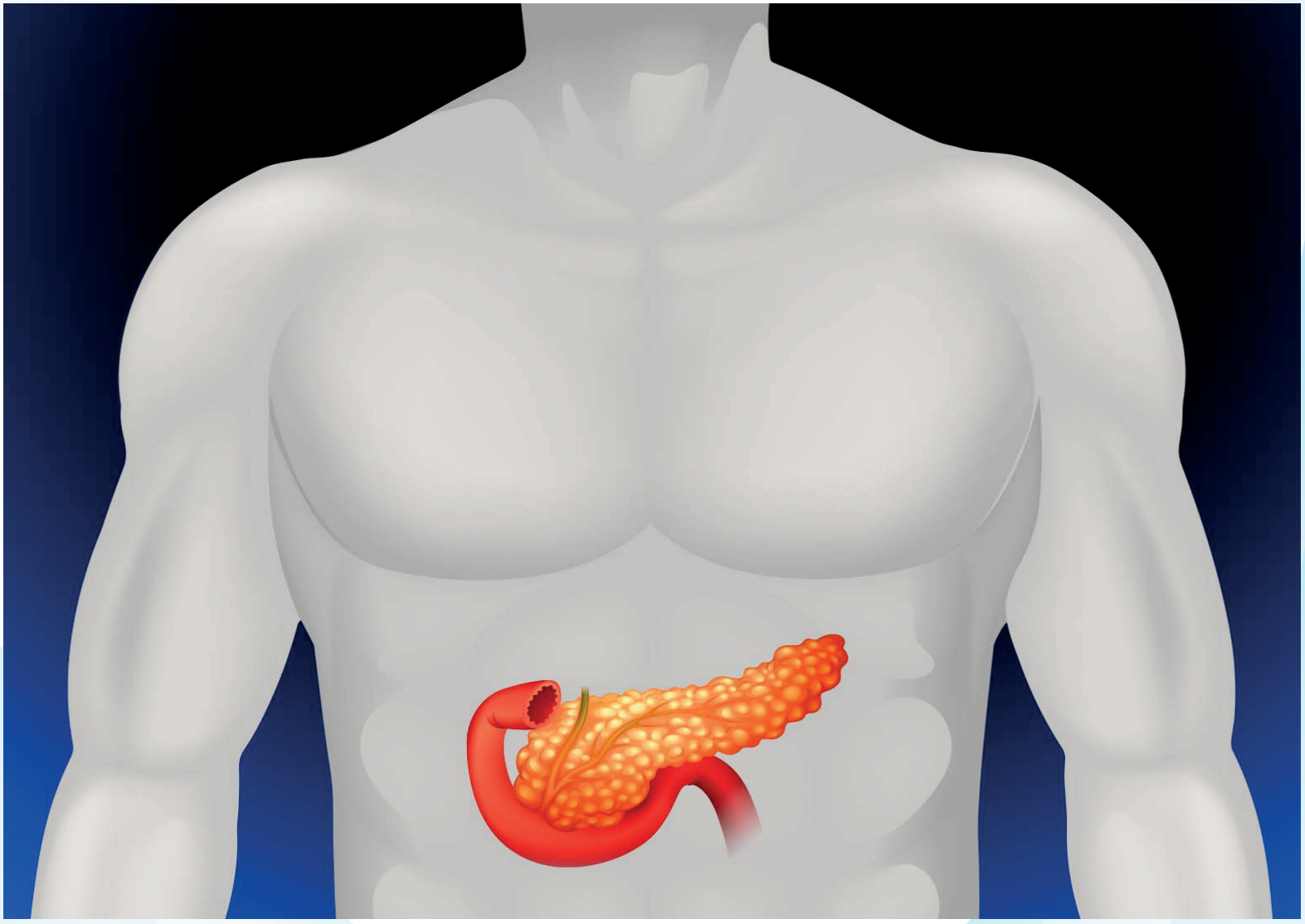
THE REPUBLIC OF UGANDA

MINISTRY OF HEALTH

INTEGRATED DIABETES MANAGEMENT GUIDELINE FOR UGANDA: THE SUMMARISED VERSION FOR HEALTHCARE PROFESSIONALS



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This Diabetes Management Guideline was developed in close collaboration between the Department of Non-Communicable Diseases Prevention and Control, MOH Uganda, and the Uganda Diabetes Association.

PREFACE

Diabetes is a complex and multifaceted disease that affects millions of people worldwide, imposing a significant burden on individuals, families, and healthcare systems. The prevalence of diabetes continues to rise, driven by factors such as malnutrition, obesity, sedentary lifestyles, unhealthy diets, harmful use of alcohol, use of tobacco-related products, and an aging population. Effective management of diabetes requires a comprehensive approach that incorporates lifestyle modifications, medication, and regular monitoring, as well as patient education, support, and empowerment.

These guidelines aim to provide healthcare professionals with evidence-based recommendations for the diagnosis, treatment, and management of diabetes. Developed by a multi-disciplinary team of experts, these guidelines synthesize the latest research and clinical evidence to inform best practices in diabetes care. Our goal is to improve patient outcomes, enhance quality of life, and reduce the risk of complications, such as cardiovascular disease, kidney damage, and visual loss.

These guidelines cover various aspects of diabetes management, including screening and diagnosis, glycaemic control, blood pressure and lipid management, and prevention and treatment of diabetes-related complications. They also emphasise the importance of patient-centred care, cultural sensitivity, and individualised treatment plans.

I hope these guidelines will serve as a valuable resource for healthcare providers, patients, and caregivers, ultimately contributing to better diabetes care and management. By following these guidelines, we can work together to improve the lives of people living with diabetes and reduce the burden of this disease on individuals, communities, and healthcare systems.

Dr. Diana Atwine
Permanent Secretary,
Ministry of Health

ACKNOWLEDGEMENT

The Ministry of Health is grateful and indebted to the Uganda Diabetes Association for facilitating the development of this first-ever diabetes management guideline for Uganda. The development of these guidelines was made possible through the dedication and expertise of numerous individuals and organisations. We would like to extend our sincerest gratitude to the following:

-The multi-disciplinary team of health care professionals, researchers, and patient advocates who contributed their time, knowledge, and experience to the development of these guidelines. Their expertise in diabetes, primary care, nutrition, and other relevant fields was invaluable in shaping the guidelines.

-The external peer reviewers who provided valuable feedback and insights to enhance the quality and relevance of the guidelines. Their thoughtful comments and suggestions helped to ensure that the guidelines are evidence-based, practical, and effective.

-The organisations and institutions that supported the development of these guidelines (the Uganda Diabetes Association (UDA), the Ministry of Health-NCD Department, and the Uganda NCD Alliance). Their support and resources were essential in facilitating the development process.

-The individuals living with diabetes who shared their experience and perspectives, helping to ensure that the guidelines are patient-centred and relevant to real-world needs. Their input was instrumental in shaping the focus on individualised treatment plans.

-The pharmaceutical companies that provided the UDA with financial support for the development of these guidelines (Ajanta Pharmaceutical Limited, Cipla Pharmaceutical Limited, Denk Pharmaceutical Limited, Microlabs Pharmaceutical Limited, Sanofi Global Health Unit, and Zydus LifeSciences). The investment in this project has enabled the creation of a valuable resource for healthcare professionals, patients, and caregivers.

We appreciate the collective effort and commitment that has gone into creating these guidelines, and we are confident that they will make a positive impact on the lives of people with diabetes and the economy at large.

Prof. Charles Olaro
Director General Health Services
Ministry of Health

INTRODUCTORY REMARK

The Uganda Diabetes Management Guidelines have come at a crucial time when the burden of diabetes in the country has increased threefold in the last 10 years. Moreover, Uganda is currently facing unique challenges in healthcare delivery due to the compounded phenomenon arising from inadequate financial resources, lack of adequately trained healthcare workers, unavailability of essential medicines and associated technologies, and inequity imposed by public and private sector healthcare. It is probably because of these unresolved challenges that diabetes has an immense impact on morbidity and mortality in our country. With all the constant evolution of diabetes and emerging novel therapeutic choices and technological advancements, there is a need to provide evidence-based, clinical guidance for the best management of different aspects of diabetes to healthcare workers at all levels of healthcare in the country.

These guidelines have been developed by the Uganda Diabetes Association (UDA) guidelines committee, comprised of experts from diverse fields, and cover a wide range of topics that are contextualized to our resources and technologies. Moreover, for effective diabetes care, these guidelines are premised upon the Chronic Care Model and centered around the individual living with diabetes managed by a multi-team of health experts.

Whereas the evidence-based recommendations made in this clinical guideline are consistent with those made in most International guidelines, special attention was paid to resource- and cost-related issues affecting the care of people living with diabetes in Uganda. The guidelines are advisory and are not intended as a set of rigid rules, since individual patients require tailored treatment for their particular condition.

We hope if used appropriately, they will lead to a uniformly high standard and comprehensive management of diabetes in our country.

Dr. William Lumu
President, Uganda Diabetes Association.

PURPOSE OF THE INTEGRATED DIABETES MANAGEMENT GUIDELINES

Globally, diabetes is one of the leading causes of morbidity and mortality. According to the 2021 International Diabetes Federation estimates, about one in ten adults aged 20-79 years live with diabetes.

In Uganda, the most recently concluded population-based survey reported a two-fold increase in the prevalence of diabetes over 10 years. This survey also reported that about 50% of adult Ugandans are unaware of their diabetes status, resulting in late diagnosis and presentation with debilitating diabetes complications.

One of the most frequently mentioned challenges in clinical practice in Uganda is the presence of significant knowledge gaps in diabetes management among healthcare professionals. To address this challenge, it is important to develop a comprehensive and locally relevant diabetes management guideline.

The purpose of this integrated diabetes management guideline is to provide practical and evidence-based lessons on early diagnosis, optimal management, and detailed prevention of diabetes. We are optimistic that this guideline will ultimately improve the health outcomes of people living with diabetes. Because diabetes is a complex and expensive condition to manage, we are also optimistic that the guideline will provide key tips on how to prevent the condition.

This guideline is not meant to replace one's clinical judgement. Its aim is only to guide healthcare professionals in managing people with diabetes. It also serves to complement the section on diabetes management in the 2023 Uganda Clinical Guidelines. We hope you find it a valuable resource for managing diabetes in Uganda.

GUIDELINE DEVELOPMENT EXPERT COMMITTEE CORE TEAM FROM THE UGANDA DIABETES ASSOCIATION

DR. DAVIS KIBIRIGE
(CHAIRPERSON AND GUIDELINE LEAD AUTHOR)
Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Uganda Martyrs Hospital
Lubaga, Kampala.

DR. WILLIAM LUMU
VICE-CHAIRPERSON
Consultant Physician, and Diabetologist, Department of Medicine, Mengo Hospital, Kampala, Uganda & President, Uganda Diabetes Association.

DR. SUSAN NAKIREKA
COMMITTEE MEMBER
Consultant Physician, Department of Medicine, Mengo Hospital, Kampala, Uganda.

DR. THERESA PILOYA
COMMITTEE MEMBER
Senior Lecturer and Peadiatric Endocrinologist/ Diabetologist, Department of Peadiatrics, Makerere University College of Health Sciences, Kampala, Uganda.

DR. CISSY NALUNKUMA
COMMITTEE MEMBER
Consultant Peadiatrician and Peadiatric Endocrinologist/Diabetologist, Department of Peadiatrics, Uganda Martyrs Hospital Lubaga, Kampala, Uganda.

MS. EDITH MUKANTWARI
COMMITTEE MEMBER
Nutritionist and patient advocate, African Diabetes Alliance, Kampala, Uganda.

DR. RAYMOND MWEBAZE
COMMITTEE MEMBER
Senior Consultant Physician and Diabetologist, Department of Medicine, St. Francis Hospital Nsambya, Kampala, Uganda.

DR. EDRISA MUTEBI
COMMITTEE MEMBER
Senior Lecturer, Physician, Endocrinologist, and Diabetologist, Department of Medicine, Makerere University College of Health Sciences, Kampala, Uganda.

EXTERNAL COMMITTEE MEMBERS

MS. JOSEPHINE EJANG
Diabetes nurse and educator, Faculty of Nursing, Islamic University of Uganda, Mbale, Uganda.

MR. IVAN OKOTH
Patient advocate, Sonia Nabeta Foundation, Kampala, Uganda.

PROF. SILVER BAHENDEKA
Senior Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Mother Kevin Postgraduate Medical School, Uganda Martyrs University Nkozi, Kampala, Uganda.

DR. ANTHONY MUYINGO
Senior Lecturer, Department of Medicine, Mother Kevin Postgraduate Medical School, Uganda Martyrs University Nkozi, Kampala, Uganda.

DR. ELIZABETH NAKABUYE
Consultant Obstetrician and Gynaecologist, Department of Obstetrics and Gynaecology, Mulago Specialised Women's Hospital, Kampala, Uganda.

ASSOC. PROF. EMMY OKELLO
Senior Consultant Physician and Cardiologist, Division of Adult Cardiology, Uganda Heart Institute, Kampala, Uganda.

DR. CHARLES LUGERO
Physician and Cardiologist, Division of Adult Cardiology, Uganda Heart Institute, Kampala, Uganda.

DR. JAMES KAYIMA
Consultant Physician and Cardiologist, Division of Adult Cardiology, Uganda Heart Institute, Kampala, Uganda.

ASSOC. PROF. ROBERT KALYESUBULA
Physician, and Nephrologist, Department of Physiology, College of Health Sciences Makerere University, Kampala, Uganda.

DR. DAVID MARTIN ATUHE
Physician and Nephrologist, Department of Medicine, St. Francis Hospital Nsambya, Kampala, Uganda.

DR. DANIEL SSEKIKUBO KIGGUNDU
Physician and Nephrologist, Department of Medicine, Kiruddu National Referral Hospital, Kampala, Uganda.

DR. DENIS ERIMA
Ophthalmologist, Department of Ophthalmology, Uganda Martyrs Hospital Lubaga, Kampala, Uganda.

DR. WILLIAM KALULE
Pharmacist, Department of Pharmacy, Uganda Martyrs Hospital Lubaga, Kampala, Uganda.

DR. BEATRICE ODONGKARA
Senior Lecturer and Peadiatric Endocrinologist/Diabetologist, Department of Peadiatrics and Child Health, Faculty of Medicine, Gulu University, Gulu, Uganda.

EXTERNAL COMMITTEE MEMBERS

DR. NOELA OWARWO
Physician, Prevention, Care, and Treatment Programme, Infectious Diseases Institute, Kampala, Uganda.

DR. FRANK MULINDWA
Physician, Prevention, Care, and Treatment Programme, Infectious Diseases Institute, Kampala, Uganda.

DR. GEORGE PATRICK AKABWAI
Physician, Department of Clinical Care, Baylor College of Medicine Children's Foundation, Kampala, Uganda.

ASSOC. PROF. MILTON MUSABA
Obstetrician and Gynaecologist, Department of Obstetrics and Gynaecology, Faculty of Health Sciences, Busitema University, Mbale, Uganda.

ASSOC. PROF. JULIUS WANDABWA
Obstetrician and Gynaecologist, Department of Obstetrics and Gynaecology, Faculty of Health Sciences, Busitema University, Mbale, Uganda.

DR. MIKE NANTAMU KAGAWA
Senior Lecturer, Obstetrician and Gynaecologist, Department of Obstetrics and Gynaecology, School of Medicine, Makerere University College of Health Sciences, Kampala, Uganda.

DR. ALBERT KAMUGISHA
Consultant Peadiatrician, Department of Peadiatrics, Naguru National Referral Hospital, Kampala, Uganda.

DR. GIDIO AGABA
Senior Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Kiruddu National Referral Hospital, Kampala, Uganda.

DR. FREDERICK NAKWAGALA
Senior Consultant Physician, Endocrinologist, and Diabetologist, Directorate of Medicine and Diabetes/ Endocrine Unit, Mulago National Referral Hospital, Kampala, Uganda.

INTERNAL PEER REVIEWERS FROM THE MINISTRY OF HEALTH

DR. CHARLES OYOO AKIYA
Commissioner, Ministry of Health, Department of Non-Communicable Diseases Prevention and Control

DR. GERALD MUTUNGI
Ministry of Health, Department of Non-Communicable Diseases Prevention and Control

DR. FRANK MUGABE RWABINUMI
Ministry of Health, Department of Non-Communicable Diseases Prevention and Control

DR. JAMES OCAKACON
Ministry of Health, Department of Non-Communicable Diseases Prevention and Control

EXTERNAL PEER REVIEWERS

DR. APOLLO EPUWATT
Consultant Physician, Kliniks of St. Francis, Tororo, Uganda

DR. ANTHONY MAKHOBA
Physician and Endocrinologist, Department of Medicine, St. Francis Hospital, Nsambya, Uganda

DR. IVAN MUBANGIZI
Physician, Department of Adult Medicine, Mildmay, Uganda

DR. ROSSLYN NGUGI
Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Kenyatta University, Nairobi, Kenya.

DR. ERICK NJENGA
Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Kenyatta University, Nairobi, Kenya.

DR. ERIC MUGAMBI
Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Kenyatta University, Nairobi, Kenya.

MS. ATIENO JALANG'O
Diabetes educator, Nissi Health, Nairobi, Kenya.

DR. FARAJA CHIWANGA
Consultant Physician, Endocrinologist, and Diabetologist, Department of Medicine, Muhimbili National Referral Hospital, Dar-es-Salaam, Tanzania

DR. EDNA MAJALIWA
Consultant Peadiatrician, Peadiatric Endocrinologist, and Diabetologist, Department of Peadiatrics, Muhimbili National Referral Hospital, Dar-es-Salaam, Tanzania.

DR. JEAN CLAUDE KATTE
Public Health Physician and Diabetologist, National Obesity Centre and The Endocrinology and Metabolic Diseases Unit, Yaoundé Central Hospital, Yaoundé, Cameroon.

PROF. GEOFFREY BUGA
Obstetrician and Gynaecologist, Department of Obstetrics and Gynaecology, Walter Sisulu University, South Africa.

EXECUTIVE SUMMARY

Background

Despite the growing burden of diabetes in Uganda, we lack a comprehensive, locally adapted clinical guideline for managing diabetes.

Objective

This integrated diabetes management guideline aims to provide healthcare professionals with the latest evidence to inform clinical decision-making when managing individuals with diabetes.

Methods

The Uganda Diabetes Association selected an expert committee to collate, review, and provide an internal peer review of the initial draft of the guideline. This was followed by an external peer review by 11 randomly selected independent African diabetes experts. A working group from the Department of Non-communicable Diseases Prevention and Control, Ministry of Health, Republic of Uganda, conducted an additional external peer review.

Results

This clinical guideline includes these 18 chapters: (1) Epidemiology of diabetes; (2) Definition and classification of diabetes; (3) Screening and diagnosis of diabetes; (4) Organisation of diabetes care; (5) Preventive strategies for type 2 diabetes; (6) Diabetes self-management education, peer support, and medical nutritional therapy; (7) Comprehensive medical evaluation, screening for related comorbidities, and follow-up; (8) Optimal glycaemic targets; (9) Non-insulin pharmacological approaches of glycaemic management in type 2 diabetes; (10) Insulin therapy in type 2 diabetes; (11) Cardiovascular disease risk profiling and management; (12) Management of acute diabetes complications; (13) An overview of chronic diabetes complications; (14) In-hospital management of hyperglycaemia; (15) Diagnosis and management of type 1 diabetes; (16) Management of acute and chronic diabetes complications in type 1 diabetes; (17) Management of hyperglycaemia in pregnancy; (18) Management of diabetes-HIV and tuberculosis comorbidity.

Conclusions

This integrated diabetes management guideline for Uganda provides recent evidence on how to diagnose and manage diabetes, emphasising an individualised and comprehensive approach.

ABBREVIATIONS

2h-BG: 2-hour blood glucose
ACEI: Angiotensin-converting enzyme inhibitor
ACOG: American College of Obstetricians and Gynaecologists
ADA: American Diabetes Association
ARB: Angiotensin II receptor blocker
ASCVD: Atherosclerotic cardiovascular disease
BG: Blood glucose
BMI: Body mass index
BP: Blood pressure
CAD: Coronary artery disease
CCB: Calcium channel blocker
CGM: Continuous glucose monitoring
CCF: Congestive cardiac failure
CKD: Chronic kidney disease
CV: Cardiovascular
CVD: Cardiovascular disease
DASH: Dietary Approaches to Stop Hypertension
DKA: Diabetic ketoacidosis
DKD: Diabetic kidney disease
DM: Diabetes mellitus
DPP-4: dipeptidyl peptidase-4
EADSG: East African Diabetes Study Group
EASD: European Association of the Study of Diabetes
e-GFR: Estimated glomerular filtration rate
FBG: Fasting blood glucose
GLP-1 RA: Glucagon-like peptide-1 receptor agonist
HbA1c: Glycated haemoglobin
HDLC: High-density lipoprotein cholesterol
HT: Hypertension
IADPSG: International Association of Diabetes and Pregnancy Study Groups
IDF: International Diabetes Federation
IFG: Impaired fasting glucose
IGT: Impaired glucose tolerance
ISPAD: International Society for Peadiatric and Adolescent Diabetes
LADA: Latent autoimmune diabetes in adults
LDLC: Low-density lipoprotein cholesterol
MI: Myocardial infarction
MRA: Mineralocorticoid receptor antagonist
NPH: Neutral protamine Hagedorn
OGTT: Oral glucose tolerance test
OSA: Obstructive sleep apnea
PAD: Peripheral arterial disease
PCOS: Polycystic ovary syndrome
PPG: Postprandial glucose
SGLT2i: Sodium-glucose cotransporter 2 inhibitors
SU: Sulfonylurea
TDD: Total daily dose
TGL: Triglyceride
TIA: Transient ischemic attack
TIR: Time in range
TZD: Thiazolidinedione
T1D: Type 1 diabetes
T2D: Type 2 diabetes
UACR: Urine albumin-to-creatinine ratio
The Union: International Union against Tuberculosis and Lung Disorders
VLDLC: very low-density lipoprotein cholesterol
WHO: World Health Organisation

INTRODUCTION

The management of diabetes mellitus is constantly evolving due to emerging novel therapeutic choices and technological advancements. To address the gap of lack of comprehensive and locally adapted clinical guidelines for managing diabetes in Uganda, the Uganda Diabetes Association (UDA) expert guideline committee working in collaboration with the Department of Non-communicable Diseases Prevention and Control, Ministry of Health, Republic of Uganda developed these comprehensive and evidence-based guidelines for managing diabetes in Uganda.

A team of experts from diverse fields has developed this integrated diabetes management guideline for Uganda. It comprises 18 chapters discussing in great detail the epidemiology, definition, classification, screening, diagnosis, prevention, and management of diabetes and related comorbidities.

The evidence-based recommendations made in this clinical guideline are consistent with those made in most guidelines of international professional societies or bodies such as the American Diabetes Association (ADA) (1), International Diabetes Federation (IDF) (2), World Health Organisation (WHO) (3-5), European Association of the Study of Diabetes (EASD) (6), East African Diabetes Study Group (EADSG) (7-9), Joint British Diabetes Societies (JBDS) (10), International Society for Peadiatric and Adolescent Diabetes (ISPAD) (11), American College of Obstetricians and Gynaecologists (ACOG) (12, 13), International Association of Diabetes and Pregnancy Stud Groups (IADPSG) (14) and International Union against tuberculosis and Lung Disorders (The Union) (15).

CHAPTER 1: EPIDEMIOLOGY OF DIABETES: THE GLOBAL, AFRICAN, AND UGANDAN PERSPECTIVE

Adapted from: www.alamy.com

GLOBAL

- According to the 2021 International Diabetes Federation (IDF) estimates, about 537 million adults (10.5%) aged between 20 and 79 years are living with diabetes globally.
- About 75% of people with diabetes live in low- and middle-income countries.
- More than 90% of people living with diabetes have type 2 diabetes.
- About 240 million people are living with undiagnosed diabetes, with most living in Africa (54%).

AFRICA

- About 24 million adults (1 in 22 adults or 4.5%) live with diabetes in Africa (an age-adjusted comparative prevalence of 5.3%).

UGANDA

- In the 2023 Uganda national non-communicable diseases risk factor WHO STEPwise survey, the reported prevalence of diabetes and impaired fasting glycaemia (IFG) was 3.3% and 4.9%, respectively.
- These findings reflect a two-fold increase in the burden of diabetes and IFG over 10 years.
- No urban-rural differences in the prevalence of diabetes and prediabetes were noted.
- However, sex-based differences were noted, with women having a greater prevalence of diabetes and IFG in contrast to men.

CHAPTER 2: DEFINITION AND CLASSIFICATION OF DIABETES

- Diabetes is a collection of metabolic disorders mainly characterised by hyperglycaemia and carbohydrate, protein, and fat metabolism dysfunction.
- The main aetiopathogenic processes involved in the onset of diabetes are:
  1. Pancreatic beta-cell damage (autoimmune or nonautoimmune) resulting in insulin deficiency
  2. Reduced insulin action on the peripheral tissues such as skeletal muscle, liver, and adipose tissue, especially in the presence of overweight and obesity (insulin resistance).
- There are several subtypes of diabetes as summarised in Table 1 below.

Table 1: Subtypes of diabetes

COMMON SUBTYPES OF DIABETES
1. Type 1 diabetes
2. Type 2 diabetes
3. Hyperglycaemia in pregnancy (gestational diabetes, diabetes in pregnancy, and pregestational or pre-existing diabetes)
RARE SUBTYPES OF DIABETES
1. Hybrid forms of diabetes, such as ketosis-prone diabetes and slowly evolving immune-mediated diabetes of adults or latent autoimmune diabetes of adults (LADA)
2. Monogenic diabetes (neonatal diabetes and maturity-onset diabetes of the youth or MODY)
3. Diabetes due to diseases of the exocrine pancreas, such as chronic pancreatitis and fibrocalculous pancreatic diabetes
4. Diabetes due to endocrine disorders such as Cushing's syndrome, and drug- or chemical-induced diabetes
5. Type 5 diabetes or malnutrition-related diabetes

CHAPTER 3: DIAGNOSIS AND SCREENING FOR DIABETES

- Diabetes can be diagnosed based on blood glucose and glycated haemoglobin (HbA1c) criteria in the presence of the classic symptoms of hyperglycaemia.
- These classic symptoms include:

1. The 5P's - polyuria, polydipsia, polyphagia, paraesthesia, pruritis, and
2. The 3W's - weight loss, wasting, and weakness.

- The blood glucose criteria comprise the measurement of the fasting blood glucose (FBG), 2-hour blood glucose (2h BG) after a 75-gram oral glucose tolerance test (OGTT), or random blood glucose (RBG) levels.
- The OGTT should be performed after overnight fasting for at least eight hours using 75 grams of anhydrous glucose dissolved in 250 ml of water and ingested within five to ten minutes.
- Patients should be encouraged to have balanced meals for at least 3 days before the OGTT is performed to avoid inaccurate results.

Table 2: Diagnostic criteria for normoglycaemia, prediabetes, and diabetes

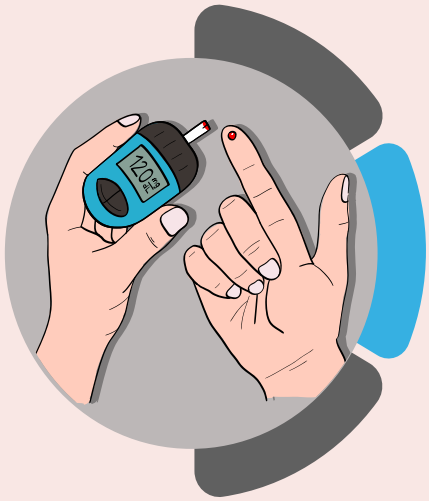
Diagnostic tests	Normoglycaemia	Prediabetes	Diabetes
Fasting blood glucose (FBG)	<5.6 mmol/l (<100 mg/dl)	5.6 - 6.9 mmol/l (100 -125 mg/dl)	≥ 7.0 mmol/l (≥126 mg/dl)
2-hour blood glucose (2h BG) after OGTT	<7.8 mmol/l (<140 mg/dl)	7.8 - 11.0 mmol/l (140-199 mg/dl)	≥ 11.1 mmol/l (200 mg/dl)
Glycated haemoglobin (HbA1c)	≤5.6% (38 mmol/mol)	5.7-6.4% (39-47 mmol/mol)	≥ 6.5% (48 mmol/mol)
Random blood glucose (RBG)	<7.8 mmol/l (<140 mg/dl)	7.8-11.0 mmol/l (140-199 mg/dl)	≥ 11.1 mmol/l (200 mg/dl)

- In the presence of classic symptoms of hyperglycaemia described above and/or a hyperglycaemic crisis such as diabetic ketoacidosis or hyperosmolar hyperglycaemic state, a single blood glucose test (RBG ≥11.1 mmol/l or 200 mg/dl or FBG ≥7.0 mmol/l or 126 mg/dl) is sufficient to diagnose diabetes.
- In cases where an individual doesn't present with the classic symptoms of hyperglycaemia

discussed above, the diagnosis of diabetes should be based on two abnormal tests (RBG or FBG or 2h BG after an OGTT or HbA1c) performed at the same time or at two different time points.

- The OGTT is the gold standard test for diagnosing diabetes because performing only a FBG test can miss 30% of cases of diabetes.
- In hospitals, venous plasma glucose measurement using clinical chemistry analyser machines, as opposed to capillary blood glucose measurement using glucometers, is the recommended method of blood glucose assessment because it provides more accurate results.
- The HbA1c test must be performed in the laboratory using assays that are standardised and clinical chemistry analysers that are regularly calibrated.
- Do not use point-of-care HbA1c machines to diagnose diabetes because they provide inaccurate results.
- Remember that the accuracy of HbA1c results can be affected by several clinical factors such as iron and vitamin B12 deficiency, anaemia due to blood loss, pregnancy, and certain haemoglobin traits such as sickle cell trait.
- The approach for screening type 2 diabetes is summarised in Figure 1 below.

Figure 1. Screening for type 2 diabetes



WHY SCREEN?

- Laboratory testing is safe and cheap.
- Screening offers an opportunity to identify and manage co-existing cardiovascular risk factors such as hypertension and dyslipidaemia.

HOW TO SCREEN?

- Use a targeted strategy (identify and test high-risk individuals)
- Performing either a RBG, FBG, OGTT, or HbA1c test.

WHEN TO SCREEN?

- Monitor high-risk individuals at least annually.
- For individuals with normal blood glucose results, repeat screening at least every 3 years.
- Screen individuals with symptoms suggestive of diabetes

CHAPTER 4: ORGANISATION OF DIABETES CARE AT EACH HEALTHCARE LEVEL

- Uganda's national health system consists of the public and private (for-profit and not-for-profit faith-based) sectors.
- The national public health system consists of National Referral Hospitals, Regional Referral Hospitals, General District Hospitals, referral-level Health Centres IVs, IIIs, and community workers (community health workers and village health teams).
- Comprehensive and individualised diabetes care should be offered at each healthcare level.
- Because diabetes is a chronic and progressive condition, long-term follow-up of individuals with diabetes should be emphasised and encouraged.
- Tables 3 and 4 below summarise the requirements for setting up a functional diabetes clinic at each healthcare level and the essential assessments and tests to be performed at each follow-up visit at each healthcare level, respectively.

Table 3. A summary of the requisite staff and equipment for a functional diabetes clinic at each healthcare level

HEALTHCARE LEVEL	STAFF	EQUIPMENT
Community level	○ Community health workers ○ Village health teams	○ Diabetes guideline ○ Urine strips for ketones, proteins, pus cells, and casts ○ Digital blood pressure machine ○ Glucometers (preferably calibrated ones) with an adequate supply of glucose strips ○ Weighing scales ○ Stadiometers ○ Tape measures ○ General community register
Primary (Health Centres III and IV)	○ Nurses ○ Clinical officers ○ Health educators ○ Health assistants ○ Laboratory staff ○ Doctors ○ Health information assistants ○ Nutritionists ○ Pharmacy staff	All the above plus ○ Diabetes register ○ Monofilaments ○ Snellen's charts for visual acuity assessment ○ Cardiovascular disease risk assessment charts ○ A biochemical analyser machine (for measurement of venous plasma glucose, glycated haemoglobin, renal and liver function tests, lipid profile) ○ A haematology analyser (to perform full blood counts)
Secondary (District General Hospitals and Regional Referral Hospitals)	All the above plus ○ Podiatrist (foot care expert) ○ Physicians ○ Peadiatricians ○ General Surgeons ○ Obstetricians ○ Ophthalmologists ○ Dentists or dental officers ○ Psychiatric care team ○ Certified diabetes educators	All the above plus ○ Tuning fork ○ Patella hammer ○ Ophthalmoscope ○ A biochemical analyser machine (to perform additional tests such as uric acid, troponin, C-peptide, serum vitamin B12, and microalbuminuria) ○ Electrocardiography (ECG) and echocardiography (ECHO)
Tertiary (National Referral Hospitals and subspecialty autonomous public and private hospitals)	All the above plus ○ Adult diabetologists ○ Paediatric diabetologists ○ Cardiologists ○ Nephrologists ○ Orthopaedic Surgeons ○ Cardiovascular Surgeons	All the above plus ○ Non-mydriatic fundus camera ○ Retinal laser unit ○ Operating theatres ○ Cardiac diagnostic facilities such as cardiac interventional laboratories ○ Haemo/peritoneal dialysis ○ Renal transplant services

Table 4. Essential tests and assessments recommended for each individual with diabetes at each follow-up visit and at each healthcare level

HEALTHCARE LEVEL	WORKUP (History or test)	TIME POINT OF ASSESSMENT		
		Initial visit	3 monthly visits	Annual visit
A: PRIMARY				
	History and diagnosis	x		
	Height and weight measurement (for body mass index calculation)	x	x (weight measurement)	x (weight measurement)
	Waist and hip circumference measurement	x		x
	Resting blood pressure measurement	x	x	x
	Detailed foot inspection	x	x	x
	Oral cavity inspection	x		x
	Monofilament testing	x		x
	Eye examination (for visual acuity)	x		x
	Blood glucose measurement	x	x	x
	Urinalysis for ketones, protein, and casts	x	x	x
	Diabetes education (self-monitoring and care)	x	x	x
	Nutritional counselling	x	x	x
	Psychosocial counselling	x	x	x
	Assessment for drug adherence and adverse events		x	x
B: SECONDARY & TERTIARY	**All the above**	x	x	x
	Eye examination (non-mydriatic fundoscopy)	x		x
	Glycated haemoglobin	x	x	x
	Lipid profile	x		x
	Renal and liver function tests	x		x
	C-peptide	x		
	Microalbuminuria	x		x
	Electrocardiography (if needed)	x		x
	Troponin (if indicated)	x		x
	Serum vitamin B12 (if indicated)			x
	Vibration sense assessment	x		x
	Evaluation for peripheral arterial disease	x		x

CHAPTER 5: PREVENTIVE STRATEGIES FOR TYPE 2 DIABETES

- Management of diabetes is very complex and expensive. Because of this, preventive strategies are very important in clinical practice.
- Encourage lifestyle behavioural changes such as achieving and maintaining a 7% body weight reduction, low-calorie intake, and ≥ 150 minutes of moderate-intensity physical activity per week, such as brisk walking, to prevent and/or delay the onset of type 2 diabetes in high-risk adult individuals.
- Nutrition counselling and changes in an individual's diet are key in preventing type 2 diabetes in high-risk individuals.
- Encourage the intake of low-calorie, Mediterranean, and/or Dietary Approaches to Stop Hypertension (DASH) diets to reduce the risk of onset of type 2 diabetes.
- Examples of Mediterranean and DASH diets include plant-based diets (high intake of vegetables, fruits, legumes, whole grains), high intake of fish, moderate consumption of alcohol, low-fat dairy and poultry products, and low red meat consumption.
- Encourage dietary intake of whole grains (such as brown rice and whole-grain bread), fish, legumes (such as soya beans, beans, groundnuts, and peas), low-fat sugar-free dairy products (such as plain yoghurt and low-fat milk), and the use of vegetable-based cooking oils (such as sunflower or olive oil).
- Avoid intake of refined or processed foods, such as fried fast foods, processed meats, fatty red meat, and high sugar content beverages, such as sodas (including diet sodas).
- Ideally, alcohol consumption should be avoided. However, if it is to be consumed, consider moderate intake (one drink per day for women and up to 2 drinks per day for men).

Drugs that can be used to lower risk of developing type 2 diabetes in high-risk individuals

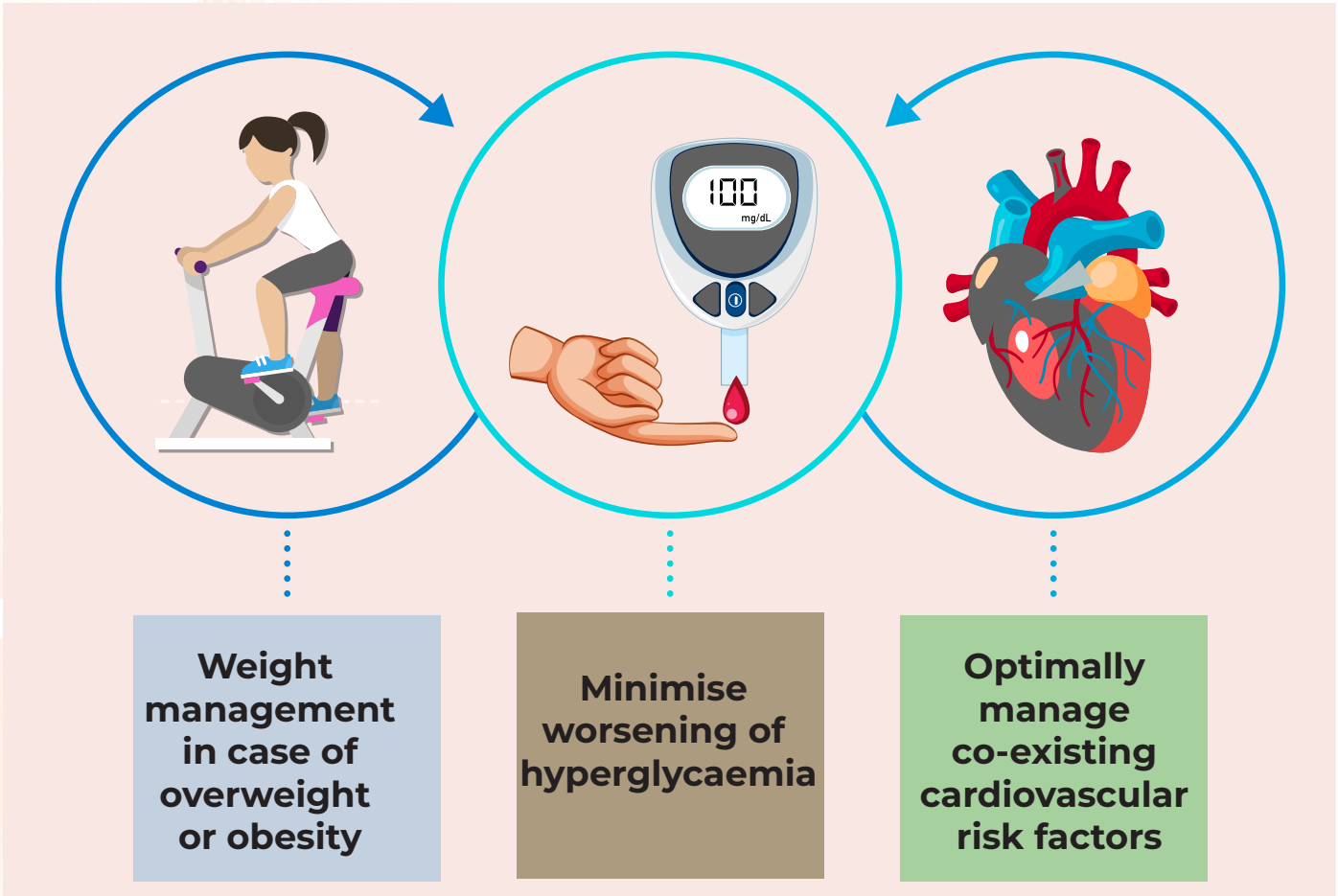
Metformin

Thiazolidinediones such as pioglitazone

Glucagon-like peptide 1 receptor agonists such as semaglutide

- In addition to lifestyle behavioural changes, metformin therapy is an effective therapeutic agent in preventing the onset of type 2 diabetes, especially in individuals aged 25-44 years, with a BMI ≥35 kg/m2, and women with a prior history of gestational diabetes mellitus.
- Individualised goals for individuals with a high risk of developing type 2 diabetes are summarised in Figure 2 below

Figure 2: Individualised goals for high-risk individuals



CHAPTER 6: DIABETES SELF-MANAGEMENT EDUCATION AND SUPPORT, PEER SUPPORT, AND MEDICAL NUTRITIONAL THERAPY

Diabetes self-management education and support

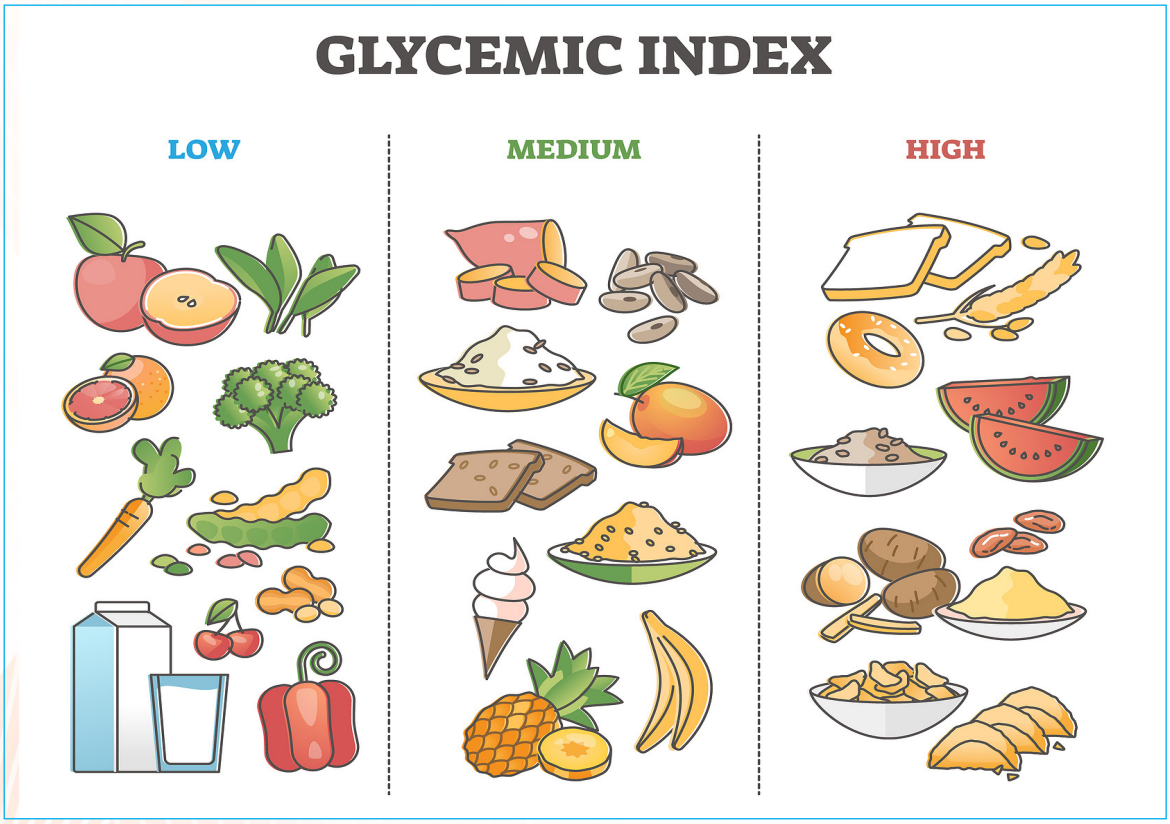
- Diabetes self-management education and support (DSMES) is a structured and multi-disciplinary support program aimed at delivering comprehensive and personalised knowledge about diabetes to individuals at risk or with diabetes.
- DSMES is a key component of diabetes care offered by a multi-disciplinary team comprising doctors, diabetes educators, nutritionists, and other healthcare professionals who care for individuals with diabetes.
- At the core of DSMES is the individual living with diabetes who must be actively involved in clinical decision making to encourage behavioural change.
- Regarding the self-care of individuals with diabetes, seven essential self-care behaviours should be emphasised and encouraged. These are:

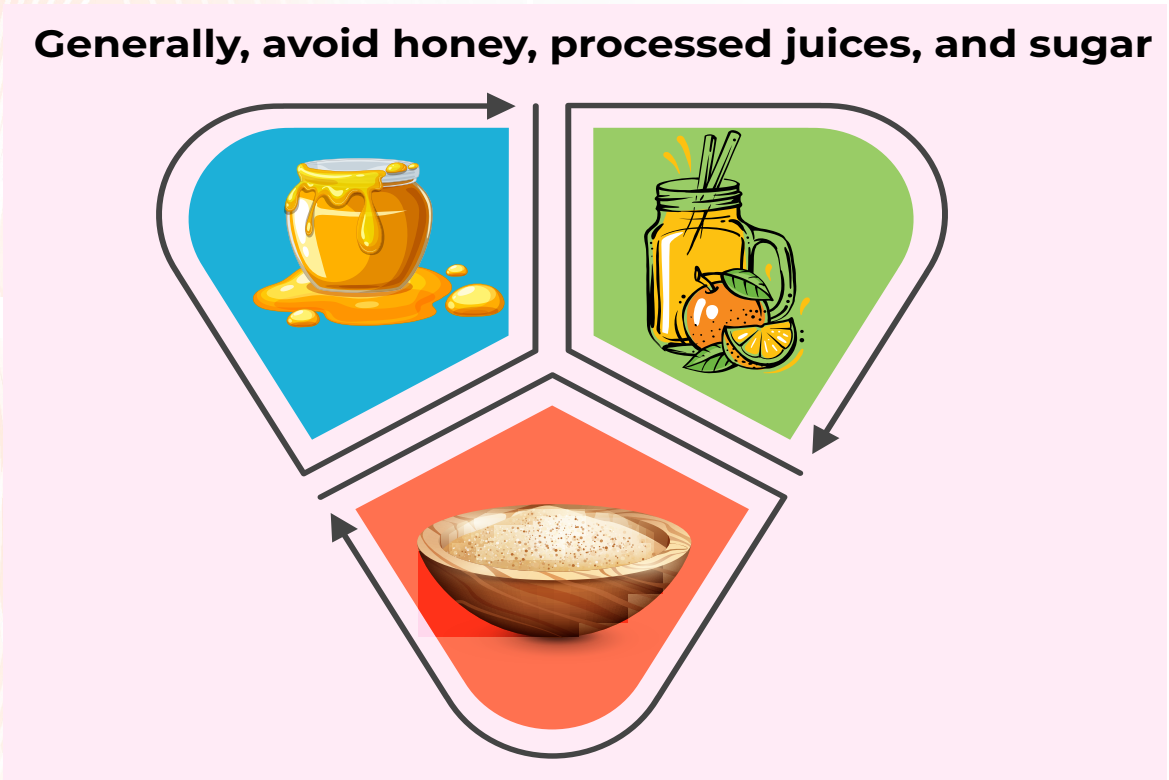
1. Healthy eating
2. Being physically active
3. Self-monitoring of blood glucose
4. Adherence to medicine (glucose-lowering and other ancillary therapies)
5. Good problem-solving skills
6. Healthy coping skills
7. Reduction of risky behaviour.

Medical nutritional therapy

- Medical nutritional therapy (MNT) is important in diabetes prevention and management.
- Regarding a nutritional plan for individuals with diabetes, encourage an intake of a balanced diet of carbohydrates, protein, fat, vitamins, and minerals to achieve individual treatment goals, maintain an ideal body weight, and delay the onset or progression of diabetes complications.
- When planning a meal, individuals with diabetes are advised to fill half the plate with non-starchy vegetables such as greens, tomatoes, and onions, and one-quarter of the plate with lean protein such as fish, chicken, and lean meat. The remaining quarter of the plate can be filled with whole grains such as brown rice or starchy foods such as sweet potatoes, or legumes such as beans, groundnuts, and peas.
- Serve portions that are equivalent to the fist of one's hand.
- Figure 3 below shows a diabetes plate that should be used as a guide when planning healthy meals for individuals with diabetes.

Figure 4: Food types and their respective glycaemic index





Routine use of micronutrient and herbal supplementation, such as chromium, vitamin D, cinnamon, and aloe vera, is also not recommended due to the lack of robust clinical evidence to support their use, and they are associated with an increased risk of hepato- and renal toxicity.

CHAPTER 7: COMPREHENSIVE MEDICAL EVALUATION AND SCREENING FOR RELATED COMORBIDITIES

- Diabetes is associated with multiple complications. Because of this, a comprehensive medical evaluation in diabetes care is essential.
- A comprehensive medical evaluation involves several components, such as:

1. Efficient initial evaluation and follow-up plan
2. In-depth assessment for acute and chronic diabetes complications
3. Optimal screening and management of comorbidities
4. Psychosocial evaluation
5. Self-monitoring and preventive care services.

- A comprehensive medical evaluation plan should be individualised and implemented at diagnosis or initial clinical encounter and each follow-up visit.
- Table 5 below shows the components of a comprehensive medical evaluation of an individual with diabetes at the initial visit, follow-up visits, and annual visit.

Table 5. Components of a comprehensive medical evaluation of an individual with diabetes.

ESSENTIAL COMPONENT	INITIAL VISIT	EVERY FOLLOW-UP VISIT	ANNUAL VISIT
A: FOCUSED SOCIO-DEMOGRAPHIC HISTORY			
Age of diabetes onset	X		
Prevalent symptoms at diagnosis	X		
Social habits: Alcohol ingestion and smoking history	X		
History of diabetes in first-degree relatives	X		
Family history of autoimmune conditions	X		
History of mental health conditions	X		
B: PAST MEDICAL HISTORY			
History of any past hospitalisation	X		
History of common comorbidities and complications such as hypertension, dyslipidaemia, HIV, micro- and macrovascular diabetes complications, thyroid dysfunction	X		
Any supplementary medication such as oral antiplatelet, lipid-lowering, anticoagulant, and antiretroviral therapies	X		
History of long-term use of drugs associated with an increased risk of diabetes, such as corticosteroids, anti-psychotics, and older-generation beta blockers	X		
Any drug-related side effects	X		
Date of last dental, foot, eye, kidney, heart, lipid, and blood pressure review	X		
C: PHYSICAL EXAMINATION			
Height and weight measurement (for the calculation of body mass index)	X	X (mainly weight)	X
Waist circumference	X		X
Visual acuity assessment and fundoscopic eye exam (preferably non-mydriatic fundal photography)	X		X
Oral examination for dental caries and gum disease	X		X
Thyroid palpitation	X		
Skin inspection (for insulin injection sites and acanthosis nigricans at the base of the neck, a key sign of insulin resistance)	X		X

Table 5. Components of a comprehensive medical evaluation of an individual with diabetes.

ESSENTIAL COMPONENT	INITIAL VISIT	EVERY FOLLOW-UP VISIT	ANNUAL VISIT
Comprehensive foot examination for deformities, ulcers, calluses, skin discolouration, hair, and nail changes. Assess for vibration, pinprick, and temperature sensation.	X	X	X
Screen for peripheral arterial disease (palpation for pedal pulses and perform ankle-brachial index assessment if available)	X		X
Assess for any psychosocial disorders such as depression, anxiety, and diabetes distress.	X		X
D: LABORATORY WORKUP			
Blood glucose level (preferably measured from a venous blood sample using a clinical chemistry analyser machine)	X	X	X
Glycated haemoglobin	X	X (every 3-6 months)	X
Random or fasting lipid profile (Total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides)	X		X
Liver function tests	X		X
Renal function tests (serum creatinine and estimation of the glomerular filtration rate)	X		X
Spot urine albumin creatinine ratio	X		X
Urinalysis (for ketones, pus cells, and protein)	X		X
Serum potassium for individuals on angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, and/or diuretics	X		X
Random or fasting serum C-peptide	X		
Thyroid stimulating hormone and free thyroxine levels in individuals with type 1 diabetes and selected individuals with type 2 diabetes	X		X
Electrocardiography and echocardiography (if indicated)	X		X
Serum vitamin B12 levels (if on long-term and high-dose metformin)			X
Complete blood count	X		X
HIV serology	X		
Serum total corrected calcium and phosphate (if indicated, such as in the elderly and individuals with chronic kidney disease)	X		X
E: OTHER IMPORTANT COMPONENTS			
Structured diabetes education (diabetes self-management education and support)	X	X	
Preconception counselling and family planning	X	X	X
Setting of treatment and self-management goals	X	X	X
Review and adjustment of medication	X	X	X

CHAPTER 8: OPTIMAL BLOOD GLUCOSE TARGETS

- Measure glycated haemoglobin (HbA1c), fasting blood glucose (FBG), and post-prandial blood glucose (PPG) to assess blood glucose control.
- Measure the HbA1c level in every individual with diabetes at the time of diagnosis of diabetes or initial clinical encounter or visit.
- All individuals with poorly controlled diabetes should have an HbA1c measurement every three months.
- In individuals with well-controlled diabetes, the HbA1c measurement should be performed every six months.
- The HbA1c targets to reflect optimal blood glucose control should be individualised based on an individual's clinical characteristics, such as age, presence of co-existing comorbidities or complications (notably renal dysfunction, hypoglycaemia unawareness, and atherosclerotic cardiovascular diseases [ASCVD]), and duration of diabetes.
- Table 6 summarises the individualised HbA1c targets.

Table 6. Individualised glycated haemoglobin targets

PATIENT PROFILE	HbA1c TARGET
Nonpregnant individuals with diabetes	<7% (53 mmol/mol)
Newly diagnosed young individuals with a long-life expectancy (>10 years), no comorbidities, and a low risk of hypoglycaemia	<6.5% (48 mmol/mol)
Elderly individuals (≥60 years) with long-standing diabetes, a high risk of hypoglycaemia, short-life expectancy, and comorbidities such as renal dysfunction and atherosclerotic cardiovascular diseases	<8% (64 mmol/mol)

- The recommended optimal FBG and PPG levels are <7.0 mmol/l (126 mg/dl) and <10.0 mmol/l (180 mg/dl), respectively.
- A PPG measurement should be performed at least one to two hours after the beginning of the meal.

All individuals with diabetes should regularly monitor their blood glucose levels using a well-calibrated glucometer.

Self-monitoring of blood glucose (SMBG) is an essential component in diabetes care.

The frequency of SMBG depends on glucose-lowering therapy being used and its frequency of administration.

- Table 7 below summarises the frequency of self-monitoring of blood glucose (SMBG) in individuals with diabetes

Table 7. Frequency of self-monitoring of blood glucose

PATIENT PROFILE	FREQUENCY OF SMBG
Individuals on a basal-bolus insulin regimen (receiving three pre-meal short-acting or rapid-acting insulin doses and once-a-day basal insulin dose),	3 - 4 times a day
Individuals on two pre-meal (pre-breakfast and supper) premixed insulin doses	2 - 3 times a day
Individuals on once-a-day basal insulin at bedtime	Once a day (preferably in the morning to measure the fasting blood glucose level)
Individuals on oral hypoglycaemic agents alone and stable glycaemic control	2 - 3 times per week
Critically ill individuals, those with prolonged periods of poorly controlled diabetes, and frequent episodes of hypoglycemia	≥4 times per day

CHAPTER 9: NON-INSULIN PHARMACOLOGICAL APPROACHES OF GLYCAEMIC MANAGEMENT IN TYPE 2 DIABETES

- While the 2023 Uganda Clinical Guidelines recommend an algorithmic approach to managing type 2 diabetes, recent evidence supports an individualised or person-centered approach.
- The individual's clinical characteristics that should be considered while selecting glucose-lowering therapies include:

1. Age
2. Body mass index
3. Prevalent diabetes complications and comorbidities
4. Duration of diabetes
5. External factors such as availability and cost of the drug, side effect profile, and patient preference.

- Additional factors to consider are the underlying pathophysiologic defect of type 2 diabetes and the status of pancreatic beta-cell function.
- Table 8 below summarises the appropriate oral glucose-lowering therapy depending on specific patient characteristics

Table 8. Recommended oral glucose-lowering therapies based on specific patient characteristics (ABCD and 2Ps approach)

CHARACTERISTIC	OPTIMAL DIABETES DRUG	REASON	HEALTH CENTRE LEVEL
A: Age **Elderly patients** **(≥ 60 years)**	-Metformin -DPP-IV inhibitors such as sitagliptin, teneligliptin, and vildagliptin -SGLT2i such as dapagliflozin and empagliflozin -Gliclazide is the SU of choice	-Elderly patients are prone to hypoglycaemia -These drugs have a low risk of hypoglycaemia	IV, secondary, & tertiary levels
B: Body mass index (BMI)	-SU and DPP-IV inhibitors in individuals with BMI <25 kg/m^2 (lean type 2 diabetes)	-Individuals with a BMI <25 kg/m^2 have signs of low insulin secretion -SU and DPP-IV inhibitors stimulate insulin secretion by the pancreatic beta cells	IV, secondary, & tertiary levels
	-GLP-1 RA such as semaglutide, SGLT2i, and metformin for individuals with BMI ≥25 kg/m^2 (non-lean type 2 diabetes)	-Individuals with a BMI ≥25 kg/m^2 have signs of insulin resistance and metabolic syndrome -These drugs promote weight loss and improve peripheral insulin sensitivity	IV, secondary, & tertiary levels

Table 8. Recommended oral glucose-lowering therapies based on specific patient characteristics (ABCD and 2Ps approach)

CHARACTERISTIC	OPTIMAL DIABETES DRUG	REASON	HEALTH CENTRE LEVEL
C: Co-existing complications -High risk of ASCVD* -Established ASCVD -Renal dysfunction -Heart failure (regardless of the ejection fraction) -High risk of hypoglycaemia	-SGLT2i and GLP-1 RA as the first-line in combination with metformin or other oral glucose-lowering agents -In addition to SGLT2i and GLP-1 RA, DPP-IV inhibitors can be used if the risk of hypoglycaemia is high	-These drugs have proven cardio-renal protective effects and reduce CV-related mortality -The drugs have a low risk of hypoglycaemia	IV, secondary, & tertiary levels
D: Duration of type 2 diabetes	-SGLT2i, GLP-1 RA, DPP-IV inhibitors, and metformin in individuals with long-standing type 2 diabetes (≥10 years)	-A long duration of diabetes increases the risk of developing complications such as ASCVD, renal dysfunction, and autonomic neuropathy	IV, secondary, & tertiary level
P: Predominant pathophysiologic defect of type 2 diabetes	-Metformin, GLP-1 RA, SGLT2i, and TZDs in individuals with signs of insulin resistance (overweight or obesity, acanthosis nigricans, and dyslipidaemia)	-These drugs promote weight loss and improve peripheral insulin sensitivity	IV, secondary, & tertiary level
	-SU and DPP-IV inhibitors in individuals with signs of pancreatic dysfunction, such as BMI <25 kg/m^2 and absence of markers of metabolic syndrome	-These drugs stimulate insulin secretion by the pancreatic beta-cells	
P: Pancreatic function status	-SU and DPP-IV inhibitors in individuals with signs of pancreatic dysfunction, such as BMI <25 kg/m^2 and severe hyperglycaemia	-These drugs stimulate insulin secretion by the pancreatic beta-cells	IV, secondary, & tertiary levels

*High risk for atherosclerotic cardiovascular diseases: presence of overweight or obesity, hypertension, dyslipidaemia, hyperuricaemia, albuminuria, 10-year risk of ASCVD >20% on using the pooled cohort risk equations score or Framingham risk score
ASCVD - Atherosclerotic cardiovascular diseases, BMI- Body mass index, CV- Cardiovascular, DPP-IV - dipeptidyl peptidase IV, GLP-1 RA - Glucagon-like peptide 1 receptor agonists, SGLT2i - Sodium-glucose cotransporter-2 inhibitors, SU – Sulphonylurea, TZDs – Thiazolidinediones

Caution

Do not prescribe glibenclamide for elderly individuals (age ≥60 years) due to its high risk of hypoglycaemia

Avoid using pioglitazone in patients at risk of osteoporosis and heart failure such as elderly patients

Avoid using metformin in individuals with diabetes and an estimated glomerular filtration rate (e-GFR) <30 ml/min/1.73 m²

Avoid using SGLT2i and GLP-1 RA in individuals with type 2 diabetes and an e-GFR <20 mL/min/1.73 m²

Because type 2 diabetes develops due to multiple underlying pathophysiological defects, combination glucose-lowering therapy is recommended in its management

Initiate combination glucose-lowering therapy as clinically indicated in:

1. Individuals with newly diagnosed type 2 diabetes with glycated haemoglobin (HbA1c) ≥ 7.5% or 58 mmol/mol

OR

2. Individuals with HbA1c levels 1.5 - 2.0% above target.

CHAPTER 10: INSULIN THERAPY IN THE MANAGEMENT OF TYPE 2 DIABETES

- Type 2 diabetes is characterised by a progressive decline in the pancreatic beta-cell mass and secretory function, resulting in worsening glycaemic control, secondary oral hypoglycaemic agent failure, and the eventual need for insulin therapy.
- Because of the progressive nature of type 2 diabetes, most adults with type 2 diabetes will eventually require and benefit from insulin therapy later in the course of the condition.
- In Uganda, insulin therapy is mainly available at the level of health centre IV, secondary, and tertiary healthcare levels.

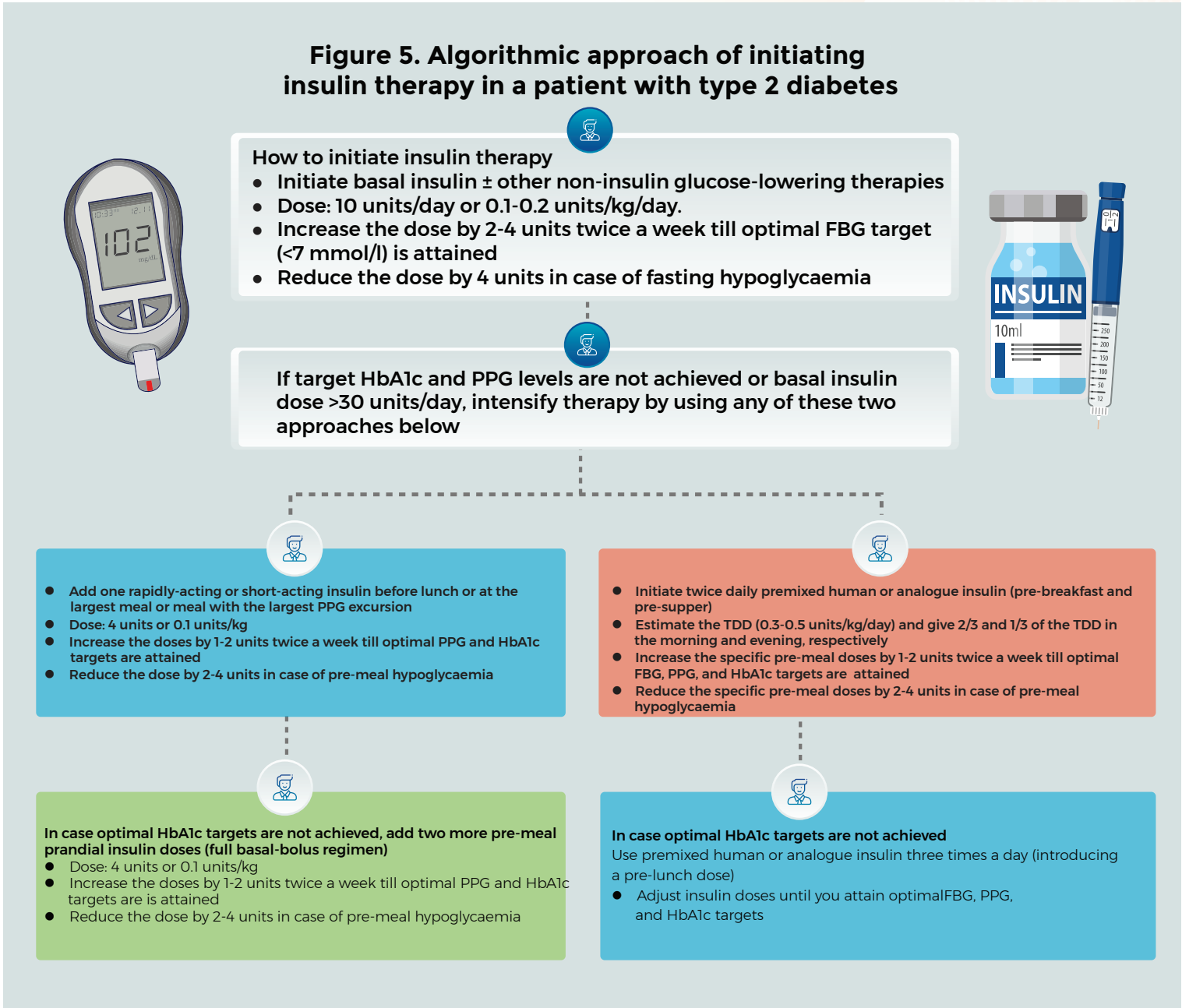
Indications of insulin therapy in adults with type 2 diabetes

1. Symptomatic patients with newly diagnosed type 2 diabetes and fasting blood glucose (FBG) >14 mmol/l (250 mg/dl), random blood glucose (RBG) >16.7 mmol/l (300 mg/dl), and/or HbA1c ≥10% (86 mmol/mol).
2. Persistently high HbA1c levels (≥2 results of HbA1c ≥10% or 86 mmol/mol over 6-12 months)
3. Clinical presentation in diabetic ketoacidosis
4. Presence of secondary oral hypoglycaemic agent failure (failure to attain optimal glycaemic control despite using maximum doses of >2 oral hypoglycaemic agents)
5. Biochemically confirmed insulin deficiency (fasting serum C-peptide <0.76 ng/ml [0.25 nmol/l] or random serum C-peptide concentration <1.80 ng/ml [0.6 nmol/l])
6. In cases of surgery (pre-, intra-, and post-operative periods)
7. Patients on high-dose steroids for management of any medical condition
8. Patients with acute illnesses necessitating inpatient management such as sepsis and post-myocardial infarction
9. Patients with comorbidities or complications that deem the use of oral hypoglycaemic agents as contraindicated, such as end-stage renal and hepatic dysfunction, and acute or chronic pancreatitis
10. Pre-gestational and gestational diabetes.

How to initiate insulin therapy in individuals with type 2 diabetes

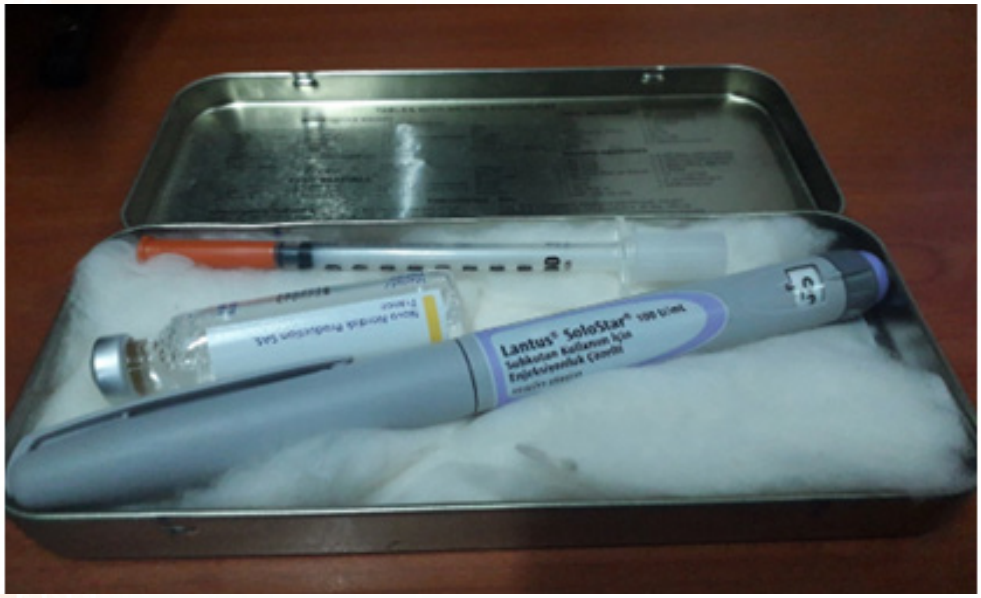
- Initiation of insulin therapy in individuals with type 2 diabetes should be individualised or person-centred.
- Figure 5 below summarises the algorithmic approach of insulin initiation.

Figure 5. Algorithmic approach to initiating insulin therapy in a patient with type 2 diabetes



Insulin storage and delivery devices

- Insulin should be stored in a cool environment of temperatures <30°C and away from exposure to extremes of temperature.
- In the absence of a refrigerator, individuals on insulin therapy should be advised to store their insulin in a simple, clean plastic container with dry cotton wool in a cool environment at room temperature, as shown in the figure below.



Picture by Dr. Davis Kibirige

Caution

Do not store insulin in water, on the floor, or sand

This is because it increases the potential for contamination of insulin resulting in repeated injection abscesses

The recommended insulin syringes for insulin administration are U100 0.5 ml or 1 ml insulin syringes with a 6 mm needle length

For insulin pen needles, the recommended ones should be 4 mm in length or 5 mm for individuals who are overweight or obese

Insulin injection techniques

- The recommended insulin injection sites are the abdomen, thigh, buttocks, and outer aspect of the arms.
- These sites should be rotated to avoid excessive pain and lipo-hypertrophy associated with injecting insulin in the same spot.
- The insulin should be injected perpendicularly with or without a gentle skin pinch to avoid intramuscular administration of insulin.
- The insulin syringe or insulin pen needle should ideally be changed daily.
- Figures 6 and 7 below illustrate the recommended insulin injection sites and techniques.

Figure 6. Recommended insulin injection sites

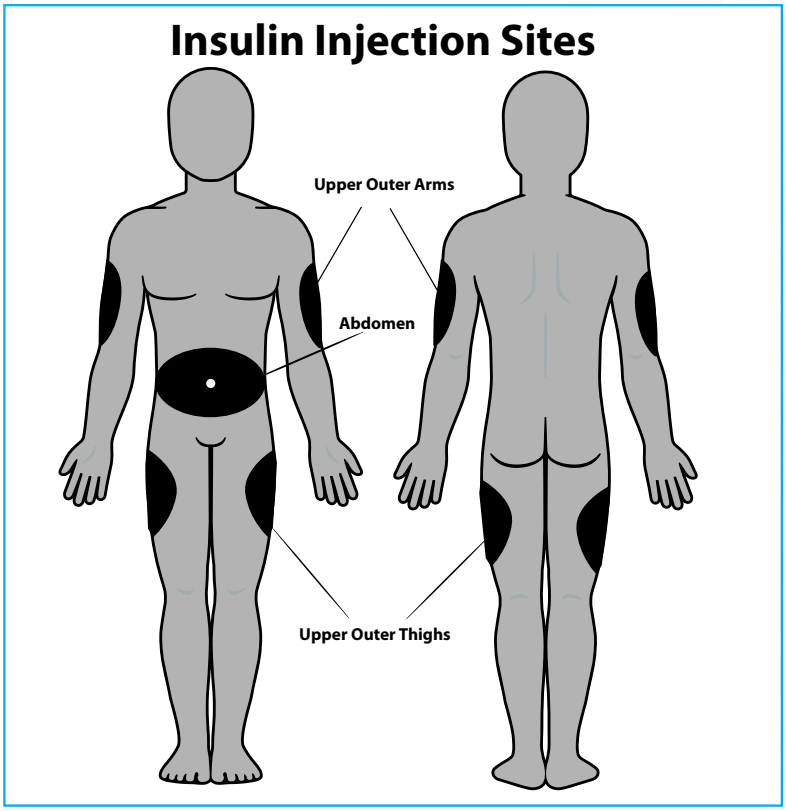
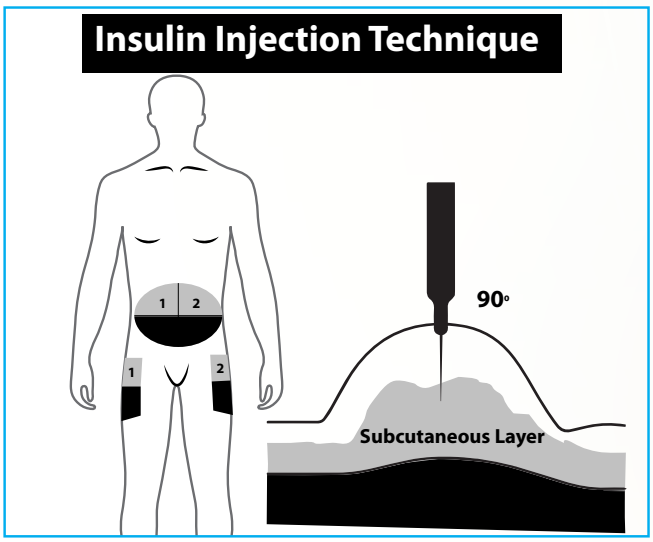
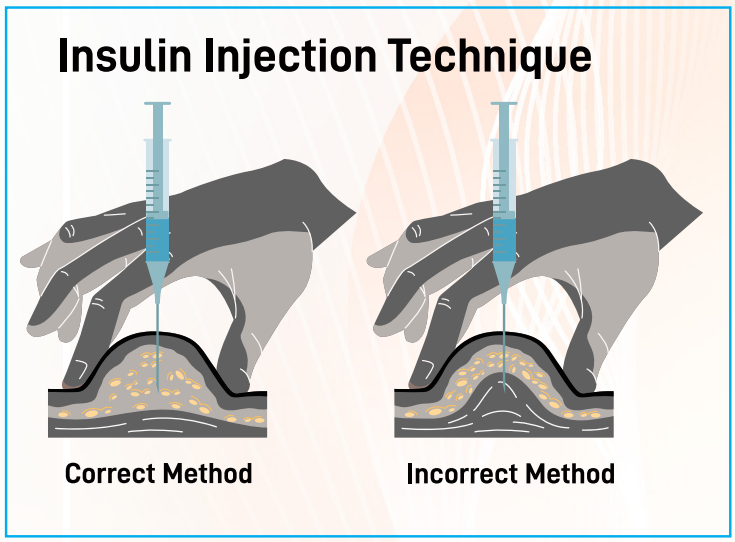


Figure 7. Recommended insulin injection technique





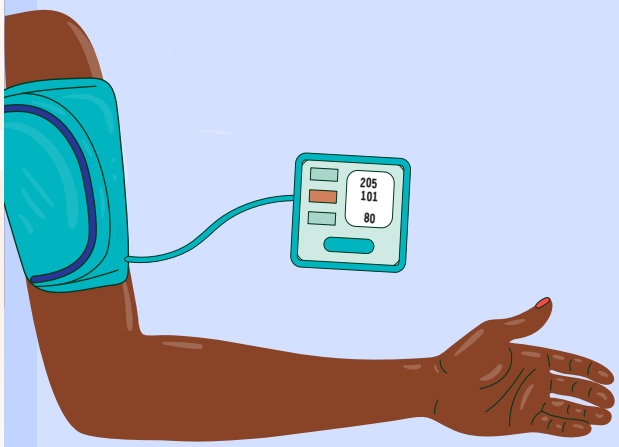
CHAPTER 11. CARDIOVASCULAR DISEASE RISK PROFILING AND MANAGEMENT

- Cardiovascular (CV) risk factors such as hypertension, smoking, family history of premature CV death, overweight or obesity, and dyslipidaemia are common in individuals with type 2 diabetes.
- They are associated with an increased risk of atherosclerotic cardiovascular diseases (ASCVD) such as coronary heart disease, cerebrovascular disease, peripheral arterial disease, and heart failure.
- Optimally manage the above-mentioned CV risk factors to reduce the burden of diabetes complications and CV-related death.
- A multifactorial approach is recommended to control CV risk factors. This involves:

1. Proper assessment of the risk of ASCVD
2. Optimal glycaemic control
3. Appropriate use of antiplatelet therapy
4. Optimal blood pressure (BP) control
5. Optimal blood cholesterol control
6. Cessation of smoking
7. Appropriate diet and weight management.

- Screen all individuals with type 2 diabetes for CV risk factors at the time of diagnosis or initial clinical visit and then repeat annually.

Screening for hypertension in individuals with type 2 diabetes



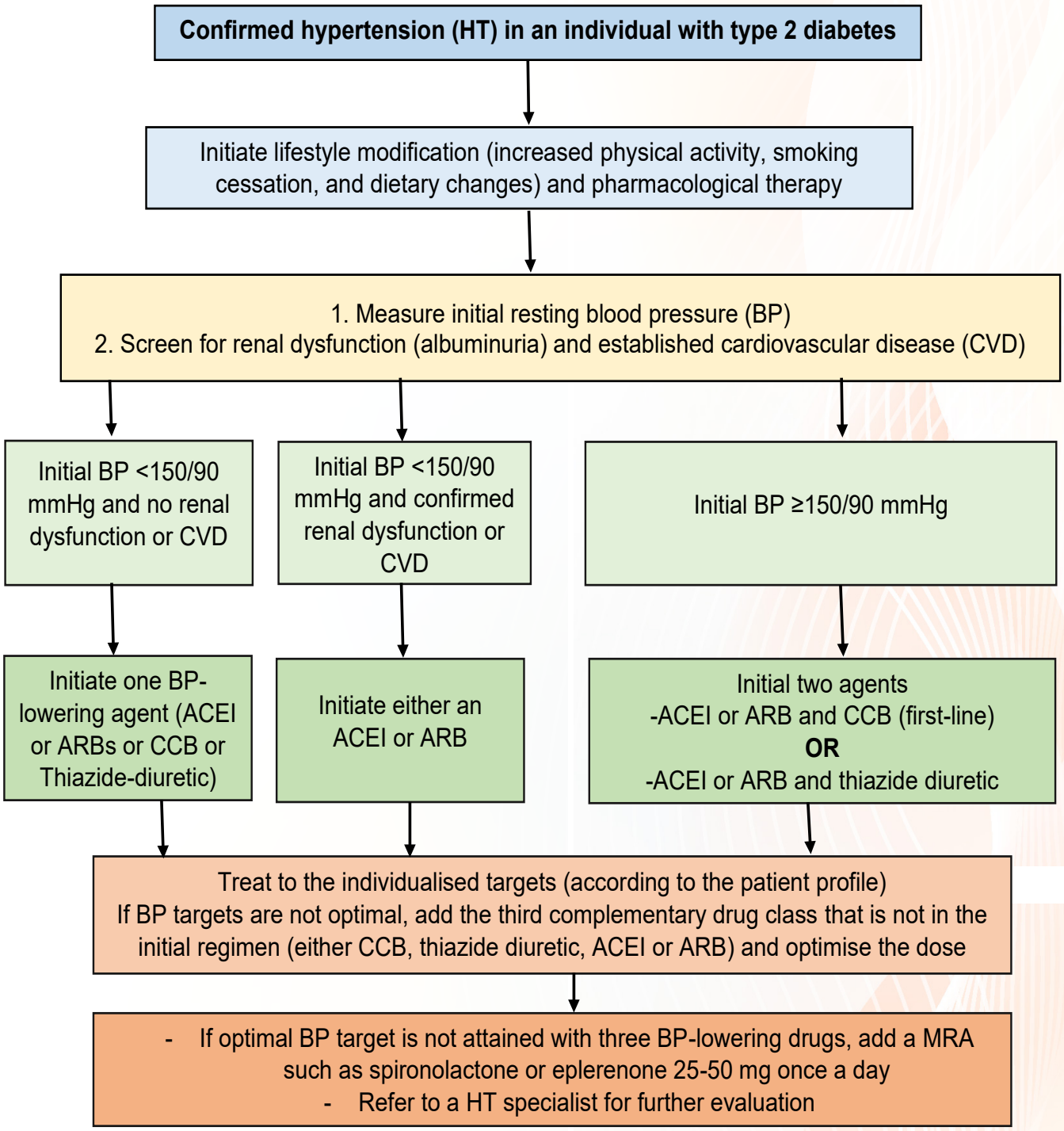
Routinely measure blood pressure (BP) at each clinic visit

Individualise BP targets

Less stringent BP targets are recommended in the elderly, patients with orthostatic hypotension, and cognitive dysfunction

Generally, the recommended optimal BP targets are <130/80 mmHg in all individuals with type 2 diabetes and hypertension

Management of hypertension in individuals with type 2 diabetes



ACEI – Angiotensin converting enzyme inhibitor, ARB – Angiotensin II receptor blocker, CCB – Calcium channel blocker, MRA- mineralocorticoid receptor antagonist

- Use beta-blocker therapy as an add-on BP-lowering therapy only in patients with heart failure with reduced ejection fraction, atrial fibrillation, post-myocardial infarction, stable and unstable angina, and hyperthyroidism.
- Avoid using loop diuretics such as furosemide as a BP-lowering therapy.

Screening for dyslipidaemia in individuals with type 2 diabetes

Perform a lipid profile test (total cholesterol [TC], triglycerides [TGL], low-density lipoprotein cholesterol [LDLC], small-density LDLC, apolipoprotein B, and high-density lipoprotein cholesterol [HDLC]) in every individual with type 2 diabetes at the time of diagnosis or the initial clinical contact

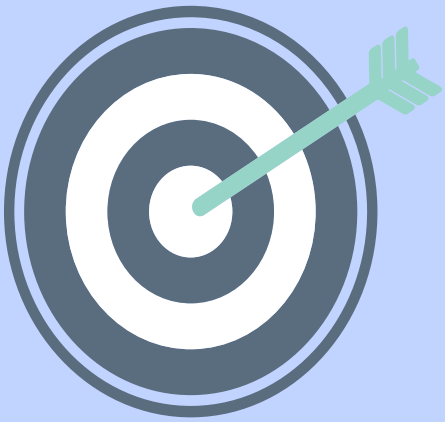
The lipid profile test can be performed either in a fasting or random state

A random or non-fasting lipid profile test is preferred because it is convenient

Lipid profile testing should be repeated 4-12 weeks after the initiation of lipid-lowering therapy and then annually

Recommended lipid treatment targets

RECOMMENDED LIPID TARGETS



TC: <5.0 mmol/l (200 mg/dl)

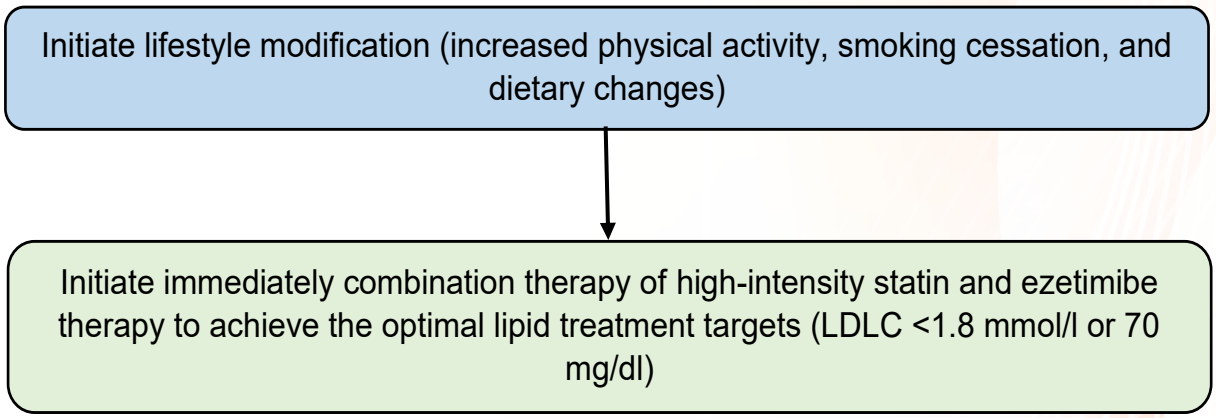
TGL: <1.7 mmol/l (150 mg/dl)

HDLC: >1.0 mmol/l (40 mg/dl) for males and >1.3 mmol/l (50 mg/dl) females

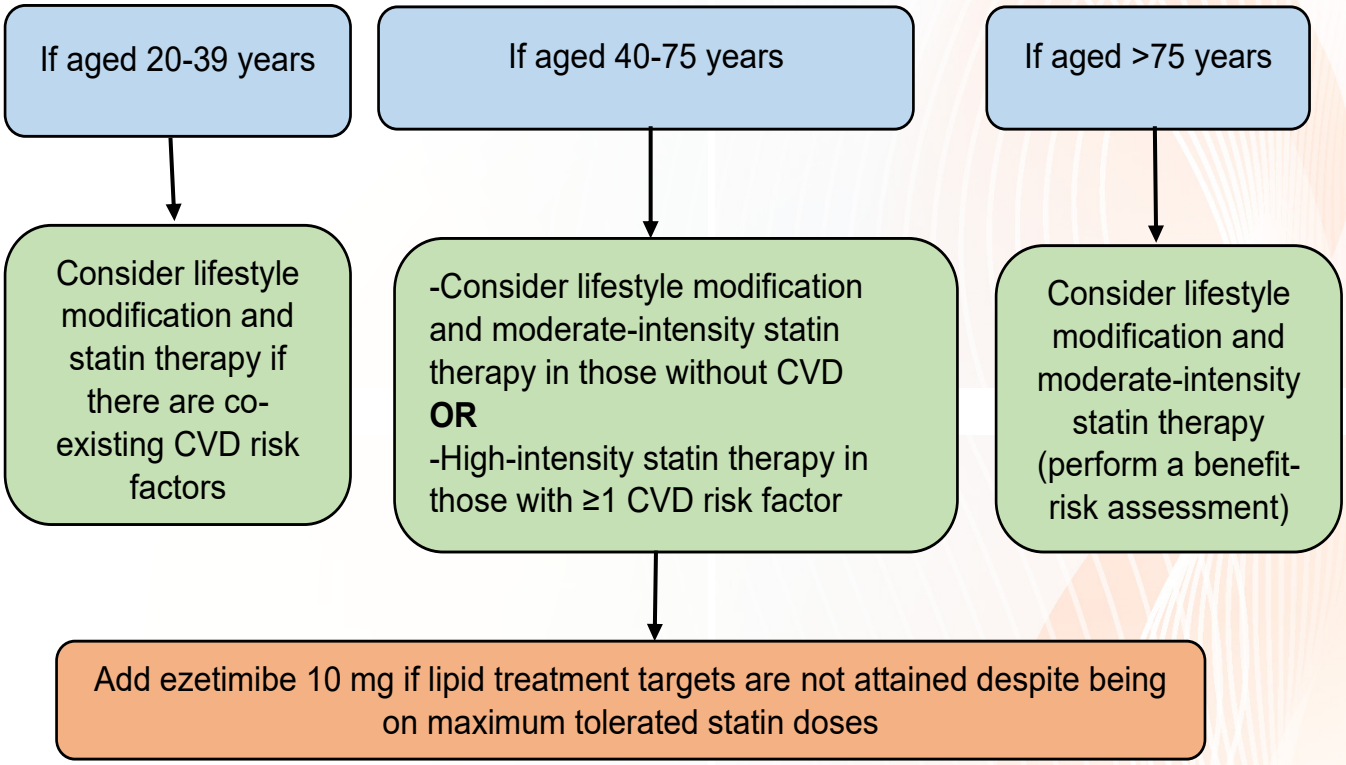
In individuals with established CVD or high cardiovascular disease risk: LDLC level <1.8 mmol/l (70 mg/dl).

In those without CVD, LDLC level <2.6 mmol/l (100 mg/dl)

Management of dyslipidaemia for secondary prevention of cardiovascular disease events in individuals with type 2 diabetes



Management of dyslipidaemia for primary prevention of cardiovascular disease events in individuals with type 2 diabetes



- Table 9 below shows the respective statin doses and the effect of LDLC lowering.

Table 9: Statin therapy doses

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

Oral antiplatelet therapy in individuals with type 2 diabetes

- Initiate low-dose oral antiplatelet therapy (cardiac aspirin or clopidogrel 75-150 mg per day) in individuals with type 2 diabetes and a history of ASCVD (ischemic stroke, stable and unstable angina, myocardial infarction, and peripheral arterial disease) as secondary prophylaxis.
- Don't use low-dose oral antiplatelet therapy as primary prophylaxis for ASCVD in individuals with type 2 diabetes because of a lack of clinical evidence about its effectiveness in reducing all-cause and CV-related mortality.

CHAPTER 12: MANAGEMENT OF ACUTE DIABETES COMPLICATIONS

- The three acute diabetes complications commonly encountered in clinical practice in individuals with type 1 and type 2 diabetes are hypoglycaemia, diabetic ketoacidosis (DKA), and hyperosmolar hyperglycaemic state (HHS).

HYPOGLYCAEMIA

- Table 10 below summarises the different levels of hypoglycaemia.

Table 10. Levels of hypoglycaemia

LEVEL OF HYPOGLYCAEMIA	DEFINITION
Level 1 or mild hypoglycaemia	Measured blood glucose concentration of <3.9 mmol/l (<70 mg/dl), but ≥ 3.0 mmol/l (≥54 mg/dl)
Level 2 or moderate hypoglycaemia	Measured blood glucose concentration of <3.0 mmol/l (<54 mg/dl)
Level 3 or severe hypoglycaemia	Severe life-threatening event characterised by altered mental and physical status requiring assistance.

- Signs and symptoms of hypoglycaemia are either due to the brain's deprivation of glucose (neuroglycopenic) or due to the activation of the sympathoadrenal system (neurogenic).
- The neuroglycopenic signs and symptoms include behavioural changes, fatigue, confusion, irritability, seizures, and loss of consciousness.
- The neurogenic signs and symptoms include palpitations, tremors, anxiety, profuse sweating, hunger, and paraesthesia.
- Some individuals with diabetes, especially long-standing diabetes, may present with hypoglycaemic unawareness despite having low blood glucose levels.
- Assess every individual with diabetes for the risk of hypoglycaemia at every clinical visit in routine care.
- This assessment involves evaluating the frequency, timing, and severity of the hypoglycaemic episodes, the potential causes, and the management of the hypoglycaemic episodes.

Risk factors for hypoglycaemia

1. Individuals on glucose-lowering therapies associated with hypoglycaemia, such as insulin (especially human insulins) and sulfonylureas (especially glibenclamide)
2. Individuals with diabetes and kidney and liver dysfunction
3. Elderly individuals
4. Preschool-age children
5. Individuals with a history of severe hypoglycaemia.
6. Individuals with a history of cognitive impairment or intellectual disability that impairs swift response to a

hypoglycaemic episode.

7. Individuals with hypoglycaemia unawareness.
8. Individuals with long-standing type 1 and type 2 diabetes.
9. Individuals with irregular eating schedules.

Prevention and management of hypoglycaemia

- Hypoglycaemia should be promptly managed by consuming any readily available fast-acting carbohydrate such as pure glucose powder.
- Use intravenous glucose infusions such as 50% or 5% dextrose solutions in hospital settings.
- Provide structured patient education at each clinic visit to prevent hypoglycaemic episodes.
- Teach individuals with diabetes what hypoglycaemia is, how to recognise it, situations that can provoke a hypoglycaemic episode such as fasting, physical activity, and skipping or delaying meals, and how to manage and avoid a hypoglycaemic episode (such as ingestion of a fast-acting carbohydrate, bedtime snacking, and dose adjustment).
- All individuals with diabetes, especially those with a high risk of hypoglycaemia, should consistently monitor their blood glucose levels using a glucometer.

HYPERGLYCAEMIC EMERGENCIES

- The two hyperglycaemic emergencies commonly encountered in clinical practice are diabetic ketoacidosis (DKA) and hyperglycaemic hyperosmolar state (HHS).
- In Uganda, these hyperglycaemic emergencies should be managed at health centre IVs, secondary, and tertiary health care levels.
- Healthcare professionals at health centre III should initiate fluid therapy and then promptly refer the patient to a health centre IV, secondary, and tertiary hospital for further management.
- Table 11 summarises the diagnostic

Table 11. Diagnostic criteria of diabetic ketoacidosis and hyperglycaemic hyperosmolar state

HYPERGLYCAEMIC EMERGENCY	DIAGNOSTIC CRITERIA
Diabetic ketoacidosis	A triad of: 1. Hyperglycaemia (blood glucose >11.0 mmol/l or 200 mg/dl) 2. Significant ketonemia or ketonuria (serum ketone concentrations >3.0 mmol/l or >2+ ketones on urine dipsticks) 3. Acidosis (serum bicarbonate concentration of <15 mmol/l and/or venous pH <7.3)
Hyperglycaemic hyperosmolar state	1. Severe dehydration 2. Marked hypovolemia (hypotension and tachycardia) 3. Calculated effective serum osmolality >300 mOsm/kg or total serum osmolality >320 mOsm/kg 4. Hyperglycaemia (≥30 mmol/l or ≥540 mg/dl) 5. Absence of significant ketonemia (serum ketone concentrations ≤3.0 mmol/l or urine ketone strip test <2+) and acidosis (pH ≥7.3 and serum bicarbonate concentrations ≥15 mmol/l).

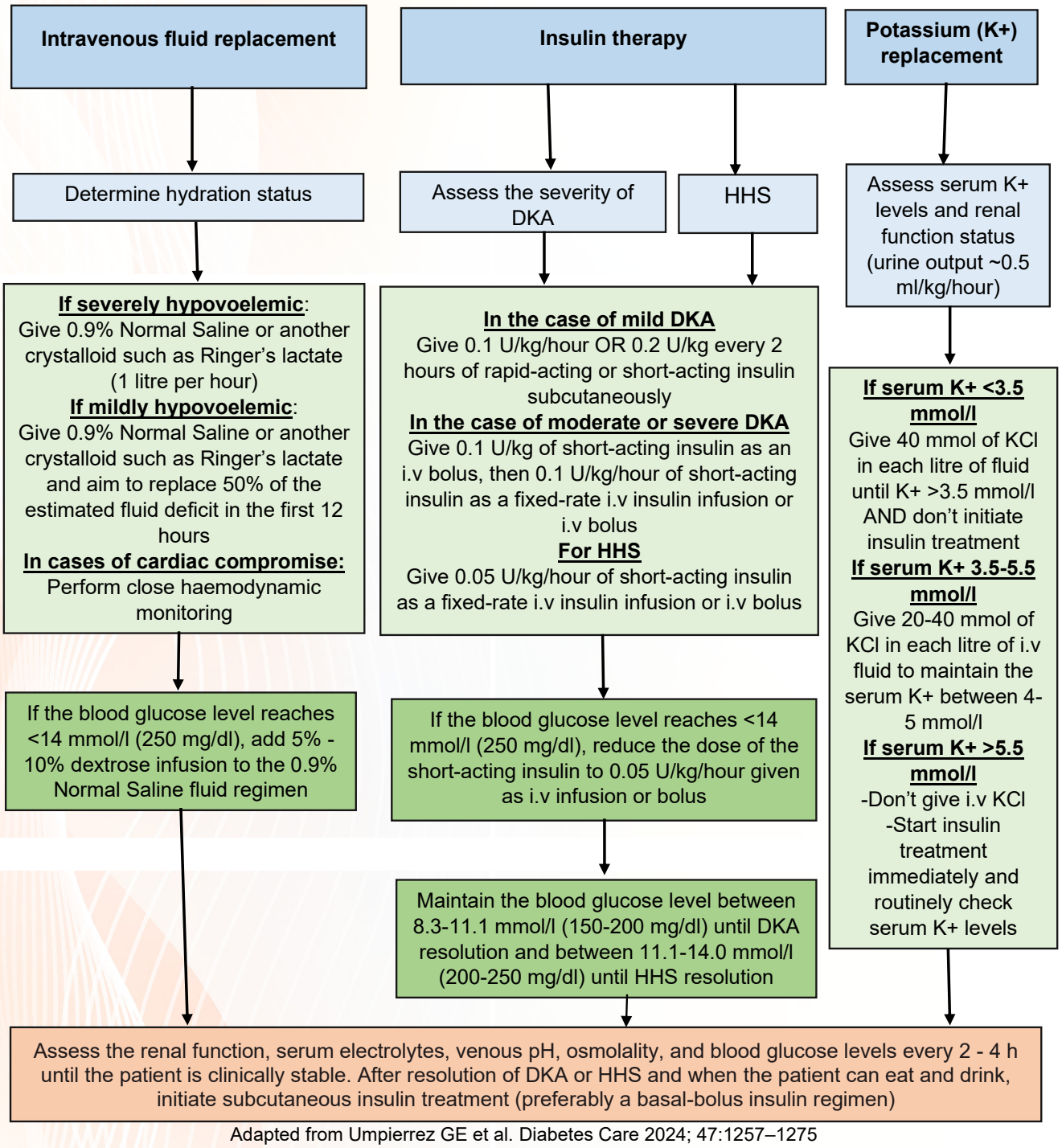
- A distinct form of DKA called euglycaemic DKA occurs in chronic alcoholic consumption, pregnancy, and individuals with type 2 diabetes on concomitant use of sodium-glucose cotransporters 2 (SGLT2) inhibitors and insulin therapy.
- Euglycaemic DKA is characterised by the presence of ketosis and acidosis in the presence of normal or near-normal blood glucose levels (blood glucose levels <11.0 mmol/l or 200 mg/dl).
- The common precipitating factors for DKA and HHS include infections (mainly respiratory, urinary, and skin infections), intercurrent illnesses, poor adherence, dosing, and non-compliance to glucose-lowering therapies, cardio or cerebrovascular events such as myocardial infarction and stroke.
- To diagnose HHS, the effective or total serum osmolarity is calculated using the formulae: 2xNa+(mmol/L) + glucose (mmol/L) OR 2xNa+ (mmol/L) + glucose (mmol/L) + urea (mmol/L), respectively.

Clinical workup of an individual presenting with diabetic ketoacidosis and hyperglycaemic hyperosmolar state

- Perform these tests to facilitate diagnosis, identification of the trigger factor and co-existing complications, and to guide treatment:

1. Blood glucose and ketone measurement
2. Urinalysis (to confirm urine ketosis and screen for urinary tract infection as a trigger)
3. Renal function tests (serum urea and creatinine concentrations with an estimated glomerular filtration rate)
4. Serum electrolytes (sodium, potassium, and phosphate [if available])
5. A full blood count
6. A chest X-ray and ECG (if indicated to screen for a respiratory tract infection and cardiac condition)

Management of diabetic ketoacidosis and hyperglycaemic hyperosmolar state

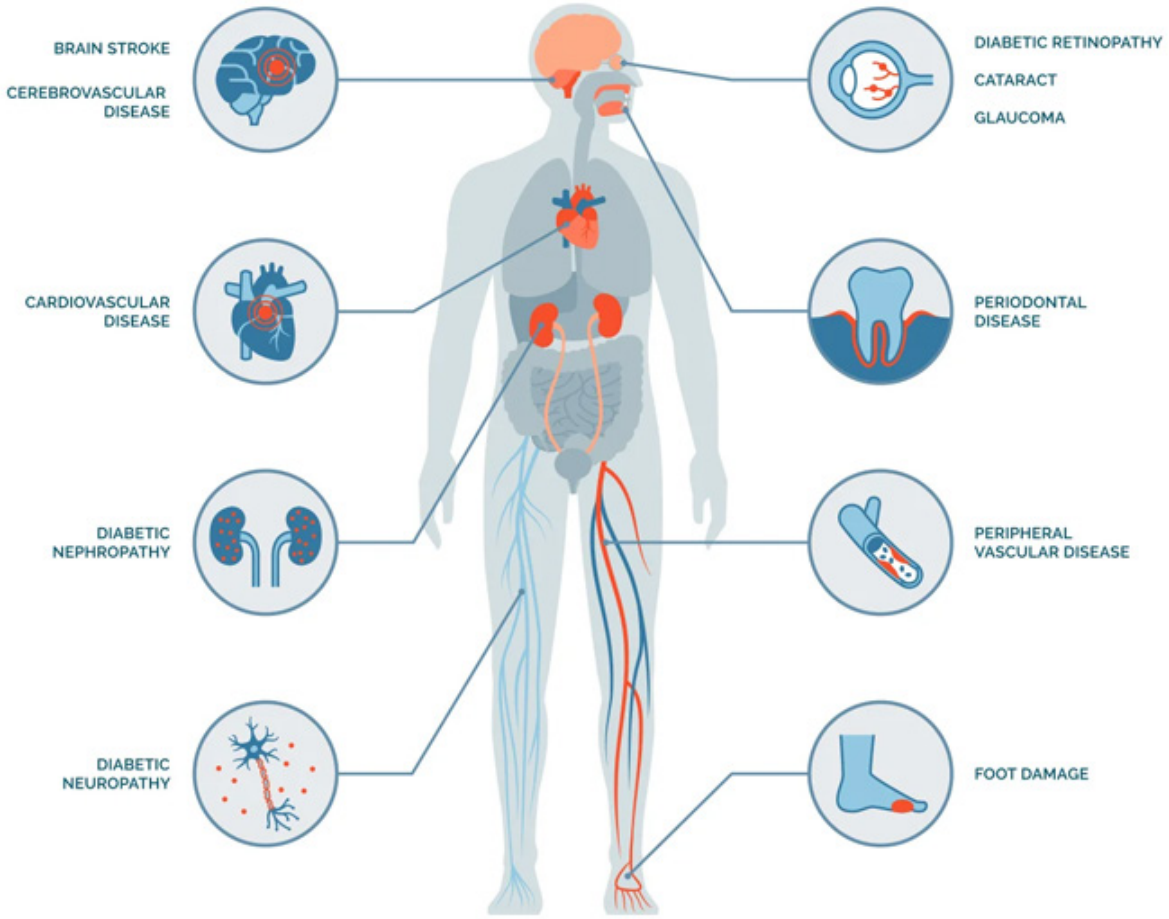


Adapted from Umpierrez GE et al. Diabetes Care 2024; 47:1257–1275

CHAPTER 13: AN OVERVIEW OF THE CHRONIC DIABETES COMPLICATIONS

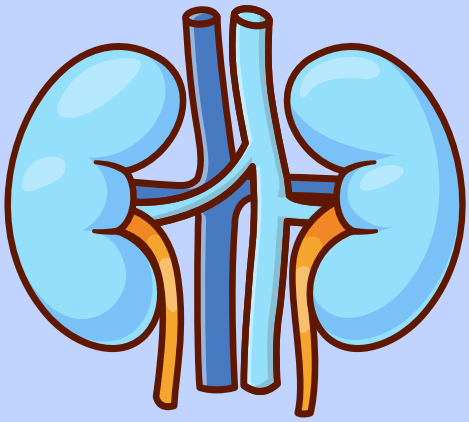
- Chronic diabetes complications are classified into microvascular and macrovascular diabetes complications.
- Examples of microvascular diabetes complications include diabetic kidney disease, diabetic retinopathy, and diabetic peripheral neuropathy, while diabetes-related foot disease, heart diseases, and peripheral arterial disease constitute macrovascular diabetes complications.
- Figure 8 below summarises the commonly encountered diabetes related complications

Figure 8: Diabetes related complications



Adapted from https://www.endocrine.org/patient-engagement/endocrine-library/diabetes-complications

DIABETIC KIDNEY DISEASE



WHEN TO SCREEN:
Screen all individuals with diabetes for diabetic kidney disease (DKD) at the time of diagnosis or initial clinical encounter and then repeat the assessment annually.

HOW TO SCREEN
Measure:
1. Serum creatinine concentrations (to calculate the estimated glomerular filtration rate or e-GFR)
2. Urine albumin: creatinine ratio (UACR) on a random spot urine sample by immunoassay or a dipstick specific for microalbuminuria

OR
Perform a urinalysis to detect proteinuria (if unable to measure UACR)

- A normal UACR should be <30 mg/g (<3 mg/mmol). Levels between 30-300 mg/g (3-30 mg/mmol) and >300 mg/g (>30 mg/mmol) suggest the presence of microalbuminuria and macroalbuminuria, respectively.
- The UACR measurement is affected by many factors such as fever, exercise, infections, menses, and marked hypertension. Because of this, it is advised to perform two to three additional tests within three to six months to confirm any abnormality in renal function.
- Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function present for a minimum of 3 months.
- It is classified based on cause, e-GFR category (G1–G5), and albuminuria category (A1–A3). It is also categorised into four grades as shown in Table 12 below.

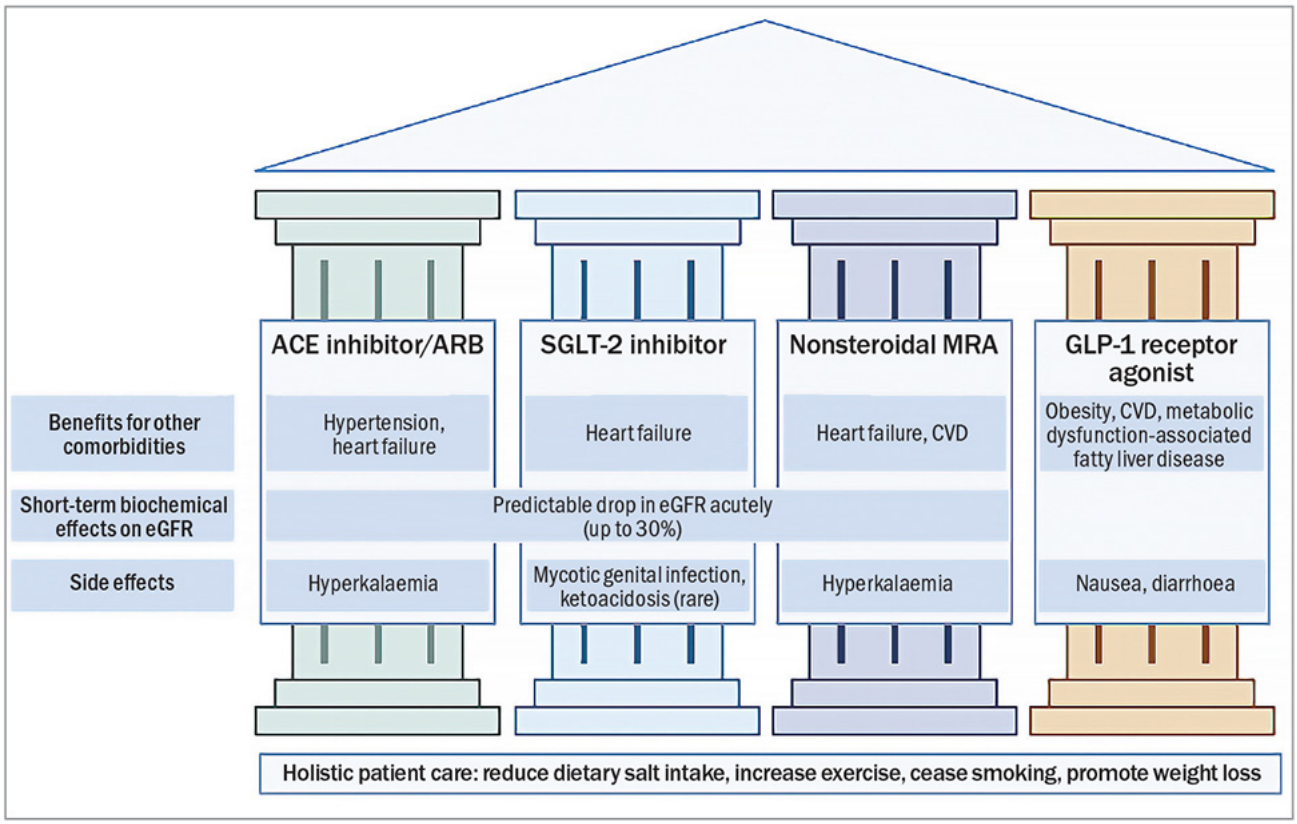
Table 12. Categories of chronic kidney disease

CATEGORY OF CKD	DEFINITION
Low-risk	e-GFR >60 mL/min/1.73 m^2 with normal or mildly increased albuminuria (UACR <30 mg/g or <3 mg/mmol)
Moderately-increased risk	e-GFR 45-59 mL/min/1.73 m^2 with normal to mild albuminuria (UACR <30 mg/g or <3 mg/mmol) **OR** e-GFR >60 mL/min/1.73 m^2 with moderately increased albuminuria (UACR of 30-300 mg/g or 3-30 mg/mmol)
High-risk	e-GFR 30-44 mL/min/1.73 m^2 with mild albuminuria **OR** e-GFR 45 – 59 mL/min/1.73 m^2 with moderate albuminuria **OR** e-GFR >90 mL/min/1.73 m^2 with severely increased albuminuria
Very high-risk	e-GFR <30 mL/min/1.73 m^2 with normal to mild albuminuria **OR** e-GFR is 30-44 mL/min/1.73 m^2 with moderate albuminuria **OR** e-GFR is 45-<60 with severe albuminuria

Prevention and management of diabetic kidney disease

- Primary prevention for CKD in individuals with diabetes can be attained by maintaining optimal glycated haemoglobin (HbA1c) and blood pressure (BP) targets of <7% (53 mmol/mol) and <130/80 mmHg, respectively.
- Do not routinely use angiotensin converting enzyme inhibitors (ACEI) or angiotensin II receptor blockers (ARBs) as a strategy for preventing DKD in individuals with diabetes without co-existing hypertension and/ or albuminuria.
- The management of DKD aims to slow its progression and prevent related complications.
- Optimal and individualised blood glucose and pressure control significantly reduce the risk of developing microalbuminuria, macroalbuminuria, and/or overt nephropathy in individuals with type 1 or type 2 diabetes.
- Figure 9 below summarises the key pillars of the management of diabetic kidney disease

Figure 9. Pillars of management of diabetic kidney disease



Adapted from https://medicinetoday.com.au/mt/2024

- Examples of these key drugs used in the management of DKD are summarised below:

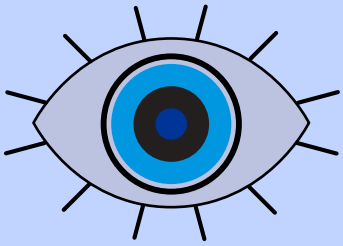
1. Angiotensin converting enzyme inhibitor (ACEI): enalapril, ramipril, and captopril
2. Angiotensin II receptor blockers (ARB): losartan, telmisartan, and valsartan
3. Sodium-glucose cotransporter 2 inhibitors (SGLT2i): dapagliflozin and empagliflozin
4. Glucagon-like peptide 1 receptor agonists (GLP-1 RA) include semaglutide and liraglutide
5. Nonsteroidal mineralocorticoid antagonists include finerenone.

- Adjust drug doses depending on the stage of CKD is required.
- Initiate all individuals with DKD on moderate- or high-intensity statin therapy (atorvastatin 10-80 mg or rosuvastatin 5-20 mg) depending on the prevalent cardiovascular risk status.
- Avoid using a combination of ACEI and ARB because it increases the risk of hyperkalemia and hypotension.
- Avoid using metformin in individuals with DKD and e-GFR <30 ml/min/1.73 m2.
- Avoid using SGLT2i and GLP-1 RA in individuals with type 2 diabetes, CKD, and an e-GFR <20 mL/min/1.73 m2.

DIABETIC RETINOPATHY

- Diabetic retinopathy (DR) or diabetic eye disease is a common diabetes complication and the leading cause of visual loss in middle-aged and elderly people with diabetes.
- It is classified into two stages, i.e. nonproliferative DR (NPDR) and proliferative DR (PDR).
- The NPDR represents the early stage of the condition and is characterised mainly by microaneurysms, retinal dots, blot haemorrhages, and hard exudates or cotton wool spots seen on fundoscopy and may be largely asymptomatic.

- The PDR is the advanced stage of DR and is characterised by the presence of neovascularisation, vitreous or pre-retinal haemorrhage, retinal detachment, and diabetic macular oedema (which is the commonest cause of vision loss).



WHEN TO SCREEN:

- Screen all individuals with type 2 diabetes for diabetic retinopathy (DR) at the time of diagnosis or initial clinical encounter
- Repeat every two years if there are no signs of DR
- In the presence of signs of DR, repeat the screening depending on the severity of the DR (annually for mild to moderate NPDR, 3-6 monthly screening for severe NPDR, and <3 monthly screening for PDR)

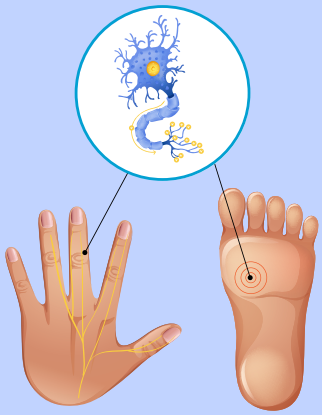
HOW TO SCREEN:

- Screen for DR using visual acuity assessment and indirect ophthalmoscopy using a dilated slit lamp examination or direct ophthalmoscopy using fundus photography

HOW TO MANAGE

- Optimally and intensively manage glycaemia, blood pressure, and lipid levels
- Specialised treatment for DR should be performed by an experienced ophthalmologist

DIABETIC NEUROPATHY



WHEN AND HOW TO SCREEN

- Screen for peripheral neuropathy at puberty or from 11 years with 2-5 years of diabetes duration and then repeat it annually.

- Screening should involve:
  1. A comprehensive foot examination (inspection, palpation of dorsalis pedis and posterior tibial pulses, determination of proprioception, vibration, and monofilament sensation).
  2. Assessment of symptoms of neuropathic pain.

HOW TO PREVENT AND MANAGE

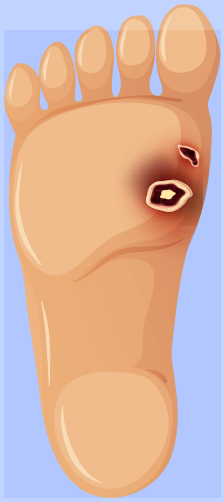
- Optimally manage glycaemia, blood pressure, and lipid levels to prevent and/or delay the onset and progression of diabetic peripheral neuropathy

- Drugs used in the treatment include: gabapentin, pregabalin, duloxetine, carbamazepine, valproic acid, tramadol, and antioxidants such as alpha-lipoic acid

DIABETES-RELATED FOOT DISEASE

- Diabetes-related foot disease (DFD) is defined as a disease of the foot of an individual with current or previously diagnosed diabetes that includes ≥1 of the following: peripheral neuropathy, peripheral arterial disease (PAD), infection, ulcer(s), neuro-osteoarthropathy, gangrene, or amputation.
- It is a common complication in individuals with diabetes, especially type 2 diabetes.
- In Uganda, most patients with DFD present with severe disease (Wagner classification 3-5) and combined clinical features of distal sensorineuropathy and peripheral ischaemia.
- The clinical factors that increase the risk of developing DFD include:

1. Poor glycaemic control
2. Smoking
3. Presence of peripheral neuropathy, diabetic retinopathy, nephropathy, PAD, foot deformities, and pre-ulcerative corns or calluses
4. Prior ulceration and amputation



WHEN TO SCREEN

Screen all individuals with diabetes for diabetic foot disease (DFD) at the time of diagnosis and then repeat it annually (or more frequently in individuals at risk of DFD)

HOW TO SCREEN

- Screening for DFD should be done by taking a focused history and clinical examination of the feet

- A detailed clinical examination of the feet involves:

1. Assessment of the skin integrity (colour, temperature, presence of ulcers, calluses, and infection)
2. Evaluation for loss of protective sensation, position, and vibration sense using a 10 g monofilament and a 128 HZ tuning fork, respectively
3. Assessment for foot deformities
4. Palpation of the feet pulses

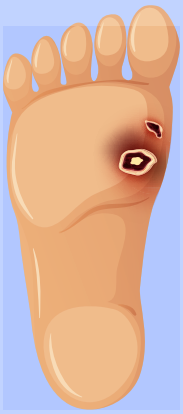
- Routinely inspect the footwear of individuals with diabetes to ensure that it is well-fitting and appropriate.

Prevention of diabetes-related foot disease

- The prevention of DFD involves these five key components:

1. Identification of individuals at risk of DFD
2. Regular self- and healthcare professional-provided inspection and examination of the feet of every individual with diabetes, especially those at risk of DFD
3. Provision of regular and structured education about proper foot care to the patients, their immediate families, and healthcare professionals
4. Encouraging routine wearing of appropriate footwear
5. Optimal management of all risk factors

Management of diabetes-related foot infections



1. Surgical intervention to remove all necrotic tissue

2. Assessment for peripheral arterial disease using computed tomography (CT) angiography (if available) and duplex lower limb ultrasound Doppler scan of the lower limbs.

3. Urgent initiation of empiric, parenteral, and broad-based antibiotics to cover both gram-positive and negative bacteria and obligate anaerobes.

4. Adjustment of the parenteral antibiotic regimen based on clinical response and culture and sensitivity results when available.

- The duration of antibiotic coverage depends on the severity of the diabetes-related foot infections (DFI).
- Give antibiotics for 1-2 weeks in case of soft tissue DFI.
- Give antibiotics for a longer duration (≥3 weeks) in case of slowly resolving infections, severe PAD, or post-amputation.
- Table 13 below summarises the empirical broad-spectrum oral or parenteral antibiotics that can be used in the management of diabetic-related foot infections.

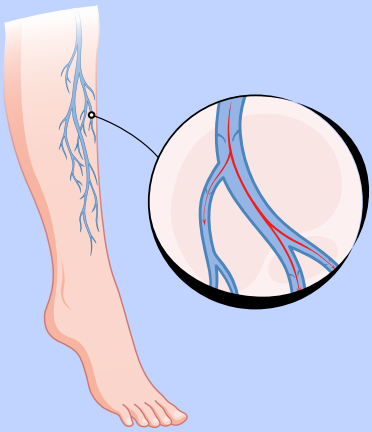
Table 13. Recommended empirical antibiotic therapy for diabetes-related foot infections

SEVERITY OF DFI	ANTIBIOTIC THERAPY	DURATION OF TREATMENT
DFI of mild severity	1. Oral cloxacillin and cephalexin OR 2. Oral amoxicillin-clavulanate OR 3. Oral fluoroquinolones such as levofloxacin and moxifloxacin (in case of beta-lactam allergy or recent exposure to antibiotics) OR 4. Oral linezolid in cases of high-risk MRSA.	1-2 weeks
DFI of moderate to severe severity	1. Intravenous amoxicillin-clavulanate OR 2. A 2nd or 3rd generation intravenous cephalosporin such as cefuroxime, cefotaxime, and ceftriaxone OR 3.Intravenous piperacillin-tazobactam and ceftazidime OR 4. Intravenous carbapenems such as meropenem. **If suspecting MRSA-associated DFI, consider adding or substituting with vancomycin or linezolid.	2-4 weeks

DFI- Diabetes-related foot infections, MRSA- Methicillin-resistant Staphylococcus aureus

PERIPHERAL ARTERIAL DISEASE

- Peripheral arterial disease (PAD) is another common macrovascular diabetes complication seen in individuals with type 2 diabetes
- It often precedes the onset of DFD and most cardiovascular events.
- It is defined as an obstructive atherosclerotic vascular disease of the arteries from the aorta to the foot with clinical symptoms, signs, or abnormalities on non-invasive or invasive vascular assessment, resulting in disturbed or impaired circulation in one or more extremities.



WHEN TO SCREEN

- Screen all individuals with type 2 diabetes and >50 years of age for peripheral arterial disease (PAD) at the time of diagnosis or initial clinical visit and then repeat it annually.

HOW TO SCREEN

- The screening for PAD should be performed using a detailed history (assessing for risk factors and symptoms of PAD) and clinical examination (assessing for signs of ischaemia).
- On suspecting PAD, assess using an arterial Doppler ultrasound scanning or CT angiography of the lower limbs

HOW TO MEDICALLY MANAGE

- Optimally manage glycaemia (HbA1c <8%), blood pressure (<140/90 mmHg), and lipids (LDCL <1.8 mmol/l)
- Initiate oral antiplatelet and high-intensity statin therapy
- Initiate SGLT2 inhibitors of GLP-1 RA
- Use combination therapy of cardiac aspirin (75-100 mg) and low-dose rivaroxaban (2.5 mg) in those with a low bleeding risk

CHAPTER 14. IN-HOSPITAL MANAGEMENT OF HYPERGLYCAEMIA

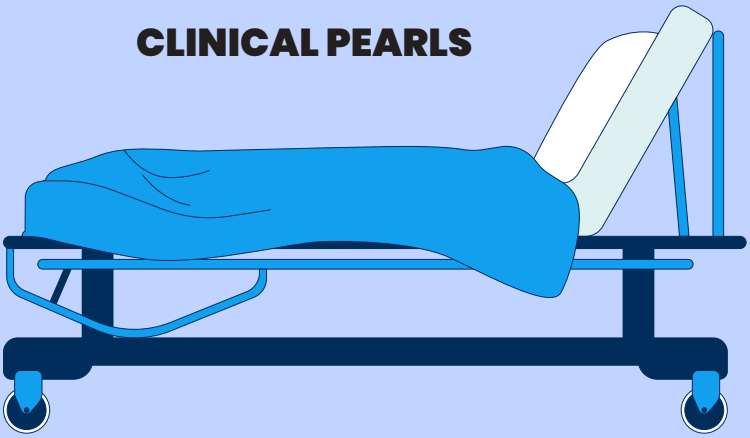
- In-hospital hyperglycaemia is defined as blood glucose levels >7.8 mmol/l (>140 mg/dl) in a hospitalised individual.
- It constitutes:

1. Overt diabetes (pre-existing diabetes and undiagnosed diabetes)
2. Stress or reactionary hyperglycaemia (hyperglycaemia that develops during hospitalisation but reverts to normoglycaemia post-hospital discharge).

- An admission glycated haemoglobin (HbA1c) ≥6.5% (48 mmol/mol) suggests overt diabetes preceding hospitalisation.
- Routinely screen all admitted medical and surgical patients for hyperglycaemia by measuring random blood glucose (RBG) and glycated haemoglobin (HbA1c) levels.

Pharmacological management of in-hospital hyperglycaemia

CLINICAL PEARLS



- Initiate glucose-lowering therapy only if the blood glucose levels are persistently above 10 mmol/l (≥180 mg/dl).
- Treat critically ill hospitalised medical and surgical patients with hyperglycaemia to a glycaemic target of 7.8-10.0 mmol/l (140-180 mg/dl).
- Treat noncritically ill medical and surgical patients with in-hospital hyperglycaemia to a glycaemic target of 5.6-10.0 mmol/l (100-180 mg/dl).
- Use continuous intravenous fixed-dose insulin infusion therapy to manage hyperglycaemia in critically ill patients in the intensive care unit (ICU).
- Use subcutaneous rapidly-acting or short-acting insulin every 4-6 hours and once a day basal insulin in noncritically ill individuals.

Caution

Avoid using the sliding scale in administering insulin because it is associated with poor in-hospital glycaemic control, recurrent episodes of hypoglycaemia, and glycaemic variability.

Avoid using premixed insulin therapy (especially human insulin) in managing in-hospital hyperglycaemia because it is associated with high rates of hypoglycaemia.

Avoid using metformin due to risk of developing lactic acidosis.

Avoid using sulfonylureas such as glibenclamide and glimepiride because of the high risk of hypoglycaemia.

Avoid using thiazolidinediones such as pioglitazone because they are associated with fluid retention and can aggravate heart failure.

- Generally, dipeptidyl peptidase IV (DPP-IV) inhibitors such as sitagliptin, vildagliptin, and teneligliptin are relatively well-tolerated and can also be used in managing in-hospital hyperglycaemia.
- This is because they are also associated with a low risk of hypoglycaemia.
- Sodium-glucose cotransporter 2 inhibitors such as dapagliflozin and empagliflozin can also be initiated early in hospitalised patients with hyperglycaemia and acute heart failure.
- This is because they are well-tolerated and reduce the risk of in-hospital mortality and acute kidney injury.

Peri-operative care: a summary of recommendations

- Table 14 below summarises the recommendations for peri-operative care for patients with diabetes

Table 14. Peri-operative care for patients with diabetes

CARE ASPECT	RECOMMENDATION
HbA1c and blood glucose targets	-Elective surgery HbA1c goal: <8% (64 mmol/mol) -Random blood glucose goal within 4 hours of surgery: 5.6–10.0 mmol/l (100–180 mg/dl)
Adjustment of glucose-lowering therapies	-Hold metformin on the day of surgery. -Discontinue sodium-glucose cotransporter 2 inhibitors 3-4 days before surgery. -Hold other oral glucose-lowering agents on the morning of the surgery or procedure.
Insulin therapy adjustments	-Reduce the dose of NPH insulin by 50% and by 75–80% for long-acting analogue insulin before the day of the surgery

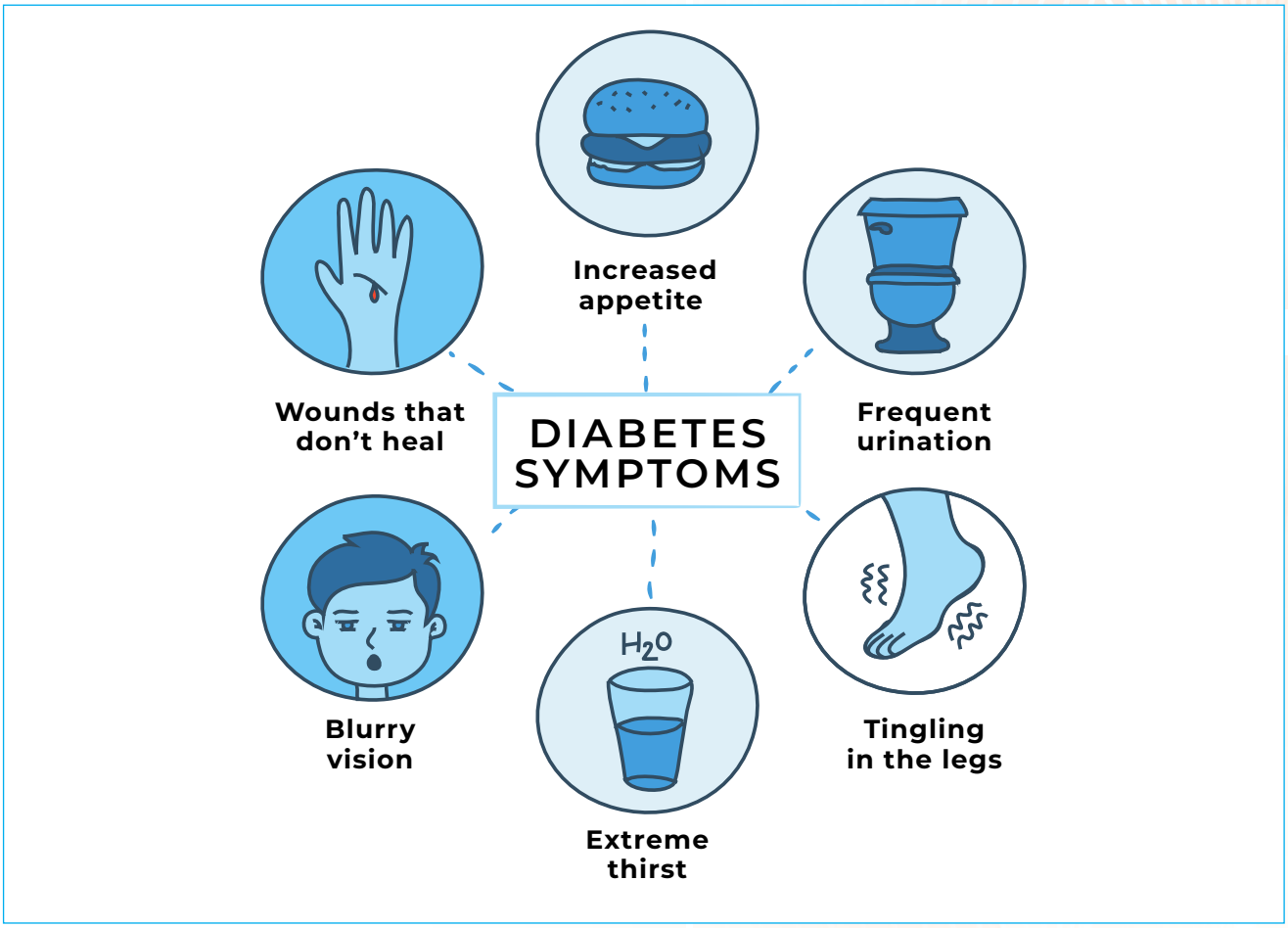
CHAPTER 15: DIAGNOSIS AND MANAGEMENT OF TYPE 1 DIABETES IN CHILDREN, ADOLESCENTS, AND YOUNG ADULTS

- Type 1 diabetes (T1D) is an acquired chronic disease that develops due to autoimmune destruction of the beta-cells in the islets of Langerhans, resulting in absolute or relative insulin deficiency and hyperglycemia.
- It is the most common chronic endocrine condition in children.
- The aetiology of T1D is multifactorial.
- Genetic predisposition (HLA DR and DQ alleles) and environmental factors such as early life (in-utero or during infancy, childhood, and adulthood), enterovirus infections and congenital rubella syndrome have been associated with the onset of islet-cell autoimmunity.

Diagnosis of type 1 diabetes

- Healthcare professionals and the community should have a high index of suspicion to diagnose T1D early.
- This is because the condition commonly presents in childhood and adolescence, and mimics several childhood illnesses.
- The common symptoms of T1D in children, adolescents, and young adults are shown in Figure 10 below.

Figure 10. Common symptoms of type 1 diabetes

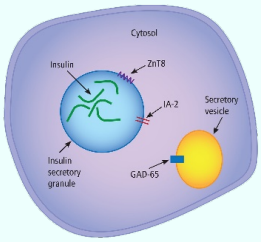


- In addition to the above clinical signs and symptoms, diagnose T1D by confirming the presence of hyperglycaemia and ≥2 islet-cell autoantibodies.

- ≥2 abnormal blood glucose tests:

1. Random blood glucose [RBG] level ≥11.1 mmol/l or 200 mg/dl
2. Fasting blood glucose [FBG] level ≥7.1 mmol/l or 126 mg/dl
3. Glycated haemoglobin [HbA1c] ≥6.5 % or 48 mmol/mol).

- In the presence of classical symptoms of hyperglycaemia, a single diagnostic test such as RBG test result of ≥11.1 mmol/L (200 mg/dL) is enough



Presence of ≥2 of these islet-cell autoantibodies:

1. Glutamic acid decarboxylase autoantibodies (GADA)
2. Insulinoma-associated-2 autoantibodies (IA-2A)
3. Zinc transporter-8 autoantibodies (ZnT8A)
4. Insulin autoantibodies (IAA) (before initiation of insulin)

Establishing a comprehensive management plan after diagnosing type 1 diabetes

- After confirming the diagnosis of T1DM, establish a comprehensive management plan that embraces a compassionate approach and a holistic understanding of the child or adolescent and his or her immediate family and other caregivers.
- Healthcare professionals should endeavour to keep the discussion about T1D as simple and honest as possible in a language that the family members and other caregivers can comprehend.
- Because of the complexity of the treatment of T1D as a condition, children, adolescents, and young adults with T1D plus their families and caregivers require continuous support and patient-centred diabetes education from a multi-disciplinary team of healthcare professionals to achieve optimal treatment outcomes.

Nutritional management in type 1 diabetes mellitus

- An appropriate and individualised nutritional management plan is integral in managing children, adolescents, and young adults with type 1 diabetes.
- A nutritionist with diabetes knowledge and training should be part of the multidisciplinary paediatric diabetes care team to provide essential nutrition education to the young person with diabetes, parents, caregivers, and family members.
- As part of healthy eating habits, a balanced diet composed of protein, carbohydrates, fat, dietary fibre, vitamins, and minerals is recommended for children, adolescents, and young adults with type 1 diabetes.

Insulin therapy in type 1 diabetes

- Because T1D is a progressive condition and most individuals have absolute insulin deficiency, insulin therapy is the mainstay of managing T1D.
- Children, adolescents, and young adults with T1D should be managed using multiple daily insulin injections (MDI) or a basal-bolus insulin regimen to achieve optimal and sustained glycaemic control.
- The basal bolus insulin regimen involves administering three pre-meal short-acting or rapid-acting insulin doses and a bedtime long-acting basal insulin dose or two pre-meal intermediate-acting insulin doses.
- The basal-bolus approach of insulin administration closely mimics the normal physiologic pattern of insulin secretion by the pancreatic beta-cells and is associated with better glycaemic control compared with using premixed insulin.
- The appropriate insulin dose for a child, adolescent, or young adult with T1D is dependent on several factors such as age, weight, pubertal stage, duration of diabetes, nutritional patterns, exercise patterns, menstrual cycles, intercurrent illness, and results of blood glucose and HbA1c.
- The recommended total daily insulin doses (TDD) for prepubertal, pubertal children and adolescents are 0.7-1.0 IU/kg/day, 1.0 IU/kg/day, and 2.0 IU/kg/day, respectively.
- For young individuals with T1D in a partial remission period or honeymoon period (characterised by a transient increase in beta-cell insulin secretion), the TDD is usually <0.5 IU/kg/day.
- After calculating the TDD, the prandial (pre-meal) insulin dose requirements are about 55-70% of the TDD, while the basal or long-acting insulin dose requirement is about 30-45% of the TDD.
- The insulin doses to be administered are dependent on the measured pre-meal blood glucose levels, the composition of the meal (especially the portion and type of carbohydrate to be ingested), and any planned physical activity.

Self-monitoring of blood glucose and glycaemic targets in type 1 diabetes

- All children, adolescents, and young adults with T1D should regularly monitor their blood glucose levels using a well-calibrated glucometer or continuous glucose monitoring (CGM) using CGM devices (if available and affordable).

- Monitor blood glucose levels 4-6 times a day
- The recommended target RBG and FBG levels are 4.0-10.0 mmol/l (70-180 mg/dl) and 4.0-7.0 mmol/l (70-126 mg/dl)

- Perform the glycated haemoglobin (HbA1c) test every three months
- The recommended target HbA1c for children, adolescents, and young adults with T1D is <7% (53 mmol/mol) without frequent hypoglycaemia and/or severe hypoglycaemia

CHAPTER 16: MANAGEMENT OF ACUTE AND CHRONIC COMPLICATIONS IN CHILDREN, ADOLESCENTS, AND YOUNG ADULTS WITH TYPE 1 DIABETES

HYPOGLYCAEMIA

- Hypoglycaemia, a common acute complication in individuals with T1D, is characterised by the presence of Whipple's triad, i.e.

1. Presence of signs and symptoms of hypoglycaemia
2. Low measured blood glucose concentration (blood glucose level ≤3.9 mmol/l or 70 mg/dl)
3. Resolution of the signs and symptoms after the correction of the low blood glucose concentration.

Risk factors of hypoglycaemia in young individuals with T1D

1. Excess insulin doses
2. Reduced food intake
3. Increased physical activity or exercise
4. Excess alcohol ingestion
5. Long duration of diabetes
6. Comorbidities such as coeliac disease, Addison's disease, and hypothyroidism.

- Because episodes of hypoglycaemia may occur at night, it is important to be aware of some of the clues of nocturnal hypoglycaemia in children, adolescents, and young adults with T1D such as inability to sleep or restless, moaning, sweating profusely, waking up with a fast heart rate, memory loss, and headache, sleepwalking, and having nightmares.

Management of hypoglycaemia in children, adolescents, and young adults with type 1 diabetes

- Diabetes education is important in the management of hypoglycaemia in children, adolescents, and young adults with type 1 diabetes.
- Diabetes education should focus on the recognition of precipitants and risk factors for hypoglycaemia, the ability to detect subtle symptoms, the importance of confirming low glucose levels by blood glucose monitoring, appropriate hypoglycaemia treatment, and how to prevent future hypoglycaemic events.
- The general rule for managing a hypoglycaemic episode is to give sugar in any available form immediately, such as sweets, glucose tablets or powder, sugar, honey (1 tablespoon), a glass (125 mls) of juice or soda (not diet soda).

Prevention of hypoglycaemic episodes

- One of the key strategies for preventing future and recurrent episodes of hypoglycaemia is providing regular structured diabetes education to the patients, parents, caregivers, peers, and community.
- Regular blood glucose monitoring is also important in preventing recurrent episodes of hypoglycaemia.

DIABETIC KETOACIDOSIS IN CHILDREN, ADOLESCENTS, AND YOUNG ADULTS WITH TYPE 1 DIABETES

- Diabetic ketoacidosis (DKA) is another common acute complication in young individuals with T1D.
- It develops due to an absolute or relative insulin deficiency with a concomitant increase in the circulating concentrations of the counter-regulatory hormones such as glucagon and epinephrine.
- It is characterised by the triad of:

1. Hyperglycaemia (blood glucose >11.0 mmol/l or 200 mg/dl)
2. Significant ketonemia or ketonuria (serum ketone concentrations >3.0 mmol/l or >2+ ketones on urine dipsticks)
3. Acidosis (serum bicarbonate concentration of <15 mmol/l and/or venous pH <7.3).

Diagnosis and clinical workup of a patient presenting with diabetic ketoacidosis

- The signs and symptoms of DKA are nonspecific and may mimic several infections, such as malaria, pneumonia, and gastroenteritis.
- Because of this, healthcare professionals should routinely perform fingerstick blood glucose measurement for children or adolescents presenting with unexplained reduced levels of consciousness, rapid breathing, abdominal pain, nausea, and vomiting without diarrhoea.

- The evaluation of a child or adolescent with DKA should involve:

1. Assessment for dehydration or volume depletion (to determine the severity of DKA)
2. Assessment of the level of consciousness
3. Measurement of weight (to guide treatment)
4. Measurement of blood glucose and ketone levels using glucometers or ketone blood or urine test strips.

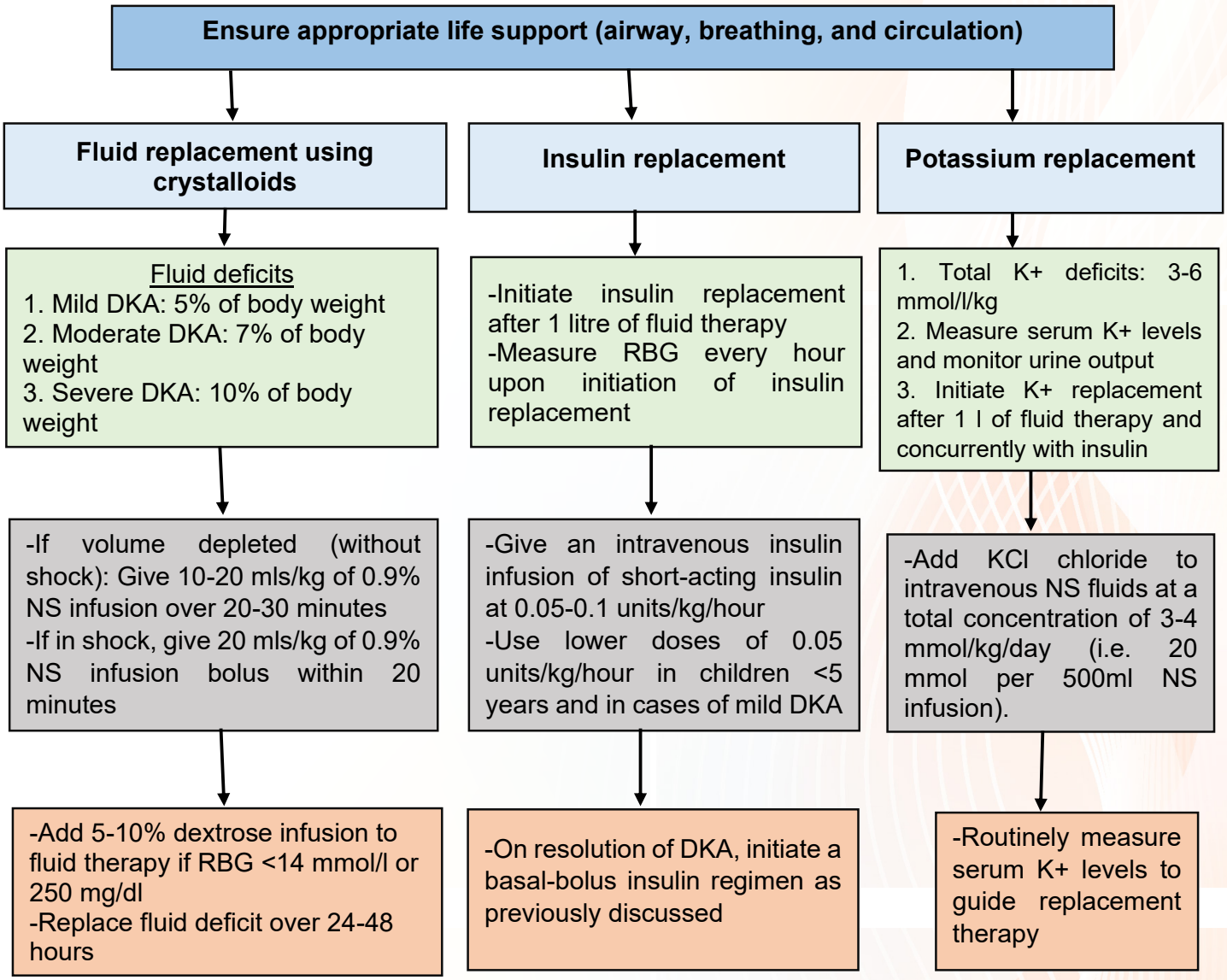
Management of diabetic ketoacidosis

- The goals of the management of DKA in children, adolescents, and young adults with T1D include:

1. Restoration of normal circulatory blood volume
2. Prevention and/or correction of prevalent electrolyte imbalances
3. Correction of acidosis and hyperglycaemia
4. Monitoring for complications associated with DKA
5. Addressing the underlying cause.

Figure 11 below summarises the management of diabetic ketoacidosis in children, adolescents, and young adults with type 1 diabetes.

Figure 11. Management of diabetic ketoacidosis in individuals with type 1 diabetes



CHRONIC MICROVASCULAR AND MACROVASCULAR DIABETES COMPLICATIONS IN CHILDREN, ADOLESCENTS, AND YOUNG ADULTS WITH TYPE 1 DIABETES

- Individuals with T1D can also develop chronic microvascular and macrovascular diabetes complications, leading to premature morbidity and mortality.
- These diabetes complications include diabetic neuropathy, diabetic retinopathy (DR), diabetic kidney disease (DKD), stroke, peripheral arterial disease (PAD), and cardiac disease.
- These complications are rarely clinically evident in childhood and adolescence.
- However, in cases where an individual was diagnosed with T1D at a young age or has had poor glycaemic control over a prolonged period, these complications can develop even in childhood and adolescence.
- Growth failure and pubertal delay are some of the early indicators of poor glycemic control and may indicate the onset of chronic diabetes complications.

Risk factors of diabetes complications in young individuals with T1D

1. Longer duration of diabetes
2. Increasing age
3. Puberty
4. Smoking
5. Dyslipidaemia
6. Co-existing hypertension
7. Obesity
8. Family history of cardiovascular disease (CVD).

- Table 16 below summarises how to screen, diagnose, and manage diabetes complications in individuals with type 1 diabetes.

Table 16. Screening, diagnosis, and management of diabetes complications in individuals with type 1 diabetes

DIABETES COMPLICATION	WHEN & HOW TO SCREEN	HOW TO DIAGNOSE	HOW TO MANAGE
Diabetic kidney disease (DKD)	-Screen for DKD at puberty or from age 11 years, whichever is earlier, with 2–5 years of diabetes duration, and repeat it annually thereafter -Measure urine albumin-creatinine ratio (UACR) and serum creatinine (calculate the estimated glomerular filtration rate or e-GFR)	UACR ≥3 mg/mmol (30 mg/g) NOTE: Confirm with a repeat test within 3-6 months	-Optimise blood glucose, blood pressure, and lipid control -Initiate ARB or ACEI therapy -Counsel women of childbearing age about the teratogenic potential of ACEI and ARB
Diabetic peripheral neuropathy	-Screen at puberty or from 11 years with 2-5 years of diabetes duration, and then repeat it annually. -Screening by performing: 1. A comprehensive foot examination (inspection, palpation of foot pulses, determination of proprioception, vibration, and monofilament sensation) 2. Assessment of symptoms of neuropathic pain.	-Presence of signs and symptoms of peripheral neuropathy	-Optimise blood glucose, blood pressure, and lipid control -Use drugs such as gabapentin, pregabalin, and carbamazepine
Diabetic retinopathy (DR)	-Screen at puberty or from age 11 years with 2 - 5 years of diabetes duration. -Screen using fundal photography or indirect ophthalmoscopy using a dilated slit lamp examination -Repeat screening every two years for those with diabetes duration of <10 years, mild nonproliferative DR (NPDR) and optimal glycaemic targets -Repeat screening every 3 years if no signs of DR -Screen every three months for 6-12 months in those with long-standing suboptimal glycaemic control and moderate to severe NPDR and proliferative DR	-Presence of features of DR such as microaneurysms, hard exudates, macular oedema, retinal haemorrhages, and neovascularisation	-Optimise blood glucose, blood pressure, and lipid control -Refer to an experienced ophthalmologist for specialised treatment
Hypertension	-Measure blood pressure at each clinic visit	-Blood pressure (BP) ≥ the 95th percentile for	-Lifestyle modification and ACEI or ARB & a

DIABETES COMPLICATION	WHEN & HOW TO SCREEN	HOW TO DIAGNOSE	HOW TO MANAGE
		age, sex, and height OR -Systolic BP ≥130 and/or diastolic BP ≥80 mmHg (for older adolescents)	long-acting CCB or a thiazide diuretic -Treat to a BP target <90th percentile for age, sex, and height
Dyslipidaemia	-Screen by performing a random lipid profile test and repeat it every three years if normal. -Screen from 11 years of age -Screen from as early as 2 years in the presence of a family history of either hypercholesterolemia or early cardiovascular death	LDLC ≥ 2.6 mmol/l, TC ≥ 5.0 mmol/l TGL ≥ 1.7 mmol/l	-Lifestyle management -Statin therapy in children aged >10 years if the lifestyle management fails to achieve the optimal LDL level. -The optimal LDL level is <2.6 mmol/l (100 mg/dl).

ACEI- Angiotensin converting enzyme inhibitors, ARB- Angiotensin II receptor blockers, CCB- Calcium channel blocker, LDLC- Low-density lipoprotein cholesterol, TC- Total cholesterol, TGL- Triglyceride

Additional commonly encountered complications in children, adolescents, and young adults with type 1 diabetes

- Type 1 diabetes is associated with several autoimmune conditions that should be screened for at diagnosis or initial clinical visit. These include:

1. Autoimmune thyroid dysfunction causing either hyperthyroidism or hypothyroidism
2. Coeliac disease (characterised by recurrent gastrointestinal symptoms, intolerance to gluten-containing foods, and micronutrient deficiencies)
3. Addison's disease (primary adrenal insufficiency)
4. Pernicious anaemia (vitamin B12 deficiency)
5. Autoimmune hepatitis

CHAPTER 17: MANAGEMENT OF HYPERGLYCEAMIA IN PREGNANCY

- The term hyperglycaemia in pregnancy (HIP) broadly encompasses all degrees of hyperglycaemia in pregnancy. These include:

1. Pre-existing or pre-gestational diabetes (diabetes known to exist before the index pregnancy).
2. Overt diabetes in pregnancy (DIP), which appears for the first time after the first trimester in an asymptomatic woman and may resolve following delivery in some women.
3. Gestational diabetes mellitus (GDM).

- Gestational diabetes mellitus constitutes the majority of cases of HIP (~90%) and is the milder form of HIP.

Maternal, foetal, and neonatal complications of hyperglycaemia in pregnancy

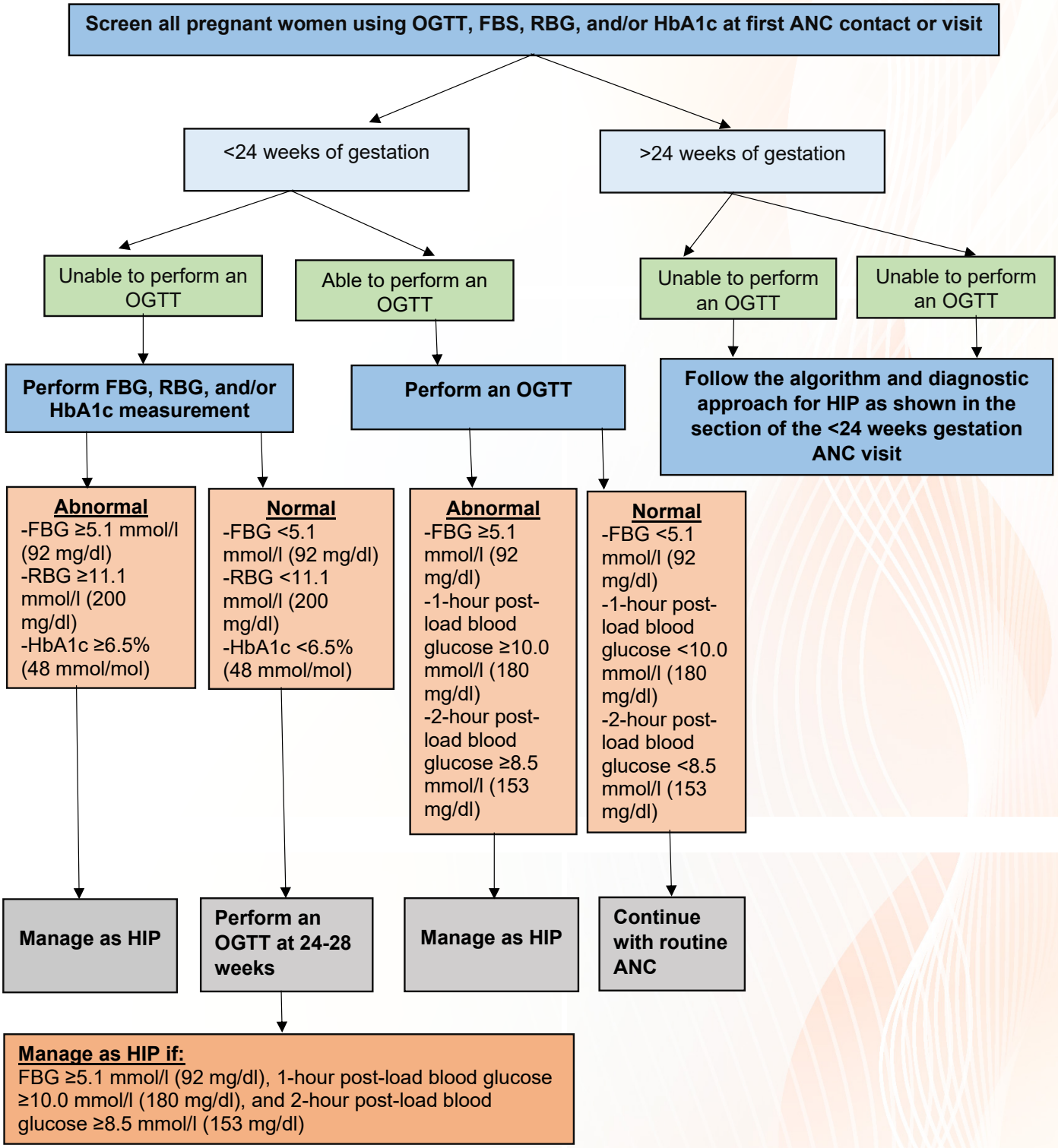
- Preeclampsia
- Gestational hypertension
- Polyhydramnios
- Instrumental delivery
- Caesarean delivery
- Traumatic labour or perineal tears
- Postpartum haemorrhage

- Stillbirth
- Neonatal death
- Preterm birth
- Congenital malformations
- Macrosomia
- Birth trauma
- Shoulder dystocia
- Hypoglycaemia
- Hyperbilirubinemia
- Respiratory distress syndrome

Screening and diagnosis of hyperglycaemia in pregnancy

- Screen HIP using the one-step approach as recommended by the International Association of Diabetes and Pregnancy Study Groups (IADPSG) and the World Health Organisation (WHO).
- It involves performing an oral glucose tolerance test (OGTT) using 75 grams of anhydrous glucose at any gestation age or 24-28 weeks of gestation.
- After a minimum of eight hours of overnight fasting, a fasting blood glucose (FBG) is measured, followed by measurement of blood glucose levels one and two hours later after ingestion of a 75-gram glucose solution (one- and two-hour post-load glucose levels).
- Based on current evidence, universal screening for HIP using the one-step approach is superior to the selective risk-based approach, which can miss over 30% of women with HIP.
- Figure 12 below summarises the screening and diagnostic algorithm for hyperglycaemia in pregnancy.

Figure 12. Screening and diagnosing hyperglycaemia in pregnancy



ANC: Antenatal care, FBG: Fasting blood glucose, HbA1c: Glycated haemoglobin, HIP: Hyperglycaemia in pregnancy, OGTT: Oral glucose tolerance test, RBG: Random blood glucose

GESTATIONAL DIABETES
Management of gestational diabetes mellitus

- Initiate early management of GDM with lifestyle behavioural modification and/or pharmacological agents to reduce the risk of adverse foetal and neonatal outcomes.
- Lifestyle behavioural modification is the first-line approach for managing GDM.

Recommend

1. A balanced diet of high-fibre carbohydrates, protein, unsaturated fat

2. Physical activity (30 minutes of moderate-intensity physical activity at least 5 days/week or a minimum of 150 minutes/week)

- Pharmacological management is recommended in women who are unable to attain optimal glycaemic control with lifestyle behavioural modification measures.

- Insulin is recommended as the first-line agent for managing GDM
- Initiate insulin therapy at a dose of 0.7-1.0 units/kg/day using the basal-bolus insulin regimen, preferably (3 pre-meal short-acting or rapidly acting insulin doses and 1 bedtime long-acting insulin dose)
- Metformin can be used as the second-line mode of management of GDM in women who refuse insulin or cannot access insulin

Caution

Avoid using sulfonylureas because they cross the placenta and are associated with an increased risk of neonatal hypoglycaemia, macrosomia, and adiposity (increased neonatal abdominal circumference)

Glycaemic targets

- Women with GDM should be optimally managed to achieve these glycaemic targets:

1. FBG <5.3 mmol/l (95 mg/dl) and either
2. One-hour postprandial blood glucose level <7.8 mmol/l (140 mg/dl) or two-hour postprandial blood glucose level <6.7 mmol/l (120 mg/dl).

Foetal surveillance and timing of delivery of women diagnosed with gestational diabetes mellitus

- Assess the well-being of the foetus by assessing foetal growth (estimated foetal weight percentile growth) and biophysical profile with foetal Doppler velocimetry studies to assess the umbilical blood flow.
- Perform a first-trimester ultrasound scan done at 11 -14 weeks of gestation in all women with GDM to assess foetal viability, number of foetuses, pregnancy dating, and identification of major congenital anomalies.
- Plan to deliver women with GDM who are well-controlled on diet between 39 weeks and <41 weeks of gestation.
- Plan to deliver women with GDM who are well-controlled on medication between 39+0 – 39+6 weeks of gestation.
- Individualise the mode of delivery for women with GDM who are poorly controlled on diet and medicines because there is a lack of clinical evidence to guide the decision of when to plan the delivery.
- Plan an early delivery between 36+0 – 38+6 weeks of gestation in cases of suboptimal glycemic control and the presence of comorbidities such as preeclampsia, and a history of in-utero foetal death.

Long-term management of women with gestational diabetes mellitus

- Women with a history of GDM have a 50-60% lifetime risk of diabetes and an almost ten-fold increased risk of developing type 2 diabetes when compared with women who were normoglycaemic during pregnancy.
- Because of this evidence, repeat an OGTT between 6-12 weeks postpartum and perform lifetime screening for diabetes every 1-3 years using either FBG, HbA1c, or OGTT in all women with a history of GDM.

PRE-GESTATIONAL OR PRE-EXISTING DIABETES

- Pre-gestational diabetes, which constitutes type 1 and type 2 diabetes and other forms of diabetes present before pregnancy, accounts for ~10% of cases of HIP.
- Women with type 1 and 2 diabetes should receive preconception counselling, underscoring the need to achieve optimal glycaemic control.
- This is essential in reducing the risk of congenital anomalies and obstetric complications such as pre-eclampsia and intrauterine foetal death.
- Counsel women with type 1 and type 2 diabetes about the risk of diabetic ketoacidosis and new-onset diabetic retinopathy in pregnancy.
- Screen all women with type 1 and type 2 diabetes for diabetic retinopathy before conception and in the first trimester, and repeat the screening 3-12 months later, depending on its severity.

Management of pre-gestational diabetes

Recommend

1. A balanced diet of high-fibre carbohydrates, protein, unsaturated fat

2. Physical activity (30 minutes of moderate-intensity physical activity at least 5 days/ week or a minimum of 150 minutes/week)

Insulin therapy

- Insulin is recommended as the first-line agent using a basal-bolus insulin regimen, preferably
- Initiate with total daily insulin doses in the first, second, and third trimesters of 0.7-0.8 units/kg/day, 0.8-1.0 units/kg/day, and 0.9-1.2 units/kg/day, respectively.
- Metformin can be used as the second-line therapy or an add-on therapy if optimal glycaemic targets are not achieved.
- Start aspirin 150mg once daily from 12–16 weeks of gestation to reduce the risk of preeclampsia.
- Avoid using sulfonylureas, dipeptidyl peptidase 4 inhibitors, sodium-glucose cotransporter 2 inhibitors, thiazolidinediones, and injectable glucagon-like peptide 1 agonists in pregnancy due to a lack of evidence about their safety when used in pregnancy.

Foetal monitoring, surveillance, and timing of delivery of women with pre-gestational diabetes

- Perform a 1st-trimester ultrasound scan at 11-14 weeks of gestation to assess foetal viability, gestation dating, and prenatal aneuploidy.
- Perform a detailed anatomical scan at 18-24 weeks to detect any foetal anomalies, followed by regular obstetric ultrasound scans performed every four weeks from 28-36 weeks.
- Perform biophysical profiles from 28-32 weeks of gestation and repeat every 2-4 weeks till delivery.
- In the case of foetal macrosomia (estimated foetal weight ≥4.5 kg) on ultrasound scan, consider caesarian delivery to avert related complications such as birth trauma, vaginal tears, shoulder dystocia, and obstructed labour.
- Plan delivery between 36 weeks and <37 weeks of gestation for women with diabetes complications (diabetic nephropathy, macrovascular complications, suboptimal glycaemic control, and history of intrauterine foetal death)
- Plan delivery at 39 weeks for women well controlled by lifestyle intervention and medicine.
- Avoid planning deliveries after 40 weeks of gestation.

Post-delivery care of the baby and women with hyperglycaemia in pregnancy

- Closely monitor all babies of women with HIP for neonatal hypoglycaemia for at least 24 hours post-delivery.
- Encourage mothers to initiate breastfeeding immediately following delivery.
- Thoroughly examine babies of women with HIP before discharge from the hospital for any congenital anomalies and hyperbilirubinemia.

Postpartum care of women with hyperglycaemia in pregnancy

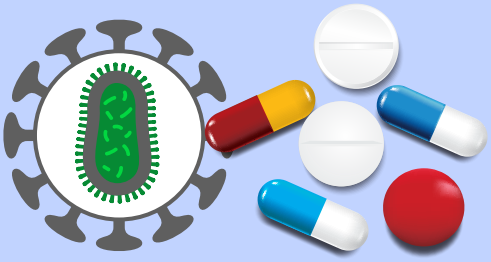
- Counsel all women with HIP about the need to use safe, effective contraceptive methods to avoid unplanned pregnancies.
- Counsel all women with HIP to plan future pregnancies when glycaemic control is optimal (HbA1c <6.5% or 48 mmol/mol).
- For women with a prior diagnosis of GDM, measure the FBG level at 6-12 weeks post-delivery to diagnose postpartum diabetes, followed by lifelong screening for type 2 diabetes by FBG, RBG, and/or HbA1c measurement every 1-3 years.
- For women with a history of GDM and a clinical phenotype signifying an increased risk of developing type 1 diabetes, the screening can be performed every 1-3 years for 7-10 years.

CHAPTER 18: MANAGEMENT OF DIABETES - HIV AND TUBERCULOSIS COMORBIDITY

TYPE 2 DIABETES AND HIV COMORBIDITY

- Globally, there is a steadily growing dual burden of non-communicable diseases such as diabetes and infectious diseases such as HIV and tuberculosis (TB).
- Generally, type 2 diabetes and related cardiometabolic disorders such as prediabetes, dyslipidaemia, obesity, and hypertension are very common in individuals living with HIV.
- Because of this, proactively screening, monitoring, and optimally managing these chronic metabolic conditions in individuals living with HIV is recommended.

EFFECT OF HIV AND ANTIRETROVIRAL THERAPY ON GLUCOSE METABOLISM



An increased risk of new-onset type 2 diabetes with specific antiretroviral therapies such as protease inhibitors, integrase strand transfer inhibitors such as dolutegravir, and non-nucleoside reverse transcriptase inhibitors such as efavirenz

Comprehensive evaluation, monitoring, and management of an individual with HIV and diabetes comorbidity

Comprehensive evaluation, monitoring, and management of an individual with HIV and diabetes comorbidity

Screen all individuals living with HIV for type 2 diabetes and related cardiovascular risk factors such as hypertension and dyslipidaemia before the initiation of antiretroviral therapy (ART) and while on ART.

Screen all individuals living with HIV for type 2 diabetes every six months

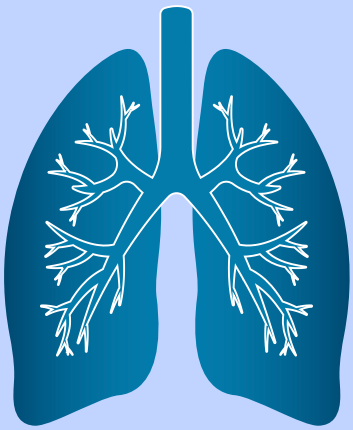
- Recommend lifestyle interventions such as healthy diets, weight management, and increased physical activity
- Use metabolically neutral nucleoside reverse transcriptase inhibitors such as abacavir, tenofovir, emtricitabine, and lamivudine, and PIs such as darunavir and atazanavir
- Avoid dolutegravir in individuals with diabetes and HIV comorbidity
- Initiate statin therapy in individuals living with HIV and low- to moderate-risk of cardiovascular disease (CVD) to reduce the rates of CVD

DIABETES AND TUBERCULOSIS COMORBIDITY

- Compelling evidence shows that diabetes increases the odds of developing tuberculosis (TB) by three times.
- In a bidirectional relationship, diabetes and TB directly affect each other's clinical presentation and treatment outcomes of TB.

Screening and diagnosis of diabetes and tuberculosis comorbidity

- Because of the close interaction between diabetes and TB, the International Union against TB and Lung Disease (The Union) recommends bidirectional screening and integrated management of DM and TB to improve early diagnosis, optimal management, and treatment outcomes.



- Screen for TB in individuals with diabetes using:
  1. Sputum-smear microscopy
  2. WHO-approved rapid molecular tests such as Gene Xpert
  3. Chest radiograph

- Screen at the time of diagnosis or on presentation with symptoms of TB

Screen for diabetes in individuals with tuberculosis (TB) by measuring random blood glucose (RBG) levels initially followed by the measurement of either the fasting blood glucose (preferably) or glycated haemoglobin levels if the RBG level is ≥6.1 mmol/l

Screen for diabetes at diagnosis of TB or first clinical encounter

Management of diabetes in individuals with tuberculosis

- The management of diabetes in individuals with TB should be individualised.
- Because rifampicin is a potent inducer of cytochrome P450 enzymes, it reduces the plasma concentrations of most oral glucose-lowering therapies such as metformin, sulfonylureas, and DPP-IV inhibitors by 30-80%.
- Because of this, dose adjustment of most oral glucose-lowering therapies will be required.

Start insulin therapy as the first-line diabetes therapy in individuals with TB and severe hyperglycaemia (HbA1c ≥10.0% or 86 mmol/mol, FBG ≥14.0 mmol/l or 250 mg/dl, and RBG ≥16.7 mmol/l or 300 mg/dl)

In individuals with TB and mild to moderate hyperglycaemia (RBG <16.7 mmol/l or FBG <14.0 mmol/l) and BMI<25 kg/m2, start oral agents such as sulfonylureas and dipeptidyl peptidase IV (DPP-IV) inhibitors as first-line

Use metformin as the first-line agent in obese or overweight --individuals with TB and mild to moderate hyperglycaemia

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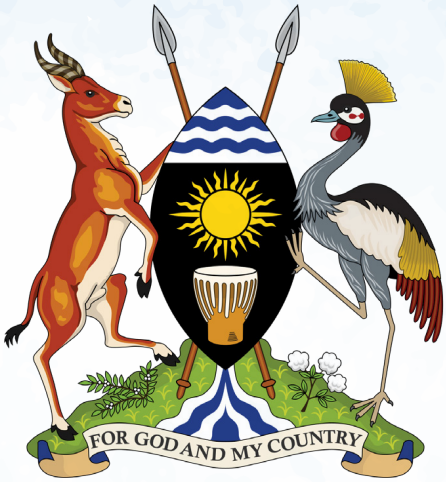

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