapeutic target, preservation of beta cell function is particularly important as beta cell failure largely underlies the transition from the pre-diabetic state to diabetes (as well as worsening of glycaemic control once diabetes has developed).

Strategy for Prevention of Diabetes
Identify Individuals for Preventive Measures
See section Screening.

Treatment of Pre-Diabetes
Recommendation: Patients with pre-diabetes should be provided with a comprehensive lifestyle modification programme that includes weight management, medical

nutrition therapy (MNT), exercise and advice or therapy to help with smoking cessation.

The programme should achieve 5–10% weight loss through medical nutrition therapy and moderate-intensity physical activity (~30 min/day, ≥150 min/week). Allow 6 months on the programme before using pharmacotherapy. Repeat testing every 6 months (Fig. 1).

- *If lifestyle modification is successful*: Patients who improve or maintain their glycaemic indices should continue programme with repeat examination and measurements of FPG OGTT or HbA1c and serum lipids on a 6-monthly basis
- *If lifestyle modification was unsuccessful*: For patients in whom lifestyle intervention fail to improve glycaemic indices, we suggest metformin for diabetes prevention. Repeat diagnostic tests for diabetes every 6 months

If FPG increases to ≥126 mg/dL (7.0 mmol/L), OGTT ≥200 mg/dL (11.1 mmol/L) or HbA1c ≥6.5% (48.0 mmol/mol), appropriate management of diabetes is necessary.

Individuals with IFG, IGT or HbA1c (5.7 to <6.4% [39.0 to 47.0 mmol/mol]), with additional risk factors, i.e. age ≥60 years, obesity (BMI ≥35 kg/m²), family history of diabetes, and women with prior gestational diabetes, are more likely to develop diabetes. Lifestyle changes should be recommended. Allow 6 months for lifestyle modification prior to starting medication (metformin: ≥1,500 mg per day).

Lifestyle Modification for Pre-Diabetes
The goal of lifestyle modification is to achieve weight loss and return to normoglycaemia. A comprehensive lifestyle modification programme should be structured to achieve significant weight reduction and improve clinical indicators. Regular reinforcement of the programme is important for successful compliance.

Weight Management
Weight management is especially important for overweight or obese persons with pre-diabetes and T2DM. Among the three components of lifestyle intervention (weight loss, exercise and diet change), diabetes prevention correlated most strongly with weight loss: with 16.0% risk reduction per kilogram of weight loss [17]. While no single weight loss approach has been proven to be superior, sustaining weight loss has well-known and long-term benefits. A weight loss of ≥5% is needed to produce beneficial outcomes in glycaemic control, lipids and blood pressure [18]. Studies such as the Finnish Dia-
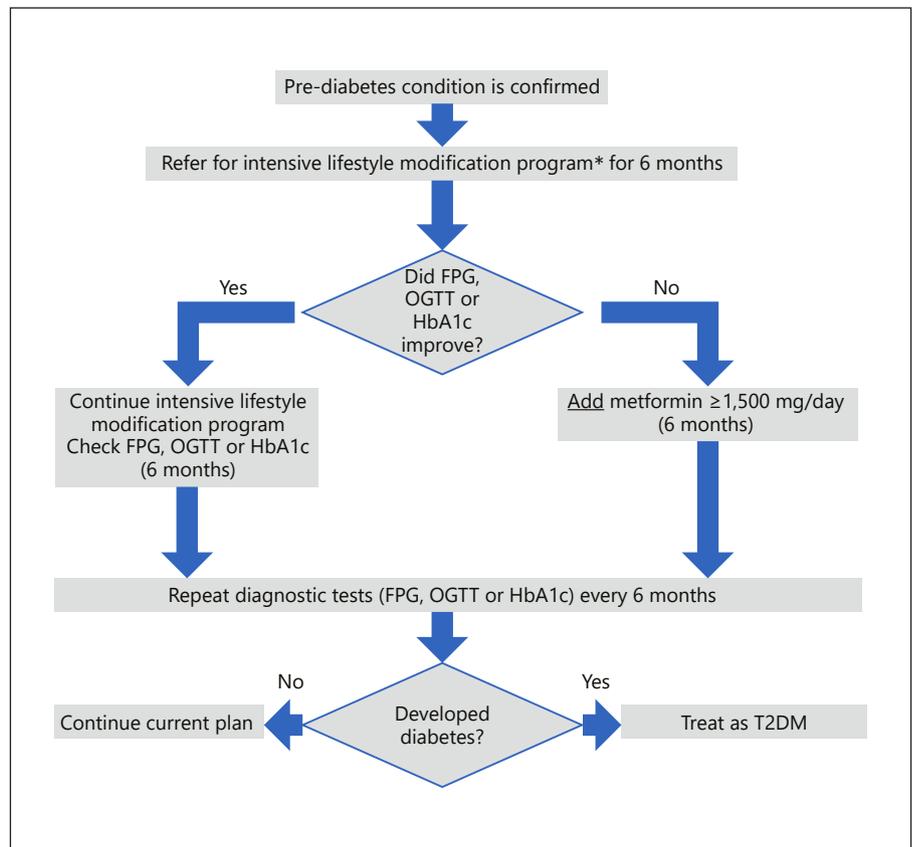
Fig. 1. Management of individuals with pre-diabetes. * The target is to achieve and maintain 5–10% weight loss and increase moderate-intensity physical activity (such as brisk walking) to at least 150 min/week. FPG, fasting blood glucose; HbA1c, glycated haemoglobin; OGTT, 75 g oral glucose tolerance test; T2DM, type 2 diabetes mellitus.

betes Prevention Study [18] and the Diabetes Prevention Program [19] have shown that changes in lifestyle can achieve weight reduction and slow the progression to diabetes.

Exercise

Aerobic exercise like brisk walking, swimming, cycling or jogging are advisable. When feasible, highly intense exercises and supervised physical programmes are recommended [20, 21]. The physical activity can be spread over ≥3 days/week, with no more than 2 consecutive days without exercise. In a prospective cohort study, men who performed either weight training or aerobic exercise for >150 min/week were associated with a lower risk of T2DM when compared with no physical activity [22]. We suggest using technology, e.g. pedometer, smartphone applications and wearable devises, to promote walking and physical fitness [23].

Dietary Therapy

We suggest choosing a dietary pattern of healthy foods, e.g. Dietary Approaches to Stop Hypertension (DASH) or

Mediterranean-style diets, rather than focusing on specific nutrients. This approach allows greater flexibility and personal preference in diet and may improve long-term adherence [24]. A Mediterranean-style diet can reduce the incidence of diabetes, independent of caloric restrictions. In a trial that examined the effects of two Mediterranean diets (one supplemented with extra virgin olive oil [EVOO] and the other, mixed nuts) and a low-fat diet (control) on cardiovascular outcomes [25], showed that the EVOO diet had the lowest diabetes risk. Changes in weight and physical activity did not differ among the three groups.

Smoking Cessation

Avoidance of smoking and smoking cessation should be encouraged as smokers have increased risk of diabetes-related microvascular and macrovascular complications and premature death. Cigarette smoking is a predictor of incident T2DM (hazard ratio: 1.31, CI: 1.04–1.65) [26]. While weight gain is often reported after smoking cessation [27], the net effect is better cardiovascular protection including improved exercise tolerance, lipid profile,

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Table 3. Structured education programme for diabetes self-management [31, 32]

When should the programme be offered:	The programme must aim to:	Curriculum should contain:
– At and around the time of diagnosis – Annually thereafter for reinforcement and review – When complicating factors occur – During transition of care – At intensification of treatment (e.g., introduction of injectable therapy, change from basal to intensive insulin)	– Have specific aims and learning objectives – Suit the needs of the person (individualised) – Have a documented, structured curriculum that is theory-driven, evidence-based and resource-effective; together with supporting materials (leaflets) – Have specific aims and learning objectives – Support the person and their family members and caregivers in developing attitudes, beliefs, knowledge and skills to self-manage his/her diabetes – Be quality assured, and reviewed by trained, competent and independent assessors who can measure the programme against its objectives; ensure consistency, and audit its outcomes regularly	– 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 – Social aspects such as fasting, driving and travelling for patients on insulin

blood pressure and proteinuria. Smoking cessation should be coupled with strategies for diabetes prevention and early detection.

Pharmacologic Therapy for Pre-Diabetes

Drug therapy is helpful in preventing T2DM in high-risk patients for whom lifestyle modification failed or is not sustainable. For selected patients (section Treatment of Pre-Diabetes) in whom lifestyle interventions failed to improve glycaemic indices, the ADA recommends metformin for diabetes prevention or delay [28]. Additional benefits of metformin include reductions in FPG, fasting insulin and modest improvements in BMI, high-density lipoprotein, low-density lipoprotein and TG [29]. These benefits persist for some time after stopping metformin [30]. Metformin has been used for prevention of T2DM in many parts of the world including the UAE and most of the Gulf countries. However, in older individuals (≥60 years of age at baseline), lifestyle intervention was found to be more effective [19].

Management of Hyperglycaemia in Diabetes

The strategy for the management of glycaemia in patients with diabetes requires a comprehensive programme consisting of structured education, glucose monitoring, lifestyle modification and pharmacotherapy.

Structured Education

Structured education for diabetes self-management should be delivered by certified Diabetes Educators (i.e., nurse, dietician or pharmacist) who have an understanding of diabetes; and in a manner appropriate to the age and needs of the patient. Diabetes educators need to be well trained and competent to deliver the principles and content of such education. Structured education programmes can be delivered in a group format, if suitable. They equip the patient with the knowledge, skills and ability necessary for diabetes self-management; and provide activities that sustain the lifestyle modifications needed to manage his/her condition on an ongoing basis (Table 3 [31, 32]). Such programmes have been shown to improve HbA1c by 0.6%, with no adverse side effects [32].

Recommendation: Structured education for diabetes self-management should be an integral part of diabetes care and offered to all individuals diagnosed with T2DM and/or their family members or caregivers (as appropriate) [7, 32].

Glucose Monitoring

HbA1c is the major tool for assessing glycaemic control with strong predictive value for diabetes complications. It reflects the extent of glycation (exposure to glucose) of haemoglobin in the preceding 120 days due to the rate of turnover of red blood cells. However, its accuracy can be affected by disorders that cause higher or lower red blood cell turnover (Table 2). The recommended frequency of HbA1c testing is every 3 months in most patients with diabetes; and at the very least, an HbA1c should be performed 2–4 times per year in all diabetic patients - Appendix B (Table B-3).

Point-of-care testing for HbA1c provides an opportunity for more timely treatment changes. Self-monitoring

of blood glucose (SMBG) is the testing of glucose levels by patients using a home glucometer. In patients with diabetes:

- SMBG allows patients to evaluate their response to therapy and assess whether their glycaemic targets are being safely achieved
- Integrating SMBG results into diabetes management helps to guide therapy including diet, exercise and medication (particularly in titrating prandial insulin doses), and prevents hypoglycaemia
- The specific needs and goals of the patient should dictate the SMBG frequency and timing, or the use of continuous glucose monitoring
- For patients on basal insulin, assessing fasting glucose with SMBG to inform dose adjustments to achieve blood glucose targets results in lower HbA1c

SMBG should be offered to all patients with diabetes, at least 3–5 times per week. In patients who are at high risk of hypoglycaemia, poor glycaemic control or have fluctuations in blood sugar, blood glucose should be monitored at least 3 times/day.

For patients on SMBG, education and support should be provided on initiation and during the annual assessment thereafter, and should include a review of self-monitoring skills, equipment used, quality and frequency of testing, interpretation of blood glucose results and action taken to optimise therapy. Continuous glucose monitoring or intermittently scanned (flash) glucose monitoring (FGM) may be helpful in some patients who are on intensive insulin regimes, e.g. patients requiring multiple daily injections of insulin or on insulin pumps, or pregnant women. In some situations, there is a discrepancy between FGM and capillary blood glucose especially in the hypoglycaemic range when FGM tends to give lower readings. If in doubt, a patient should confirm with a capillary blood glucose reading.

Lifestyle Modification for Diabetes

Please see also section Lifestyle Modification for Pre-Diabetes.

Exercise

Exercise is an important component of lifestyle change for the prevention and treatment of many chronic illnesses, especially diabetes [33, 34]. It has been shown to improve insulin sensitivity, reduce blood glucose variability and lower HbA1c [33, 34]. Physical activity has health benefits even if the weight and glucose control do not change.

Sedentary behaviour involves prolonged sitting or reclining while awake, e.g. television viewing, working on a computer and driving. Systematic reviews of observational studies have demonstrated positive associations between the amount of sitting and the risk of premature mortality in the general population and people with diabetes [35, 36]. In the UAE, it has been shown that the majority of patients with diabetes were leading sedentary lifestyles: a self-reported questionnaire showed that only 3% of patients met the ADA target for physical activity [37]. As prolonged sitting negatively impacts health, patients should be advised to limit inactivity time through walking or light physical activities and to interrupt sitting time by getting up briefly every 20–30 min [38].

Recommendation: Patients with diabetes should be encouraged to embark on ≥150 min of moderate aerobic exercise in addition to 2–3 sessions of resistance exercise weekly [39, 40].

If proliferative or severe non-proliferative diabetic retinopathy is present, vigorous-intensity aerobic or resistance exercise should be avoided to prevent vitreous haemorrhage or retinal detachment; and similar precautions should be advised in patients with advanced autonomic or peripheral neuropathy [41]. Patients treated with insulin or sulfonylurea should be educated to take the right corrective measures to reduce risk of hypoglycaemia during and after exercise. Such patients should discuss with their physicians or diabetes educators the ways and means to adjust medications or insulin doses if hypoglycaemia is anticipated.

Initiatives that encourage physical fitness across the community should be promoted, together with their dissemination across the country. The healthcare provider should work collaboratively with the patient with diabetes to set specific exercise goals, resolve potential barriers to physical activity and provide information on where and when to exercise, and perform self-monitoring in order to increase physical activity and improve glucose control.

Dietary Therapy

Healthy eating patterns are reported to improve overall health, achieve and maintain body weight, glycaemic, blood pressure and lipid goals and delay or prevent complications of diabetes [42]. Research has shown that MNT is effective for the treatment of T2DM [43]. MNT delivered by registered dietician is associated with HbA1c decreases of 0.3–2.0% for patients with T2DM [44]. They should be referred to certified dieti-

tians who can provide practical tools for developing healthy eating patterns and nutritional recommendations that address specific needs and goals based on personal and cultural preferences. It is important to individualise the meal plan and reassess the dietary guidance regularly.

Recommendation: MNT guidance throughout the course of a structured weight management plan is strongly recommended.

In adults with diabetes, the macronutrient distribution as a percentage of total energy can range from 45 to 60% for carbohydrates, 15–20% proteins and 20–35% fats. This can accommodate an MNT based on individual preferences and treatment goals as there is no ideal percentage of calories from carbohydrates, proteins and fats for patients with diabetes [45].

Carbohydrates, Dates and Honey. Dietary patterns emphasising fruit and vegetables can improve glycaemic control and reduce cardiovascular mortality. Patients with diabetes are advised to minimise their intake of refined carbohydrates, added sugars and sugar-sweetened beverages including fruit juices. To maintain a balanced diet, patients are advised to consume vegetables, fruits, legumes, dairy, lean protein nuts, seeds and whole grains. A relatively fixed carbohydrate consumption pattern with respect to both time and quantity is recommended, particularly for patients on insulin. Patients on a healthy balanced diet and supervised SMBG (section Glucose Monitoring) can use limited amounts of natural honey and benefit from the high fibre, mineral and vitamin content of dates. The consumption of dates in the Arab world is a deep-rooted tradition; and therefore, any dietary plan needs to address this custom. The consumption of 7–10 dates per serving of 5 local varieties has been studied and its results confirmed relatively low glycaemic index and post-prandial glucose excursions in both diabetic and healthy volunteers [46]. The caloric content, however, should be accounted for in any meal plan, as dates are rich in energy (314 kcal/100 g) [47].

Proteins. There is no evidence that adjusting the daily level of protein intake (typically 1–1.5 g/kg body weight/day or 15–20% total calories) will improve health in individuals without diabetic kidney disease (DKD). The research is also inconclusive regarding the ideal amount of dietary protein to optimise glycaemic management or CVD risk [48, 49]. Therefore, protein intake goals should be individualised based on current eating patterns. Patients with DKD should reduce their daily intake to 0.8 g/kg body weight/day [50]. The use of carbohydrate sources, which are high in proteins (e.g., milk

and nuts), to treat or prevent hypoglycaemia should be avoided due to the potential concurrent rise in endogenous insulin.

Fats. A Mediterranean-style eating pattern rich in polyunsaturated and monounsaturated fats can improve both glycaemic control and blood lipids. However, supplements do not seem to have the same effects as their whole-food counterparts. Controlled trials do not support *n*-3 supplements for primary or secondary prevention of CVD [51, 52]. *Trans*-fats should be avoided, and saturated fats replaced with unsaturated fats but not refined carbohydrates. The type of fats consumed is more important than total amount of fat when looking at metabolic goals and CVD risk, and it is recommended that the percentage of total calories from saturated fats should be limited [53]. Patients with diabetes should be advised to follow the guidelines for the general population on the recommended intake of saturated fat, dietary cholesterol and *trans*-fats [54].

Additional Considerations
- Sodium, micronutrients and supplements. Patients with diabetes should limit their sodium consumption to <2,300 mg/day [55]. Restrictions below 1,500 mg are not recommended even for those with hypertension. Patients treated with metformin should be tested for vitamin B_{12} deficiency, particularly in those with anaemia or peripheral neuropathy. Routine supplementation with antioxidants and micronutrients, e.g. vitamins E, C and D, chromium or carotene, herbs or spices (e.g., cinnamon, aloe vera and curcumin) is not advised due to insufficient evidence of efficacy and concerns relating to their long-term safety when taken in large doses. However, for special populations such as pregnant or lactating women, older adults, vegetarians and people following very low-calorie or low-carbohydrate diets, a multivitamin may be necessary [56].
- Advice should be given to limit alcohol consumption. Risks associated with alcohol consumption include hypoglycaemia (sometimes associated with poor hypoglycaemia awareness), hyperglycaemia, dyslipidaemia (particularly high TG) and weight gain [24].

Pharmacotherapy
Patients with diabetes are at increased risk of CVD [57]. This risk is usually related to age of the patient, duration of diabetes and the presence of CVD risk factors. Such cardiovascular outcome trials (CVOT) findings have resulted in a significant change in the choice of drug

Cardiovascular risk category	Treatment considerations
Very high risk	Drugs with cardiovascular and/or renal benefits are preferred as a second choice of treatment after metformin regardless of the level of glycaemic control for those who are considered as very high risk for CVD. (Figure 3)
High risk	For patients who are considered at high risk, our recommendations have taken into consideration not only the benefit of the drugs for patients with multiple CVD risk factors, but also the limited evidence for these drugs (small number of studies) and their cost effectiveness (patients may not have the ability to afford these expensive medications). (Figure 4)
Moderate risk	For patients with moderate and low risk of CVD, the choice of drug therapy for those not well-controlled on metformin will also depend on other associated factors such as the glycaemic effectiveness of the drug, risk of hypoglycaemia, the impact of the drug on body weight and its cost. (Figure 5)
Low risk	Similar to moderate risk.
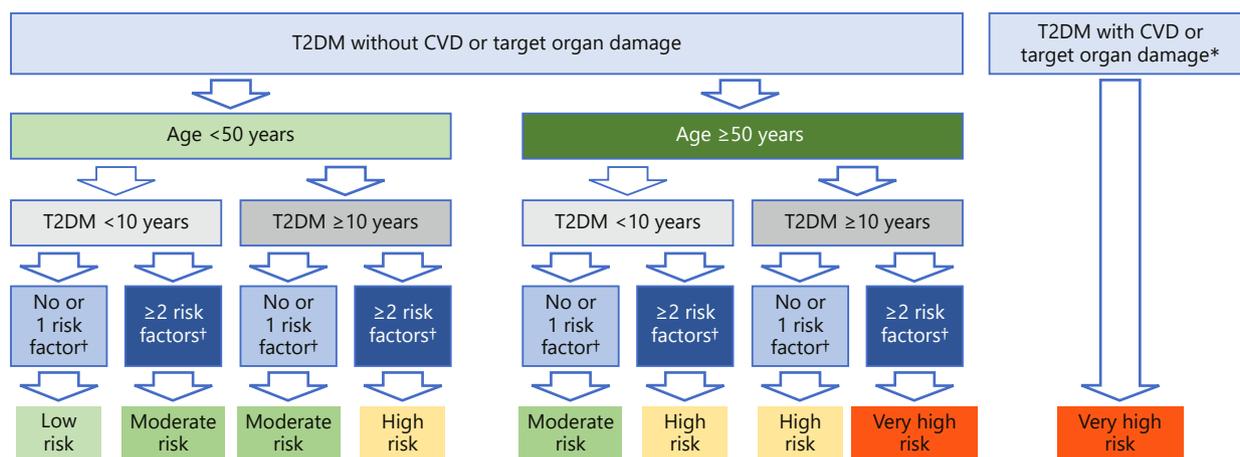
Fig. 2. Cardiovascular risk categorisation for patients with diabetes [58]. * Target organ damage = proteinuria, renal impairment defined as eGFR <60 mL/min/1.73 m^2, left ventricular hypertrophy or moderate NPDR or more advanced retinopathy. † Cardiovascular risk factors include hypertension, dyslipidaemia, smoking, obesity. CVD, cardiovascular disease; T2DM, type 2 diabetes mellitus.

treatment for patients with diabetes with or without CVD risk factors.

T2DM and Risk of CVD

The European Society of Cardiology (ESC) in collaboration of European Society for the Study of Diabetes (EASD) has recommended that the risk of cardiovascular disease (CVD) in patients with diabetes be stratified according to risk factors [58]. This risk stratification represents a further step to the earlier ADA recommendations [59, 60].

The CVD risk stratification in these guidelines reflected the changes in the ESC/EASD guidelines together with the cardiovascular outcome trials (CVOT) evidence

which has become available in recent years. The main points of consideration for CVD risk stratification are: history of CVD, history of end-organ damage, presence of CVD risk factors, age and duration of T2DM. Figure 2 shows the cardiovascular risk categories and the recommended treatment considerations for each group [58].

Recommendation: We recommend risk-based pharmacotherapy for patients with diabetes (based on cardiovascular, renal, hypoglycaemia and weight risks).

Treatment algorithms based on cardiovascular risk (adapted from the ESC/EASD guidelines and ADA 2020 standards of care [6, 58]) are shown in Figures 3–6, and information on anti-diabetic medication [61] is given in Appendix C.

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Fig. 3. Pharmacotherapy for patients with diabetes in the very high risk category. * Sodium-glucose cotransporter 2 inhibitors (SGLT2is) are the preferred option in people with heart failure or impaired renal function. GLP-1 RA, glucagon-like peptide 1 receptor agonist; CVD, cardiovascular disease; HbA1c, glycated haemoglobin.
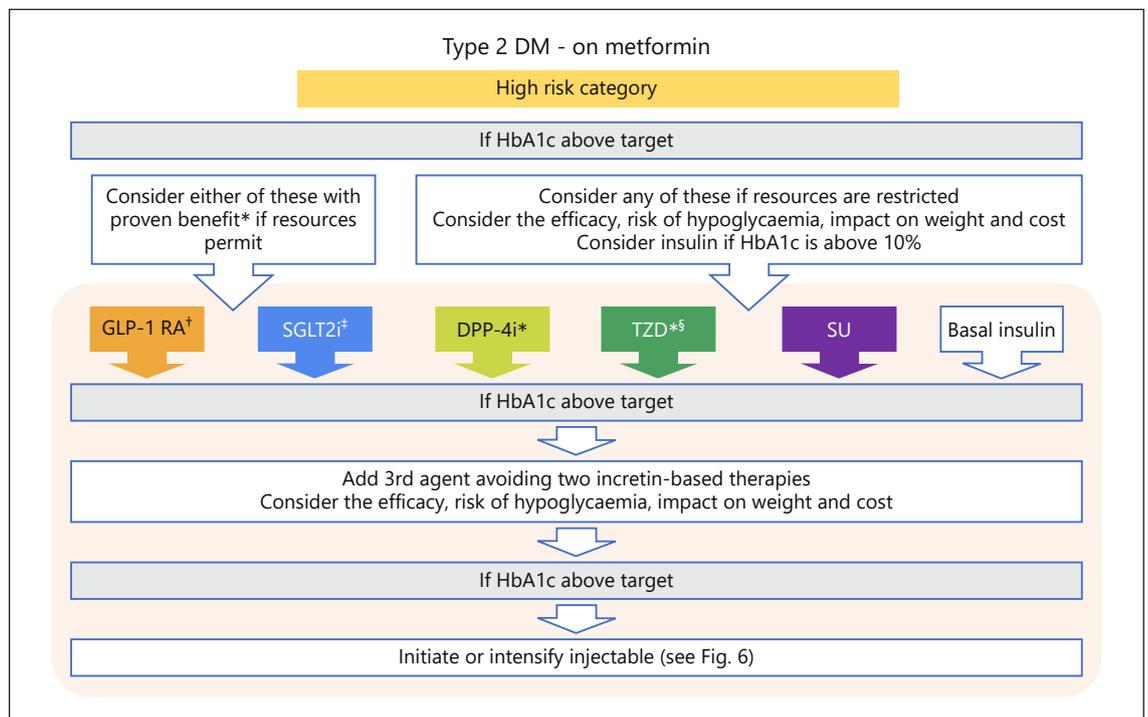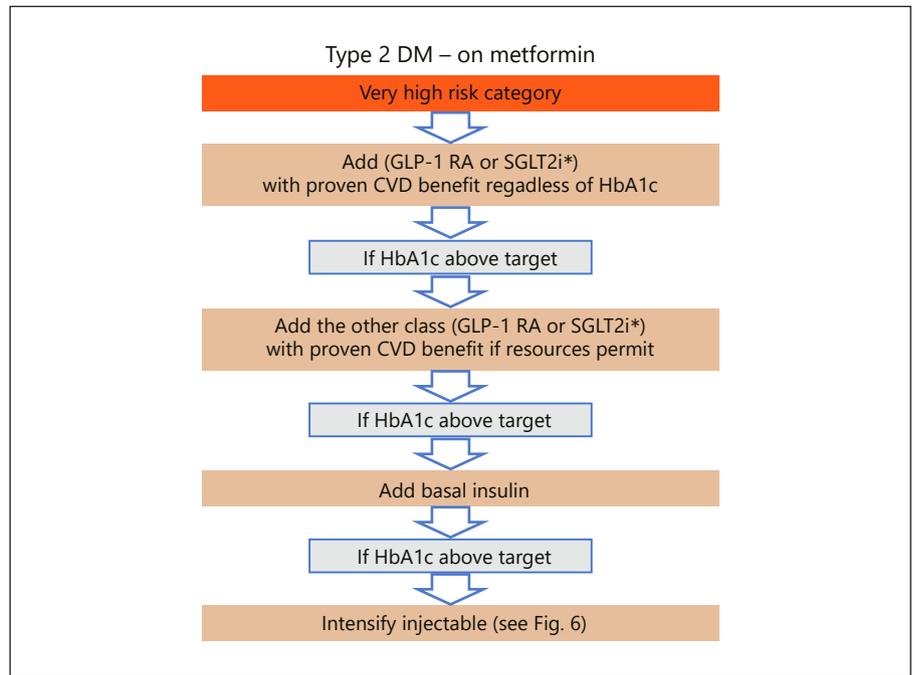

Fig. 4. Pharmacotherapy for patients with diabetes in the high risk category. * Avoid pioglitazone, saxagliptin and alogliptin in congestive heart failure. † GLP1-RA: refer to prescribing information with regard to renal function. ‡ SGLT2i is the preferred option in people with heart failure or impaired renal function (refer to prescribing information with regards to renal function). § Pioglitazone No dose adjustment is required. BMI, body mass index; DPP-4i, dipeptidyl peptidase 4 inhibitors; GLP-1 RAs, glucagon-like peptide 1 receptor analogues; SGLT2i, sodium-glucose cotransporter 2 inhibitors; SU, sulfonylureas; TZD, thiazolidinediones.
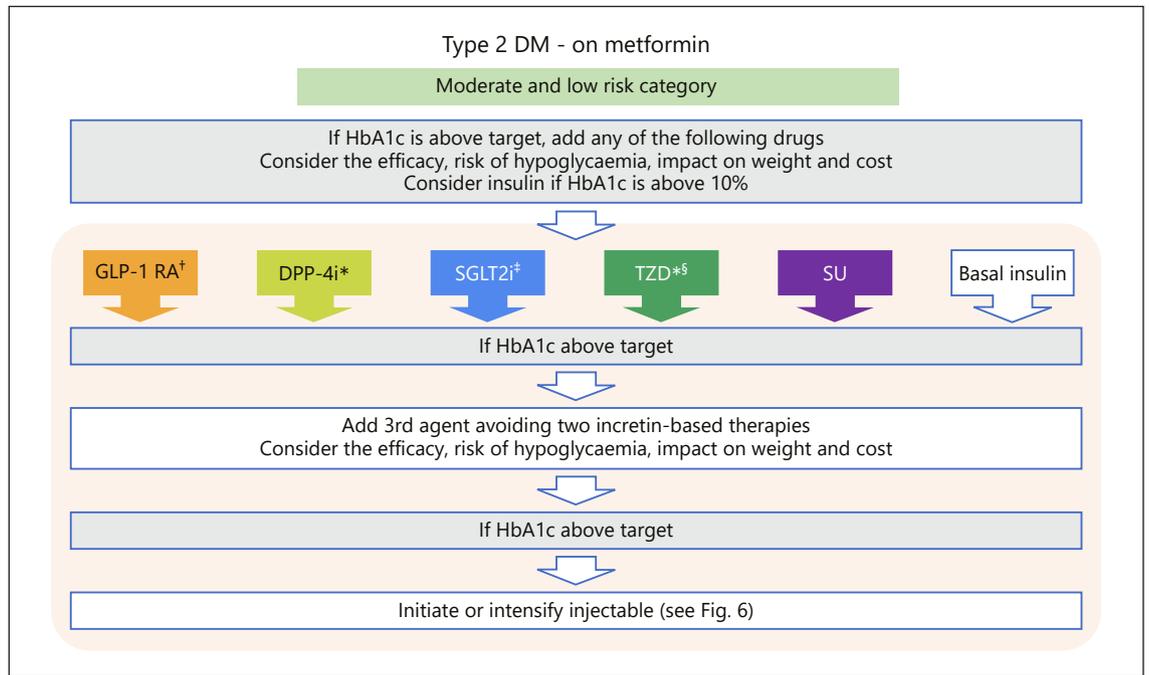
Fig. 5. Pharmacotherapy for patients with diabetes in the moderate and low risk category. * Avoid pioglitazone, saxagliptin and alogliptin in congestive heart failure. [†] GLP1-RA: refer to prescribing information with regards to renal function. [‡] SGLT2i is the preferred option in people with heart failure or impaired renal function (refer to prescribing information with regards to renal function). [§] Pioglitazone No dose adjustment is required. BMI, body mass index; DPP-4i, dipeptidyl peptidase 4 inhibitors; GLP-1 RAs, glucagon-like peptide 1 receptor analogues; SGLT2i, sodium-glucose cotransporter 2 inhibitors; SU, sulfonylureas; TZD, thiazolidinediones.
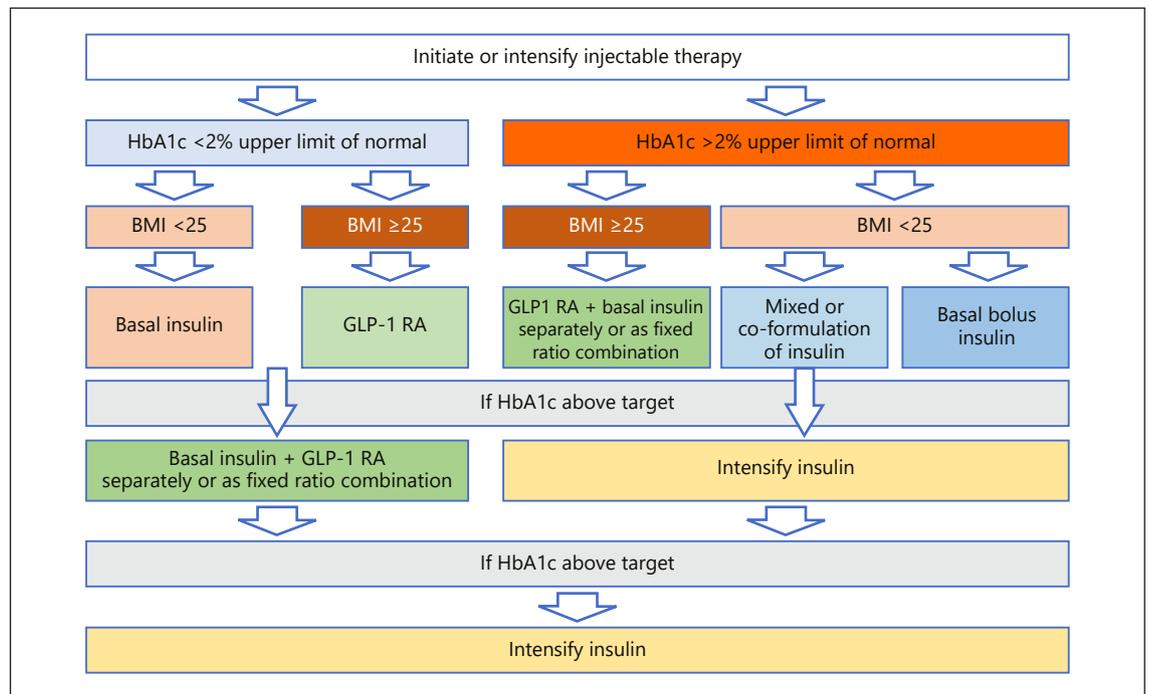
Fig. 6. Injectable therapy. BMI, body mass index; GLP-1 RAs, glucagon-like peptide 1 receptor agonists; HbA1c, glycated haemoglobin.

Initial and Follow-Up Assessment of Patients with Diabetes

The objective of timely medical evaluation is to ensure that the healthcare team addresses all elements of diabetes care, with special attention given to the monitoring of comorbidities and detection of early signs of complications. This is driven by the reported high rates of comorbidities in the UAE, namely, overweight, obesity, dyslipidaemia and hypertension (31.9, 35.4, 44.2 and 23.1%, respectively) [3]. One in 5 patients with diabetes (20.4%) had microvascular complications, almost twice as often as of macrovascular complications (10.2%) [62]. This highlighted the need for close monitoring and screening strategies. Although the assessment during the initial visit should be as comprehensive as possible, assessments during follow-up visits are also equally important, as many of the early signs of complications can easily be missed in a busy clinic. The initial and periodic evaluation processes should include significant information on patient's history, physical examination and laboratory tests [63, 64]. (Appendix B [28, 31, 32, 63]).

Recommendation: A comprehensive set of periodic assessment checklists for patients with diabetes are provided (Appendix B).

It should be clear that recommended targets need to be individualised and discussed with the patient and caregiver for optimum compliance. The indicated metabolic targets have been chosen carefully based on best available evidence and are in line with international guidelines. The proposed frequency of testing is based on demand management with careful consideration of the scientific evidence, built-in quality measures and feasibility. Appropriate test utilisation criteria should be mutually agreed by different stakeholders and need to be regularly updated in accordance with recent literature and changing local healthcare structures [65].

Appendix A

Screening for Diabetes in Special Populations

1	Patients taking medications known to increase risk of diabetes – Consider patient's use of medications known to increase risk of diabetes (e.g., glucocorticoids and thiazide diuretics) when deciding whether to perform screening. – Perform annual screening for diabetes and pre-diabetes for patients taking atypical anti-psychotic medication.
2	Patients with presence of end organ damage associated with diabetes especially microvascular diseases such as retinopathy, neuropathy, nephropathy or macrovascular disease such as coronary heart disease, stroke or peripheral vascular disease.
3	Patients with HIV infection – Test for diabetes or pre-diabetes (Table 1): – before starting antiretroviral therapy – at the time of changing antiretroviral therapy – 3–6 months after initiating/changing antiretroviral therapy – if results are normal, re-test glucose annually
4	Patients with cystic fibrosis – Use of HbA1c for screening for cystic fibrosis-related diabetes is not recommended. – Perform oral glucose tolerance test in all patients aged ≥10 years old annually, if not already diagnosed with cystic fibrosis-related diabetes. – Consider annual monitoring for diabetes-related complications starting >5 years after cystic fibrosis-related diabetes diagnosis.
5	Patients after organ transplantation – Screen for hyperglycaemia after patient is stable on immune-suppressive regimen and when the absence of acute infection has been confirmed. – Perform OGTT to assess presence of post-transplantation diabetes.

Reference: American Diabetes Association, 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes – 2020. Diabetes Care 2020;43:S14–S31.

Appendix B

Periodic Assessment Checklists for Patients with Diabetes

Table B-1
Comprehensive diabetes medical evaluation by history.

	Factors	Initial visit	Periodic visits	Annual visit
Diabetes	Hypoglycaemia symptoms	√	√	√
	Hyperglycaemia symptoms	√	√	√
	Hospitalization	√	√	√
Comorbidities	Dyslipidaemia	√	√	√
	Hypertension	√	√	√
	Neuropathy:			
	– Peripheral	√	√	√
	– Autonomic	√		√
	– Mononeuritis	√		√
	Visual impairment	√		√
	Depression/anxiety	√		√
	Haemoglobinopathies	√		
	Thyroid disorder	√		√
	Infections	√	√	√
	Cancer	√		√
Lifestyle	Work status	√		√
	Smoking status	√	√	√
	Alcohol	√		√
	Physical activity	√	√	√
	Eating patterns/disorder	√	√	√
	Sleep pattern	√		√
Medications	Compliance	√	√	√
	Side effects	√	√	√
	Alternative therapies	√	√	√
	Vaccinations:			
	– Pneumococcus	√		
	– Influenza	√		√
	– Hepatitis B	√		
Self-care	Glucose monitoring	√	√	√
	Independency	√		√
	Accessibility to healthcare	√		√
	Support at home	√		√
	Personal hygiene/oral health	√		√

Table B-2
Comprehensive diabetes medical evaluation by physical examination.

Physical examination	Target procedure or value	Initial visit	Periodic visits	Annual visit
Vitals				
Weight/BMI	<28 kg/m², for BMI 28–35 kg/m², aim for 5–10% weight loss BMI 30 to <40 kg/m², consider bariatric surgery if diabetes is uncontrolled and weight loss is unsuccessful with lifestyle and medication BMI >40, advise to have bariatric surgery if weight loss is unsuccessful with lifestyle modification and medication	✓	✓	✓
Blood pressure (BP)	<140/90 mm Hg	✓	✓	✓
Orthostatic BP	<130/80 in patients with high risk of CVD [1]	✓		✓
Complications				
Skin exam	Look for injection sites, evidence of lipodystrophy, or more frequently if applicable	✓		✓
Fundus examination*		✓		✓
Foot exam for evidence of neuropathy, PAD, deformity or infection	– Inspection (skin integrity, callous, ulcers, gangrene, and toenails) [2]	✓	✓	✓
	– Palpation of peripheral pulses	✓	✓	✓
	– Vibration testing	✓	✓	✓
	– Sensitivity with 10 g monofilament†	✓	✓	✓
	– Ankle Brachial Pressure Index‡	✓		
Systemic				
Cardiovascular	Auscultation of carotid, heart and lung bases	✓		✓
	ECG	✓		✓
	2D echo if symptoms or signs of heart failure	✓		✓
Abdomen	Liver	✓		✓
Lower limbs	Look for oedema, lipodystrophy	✓		✓

2D, 2-dimensional; ABI, Ankle Brachial Pressure Index; BMI, body mass index; ECG, electrocardiogram; PAD, peripheral vascular disease. * Digital fundus examination is the preferred method. Refer to specialist every 2 years if no retinopathy and more frequently as necessary. † 10-g monofilament test should be performed with at least one other assessment (pinprick, temperature or vibration) [3]. ‡ An Ankle Brachial Pressure Index (ABI) should be performed on a patient with diabetes who is >50 years of age; or in under 50 years of age and has other PAD risk factors (e.g. smoking, HTN, lipids); or a duration of diabetes of >10 years. The ABI should be repeated in 5 years if normal [2, 4].

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Table B-3
Comprehensive diabetes medical evaluation by laboratory tests.

Test	Target	Initial visit	Periodic visits	Annual visit
Glycaemia				
Blood glucose levels	FPG 5–7 mmol/L (90–126 mg/dL) RBG or 2 h post-prandial BG 7–10 mmol/L (126–180 mg/dL)*	✓	✓	✓
HbA1c†	≤7% (53 mmol/mol) – individualised 6.5–7.5% (48–58 mmol/mol) in majority of patients*	✓	✓	✓
Lipids profile‡				
– Total cholesterol	<4.0 mmol/L (<160 mg/dL)	✓		✓
– LDL		✓		✓
– Very high risk	<1.4 mmol/L (<55 mg/dL)			
– High risk	<1.8 mmol/L (<70 mg/dL)			
– Moderate risk	<2.6 mmol/L (<100 mg/dL)			
– Low risk	<3.0 mmol/L (<116 mg/dL)			
– Triglycerides	<2.0 mmol/L (<178 mg/dL)	✓		✓
Kidney function				
– Electrolytes	eGFR >60 mL/min/1.73 m^2	✓	✓	✓
– eGFR§		✓		✓
– Urine albumin:creatinine ratio	<3.5 mg/mmol in women <2.5 mg/mmol in men	✓		✓
Other tests				
Liver function tests		✓		✓
Vitamin B$_{12}$	For patients on metformin	✓		✓

HbA1c, haemoglobin HbA1c; FPG, fasting blood glucose; LDL, low-density lipoproteins; HDL, high-density lipoproteins; eGFR, estimated glomerular filtration rate; RBG, random blood glucose. * Less stringent targets between 7.5 and 8.0% (58–64 mmol/mol) can be recommended for elderly, patients with short life expectancy, recurrent hypoglycaemia, and hypoglycaemia unawareness [5, 6]. † The recommended frequency of HbA1c testing is 2–4 times per year [7]. ‡ The recommended frequency of lipids testing is 1–3 times per year. Patients without dyslipidaemia and not on lipid lowering agents, testing can be less frequent. ** LDL target is based on the ESC/EAS risk categorisation mentioned in Figure 2. § eGFR and liver function tests can be done more frequently based on the condition of the patient upon initiation or dose modification of medications.

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Appendix C

Detailed Information on Anti-Diabetic Medication

Generic name Brand name	Efficacy	Hypo- glycaemia	Weight change	CV effects		Cost	Oral/SQ	Renal effects		Additional considerations
				ASCVD	HF			progression of DKD	dosing/ use consideration	
Metformin	High	No	Neutral (potential for modest loss)	Potential benefit	Neutral	Low	Oral	Neutral	– Contraindicated with eGFR <30 mL/min/1.73 m^2	– Gastrointestinal side effects common (diarrhoea, nausea) – Potential for B12 deficiency
SGLT-2 inhibitors	Inter- mediate	No	Loss	Benefit: empagliflozin[†], canagliflozin	Benefit: empagliflozin[†], canagliflozin, dapagliflozin[‡]	High	Oral	Benefit: canagliflozin[§], empagliflozin, dapagliflozin	– Renal dose adjustment required (canagliflozin, dapagliflozin, empagliflozin, ertugliflozin)	– FDA Black Box: Risk of amputation (canagliflozin) – Risk of bone fractures (canagliflozin) – DKA risk (all agents, rare in T2DM) – Genitourinary infections – Risk of volume depletion, hypotension – ↑ LDL cholesterol – Risk of Fournier's gangrene
GLP-1 RAs	High	No	Loss	Neutral: lixisenatide Benefit: See label indication of reducing CVD events	Neutral	High	SQ; oral (sema- glutide)	Benefit: liraglutide	– Renal dose adjustment required (exenatide, lixisenatide) – Caution when initiating or increasing dose due to potential risk of acute kidney injury	– FDA Black Box: Risk of thyroid C-cell tumours (liraglutide, albiglutide, dulaglutide, exenatide) – Gastrointestinal side effects common (nausea, vomiting, diarrhoea) – Injection site reactions – ?Acute pancreatitis risk
DPP-4 inhibitors	Inter- mediate	No	Neutral	Neutral	Potential risk: saxagliptin	High	Oral	Neutral	– Renal dose adjustment required (sitagliptin, saxagliptin, alogliptin); can be used in renal impairment – No dose adjustment required for linagliptin	– Potential risk of acute pancreatitis – Joint pain
Thiazolidinediones	High	No	Gain	Potential benefit: pioglitazone	Increased risk	Low	Oral	Neutral	– No dose adjustment required – Generally not recommended due to potential for fluid retention	– FDA Black Box: Congestive heart failure (pioglitazone, rosiglitazone) – Fluid retention (oedema; heart failure) – Benefit in NASH – Risk of bone fractures – Bladder cancer (pioglitazone) – ↑ LDL cholesterol (rosiglitazone)
Sulfonylureas	High	Yes	Gain	Neutral	Neutral	Low	Oral	Neutral	– Glyburide: not recommended – Glipizide and glimepiride: initiate conservatively to avoid hypoglycaemia	– FDA Special Warning on increased risk of CV mortality based on studies of an older sulfonylurea (tolbutamide)
Insulin										
Human insulin	Highest	Yes	Gain	Neutral	Neutral	Low	SQ: Inhaled		– Lower insulin doses required with a decrease in eGFR; titrate per clinical response	– Injection site reactions – Higher risk of hypoglycaemia with human insulin (NPH or premixed formulations) vs. analogues
Analogues						High	SQ			

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