المبادئ الإرشادية السريرية لدولة قطر
NATIONAL CLINICAL GUIDELINES FOR QATAR

Clinical Guidelines

for the State of Qatar

The diagnosis and management of type 1 diabetes mellitus in adults and the elderly

Ministry of Public Health
P.O. Box 42,
Doha, Qatar

Phone: (+974)4 407 0969
E-mail: clinicalguidelines@moph.gov.qa

Date issued: December 2016
Date of next revision: April 2019

TRANSFORMING HEALTHCARE

الاستراتيجية الوطنية للصحة
National Health Strategy

Version history

Version	Status	Date	Editor	Description
1.0	Final	24th April 2017	Guidelines Team	Final version for publication.

Acknowledgements

The following individuals are recognised for their contribution to the successful implementation of the National Diabetes Guidelines.

Healthcare Quality Management and Patient Safety Department of the MOPH:

- **Ms Huda Amer Al-Katheeri**, *Acting Director & Project Executive.*
- **Dr Alanoud Saleh Alfehaidi**, *Guideline & Standardisation Specialist.*
- **Dr Ilham Omer Siddig**, *Guideline & Standardisation Specialist.*
- **Ms Maricel Balagtas Garcia**, *Guideline & Standardisation Coordinator.*
- **Dr Rasmeh Ali Salameh Al Huneiti**, *Research Training & Education Specialist.*
- **Mr Mohammad Jaran**, *Risk Management Coordinator.*

Contributors:

- **Prof Abdul Badi Abou Samra**, *Chairman, Department of Medicine, Hamad Medical Corporation, Director of Qatar Metabolic Institute and Co-Chair of the National Diabetes Committee.*
- **Dr Al-Anoud Mohammed Al-Thani**, *Manager, Health Promotion & Non-Communicable Diseases, MOPH and Co-Chair National Diabetes Committee.*
- **Mr Steve Phoenix**, *Chief of General Hospitals Group & Senior Responsible Owner of Pillars 3 & 4 of the National Diabetes Strategy, Hamad Medical Corporation.*
- **Dr Mahmoud Ali Zirie**, *Senior Consultant, Head of Endocrinology, Hamad General Hospital & Senior Responsible Officer for Pillar 3 of the National Diabetes Strategy.*
- **Dr Samya Ahmad Al Abdulla**, *Senior Consultant Family Physician, Executive Director of Operations, Primary Health Care Corporation.*
- **Dr Aiman Hussein Farghaly**, *Public Health Specialist, Public Health Department MOPH*
- **Mr Daniel Mills**, *Assistant Executive Director, Hamad Medical Corporation.*
- **Ms Ioanna Skaroni**, *Strategy Manager, Hamad Medical Corporation.*

Hearst Health International:

- **Dr Mehmood Syed,** *Middle East Clinical Director & Project Clinical Lead.*
- **Mr Michael Redmond,** *Clinical Programmes Manager.*
- **Ms Deepti Mehta,** *Editorial and Research Manager.*
- **Ms Rebecca Cox,** *Editorial and Research Team Leader.*
- **Ms Shuchita Deo,** *Lead Editorial Assistant.*
- **Ms Siobhan Miller,** *Editorial Assistant.*
- **Ms Fatima Rahman,** *Editorial Assistant.*
- **Ms Tahmida Zaman,** *Editorial Assistant.*
- **Ms Emma Ramstead,** *Information Specialist.*
- **Dr Amy Glossop,** *Clinical Editor.*
- **Dr Zara Quail,** *Clinical Editor.*
- **Dr Sabine Fonderson,** *Clinical Editor.*

Table of contents

1 Information about this guideline

1.1 Objective and purpose of the guideline

The purpose of this guideline is to define the appropriate diagnosis and management of type 1 diabetes mellitus in adults and the elderly. The objective is to improve the appropriateness of investigation, prescribing and referral of patients presenting to provider organisations in Qatar. It is intended that the guideline will be used primarily by physicians in primary care and outpatient settings.

1.2 Scope of the guideline

Aspects of care covered within this guideline include:

- Assessment and management of type 1 diabetes mellitus in adults and elderly including:
    - Diagnosis.
    - Lifestyle management.
    - Pharmacological management.
    - Considerations in older adults.

Aspects of care not covered within this guideline include:

- Type 1 diabetes mellitus in children and adolescents.
- Management of diabetes in pregnancy.
- Detailed discussion of the chronic complications of type 1 diabetes.

1.3 Editorial approach

This guideline document has been developed and issued by the Ministry of Public Health of Qatar (MOPH), through a process which aligns with international best practice in guideline development and localisation. The guideline will be reviewed on a regular basis and updated to incorporate comments and feedback from stakeholders across Qatar.

The editorial methodology, used to develop this guideline, has involved the following critical steps:

- Extensive literature search for well reputed published evidence relating to the topic.
- Critical appraisal of the literature.
- Development of a draft summary guideline.
- Review of the summary guideline with a Guideline Development Group, comprised of practising physicians and subject matter experts from across provider organisations in Qatar.
- Independent review of the guideline by the Clinical Governance body appointed by the MOPH, from amongst stakeholder organisations across Qatar.

Explicit review of the guideline by patient groups was not undertaken.

Whilst the MOPH has sponsored the development of the guideline, the MOPH has not influenced the specific recommendations made within it.

1.4 Sources of evidence

The professional literature published in the English language has been systematically queried using specially developed, customised, and tested search strings. Search strategies are developed to allow

efficient yet comprehensive analysis of relevant publications for a given topic and to maximise retrieval of articles with certain desired characteristics pertinent to a guideline.

For each guideline, all retrieved publications have been individually reviewed by a clinical editor and assessed in terms of quality, utility, and relevance. Preference is given to publications that:

1. Are designed with rigorous scientific methodology.
2. Are published in higher-quality journals (i.e. journals that are read and cited most often within their field).
3. Address an aspect of specific importance to the guideline in question.

Where included, the 'goal length of stay' stated within this guideline is supported by and validated through utilisation analysis of various international health insurance databases. The purpose of database analysis is to confirm the reasonability and clinical appropriateness of the goal, as an achievable benchmark for optimal duration of inpatient admission.

1.5 Evidence grading and recommendations

Recommendations made within this guideline are supported by evidence from the medical literature and where possible the most authoritative sources have been used in the development of this guideline. In order to provide insight into the evidence basis for each recommendation, the following evidence hierarchy has been used to grade the level of authoritativeness of the evidence used, where recommendations have been made within this guideline.

Where the recommendations of international guidelines have been adopted, the evidence grading is assigned to the underlying evidence used by the international guideline. Where more than one source has been cited, the evidence grading relates to the highest level of evidence cited:

- **Level 1 (L1):**
  - Meta-analyses.
  - Randomised controlled trials with meta-analysis.
  - Randomised controlled trials.
  - Systematic reviews.

- **Level 2 (L2):**
  - Observational studies, examples include:
    - Cohort studies with statistical adjustment for potential confounders.
    - Cohort studies without adjustment.
    - Case series with historical or literature controls.
    - Uncontrolled case series.
  - Statements in published articles or textbooks.

- **Level 3 (L3):**
  - Expert opinion.
  - Unpublished data, examples include:
    - Large database analyses.
    - Written protocols or outcomes reports from large practices.

In order to give additional insight into the reasoning underlying certain recommendations and the strength of recommendation, the following recommendation grading has been used, where recommendations are made:

- **Recommendation Grade A1 (RGA1):** Evidence demonstrates at least moderate certainty of at least moderate net benefit.
- **Recommendation Grade A2 (RGA2):** Evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care.
- **Recommendation Grade B (RGB):** Evidence is insufficient, conflicting, or poor and demonstrates an incomplete assessment of net benefit vs harm; additional research is recommended.
- **Recommendation Grade C1 (RGC1):** Evidence demonstrates a lack of net benefit; additional research is recommended.
- **Recommendation Grade C2 (RGC2):** Evidence demonstrates potential harm that outweighs benefit; additional research is recommended.
- **Recommendation of the GDG (R-GDG):** Recommended best practice on the basis of the clinical experience of the Guideline Development Group members.

1.6 Guideline Development Group members

The following table lists members of the Guideline Development Group (GDG) nominated by their respective organisations and the Clinical Governance Group. The GDG members have reviewed and provided feedback on the draft guideline relating to the topic. Each member has completed a declaration of conflicts of interest, which has been reviewed and retained by the MOPH.

Guideline Development Group members		
Name	**Title**	**Organisation**
Dr Abeer Abu Abbas	Clinical Operations & Support Manager	Primary Health Care Corp
Dr Hamda Abdulla M K Ali	Consultant Endocrinologist, Associate Programme Director for Endocrine Fellowship Programme	Hamad Medical Corp
Dr Dabia Hamad S H Al-Mohanadi	Senior Consultant Endocrinologist, Head of Technology and Diabetes Unit	Hamad Medical Corp
Dr Ahmed M. Hussein Babiker	Head of Registration Section & Clinical Pharmacist	Dept of Pharmacy and Drug Control, MOPH[1]
Mr Ragae Ahmad M. Dughmosh	Senior Patient Educator - Diabetes	Hamad Medical Corp
Dr Mohammed El-Rishi	Consultant Endocrinologist	Al Ahli Hospital
Dr Arif Mahmood	Consultant, Family Medicine	Qatar Petroleum
Dr Mohsin Saleh Ahmed Mismar	NCD Service Development Lead	Primary Health Care Corp
Dr Navas Naddukkandiyil	Chair of Quality & Patient Safety Geriatric Medicine	Hamad Medical Corp
Mr Basim Odeh	Nursing Affairs Specialist	Primary Health Care Corp
Dr Mahmoud Ali Zirie	Senior Consultant & Head of Endocrinology	Hamad Medical Corp

[1] Dr Ahmed Babiker attended the MOPH in his capacity as a Clinical Pharmacist and advisor on the availability of medications in Qatar.

1.7 Responsibilities of healthcare professionals

This guideline has been issued by the MOPH to define how care should be provided in Qatar. It is based upon a comprehensive assessment of the evidence as well as its applicability to the national context of Qatar. Healthcare professionals are expected to take this guidance into account when exercising their clinical judgement in the care of patients presenting to them.

The guidance does not override individual professional responsibility to take decisions which are appropriate to the circumstances of the patient concerned. Such decisions should be made in consultation with the patient, their guardians, or carers and should consider the individual risks and benefits of any intervention that is contemplated in the patient's care.

1.8 Abbreviations used in this guideline

The abbreviations used in this guideline are as follows:

ACC/AHA	American College of Cardiology / American Heart Association
ACE	Angiotensin converting enzyme
ACR	Albumin-creatinine ratio
ADL	Activities of daily living
Anti-TPO	Anti-thyroid peroxidase antibody
ARB	Angiotensin receptor blocker
ASCVD	Atherosclerotic cardiovascular disease
BG	Blood glucose
BMI	Body mass index
BP	Blood pressure
CCB	Calcium channel blocker
CGM	Continuous glucose monitoring
CSII	Continuous subcutaneous insulin infusion
DAFNE	Dose Adjustment For Normal Eating
DKA	Diabetic ketoacidosis
DSME	Diabetes self-management education
DSMS	Diabetes self-management support
eGFR	Estimated glomerular filtration rate
GADA	Glutamic acid decarboxylase antibodies
HAAF	Hypoglycaemia-associated autonomic failure
HBA_{1c}	Glycated haemoglobin
LDL-C	Low density lipoprotein-cholesterol
MDI	Multiple-dose insulin injections
MDT	Multidisciplinary team

MOPH	Ministry of Public Health of Qatar
MNT	Medical nutrition therapy
NPH	Neutral protamine Hagedorn
OGTT	Oral glucose tolerance test
PHQ	Patient health questionnaire
SSI	Sliding scale insulin
SMBG	Self-monitoring of blood glucose
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
TDD	Total daily dose
TSH	Thyroid stimulating hormone

2 Organisation of care in Qatar

2.1 Role of the Ministry of Public Health

The Ministry of Public Health of Qatar (MOPH) has been given the responsibility to guide reform in Qatar in order to establish one of the world's most admired and renowned healthcare systems. The MOPH's role is to create a clear vision for the nation's health direction, set goals and objectives for the country, design policies to achieve the vision, regulate the medical landscape, protect the public's health, set the health research agenda, and monitor and evaluate progress towards achieving those objectives.

The MOPH has the dual mandate to develop policies and programmes to improve the people's health so that they may enjoy longer and more productive lives, and to lay the foundation for a vibrant country for decades to come.

The MOPH does not provide clinical services. Instead its goal is to vest responsibility for care in the hands of both public and private sector healthcare institutions, whilst regulating, monitoring, and evaluating this care against agreed upon outcomes. The MOPH is committed to establishing an environment that promotes quality and wellness through policies in such areas as public health, health insurance, information technology, licensure and credentialing; and continuing medical education.

2.2 Provision of care

Healthcare provision in Qatar comprises of the following main entities:

- Public Sector:
    - Primary care health centres - provided by the Primary Health Care Corporation of Qatar.
    - Secondary and tertiary care hospitals and outpatient clinics - provided by the Hamad Medical Corporation (HMC).
    - Paediatric Emergency Care provided by specialist Paediatric Emergency Centres within HMC.
    - QP Clinics for personnel and families of Qatar Petroleum.
    - Sports Medicine centre provided by a specialist Sport Medicine Hospital – Aspetar.
    - Ministry of Interior clinics for personnel and families of Qatar's police services.
    - Ministry of Defence clinics for personnel and families of Qatar's armed forces.
    - Specialist obstetric, gynaecological and paediatric care provided by Sidra Medical & Research Center.

- Private sector:
    - A range of single-handed generalist and specialist clinics.
    - Polyclinics.
    - Specialist hospitals.

The aim of the MOPH's National Health Strategy is to rebalance healthcare delivery with a greater emphasis on primary and community care and an expansion of the role played by the private sector.

3 Key recommendations of the guideline

The key recommendations of this guideline are:

Clinical presentation (see *Section 5*):

- The clinical presentation of type 1 diabetes (T1DM) in adults:
    - Typically has a more gradual onset than in children, with slower destruction of beta-cells [1,2].
    - May initially appear consistent with type 2 diabetes mellitus (T2DM), and differentiating between T1DM and type 2 diabetes (T2DM) may be challenging [2].
    - Clinical clues suggestive of T1DM may include: A lean individual with [2]:
        - Clinical symptoms of hyperglycaemia.
        - Without a first-degree relative with diabetes.
        - But often with a history of distant relatives with T1DM or other autoimmune disease.
        - It should be noted that obesity does not rule out autoimmunity.
    - Adults may retain sufficient beta-cell function to prevent ketoacidosis for many years [1].

Diagnosis (see *Section 6)*:

- Diagnostic criteria for the diagnosis of T1DM requires one of the following [1]:
    - Fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) (where fasting is for at least 8 hours).
    - 2-hour plasma glucose ≥11.1 mmol/L (200 mg/dL) during an oral glucose tolerance test (OGTT) performed using a glucose load containing the equivalent of 75g anhydrous glucose dissolved in water.
    - In patients with classic symptoms of hyperglycaemic crisis or hyperglycaemia, a random plasma glucose of ≥11.1 mmol/L (200 mg/dL).
    - HBA_{1C} of ≥6.5%:
- A second diagnostic test is required to confirm the diagnosis, unless [1][**L2**]:
    - Patient is in hyperglycaemic crisis.
    - Patient has classic symptoms of hyperglycaemia and a random plasma glucose ≥11.1 mmol/L (200 mg/dL).
    - The results are unequivocal [**R-GDG**].
- A diagnosis of T1DM should be considered, if hyperglycaemia and/or osmotic symptoms (i.e. polyuria, polydipsia) persists in a patient, suspected to have T2DM treated with non-insulin agents [2][**L2**].

Multidisciplinary team approach (see *Section 7*):

- All adults diagnosed with type 1 DM should be referred to a secondary/specialist diabetology service and receive care within a multidisciplinary team (MDT), which includes the following [**R-GDG**]:
    - Physicians.
    - Nurses.
    - Diabetes educator.
    - Dieticians.
    - Podiatrists.
    - Clinical pharmacists, if available.
    - Other professionals which may form part of the team may include:
        - Exercise therapists.
        - Mental health professionals (psychologists).
        - Ophthalmologists.

Management (see *Section 7*):

- The treatment approach includes [1]:
  - Diabetes self-management education (DSME).
  - Diabetes self-management support (DSMS).
  - MNT.
  - Education on physical activity.
  - Psychosocial care.
  - Screening for complications and comorbidities.
  - Preventive care services [1]:
    - Immunisation.
    - Referral for smoking cessation.
    - Podiatric, ophthalmological, and dental referrals.
  - If any of the above not available in the immediate care settings refer the patient to the appropriate setting [**R-GDG**].

Insulin therapy (see *Section 8*):

- Treatment for T1DM consists of the following [1]:
  - Intensive insulin therapy consisting of multiple-dose insulin injections (MDI) or continuous subcutaneous insulin infusion (CSII) therapy, i.e. insulin pump [1][**L1, RGA1**]:
    - MDI should include three or more injections of prandial insulin per day, and one or two injections of basal insulin [2][**L1**].
  - Match prandial insulin to carbohydrate intake, pre-meal BG, and expected physical activity [1][**L3, RGA2**].
  - Insulin analogues should be used for most patients, especially those at elevated risk of hypoglycaemia to reduce hypoglycaemia risk [1][**L1, RGA1**].
  - A sensor-augmented low-glucose threshold-suspend pump, may be considered for patients with [1][**L2**]:
    - Frequent nocturnal hypoglycaemia.
    - Recurrent severe hypoglycaemia; and/or
    - Hypoglycaemia unawareness.

Treatment targets (see *Section 7.12*):

- The target BG and HBA_{1C} levels for non-pregnant adults are as follows [1]:
  - Before meals: 4.4 – 7.2 mmol/L (80 – 130 mg/dL).
  - Peak post-prandial: <10.0 mmol/L (<180 mg/dL).
  - HBA_{1C}: <7.0%.

Treatment targets in the elderly (see *Section 7.13*):

- In elderly patients who are cognitively and functionally intact and have significant life expectancy, consider setting treatment targets which are similar to those used in younger adults [6][**L3, RGA2**].
- Blood glucose targets may be relaxed in elderly adults on an individual basis, e.g. in patients with [1][**L3, RGA2**]:
  - Advanced diabetes.
  - Life-limiting comorbid illness.
  - Substantial cognitive or functional impairment.
- Hyperglycaemia leading to risk or symptoms of acute hyperglycaemic complications should be avoided in all patients [1][**L3, RGA2**].
- At a minimum, glycaemic goals should avoid acute complications of diabetes, including [1][**L2**]:
  - Dehydration.

    - Poor wound healing.
    - Hyperglycaemic hyperosmolar coma.
- See *Table 7.13* for blood glucose targets in specific patient groups.

Hypoglycaemia prevention and management (see *Section 11*):

- Patients at risk for hypoglycaemia should be asked about symptomatic and asymptomatic hypoglycaemia at each encounter [1][**L2**].
- Patients should understand the situations that increase their risk of hypoglycaemia, such as [1]**[L2]**:
    - Taking insulin without eating adequately.
    - Fasting (e.g. for tests or procedures or if fasting during Ramadan).
    - During or after intense exercise.
    - During sleep.
- Teaching patients how to balance their insulin use with their carbohydrate intake and exercise is required to reduce the risk of hypoglycaemia, however this method is not always sufficient for prevention [1][**L2**].
- Those in close contact with hypoglycaemia-prone patients should be educated in the use of glucagon kits [1][**L2**].
- Elderly patients in long term care facilities are at increased risk of hypoglycaemia [1]:
    - Assess for hypoglycaemia at least every 30 days for the first 90 days after admission, and then at least every 60 days thereafter [1][**L2**].
    - An alert strategy and protocol should be in place and the provider should be called in case of hypoglycaemia, hyperglycaemia, or the patient is unwell [1,4].
- Ongoing assessment of cognitive function is suggested [1,4][**L2, RGA2**]:
    - If low or declining cognition is detected, the clinician, patient, and caregivers should pay increased attention to hypoglycaemia risk.
    - Education should cover how to properly use flexible insulin therapy using basal-bolus regimens.
    - If impaired hypoglycaemia awareness is ongoing, offer additional education with a focus on avoiding and treating hypoglycaemia.

4 Background information

4.1 Classification

Type 1 diabetes mellitus (T1DM):

- Arises as the result of beta-cell insufficiency or destruction, usually leading to absolute insulin deficiency [1,2].

Immune mediated T1DM [1]:

- Due to cellular-mediated autoimmune destruction of pancreatic beta-cells.
- Is defined by the presence of one or more autoimmune markers [1]:
- Strong HLA associations, with linkage to the DQA and DQB genes [1]:
    - HLA-DR/DQ alleles can either predispose to, or protect against, T1DM.

Idiopathic T1DM [1]:

- Insulinopaenia in the absence of beta-cell autoimmunity.
- Strongly inherited (usually of African or Asian ancestry) and not HLA-associated.
- Patients typically have an intermittent requirement for insulin replacement therapy [**R-GDG**].

4.2 Risk factors

Risk factors:

- Family member with T1DM (15-fold increase in risk) [2].
- Genetics:
    - Predisposing haplotypes include [3]:
        - DRB1*0401-DQB1*0302.
        - DRB1*0301-DQB1*0201.
- Viral infections [3].
- Psychological trauma [3].

4.3 Epidemiology

The 2013 prevalence of T1DM in children in Qatar was 11.4 per 100,000 [3]. The incidence and prevalence of T1DM is increasing worldwide [1,3].

Immune mediated diabetes [1]:

- Accounts for 5-10% of diabetes.
- Most commonly manifests in childhood and adolescence, but may also occur later in life.

5 Clinical presentation

5.1 Presentation

T1DM is typically diagnosed on the basis of clinical symptoms associated with insulin deficiency [1,2]:

- Polyuria.
- Polydipsia.
- Weight loss.
- Marked hyperglycaemia that is not responding to oral agents.
- Acute onset includes:
    - Classic symptoms of hyperglycaemia or hyperglycaemic crisis.

- Random plasma glucose of ≥ 11.1 mmol/L (200 mg/dL).

Clinical presentation in adults:

- Typically has a more gradual onset than in children, with slower destruction of beta-cells [1,2].
- May initially appear consistent with type 2 diabetes mellitus (T2DM), and differentiating between T1DM and T2DM may be challenging [2].
- Clinical clues suggestive of T1DM may include: A lean individual with [2]:
  - Clinical symptoms of hyperglycaemia.
  - Without a first-degree relative with diabetes.
  - But often with a history of distant relatives with T1DM or other autoimmune disease.
  - It should be noted that obesity does not rule out autoimmunity.
- Adults may retain sufficient beta-cell function to prevent ketoacidosis for many years [1].

Diagnose T1DM on clinical grounds in adults presenting with hyperglycaemia, whilst considering that patients will often have one or more of the following [4]:

- Ketosis.
- Rapid weight loss.
- BMI below 25 kg/m^2.
- Personal and/or family history of autoimmune disease.

5.2 History

Take a comprehensive medical history, including [1][**L2**]:

- Age and features of onset of diabetes, e.g.:
  - Diabetic ketoacidosis (DKA), asymptomatic laboratory finding etc.
- Eating patterns.
- Nutritional status.
- Weight history.
- Physical activity habits.
- Nutrition education and behavioural support history and needs.
- Presence of co-morbidities including psychosocial disorders and dental disease
- Screen for depression using the patient health questionnaire-2 (PHQ-2) (use the PHQ-9, if PHQ-2 is positive).
- History of smoking, alcohol consumption, substance use.
- History of diabetes education and self-management plans
- Review of previous treatment regimens
- Review of previous response to diabetic medications
- Results of previous glucose monitoring.
- History of DKA:
  - Frequency.
  - Severity.
  - Cause.
- History of hypoglycaemic episodes:
  - Awareness.
  - Frequency.
  - Causes.
- History of hypertension.
- History of hypercholesterolaemia.

- Microvascular complications:
  - Retinopathy.
  - Nephropathy.
  - Neuropathy:
    - Sensory, including history of foot lesions.
    - Autonomic, including sexual dysfunction and gastroparesis.
- Macrovascular complications:
  - Coronary heart disease.
  - Cerebrovascular disease.
  - Peripheral arterial disease.

5.3 Physical examination

Conduct a general physical examination noting in particular the following [1][**L2**]:

- Height, weight and body mass index (BMI).
- Blood pressure (BP), including orthostatic BP, if indicated.
- Head and neck examination including:
  - Thyroid enlargement.
- Skin stigmata (e.g. striae, acanthosis nigricans, hyperpigmentation, alopecia or vitiligo).
- Comprehensive foot examination, including [**R-GDG**]:
  - Inspection for skin damage.
  - Palpation of dorsalis pedis and posterior tibialis pulses.
  - Absence or presence of patellar and Achilles tendon reflexes.
  - A full neurological examination including proprioception, vibration, and monofilament sensation.

5.4 Complications and comorbidity assessment

Complications of T1DM include [1]:

- Diabetic kidney disease.
- Diabetic retinopathy.
- Neuropathy.
- Foot ulcers.
- Charcot foot.
- Foot amputations.

In elderly patients, screening for diabetes complications should [1]:

- Be individualised.
- Focus on complications that lead to functional impairment and/or can appear over short time period, e.g.:
  - Visual complications.
  - Lower-extremity complications.
- Include screening for [1,5]
  - Depression and treat if detected.
  - Cognitive dysfunction.
  - Functional status.
  - Fall risk.

Commonly associated conditions include [1,2].:

- Atherosclerotic cardiovascular disease (ASCVD)

- Fatty liver disease.
- Fractures due to osteoporosis.
- Low serum levels of testosterone in men.
- Periodontal disease.
- Cognitive impairment in long-standing and poorly controlled T1DM.

Patients with autoimmune T1DM are also prone to other autoimmune disorders, such as [1]:

- Hashimoto's thyroiditis.
- Coeliac disease.
- Graves' disease.
- Addison's disease.
- Vitiligo.
- Autoimmune hepatitis.
- Myasthenia gravis.
- Pernicious anaemia.

6 Investigation

6.1 Initial tests

Diagnostic criteria for the diagnosis of T1DM requires one of the following [1]:

- Fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) (where fasting is for at least 8 hours).
- 2-hour plasma glucose ≥11.1 mmol/L (200 mg/dL) during an oral glucose tolerance test (OGTT) performed using a glucose load containing the equivalent of 75g anhydrous glucose dissolved in water.
- In patients with classic symptoms of hyperglycaemic crisis or hyperglycaemia, a random plasma glucose of ≥11.1 mmol/L (200 mg/dL).
- HBA_{1C} of ≥6.5%:
    - Does not require the patient to fast.
    - Some haemoglobinopathies and anaemias may make interpretation difficult:
        - For patients with abnormal haemoglobin but normal red blood cell turnover, an HBA_{1C} assay without interference from abnormal haemoglobins should be used [6][**L2**].

NB [6,7]:

- A second diagnostic test is required to confirm the diagnosis, unless [1][**L2**]:
    - Patient is in hyperglycaemic crisis.
    - Patient has classic symptoms of hyperglycaemia and a random plasma glucose ≥11.1 mmol/L (200 mg/dL).
    - The results are unequivocal [**R-GDG**].
- If a second test is required, the same diagnostic test should be used with a new blood sample.
- If a patient has had inconsistent results from two diagnostic tests, the test result that is above the diagnostic threshold should be repeated without delay.
- If a repeat test is below the diagnostic threshold, the test should be repeated again after 3-6 months.
- Only blood glucose (BG) criteria should be used to diagnose diabetes in conditions associated with increased red blood cell turnover, e.g.:
    - Erythropoietin therapy.
    - Pregnancy (second and third trimesters).
    - Recent blood loss or transfusion.

    - Haemolysis.
- A diagnosis of T1DM should be considered, if hyperglycaemia and/or osmotic symptoms (i.e. polyuria, polydipsia) persists in a patient, suspected to have T2DM treated with non-insulin agents [2][**L2**].

6.2 Further laboratory evaluation

Perform the following test [1][**L2**]:

- HBA_{1C}: If a result from the past 3 months is not available.
- If not performed in the last 12 months:
    - Fasting lipid profile.
    - Liver function tests.
    - Spot urinary albumin-creatinine ratio (ACR).
    - Serum creatinine and estimated glomerular filtration rate (eGFR).
    - Thyroid stimulating hormone (TSH):
        - If abnormal, consider testing for anti-thyroid peroxidase antibody (Anti-TPO).
- Screening for autoimmune markers:
    - Autoimmune markers of immune-mediated diabetes include [1,2]:
        - Islet cell autoantibodies.
        - Insulin autoantibodies.
        - Glutamic acid decarboxylase antibodies (GADA).
    - Autoantibody titres diminish as time passes from diagnosis [2].
    - The lowest false-positive rate is at the time of diagnosis, the rate of false positives increases thereafter [4]:
        - The false negative rate can be reduced by conducting two different tests.
- C-peptide levels measurement [2]:
    - A surrogate marker for insulin secretion.
    - Occasionally needed to confirm T1DM in a patient on insulin.
    - May be detected over 40 years after the initial diagnosis, irrespective of whether the diagnosis was made in childhood or adulthood.
    - The more time that has passed since diagnosis, the higher the discriminative value of C-peptide testing [4].

C-peptide and/or diabetes-specific autoantibody titres should [4]:

- Not be routinely used to confirm T1DM in adults.
- Should be considered if [4][**L2**]:
    - T1DM is suspected, but features are atypical, e.g.:
        - Patient is aged ≥50 years.
        - BMI of ≥30 kg/m^2 [**R-GDG**].
        - Slow evolution of hyperglycaemia.
        - Long prodrome.
    - If there is a clinical suspicion of a monogenic form of diabetes.
    - The classification is uncertain, and confirmation of the diagnosis would alter the therapy.

7 Multidisciplinary approach

All adults diagnosed with type 1 DM should be referred to a secondary/specialist diabetology service and receive care within a multidisciplinary team (MDT), which includes the following [**R-GDG**]:

- Physicians.
- Nurses.
- Diabetes educator.
- Dieticians.
- Podiatrists.
- Clinical pharmacists, if available.
- Other professionals which may form part of the team may include:
    - Exercise therapists.
    - Mental health professionals (psychologists).
    - Ophthalmologists.

The management plan should be individualised to the patient [1]**[L2]**:

- Taking patient and family's needs, circumstances and preferences into account [1,8].
- People with diabetes must also take an active role in their care.
- Health care providers must take into account [1,8]:
    - The patient's age.
    - Comorbidities and diabetes-related complications.
    - Life expectancy.
    - School/work conditions.
    - Lifestyle choices.
    - Social situation.
    - Cultural factors.
    - Polypharmacy.

7.1 Referrals for initial care management

If unavailable within the MDT, consider referral for the following speciality services, after initial diagnosis [1][**L2**]:

- Ophthalmologist for dilated eye exam within 3 months of diagnosis and annual review thereafter.
- Diabetes educator for structured education and support.
- Registered dietician for medical nutrition therapy (MNT).
- Dental referral for a full dental and periodontal exam.
- Mental health professional (psychologist), if indicated.
- Family planning for women of reproductive age.

7.2 Initial diabetes care management

Treatment approach includes [1]:

- Diabetes self-management education (DSME).
- Diabetes self-management support (DSMS).
- MNT.
- Education on physical activity.
- Psychosocial care.
- Screening for complications and comorbidities.
- Preventive care services [1]:

    - Immunisation.
    - Referral for smoking cessation.
    - Podiatric, ophthalmological, and dental referrals.
- If any of the above not available in the immediate care settings refer the patient to the appropriate setting [**R-GDG**].

7.3 Diabetes self-management education and support

All people with diabetes should participate in DSME and DSMS [1][**L1, RGA1**]:

- DSME helps patients to gain the knowledge, skills, and abilities needed for self-care (e.g. *Dose Adjustment For Normal Eating* (DAFNE)[9]).
- DSMS helps the patient implement and sustain skills and behaviours required for ongoing self-management.
- Measure and monitor effective self-management, improved clinical outcomes, health status, and quality of life as part of care [1][**L2**].
- Programmes should be:
    - Patient centred, respectful, and responsive to individual patient preferences, needs, and values, which should guide clinical decisions [1][**L1**].
    - Reviewed by trained, competent and independent assessors who measure it against criteria that ensure consistency

For DSME in older adults [5]:

- Involve care partners (family, friends, or other caregivers).
- Patients may have low health literacy and numeracy skills, and be overwhelmed due to many coexisting conditions.

There are five critical time points for DSME and DSMS delivery [1]:

- At diagnosis.
- An annual assessment to include assessment of diabetes education, nutrition, and psychological support
- When new complicating factors arise that influence self-management.
- When transitions in care occur.
- Special occasions e.g. Ramadan and Hajj [**R-GDG**].

Adult patients should be offered a structured education programme 6-12 months following diagnosis [9].

7.4 Medical nutrition therapy

MNT [1,4]:

- Should be individualised to the patient.
- Implementation should be supported by each member of the care team all of whom should be knowledgeable about the principles of MNT [1][**L2**].
- Should be preferably delivered by a registered dietician [1][**L1, RGA1**].

Goals of MNT include [1]:

- Effectiveness of nutrition therapy.
- Energy balance.
- Eating patterns and both micronutrient and macronutrient distribution.
- If alcohol is consumed, discourage excessive intake.

Nutrition considerations in older adults [1]:

- Older adults living in long term care facilities may have:
    - Irregular meal consumption.
    - Undernutrition.
    - Anorexia.
    - Impaired swallowing.
- Therapeutic diets should be avoided, as they may lead to decreased food intake resulting in weight loss and undernutrition [4].
- Diets considering the patient's culture, preferences, and personal goals may increase quality of life, nutritional status, and satisfaction with meals.

7.5 Smoking cessation

All patients should be advised not to smoke cigarettes, or use other tobacco products [1][**L1**]. Ensure that smoking cessation counselling, or referral to a smoking cessation service, is provided to patients as a routine part of diabetes management [1].

7.6 Physical activity

Physical activity:

- Is recommended for all patients [2][**L3, RGA2**].
- Regimens should be individualised to each patient [1]:
    - Recommendations may need to be altered in the presence of macro- and microvascular complications [2][**L3, RGA2**].

7.6.1 Pre-exercise evaluation

Prior to initiation of physical exercise, completion of the PAR-Q questionnaire is advised (available from: http://www.csep.ca/view.asp?ccid=517). The questionnaire should be completed by patients before starting a moderate to vigorous physical activity programme. If patients answer 'yes' to one or more questions on the form, clearance from a physician should be sought prior to commencement of a physical activity program [10].

Pre-exercise evaluation [1]:

- Take a careful history considering the possibility of an atypical presentation of coronary artery disease.
- Assess for cardiovascular risk factors.
- Assess for conditions that may contraindicate certain types of exercise or predispose the patient to injury, such as:
    - Uncontrolled hypertension.
    - Autonomic neuropathy.
    - Peripheral neuropathy.
    - A history of foot lesions.
    - Untreated proliferative retinopathy.
- Consider the patient's age and previous physical activity levels.
- Patients with complications may require a more in-depth evaluation.

7.6.2 Exercise recommendations

Adults with diabetes should be advised [1]:

- To participate in at least 150 minutes of physical activity per week, reaching 50-70% of maximum heart rate [1][**L1, RGA1**].
- Physical activity should be spread over at least 3 days per week with no more than 2 consecutive days without exercise [1][**L1, RGA1**].
- To take part in muscle strengthening training activities that involve all major muscle groups on 2 or more days/week [1][**L2**].
- To reduce the amount of time they spend sitting [1][**L1, RGA1**]:
    - Extended periods of time spent sitting (more than 90 minutes) should be avoided, advise that these are broken up by briefly standing or walking [1][**L1**].

High risk patients should be encouraged to start with short periods of low-intensity exercise and slowly increase the duration and intensity [1][**L2**].

Adults over the age of 65 years or patients with disabilities should be advised to follow the recommendations for adults under the age of 65 years. If the patient is unable to follow these guidelines, they should be as active as they are physically able [1][**L2**].

NB: Intensive physical activity may increase BG levels rather than lowering them [1][**L2**].

7.7 Immunisation

All adults with T1DM should receive the routine vaccinations in line with general recommendations for the adult population [6]. In addition, the Ministry of Public Health of Qatar (MOPH) Public Health department recommends the following [11,12]:

- Annual influenza vaccination prior to the start of the influenza season.
- Pneumococcal vaccination:
    - 1 dose of PCV13.
    - Up to 3 doses of PPSV23, with the final dose given after the age of 65 years.

7.8 Psychosocial care

Consider the patient's psychosocial circumstances while managing patients with T2DM [1]:

- Psychosocial screening, includes consideration of [1][**L2**]:
    - Attitude about the illness.
    - Expectations surrounding medical management and outcomes.
    - Mood.
    - Quality of life.
    - Resources:
        - Financial.
        - Social.
        - Emotional.
    - Psychiatric history.
- Routinely screen for psychosocial problems, using the PHQ-2 questions [1]:
    - If positive, assess for depression using the PHQ-9 scoring system.

Referral to an appropriate mental health specialist should be considered if [1]:

- Depression, self-harm or suicidal ideation.
- Gross disregard for the medical regimen.
- Debilitating anxiety (alone or with depression).
- Indications of an eating disorder.

- Cognitive function that significantly impairs judgement.

Encourage patients to join the *Qatar Diabetes Association* to promote a healthy lifestyle, emotional support and improve motivation [**R-GDG**].

7.9 Considerations in older adults in long term care

Patients with T1DM residing in long-term care facilities need careful assessment [1,4][**L3, RGA2**]:

- To establish a glycaemic goal.
- To make appropriate choices between glucose lowering agents based on their clinical and functional status.
- To simplify treatment regimens (as these are preferred and better tolerated) [4][**L3, RGA2**].

Insulin considerations in long term care patients [5,13]:

- High risk of hypoglycaemia.
- Matching carbohydrate content with prandial insulin if variable appetite may be difficult.
- The use of sliding scale insulin (SSI) alone for chronic glycaemic management is not recommended in inpatient settings and long term care facilities [5][**L2**].

Comorbidities	Treatment approach
Confusion, cognitive dysfunction, delirium.	• Offer a regular diet and food preferences. • If food intake is <75% of recommended intake, offer food substitutions. • Administer prandial insulin immediately after meals to match carbohydrate intake. • Block testing: • Monitor the patient at different times of the day. • Check fasting glucose on some days, pre-lunch or pre-dinner on other days. • Increase glucose monitoring during acute mental status or behavioural changes.
Depression.	• Assess and treat depression. • Encourage physical activity. • Encourage socialisation, especially during meals.
Physical disability.	• Encourage activity within the patient's abilities. • Assess for pressure ulcers. • Encourage ADL independence.
Skin problems, e.g. infections, ulcers, delayed wound healing.	• Consider a consultation with a dietician • Consider more frequent glucose monitoring and temporary regimen intensification. • Consider non-weight bearing exercises. • Ensure regular skin checks and foot assessments by nursing staff.
Hearing and vision problems.	• Screen for hearing and vision problems and implement preventive strategies if possible.
Oral health problems, teeth decay, dry mouth.	• Regular oral health evaluations and cleaning. • Ensure appropriate daily oral care.

Table 7.9: Older adults in long term care: common comorbidities, and treatment approaches [4].

7.10 Self-monitoring of blood glucose and HBA_{1C}

Patients with T1DM [1,2]:

- Should perform self-monitoring of blood glucose (SMBG) [1,2][**L2, RGA1**]
    - At a minimum, 3-4 times per day, prior to meals and at bedtime.
    - At other times, including:
        - Postprandial.
        - Mid-sleep (c.3-4am), if risk of hypoglycaemia during sleep.
        - Prior to, during, and/or after exercise.
        - When low BG is suspected.
        - After treating low BG until normoglycaemia has been restored.
        - When correcting a high BG level.
        - Prior to critical tasks such as driving and during prolonged journeys of ≥2 hours duration [**R-GDG**].
        - At more frequent intervals during illness or stress.

Make sure that patients receive ongoing instruction and evaluation of their [1][**L3, RGA2**]:

- SMBG technique.
- SMBG results.
- Their ability to use their SMBG results to adjust therapy [1][**L3**].
- These skills should be reviewed at least annually [4].

NB: SMBG should not be routinely carried out using sites other than the fingertips [4].

HBA_{1C} testing:

- Perform HBA_{1C} testing every 3 months [2].
- Consider point of care testing in order to provide quicker treatment changes [1][**L3, RGA2**].

7.11 Continuous glucose monitoring

Continuous glucose monitoring (CGM) [1]:

- Is a useful tool to lower HBA_{1C} in conjunction with intensive insulin regimens in adults with T1DM.
- May be used as a supplemental tool to SMBG in patients with hypoglycaemia unawareness and/or frequent hypoglycaemic episodes [1][**L2**].
- Prior to prescribing CGM assess the patient's individual readiness for continuing CGM [1][**L3**].
- Education, training, and support are needed for optimal CGM initiation and maintenance [1][**L3**].
- Patients should be willing to commit to using it at least 70% of the time and have it calibrated if needed [4].

7.12 Glycaemic targets and testing

For patients with T1DM, a combination of frequent SMBG levels (including CGM), in addition to HBA_{1C}, is the most accurate way of evaluating glycaemic control [1][**L2, RGA1**].

Glycaemic treatment targets:

- Individualise treatment targets based on patient circumstances including [1,2]:
    - Duration of diabetes.
    - Age/life expectancy.
    - Comorbid conditions.

    - Known CVD or advanced microvascular complications.
    - Hypoglycaemia unawareness.
    - Individual patient considerations.
- Agree individualised bedtime and waking plasma glucose goals with each adult patient, considering timing of their last meal and corresponding insulin dose [4].

The target BG and HBA_{1C} levels for non-pregnant adults are as follows [1]:

- Before meals: 4.4 – 7.2 mmol/L (80 – 130 mg/dL).
- Peak post-prandial: <10.0 mmol/L (<180 mg/dL).
- HBA_{1C}: <7.0%.

Note [1]:

- Measure post-prandial BG 1-2 hours after the start of the meal.
- Post-prandial measures may be targeted if pre-prandial values have been attained, but HBA_{1C} remains above the target level.

7.13 Glycaemic targets for elderly patients

In elderly patients who are cognitively and functionally intact and have significant life expectancy, consider setting treatment targets which are similar to those used in younger adults [6][**L3, RGA2**].

BG targets:

- May be relaxed in elderly adults on an individual basis, e.g. in patients with [1][**L3, RGA2**]:
    - Advanced diabetes.
    - Life-limiting comorbid illness.
    - Substantial cognitive or functional impairment.
- Hyperglycaemia leading to risk or symptoms of acute hyperglycaemic complications should be avoided in all patients [1][**L3, RGA2**].
- At a minimum, glycaemic goals should avoid acute complications of diabetes, including [1][**L2**]:
    - Dehydration.
    - Poor wound healing.
    - Hyperglycaemic hyperosmolar coma.

Applicable patient group	Fasting/pre-prandial BG target	Bedtime BG target
Patients with both of the following: • Few coexisting chronic illnesses. • Intact cognitive and functional status.	5.0-7.2 mmol/L (90-130 mg/dL)	5.0-8.3 mmol/L (90-150 mg/dL)
Patients with any of the following: • Multiple coexisting chronic illnesses. • ≥2 instrumental impairments of activities of daily living (ADL). • Mild to moderate cognitive impairment.	5.0-8.3 mmol/L (90-150 mg/dL)	5.6-10.0 mmol/L (100-180 mg/dL)
Patients with any of the following: • ≥2 ADL dependencies. • Long-term care needs. • End-stage chronic illnesses. • Moderate to severe cognitive impairment.	5.6-10.0 mmol/L (100-180 mg/dL)	6.1-11.1 mmol/L (110-200 mg/dL)

Table 7.13: Blood glucose targets by patient group [8][**L2**].

In older adults, avoid hyperglycaemia [5]:

- BG levels consistently over the renal threshold [about 10.0-11.1 mmol/L (180–200 mg/dL), but can vary] increase the risk of:
    - Dehydration.
    - Electrolyte abnormalities.
    - Urinary incontinence.
    - Dizziness.
    - Falls.
    - Poor wound healing.
    - Hyperglycaemic hyperosmolar syndrome:
        - A severe complication of unrecognised or undertreated hyperglycaemia in older adults.

8 Pharmacological therapy

8.1 Insulin types

Insulin Type	Trade Name	Onset of Action	Duration of action
Rapid-acting analogues			
Lispro	*Humolog*	5-15 minutes	2-4 hours
Aspart	*Novorapid*		
Glulisine	*Apidra*		
Short-acting			
Human Regular	*Actrapid*	30 minutes	5-8 hours
Intermediate- acting			
Human NPH	*Isophane*	1-3 hours	12-18 hours
Basal insulin analogues			
Glargine	*Lantus*	1-2 hours	20-24 hours
Glargine U300	*Toujeo*	1-2 hours	Up to 36 hours
Detemir	*Levimer*	1-3 hours	6-24 hours
Degludec	*Tresiba*	1-2 hours	up to 42 hours
Premixed (several Type)			
Human regular/NPH	*Human Mixtard 30/70*	Variable	Variable
Lispro/lispro protamine	*Humalog Mix 25/75*	Variable	Variable
Lispro/lispro protamine	*Humalog Mix 50/50*	Variable	Variable
Aspart/aspart protamine	*NovoMix 30/70*	Variable	Variable
Aspart/aspart protamine	*NovoMix 50/50*	Variable	Variable

NPH: Neutral protamine Hagedorn

Table 8.1: Common insulin options available [**R-GDG**].

8.2 Insulin regimens

Treatment for T1DM consists of the following [1]:

- Intensive insulin therapy consisting of multiple-dose insulin injections (MDI) or continuous subcutaneous insulin infusion (CSII) therapy, i.e. insulin pump [1][**L1, RGA1**]:
  - MDI should include three or more injections of prandial insulin per day, and one or two injections of basal insulin [2][**L1**].
- Match prandial insulin to carbohydrate intake, pre-meal BG, and expected physical activity [1][**L3, RGA2**].
- Insulin analogues should be used for most patients, especially those at elevated risk of hypoglycaemia to reduce hypoglycaemia risk [1][**L1, RGA1**].
- A sensor-augmented low-glucose threshold-suspend pump, may be considered for patients with [1][**L2**]:
  - Frequent nocturnal hypoglycaemia.
  - Recurrent severe hypoglycaemia; and/or
  - Hypoglycaemia unawareness.

Use the principles of flexible insulin therapy in adults who use real-time CGM, using one of [4]:

- MDI regimen.
- CSII (i.e. insulin pump).

8.2.1 Insulin administration

Initiation of insulin [**R-GDG**]:

- The recommended total daily dose (TDD) of insulin is approximately 0.5 units/kg.
- 50% of TDD should be from basal insulin and 50% from bolus insulin.

NB: Recommendations on optimal prandial insulin dose administration should be individualised to each patient.

Basal insulin [**R-GDG**]:

- Is usually injected on a once-daily basis (consider twice daily if detemir is used).
- Preferably injected in the evening, approximately one hour before bedtime, but can also be given in the morning, according to the patient's preference.
- Titrate the dose according to the pre-prandial (fasting) glucose level.

The optimal time to inject prandial insulin is based on the following [1][**L2**]:

- The type of insulin used:
  - Offer rapid-acting insulin analogues (rather than rapid-acting soluble human or animal insulins) for mealtime insulin replacement [4].
  - Do not advise rapid-acting insulin analogues for routine use after meals [4].
- The measured BG level.
- Timing of meals.
- Carbohydrate consumption.
- Anticipated physical activity.

CSII (insulin pump) therapy [14]:

- Is recommended as a treatment option if an of the following apply [14]:
  - HBA_{1C} levels remain ≥8.5%, despite intensive MDI therapy.

    - Treatment with MDI results in disabling hypoglycaemia or hypoglycaemia unawareness.
    - Patient preference.
    - Pregnancy.
- CSII should only be initiated by a trained specialist team, including:
    - A physician with a specialist interest in insulin pump therapy.
    - A diabetes specialist nurse.
    - A registered dietician.
- Structured education programmes should be provided by the team which includes information about:
    - Managing insulin pumps.
    - CGM.
    - Carbohydrate counting.
    - The impact of lifestyle and exercise.
- After CSII therapy is started in adults, it should only be continued if continued improvement in glycaemic control is seen by:
    - A reduction in HBA_{1C} levels, or
    - A sustained reduction in the frequency of hypoglycaemic episodes.
    - The physician should discuss and set appropriate targets for these improvements with the patient or their carer.

8.3 Intercurrent illness

Patients and their relatives should be advised of the following general measures to manage intercurrent illness and prevent DKA or hypoglycaemia (i.e. sick-day management)[15]:

Monitoring [15]:

- Increase the frequency of observation of the patient.
- Measure BG every 2-3 hours and ketones every 4 hours.

Food and fluid intake [15]:

- Encourage fluids and rest.
- Encourage normal meals but encourage carbohydrate intake.

8.3.1 Patients on multi-dose injection regimens

Insulin management [**R-GDG**]:

- Basal insulin should always be continued, but doses should be modified if food consumption is less than usual [15].
- If BG is >250 mg/dL (13.9 mmol/L), or ketones are detected in urine:
    - Give additional correction doses of rapid-acing insulin analogues.
    - Encourage eating between doses of rapid-acting insulin analogues.
    - NB:
        - Omit additional doses if the BG is not elevated, even if ketones are present in blood or urine.
        - Ketones should decrease within 8 hours from the first dose of additional insulin.

Specialist advice and support [**R-GDG**]:

- Advise the patient and their family/carer to seek additional advice from the diabetes team.
- Emergency Department attendance is warranted if:

- Ketones remain elevated despite two additional doses of rapid-acting insulin analogues.
- Symptoms of DKA develop.
- The patient or their relatives are concerned about the illness or BG control.
- BG is persistently >300 mg/dL (16.5 mmol/L), despite additional insulin.
- BG is persistently <70 mg/dL (3.9 mmol/L).

8.3.2 Patients using insulin pumps

In addition to the general measures listed above. Patients should be advised to manage their insulin as outlined in *Table 8.3.2* below.

<table>
<tr><th>Blood glucose</th><th>Urinary ketones</th><th>Blood ketones</th><th>Actions</th></tr>
<tr><td><6 mmol/L
(110 mg/dL)</td><td>Negative or positive</td><td>0 - 3 mmol/L</td><td>• Reduce the dose of both basal insulin and any bolus doses by 10 - 20%.
• Encourage consumption of sugar-containing fluids.
• Seek specialist advice if
  ○ Further insulin reductions are required.
  ○ If the patient is unable to drink, or
  ○ If vomiting occurs.
• Administer glucagon if BG remains low.</td></tr>
<tr><td>6 - 14 mmol/L
(110 - 250 mg/dL)</td><td>Negative or positive (any amount)</td><td>0 - 3 mmol/L</td><td>• Give the usual insulin at the usual time.
• Do NOT give extra insulin.
• Retest BG in 2-4 hours.</td></tr>
<tr><td rowspan="2">>14 mmol/L
(250 mg/dL)</td><td>negative or small (+)</td><td>0 - 0.6 mmol/L</td><td>• Temporarily increase the basal insulin rate by 20%.
  ○ Further increases may be required if BG remains elevated.
• Give an additional bolus dose of insulin - up to 10% of the TDD.
• Retest BG in 2-4 hours.</td></tr>
<tr><td>moderate or large (+, ++)</td><td>0.7 - 3 mmol/L</td><td>• Temporarily increase the basal rate by 20%.
  ○ Further increases may be required if BG remains elevated.
• Give an additional bolus dose of insulin - at least 10-20% of the TDD.
• Retest BG in 2-4 hours.</td></tr>
</table>

Table 8.3.2: Insulin management of patients using insulin pumps [**R-GDG**].

8.4 Injection site monitoring

Advise patients to [4]:

- Rotate their insulin injection site.
- Avoid repeated injections at the same point within sites.
- Have injection sites checked at least annually, or if new problems with BG control arise.

8.5 Insulin delivery devices

Insulin delivery devices [4]:

- Provide an insulin injection delivery device that helps patients optimise wellbeing; one or more types of insulin injection pen may be needed.
- Patients with special visual or psychological needs require injection devices or needle-free systems that can be used independently for accurate dosing.
- Provide needles of different lengths to patients experiencing problems like pain, local skin reactions and injection site leakages.
- Arrangements should be made to allow the safe disposal of used needles, e.g. the provision of sharps containers and their disposal.

8.6 Metformin

The addition of metformin to insulin therapy, can be considered as an adjunct if an adult patient has a BMI of ≥30 kg/m^2, to improve BG control while minimising their effective insulin dose [1,2].

9 Pancreas and islet cell transplantation

Pancreas and islet cell transplantation [1]:

- Have been demonstrated to normalise glucose levels.
- Patients require lifelong immunosuppression to prevent graft rejection and recurred autoimmune islet destruction.
- Pancreas transplantation should only be considered in patients [1][**L2**]:
    - Who are undergoing simultaneous renal transplantation.
    - After renal transplantation; or
    - With recurrent ketoacidosis or severe hypoglycaemia despite aggressive glycaemic management.
- The use of islet transplantation is still under investigation therefore patients with the following criteria may be considered for referral to research centres for consideration [1,2]:
    - Debilitating complications.
    - Interest in research possibilities.
    - Fit the criteria for the research protocol.
- Auto-islet transplantation can be considered in patients who require total pancreatectomy if they meet the eligibility criteria [1].

10 ASCVD risk management

10.1 Management of hypertension

For patients with T1DM without known hypertension, review BP at every visit and at least annually [6,16]. Provide and emphasise lifestyle advice to all diabetic patients [1,17].

Aim to achieve a clinic BP of [1]:

- <140/90 mmHg; or
- <130/80 mmHg in:
    - Younger patients.
    - Those with albuminuria.
    - Those with hypertension and one or more additional ASCVD risk factors, if the target can be achieved without undue treatment burden.

If BP remains above target levels following lifestyle improvement, add medication to reduce BP to target levels [17].

10.1.1 First-line medication

First-line BP-lowering therapy for patients with T1DM should be [1,17]:

- A once daily angiotensin converting enzyme (ACE) inhibitor; or
- For people of African or Afro-Caribbean descent use an ACE inhibitor plus either a diuretic or calcium channel blocker (CCB).
- For women who may become pregnant, start with a CCB:
    - Avoid the use of ACE inhibitors and angiotensin II-receptor antagonists.
- If there is ongoing intolerance to an ACE inhibitor, other than renal deterioration or hyperkalaemia, an angiotensin receptor blocker (ARB) may be used instead.
- NB: Unless contraindicated, for diabetic patients with hypertension and renal impairment, an ACE inhibitor or ARB must be the first line drug [1,17].

Monitor BP every 1-2 months and intensify therapy until BP is consistently within target range. Continue to reinforce lifestyle advice [17]. If BP is consistently attained at the target level, continue to monitor the patient's BP at every clinic visits and check for adverse effects including risks of hypotension [6,17].

10.1.2 Inadequate control with first line medication

If BP is not adequately controlled to the agreed target level [17]:

- Second line treatment:
    - With first-line therapy, add a CCB or a diuretic (usually thiazide or thiazide-like diuretic) [17].
- Third-line treatment:
    - With dual therapy, add the other drug, i.e. either a CCB; or a diuretic [17].
- Fourth-line treatment:
    - With triple therapy, add either an alpha-blocker; or a beta-blocker; or a potassium-sparing diuretic [17].

Note the following key points [17]:

- Use potassium-sparing diuretics with caution if the patient is already taking an ACE inhibitor or ARB.

- Do not combine an ACE inhibitor with an ARB.
- Refer to secondary/specialist care if BP remains above target levels following triple therapy including a diuretic [**R-GDG**].

10.2 Lipid management

Unless contraindicated, offer a **moderate intensity statin** in the following patients:

- Patients aged 40-75 years who have a 10-year risk of ASCVD using the American College of Cardiology / American Heart Association (ACC/AHA) Pooled cohort equations of ≥7.5% [18].
- Patients aged ≥50 years with chronic kidney disease stage 3-5 or those of any age with other manifestations of chronic kidney disease (e.g. albuminuria or polycystic kidney disease) [19].

Unless contraindicated, offer a **high intensity statin** to the following patients [18,20]:

- Pre-existing ASCVD - for secondary prevention [36,38,39]
- All patients with a low density lipoprotein-cholesterol (LDL-C) level of ≥4.9 mmol/L.
- Adults with type 1 diabetes who:
    - Are older than age 40 years; or
    - Have had diabetes for more than 10 years; or
    - Have established nephropathy; or
    - Have other ASCVD risk factors.
- Statin therapies should be considered in conjunction with lifestyle advice which should continue throughout drug treatment, where pharmacological intervention is indicated (see *Section 8.1*)[18,20-22].

Ezetimibe is a recommended option for hypercholesterolaemia in adults, under the following conditions [23][**L1, RGA1**]:

- In conjunction with initial statin treatment when:
    - Serum total cholesterol or LDL-C levels are not appropriately controlled after titration of the statin treatment; or dosing is limited by intolerance to the statin.
- As monotherapy if there is:
    - A contraindication to initial statin treatment.
    - Intolerance to statin treatment.

10.3 Antiplatelet therapy

Aspirin and other antiplatelets are not routinely recommended for patients with T1DM in the absence of established ASCVD [1,18,21,24].

However, the *American Diabetes Association* recommends initiating low-dose aspirin use for the primary prevention of ASCVD in adults aged ≥50 years, who have a 10-year ASCVD risk of a ≥10%, using the ACC/AHA Pooled Cohort Equations. Patients must not be at increased risk for bleeding, have a life expectancy of at least 10 years and be willing to take low-dose aspirin daily for at least 10 years [1].

11 Hypoglycaemia prevention and management

11.1 Hypoglycaemia

Hypoglycaemia is defined as [1]:

- Plasma glucose concentration of <3.9 mmol/L (70 mg/dL).

Mild to moderate hypoglycaemia is defined as [derived from [1]]:

- Plasma glucose concentration of 2.2 – 3.9 mmol/L (40-70 mg/dL).
- Which does not require assistance from another person.

Severe hypoglycaemia is defined as [1]:

- Plasma glucose concentration of <2.2 mmol/L (40 mg/dL).
- Hypoglycaemia requiring assistance from another person.
- It is characterised by cognitive impairment that may be recognised or unrecognised and can progress to loss of consciousness, seizure, coma or death.

11.1.1 Education

Patients at risk for hypoglycaemia should be asked about symptomatic and asymptomatic hypoglycaemia at each encounter [1][**L2**].

Patients should understand the situations that increase their risk of hypoglycaemia, such as [1]**[L2]**:

- Taking insulin without eating adequately.
- Fasting (e.g. for tests or procedures or if fasting during Ramadan).
- During or after intense exercise.
- During sleep.

Teaching patients how to balance their insulin use with their carbohydrate intake and exercise is required to reduce the risk of hypoglycaemia, however this method is not always sufficient for prevention [1][**L2**].

Those in close contact with hypoglycaemia-prone patients should be educated in the use of glucagon kits [1][**L2**].

11.1.2 Treatment

Mild to moderate hypoglycaemia:

Treatment of patients with mild-to-moderate hypoglycaemia comprises of [1]:

- 15–20g of Glucose (juice or glucose tablets/gels) is the preferred treatment for the conscious individual with hypoglycaemia, although any form of carbohydrate that contains glucose may be used.
- 15 mins after treatment, if SMBG shows continued hypoglycaemia, the treatment should be repeated.
- Once SMBG returns to normal, the individual should consume a meal or snack to prevent recurrence of hypoglycaemia.

Severe hypoglycaemia:
Patients with a decreased level of consciousness [4]**[L1**]:

- Should be administered intramuscular glucagon by a family member or friend who has been educated on its use; and
- Then monitored for 10 minutes, if their level of consciousness is not significantly improving then they should be administered intravenous glucose; and
- Then given oral carbohydrate when it is safe for the patient, and put under continued observation by a third party who has been warned of the risk of relapse.
- Send the patient to the Paediatric Emergency Centre if not improving [**R-GDG**].

11.2 Hypoglycaemia in elderly patients

Avoid hypoglycaemia in elderly patients with T1DM by [1][**L2**]:

- Screening for hypoglycaemia and discuss findings with caregivers.
- Adjusting glycaemic targets.
- Considering pharmacological interventions.

Elderly patients in long term care facilities are at increased risk of hypoglycaemia [1]:

- Assess for hypoglycaemia at least every 30 days for the first 90 days after admission, and then at least every 60 days thereafter [1][**L2**].
- An alert strategy and protocol should be in place and the provider should be called in case of hypoglycaemia, hyperglycaemia, or the patient is unwell [1,4].
- Ongoing assessment of cognitive function is suggested [1,4][**L2, RGA2**]:
    - If low or declining cognition is detected, the clinician, patient, and caregivers should pay increased attention to hypoglycaemia risk.
    - Education should cover how to properly use flexible insulin therapy using basal-bolus regimens.
    - If impaired hypoglycaemia awareness is ongoing, offer additional education with a focus on avoiding and treating hypoglycaemia.

11.3 Hypoglycaemia unawareness

Hypoglycaemia unawareness is indicated by or one or more episodes of severe hypoglycaemia and should trigger re-evaluation of the treatment regimen [1][**L3**].

Insulin-treated patients with hypoglycaemia unawareness or an episode of severe hypoglycaemia should be advised:

- To raise their glycaemic targets to strictly avoid further hypoglycaemia for at least several weeks in order to partially reverse hypoglycaemia unawareness and reduce risk of future episodes [1][**L1**].
- Ongoing assessment of cognitive function is suggested with increased vigilance for hypoglycaemia by the clinician, patient, and caregivers if low cognition or declining cognition is found [1][**L2**].

11.3.1 Hypoglycaemia-associated autonomic failure

Hypoglycaemia-associated autonomic failure (HAAF) [25]:

- Is the combination of defective glucose counter-regulation and hypoglycaemia unawareness.
- Often caused by recent iatrogenic hypoglycaemia.
- Is partially reversible by avoiding hypoglycaemia.

- Is associated with a ≥25-fold increase in the risk of severe hypoglycaemia during intensive glycaemic therapy.
- It is important to distinguish HAAF from classical autonomic neuropathy, which may occur as one form of diabetic neuropathy.

Restore recognition of hypoglycaemia in patients with HAAF [25]**[L2]**:

- Monitoring and goal setting:
  - Encourage SMBG before meals, at bedtime, and when symptoms occur.
  - Encourage SMBG between 2am and 5am, at least three times a week.
  - Set a preprandial glucose target of 100-150 mg/dL.
- Patient education:
  - Explain to the patient the symptoms of hypoglycaemia and the role of repeated hypoglycaemia in the development of hypoglycaemia unawareness.
  - Ensure that the patient understands that hypoglycaemia unawareness is reversible through avoidance of hypoglycaemia.
- Dietary intervention:
  - Ensure adequate calorie intake.
  - Recommend the consumption of interprandial and bedtime snacks.
  - Ensure that the patient has access to readily absorbable carbohydrates at all times.
  - Consider moderate amounts of xanthine beverages, if tolerated.
- Exercise counselling:
  - Encourage SMBG before, during, and after exercise.
  - If BG is < 140 mg/dL, advise:
    - That the patient consumes additional calories before, during, and after exercise.
- Medication adjustment:
  - Consider adjusting the insulin regimen to attain target glucose levels.
  - To reduce the risk of interprandial hypoglycaemia:
    - Use rapid-acting insulin analogues.
  - To reduce the risk of nocturnal hypoglycaemia:
    - Use basal insulin analogues.
  - Consider using a CSII pump.
  - Consider a CGM device.

11.4 Hypoglycaemia during physical activity

Risk of hypoglycaemia [1,25,26]:

- Patients who take insulin and/or insulin secretagogues are at increased risk of hypoglycaemia as a result of exercise.
- Medication dose or carbohydrate intake must be altered in line with the amount of physical exercise if pre-exercise glucose levels are <5.6 mmol/L (100 mg/dL).
- Intense activities may raise BG levels instead of lowering them.
- Further risk factors for exertional hypoglycaemia include:
  - Prolonged exercise time.
  - Exercise intensity the patient is not used to.
  - Inadequate supply of energy in relation to blood insulin levels.
- Post-exertional hypoglycaemia can be prevented or minimised by careful glucose monitoring before and after exercise:
  - Snacks should be consumed prior to exercise if BG levels are falling.
- Patients should carry a readily absorbable source of carbohydrates when exercising, including sporadic housework or outdoor work.

- It may be useful to alter the insulin dose on days with planned exercise:
    - Especially in patients with well controlled diabetes and a history of exercise-induced hypoglycaemia.

11.5 Hypoglycaemia follow up

Patients with one or more episodes of severe hypoglycaemia may benefit from at least short-term relaxation of their glycaemic goals [1].

If hypoglycaemia increases in frequency or becomes unusually problematic, consider the following causes [4][**L2**]:

- Inappropriate insulin regimens.
- Meal and activity patterns, including alcohol.
- Injection technique and skills, including insulin resuspension.
- Injection site problems.
- Possible organic causes, e.g. gastroparesis.
- Changes in insulin sensitivity.
- Psychological problems.
- Previous physical activity.
- Lack of the necessary skills and knowledge for adequate self-management.

In there is hypoglycaemia unawareness with recurrent severe hypoglycaemia, consider referral to a specialist centre if they are not responsive to interventions [4][**L2**].

12 Advice for fasting during Ramadan

Fasting during Ramadan:

- All adults with T1DM are considered exempt from fasting on medical and religious grounds [27], due to the risk of severe complications.
- In those patients who insist on fasting, strategies to ensure safety should be discussed with a diabetes-specialist MDT and include [27]:
    - Ramadan-focused medical education.
    - Pre-Ramadan medical assessment – 2-3 months prior to Ramadan[**R-GDG**].
    - Robust assessment of hypoglycaemia awareness.
    - Emphasising the importance of following a healthy diet and physical activity pattern.
    - Modification of insulin regimen.
    - Frequent SMBG or CGM.
    - Regular follow-up with the diabetes specialist team.

13 References

1. Cefalu WT, Bakris G, Blonde L et al. American Diabetes Association (ADA). Standards of medical care in diabetes. Diabetes Care 2016; 39: S1-111.
2. Chiang JL, Kirkman MS, Laffel LM et al. Type 1 diabetes through the life span: a position statement of the American Diabetes Association. Diabetes Care 2014; 37: 2034-54.
3. Habibzadeh F. Type 1 diabetes in the Middle East. The Lancet 2014; 383: 1.
4. National Clinical Guideline Centre (NCGC). Type 1 diabetes in adults: diagnosis and management. London: NCGC; 2016.
5. Qatar Diabetes Association (QDA). Haji & diabetes. Doha, State of Qatar: QDA; 2016.
6. National Collaborating Centre for Women's and Children's Health (NCC-WCH). Diabetes (type 1 and type 2) in children and young people: diagnosis and management. London: NCC-WCH; 2015.
7. National Institute for Health and Care Excellence (NICE). Diabetes in children and young people. Quality Standard 125. London: NICE; 2016.
8. Kirkman MS, Jones Briscoe V, Clark N et al. Diabetes in older adults. Diabetes Care 2012; 35: 2650-64.
9. National Institute for Health and Care Excellence (NICE). Diabetes in adults. Quality Standard 6. London: NICE; 2016.
10. The Look AHEAD Research Group. The Look AHEAD Study: A Description of the Lifestyle Intervention and the Evidence Supporting It. Obesity (Silver Spring) 2006; 14:737-52.
11. Ministry of Public Health. National immunisation guidelines for vaccine providers. 2016.
12. Supreme Council of Health. Pneumococcal vaccination in children and teens. 2015.
13. Munshi MN, Florez H, Huang ES et al. Management of diabetes in long-term care and skilled nursing facilities: a position statement of the American Diabetes Association. Diabetes Care 2016; 39: 308-18.
14. National Institute for Health and Care Excellence (NICE). Continuous subcutaneous insulin infusion for the treatment of diabetes mellitus. Technology Appraisal Guidance 151 London: NICE; 2008.
15. Wolfsdorfa JI, Allgrove J, Craig ME et al. ISPAD Clinical Practice Consensus Guidelines 2014 Compendium. Diabetic ketoacidosis and hyperglycemic hyperosmolar state. Pediatr Diabetes 2014; 15: 154-79.
16. Pignone M, Alberts MJ, Colwell JA et al. Aspirin for primary prevention of cardiovascular events in people with diabetes: a position statement of the American Diabetes Association, a scientific statement of the American Heart Association, and an expert consensus document of the American College of Cardiology Foundation. Diabetes Care 2010; 33: 1395-402.
17. National Clinical Guideline Centre (NCGC). Hypertension: The clinical management of primary hypertension in adults. Clinical Guideline 127. London: NCGC; 2011.
18. Stone NJ, Robinson JG, Lichtenstein AH et al. 2013 American College of Cardiology (ACC)/American Heart Association (AHA) guideline on the treatment of blood cholesterol to reduce atherosclerotic cardiovascular risk in adults: a report of the ACC/AHA task force on practice guidelines. Circulation 2014; 129: S1-45.
19. Kidney Disease: Improving Global Outcomes Guidelines. 2012 Clinical Practice Guideline for the evaluation and management of chronic kidney disease. Kidney International Supplements 2013; 3: 1-150.
20. National Clinical Guideline Centre (NCGC). Lipid modification: Cardiovascular risk assessment and the modification of blood lipids for the primary and secondary prevention of cardiovascular disease. Clinical Guideline 181. London: NCGC; 2014.
21. Catapano AL, Graham I, De Backer G et al. European Society of Cardiology/European Atherosclerosis Society Guidelines for the management of dyslipidaemias. Eur Heart J. 2016; 37: 2999-3058.
22. Scottish Intercollegiate Guidelines Network (SIGN). Risk estimation and the prevention of cardiovascular disease. A national clinical guideline. SIGN Publication no. 97. Edinburgh: SIGN; 2007.
23. National Institute for Health and Care Excellence (NICE). Ezetimibe for the treatment of primary heterozygous-familial and non-familial hypercholesterolaemia. Technology Appraisal Guidance 385. London: NICE; 2016.
24. Scottish Intercollegiate Guidelines Network (SIGN). Antithrombotics: indications and management. A national clinical guideline. SIGN Publication no. 129. Edinburgh: SIGN; 2013.

25. Seaquist ER, Anderson J, Childs B et al. Hypoglycemia and diabetes: a report of a workgroup of the American Diabetes Association and the Endocrine Society. Diabetes Care 2013; 36: 1384-95.
26. Al-Bibi K. The State of Qatar National Physical Activity Guidelines. 1st edn. Doha, Qatar: Aspetar; 2014.
27. International Diabetes Federation (IDF); Diabetes and Ramadan (DAR) International Alliance. Diabetes and Ramadan: Practical Guidelines. Brussels, Belgium: IDF; 2016. Available at: www.idf.org/guidelines/diabetes-in-ramadan [Accessed 27th December 2016].