



المبادئ الإرشادية السريرية لدولة قطر
NATIONAL CLINICAL GUIDELINES FOR QATAR

Clinical Guidelines

for the State of Qatar

The diagnosis and management of diabetes mellitus in children and adolescents

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: March 2019

**TRANSFORMING
HEALTHCARE**



الاستراتيجية الوطنية للصحة
National Health Strategy

Version history

Version	Status	Date	Editor	Description
1.0	Final	19 th March 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 Alfahaidi**, *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 Mehmoed 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.*

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

Table of contents

1	Information about this guideline	6
1.1	Objective and purpose of the guideline.....	6
1.2	Scope of the guideline	6
1.3	Editorial approach.....	6
1.4	Sources of evidence	7
1.5	Evidence grading and recommendations	7
1.6	Guideline Development Group members.....	8
1.7	Responsibilities of healthcare professionals.....	8
1.8	Abbreviations used in this guideline	9
2	Organisation of care in Qatar.....	10
2.1	Role of the Ministry of Public Health	10
2.2	Provision of care	10
3	Key recommendations of the guideline.....	11
4	Background information	15
4.1	Classification	15
5	Clinical presentation	15
5.1	History and examination.....	15
5.2	Differentiating between type 1 and type 2 diabetes mellitus.....	16
6	Initial investigations.....	17
6.1	Diagnostic tests for diabetes mellitus.....	17
6.1.1	Diagnostic criteria for diabetes mellitus	18
6.1.2	Diagnostic criteria for prediabetes.....	18
6.1.3	Confirmatory testing	18
6.2	Additional investigations.....	18
7	Initial management of an acute presentation of type 1 diabetes mellitus	19
7.1	Admission criteria	19
7.2	Management of diabetic ketoacidosis:.....	19
7.3	Management of hyperglycaemia without metabolic decompensation	19
8	Management of type 1 diabetes.....	20
8.1	Multi-disciplinary approach	20
8.2	Roles and responsibilities of the multidisciplinary team	20
8.3	Multi-disciplinary team roles in patient education.....	21
8.4	Insulin therapy	22
8.4.1	Comparison of common insulins.....	23
8.5	Glycaemic control and targets	24
8.6	Diabetes self-management education and support	24

8.6.1	Self-monitoring of blood glucose	24
8.6.2	Continuous glucose monitoring	24
8.7	Dietary advice	25
8.8	Physical activity	25
8.8.1	Hypoglycaemia during physical activity	26
8.9	Psychosocial care	26
8.10	Immunisation	26
8.11	Management of T1DM in the school setting	27
8.12	Pancreas and islet cell transplantation	27
9	Management of acute complications of type 1 diabetes mellitus	28
9.1	Hypoglycaemia.....	28
9.1.1	Education	28
9.1.2	Treatment	28
9.1.3	Hypoglycaemia unawareness.....	29
9.2	Hyperglycaemia.....	29
9.3	Managing diabetes during an intercurrent illness.....	29
9.3.1	Patients on multi-dose injection regimens	30
9.3.2	Patients using insulin pumps.....	31
10	Management of chronic complications of type 1 diabetes mellitus	32
11	Screening for associated autoimmune conditions	32
12	Management of type 2 diabetes mellitus.....	33
12.1	Multidisciplinary approach	33
12.2	Lifestyle intervention	33
12.3	Metformin.....	34
12.4	Insulin therapy	34
12.5	Glucose targets and monitoring	35
12.6	Diabetes self-management education and support	35
12.6.1	Self-monitoring of blood glucose.....	36
12.7	Psychological and social issues	36
12.8	Immunisation	36
13	Screening and prevention of type 2 diabetes mellitus	37
13.1	Risk factors for screening and testing in asymptomatic patients.....	37
13.2	Prevention of type 2 diabetes.....	37
14	Management of comorbidities of type 2 diabetes mellitus	38
14.1	Obesity	38
14.2	Non-alcoholic fatty liver disease.....	38
14.3	Hypertension.....	38

14.3.1	Monitoring of hypertension	38
14.3.2	Management of hypertension	39
14.4	Dyslipidaemia	39
14.4.1	Screening	39
14.4.2	Lifestyle intervention	39
14.4.3	Pharmacotherapy	40
15	Management of complications of type 2 diabetes mellitus	40
15.1	Acute complications	40
15.1.1	Hypoglycaemia	40
15.1.2	DKA and HHS:	41
15.2	Chronic complications	41
15.2.1	Diabetic nephropathy	41
15.2.2	Retinopathy	42
15.2.3	Neuropathy	42
16	Advice for fasting during Ramadan	42
17	References	43

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 both type 1 and type 2 diabetes mellitus in children and adolescents. 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 generalist physicians in all healthcare settings.

1.2 Scope of the guideline

Aspects of care covered in this guideline include the following:

- Assessment and management of type 1 and type 2 diabetes mellitus in children and adolescents including:
 - Diabetes screening.
 - Lifestyle management of confirmed type 1 and type 2 diabetes.
 - Pharmacological therapy for type 1 and type 2 diabetes.
 - Glycaemic targets and glucose monitoring.
 - Hypoglycaemia prevention and management.
 - Complications and comorbidity screening and management.

Aspects of care not covered in this guideline include the following:

- Neonatal diabetes mellitus.
- Maturity-onset diabetes of the young.
- Detailed management of diabetic complications.

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 Fawziya Al-Khalaf	Senior Consultant, Paediatrics	Hamad Medical Corp
Dr Ahmed M. Hussein Babiker	Head of Registration Section & Clinical Pharmacist	Dept of Pharmacy and Drug Control, MOPH ¹
Ms Mona H M M El Gamal	Diabetes Educator	Hamad Medical Corp
Prof Khalid Hussain	Division Chief - Endocrinology, Vice Chair for Research, Department of Paediatric Medicine	Sidra Medical & Research Center
Dr Mahmood Ali Zirie	Senior Consultant and Head of Endocrinology	Hamad Medical Corp

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.

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

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:

ACE	Angiotensin-converting enzyme
ACR	Albumin-creatinine ratio
ASCVD	Atherosclerotic cardiovascular disease
BG	Blood glucose
BMI	Body mass index
BP	Blood pressure
CBC	Complete blood count
CSII	Continuous subcutaneous insulin infusion
DBP	Diastolic blood pressure
DKA	Diabetic ketoacidosis
DSME	Diabetes Self-Management Education
DSMS	Diabetes Self-Management Support
FBS	Fasting blood sugar
HBA_{1c}	Glycated haemoglobin level
HDL	High density lipoprotein
HHS	Hyperglycaemic hyperosmolar state
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
IV	Intravenous route
LDL-C	Low density lipoprotein cholesterol
MODY	Maturity-onset diabetes of the young
MOPH	Ministry of Public Health of Qatar
NAFLD	Non-alcoholic fatty liver disease
OGTT	Oral glucose tolerance test
PCOS	Polycystic ovary syndrome
PCV	Pneumococcal conjugate vaccine
PPSV23	23-valent pneumococcal polysaccharide vaccine
RBS	Random blood sugar
SBP	Systolic blood pressure
SMBG	Self-monitoring of blood glucose
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
TDD	Total daily dose

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:

Diagnosis (see Section 6.1):

- Distinguishing between T1DM and T2DM in the paediatric and adolescent population is not consistently easy to define [3].
- T2DM remains a diagnosis of exclusion in adolescents [5].
- Exclude T1DM by assessing immune markers and monogenic diabetes through a careful family history and genetic testing [5]
- American Diabetes Association criteria for the diagnosis of T2DM requires one of the following [1]:
 - FBS: ≥ 7.0 mmol/L (126 mg/dL).
 - OGTT: ≥ 11.1 mmol/L (200 mg/dL) at 2-hours post-glucose.
 - RBS: ≥ 11.1 mmol/L (200 mg/dL) and the patient has classic symptoms of hyperglycaemia.
 - HBA_{1c}: $\geq 6.5\%$.
- In the absence of unequivocal hyperglycaemia, the diagnosis of diabetes should be confirmed by repeat testing [1][L2].

Initial management of an acute presentation of type 1 diabetes (see Section 7):

- Patients with symptoms can deteriorate rapidly, irrespective of the underlying type of diabetes and require urgent assessment and appropriate treatment [R-GDG].
- See Section 7.1 for admission criteria.
- Refer acutely unwell patients to the Paediatric Emergency Centre for evaluation and management [1,8].

Management of type 1 diabetes (see Section 8):

- Care should be provided by an integrated and collaborative multidisciplinary team [1].
- The majority of type 1 diabetes patients should be managed using multiple-dose insulin injections from the time of diagnosis; or continuous subcutaneous insulin infusion (CSII), if multi-dose injections are not appropriate for the child [1,10].
- Most patients should be managed with insulin analogues that reduce hypoglycaemia risk, especially if the patient is at elevated risk of hypoglycaemia [1][L1].
- Intensive management strategies should be used that employ pump therapy or continuous glucose monitoring and encourage active participation of the patient and family [1][L1].
- Recommendations on optimal prandial insulin dose administration should be individualised to each patient [1].
- Recommended total daily doses (TDD) of insulin [R-GDG]:
 - Infants: TDD: 0.5- 0.7 unit/kg
 - Pre-pubertal children: TDD: 0.75- 1.0 unit/kg
 - Pubertal children: TDD :1.0–1.2 unit/kg
- NB: 50% of the TDD should be from basal insulin and 50% should be from prandial insulin [R-GDG].

Glycaemic controls and targets (see Section 8.4):

- The target BG levels across all paediatric age groups are as follows [1]:
 - Before meals: 5.0 – 7.2 mmol/L (90 – 130 mg/dL).
 - Bedtime/overnight: 5.0 – 8.3 mmol/L (90 – 150 mg/dL).

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- HBA_{1c}: <7.5% (a target of <7.0% is reasonable if it can be achieved without problematic hypoglycaemia).

Lifestyle advice (see *Section 8.5*):

- All patients should receive dietary advice delivered by a registered paediatric diabetes dietician [1][L1].
- Consider individualised dietary advice for all children and adolescents with T1DM [1][L1].
- Each member of the care team should be knowledgeable about the principles of appropriate well balanced nutrition and be supportive of its implementation [1][L2].
- All children and adolescents with T1DM should be encouraged to exercise normally [9][L2].

Management of type 1 diabetes in a school setting (see *Section 8.11*):

- The school nurse and other school staff should be trained to meet the needs of students with T1DM [14][L2].
- School staff should have access to relevant equipment and be trained in their use [14][L2].
- Students with diabetes should participate fully in school sports and physical education.
- Parental attendance should not be required for a child's participation during the school day, on school trips or at extracurricular activities.

Management of complications of type 1 diabetes (see *Sections 9 & 10*):

- Hypoglycaemia:
 - Patients at risk for hypoglycaemia should be asked about symptomatic and asymptomatic hypoglycaemia at each encounter [1][L2].
 - Those in close contact with hypoglycaemia-prone patients should be educated in the treatment of hypoglycaemia and the use of glucagon kits [1][L2].
- Intercurrent illness:
 - See *Section 9.3* for advice on the management of patients with an intercurrent illness.
- Nephropathy:
 - In children who have had T1DM for 5 years [8]:
 - Screen annually for nephropathy, using a random spot urine sample for ACR.
 - Refer to paediatric nephrology if elevated ACR is confirmed on repeat sampling [R-GDG].
- Retinopathy:
 - In children aged ≥10 years or who are post-puberty (whichever occurs first), who have had T1DM for 3-5 years, should have an eye examination performed by an ophthalmologist [R-GDG]:
 - At the time of the initial diagnosis [1].
 - Annually thereafter [1].
- Dyslipidaemia:
 - Obtain a fasting lipid profile in children aged ≥10 years, soon after the initial diagnosis and annually thereafter [1].

Management of type 2 diabetes (see *Section 12*):

- Care should be provided by an integrated and collaborative multidisciplinary team [1].
- A lifestyle modification programme including nutrition and physical activity should be started in all patients irrespective of pharmacotherapy [3][L1].
- Nutritional interventions should only be provided by a healthcare professional (e.g. dietician) who has the relevant expert knowledge and experience in growth and development in children [6].

Pharmacotherapy for type 2 diabetes (see Sections 12.3 & 12.4):

- Initial treatment is determined by the symptoms and severity of hyperglycaemia and the presence or absence of ketosis or ketoacidosis [1,3].
- Start metformin with lifestyle intervention as first-line therapy at the time of diagnosis of T2DM, unless the patient requires insulin therapy [3].
- Insulin should be used for patients presenting with [1,3,6]:
 - Ketosis.
 - Diabetic ketoacidosis (DKA) or hyperglycaemic hyperosmolar state (HHS).
 - In whom the distinction between T1DM and T2DM is unclear.
 - Who have RBS or FBS ≥ 13.9 mmol/L (250 mg/dL).
 - Whose HBA_{1c} is $\geq 9\%$.
- Insulin therapy in patients started on metformin:
 - Should be considered when glycaemic targets are not achieved with lifestyle measures and metformin therapy [5][L1].
 - Should be supervised by a physician with experienced in insulin treatment in diabetic patients.

Treatment targets for type 2 diabetes (see Section 12.5):

- Blood glucose range [1]:
 - 5.0-7.2 mmol/L (90-130 mg/dL) before meals.
 - 5.0-8.3mmol/L (90-150 mg/dL) 2 hours after meals.
 - Blood glucose (BG) targets should be modified in children with frequent hypoglycaemia or hypoglycaemia unawareness.
- HBA_{1c} of $\leq 7.0\%$ across all patient age groups [3].

Screening for type 2 diabetes in asymptomatic patients (see Section 13):

- Screening for diabetes and prediabetes should be undertaken in those individuals who are overweight or obese, and who have additional risk factors for diabetes (see Section 8.1)[1]:

Management of common comorbidities associated with type 2 diabetes:

- See Section 14 for information on the management of common comorbidities associated with T2DM.

Management of complications of type 2 diabetes (see Section 15):

- Patients with symptoms can deteriorate rapidly, irrespective of the underlying type of diabetes and require urgent assessment and appropriate treatment [R-GDG].
- Hypoglycaemia:
 - Patients at risk for hypoglycaemia should be asked about symptomatic and asymptomatic hypoglycaemia at each encounter [1].
 - Patients should be aware of situations in which they have an increased risk of hypoglycaemia [R-GDG].
- DKA and HHS:
 - Refer all patients to the Paediatric Emergency Centre for evaluation and management of DKA and HHS [R-GDG].
- Diabetic nephropathy:
 - Annual screening for albuminuria random spot urine sample for albumin–creatinine ratio (ACR) should be considered once diabetes has been present for ≥ 5 years [1].
 - Treatment is indicated when elevated urinary ACR (>30 mg/g) is documented in at least 2 of 3 urine samples which have been obtained over a 6-month interval, following efforts to improve glycaemic control and normalise BP [1].

- Retinopathy screening [1]:
 - Should be performed at age ≥ 10 years or after puberty has started (whichever is earlier), once the patient has had diabetes for 3–5 years [R-GDG].
 - After the initial examination, annual routine follow-up is generally recommended.
- Neuropathy screening [1]:
 - Should be performed at age ≥ 10 years or post-puberty (whichever occurs first) [1]:
 - Screen for neuropathy at the time of diagnosis of T2DM.
 - Perform a comprehensive foot examination annually thereafter.

Psychosocial care for all children with diabetes (see Sections 8.9 & 12.7):

- Children and young people with diabetes have a greater risk of emotional and behavioural difficulties [1,10].
- A lack of adequate psychosocial support has a negative effect on various outcomes, including BG control, and can also reduce self-esteem [1,10]
- Offer children and adolescents with diabetes and their family members or carers [1,10]:
 - Timely and ongoing access to mental health professionals.
 - Emotional support after diagnosis, which should be tailored to their emotional, social, cultural and age dependent needs.
 - Screening for anxiety and depression to patients who have persistently suboptimal BG control.
 - Prompt referral for those with suspected anxiety and/or depression to child mental health professionals.

4 Background information

4.1 Classification

The general categories of diabetes mellitus are classified as follows [1,2]:

- Type 1 diabetes mellitus (T1DM) arises as the result of beta-cell insufficiency or destruction, usually leading to absolute insulin deficiency.
- Type 2 diabetes (T2DM) arises as the result of progressive loss of insulin secretion on the background of insulin resistance.
- Specific types of diabetes due to other causes, including:
 - Monogenic diabetes syndromes e.g.:
 - Neonatal diabetes.
 - Maturity-onset diabetes of the young (MODY).
 - Secondary diabetes, including:
 - Diseases of the exocrine pancreas.
 - Drug- or chemical-induced diabetes.
 - Endocrinopathies.

Childhood T1DM is defined by the presence of one or more of the following autoimmune markers [1]:

- Islet cell autoantibodies.
- Insulin autoantibodies.
- Glutamic acid decarboxylase (GAD65) antibodies.
- Antibodies to tyrosine phosphatases IA-2 and IA-2 β .
- Antibodies to zinc transporter 8 (ZnT8).

Childhood T2DM is typically seen in children who [3]:

- Are overweight or obese.
- Have a strong family history of T2DM.
- At diagnosis, have substantial residual insulin secretory capacity (reflected by normal or elevated insulin and C-peptide concentrations).
- Demonstrate insulin resistance (including clinical evidence of polycystic ovarian syndrome (PCOS) or acanthosis nigricans).
- Lack evidence for diabetic autoimmunity (i.e. are negative for autoantibodies typically associated with T1DM).

Pre-diabetes [4]:

- Is a term used to refer to individuals with an impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT).
- Indicates a high risk for the future development of T2DM and cardiovascular disease.

5 Clinical presentation

5.1 History and examination

Key points to note in the medical history include [1,3][L2]:

- Symptoms and duration of hyperglycaemia:
 - Including polyuria, polydipsia, polyphagia, fatigue, blurred vision and weight loss.
- Symptoms of diabetic ketoacidosis, including:
 - Abdominal pain, vomiting, drowsiness, tachypnoea and acetone-smelling breath.
- Pre-natal, birth and post-natal history, including:

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- Maternal gestational diabetes, gestational age at birth, birth weight, NICU admission.
- Family history of autoimmune-mediated disorders, including:
 - T1DM, thyroid disease, coeliac disease, adrenal disease.
- Lifestyle risk factors for DM, including:
 - Eating patterns and habit.
 - Weight history.
 - Physical activity.
- Symptoms of comorbidities associated with obesity including psychosocial problems.
- Social history, including:
 - Family circumstances.
 - School performance.
 - Nurse availability at school.
 - Smoking, alcohol and/or substance use.
- Medication history:
 - Especially medication that may exacerbate hyperglycaemia e.g.:
 - Glucocorticoids.
 - Beta-blockers.

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

- Height (including standard deviation), weight and body mass index (BMI).
- Pubertal development.
- Blood pressure (BP), including orthostatic BP, if indicated.
- Head and neck examination including:
 - Facial dysmorphism.
 - Thyroid or tonsillar enlargement.
- Skin stigmata (e.g. striae, acanthosis nigricans, hyperpigmentation, alopecia or vitiligo).
- Hepatomegaly.
- 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.
 - Determination of proprioception, vibration, and monofilament sensation.

5.2 Differentiating between type 1 and type 2 diabetes mellitus

The American Paediatric Association acknowledges that [3,4]:

- Distinguishing between T1DM and T2DM in the paediatric and adolescent population is not consistently easy to define.
- Clinical judgment plays an important role.

Differentiating between T1DM and T2DM [5]:

- Phenotypic overlap between T1DM and T2DM in children is common.
- T2DM remains a diagnosis of exclusion in adolescents.
- Although T2DM has been reported in preschool children, care must be taken in making this diagnosis in pre-adolescent children.
 - Exclude T1DM by assessing immune markers and monogenic diabetes through a careful family history and genetic testing.

In children and adolescents, the initial classification of diabetes is usually based on clinical features at first presentation and subsequent course [1,6].

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

Typical presentations	
Type 1 diabetes mellitus	Type 2 diabetes mellitus
<ul style="list-style-type: none"> • Usually not overweight: <ul style="list-style-type: none"> ○ However, percentage of those who are overweight is increasing. • Have recent weight loss, polyuria, and polydipsia. • Short duration of symptoms. • Frequently have ketosis: <ul style="list-style-type: none"> ○ 30–40% have ketoacidosis at presentation. • 5% have a first- or second-degree relative with the same disease. • Commonly occurs in childhood and adolescence, but can occur at any age. • After metabolic stabilization, may initially have diminished insulin needs, but thereafter require insulin for survival. • Are at ongoing risk of ketoacidosis. 	<ul style="list-style-type: none"> • Usually overweight or obese. • Absent or mild polyuria and polydipsia, with little or no weight loss. • Acanthosis nigricans and PCOS may be present. • Usually present with glycosuria without ketonuria: <ul style="list-style-type: none"> ○ However up to 33% have ketonuria at diagnosis. ○ 5-25% of patients who are subsequently classified as T2DM, have ketoacidosis as the initial finding. ○ Ketoacidosis is usually without any associated stress, other illness, or infection. • 74-100% have a first- or second-degree relative with T2DM. • Usually diagnosed over the age of 10 and in middle or late puberty. <ul style="list-style-type: none"> ○ As obesity increases, may be diagnosed in younger or prepubertal children.

Table 5.2: Typical presentations of T1DM and T2DM in children [1,4,6].

6 Initial investigations

6.1 Diagnostic tests for diabetes mellitus

The following investigations are used to test for diabetes [1]:

- Fasting blood sugar (FBS).
 - Patients should be fasting for at least 8 hours.
- Oral glucose tolerance test (OGTT):
 - Studies have confirmed that the 2-hour post-glucose value diagnoses more people with diabetes compared with FBS cut points and HBA_{1c}.
 - An anhydrous glucose load of 1.75 g/kg (up to a maximum of 75g) should be used in children [7].
- Random blood sugar (RBS).
- HBA_{1c} [1]:
 - In the diagnosis of diabetes in children and adolescents, it is not clear if the same HBA_{1c} cut points as adults, should be used.
 - Point-of-care HBA_{1c} assays are not recommended for diagnostic purposes.
 - In haemoglobinopathies and anaemias, a HBA_{1c} assay without interference from abnormal haemoglobins should be used.

6.1.1 Diagnostic criteria for diabetes mellitus

American Diabetes Association criteria for the diagnosis of diabetes requires one of the following [1]:

- FBS: ≥ 7.0 mmol/L (126 mg/dL).
- OGTT: ≥ 11.1 mmol/L (200 mg/dL) at 2 hours post-glucose.
- RBS: ≥ 11.1 mmol/L (200 mg/dL) - if the patient also has classic symptoms of hyperglycaemia.
- HBA_{1c}: $\geq 6.5\%$.

6.1.2 Diagnostic criteria for prediabetes

American Diabetes Association criteria for diagnosis of prediabetes requires one of the following [1]:

- Impaired fasting glucose (IFG):
 - FBS: 5.6-6.9 mmol/L (100-125mg/dL).
- Impaired glucose tolerance (IGT):
 - OGTT: 7.8-11.0 mmol/L (140-199 mg/dL) at 2 hours post-glucose.
- HBA_{1c}: 5.7–6.4%.

6.1.3 Confirmatory testing

Confirming the diagnosis:

- A second diagnostic test is usually required to confirm the diagnosis [1][L2]:
 - Unless the diagnosis is clear, e.g.:
 - Patient is in hyperglycaemic crisis.
 - Patient has classic symptoms of hyperglycaemia and a RBS ≥ 11.1 mmol/L (200 mg/dL).
- The same diagnostic test should be repeated using a new blood sample [1][L2].

6.2 Additional investigations

In patients with symptoms of hyperglycaemia and an elevated plasma glucose of ≥ 13.9 mmol/L (250 mg/dL) [3]:

- Test for ketosis with serum (e.g. beta-hydroxybutyrate) or urinary ketones.
- If positive, test for ketoacidosis by performing a venous blood gas.

Further laboratory evaluation [1]:

- Complete blood count (CBC).
- Urea, electrolytes and creatinine.
- Spot urinary albumin-creatinine ratio.
- Liver function tests.
- Fasting lipid profile (in children ≥ 5 years of age), including:
 - Total, LDL and HDL cholesterol and triglycerides.
- Fasting insulin level.
- C-peptide level.
- Thyroid function tests.
- Anti-thyroid antibodies (anti-thyroid peroxidase antibodies).
- Anti-insulin antibodies and anti-islets cell antibodies.
- GAD65 antibodies.
- Coeliac screen:
 - IgG and IgA anti-tissue transglutaminase antibody.
 - Deamidated gliadin antibodies.

Other investigations may be required for evaluation of obese children and adolescents e.g. [R-GDG]:

- Sleep studies for sleep apnoea.
- Hepatic ultrasound for fatty liver disease.

7 Initial management of an acute presentation of type 1 diabetes mellitus

Patients with symptoms can deteriorate rapidly, irrespective of the underlying type of diabetes and require urgent assessment and appropriate treatment [R-GDG].

7.1 Admission criteria

Admission to hospital is recommended for any of the following [R-GDG]:

- Children who have any of the following:
 - Diabetic ketoacidosis.
 - Dehydration.
 - Inability to tolerate oral fluids.
 - Electrolyte disturbance.
- Children aged <5 years.
- Parents who are unable to cope with management of the child as an outpatient.
- Presentation over the weekend (i.e. on a Thursday, Friday or Saturday).

7.2 Management of diabetic ketoacidosis:

Refer all patients to the Paediatric Emergency Centre for evaluation and management with [1,8]:

- Intravenous (IV) fluids.
- IV insulin.
- Electrolyte monitoring.
- BG monitoring.
- Cerebral oedema prevention measures.

7.3 Management of hyperglycaemia without metabolic decompensation

All patients who present with hyperglycaemia, but without metabolic decompensation should be referred first to the Paediatric Emergency Centre and then to the Paediatric Diabetes Day Care Unit, if all of the following criteria are met [R-GDG]:

- Children with normal hydration status, normal electrolytes and tolerating oral intake.
- Children aged 5 years and older.
- Children who are transferred from the Paediatric Emergency Centre at day time before 12 noon.

NB: If the above criteria are not met, consider hospital admission.

8 Management of type 1 diabetes

8.1 Multi-disciplinary approach

Care should be provided by an integrated and collaborative multidisciplinary team, which may include the following [1]:

- Paediatric endocrinologists with an interest in diabetes.
- Paediatric diabetes educator.
- Paediatric dieticians.
- Mental health professionals.

8.2 Roles and responsibilities of the multidisciplinary team

The role of the diabetologist includes [R-GDG]:

- Monitor physical development and well-being with particular emphasis on
 - Growth.
 - Pubertal development.
 - Associated conditions including:
 - Goitre or thyroid disease.
 - Coeliac disease.
 - Other autoimmune conditions
 - Skin or foot problems.
- Choice of insulin types, doses, and injection/insulin delivery devices.
- Insulin adjustments based on BG values, food, and exercise.
- Glycaemic control, including:
 - HBA_{1c}
 - Analysis of home BG records.
- Hypoglycaemia history, including determination of hypoglycaemia awareness.
- Assessment of the psychosocial burden and referral to mental health professionals if needed.
- Management of intercurrent health problems, including:
 - Infections.
 - Disabilities.
 - Enuresis.
 - Nocturia
 - Diabetes-related emergency and Emergency Department visits.
 - Other paediatric and developmental problems.
- Assessment of the patient's understanding of the risks of complications.
- Formulation of care plans to minimise risk of complications and provide age-appropriate information.
- Ensure complication risk screening.
- Introducing insulin pump therapy.
- Introducing new technologies where available (e.g. continuous glucose monitoring).
- Assessment for co-morbidities.

The role of the paediatric diabetes educator includes education on the following [R-GDG]:

- The importance and timing of BG monitoring.
- The importance of insulin, different types and storage conditions.
- Promote Diabetes Self-Management Education (DSME) and Support (DSMS).
- Key skills, including: safe glucometer use, insulin administration technique and injection sites.
- Acute complications of T1DM:

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- Prevention, recognition and management of hypoglycaemia, including glucagon injections.
- Prevention, recognition and management of intercurrent illness, hyperglycaemia, ketosis and ketoacidosis.
- Chronic complications of T1DM.
- T1DM management during physical activity.
- Sick-day management.
- Management of diabetes in school particularly school absences/problems and sport
 - Holiday planning and travel, including educational holidays and camps.
 - Establish and maintain follow-up in Paediatric Diabetes Educator's clinic
- Education regarding insulin pumps or new technologies, if prescribed by the diabetologist.
- Re-education when needed (at least 4 times/year).

The role of the paediatric dietician includes **[R-GDG]**:

- Qualitative and quantitative advice on intake of:
 - Carbohydrates
 - Fat.
 - Protein.
 - Dietary fibre.
- Advanced carbohydrate counting.
- Advice on the adjustment of the carbohydrate intake during exercise, social events and activities.
- Coping with special events and eating out.
- Growth and weight gain.
- Diabetic foods.
- Sweeteners and drinks.
- Management of hypoglycaemia.
- Re-education when needed (at least 3 times/year)

The role of the mental health professionals includes **[R-GDG]**:

- Age-appropriate assessment of the typical range of emotional reactions to the diagnosis of T1DM.
- Adherence to treatment.
- Anxiety and depression assessment and increased risk factors.
- Establish and maintain a system of recall and review.
- Provision of support for family & careers.

8.3 Multi-disciplinary team roles in patient education

Education should be provided by the multidisciplinary team as outlined below **[R-GDG]**.

The role of the diabetologist includes **[R-GDG]**:

- Psychosocial support for the child and family, ensuring parents do not blame themselves.
- Assessment of the growth of the child, and pubertal stage.
- Simple explanation of the unknown aetiology of T1DM.
- Describing the diabetes disease process and treatment options
- Follow up of the glucose monitoring and modify the insulin dose and/or regimen accordingly.
- Honeymoon remission period.
- Importance of glucose monitoring and HBA_{1c}.

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

The role of the paediatric diabetes educator includes [R-GDG]:

- Education about glucose, normal BG levels and glucose targets.
- Types of diabetes and the pathophysiology of T1DM.
- Teaching practical skills, including:
 - Insulin injection technique.
 - BG testing and timings.
 - Interpretation of results.
- Simple explanation of prevention and management of hypoglycaemia or hyperglycaemia.
- Management of diabetes during illnesses.
- How to prevent DKA.
- Importance of adherence to insulin therapy.
- Diabetes management at school.
- Encourage membership of a diabetes association.
- Provision of emergency telephone contacts.
- Provision of written education materials for parents and children.

The role of the paediatric dietician includes [R-GDG]:

- Anthropometric assessment.
- Diet history including:
 - Usual diet.
 - Energy intake.
 - Total and saturated fat intake.
 - Basic carbohydrate counting.
 - Intake and distribution of carbohydrates.
 - Appetite and food preferences.
- Family structure, social situation and factors may impact on diet
- Nutritional Requirements calculations for age.
- Meal Planning: provide suitable meal plan that matches the patient's nutrient requirements.
- Provision of patient information leaflets regarding diet in diabetes.

8.4 Insulin therapy

Insulin regimens:

- The majority of type 1 diabetes patients should be managed using multiple-dose insulin injections or continuous subcutaneous insulin infusion (CSII, i.e. insulin pump) [1][L1].
- Multiple-dose insulin injections should include [9][L1]:
 - ≥ 3 injections of prandial insulin per day; and
 - 1-2 injections of basal insulin.
- Children and young patients should be offered multiple daily dose basal-bolus regimens from the time of diagnosis [10].
- Offer CSII if multiple daily injection regimens are not appropriate for the child [10].
- Intensive insulin therapy using ≥ 3 injections per day, or CSII provides improved glycaemic control and patient health outcomes [1][L1].
- However, intensive insulin therapy is also linked to higher rates of severe hypoglycaemia [1][L1].

Insulin administration:

- Most patients should be managed with insulin analogues that reduce hypoglycaemia risk, especially if the patient is at elevated risk of hypoglycaemia [1][L1].

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- Intensive management strategies should be used that employ pump therapy or continuous glucose monitoring and encourage active participation of the patient and family [1][L1].
- Postprandial increases in glucose may be controlled by altering the timing of prandial (bolus) insulin administration [1][L2].
- Recommendations on optimal prandial insulin dose administration should be individualised to each patient [1].
- The optimal time to inject prandial insulin is based on the following [1][L2]:
 - The type of insulin used.
 - The measured blood glucose level.
 - Timing of meals.
 - Carbohydrate consumption.
- Provide children and young patients with needles that are an adequate length for their body fat [11].
- Consider the use of a sensor-augmented low glucose threshold suspend pump in the following patients [1][L2]:
 - Frequent nocturnal hypoglycaemia.
 - Recurrent severe hypoglycaemia
 - Hypoglycaemia unawareness.

Recommended total daily doses (TDD) of insulin [R-GDG]:

- Infants: TDD: 0.5- 0.7 unit/kg
- Pre-pubertal children: TDD: 0.75- 1.0 unit/kg
- Pubertal children: TDD :1.0–1.2 unit/kg

NB: 50% of the TDD should be from basal insulin and 50% should be from prandial insulin [R-GDG].

8.4.1 Comparison of common insulins

Table 8.4.1 below outlines the main differences between common insulin formulations.

Insulin Type	Trade Name	Onset of Action	Duration of action
Rapid-acting analogues			
Lispro	<i>Humalog</i>	5-15 minutes	2-4 hours
Aspart	<i>Novorapid</i>		
Glulisine	<i>Apidra</i>		
Short-acting insulin			
Human Regular	<i>Actrapid</i>	30 minutes	5-8 hours
Intermediate-acting insulin			
Human NPH	<i>Isophane</i>	1-3 hours	12-18 hours
Basal insulin analogues			
Detemir Used in all age groups	<i>Levimer</i>	1-3 hours	6-24 hours
Glargine Used in children ≥5 years	<i>Lantus</i>	1-2 hours	20-24 hours

Table 8.4.1: Comparison of common insulins [R-GDG].

8.5 Glycaemic control and targets

The target BG levels across all paediatric age groups are as follows [1]:

- Before meals: 5.0 – 7.2 mmol/L (90 – 130 mg/dL).
- Bedtime/overnight: 5.0 – 8.3 mmol/L (90 – 150 mg/dL).
- HBA_{1c}: <7.5% (a target of <7.0% is reasonable if it can be achieved without problematic hypoglycaemia).

Note [1]:

- Goals should be individualised to the patient and modified if frequent hypoglycaemia or hypoglycaemia unawareness is present.
- Measure post-prandial BG if pre-prandial results do not correlate with the HBA_{1c} level and if assessment of pre-prandial insulin doses in basal–bolus regimens, is required.

8.6 Diabetes self-management education and support

All children with T1DM should receive [1,3,6]:

- Comprehensive DSME, to include all knowledge and skills for self-care and self-monitoring of blood glucose (SMBG).
- Comprehensive DSMS, to teach all the necessary skills needed for ongoing self-care.
- Use of tools including social network applications, distance learning, hard drive based media, and mobile content to support lifestyle modification to prevent diabetes [1][L2].

The four critical times to deliver DSME and DSMS are [1]:

- At initial diagnosis.
- At every single outpatient visit (at least 4 times per year).
- Each time new complications arise that influence self-management.
- At transition points in care.

8.6.1 Self-monitoring of blood glucose

The following advice should be given to both the patients and their families/caregivers [10]:

- Capillary blood testing should be performed at least 5 times per day.
- Self-monitoring of capillary blood glucose should be more frequent with increased physical exertion and at times of illness – ensure adequate test strips are available for this.

Children and adolescents should be offered a choice of monitoring equipment to optimise their glucose control [10].

Explain that blood glucose levels should be interpreted in the context of the 'whole child', which includes the social, emotional and physical environment [10].

8.6.2 Continuous glucose monitoring

Ongoing real-time continuous glucose monitoring with alarms [10]:

- This should be offered to the following patients:
 - Those with frequent episodes of severe hypoglycaemia.
 - Those with an impaired awareness of hypoglycaemia associated with adverse consequences (for example, seizures or anxiety).
 - Those with an inability to explain symptoms of hypoglycaemia (e.g. very young children or those with learning difficulties).

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- This should be considered for the following patients [10]:
 - Neonates, infants and pre- school children.
 - Those who undertake high levels of physical exertion.
 - Those with significant co-morbidities or who are on medications that may make blood glucose levels difficult to control (e.g. those on corticosteroids).

Consider intermittent (real- time or retrospective) continuous glucose monitoring to help improve blood glucose control in children and young people who continue to have hyperglycaemia despite insulin adjustment and additional support [10].

8.7 Dietary advice

All patients should receive dietary advice delivered by a registered paediatric diabetes dietician [1][L1]. Consider individualised dietary advice for all children and adolescents with T1DM [1][L1]. Each member of the care team should be knowledgeable about the principles of appropriate well balanced nutrition and be supportive of its implementation [1][L2].

Educate patients on how to use carbohydrate counting or estimation to determine mealtime insulin dosing to improve glycaemic control [1][L1]. Consider a consistent pattern of carbohydrate intake in patients who have a fixed insulin therapy programme [1].

Emphasise carbohydrate intake from the following sources, avoiding those containing sugars [1]:

- Whole grains.
- Vegetable.
- Fruits.
- Legumes.
- Dairy products.
- Foods higher in fibre and lower in glycaemic control.

8.8 Physical activity

All children and adolescents with T1DM should be encouraged to exercise normally [9][L2]. Children with T1DM should be encouraged to participate in at least 60 minutes of physical activity each day [1]. All children and adolescents with T1DM, should be encourage to reduce the amount of time they spend sitting [1][L1].

Precautions [1]:

- Exercise can lead to metabolic disturbances occasionally leading to hyperglycaemia and ketosis or, more frequently, to hypoglycaemia.
- Tell children and adolescents with T1DM that they can lead a relatively normal life and take part in all forms of exercise, provided that this exercise is taken into account when reviewing their insulin requirements and diet.
- Blood glucose levels should be monitored pre- and post-exercise, as:
 - Blood glucose response varies to different types of exercise.
 - Hypoglycaemia may occur as a delayed response many hours after prolonged exercise.

8.8.1 Hypoglycaemia during physical activity

In patients managed with insulin [9]:

- Patients may need to ingest additional carbohydrate prior to exercise if pre-exercise glucose levels are <7 mmol/L (126mg/dL).
- Reducing the prandial insulin dose for the meal or snack prior to exercise or increasing food intake prior to exercise will raise the pre-exercise glucose level and reduce hypoglycaemia risk [9][L3].
- Consider reducing the overnight basal insulin the night following exercise to reduce the risk of delayed exercise-induced hypoglycaemia [9][L2].
- Keep a source of simple carbohydrate readily available before, during, and after exercise to treat and prevent hypoglycaemia [9][L3].

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

8.9 Psychosocial care

Consider the patient's psychosocial and social circumstances while managing T1DM [1]:

- Routinely screen for psychosocial problems, such as [1]:
 - Depression.
 - Diabetes-related distress:
 - Significant negative psychological reactions related to emotional burdens and worries associated with managing diabetes.
 - High levels of distress are associated with medication non-adherence, higher HBA_{1c} levels, lower self-efficacy, and poorer exercise and dietary behaviours.
 - Anxiety.
 - Eating disorders.
 - Cognitive impairment.
- Patients with diabetes and depression should receive stepwise collaborative care that aims to manage both the diabetes and the depression [1][L1].

Consider referral to a mental health specialist familiar with diabetes if [1][L2]:

- There is a possibility of self-harm.
- There is poor parental or care-giver support.
- The patient has a gross disregard for the medical regimen.
- The patient has depression.
- The patient has debilitating anxiety.
- There are indications of an eating disorder.
- Cognitive function significantly impairs function.

It is preferable to incorporate psychological assessment into the routine care of diabetes, rather than waiting for a specific problem to occur [1].

8.10 Immunisation

All children with T1DM should receive the standard vaccinations in childhood. In addition, the MOPH Public Health department recommends the following [12,13]:

- Pneumococcal vaccination:
 - 1 dose of PPSV23 at ≥2 years of age and at least 8 weeks after last dose of PCV.
 - Revaccination with PPSV23 is not required.
- Annual influenza vaccination prior to the start of the influenza season.

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

8.11 Management of T1DM in the school setting

The school nurse and other school staff should be trained to meet the needs of students with T1DM including [14][L2]:

- Recognition of the signs and symptoms of hypoglycaemia and hyperglycaemia.
- Prompt treatment of hypoglycaemia and hyperglycaemia.
- Administration of glucagon and insulin.
- Basic management of insulin pumps.

School staff should have access to the following equipment and be trained in their use [14][L2]:

- Glucometer.
- Insulin therapy.
- Needles or pens.
- Glucagon injections.
- Glucose gel.
- Diabetes information manual.

School staff should be made aware of the following [14][L2]:

- An individualised medical management plan.
- The child's management needs during the school day and during all school sponsored events.
- Help will always be required in the event of a diabetes emergency, regardless of the child's level of self-care.
- Nutritional information and carbohydrate content for school meals.
- Students with diabetes should participate fully in school sports and physical education.
- Parental attendance should not be required for a child's participation during the school day, on school trips or at extracurricular activities.
- To contact parents and the diabetes team if there are concerns about the child's health.

8.12 Pancreas and islet cell transplantation

Pancreas and islet cell transplantation is frequently explored by parents of patients with T1DM. Explain the following to patients and their families [1,9]:

- Transplantation may normalise glucose levels.
- But is only an option to be considered in adults.
- The use of islet transplantation remains under investigation at present.

9 Management of acute complications of type 1 diabetes mellitus

9.1 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).
- Hypoglycaemia, 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 (symptoms may be non-specific in children).

9.1.1 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 for tests or procedures.
- 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 patients with hypoglycaemia prone patients should be educated in the use of glucagon kits [1][L2].

9.1.2 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 [11][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].

9.1.3 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].

9.2 Hyperglycaemia

Stressful events or intercurrent illness may aggravate glycaemic control and may lead to the development of diabetic ketoacidosis [1].

Provide each child and young patient and their family members and carers with verbal and written advice about management during intercurrent illness or episodes of hyperglycaemia, including [10][L2]:

- Monitoring blood glucose.
- Monitoring and interpreting blood ketones.
- Adjusting their insulin regimen.
- Food and fluid intake.
- When and where to seek further advice for help.

9.3 Managing diabetes during an intercurrent illness

Parents (and patients) should be advised of the following general measures to manage intercurrent illness and prevent DKA or hypoglycaemia (i.e. sick-day management)[8]:

Monitoring [8]:

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

Food and fluid intake [8]:

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

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

9.3.1 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 [8].
- If BG is >250 mg/dL (13.9 mmol/L), or ketones are positive (i.e. detected in blood or urine):
 - Give additional rapid-acting insulin analogues every 2-4 hours (as per *Table 9.3.1* below), i.e. *Humalog, Novorapid* or *Apidra*.
 - Additional doses of insulin can be added to the usual dose or given with meals or snacks.
 - 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 paediatric diabetes team.
- Emergency Department attendance is warranted if:
 - Ketones remain elevated despite two additional doses of rapid-acting insulin.
 - Symptoms of DKA develop.
 - The patient/family/carer is concerned about the child's 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).

Ketone levels		Insulin response according to blood glucose level	
Urine ketones:	Blood ketones:	BG: 250 – 350 mg/dL	BG: ≥351 mg/dL
Negative (-)	< 0.6mmol/l	No extra insulin required	Give 5% of TDD
Small (+)	0.6- 1.5mmol/l	Give 5% of TDD	Give 10% of TDD
Medium (++)	1.5- 3.0mmol/l	Give 10% of TDD	Give 15% of TDD
Large (+++/++++)	> 3.0mmol/l	Give 15% of TDD	Give 20% of TDD

TDD: Total daily dose of insulin

Table 9.3.1: Insulin management according to urinary or blood ketones and BG level [R-GDG].

9.3.2 Patients using insulin pumps

In addition to the general measures listed above. Patients should be advised to manage their insulin as outlined in *Table 9.3.2* below.

Blood glucose	Urinary ketones	Blood ketones	Actions
<6 mmol/L (110 mg/dL)	Negative or positive	0 - 3 mmol/L	<ul style="list-style-type: none"> • Reduce the dose of both basal insulin and any bolus doses by 10 - 20%. • Encourage consumption of sugar-containing fluids. • Seek specialist advice if <ul style="list-style-type: none"> ○ Further insulin reductions are required. ○ If the child is unable to drink, or ○ If vomiting occurs. • Administer glucagon if BG remains low.
6 - 14 mmol/L (110 - 250 mg/dL)	Negative or positive (any amount)	0 - 3 mmol/L	<ul style="list-style-type: none"> • Give the usual insulin at the usual time. • Do NOT give extra insulin. • Retest BG in 2-4 hours.
>14 mmol/L (250 mg/dL)	negative or small (+)	0 - 0.6 mmol/L	<ul style="list-style-type: none"> • Temporarily increase the basal insulin rate by 20%. <ul style="list-style-type: none"> ○ Further increases may be required if BG remains elevated. • Give an additional bolus dose of insulin - up to 10% of the total daily dose. • Retest BG in 2-4 hours.
	moderate or large (+, ++)	0.7 - 3 mmol/L	<ul style="list-style-type: none"> • Temporarily increase the basal rate by 20%. <ul style="list-style-type: none"> ○ Further increases may be required if BG remains elevated. • Give an additional bolus dose of insulin - at least 10-20% of the total daily dose. • Retest BG in 2-4 hours.

Table 9.3.2: Insulin management of patients using insulin pumps [R-GDG].

10 Management of chronic complications of type 1 diabetes mellitus

Nephropathy:

In children who have had T1DM for 5 years [8]:

- Screen annually for nephropathy, using a random spot urine sample for ACR.
- Refer to paediatric nephrology if elevated ACR is confirmed on repeat sampling [R-GDG].

Retinopathy:

Children aged ≥ 10 years or who are post-puberty (whichever occurs first), should have an eye examination performed by an ophthalmologist at the time of the initial diagnosis [1]. For pre-pubertal children, an eye examination should be performed by an ophthalmologist, once the patient has had T1DM for 3-5 years [1]. In all cases the eye examination should be repeated annually thereafter [1].

Neuropathy:

For children aged ≥ 10 years or who are post-puberty (whichever occurs first), who have had T1DM for 3-5 years [R-GDG]:

- Perform a comprehensive foot examination annually [1].

Dyslipidaemia:

Obtain a fasting lipid profile in children aged ≥ 10 years, soon after the initial diagnosis and annually thereafter [1].

Management of dyslipidaemia [1]:

- Optimise glycaemic control and diet.
- Consider statin therapy in patients with:
 - LDL-C >4.1 mmol/L (160 mg/dL); or
 - LDL-C >3.4 mmol/L (130 mg/dL), if ≥ 1 ASCVD risk factor is present following lifestyle and diet improvement.
- Consider seeking the advice of a consultant in metabolic medicine prior to initiating therapy [R-GDG].
- LDL-C treatment target:
 - LDL-C <2.6 mmol/L (100 mg/dL).

11 Screening for associated autoimmune conditions

Hypothyroidism [1]:

- Measure TSH after the initial diagnosis and once glucose control has been established.
- Reassess every 1-2 years if normal.

Coeliac disease [1]:

- Screen after the initial diagnosis by measuring:
 - IgG and IgA tissue transglutaminase antibody (with normal serum IgA levels) and/or
 - Deamidated gliadin antibodies
- Repeat screening should be performed annually thereafter or sooner if symptoms develop [R-GDG].
- Consider in patients with any of the following:
 - Family history of coeliac disease.
 - Failure to grow or gain weight.
 - Weight loss.

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- Diarrhoea or flatulence.
- Abdominal pain.
- Signs of malabsorption.
- Repeated hypoglycaemia of unknown cause or decline in glycaemic control

12 Management of type 2 diabetes mellitus

12.1 Multidisciplinary approach

Care should be provided by an integrated and collaborative multidisciplinary team, which may include the following [1]:

- Paediatric endocrinologists with an interest in diabetes.
- Paediatric diabetes educator.
- Paediatric dieticians.
- Exercise specialists.
- Mental health professionals.

12.2 Lifestyle intervention

Lifestyle intervention [3,6]:

- A lifestyle modification programme including nutrition and physical activity should be started in all patients irrespective of pharmacotherapy [3][L1].
- Weight management and regular physical activity should be promoted in all children with T2DM.
- In paediatric patients, lifestyle change is most likely to be successful when a multidisciplinary approach is used and the entire family is involved [3][L1]:
 - The family's ideal role in lifestyle interventions varies, depending on the child's age:
 - In younger children, behavioural interventions have shown a favourable effect.
 - In adolescents, interventions based on target-age behaviours (e.g. phone or internet-based interventions as well as face-to-face or peer-enhanced activities) appear to foster better results, at least for weight management.

Physical activity should include [3]:

- Moderate-to-vigorous exercise for at least 60 mins daily.
- Defined as exercise that results in the person breathing hard and perspiring and raises his or her heart rate:
 - Moderate physical activity - a person can talk but not sing
 - Vigorous activity - a person cannot talk without pausing to catch a breath.
- 60 mins of exercise can be done in shorter time intervals e.g. 10–15 minutes.
- Recommended for reduction of BMI and improved glycaemic control.
- With patients and their families, jointly determine an individualised plan that includes specific goals to reduce sedentary behaviours and increase physical activity:
 - A written prescription to engage in physical activity may improve adherence and should include a “dose” describing ideal duration, intensity, and frequency.
 - Encourage patients to find a variety of forms of activity that can be done with ease and frequency.
 - Limit non-academic screen time to <2 hours a day:

- Discourage the presence of video screens and television sets in children's bedrooms.
- N.B. Medication dosage may need to be adjusted, especially if the patient is receiving insulin, when starting a vigorous physical activity programme.

Nutritional interventions [6]:

- Should only be provided by a healthcare professional (e.g. dietician) who has the relevant expert knowledge and experience in growth and development in children.
- Specific recommendations should be tailored to the individual and include assessment of:
 - Food preferences.
 - Meal and snack times and locations.
 - Food preparation.
 - Readiness to change behaviour.
- Regular re-evaluation is essential if weight loss interventions are to succeed.

12.3 Metformin

Initial treatment is determined by the symptoms and severity of hyperglycaemia and the presence or absence of ketosis or ketoacidosis [1,3].

Initial treatment is typically with metformin and lifestyle intervention at the time of diagnosis of T2DM, unless the patient also requires insulin therapy (see below) [3].

Gastrointestinal adverse effects of metformin therapy [3]:

- Are common at initiation of medication, but are transient.
- Include:
 - Abdominal pain.
 - Bloating.
 - Loose stools.
- Can be minimised by:
 - Starting the drug at a low dose of 500mg daily and:
 - Increasing by 500 mg every 1-2 weeks;
 - Titrating up to an ideal and maximum dose of 2000 mg daily in divided doses.
 - Taking metformin with food.

In adolescents with PCOS [6]:

- Treatment with metformin may normalise ovulatory abnormalities and increase the risk of unplanned pregnancy.
- Pre-conception and pregnancy counselling is therefore an important part of treatment.

12.4 Insulin therapy

Insulin therapy at initial presentation:

- Insulin should be used for patients presenting with [1,3,6]:
 - Ketosis.
 - Diabetic ketoacidosis (DKA) or hyperglycaemic hyperosmolar state (HHS).
 - In whom the distinction between T1DM and T2DM is unclear.
 - Who have RBS or FBS ≥ 13.9 mmol/L (250 mg/dL).
 - Whose HBA_{1c} is $\geq 9\%$.
- Metformin therapy may be used as an adjunct after resolution of ketosis/ketoacidosis.

Insulin therapy in patients started on metformin [1,3,5]:

- Should be considered when glycaemic targets are not achieved with lifestyle measures and metformin therapy [5][L1].
- Insulin therapy is required until fasting and postprandial glycaemia have been restored to normal or near-normal levels.
- Many patients diagnosed with T2DM may be slowly weaned from insulin therapy and subsequently managed with metformin and lifestyle modification.
- Should be supervised by a physician with experienced in insulin treatment in diabetic patients.

12.5 Glucose targets and monitoring

Treatment targets for T2DM are as follows [1]:

- Blood glucose range:
 - 5.0-7.2 mmol/L (90-130 mg/dL) before meals.
 - 5.0-8.3mmol/L (90-150 mg/dL) 2 hours after meals.
 - Blood glucose (BG) targets should be modified in children with frequent hypoglycaemia or hypoglycaemia unawareness.
 - Postprandial blood glucose values should be measured when there is a discrepancy between pre-prandial BG values and HBA_{1c} levels and to assess pre-prandial insulin doses in those on basal–bolus regimens.
- HBA_{1c} of ≤7.0% across all patient age groups [3].
 - HBA_{1c} concentrations should be monitored every 3 months [3,10]:
 - Patients whose HBA_{1c} concentrations remain relatively stable may only need to be tested every 6 months [3].

Treatment should be intensified if treatment goals for BG and HBA_{1c} concentrations are not being met. Intensification activities may include, but are not limited to [3]:

- Increasing the frequency of clinic visits.
- Engaging in more frequent BG monitoring.
- Adding further antidiabetic agents.
- Meeting with a registered dietitian and/or diabetes educator.
- Increasing attention to diet and exercise regimens.

Successful treatment with lifestyle and pharmacotherapy is defined as [3,6]:

- Cessation of excessive weight gain with normal linear growth.
- Near-normal fasting BG values (≤7.0 mmol/L (126 mg/dL)).
- Near-normal HBA_{1c} (≤7%).

12.6 Diabetes self-management education and support

All children with T2DM should receive [1,3,6]:

- Comprehensive Diabetes Self-Management Education (DSME):
 - To facilitate the knowledge, skills, and abilities necessary for diabetes self-care.
 - Should include teaching self-monitoring of blood glucose (SMBG).
- Diabetes Self-Management Support (DSMS):
 - To assist with implementing and sustaining skills and behaviours needed for ongoing self-management, both at diagnosis and as needed thereafter.
- Technology-assisted tools including Internet-based social networks, distance learning, DVD-based content, and mobile applications can be useful elements of effective lifestyle modification to prevent diabetes [1][L2].

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

12.6.1 Self-monitoring of blood glucose

Advise children and adolescents with T1DM to regularly monitor capillary BG concentrations and that this should be a combination of fasting, pre-prandial and post-prandial measurements [3,6].

In most children and adolescents with T2DM [3]:

- Capillary BG monitoring should be performed at least 3 times a day when using multiple insulin injections or insulin pump therapy.
- Capillary BG monitoring may be useful to identify success of therapy in patients using less-frequent insulin injections, non-insulin therapies, or medical nutrition therapy alone.
- Less frequent measurements are needed with metformin, compared with insulin therapy or sulfonylureas, due to the reduced risk of hypoglycaemia.

For newly-diagnosed T2DM patients [6]:

- Capillary BG monitoring should be performed before meals (including a morning fasting concentration) and at bedtime until a good blood sugar control is achieved, after which monitoring frequency can be reviewed.
- However, those patients who are at risk of episodes of severe hypo- or hyperglycaemia will need continued frequent blood sugar testing.

12.7 Psychological and social issues

The following psychosocial issues apply to children and young people with diabetes [1,10]:

- Children and young people with T2DM have a greater risk of emotional and behavioural difficulties.
- A lack of adequate psychosocial support has a negative effect on various outcomes, including BG control, and can also reduce self-esteem.
- Offer children and adolescents with T2DM and their family members or carers:
 - Timely and ongoing access to mental health professionals.
 - Emotional support after diagnosis, which should be tailored to their emotional, social, cultural and age dependent needs.
 - Screening for anxiety and depression to patients who have persistently suboptimal BG control.
 - Prompt referral for those with suspected anxiety and/or depression to child mental health professionals.

12.8 Immunisation

All children with T2DM should receive the standard vaccinations in childhood. In addition, the MOPH Public Health department recommends the following [12,13]:

- Pneumococcal vaccination:
 - 1 dose of PPSV23 at ≥ 2 years of age and at least 8 weeks after last dose of PCV13.
 - Revaccination with PPSV23 is not required.
- Annual influenza vaccination prior to the start of the influenza season.

13 Screening and prevention of type 2 diabetes mellitus

13.1 Risk factors for screening and testing in asymptomatic patients

Screening for diabetes and prediabetes should be undertaken in those individuals who are overweight or obese, and who have any two of the following risk factors [1]:

- Family history of T2DM in a first- or second-degree relative.
- High-risk ethnicity.
- Signs of insulin resistance or conditions associated with insulin resistance:
 - Acanthosis nigricans.
 - Hypertension.
 - Dyslipidaemia.
 - PCOS.
 - Small-for-gestational age birth weight.
- Maternal history of diabetes or gestational diabetes mellitus during the child's gestation.

Timing of screening test should [1]:

- Start at 10 years of age or at the onset of puberty, if puberty starts at a younger age.
- Use either FBS or OGTT as screening tests, as appropriate [R-GDG].
- If testing was normal, repeat screening tests every 2 years [R-GDG].
- Those with prediabetes should be tested annually.
 - In patients with prediabetes, identify and if appropriate treat, other atherosclerotic cardiovascular disease (ASCVD) risk factors.

Evaluation of patients at risk should incorporate a global risk factor assessment for both diabetes and ASCVD [4].

13.2 Prevention of type 2 diabetes

Approaches can target [6]:

- General population of children, or
- Identification of high-risk individuals:
 - Need to identify those at increased risk and provide the required services.

Intervention can take place at [6]:

- An early stage when BG levels are still normal, or
- At the stage of IGT or IFG.

Prevention of T2DM may include [1,3,6]:

- Weight management.
- Patient education:
 - T2DM and its complications.
 - The role of diet and exercise in preventing diabetes.
- Encouragement of health eating.
- Regular physical activity.

14 Management of comorbidities of type 2 diabetes mellitus

14.1 Obesity

BMI [15]:

- The BMI measurement (once it has been adjusted for age and gender) can be used as a surrogate and simple marker of adiposity, but this is not a direct measure of adiposity.

Weight loss through diet alone is not recommended, as it is vital that diet is part of a varied approach, including exercise and psychological support with trained professionals [15].

Encourage parents or carers to take responsibility for children (especially if younger than age 12 years) and also to lose weight themselves, if they are obese [15].

Drug treatment with orlistat is only recommended in the following [15]:

- Children ≥ 12 years in whom lifestyle intervention has failed and who have:
 - Physical comorbidities e.g.:
 - Orthopaedic comorbidities.
 - Sleep apnoea.
 - Severe psychological comorbidities.
- If prescribed by a paediatric diabetologist in a multi-disciplinary setting [R-GDG].

Surgical intervention is not advised as a routine procedure in children or young people with diabetes [15][L1].

- Bariatric surgery should only be considered in exceptional circumstances and where physiology maturity has, or nearly, been achieved.
- Surgery for obesity should be undertaken only by a multidisciplinary team that can provide paediatric expertise [R-GDG].

14.2 Non-alcoholic fatty liver disease

Non-alcoholic fatty liver disease (NAFLD) [16][L2]:

- Do not use routine liver function tests to exclude NAFLD.
- Offer a liver ultrasound to test children and young people for NAFLD if they:
 - Have T2DM or metabolic syndrome; and
 - Do not misuse alcohol.
- Refer children with suspected NAFLD to a relevant paediatric specialist in hepatology in tertiary care.
- Diagnose children and young people with NAFLD if:
 - Ultrasound shows they have fatty liver; and
 - Other suspected causes of fatty liver have been excluded.
- Offer liver ultrasound to retest children and young people for NAFLD every 3 years.

14.3 Hypertension

14.3.1 Monitoring of hypertension

Monitoring:

- Blood pressure (BP) should be measured at each routine visit [1]
- Children and adolescents should have their BP confirmed on 3 separate days if they have [1]:
 - High-normal BP:

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

- Systolic blood pressure (SBP) or diastolic blood pressure (DBP) $\geq 90^{\text{th}}$ percentile for age, sex, and height; or
- Hypertension:
 - SBP or DBP $\geq 95^{\text{th}}$ percentile for age, sex, and height.

14.3.2 Management of hypertension

NB: Refer all children and adolescents with hypertension to a paediatric nephrologist for evaluation [R-GDG]. The goal of BP treatment is to achieve a consistent BP of $< 90^{\text{th}}$ percentile for age, sex and height [1].

Initial treatment [1,6]:

- Lifestyle modification:
 - Dietary modification,
 - Increased exercise, and
 - Weight control.
- Pharmacological treatment should be considered if target BP is not reached within 3-6 months of lifestyle changes, with the following [1]:
 - Angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers should be considered initially.
 - ACE inhibitors are the first line of therapy in children with microalbuminuria.
 - Counselling on the potential teratogenic effects of both medication classes should be provided to female adolescents of reproductive age.
- The following may also be considered [6]:
 - Alpha-blockers.
 - Calcium antagonists (long-acting).
 - Low-dose diuretics.
- If normo-tension (for age and sex) is not achieved, combination therapy may be considered [1,6].

14.4 Dyslipidaemia

14.4.1 Screening

Obtain a fasting lipid profile in the following children and adolescents [1]:

- Patients ≥ 10 years of age; and
- Following the diagnosis of T2DM and after glucose control has been attained.

If the lipid profile is abnormal [1]:

- Annual monitoring is reasonable.
- If LDL cholesterol (LDL-C) values are within the accepted risk level (< 100 mg/dL (2.6 mmol/L)), a lipid profile repeated every 3 years is reasonable [R-GDG].

14.4.2 Lifestyle intervention

The following may be helpful for children and adolescents with T2DM who also have dyslipidaemia [6,17]:

- Weight loss.
- Increased activity.
- Improved glycaemic control.

- Changing food choices and their preparation:
 - Intake of saturated fats, trans fats, and cholesterol should be limited, while LDL-C lowering macronutrient intake should include plant stanols/sterols (approximately 2 g/ day) and soluble fibre (10-25 g/day) [17][L1].
 - A reduced calorie diet is recommended, consisting of:
 - Fruits and vegetables (≥5 servings/day) [17][L1].
 - Grains (≥6 servings/day, one-third of those as whole grains).
 - Fish and lean meats [17][L1].

14.4.3 Pharmacotherapy

Pharmacotherapy is recommended for children and adolescents >8 years who do not respond sufficiently to lifestyle modification, and particularly for those satisfying the following criteria [17][L3]:

- LDL-C of ≥4.9 mmol/L (190 mg/dL); or
- LDL-C of ≥4.1 mmol/L (160 mg/dL); and
 - The presence of 2 or more ASCVD risk factors, even after vigorous intervention; or
 - A family history of premature coronary artery disease (<55 years of age) or;
 - Overweight, obese, or other elements of the insulin resistance syndrome.

The goal of therapy is [1,17]:

- Patients with T2DM and no other ASCVD risk factors:
 - An LDL cholesterol value of <2.6 mmol/L (100 mg/dL).
- For patients with T2DM with ≥1 additional ASCVD risk factors:
 - The recommended LDL-C goal is <1.8 mmol/L (70 mg/dL).

15 Management of complications of type 2 diabetes mellitus

15.1 Acute complications

Patients with symptoms can deteriorate rapidly, irrespective of the underlying type of diabetes and require urgent assessment and appropriate treatment [R-GDG].

15.1.1 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 (symptoms may be non-specific in children).

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

The diagnosis and management of diabetes in children and adolescents
(Date of next revision: March 2019)

Patients should be aware of situations in which they have an increased risk of hypoglycaemia, such as [R-GDG]:

- Fasting e.g.:
 - For medical tests or procedures.
 - During Ramadan or for other religious purposes.
- During or after intense exercise.
- During sleep.

Treatment [1]:

- Glucose (15–20g) is the preferred treatment for the conscious individual with hypoglycaemia, although any form of carbohydrate that contains glucose may be used.
- If SMBG shows continued hypoglycaemia 15 mins after treatment, the treatment should be repeated.
- Once SMBG returns to normal, the individual should consume a meal or snack to prevent recurrence of hypoglycaemia.
- Glucagon should be prescribed for all individuals at increased risk of severe hypoglycaemia.
- Caregivers, school personnel, or family members of these individuals should be instructed in its administration. Glucagon administration is not limited to health care professionals.

15.1.2 DKA and HHS:

Refer all patients to the Paediatric Emergency Centre for evaluation and management with [R-GDG]:

- Intravenous (IV) fluids.
- IV insulin.
- Electrolyte monitoring.
- BG monitoring.
- Cerebral oedema prevention measures.

15.2 Chronic complications

15.2.1 Diabetic nephropathy

Screening:

Annual screening for albuminuria [1]:

- A random spot urine sample for albumin–creatinine ratio (ACR) should be considered once diabetes has been present for ≥ 5 years.
- Use the first urine sample of the day ('early morning urine') for screening, which reduces the risk of false positive results.
- Estimated glomerular filtration rate should be measured:
 - At initial evaluation and then,
 - Based on age, diabetes duration, and treatment.

Treatment:

Treatment is indicated when [1]:

- Elevated urinary ACR (>30 mg/g) is documented in at least 2 of 3 urine samples which have been obtained over a 6-month interval, following efforts to improve glycaemic control and normalise BP.
- Consider an ACE inhibitor titrated to normalisation of albumin excretion.

15.2.2 Retinopathy

Retinopathy screening [1]:

- Should be performed at age ≥ 10 years or after puberty has started (whichever is earlier), once the patient has had diabetes for 3–5 years [**R-GDG**].
- After the initial examination, annual routine follow-up is generally recommended.
- Less frequent examinations, every 2 years, may be acceptable on the advice of an ophthalmologist.

15.2.3 Neuropathy

For children aged ≥ 10 years or who are post-puberty (whichever occurs first) [1]:

- Screen for neuropathy at the time of diagnosis of T2DM.
- Perform a comprehensive foot examination annually thereafter.

16 Advice for fasting during Ramadan

Fasting during Ramadan:

- All children with diabetes are considered exempt from fasting on medical and religious grounds [18].
- If the child insists, a decision on fasting should be individualised to the patient and made in consultation with the patient's paediatric endocrinologist, 2-3 months prior to the start of Ramadan [**R-GDG**].
- Explain to the patient that [18]:
 - Going through a hypoglycaemic episode might be very dangerous.
 - Fasting may very rarely lead to hyperglycaemia which may lead to ketoacidosis (coma) and other serious health problems.
 - Fasting may lead to dehydration.

17 References

1. Cefalu WT, Bakris G, Blonde L et al. American Diabetes Association (ADA) Standards of medical care in diabetes – 2016. *Diabetes Care* 2016; 39: s1-112.
2. Internal Clinical Guidelines Team Diabetic foot problems. Prevention and management. London: National Institute for Health and Care Excellence (NICE); 2016.
3. Copeland KC, Silverstein J, Moore KR et al. Management of newly diagnosed type 2 diabetes mellitus (T2DM) in children and adolescents. *Pediatrics* 2013; 131: 364-82.
4. American Diabetes Association (ADA). Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2014; 37: s81-90.
5. Handelsman Y, Bloomgarden ZT, Grunberger G et al. American Association of Clinical Endocrinologists (AACE) and American College of Endocrinology (ACE)- clinical practice guidelines for developing a diabetes mellitus comprehensive care plan. *Endocr Pract* 2015; 21: 1-87.
6. American Diabetes Association (ADA). Type 2 diabetes in children and adolescents. *Diabetes Care* 2000; 23: 381-9.
7. Paediatric Formulary Committee. BNF for Children (online) London: BMJ Group, Pharmaceutical Press, and RCPCH Publications <<http://www.medicinescomplete.com>> [Accessed on 22nd November 2016].
8. Wolfsdorf 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.
9. 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.
10. 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: NCCWCH; 2015.
11. National Clinical Guideline Centre (NCGC). Type 1 diabetes in adults: diagnosis and management. London: NCGC; 2016.
12. Ministry of Public Health. National immunisation guidelines for vaccine providers. 2016.
13. Supreme Council of Health. Pneumococcal vaccination in children and teens. 2015.
14. Jackson CC, Albanese-O'Neill A, Butler KL et al. Diabetes care in the school setting: a position statement of the American Diabetes Association (ADA). *Diabetes Care* 2015; 38: 1958-63.
15. National Clinical Guideline Centre (NCGC). Obesity. Identification, assessment and management of overweight and obesity in children, young people and adults. London: NCGC; 2014.
16. National Institute for Health and Care Excellence (NICE). Non-alcoholic fatty liver disease. Assessment and management. NICE Guideline 49. London: NICE; 2016.
17. Jellinger PS, Smith DA, Mehta AE et al. American Association of Clinical Endocrinologists' (AACE) guidelines for the management of dyslipidemia and prevention of atherosclerosis. *Endocr Pract* 2012; 18: 1-78.
18. International Diabetes Federation; Diabetes & Ramadan (DAR) International Alliance. Diabetes and Ramadan: Practical Guidelines. Brussels, Belgium: (IDF), 2016. Available at: www.idf.org/guidelines/diabetes-in-ramadan [Accessed 10th December 2016].