



REPUBLIC OF KENYA

MINISTRY OF HEALTH

National Clinical Guidelines on Management of Diabetes Mellitus

2024



Third Edition.



Published by:
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Citation: Ministry of Health, Division of Non-communicable Diseases. National Clinical Guidelines on Management of Diabetes Mellitus, 2023 Edition. Nairobi, Kenya: DNCD, August 2023.



NATIONAL CLINICAL GUIDELINES ON MANAGEMENT OF DIABETES MELLITUS

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LIST OF ABBREVIATIONS

ACEI	Angiotensin converting enzyme- inhibitors
ACR	Albumin creatinine ratio
ACS	Acute coronary syndrome
ADA	American Diabetes Association
AGI	Alpha glucosidase inhibitors
AKI	Acute kidney injury
ARB	Angiotensin receptor blockers
ASCVD	Atherosclerotic cardiovascular disease
AVPU	Alert, verbal, pain, unresponsive
BCC	Behaviour Change Communication
BDI	Becks Depression Inventory
BG	Blood glucose
BGM	Blood glucose monitoring
BMI	Body Mass Index
BP	Blood pressure
CABG	Coronary artery bypass grafting
CAD	Coronary artery disease
CCB	Calcium channel blockers
CES-D	Center for Epidemiologic Studies Depression
CGM	Continuous glucose monitoring
CHA	Community Health Assistants
CHAI	Clinton Health Access Initiative
CHEW	Community Health Extension Workers
CHP	Community Health Promoters
CKD	Chronic kidney disease
COVID-19	Coronavirus disease 2019
CS	Caesarian section
CVD	Cardiovascular disease
CXR	Chest-Xray
5% D	5% dextrose
D50	50% dextrose
DASH	Dietary approaches to stop hypertension
DKA	Diabetes ketoacidosis
DNS	Dextrose normal saline
DP	Dorsalis pedis
DPP-4-I	Dipeptidyl peptidase- 4 inhibitor
DSME	Diabetes self-management education
ECG	Electrocardiogram
EGFR	Estimated glomerular filtration rate
HDL	High density lipoprotein
FBS/FBG	Fasting blood sugar/ glucose
FCDRR	Facility Consumption Data Record and Request
FPG	Fasting plasma glucose
FRII	Fixed rate insulin infusion
GC	Glucocorticoids
GCS	Glasgow coma scale
GDM	Gestational Diabetes Mellitus
GFR	Glomerular filtration rate
GI	Gastrointestinal
GLP1-RA	Glucagon like peptide 1- receptor agonists
HAART	Highly active anti-retroviral therapy

LIST OF ABBREVIATIONS

HADS	Hospital Anxiety and Depression
HBAIC/AIC	Glycosylated Hemoglobin
HF	Heart failure
HHNK	Hyperosmolar hyperglycemic non- ketotic state
HHS	Hyperosmolar hyperglycemic state
HIV	Human Immuno-deficiency virus
ICR	Insulin carbohydrate ratio
IDF	International Diabetes Federation
IEC	Information Education and Communication
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
IIEF-5	International Index of Erectile Function
ISF	Insulin sensitivity factor
IV	Intravenous
IVF	Intravenous Fluids
K	Potassium
KCL	Potassium chloride
KDSG	Kenya Diabetes Study Group
KHHSP	Kenya Health Sector Strategic Plan
LAA	Long-acting analog
LDL	Low density lipoprotein
LFT	Liver function tests
LMWH	Low molecular weight heparin
LOPS	Loss of protective sensation
MDI	Multiple dose injections
MNT	Medical nutrition therapy
MOH	Ministry of Health
MSU	Mid-stream urine
NACADA	National Authority for the Campaign Against Alcohol and Drug Abuse
NCD	Non Communicable Diseases
NGT	Nasogastric tube
NPH	Neutral protamine hagedorn
NPO	Nil per oral
NS	Normal saline
NSAIDS	Nonsteroidal anti- inflammatory drugs
OGLA	Oral glucose lowering agents
OGTT	Oral glucose tolerance test
PAD	Peripheral artery disease
PCOS	Polycystic ovarian syndrome
PESK	Paedtric Endocrine Society of Kenya
PHC	Primary Health Care
PHQ-9	Patient Health Questionnaire-9
PI	Protease inhibitors
PN	Parenteral nutrition
PT	Posterior tibial
RAA	Rapid acting analogs
RBS	Random blood sugar
SAI	Short acting insulin
SC	Subcutaneous
SDG KHHSP UHC	Sustainable Development Goal
SGLT-2I	Sodium glucose transporter- 2 Inhibitors
SIHG	Steroid induced hyperglycemia

LIST OF ABBREVIATIONS

SOP	Standard Operating Procedures
SU	Sulphonylurea
T1DM/T1D	Type 1 Diabetes mellitus
T2DM/T2D	Type 2 Diabetes mellitus
TB	Tuberculosis
TDD	Total daily dose
TG	Triglyceride
TIA	Transient ischemic activity
TIR	Time in range
TPN	Total parenteral nutrition
TWG	National Technical Working Group
TZD	Thiazolidinedione
UEC	Urea, electrolytes, creatinine
UHC	Universal Health Coverage
URAA	Ultra- rapid acting analogs
VRII	Variable rate insulin infusion
WHO	World Health Organization

FOREWORD

The burden of non-communicable disease (NCDs) is on the rise globally, as well as in Kenya. Locally, this rise is largely explained by the demographic and epidemiological transition, whereby an increasingly ageing and urbanizing population witnesses a public health shift from predominantly ill-health due to infectious agents to NCDs and injuries. There is a notable rise in type 1 diabetes in children and adolescents in sub-Saharan Africa. Nevertheless, type 1 diabetes remains under diagnosed and misdiagnosed because it mimics other common childhood illnesses.

In response to the intricate dynamics of demographic shifts and epidemiological transitions, the Ministry of Health in Kenya has taken commendable steps to address the rising incidence of diabetes and other NCDs. This commitment goes beyond a reaction to a health challenge; it represents a strategic response deeply rooted in global health goals and national policies.

The development of the National Clinical Guidelines for the Management of Diabetes Mellitus 2024 marks a pivotal moment in Kenya's ongoing health sector reforms. These guidelines are more than just documents; they embody a standardized approach to diabetes management, guiding healthcare providers in screening, diagnosing, and managing individuals with diabetes.

The significance of these guidelines extends beyond the immediate challenges of diabetes. They play a crucial role in realizing Universal Health Coverage (UHC), a key priority for the Ministry of Health. Emphasizing quality, equity, and financial protection, these guidelines ensure the delivery of quality healthcare services to the population.

As the healthcare system shifts towards primary health care (PHC), these guidelines become indispensable tools, essential for achieving UHC and bringing healthcare services closer to the people where they live and work. The guidelines are strategically aligned with national policies, including the Kenya Health Policy 2012–2030, and the NCD strategic plan 2021-2026. It reflects Kenya's commitment to global health efforts, as evidenced by partnerships and pledges during the United Nations High-Level meetings on NCDs in 2011, 2014, and 2018.

These guidelines serve as a lifeline for those living with diabetes, setting the standard for care and emphasizing the rights of access and quality for patients. To realize their desired impact, a collective effort is crucial, involving dissemination, synthesis into job aids, targeted training, a robust referral strategy, and investment in health products and technologies.

Recognizing the complexity of managing NCDs, the Ministry of Health emphasizes the importance of a broad partnership involving public and private sectors, academia, professional associations, patients' groups, and non-state actors in developing, disseminating, and implementing these guidelines.

In conclusion, effective diabetes management requires a collective endeavor involving the commitment of healthcare providers, stakeholders, and the community at large. These guidelines epitomize that commitment, providing a roadmap towards a healthier and more resilient Kenya.



Dr Patrick Amoth, EBS

AG. DIRECTOR GENERAL FOR HEALTH

ACKNOWLEDGEMENTS

The development of these diabetes guidelines was a collaboration effort between the Ministry of Health, Kenya Diabetes Study Group (KDSG), Paediatric Endocrinology Society of Kenya (PESK) and the National Technical Working Group (TWG) on diabetes. The process involved expert consultations, technical workshops, external peer review and validation. The Ministry of Health wishes to thank all the teams and institutions that were involved in the various stages of the development of these guidelines. In particular way, we wish to thank the KDSG for their efforts to develop the first versions of the guidelines and providing expert advisory on the development and structure of the guidelines. We thank the Division of Non-communicable Diseases for providing the support as the secretariat in the development of the guidelines and organizing the technical development and review workshops. We thank the diabetes TWG for their input during the organization and review of the protocols included in the guidelines. We thank Novo Nordisk and the Clinton Health Access Initiative (CHAI) for their support for the guidelines development.

We call upon all the stakeholders involved in the development of the guidelines to continue collaborating with the Ministry of Health in their dissemination as well as implementation.



Dr Issak Bashir

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EXECUTIVE SUMMARY

The diabetes guidelines 2024 are structured in the form of protocols and algorithms on various priority topics in diabetes management especially at primary health care level. The guideline is divided into four main chapters, as outlines below:

Chapter One (Introduction): this chapter includes various sub-sections: Definition, classification, epidemiology, risk factors, prevention, clinical presentation, and components of diabetes management.

Chapter Two (Outpatient protocols): this chapter includes the following sub-sections: Screening for diabetes, differences between type 1 and 2 diabetes, diagnostic cascades and treatment planning, Initial management and referrals, medical management of type 2 diabetes, physical activity guidelines in diabetes, insulin therapy, medical management of type 1 diabetes, continuing care for diabetes, sick day rules and admission criteria, criteria for referral, diabetes complications: CVD, nephropathy, neuropathy, diabetic foot, retinopathy, erectile dysfunction, oral health, DM and Ramadan, diabetes and comorbidities: hypertension, HIV, TB, pregnancy, mental health, and targets in DM (glycemic and non-glycemic).

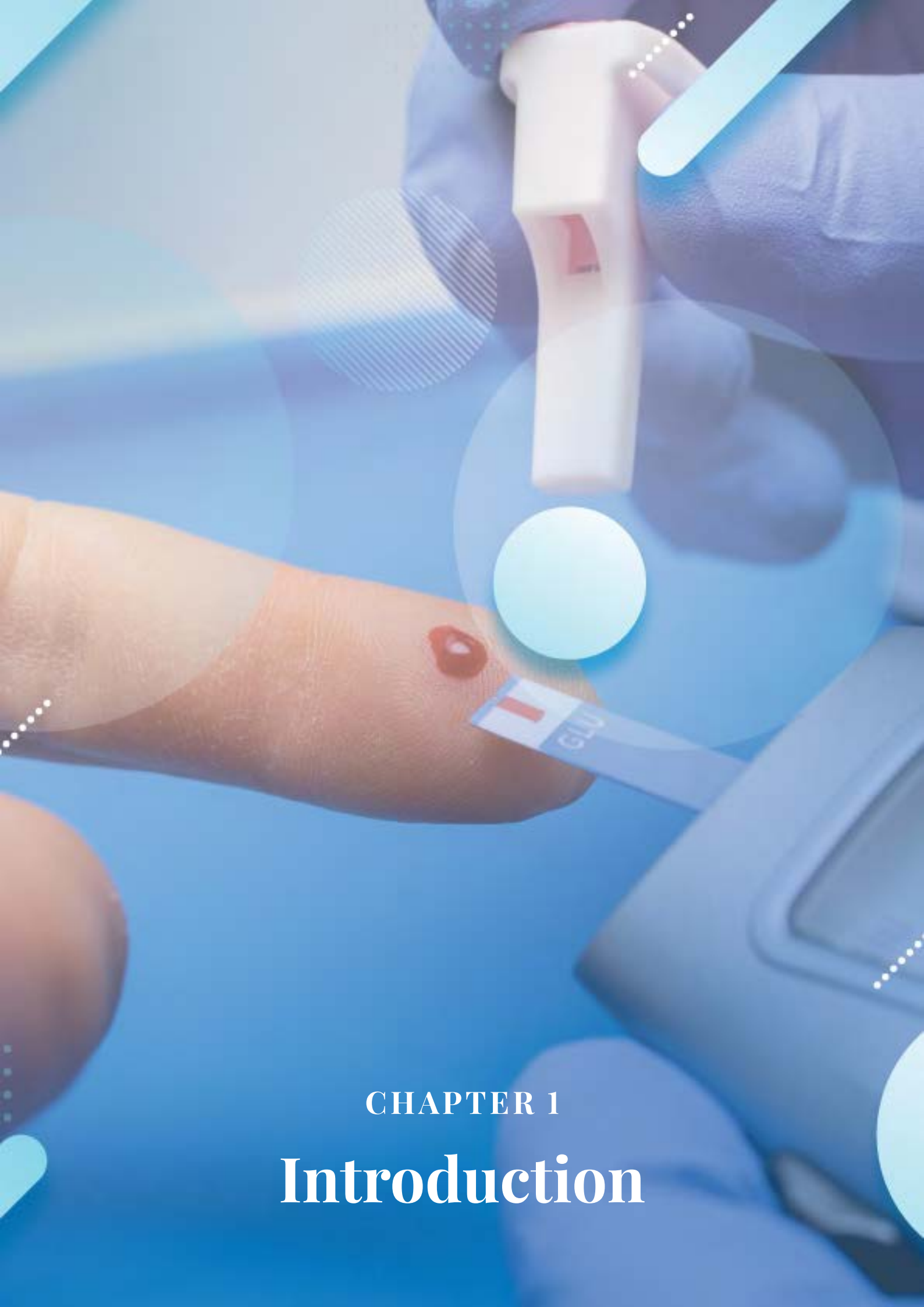
Chapter Three: Management of Diabetes in Childhood and Adolescence: this chapter includes definition of type 1 diabetes, criteria for diagnosis and risk factors, DKA management, insulin therapy, ambulatory Care, management of type 1 diabetes in special circumstances, diabetes in school, diabetes and exercise, structured diabetes education, nutrition in type 1 diabetes, long term complications in type 1 diabetes, hypoglycaemia management, neonatal hyperglycemia and growth monitoring in type 1 diabetes.

Chapter Four (Inpatient protocols): this includes hypoglycemia management, peri-partum management of DM, pre-operative management of diabetes, intra-operative management of diabetes, in-patient management of hyperglycemia: non-critical care and critical care, DKA management, hyperglycemic hyperosmolar state (HHS) management and management of steroid induced hyperglycemia.

Chapter Five (Annexes): included here are examples of sub-cutaneous insulin regimens, monitoring, and evaluation (data tools and reporting), Key indicators, data flow, and the cardiovascular risk calculator from the World Health Organization.



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CHAPTER 1

Introduction

INTRODUCTION

The objective of this diagnosis and treatment guideline is to provide the target audience with evidence-based recommendations for the treatment of diabetes. This guideline is in line with the vision of the National non-communicable disease (NCD) program which envisions a reduction by a third the premature deaths due to diabetes in Kenya by 2030. This diabetes guideline will provide a structural framework that involves: - a comprehensive package of intervention which will include, identification and testing of individuals who are at risk of developing diabetes, offering them the right diagnostic options, delivering effective and safe treatment to those with diabetes, and lastly monitoring and evaluating the process. The guideline will also be used as a reference to guide the screening, diagnosis, treatment, monitoring, and evaluation of diabetes in the Country. In the 3rd revision of the national guidelines, emphasis has been laid on:

- Patient centred care
- Provision of comprehensive care possible at that level of health care
- Multidisciplinary care

Target Audience

These guidelines are intended for:

- All healthcare workers in the public and private sector.
- Public health and policy specialists working in hospitals, research institutions, medical schools, non-governmental organisations, and agencies; working as partners in health or diabetes control.
- County and sub county managers responsible for planning, training, implementing, and monitoring service delivery.

Table 1: Essential package of Care for a Patient Living with Diabetes

HEALTH CARE TIER	PERSONNEL	SERVICES OFFERED	MATERIAL AND EQUIPMENT
Community Service	Community Health Promoters (CHP) Community Health Assistants (CHA) Trained health personnel Nutritionists	• Distribution of IEC materials • Health promotion and behaviour change communication (BCC) • Community mobilisation • Screening and outreach • Home based and palliative care; home blood glucose monitoring • Community Health Information Systems • Contact tracing and defaulter tracing • Support groups establishment • Referral and linkages	• Glucometer and Strips • Referral forms data collection tools
Dispensary and Health Centre (Primary Care Service)	Nurse Clinical Officer Medical Laboratory Personnel Medical Officer Nutritionist/dietician Pharmacy Personnel	• Distribution of IEC materials • Health promotion and behaviour change communication (BCC) • Screening for diabetes, hypertension and TB • Centre for in- and outreach screening services • Diagnosis and management of uncomplicated diabetes and hypertension • Initiation of 1st line diabetes medication for uncomplicated DM • Nutritional assessment and counselling • Referral for diabetes related complication • Follow-up care • Palliative care • Diabetes data collection	• Glucometer and strips • Urine strips and reader • HbA1C test • Serum Creatinine • BP Machine • Weighing scale and height meters • Diabetes Registers • FCDRR (Facility Consumption Data Report Request) • Monthly Summary Tools • Referral forms • Medication (As per Kenya Essential Medicine List)
County Referral Service (Primary Referral Services)	Specialists** Diabetes educators CHEW Nurse Clinical Officer Nutritionist Medical Officer Pharmacy personnel Medical lab Personnel	• Distribution of IEC materials • Health promotion and behaviour change communication (BCC) • Screening for diabetes and Comorbidities/complications • Diagnosis of diabetes and hypertension • Initiation of diabetes and hypertension treatment and follow-up, including second-line therapy, insulin and comorbidity management • Inpatient care	• Glucometer and strips • ECGs • Lipid analyser • Blood count machine • BP machine • HbA1C, UECs, LFTs, • Urine ACR • Diabetes Registers • FCDRR • Monthly Summary Tools

County Referral Service (Primary Referral Services)	Specialists** Diabetes educators CHEW Nurse Clinical Officer Nutritionist Medical Officer Pharmacy personnel Medical lab Personnel	• Nutritional assessment and counselling • Diabetic foot assessment and management • Referral for special conditions e.g. cardiac complications • Palliative care • Coordination/M&E • Research • Diabetes data collection and reporting	
National Referral Services (Tertiary Referral Services)	Specialists** Diabetes educators CHEW Nurse Clinical Officer Nutritionist Medical Officer Pharmacy personnel Medical lab Personnel Paediatricians Paediatric diabetes educators	Same as County Referral Services plus - Management of severe complications	• Glucometer and strips • ECGs • Lipid analyser • Blood count machine • BP machine • Echocardiogram • Stress test • HbA1C • Diabetes Registers • Diabetes FCDRR • Monthly Summary Tools

**Specialists could include Diabetologists, physicians, family physicians, ophthalmologists, psychiatrists, paediatricians and paediatric diabetes educators

FCDRR- Facility consumption data record and request

BACKGROUND

1.1 Definition

Diabetes mellitus is a chronic metabolic disorder characterized by sustained elevated blood glucose (hyperglycemia) resulting from defects in insulin secretion, action, or both. Diabetes, if not well controlled, it leads to serious complications, resulting in multiple diseases or disorders that affects multiple body organs resulting to increased morbidity and premature death.

1.2 Epidemiology and global burden of diabetes

The prevalence of diabetes in Kenya was estimated to be 3.1% in 2019 and is projected to rise to 4.4% by 2035. The STEPwise survey 2015 reported that more than 88% (male 88%, women 87%) of Kenyans have never had their blood sugar tested, leading to late diagnosis of diabetes. The same survey revealed an estimated 60% of Kenyans with T2DM are undiagnosed. This late diagnosis contributes to the high morbidity and mortality burden, which occurs at a younger age before the age of 60 with IDF estimating that 88.4% of Kenyans below age 60 years die due to the disease.

1.3 Aetio-pathology of diabetes

The underlying characteristic common to all forms of diabetes is the dysfunction or destruction of pancreatic beta-cells. These cells are not replaced, as the human pancreas seems incapable of renewing beta-cells after the age of 30 years. Many mechanisms can lead to a decline in function or the complete destruction of beta-cells. These mechanisms include genetic predisposition and abnormalities, epigenetic processes, insulin resistance, auto-immunity, concurrent illnesses, inflammation, and environmental factors.

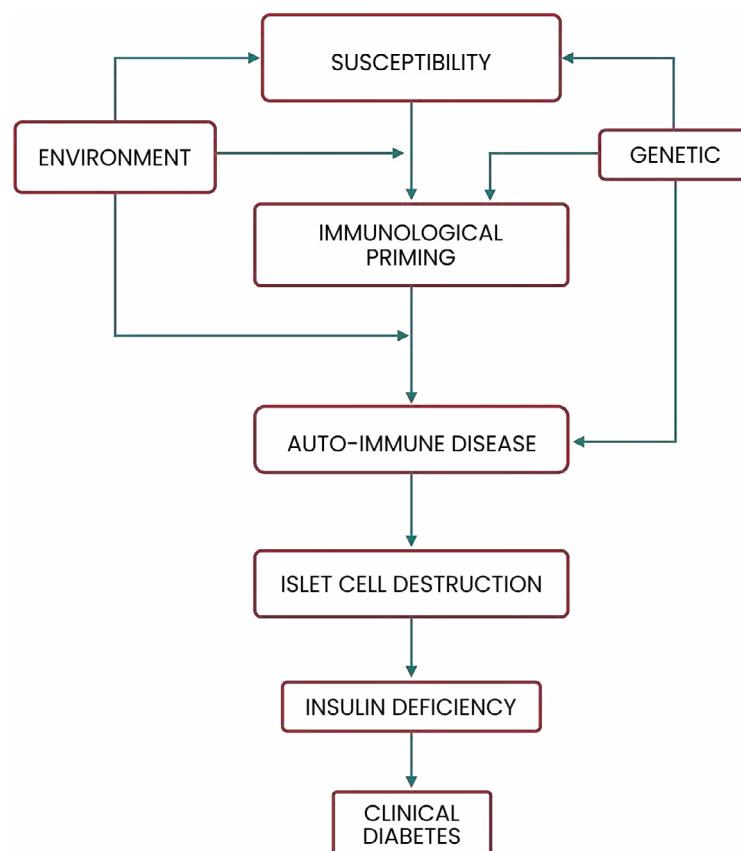


Figure 1: Mechanisms for development of type 1 diabetes

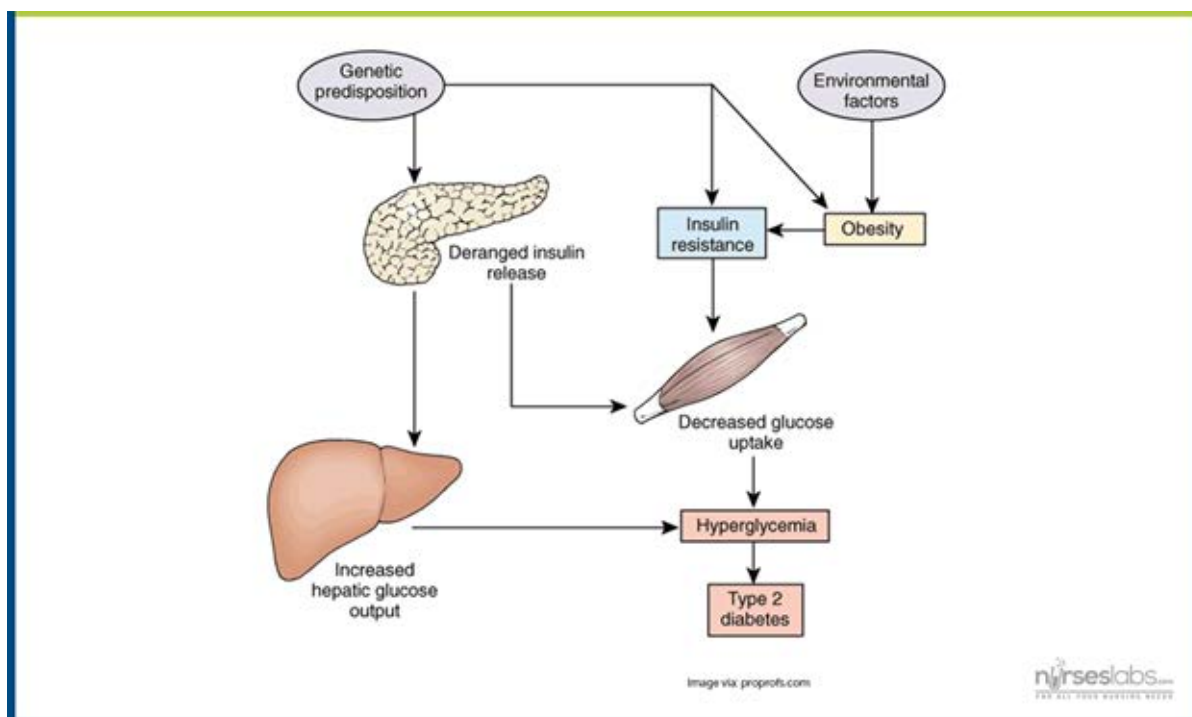


Figure 2: Pathophysiology of type 2 DM

1.4 Classification of Diabetes

There are four categories of diabetes according to WHO and are based on the aetiology as follows:

Table 2: Categories of diabetes

TYPE	CHARACTERISTICS
Type 1 Diabetes	- Occurs because of autoimmune destruction of the pancreatic beta cells leading to absolute insulin deficiency. Insulin is required for survival. - Usually presents in childhood, adolescence, and young adults
Type 2 Diabetes	- Characterized by progressive loss of b-cell insulin secretion frequently on the background of insulin resistance. - It is the most common type of diabetes.
Gestational Diabetes	- Diabetes diagnosed in the second or third trimester in a woman who was previously not known to have diabetes. - It is often asymptomatic and must be screened for. - Associated with poor pregnancy outcomes, especially if unrecognized and untreated. - It usually resolves after delivery.
Other types	- These are less common and include genetic disorders (including MODY), infections, and diseases of the exocrine pancreas (pancreatitis, pancreatic cancer), - endocrinopathies (thyrotoxicosis, Cushing's syndrome, acromegaly). - As a result of drugs (corticosteroids, anti-psychotics, HAART.)

1.5 Risk Factors

In view of the significant rise in the prevalence of Diabetes in Kenya, its well-recognized morbidity, premature mortality and increasing health costs, awareness of its risk factors is an important step towards its control and prevention.

Table 3: Risk factors for diabetes

TYPE 1	TYPE 2 DIABETES	GESTATIONAL (GDM)
HLA Type	Overweight and Obesity	Previous history of GDM
	Physical inactivity	Family history of a first degree relative with T2DM
	Unhealthy diets	Maternal age over 35
	Diabetes in first degree relative	Overweight or Obese
	History of gestational diabetes	Previous poor obstetric history
	Cardiovascular disease and its risk factors	Glycosuria at first prenatal visit
	Ethnicity (African, Asian)	Multiple gestation
	Polycystic Ovarian Syndrome	
	Dyslipidemia (raised triglycerides and/or low HDL-cholesterol)	
	Hypertension	
	Age over 40 years	
	History of Impaired Glucose Tolerance and Impaired Fasting Glucose	
	Male Gender	
	Unknown environmental factors	

1.6 Prevention of Diabetes

Prevention refers to actions aimed at eradicating, eliminating or minimizing the impact of diabetes and diabetes related disability. Diabetes prevention can be categorized into the following groups: primordial prevention, primary prevention, secondary and tertiary prevention.

Table 4: Levels of prevention for diabetes

	HEALTH PROMOTION/ PRIMORDIAL PREVENTION	PRIMARY PREVENTION	SECONDARY PREVENTION	TERTIARY PREVENTION
Targets	Entire population	People with one or more risk factors	People at an early stage of disease	People with symptomatic or advanced disease

Effects	Prevent risk factors; lower population risk	Prevent development of disease at an early age	Prevent disease progression or recurrence	Reduce complications or disability
Examples	Physical activity Health diet Limit alcohol consumption Tobacco cessation Wellness programs	Health education Environmental modification Nutritional intervention Lifestyle and behavioural changes	Treatment to targets, e.g, BP <140/80 mmhg or HbA1C <7% Lipid control Adherence counselling	Strict metabolic control Diabetes education Effective treatment Screening and monitoring of complications

1.7 Clinical Manifestations

Diabetes may present with characteristic symptoms and signs (Table 5), but it may be asymptomatic. Type 1 diabetes is more likely to present with symptoms and its onset is typically in children and young adults. However, the type of diabetes cannot always be determined at diagnosis, and initial treatment decisions should be based on clinical presentation and plasma glucose values.

Table 5: Symptoms and Signs of diabetes

SYMPTOMS
- Excessive thirst - Frequent Urination (Polyuria; In younger children bedwetting is common) - Blurring of vision - Fatigue/tiredness
SIGNS
- Unintentional weight loss - Signs of acute metabolic deterioration (signs of severe dehydration, Kussmaul's respiration, vomiting, altered level of consciousness) - Clinical signs of chronic complications (acute coronary disease, stroke, kidney disease, vision loss, diabetic foot)
LESS FREQUENT SIGNS
- Mood Changes - Skin Infection - Oral or vaginal thrush - Abdominal pain - Blurred vision - Coma - Shock - Decreased level of consciousness - Kussmaul respiration (deep, rapid, sighing) - Dehydration with continuing polyuria - Acetone smell on breath - Frequent vomiting and acute abdominal pain

1.8 Continuum of care in diabetes

Diabetes often begin without any symptoms and early screening and detection will identify more patients. Once diagnosed, people living with diabetes need continuous care over the long-term, as well as education and support to manage these conditions. In addition, patients may have comorbidities which share similar approaches for diagnosis, treatment and control, calling for provision of integrated services across the care continuum.

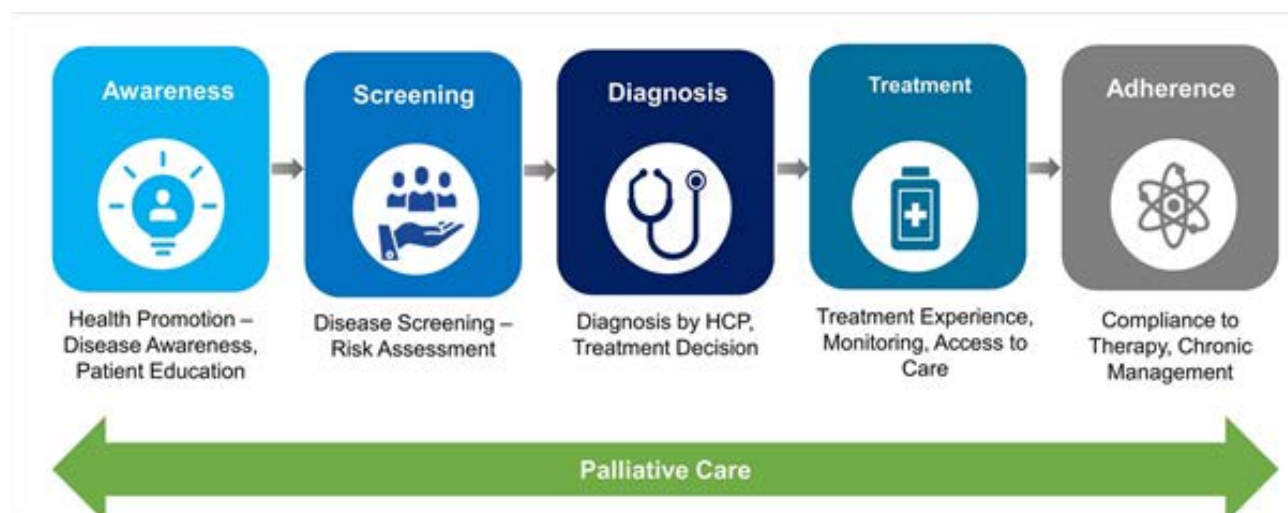


Figure 3: Patient-centric approach for improving healthcare outcomes for patients with diabetes.

1.9 COMPONENTS OF DIABETES MANAGEMENT

The components of diabetes care include pharmacologic and non-pharmacologic approaches. The overall goal of diabetes management is to improve the quality of life and productivity of people living with diabetes, control comorbidities, and prevent complications by:

- Early diagnosis
- Treatment to target (Pharmacologic and non-pharmacologic)
- Regular screening for complications and comorbid conditions
- Education on diabetes and complications, self-care and diet
- Community awareness on diabetes
- Establishing diabetes comprehensive centres served by a functional referral system
- Having a motivated, passionate and well-educated diabetes management team
- Provision of essential commodities and technologies

1.9.1 Non-Pharmacological management of diabetes

i. Nutritional Management in Diabetes:

- Children living with diabetes need a healthy diet with food in amounts and proportions appropriate to the age and stage of growth
- Nutritional counselling should be adapted to cultural, ethnic, and family traditions as well as the cognitive and psychosocial needs of the individual child
- Match the dose, type, and regimen of insulin to the amount and timing of food
- Include a healthy snack between the main meals, before, during and after
- exercise
- Nutritional advice should address food availability/food insecurity, diet, food intake and physical activity patterns
- Excessive restriction of carbohydrate intake to lower blood glucose levels
- should be avoided.
- Sugary soft drinks or foods with high levels of saturated fat should be avoided

- Prevention and management of hypoglycemia, particularly before, during and after exercise should be addressed
- Education should include preventing hypoglycemia

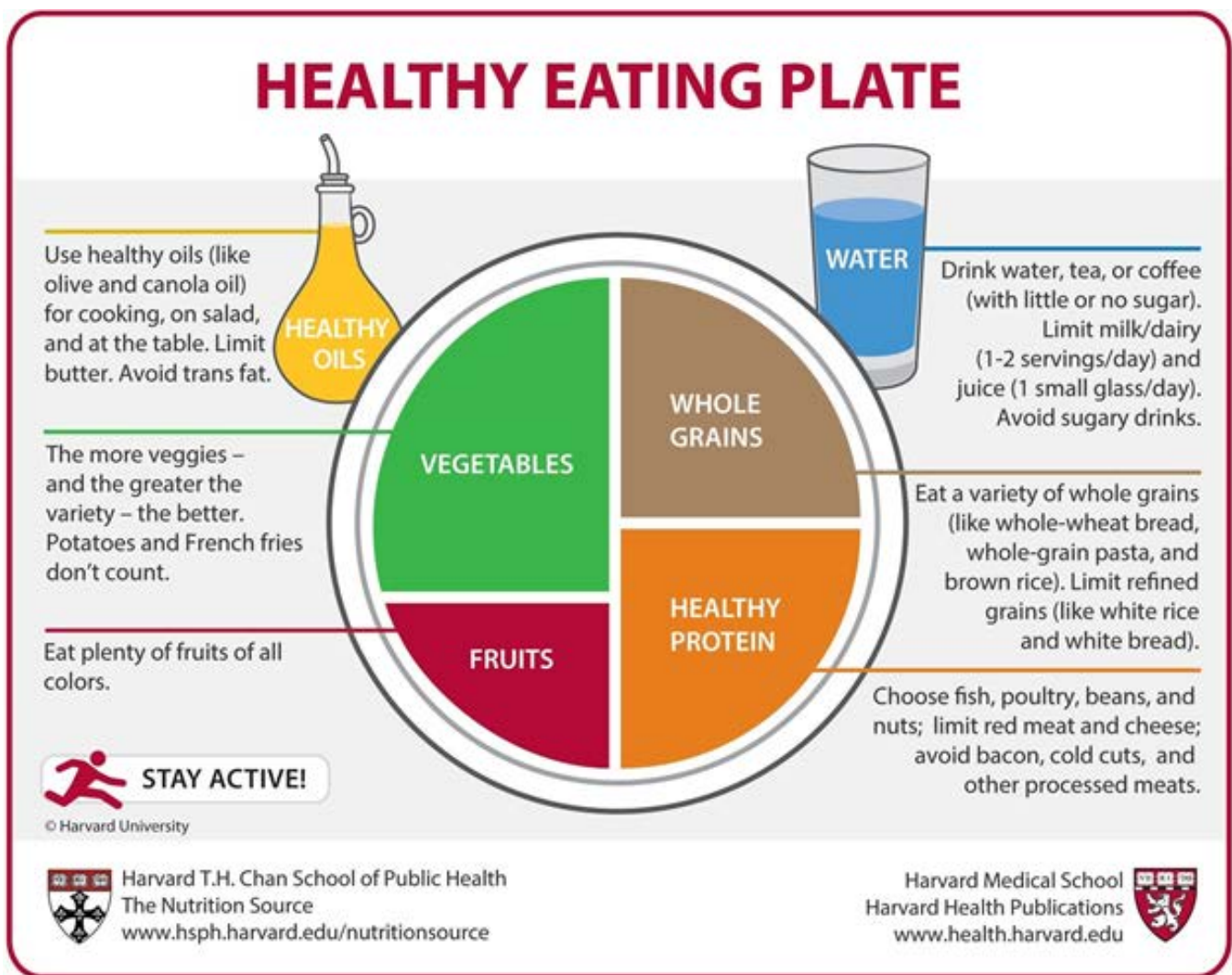


Figure 4: Healthy eating plate. Source (Harvard T.H. Chan School of Public Health)

ii. Physical activity

- Being active has significant health benefits for hearts, bodies and minds, whether you're walking, cycling, doing sport or playing with your kids. Every move counts.
- Limit sedentary time, and replace it with some physical activity.
- Any is better than none, and every move counts
- Optimizing physical activity is an integral part of the management of diabetes
- Both aerobic and resistance exercise confer benefit in diabetes
- Co-morbidities and cardiovascular risk need careful assessment before advising on a physical exercise regimen.
- Patients using insulin and/or sulphonylureas should be counselled about the symptoms and risks of hypoglycaemia before starting with a physical exercise regimen

Table 6: Recommended levels of physical activity

Life Course	Recommended level of physical activity
Children and adolescents	All children and adolescents including those living with type 1 or type 2 diabetes or prediabetes should engage in 60 min/day or more of moderate- or vigorous-intensity aerobic activity, with vigorous muscle-strengthening and bone-strengthening activities at least 3 days/week
Adults	All adults including most adults with type 1 and type 2 diabetes should engage in 150 min or more of moderate- to vigorous-intensity aerobic activity per week, spread over at least 3 days/week, with no more than 2 consecutive days without activity. Shorter durations (minimum 75 min/week) of vigorous-intensity or interval training may be sufficient for younger and more physically fit individuals
	All adults including those living with type 1 and type 2 diabetes should engage in 2–3 sessions/week of resistance exercise on nonconsecutive days
	All adults, and particularly those with type 2 diabetes, should decrease the amount of time spent in daily sedentary behavior. Prolonged sitting should be interrupted every 30 min for blood glucose benefits. Examples include walking, yoga, housework, gardening, swimming, and dancing
	Flexibility and balance training are recommended 2–3 times per week for older adults including those living with diabetes
Everyone	All people with type 2 diabetes should be encouraged to perform 150 minutes of aerobic exercise, at 50 to 70% of maximal heart rate, per week, as well as resistance training three (3) times per week
	Everyone who can (whether living with diabetes or not) should be encouraged to perform more 300 minutes of physical activity per week
Pregnant and post-partum women	150 minutes per week



CHAPTER 2

Outpatient Protocols

2.1 Screening For Diabetes and Prediabetes

Diabetes often begin without any symptoms and early screening and detection will identify more patients. Once diagnosed, people living with diabetes need continuous care over the long-term, as well as education and support to manage these conditions. In addition, patients may have comorbidities which share similar approaches for diagnosis, treatment and control, calling for provision of integrated services across the care continuum.

Table 7: Criteria for Testing for Diabetes or Prediabetes in Asymptomatic Adults

1. Testing should be considered in adults with overweight or obesity (BMI $\geq 25\text{kg/m}^2$ or $\geq 23\text{ kg/m}^2$ in Asian) who have one or more of the following risk factors: • First degree relative with diabetes • History of CVD • Hypertension ($\geq 140/90$ mmHg or on therapy for hypertension) • HDL cholesterol $< 35\text{ mg/dl}$ (0.90 mmol/L) and/or a triglyceride level $> 250\text{ mg/dl}$ (2.82 mmol/L) • Women with polycystic ovary syndrome • Physical inactivity (Less than 150 hours/week of at least moderate intensity physical activity) • Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)
2. Persons with prediabetes (HbA1c $\geq 5.7\%$), impaired glucose tolerance, or impaired fasting glucose should be tested yearly.
3. Women who were diagnosed with GDM should have lifelong testing at least every 3 years.
4. For all other patients, testing should begin at age 35 years.
5. If results are normal, testing should be repeated at a minimum of 3-year intervals, with consideration of more frequent testing depending on initial results and risk status.
6. HIV
7. TB

Table 8: Risk-Based Screening for Type 2 Diabetes or Prediabetes in Asymptomatic Children and Adolescents in a Clinical Setting

Testing should be considered in youth who are overweight (BMI $\geq 85\text{th}$ percentile) or obese (BMI $\geq 95\text{th}$ percentile) and who have one or more additional risk factors based on the strength of their association with diabetes:
• Maternal history of diabetes or GDM during the child's gestation • Family history of type 2 diabetes in first- or second-degree relative • High-risk Race/ethnicity (Native American, African American, Latino, Asian American, Pacific Islander) • Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome, or small-for-gestational-age birth weight)

Diagnosis

Table 9: Diagnostic criteria for DM

	Prediabetes (Intermediate hyperglycaemia)	Diabetes
HbA1c	5.7-6.4%	≥ 6.5%
Fasting plasma glucose	5.6-6.9 mmol/L	≥ 7.0 mmol/L
2-hour plasma glucose during 75g-OGTT*	7.8-11.0 mmol/L	≥ 11.1 mmol/L
Random plasma glucose	-	≥ 11.1 mmol/L

*OGTT Glucose Dose Paediatrics: 1.75gm/kg upto maximum of 75g

NB:

- Fasting is defined as no caloric intake for at least 8 hours.
- The HbA1c test should be performed in a laboratory using a method that is NGSP-certified and standardized to the Diabetes Control and Complications Trial assay.
- Random blood glucose only to be used in patients with symptoms.
- The 2-hour postprandial glucose test should be performed using a glucose load containing the equivalent of 75-g anhydrous glucose dissolved in water.
- Asymptomatic people, repeat the test to confirm the diagnosis, preferably with the same test, as soon as practicable on a subsequent day.
- Everyone who comes to a health facility should have blood glucose checked at least once a year

Table 10: Symptoms and Signs of Diabetes Mellitus:

More common	Less common	Severe symptoms (DKA)
Weight loss	Excessive hunger	Frequent vomiting and acute abdominal pain
Polyuria – in younger children bedwetting is common	Blurred vision	Acetone smell on breath
Excessive thirst	Mood changes	Dehydration with continuing polyuria
Tiredness/fatigue	Skin infections	Decreased level of consciousness
	Oral or vaginal thrush	Kussmaul respiration (deep, rapid, sighing)

Table 11: Key Differences Between Type 1 and Type 2 Diabetes at Diagnosis

Characteristic	Type 1	Type 2
Onset	Sudden, acute or sub-acute	Slow, insidious onset, progressive disease. Patient could be undiagnosed for years.
Age	Usually < 30-35 years	Older patients, > 35 years
Typical symptoms: Polyuria, Polydipsia, weight loss	Moderate to severe symptoms of diabetes present	Person often asymptomatic because of slow onset of the disease; asymptomatic glycosuria present
Weight	Lean, often rapid weight loss before diagnosis.	Normal to overweight at diagnosis
Insulin secretion	Insulin deficient, needs insulin treatment at diagnosis	Initially inadequate insulin secretion, with progressive deficiency over time
Insulin resistance	Absent	Present
Ketosis	Yes, often diagnosed in Ketoacidosis	Not as common as in type 1
Hereditary	Less common	More common
Metabolic syndrome	Absent	Present; a cluster of cardiovascular disease risk factors often present, e.g. hypertension, dyslipidaemia, abdominal obesity, insulin resistance, microalbuminuria, and hypercoagulability.
Treatment	Insulin therapy	Initially: lifestyle changes +/- oral glucose lowering agents, +/- Insulin
Acute complications	DKA Hypoglycemia- associated with treatment	May get DKA Hypoglycemia: Associated with treatment

2.2 Diagnostic cascade for Type 2 Diabetes

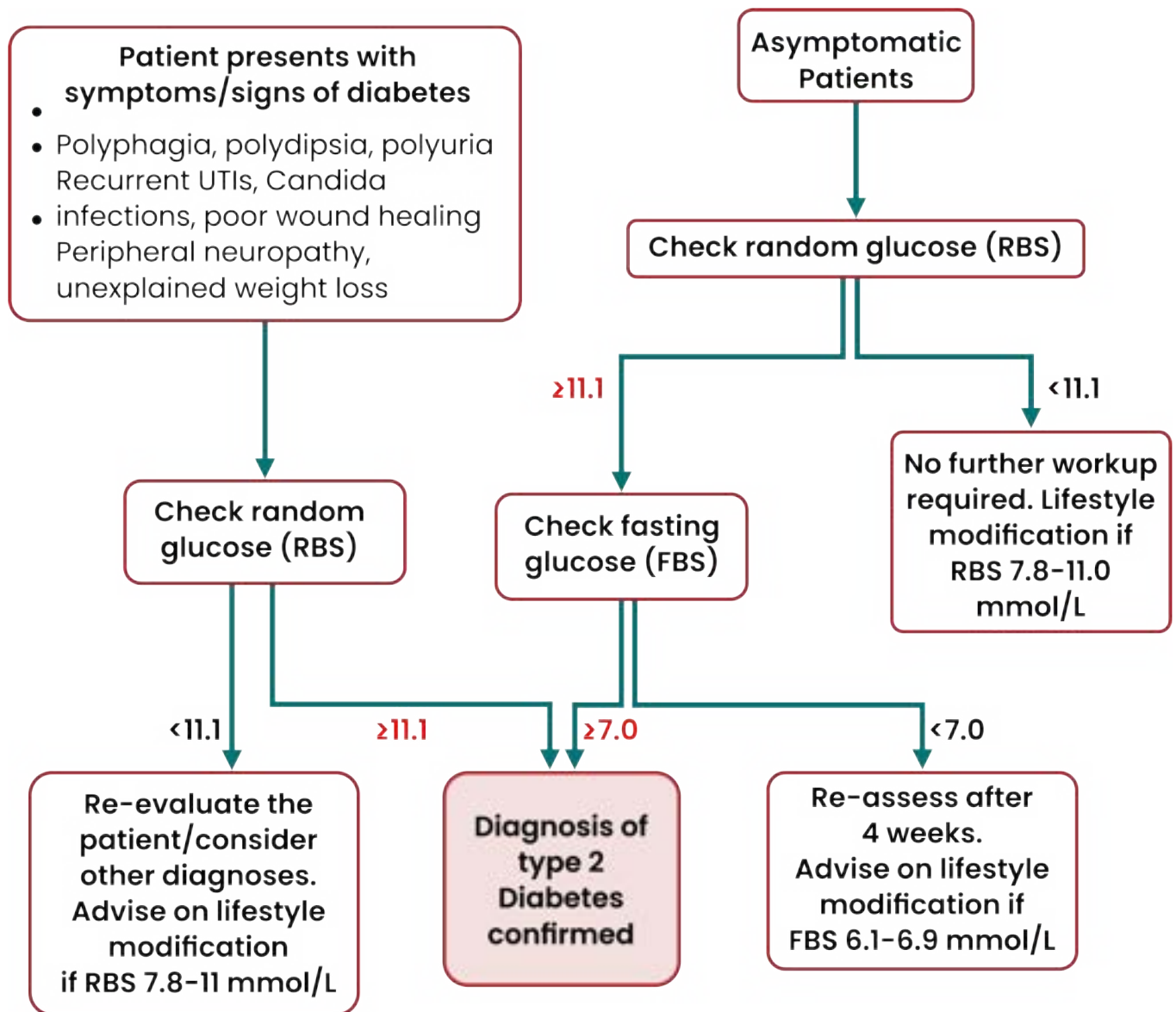


Figure 5: Diabetes diagnostic cascade

Table 12: Patient assessment at initial and follow up visits

	Initial Visit	3-6 monthly Visits	Annual Visit
Symptoms of hyperglycaemia, and duration	X	X	X
Hypoglycaemic symptoms**		X	X
Relevant family history	X		
Other risk factors (e.g., low, or high birthweight)	X		
Relevant medical history			
• Co-morbid conditions (autoimmune diseases e.g., Thyroid)	X		X
• Symptoms of complications: visual, infection, foot, edema, and palpitations	X	X	X
Drugs			
• Current (Side-effects and adherence)	X	X	X
• Allergies	X	X	X
Vaccinations	X	X	X
• KEPI (date)	X	X	X
• Influenza (date)	X		X
• Pneumococcal***	X		
Lifestyle			
• Weight/height	X		X
• Physical activity	X		X
• Eating pattern and food availability	X	X	X
• Teenagers: Alcohol and drug use, tobacco use	X	X	X
• Sexual activity	X	X	X
Psychosocial support			
• Family, school, and the community support	X	X	X
• Depression, anxiety and other mental disorders	X	X	X
Education			
• Level of education and school performance	X	X	X
• Absenteeism per term	X	X	X
• Family and community support (Parent education level, occupation)	X	X	X
• Home monitoring of blood glucose (glucometer and strips; chart)Home monitoring of blood glucose (glucometer and strips; chart)	X	X	X

	Initial Visit	3-6 monthly Visits	Annual Visit
Physical examination			
• Weight	X	X	X
• Height	X	X	X
• Body mass index (BMI) for age and sex	X	X	X
• Mid upper arm circumference (MUAC)	X	X	X
• Tanner pubertal staging	X	X	X
• Blood pressure (mmHg)	X	X	X
• Injection sites assessment	X	X	X
Oral cavity			
• Dental caries	X		X
• Gum disease	X		X
Eyes			
• Visual acuity	X		X
• Direct fundoscopy (dilated pupils), indirect fundoscopy, or fundus photographs	X		X
Special investigations			
Blood tests			
• Glucose	X	X	X
• HbA1c: (Six-monthly if at target, otherwise three-monthly. Also, whenever treatment is adjusted)	X		X
• TSH	X		X
• Lipids: Total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides	X		X
• Creatinine, and calculate estimated GFR	X		X
• Potassium	X		X
• HIV	X		X
Urine			
• Glucose	X		X
• Ketones			X
• Protein (current g/lines albumin/creatinine ratio)	X		X
Other important tasks			
• Education: Self-management and lifestyle adjustment, including smoking cessation	X	X	X
• Setting goals	X	X	X
• Family planning for teenagers and preconception counselling	X	X	X
• Medication revision/adjustment	X	X	X

- Interval for retinopathy screening can be increased to once every 2 years if the last 2 examinations were normal; more frequent examinations are required in the presence of abnormalities.
- *Symptom of hyperglycaemia include polydipsia, headaches, blurred vision, polyuria, fatigue/body malaise, weight loss
- ** Symptoms/signs of Hypoglycemia- Shakiness, nervousness or anxiety, sweating, chills and clammy extremities, irritability, confusion, including delirium, tachycardia, lightheadedness or dizziness, hunger and nausea, blurred/impaired vision, tingling or numbness in the lips or tongue, headaches, weakness or fatigue, mood changes, lack of coordination, nightmares or crying out during sleep, seizures, loss of consciousness
- ***Pneumococcal vaccine should be administered once. Revaccination is recommended for individuals >64 yr. if vaccinated >5 yrs. ago, or patients with renal disease, asplenia and immunocompromised states

Table 13: Assessment and treatment plan*

Assessing risk of diabetes complications
• ASCVD and heart failure history • ASCVD risk factors and 10-year ASCVD risk assessment • Staging of chronic kidney disease • Hypoglycemia risk
Goal setting
• Set HbA1C/blood glucose target • If hypertension is present, establish blood pressure target • Diabetes self-management goals
Therapeutic treatment plans
• Lifestyle management • Pharmacologic therapy: glucose lowering • Pharmacologic therapy: cardiovascular disease risk factors and renal • Use of glucose monitoring and insulin delivery devices • Referral to diabetes education and medical specialists (as needed)

ASCVD, *atherosclerotic cardiovascular disease*.

* *Assessment and treatment planning are essential components of initial and all follow-up visits.*

3

INITIAL MANAGEMENT OF DIABETES CARE

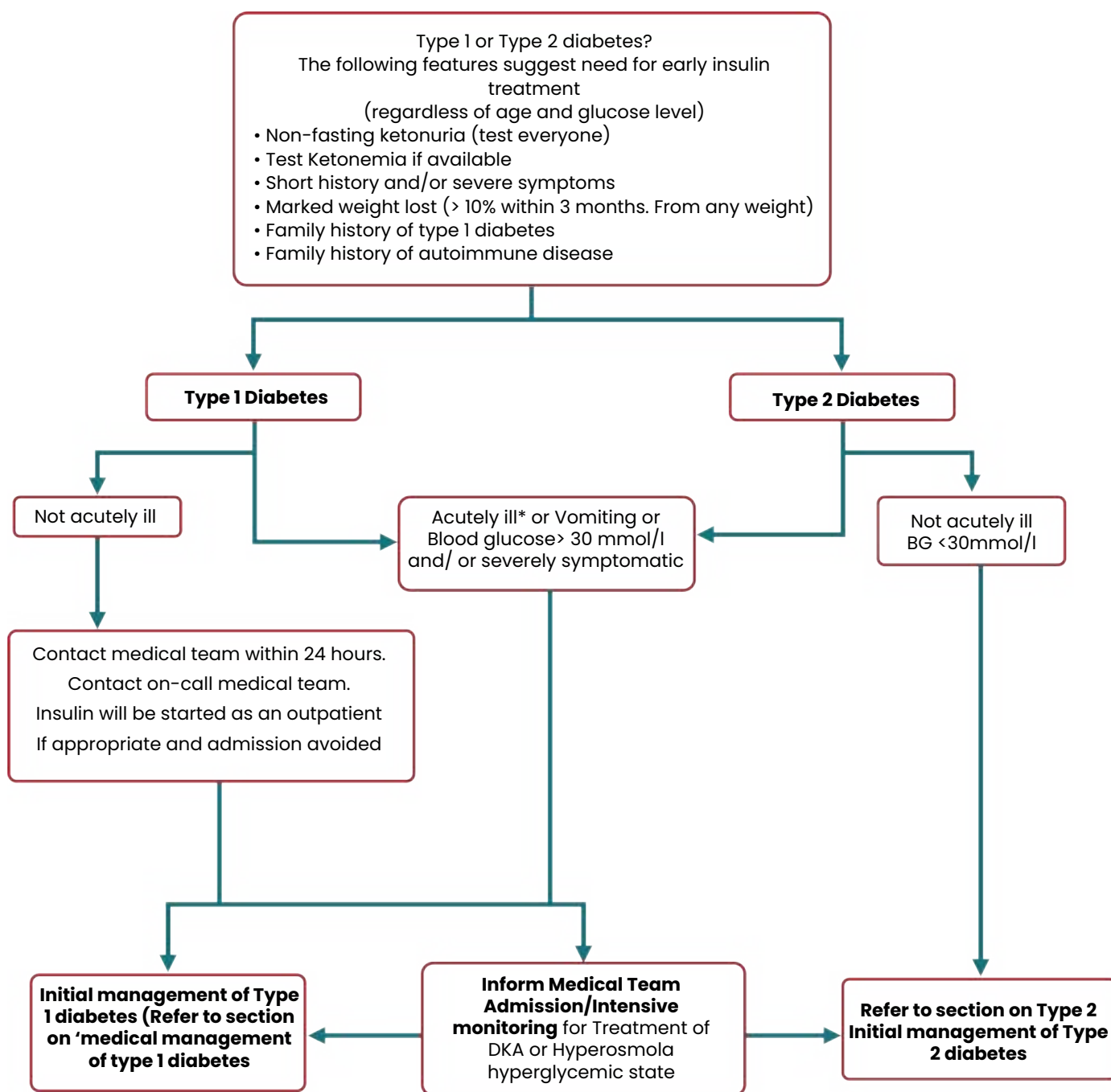


Figure 6: Initial management of diabetes

*Acutely ill: any condition requiring emergency care e.g., cardio-respiratory distress, hyperpyrexia, altered consciousness, acute abdomen etc.

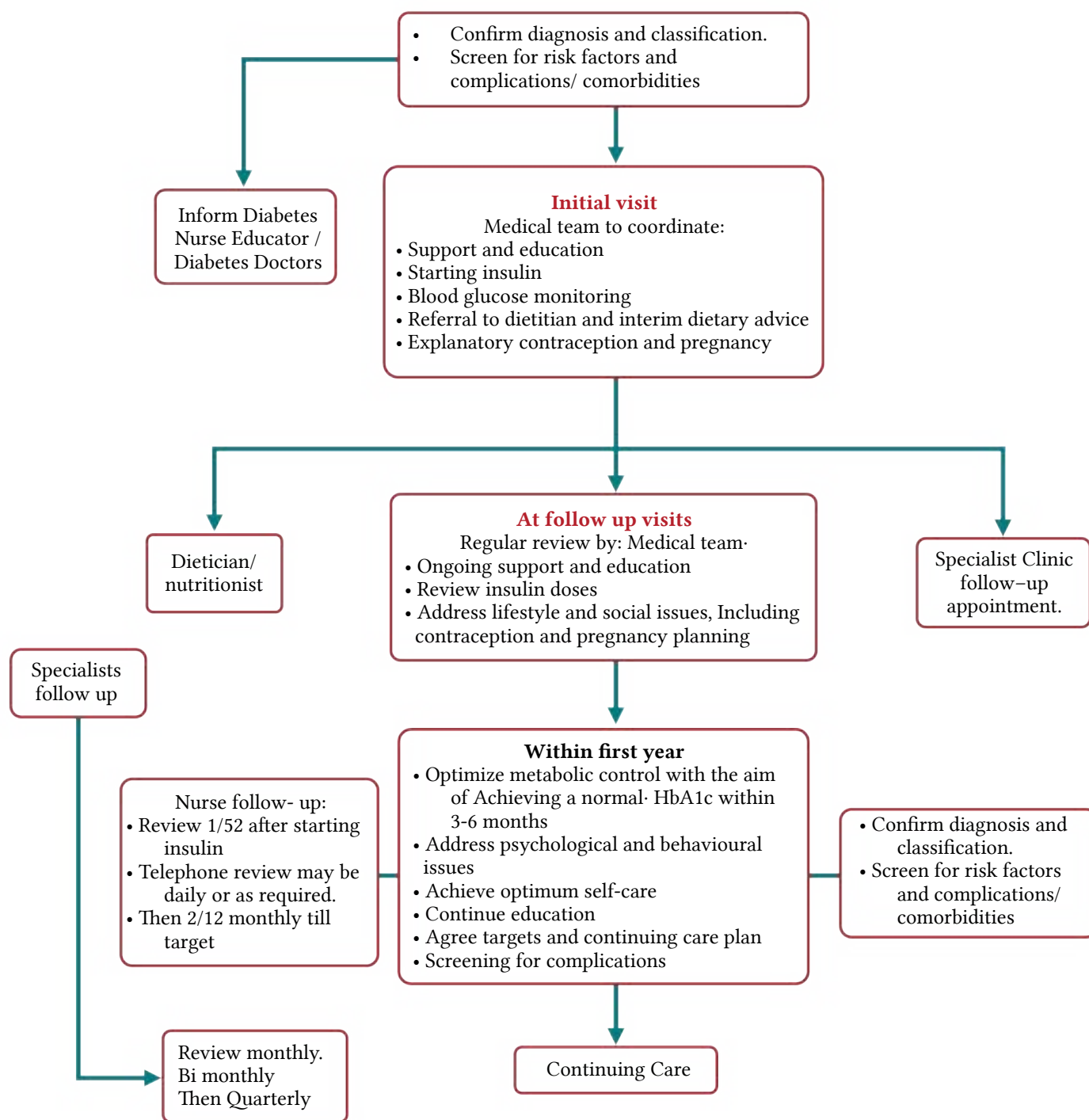


Figure 7: Treatment and Follow up

Table 14: Referrals for initial care management

Eye care professional for annual dilated eye exam
Family planning for women of reproductive age
Registered dietician/nutritionist for medical nutrition therapy
Diabetes self-management education and support (psychosocial support and patient support groups)
Dentist for comprehensive dental and periodontal examination
Mental health professional, if indicated
Audiology, if indicated

Notes:

- Encourage formation of patient support groups for people living with diabetes for sharing challenges and coping mechanisms and providing feedback mechanisms.

4

TREATMENT OF DIABETES

4.1 Physical activity guidelines in Diabetes

Co-morbidities and cardiovascular risk need careful assessment before advising on a physical exercise regimen.

Patients using insulin and/or sulphonylureas should be counselled about the symptoms and risks of hypoglycaemia before starting with a physical exercise regimen.

Table 15: Physical activity in Diabetes

• Optimizing physical activity is an integral part of the management of diabetes
• Both aerobic and resistance exercise confer benefit in diabetes
• Children and adolescents with type 1 or type 2 diabetes or prediabetes should engage in 60 min/day or more of moderate- or vigorous-intensity aerobic activity, with vigorous muscle-strengthening and bone-strengthening activities at least 3 days/week
• Most adults with type 1 and type 2 diabetes should engage in 150 min or more of moderate- to vigorous-intensity aerobic activity per week, spread over at least 3 days/week, with no more than 2 consecutive days without activity. Shorter durations (minimum 75 min/week) of vigorous-intensity or interval training may be sufficient for younger and more physically fit individuals.
• All people with type 2 diabetes should be encouraged to perform 150 minutes of aerobic exercise, at 50 to 70% of maximal heart rate, per week, as well as resistance training three (3) times per week.
• Adults with type 1 and type 2 diabetes should engage in 2–3 sessions/week of resistance exercise on nonconsecutive days.
• Flexibility and balance training are recommended 2–3 times per week for older adults with diabetes
• All adults, and particularly those with type 2 diabetes, should decrease the amount of time spent in daily sedentary behavior. Prolonged sitting should be interrupted every 30 min for blood glucose benefits. Examples include walking, yoga, housework, gardening, swimming, and dancing

4.2 Medical Management of type 2 Diabetes (resource scarce settings)

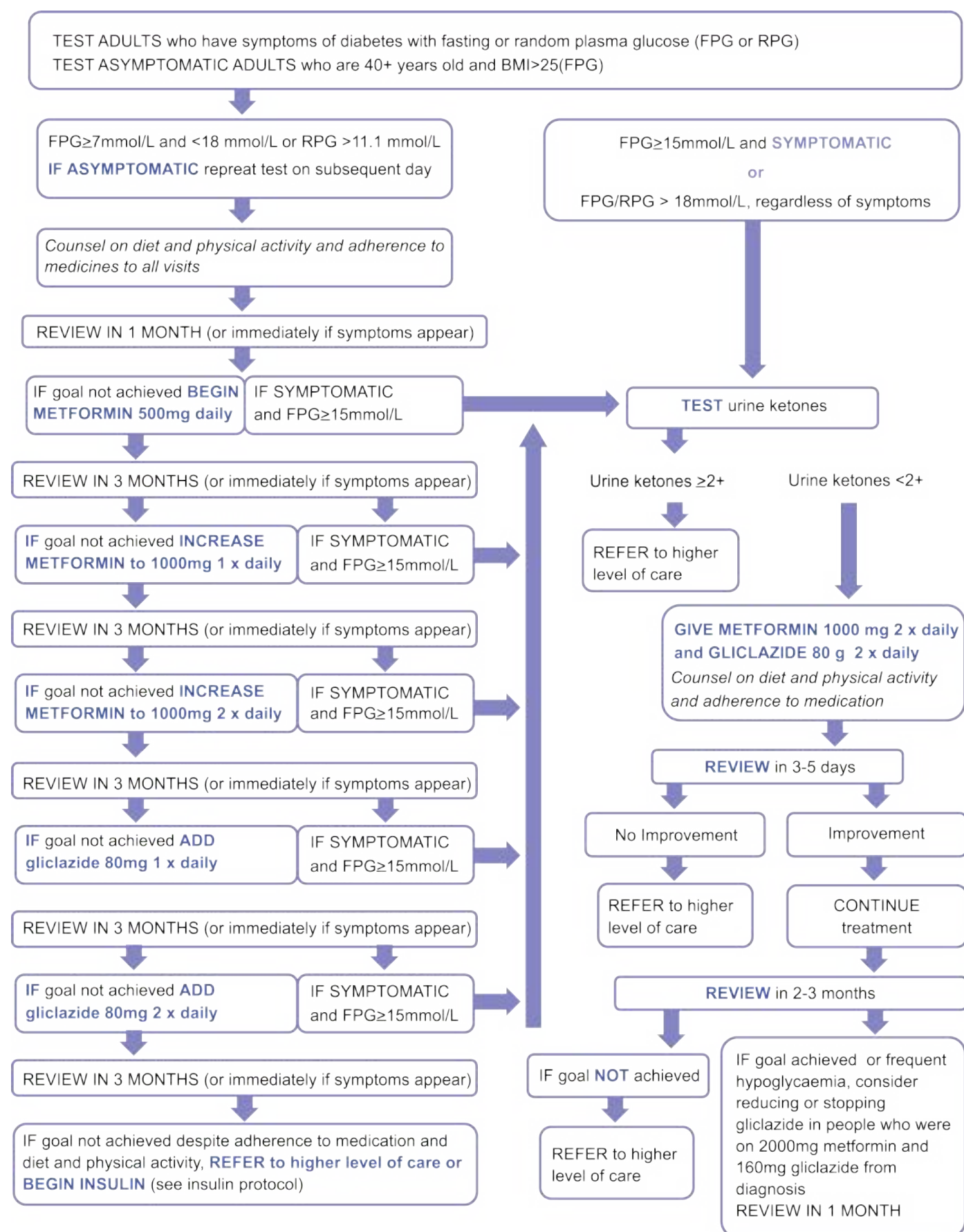


Figure 8: Medical Management of Type 2 diabetes (resource scarce settings)

4.3 Medical Management of type 2 Diabetes (depending on available resources)

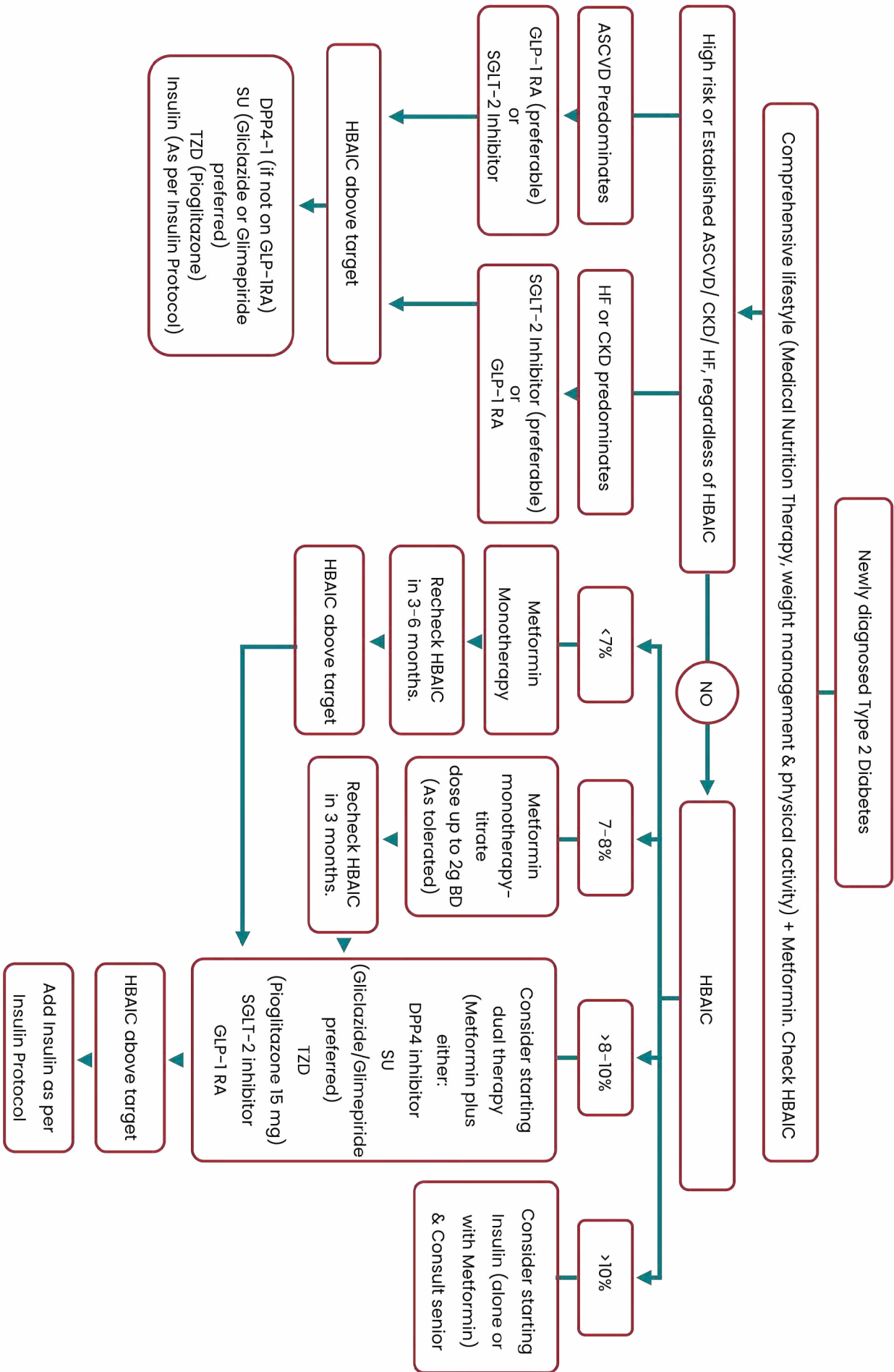


Figure 9: Medical Management of Type 2 diabetes (depending on available resources)

Note:

- If HbA1c is within target and/ or they are having hypoglycemic episodes on the current regimen, consider reducing insulin +/- oral glucose lowering agents gradually. Advice on close glucose monitoring (refer to glucose monitoring section) after dose adjustments.
- If HbA1c is not available several pre and 2 hours post prandial measurements done throughout the day can be used the preceding 8-12 weeks with targets <7 mmol/l and target of <9 mmol/l

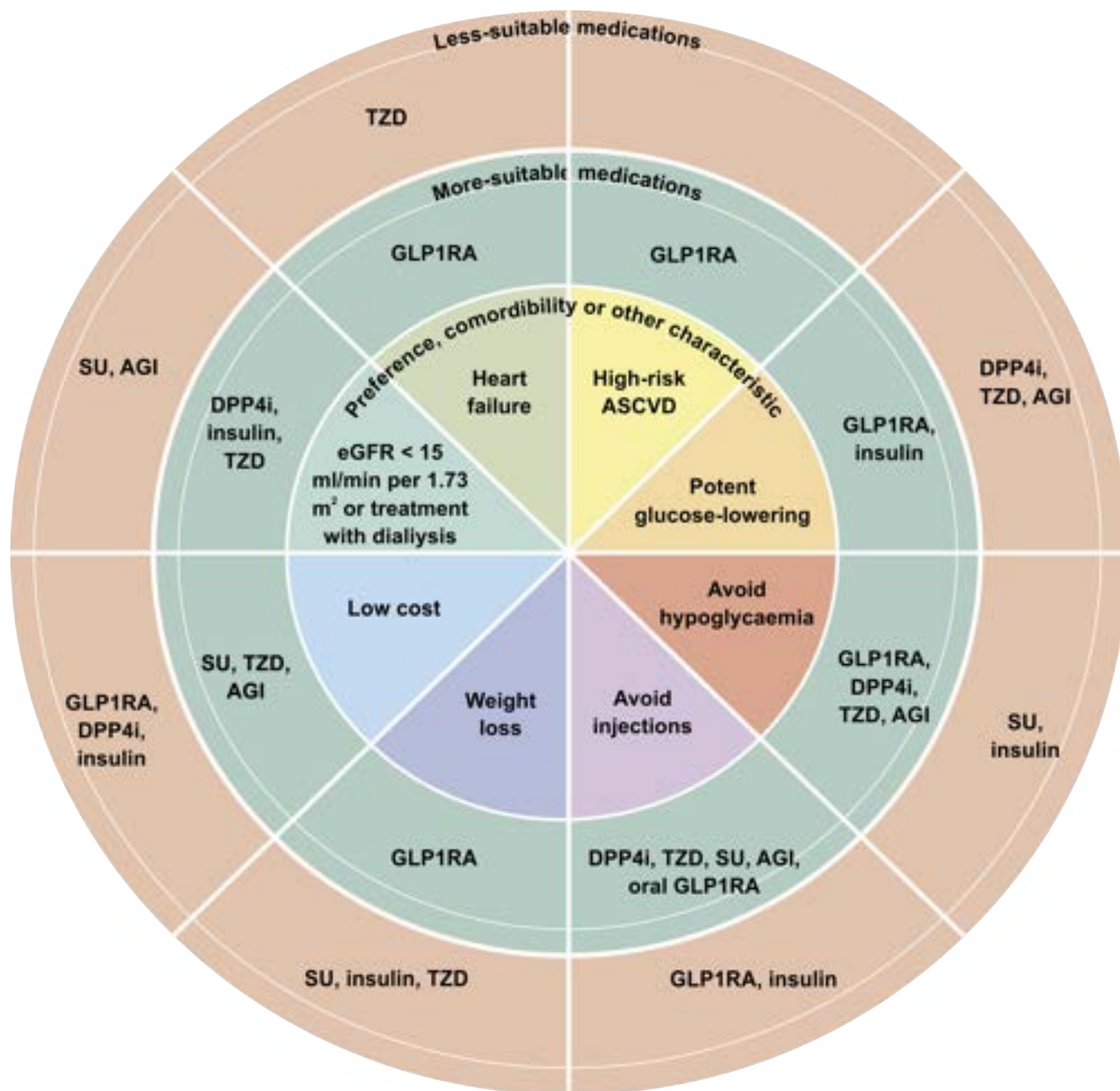


Figure 10: Summary of choice of medications in diabetes based on patients' profile

5

INITIATING INSULIN THERAPY IN TYPE 2 DIABETES

5.1 Initiating insulin therapy with basal insulin in type 2 diabetes

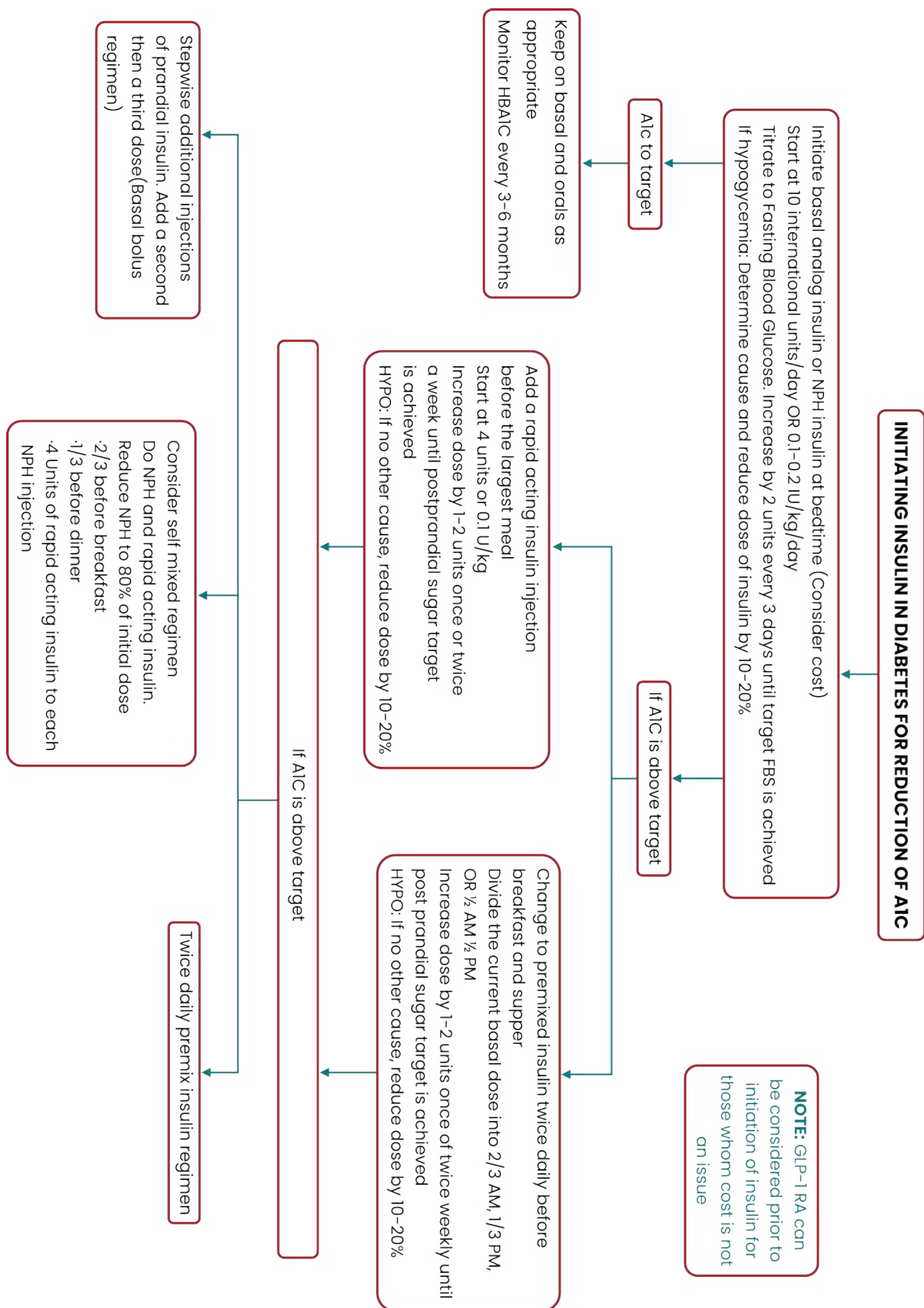


Figure 11: Initiating insulin therapy with Basal insulin in type 2 diabetes

Notes:

- Basal insulin: Glargine, Degludec, Detemir or NPH
- Where basal insulin (Glargine, Detemir, Degludec or NPH) is not an option, consider starting with pre-mixed insulin (human or analog premixed) with the largest meal.
- Short- acting insulins: Analog (Lispro, Aspart, Glulisine), Human (Regular/ soluble) insulin.

5.2 Premixed Insulin Protocol

In circumstances where basal bolus insulin regimen is not an option (due to cost, accessibility, availability, choice of patient, number of injections, etc.) in patients with Type 2 Diabetes requiring add on insulin to oral glucose lowering agents, it is reasonable to start with a mixed insulin regimen as below:

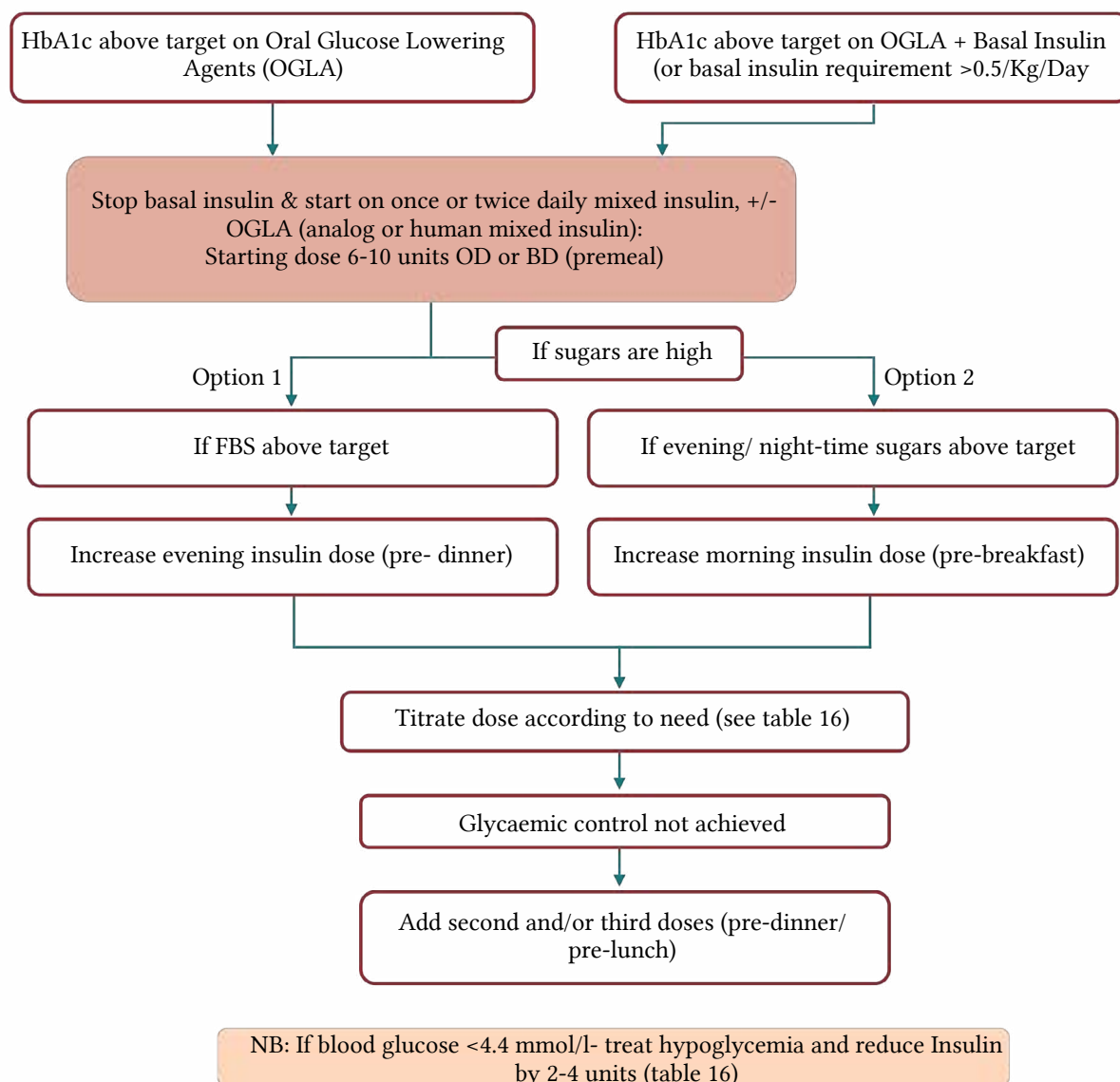


Figure 12: Insulin protocol

Precautions for premixed insulin dose adjustments:

- Titrate at least once, but not more than twice, each week
- Adjust human insulin by no more than 4 U per week in adults
- Adjust analogue insulin by no more than 6 U per week in adults
- Titrate slowly to avoid hypoglycaemia: 2-4 Units per dose
- Any episodes of hypoglycaemia should be taken into account prior to titration

Table 16 (A):) Premix Insulin Dose Adjustment - Pre Dinner Dose

Pre-breakfast Sugar (mmol/l)	Dose adjustment of pre- dinner insulin
< 4.4	- 2 units
4.4 – 6.0	No change
6.1 – 8	+ 2 units
> 8.1	+ 4 units

Table 16 (B): Premix Dose Adjustment – Pre-Breakfast Dose

Pre or post dinner Sugar (mmol/l)	Dose adjustment of next dose pre- breakfast insulin
< 4.4	- 2 units
4.4 – 6.0	No change
6.1 – 8	+ 2 units
> 8.1	+ 4 units

Note

- Pre- mixed insulin dose adjustments should be individualized on a patient-to-patient basis.

6

MEDICAL MANAGEMENT OF TYPE 1 DIABETES

6.0 Management of New-Onset Diabetes in Youth (10- 24 years old) with Overweight/ Obesity

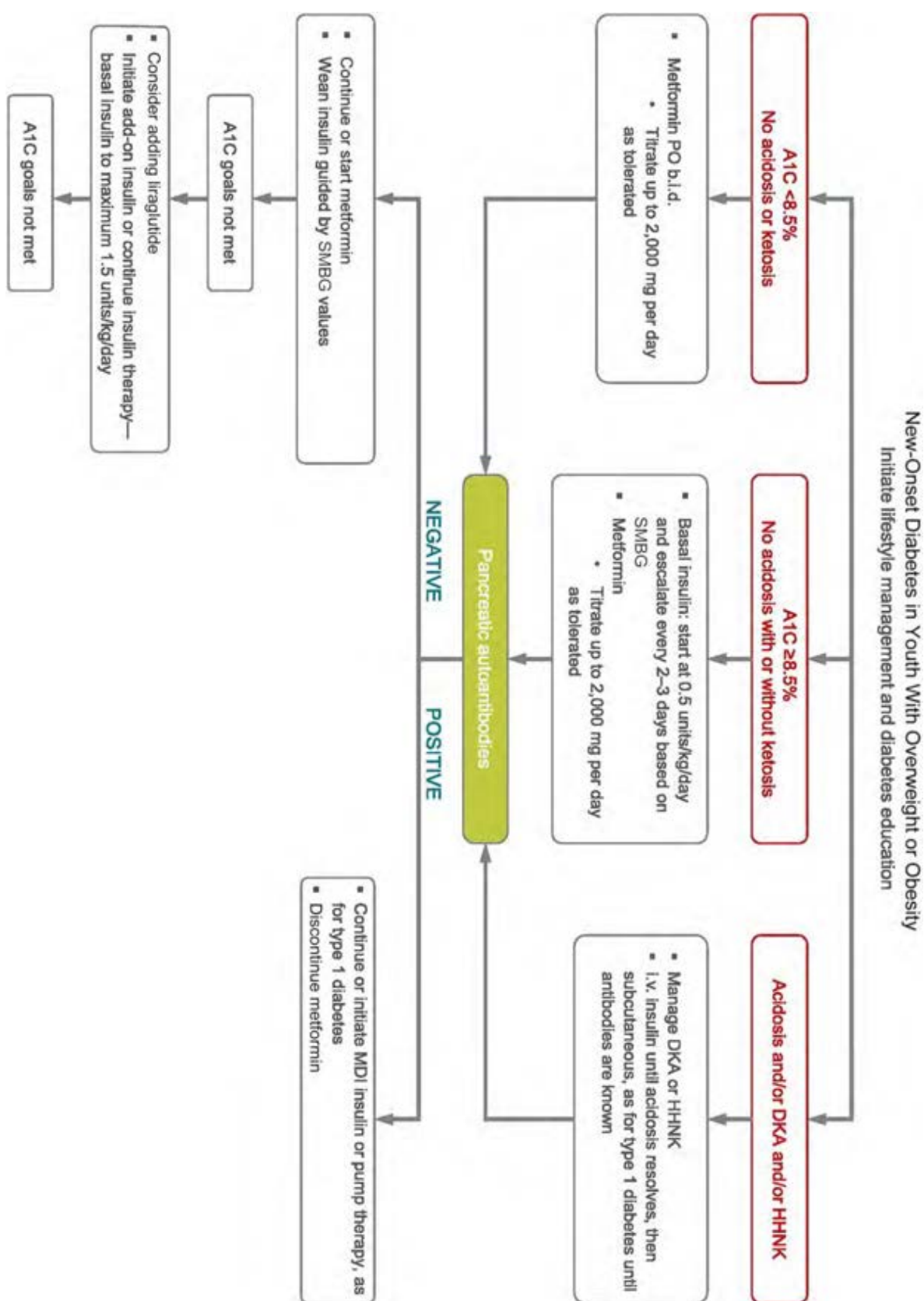


Figure 13: Management of new-onset diabetes in youth with overweight or obesity.

- A1C 8.5% = 69 mmol/mol.
- Adapted from the ADA position statement “Evaluation and Management of Youth-Onset Type 2 Diabetes”.

- DKA, diabetic ketoacidosis;
- HHNK, hyperosmolar hyperglycemic nonketotic syndrome
- MDI, multiple daily injections.

6.1 Management of Type 1 Diabetes

Most people with type 1 diabetes should be treated with multiple daily injections of prandial and basal insulin, or continuous subcutaneous insulin infusion.

- Most individuals with type 1 diabetes should use rapid-acting insulin analogs to reduce hypoglycemia risk.
- Patients with type 1 diabetes should receive education on how to match prandial insulin doses to carbohydrate intake, pre-meal blood glucose, and anticipated physical activity
- Call / refer to specialist for Type 1 Diabetes under following circumstances:
 - All patients with Type 1 Diabetes should preferably be seen by a specialist after diagnosis.
 - Catabolic symptoms- excess thirst, urination, or fatigue
 - Blood sugars >14 mmol/l
 - Frequent hypoglycemic episodes and hypoglycemia unawareness.
 - DM emergencies- DKA, Hyperglycemia, severe hypoglycemia
 - DM complications

Schematic for management of new onset type1 diabetes in an adult

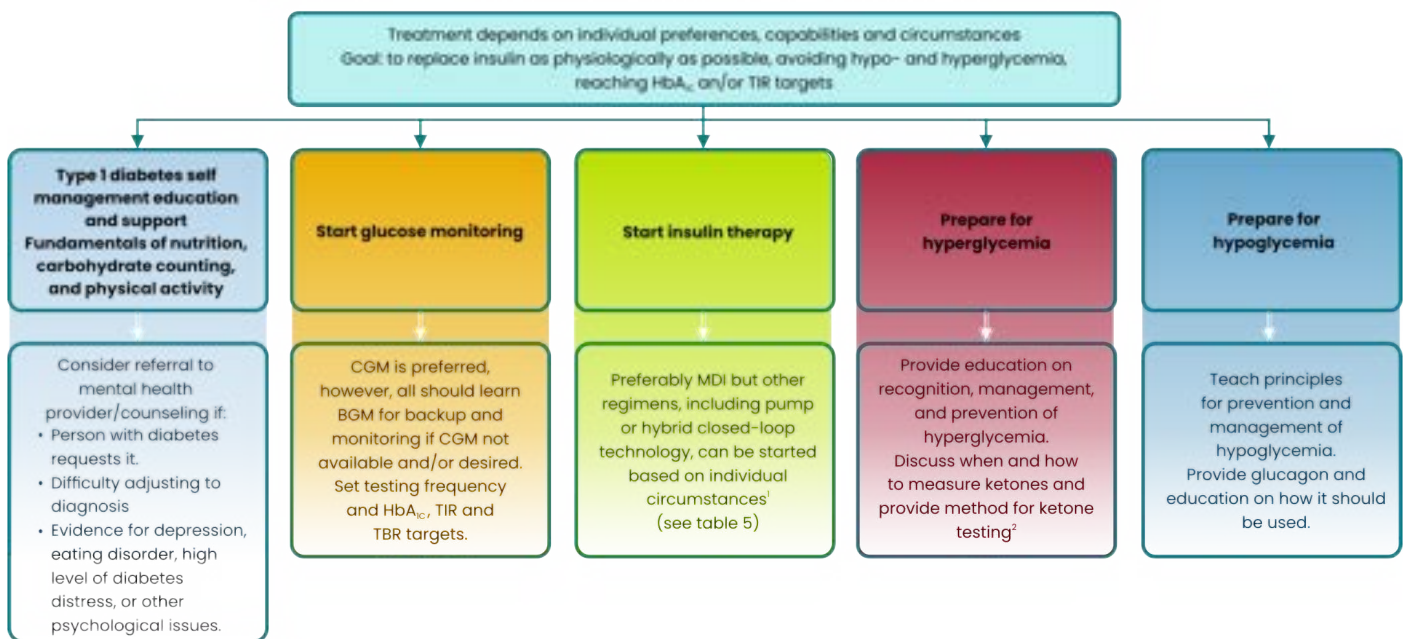


Figure 14: A framework for initial assessment and treatment of an individual with newly diagnosed type 1 diabetes.

In most people, frequent follow-up until the diabetes is stabilized is needed. ¹People can switch back and forth between Multiple daily injections (MDI) and pump or hybrid closed-loop therapy based on preference and circumstances; however, all people must be prepared to use injected insulin therapy if pump or hybrid closed-loop systems fail or are not available. ²The availability of blood and urine ketone measurement varies across health care systems. TIR- Time in range, MDI- Multiple Daily Injections, CGM- Continuous Glucose Monitoring, BGM- Blood Glucose Monitoring

Notes:

- Basal insulin options: Human (NPH), Analog (Glargine, Detemir, Degludec)
- Bolus insulin options: Human (Regular/ Soluble), Analog (Lispro, Aspart, Glulisine)
- Premixed insulin alone is not recommended as first line for management of Type 1 Diabetes, but if basal bolus regimen is not available/affordable, it may be used (minimum twice a day)

7

INSULIN TECHNIQUES AND TYPES

Table 17: Types and Properties of Insulin

Insulin Type	Onset	Peak	Duration
Ultra short acting: - Insulin Lispro, insulin Aspart, insulin Glulisine - Usually taken before a meal to cover the blood glucose elevation from eating Used with longer-acting insulin	12-30 min	0.5-3 hr	3-5 hr
Short acting: - Regular insulin - Usually taken about 30 minutes before a meal to cover blood glucose elevation from eating - Used with longer-acting insulin	30 min	2.5-5 hr	4-24 hr
Intermediate acting: - Insulin NPH - Covers the blood glucose elevations when rapid-acting insulins stop working - Often combined with rapid- or short-acting insulin and usually taken twice a day	1-2 hr	4-12 hr	14-24 hr
Long acting: - Insulin Glargine , Ultralente insulin, insulin Detemir - Often combined, when needed, with rapid- or short-acting insulin - Lowers blood glucose levels when rapid-acting insulins stop working - Taken once or twice a day	3-4 hr	No defined peak	≥24 hr
Ultra long acting: - Insulin Degludec - Available as combined with short-acting insulin - Lowers blood glucose levels when rapid-acting insulins stop working - Taken once a day	30-90 mins	No peak	≥24 hr

Notes:

- Ultra-rapid acting insulin should be administered either up to two minutes before a meal, or at the start of a meal, or up to 20 minutes after starting a meal.
- Rapid-acting, pre-mixed and co-formulated insulin should be administered 15 minutes prior to a meal.
- Short-acting insulin should be administered 20–30 minutes prior to a meal.
- Intermediate- and long-acting basal insulins can be given irrespective of a meal.

7.1 Insulin Injection Sites for Adults

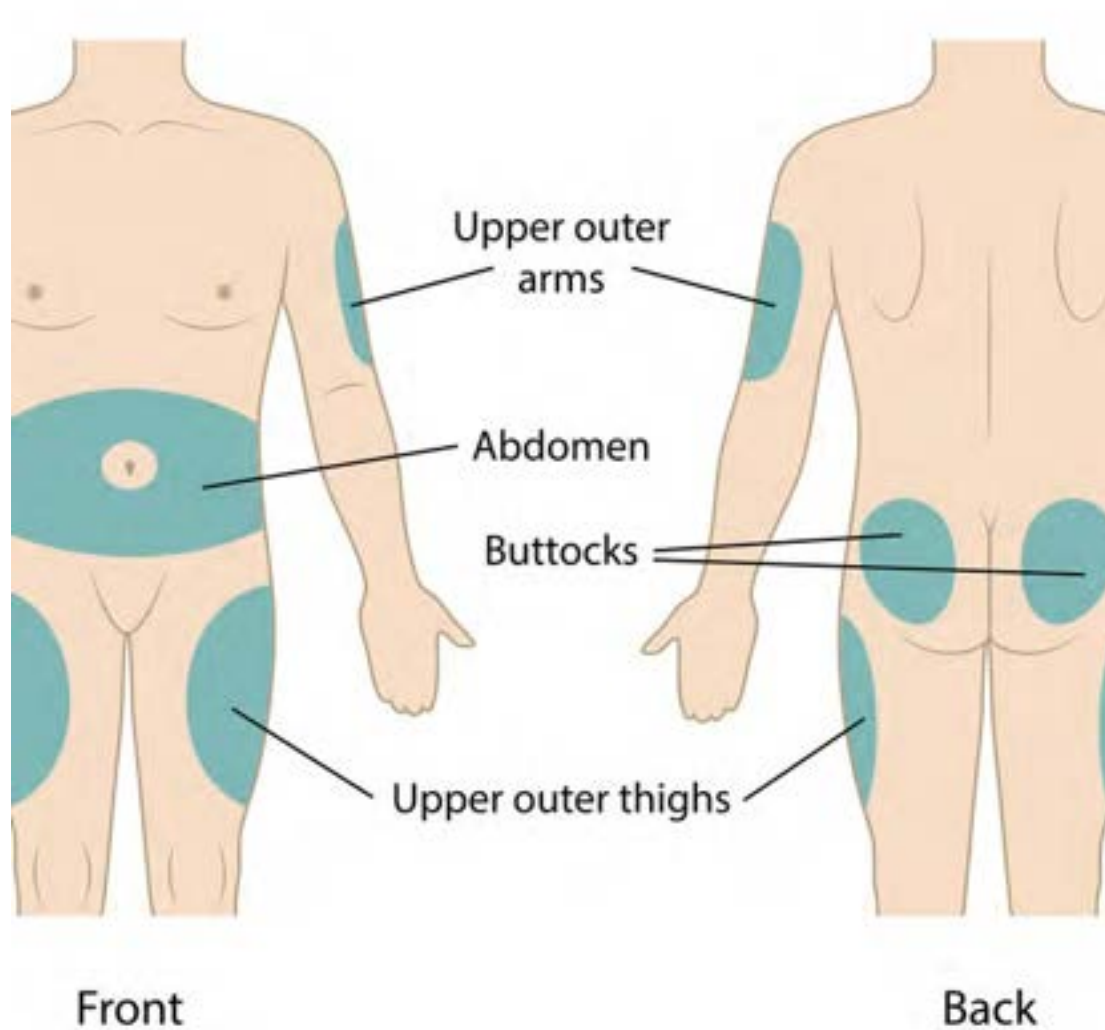


Figure 15: Insulin injection sites (adults)

7.2 Insulin Injection

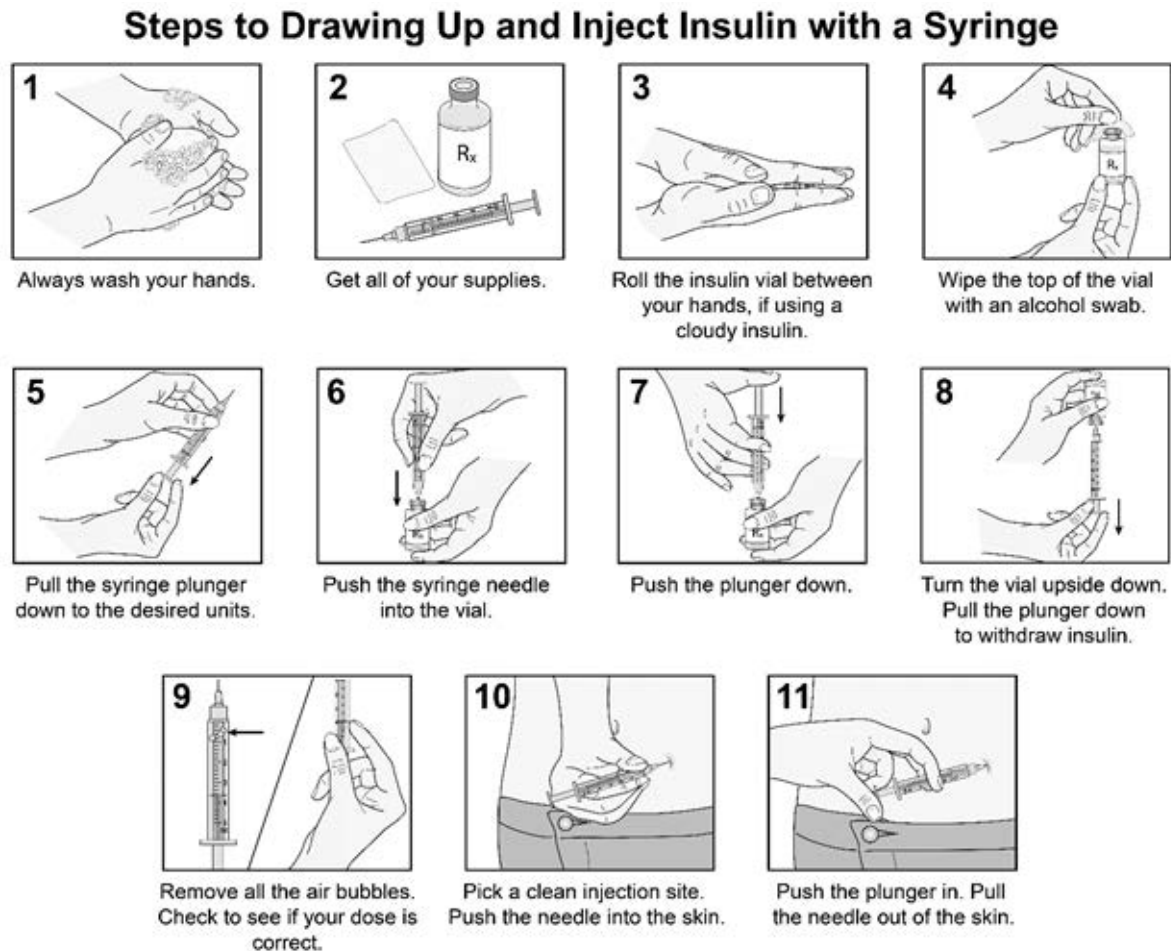


Figure 16: How to inject insulin with a syringe (a)

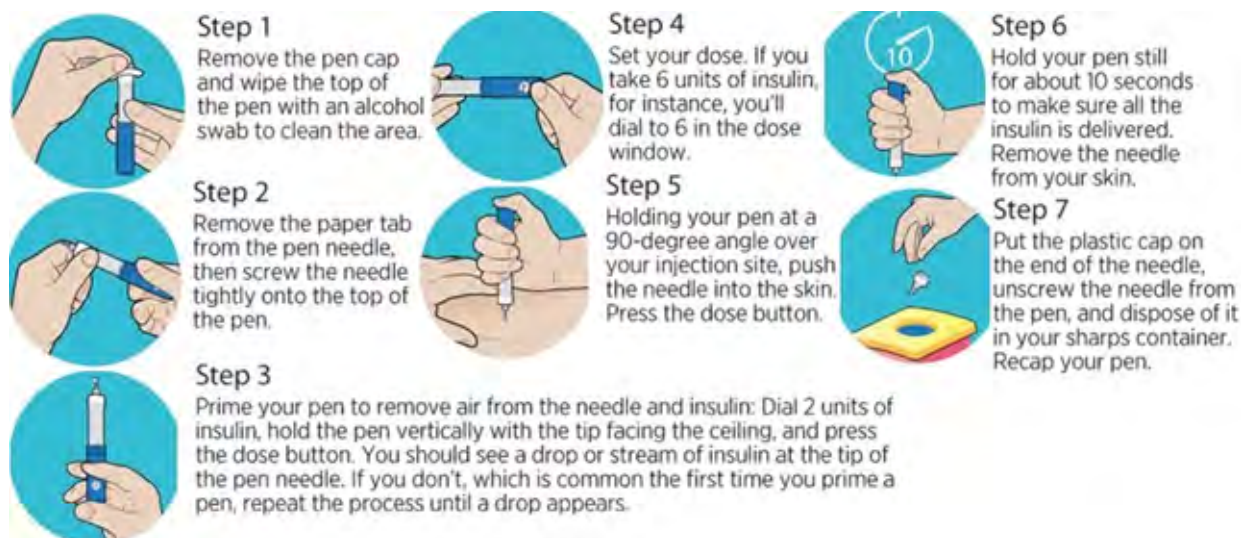


Figure 17: How to inject insulin with a Pen device (b)

8

CONTINUING CARE OF DIABETES

8.1 Continuing Care of Type 1 and Type 2 Diabetes

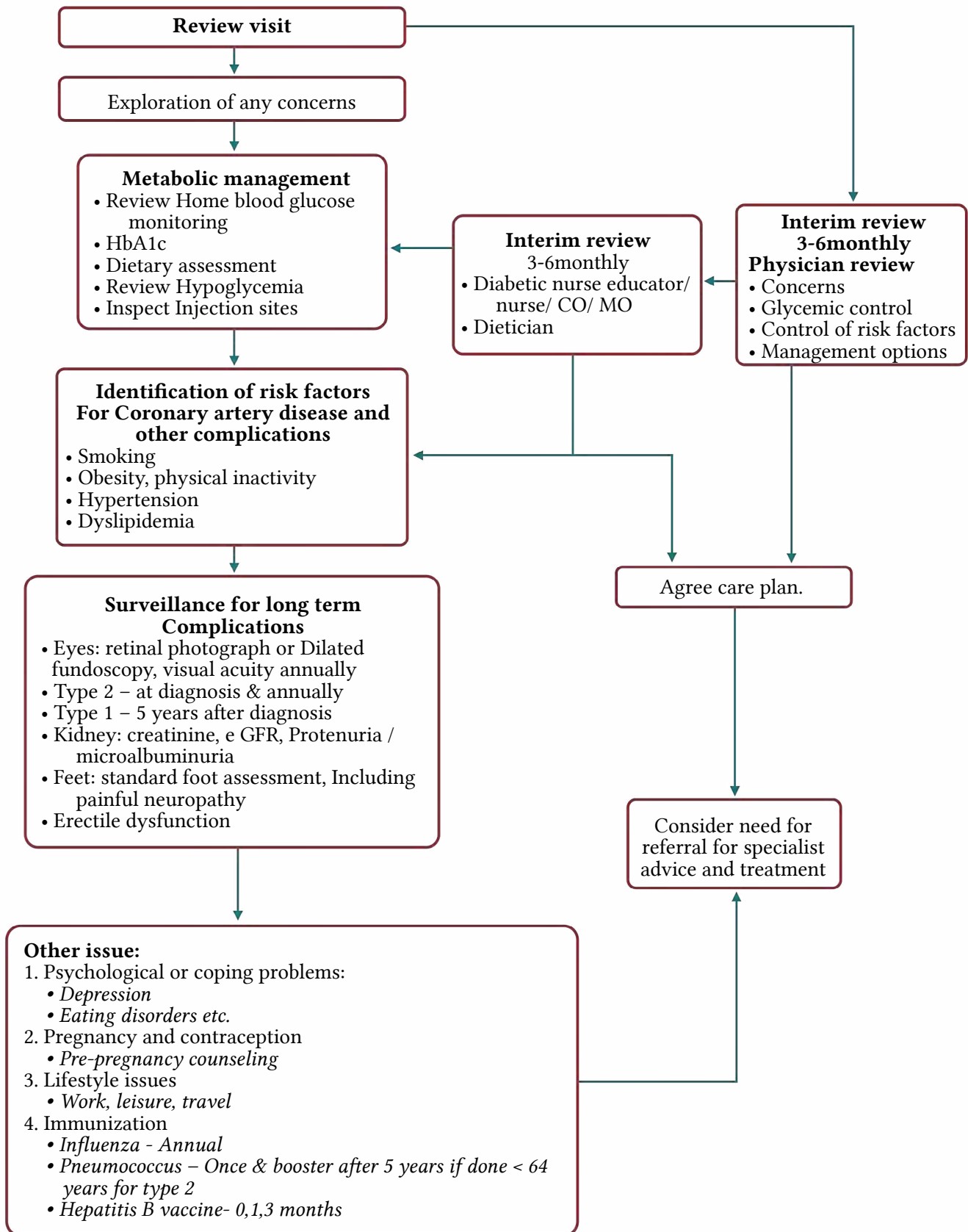


Figure 18: Continuing care for type 1 and 2 diabetes

9

SICK DAY RULES AND ADMISSION CRITERIA IN DIABETES MELLITUS

9.1 Sick Day Rules For Patients With Diabetes

Sometimes patients with diabetes can fall ill and hence the “sick day” rules should be used to guide management especially for those on insulin.

General advice for managing diabetes during intercurrent illness	
S (Sugar)	- Blood glucose levels can rise during illness even if the person is not eating - Advise to increase blood glucose monitoring if the person has access to it - Diabetes medications (sulfonylureas and insulin doses) may need to be increased temporarily during illness to manage these raised glucose levels
I (Insulin)	NEVER stop insulin or oral diabetes medications* - Insulin doses may need to be increased during illness, especially if ketones are present - Specific advice for people on insulin therapy is presented overleaf
C (Carbohydrate)	- Ensure the person maintains hydration and carbohydrate intake - If the person is not able to eat or is vomiting, advise to replace meals with sugary fluids - If blood glucose levels are high, maintain fluid intake with sugar-free fluids - If blood glucose levels are low, encourage regular intake of sugary fluids
K (Ketones)	- In type 1 diabetes, advise to check for ketones every 4–6 hours. If present, check every 2 hours - Give extra rapid-acting insulin doses (in addition to regular doses) based on total daily insulin dose if ketones are present – see insulin algorithm overleaf - Advise to drink plenty of water to maintain hydration and flush through ketones
*Metformin and SGLT2 inhibitors may need to be temporarily stopped if at risk of dehydration (see SADMAN rules below).	

Figure 19: Sick-day rules

*Flow chart on sick day management (PDF)

All people living with type 1 Diabetes Mellitus and people living with Type 2 diabetes on multiple daily insulin injections should have blood ketone monitoring devices, or if not available, urine dipsticks. They should check for ketones any time their blood glucose is >16 mmol/l or if they are unwell.

For those patients for whom the Total Daily Dose of insulin cannot be determined, their body weight can be used to estimate the amount of extra insulin needed as shown in the table below:

Table 18: Insulin dosing during sick days, based on Total daily dose.

Body Weight	10% of total daily dose Blood ketone: 1-2.9 Urine ketone: + to ++	20% of total daily dose Blood ketone: 3.0+ Urine ketone: +++ to ++++
40 kg	4 units	8 units
50 kg	5 units	10 units
60 kg	6 units	12 units
70 kg	7 units	14 units
80 kg	8 units	16 units
90 kg	9 units	18 units
100+ kg	10 units	20 units

Medications to be avoided when unwell can be summarized as follows

SADMAN rules: There are several classes of drugs that should be temporarily stopped in conditions that could lead to complications		
S	SGLT2 inhibitors	If taken during an acute illness that can lead to dehydration, there is an increased risk of developing euglycaemic DKA
A	ACE inhibitors	If taken during an acute illness that can lead to dehydration, there is an increased risk of developing AKI due to reduced renal efferent vasoconstriction
D	Diuretics	If taken during an acute illness that can lead to dehydration, there is an increased risk of developing AKI
M	Metformin	If taken during an acute illness that can lead to dehydration, there is an increased risk of developing lactic acidosis
A	ARBs	If taken during an acute illness that can lead to dehydration, there is an increased risk of developing AKI
N	NSAIDs	If taken during an acute illness that can lead to dehydration, there is an increased risk of developing AKI due to reduced renal afferent vasodilation
Once the person is feeling better and able to eat and drink for 24–48 hours, these medications should be restarted.		

Figure 20: Medications to be temporally stopped in a sick diabetic patient.

9.2 Sick day rules for T1DM/ T2DM on Insulin

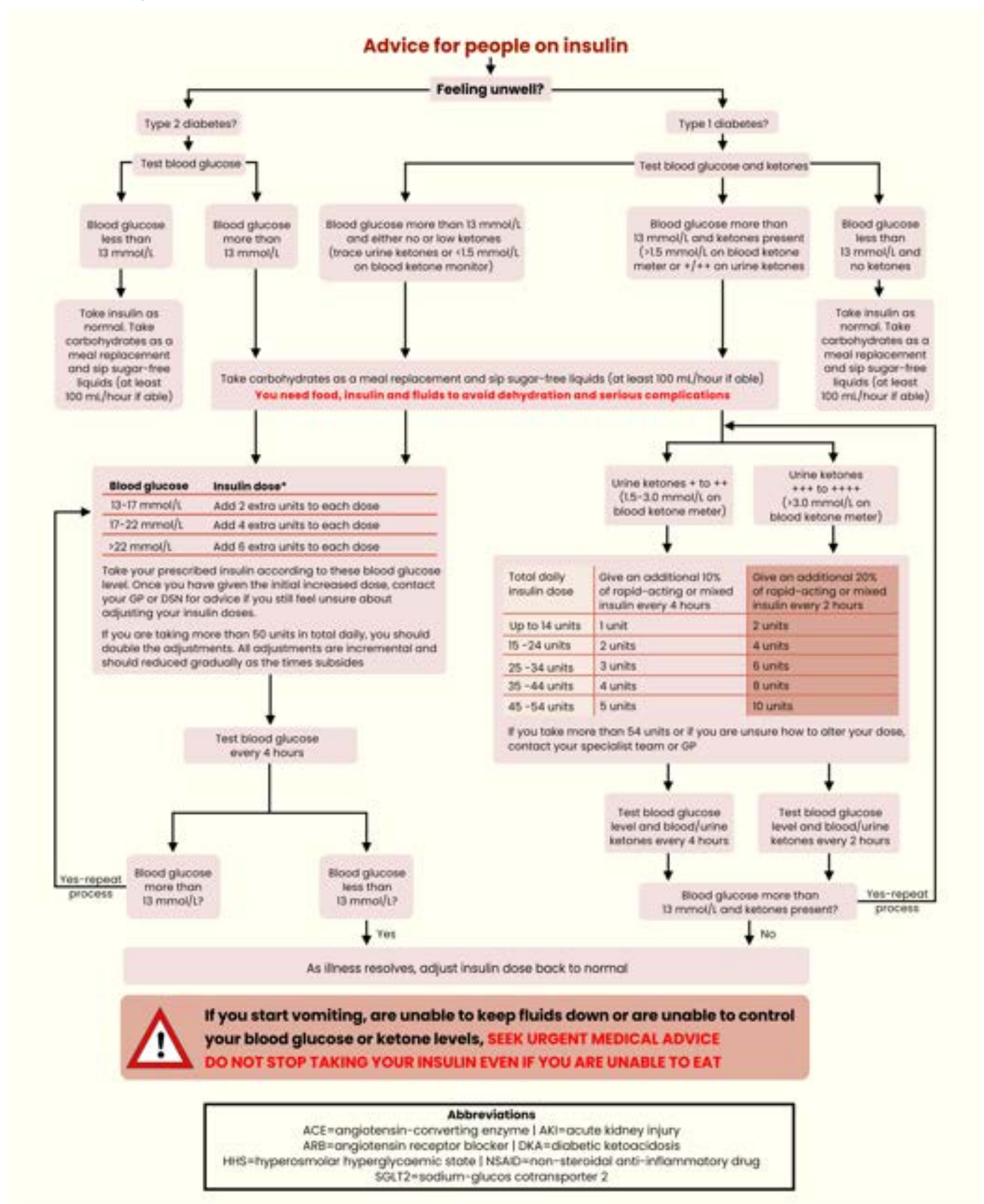


Figure 21: Sick-day rules for patients on insulin.

9.3 Admission Criteria For Diabetes

1. Life-threatening acute metabolic complications of diabetes such as:

- Diabetic ketoacidosis,
- Hyperglycaemic hyperosmolar state
- Hypoglycaemia with neuroglycopenia (coma, seizures or altered behavior). In cases of hypoglycaemia, admit the patient if the hypoglycaemia has been treated but a responsible adult cannot be with the patient for the ensuing 12-24 hours, or if the hypoglycaemia is due to a sulfonylurea drug

2. Substantial and chronic poor metabolic control that necessitates close monitoring of the patient to determine the etiology of the control problem, with subsequent modification of therapy

- Patients who have had chronic hyperglycaemia in clinic visits and require frequent outpatient therapy with FBS/RBS consistently above 16.7mmol/l
- Swings between hypo-and hyperglycaemia
- Recurrent Hypoglycaemic episodes despite intervention
- Severe psychosocial problems that cause poor metabolic control and cannot be managed on an outpatient basis

3. Severe chronic complications of diabetes that require intensive treatment or other severe conditions unrelated to diabetes that significantly affect its control or are complicated by diabetes, such as diabetic foot with sepsis, acute cardiovascular, renal, neurological, or retinal complications of diabetes

4. Uncontrolled or newly discovered insulin-requiring diabetes during pregnancy.

5. Institution of insulin in areas where doing self-monitoring of blood glucose from home is not feasible due to lack of resources and thus insulin titration cannot be done on an outpatient basis

9.4 Criteria for referral from primary healthcare(levels 1-3) to higher levels of care (level 4,5 or 6)

Urgent (same day) referral

Should occur if one of the following is detected:

- Urine ketones >2+, or no improvement in glycaemia ≥ 18 mmol/L after management with oral glucose lowering agents
- Suspicion of ketoacidosis or HHS
- Hypoglycaemia unresolved by treatment
- Clinical suspicion of type 1 diabetes in newly diagnosed patient
- Symptoms/signs of coronary heart disease and stroke
- Recent deterioration of vision
- Blood pressure >200/>110 mmHg
- Blood pressure >180/>110 mmHg with headache, shortness of breath, blurred vision, changed mental state, nausea, vomiting, reduced urine output
- Infected foot ulcer with or without symptoms of systemic infection; gangrene
- Critical limb ischaemia
- Anuria or eGFR <30 mL/min/1.73 m²

Non-emergency referral

should occur if one of the following is detected:

- Glycaemia treatment goal is not achieved despite compliance to treatment with oral medication (and insulin)
- eGFR 30–59 mL/min/1.73 m²
- Moderately and severely increased albuminuria
- Symptoms and signs of peripheral vascular disease
- Blood pressure >130/80 mmHg despite treatment with two medications
- Total cholesterol >8 mmol/L (310 mg/dL).

10

**DIABETES
COMPLICATIONS**

10.1 Cardiovascular Risk Assessment and prevention in Diabetes Mellitus

Cardiovascular Risk Calculator

useful tool to estimate 10-year risk of a first ASCVD event in age- group of 40-75 years. The 10-year risk of a first ASCVD event should be assessed at diagnosis and follow up visits annually. It is available online at: <https://apps.who.int/iris/bitstream/handle/10665/333221/9789240001367-eng.pdf>

Blood pressure (see flowchart on 'Hypertension in Diabetes')

- Measure at each visit; review therapeutic lifestyle changes if > 120/80 mm Hg
- Medical treatment to maintain goal < 140/90 mm Hg (may be lower [e.g., 130/80 mm Hg] in patients at high risk of cardiovascular disease (ASCVD or 10-year ASCVD score $\geq 15\%$) and 110–135/85 in pregnancy)
- Treatment should focus on drugs proven to reduce cardiovascular events in patients with diabetes (angiotensin-converting enzyme inhibitors, angiotensin-receptor blockers, thiazides, and dihydropyridine calcium channel blocker)

Cholesterol

- Measure at diagnosis, initial evaluation and at least every five years if <40 years, or more frequently as indicated
- Obtain a lipid profile at initiation of statins or other lipid-lowering therapy, 4–12 weeks after initiation or a change in dose, and annually thereafter
- Few clinical trials exist studying cholesterol and type 1 diabetes
- Lifestyle modification focusing on weight loss (if indicated), with Mediterranean style/DASH diet and increased physical activity should be recommended in all patients
- Intensify lifestyle therapy and optimize glycemic control for patients with high TG (≥ 150 mg/dL [1.7 mmol/L]) and/or low HDL cholesterol (<40 mg/dL [1.0 mmol/L] for men, <50 mg/dL [1.3 mmol/L] for women)

Cardiovascular disease screening:

- In asymptomatic patients, routine screening for CAD is not recommended.
- Consider investigations for CAD in those with atypical cardiac symptoms (e.g., unexplained dyspnea, chest discomfort); signs or symptoms of associated vascular disease (carotid bruits, TIA, stroke, claudication, or PAD; or ECG abnormalities (e.g., Q waves)

Smoking cessation

Ask about smoking at each visit

Advise all patients to not smoke cigarettes or use tobacco products

Offer counseling and tobacco cessation treatment as routine care

Smoking cessation hotline in Kenya: NACADA 1192

10.2 Prevention of CVD events in patients with diabetes

Table 19: CVD risk assessment

Lipid Lowering therapy

Primary prevention (in patients with Diabetes, without ASCVD):

- Aged 40–75 years, use moderate-intensity statin therapy in addition to lifestyle therapy
- Aged 20–39 years with additional ASCVD risk factors, it may be reasonable to initiate statin therapy in addition to lifestyle therapy
- At higher risk- multiple ASCVD risk factors or aged 50–70 years, it is reasonable to use high-intensity statin
- 10-year ASCVD risk $\geq 20\%$: it may be reasonable to add ezetimibe to maximally tolerated statin therapy to reduce LDL cholesterol levels by $> 50\%$.

Secondary prevention: treat with high intensity or maximally tolerated dose of statins if ASCVD is present

- If LDL cholesterol is ≥ 1.8 mmol/l (70 mg/dL) on maximally tolerated statin dose, consider adding additional LDL-lowering therapy (e.g., ezetimibe or PCSK9 inhibitor)
- In adults > 75 years with ASCVD, continue statins if already initiated, consider initiation after discussion of benefits and risks.
- Statins are contraindicated in pregnancy

Antiplatelet therapy

Secondary prevention: treat with aspirin (75 to 162 mg daily) if ASCVD is present, clopidogrel 75 mg if intolerant to aspirin

- Dual antiplatelet therapy (with low-dose aspirin and clopidogrel) is reasonable for a year after an ACS
- Combination therapy with aspirin plus low-dose rivaroxaban should be considered for patients with stable coronary and/or peripheral artery disease and low bleeding risk
- Note: there's no role for junior aspirin for primary prevention.

Table 20: High-intensity and moderate-intensity statin therapy*

High-intensity statin therapy (lowers LDL cholesterol by $\geq 50\%$)	Moderate-intensity statin therapy (lowers LDL cholesterol by 30–49%)
Atorvastatin 40–80 mg	Atorvastatin 10–20 mg
Rosuvastatin 20–40 mg	Rosuvastatin 5–10 mg
	Simvastatin 20–40 mg
	Pravastatin 40–80 mg
	Lovastatin 40 mg
	Fluvastatin XL 80 mg
	Pitavastatin 1–4 mg

*Once-daily dosing. XL, extended release.

11

DIABETES NEPHROPATHY

11.0 Screening for Nephropathy

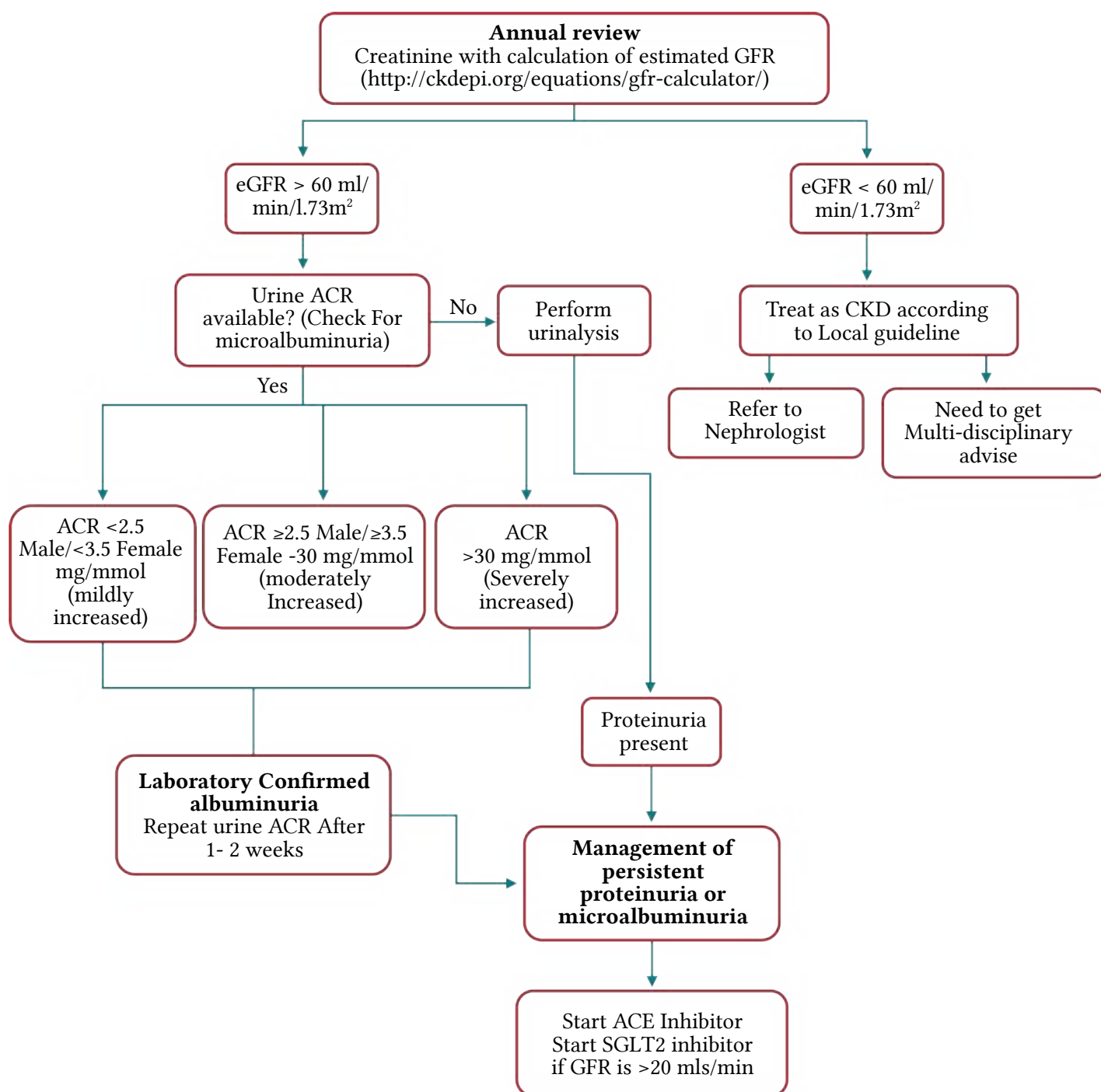


Figure 22: Screening for Nephropathy

Table 21: Frequency of screening for diabetic nephropathy based on status of kidney

Status of Kidney function	Screening Frequency
Albumin-Creatinine Ratio (ACR) – normal range and the eGFR > 60 ml/minute	Annually
Albumin-Creatinine Ratio (ACR) - abnormal range and the eGFR < 60 ml/minute:	Serum creatinine must be repeated once three months. ACR must be repeated twice within the same three months:
ACR is abnormal in two out of three tests if the eGFR < 60 ml/minute, the presence of CKD is confirmed.	The patient must be referred for further workup to exclude non-diabetic renal disease or to confirm Chronic Kidney Disease in diabetes.

11.1 Antidiabetes Drug Dose Adjustments in CKD

eGFR																		
* calculation using CKD-EPI Equation:																		
GFR = $141 \times \min(\text{Scr}/\kappa, 1)^\alpha \times \max(\text{Scr}/\kappa, 1)^{-1.209} \times 0.993^{\text{Age}} \times 1.018$ [if female] $\times 1.159$ [if black]																		
(ml/min/1.73m ²)	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5
Secretagogues																		
Glibenclamide	Caution																	
Glimepiride	Caution						↓ dose?											
Glimepiride							Caution ↓ dose?											
Gliclazide							Caution ↓ dose?											
Repaglinide							Caution		Caution ↓ dose?									
Sensitizer & @-glycisidase inhibitors																		
Metformin							Caution Full dose		Do not initiate ↓ dose (~50%)									
Pioglitazone											Caution for risk of fluid retention, anaemia and bone fragility							
Acarbose																		
DPP4 inhibitors																		
Sitagliptin							↓ dose (50mg/day)				↓ dose (25mg/day)							
Vildagliptin							↓ dose (50mg/day)											
Saxagliptin							↓ dose (2.5mg/day)											
Linagliptin																		
Alogliptin							↓ dose (12.5mg/day)				↓ dose (6.25mg/day)							
GLP-1 receptor agonists																		
Exenatide							Caution											
Liraglutide																		
Lixisenatide																		
Dulaglutide																		
SGLT2 inhibitors																		
Dapagliflozin							Do not initiate											
Canagliflozin							Do not initiate ↓dose (100mg/day)											
Empagliflozin							Do not initiate ↓dose (50mg/day)											

Figure 23: Dose adjustments in CKD

11.2 Guidelines for the dosing of metformin in CKD

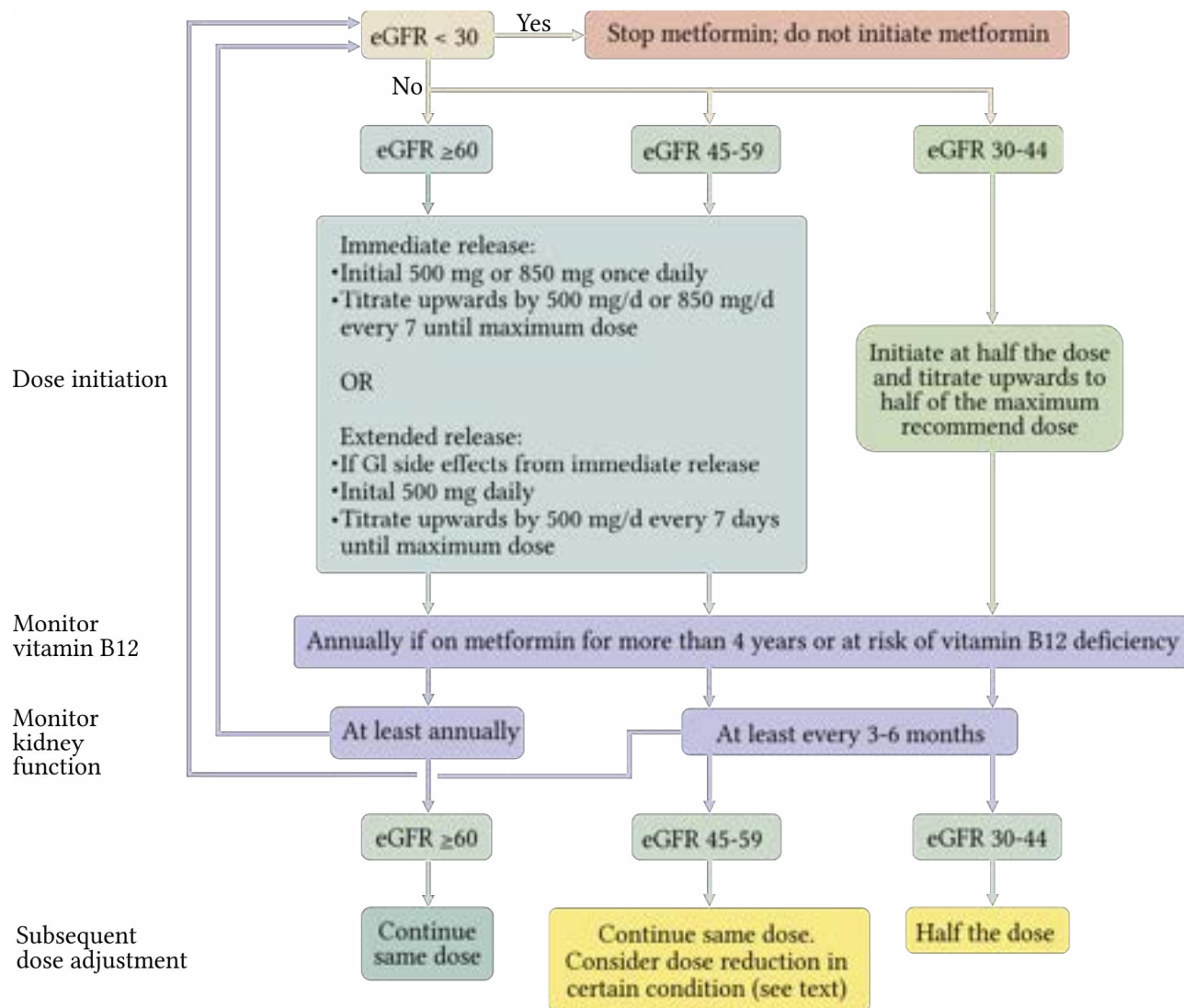


Figure 24: Metformin dosing in CKD

12

DIABETES NEUROPATHY

12.1 Introduction

This is a constellation of clinical syndromes caused by damage to peripheral and autonomic nervous systems. The injuries can be diffuse or focal. The patterns of injury are as shown below:

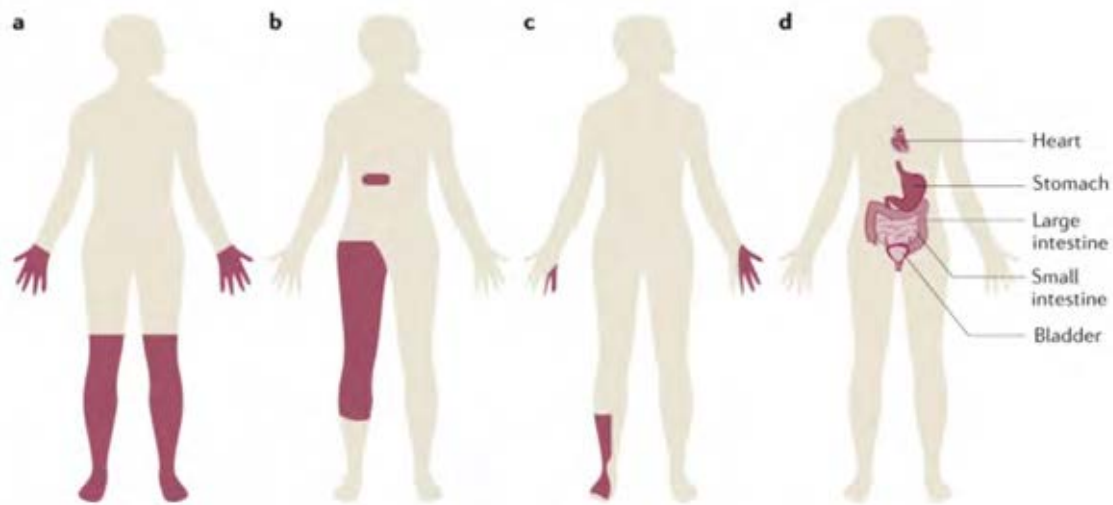


Figure 25: Patterns of nerve injury in diabetes

- | | |
|----------------------------------|-------------------------|
| A. Distal symmetrical neuropathy | C. Mononeuropathy |
| B. Radiculopathy | D. Autonomic neuropathy |

RISK FACTORS

- | | |
|------------------------|---|
| • Duration of diabetes | • Alcohol abuse |
| • Level of HBA1C | • Older age |
| • Smoking | • Presence of other microvascular complications |

CLINICAL MANIFESTATIONS

Diabetic polyneuropathy is essentially a distal symmetric sensory neuropathy.

Large nerve fibre loss leads to

- Impairment of vibration sensation
- Impairment of proprioception
- Reduced ankle reflexes

Small nerve fibre loss leads to

- Impairment of pain
- Impairment of light touch
- Impaired temperature sensation

Positive symptoms

- Tingling
- Pain
- Electric-like sensations
- Prickling like-sensations
- Burning-like sensations

Negative symptoms

- Numbness
- Deadness
- Loss of balance

SCREENING

- All type 2 diabetes patients at diagnosis and after 5 years of diagnosis for type 1 diabetes and annually thereafter
- Assessment of distal symmetrical polyneuropathy should include careful history and assessment for small nerve fibre function with either pinprick or temperature sensation and large fibre with checking for vibration sensation with a 128Hz tuning fork.
- Annual assessment for loss of protective function of the feet with a 10g-monofilament

12.2 Flowchart Approach

SUSPECT DPN BASED ON HISTORY AND PHYSICAL EXAMINATION

Positive symptoms-burning, prickling, electric like sensations and pain

Negative symptoms-numbness, deadness, loss of balance

CONFIRM NEUROPATHY USING OBJECTIVE TESTS

- Pinprick sensation
- Vibration loss with 128hz tuning fork
- Loss of protective function using 10-g monofilament

EXCLUDE NON-DIABETIC CAUSES OF NEUROPATHY

- B12 deficiency
- Chemotherapy induced neuropathy
- Alcohol induced neuropathy
- Hypothyroidism
- Malignancies
- Infections

- **Explain diagnosis to patient**
- **Advise on lifestyle measures**
- **Optimize glucose control**
- **Assess other co-morbidities**

PRESCRIBE PHARMACOLOGICAL THERAPY WITH ANY OF THE FOLLOWING

- Pregabalin
- Duloxetine
- Gabapentin

13

DIABETES FOOT COMPLICATIONS

13.1: Foot Examination 3 Minute Guide

Table 22: Foot Examination 3 Minute Guide

What to ask (1 minute)

Does the patient have a history of:

- Previous leg/foot ulcer or lower limb amputation/surgery?
- Prior angioplasty, stent, or leg bypass surgery?
- Foot wound requiring more than 3 weeks to heal?
- Smoking or nicotine use?
- Diabetes? (If yes, what are the patient's current control measures?)

Does the patient have:

- Burning or tingling in legs or feet?
- Leg or foot pain with activity or at rest?
- Changes in skin color, or skin lesions?
- Loss of lower extremity sensation?

Has the patient established regular podiatric care?

What to look for (1 minute)

Dermatologic exam:

- Does the patient have discolored, ingrown, or elongated nails?
- Are there signs of fungal infection?
- Does the patient have discolored and/or hypertrophic skin lesions, calluses, or corns?
- Does the patient have open wounds or fissures?
- Does the patient have interdigital maceration?

Neurologic exam:

- Is the patient responsive to the Ipswich Touch Test (see below)?

Musculoskeletal exam:

- Does the patient have full range of motion of the joints?
- Does the patient have obvious deformities? If yes, for how long?
- Is the midfoot hot, red, or inflamed?

Vascular exam:

- Is the hair growth on the foot dorsum or lower limb decreased?
- Are the dorsalis pedis and posterior tibial pulses palpable?
- Is there a temperature difference between the calves and feet, or between the left and right foot?

What to teach (1 minute)

Recommendations for daily foot care:

- Visually examine both feet, including soles and between toes. If the patient can't do this, have a family member do it.
- Keep feet dry by regularly changing shoes and socks, dry feet after baths or exercise.
- Report any new lesions, discolorations, or swelling to a health care professional.

Education regarding shoes:

- Educate the patient on the risks of walking barefoot, even when indoors.
- Recommend appropriate footwear and advise against shoes that are too small, tight, or rub against a particular area of the foot.
- Suggest yearly replacement of shoes—more frequently if they exhibit high wear.

Overall health risk management:

- Recommend smoking cessation (if applicable).
- Recommend appropriate glycemic control.

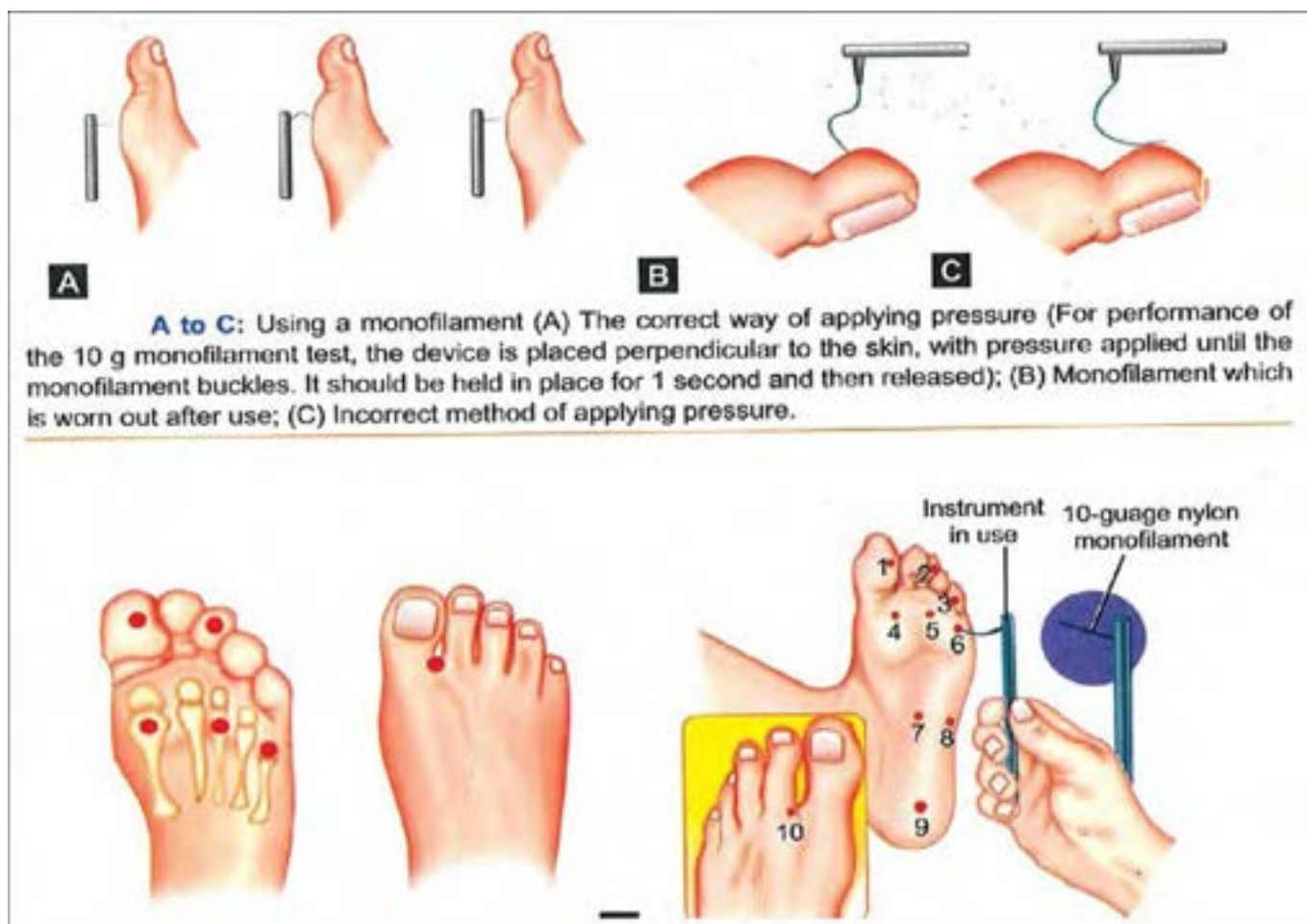


Figure 26: Diabetic Foot

Note:

Ipswich Touch Test (IPTT) procedure:

- Instruct patient to close eyes and say “yes” whenever the touch on a toe is felt.
- Lightly touch/rest the tip of the index finger for 1–2 seconds on the tips of the first, third, and fifth toes of the patient.

Scoring the IPTT:

- 0/6 is a poor score
- 6/6 is a good score
- <4/6 indicates diabetic neuropathy

13.2: Diabetes related foot complications assessment

BONE OR JOINT ABNORMALITY

- Deformity (claw toes, hammer toes, hallux valgus)
- Bony prominence, areas of abnormal pressure
- Loss of joint mobility (hallux, rigidus)

SKIN

- Callus, corns, cracks, interdigital maceration
- Inappropriate footwear

PROTECTIVE SENSATION

- Monofilament sensation abnormal at any spot on 2 attempts

ULCER

- Past history of ulcer
- Past history of amputation

VASCULAR

- Claudication or rest pain
- Absent pedal pulses

IF ANY ONE ANSWER IS YES, THE FOOT IS AT RISK OF ULCERATION OR AMPUTATION. THE FOOT MUST BE ASSESSED AT EVERY VISIT

INTERVENE AND REFER

INTERVENE

- Patient foot education
- Quit smoking
- Optimize glycaemic control
- Optimize BP control
- Optimize lipid profile

REFER

- Refer to a centre with a physician or podiatry service
- Specialist care for those with ulcer, or vascular symptoms (Cardiovascular/surgeon)

Table 23: Time for a specialist? Mapping out a treatment and follow-up plan

Priority	Indications	Timeline	Suggested follow-up by specialist
Urgent (active pathology)	Open wound or ulcerative area, with or without signs of infection New neuropathic pain or pain at rest Signs of active Charcot neuroarthropathy (red, hot, swollen midfoot or ankle) Vascular compromise (sudden absence of DP/PT pulses or gangrene)	Immediate referral/consult	As determined by specialist
High (ADA risk category 3)	Presence of diabetes with a previous history of ulcer, Charcot neuroarthropathy, or lower extremity amputation	Immediate or “next available” outpatient referral	Every 1-2 months
Moderate (ADA risk category 2)	Peripheral artery disease +/- LOPS DP/PT pulses diminished or absent Presence of swelling or edema	Referral within 1-3 weeks (if not already receiving regular care)	Every 2-3 months
Low (ADA risk category 1)	LOPS +/- longstanding, nonchanging deformity patient requires prescriptive or accommodative footwear	Referral within 1 month	Every 4-6 months
Very low (ADA risk)	No LOPS or peripheral artery disease Patient seeks education regarding foot care, athletic training, appropriate footwear, preventing injury, etc.	Referral within 1-3 months	Annually at minimum

ADA, American Diabetes Association; DP, dorsalis pedis; LOPS, loss of protective sensation; PT, posterior tibial.

*All patients with diabetes should be seen at least once a year by a foot specialist.

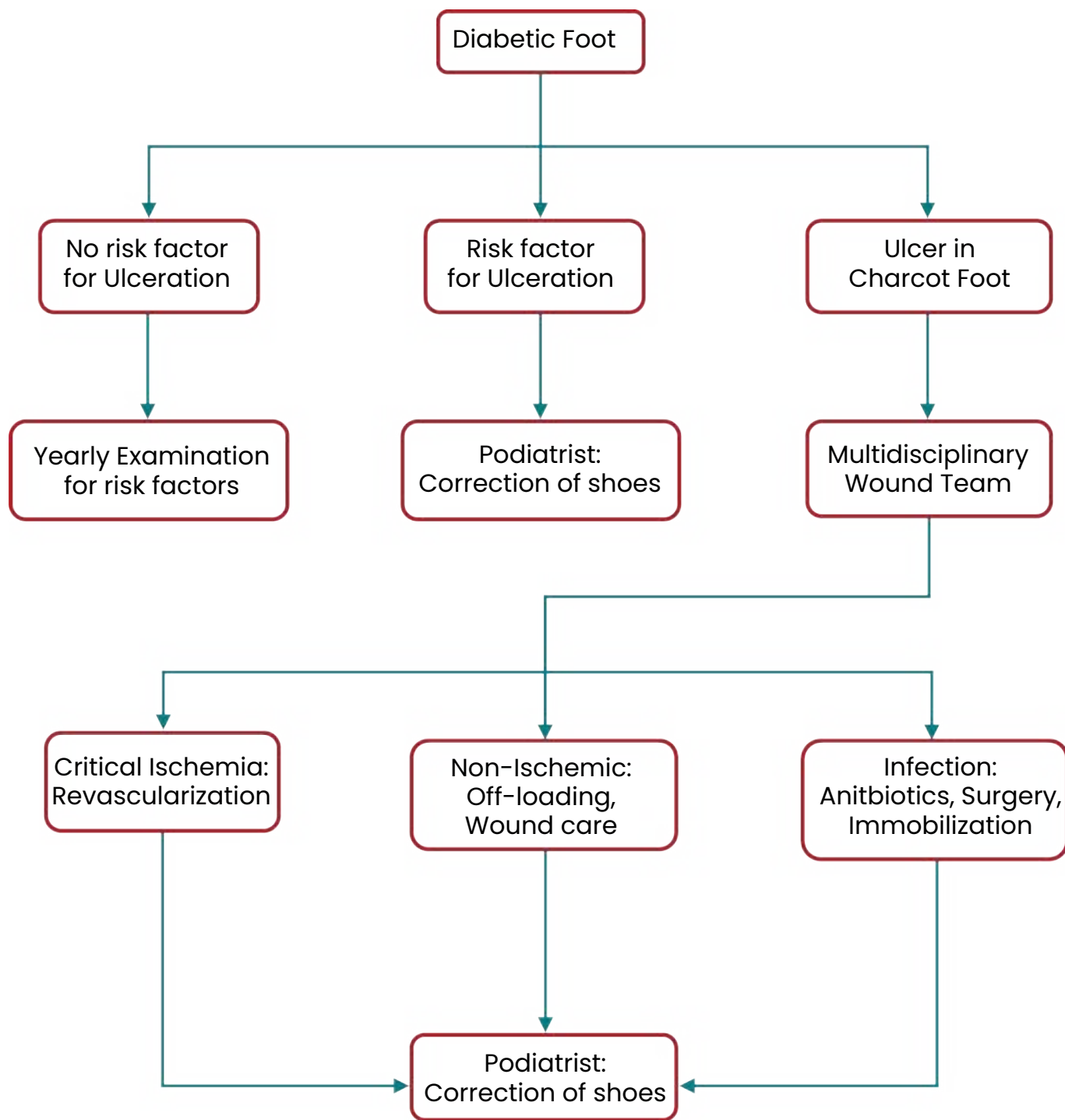


Figure 27: Patterns of nerve injury in diabetes

14

DIABETES RETINOPATHY

14.0: Introduction

Diabetic retinopathy is a neurovascular complication of both type 1 and 2 diabetes and its severity directly relates to the duration of diabetes and level of glycemic control.

It is the most common cause of new cases of blindness in those 20-74 years in developed nations.

Glaucoma, cataracts, and other eye disorders occur at an earlier age in those with diabetes.

RISK FACTORS

Factors associated with an increased incidence of diabetic retinopathy are

- Chronic hyperglycemia
 - Systemic hypertension-especially with systolic BP above 140mmHg
 - Nephropathy
 - Hyperlipidemia- associated with retinal hard exudates and visual loss
- Pregnancy and adolescence can aggravate progression of retinopathy especially in the presence of poorly controlled diabetes.
 - Gestational diabetes has not been shown to be associated with increased risk of development or progression of diabetic retinopathy
 - Intensive diabetes control with an aim of near or normoglycemia has been shown to reduce the incidence of and delay progress of diabetic retinopathy
 - Recommendations for management are to reduce blood pressure to prevent or slow down progression of diabetic retinopathy as well as optimizing glycemia and lipid control to reduce risk and slow progression of retinopath

14.1: Recommendations for Screening and Treatment of Retinopathy

Screening for Diabetic Retinopathy

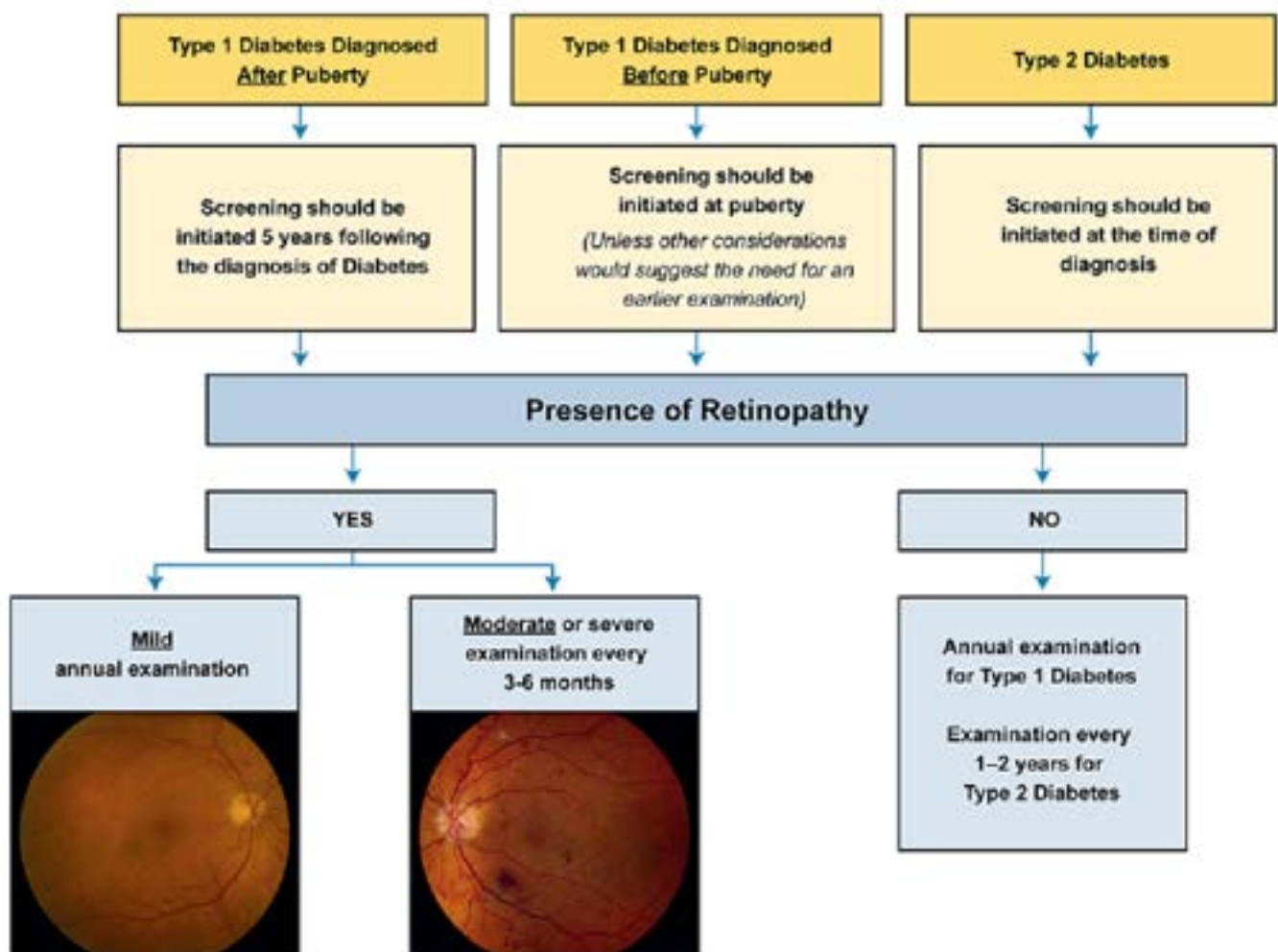


Figure 28: Screening for diabetic retinopathy

- While retinal photography may serve as a screening tool for retinopathy, it is not a substitute for a comprehensive eye exam, which should be performed at least initially and at intervals thereafter as recommended by an eye care professional.
- If diabetic retinopathy is present, prompt referral to an ophthalmologist is recommended.
- Retinal photography, with remote reading by experts, has great potential to provide screening services in areas where qualified eye care professionals are not readily available.
- The presence of retinopathy is not a contraindication to aspirin therapy for cardioprotection, as aspirin does not increase the risk of retinal hemorrhage.

15

ERECTILE DYSFUNCTION IN DIABETES

TREATING ERECTILE DYSFUNCTION IN MEN WITH DIABETES

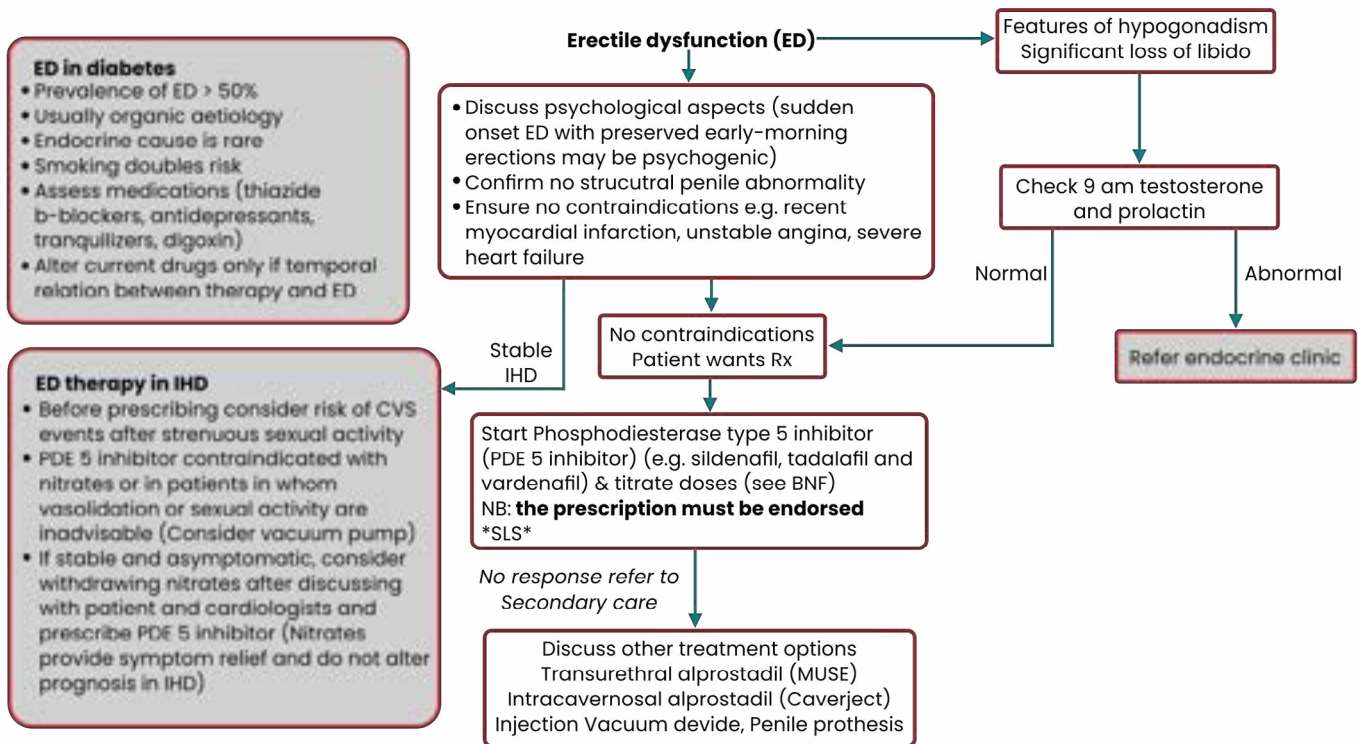


Figure 29: Treating Erectile Dysfunction in men with diabetes

Table 24: The International Index of Erectile Function (IIEF-5) Questionnaire

Over the past 6 months:					
1. How do you rate your confidence that you could get and keep an erection?	Very low 1	Low 2	Moderate 3	High 4	Very high 5
2. When you had erections with sexual simulation, how often were your erections hard enough for penetration?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5
3. During sexual intercourse, how often were you able to maintain your erection after you had penetrated (entered) your partner?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5
4. During sexual intercourse, how difficult was it to maintain your erection to completion of intercourse?	Extremely difficult 1	Very difficult 2	Difficult 3	Slightly difficult 4	Not difficult 5
5. When you attempted sexual intercourse, how often was it satisfactory for you?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5

IIEF-5 Scoring:

The IIEF-5 score is the sum of the ordinal responses to the 5 items.

22-25: No erectile dysfunction

17-21: Mild erectile dysfunction

12-16: Mild to moderate erectile dysfunction

8-11: Moderate erectile dysfunction

5-7: Severe erectile dysfunction

16

DIABETES AND ORAL HEALTH

It is important to examine all people living with diabetes for oral health

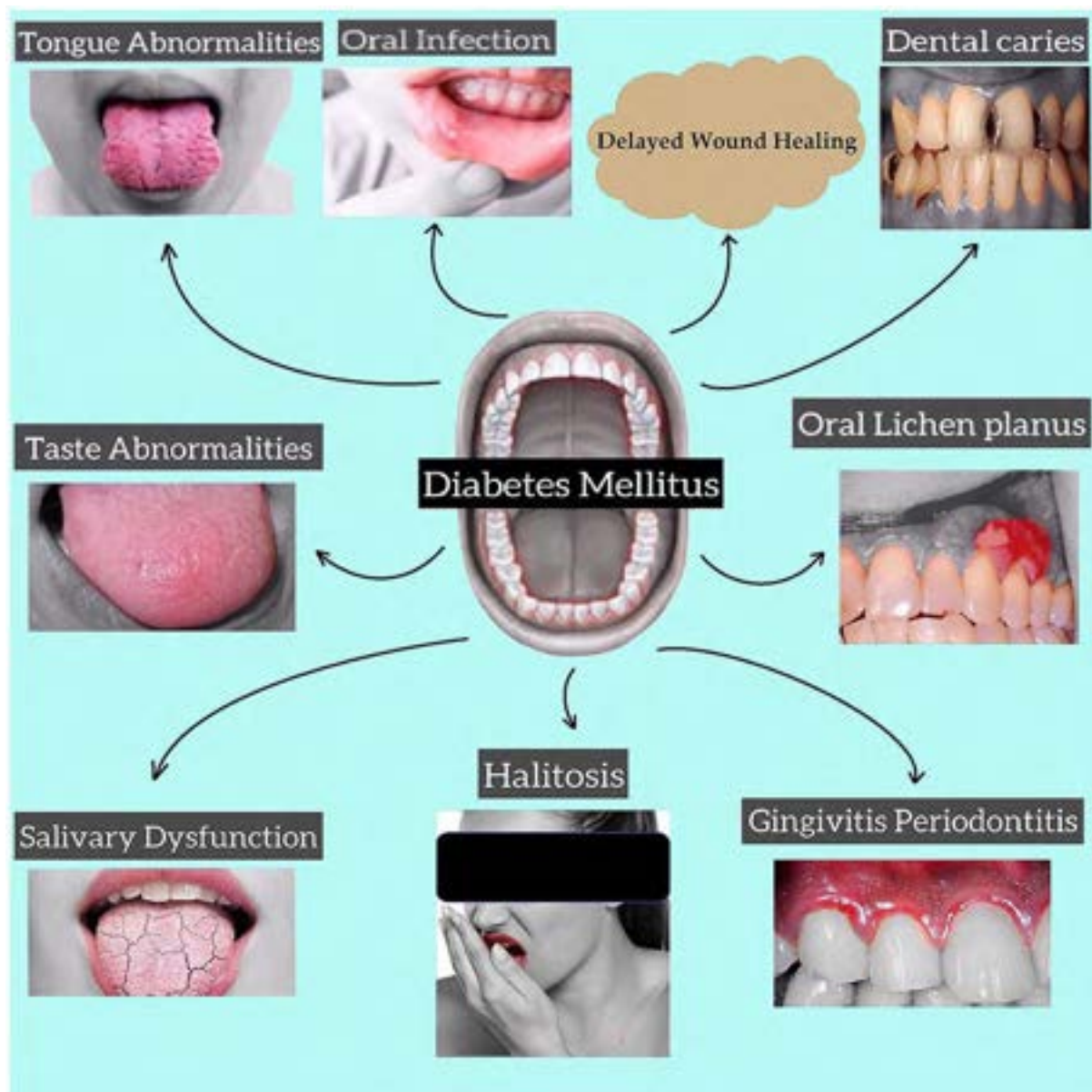


Figure 30: Oral health manifestations in diabetes

ORAL MANIFESTATIONS OF DIABETES.

- Burning Mouth Syndrome
- Candidiasis
- Dental Caries
- Gingivitis
- Glossodynia
- Lichen Planus
- Neurosensory Dysesthesias
- Periodontitis
- Salivary Dysfunction
- Taste Dysfunction
- Xerostomia

Table 25: Oral Health disorders and their presentation in Diabetes

ORAL HEALTH DISORDERS	PRESENTATION
Xerostomia	Presents with glossitis, cervical caries, buccal mucosa dryness, peeled and cracked lips.
Infections of the oral cavity	They result in halitosis, gingivitis, dental caries & mouth sores.
Poor wound healing of the oral cavity	This occurs due to chronic complications of Diabetes whereby blood supply is hindered.
Dental caries	They occur due to hyposalivation and increased glucose levels which damage the microvasculature hence favours plaque formation and ultimately caries.
Taste dysfunction	Distinction and recognition of taste sensation is altered in Diabetes and this can result in unhealthy eating habits.
Burning mouth syndrome	Neuropathic orofacial condition of pain with oral mucosal burning pain that commonly affects anterior 2/3rd of the tongue. It can be associated with peripheral neuropathy
Tongue abnormalities like fissured tongue, atrophic glossitis	Fissured tongue: It is mainly characterized by grooves with depth and size variation on the dorsal tongue surface. Symptoms occur when debris gets stuck in the fissures. Atrophic glossitis: Atrophic glossitis is a condition of the tongue in which there is the absence of fungiform and filiform papillae on the tongue's dorsal surface, which eventually alters the tongue's appearance and texture, making it smooth and soft
Halitosis	Halitosis or bad breath is one of the early diabetes symptoms, a typical ketone smell in people with diabetes. Periodontal disease may also lead to sulfide compound odor. Increased levels of fatty acid and methyl nitrate in blood cause oxidative stress that leads to Halitosis.
Oral Lichen Planus:	Presents as white raised lines forming a lace-like pattern that is symmetrical and bilateral. Patient complains of discomfort and burning sensation in the mouth that can cause feeding and swallowing difficulty. It is considered pre-malignant.

16.1: Recommendation on oral care for people with diabetes

1. Enquire annually as to whether each person with diabetes follows local recommendations for day-to-day dental care for the general population and where access permits, attends a dental professional regularly for oral health check-ups.
2. Enquire at least annually for symptoms of gum disease (bleeding when brushing teeth and gums which are swollen or red).
3. Advise those not attending regular dental check-ups to do so regularly as this forms part of diabetes self-management.
4. In those people with possible symptoms of gum disease, advise them to seek early attention from a dental health professional.
5. Education of people with diabetes should include explanation of implications of diabetes particularly poorly controlled diabetes for oral health.

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DIABETES AND CO-MORBIDITIES

17.1: Management of Hypertension in Diabetes

- Hypertension is diagnosed with at least 2 readings on separate occasions (at least 4 hours apart) of $>140/90$ mmHg
- ALL hypertensive patients with Diabetes should monitor their BP at home

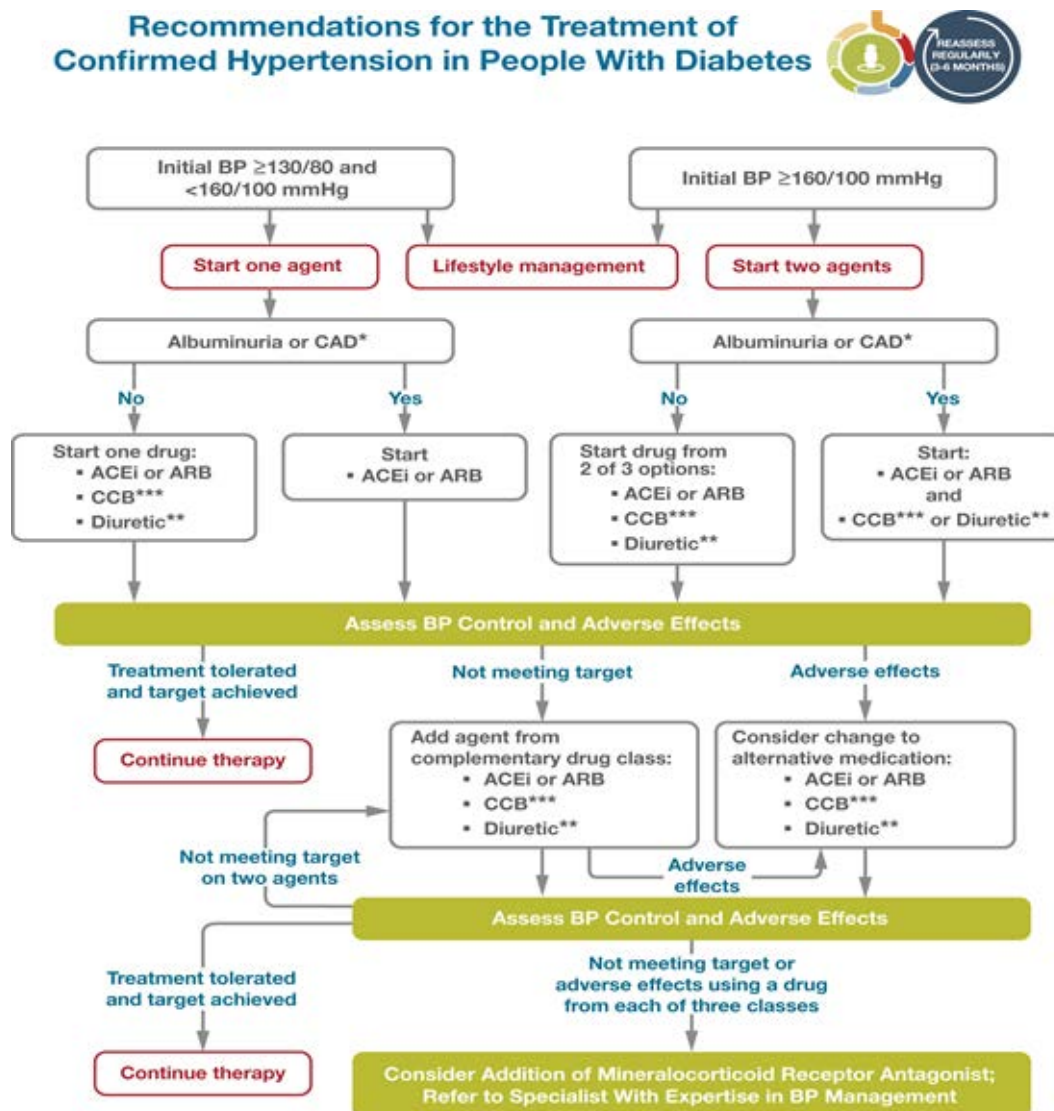


Figure 31: Recommendations for the treatment of confirmed hypertension in people with diabetes

- An ACE inhibitor (ACEi) or angiotensin receptor blocker (ARB) is suggested to treat hypertension for people with coronary artery disease (CAD) or urine albumin-to-creatinine ratio 30–299 mg/g creatinine and strongly recommended for individuals with urine albumin-to-creatinine ratio ≥ 300 mg/g creatinine.
- Thiazide-like diuretic; long-acting agents shown to reduce cardiovascular events, such as chlorthalidone and indapamide, are preferred.
- Dihydropyridine calcium channel blocker (CCB). BP, blood pressure.

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DIABETES AND HIV

- All HIV patients should be screened for diabetes before commencing antiretroviral therapy, 4-6 weeks after starting therapy and then every 3-6 months
- Dolutegravir may increase circulating levels of metformin, which still remains the first line agent in those with diabetes and HIV. Caution must be taken not to give more than 1000mg of metformin in those taking dolutegravir as part of their regimen.
- Simvastatin and lovastatin are contraindicated in HIV as they are associated with a higher incidence of muscle pains. Rosuvastatin and atorvastatin may be commenced at low doses then titrated upwards as needed
- HIV protease inhibitors (PIs) should be avoided in those with and at risk of diabetes.

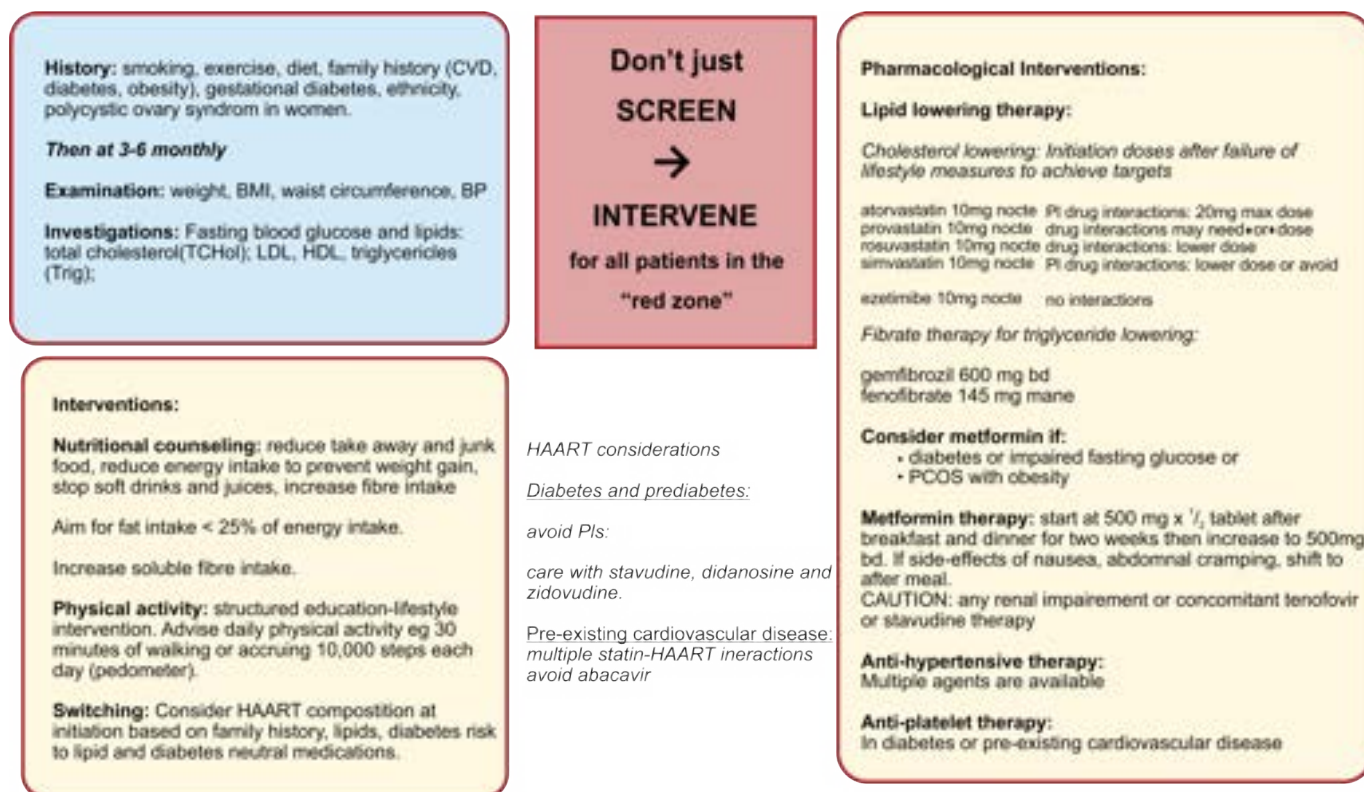


Figure 32: Diabetes and HIV

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DIABETES AND TUBERCULOSIS

- An impairment in the immune system, as occurs with diabetes mellitus, may increase the risk of progression from latent to active tuberculosis
- Cases of death and relapse are also increased in patients with tuberculosis and diabetes
- Tuberculosis may temporarily impair pancreatic function and thereby increase risk of developing diabetes

19.1: Impact of Diabetes on Tuberculosis

Increased risk of

- Active disease
- Greater time to sputum culture
- Treatment failure
- Death

Recurrent tuberculosis

- Change in clinical picture
- Extrapulmonary tuberculosis
- Lower lobe involvement
- Cavitary disease

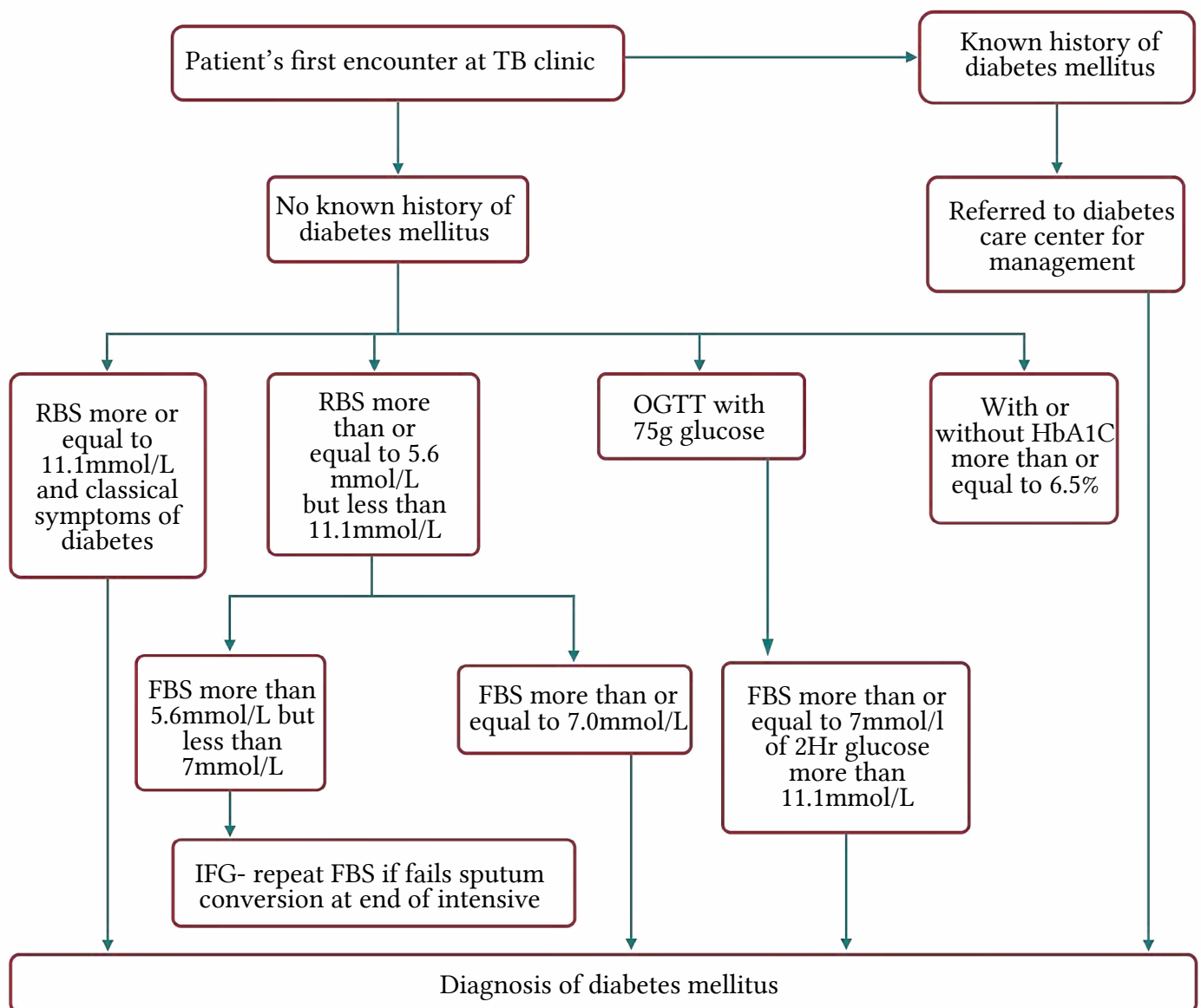


Figure 33: Screening for DM in TB patients

- A large population of those with diabetes and concurrent tuberculosis are not yet diagnosed or are diagnosed too late
- It is important that those with tuberculosis are routinely screened for diabetes and those with diabetes, living in areas with a high prevalence of tuberculosis, be screened for the same
- Intensive diabetes prevention and treatment strategies, help reduce or prevent incidence of tuberculosis

20

DIABETES AND PREGNANCY

20.1: Hyperglycaemia in Pregnancy

Hyperglycaemia in pregnancy can be caused by two conditions:

- Gestational diabetes mellitus (GDM), which is defined as glucose intolerance of variable degree with onset or first recognition during pregnancy.
- Diabetes in pregnancy: Pregnancy occurring in patients already diagnosed with either type 1 or 2 DM.

Diabetes in Pregnancy	Gestational Diabetes Mellitus
- Pregnancy in a patient known to previously have Diabetes - Hyperglycemia diagnosed for the 1st time during pregnancy, that meets the WHO criterion for DM in the non-pregnant state - May occur at any time during the pregnancy, including the 1st trimester	- Hyperglycemia diagnosed for the 1st time during pregnancy, (in 2nd or 3rd trimester) - Hyperglycemia levels do not meet WHO criterion for MD - May occur at any time during the pregnancy, but most likely after 24 weeks

Figure 34: Differences between diabetes in pregnancy and gestational diabetes

Table 26: Diagnostic criteria for diabetes in pregnancy and gestational diabetes mellitus

	Diabetes in Pregnancy	Gestational Diabetes mellitus
Fasting Blood Glucose	≥ 7 mmol/L (126 mg/dL)	5.1-6.9 mmol/L (92-125 mg/dL)
1 hour post-prandial (after 75-g oral glucose load)	Not applicable	≥ 10 mmol/L (180 mg/dL)
2 hour post-prandial (after 75-g oral glucose load)	> 11.0 mmol/L (200 mg/dL)	8.5-11.0 mmol/L (153-199 mg/dL)
Random Blood Glucose	≥ 11.0 mmol/L (200 mg/dL) in the presence of DM symptoms	Not applicable

Table 27: Identifying women at high risk for GDM for early screening

Women at high risk of GDM
• BMI>30kg/m² • Age > 35 years • Previous history of GDM • Persistent Glycosuria • Previous large baby (> 4 kg) • Poor obstetric history (previous miscarriages, still births, previous congenital anomalies) • Family history of diabetes (First degree relatives) • Pregnancy with polyhydramnios • Polycystic ovarian syndrome • Known IGT / IFG • Grand multipara • Multiple gestation

20.2: Gestational Diabetes Screening

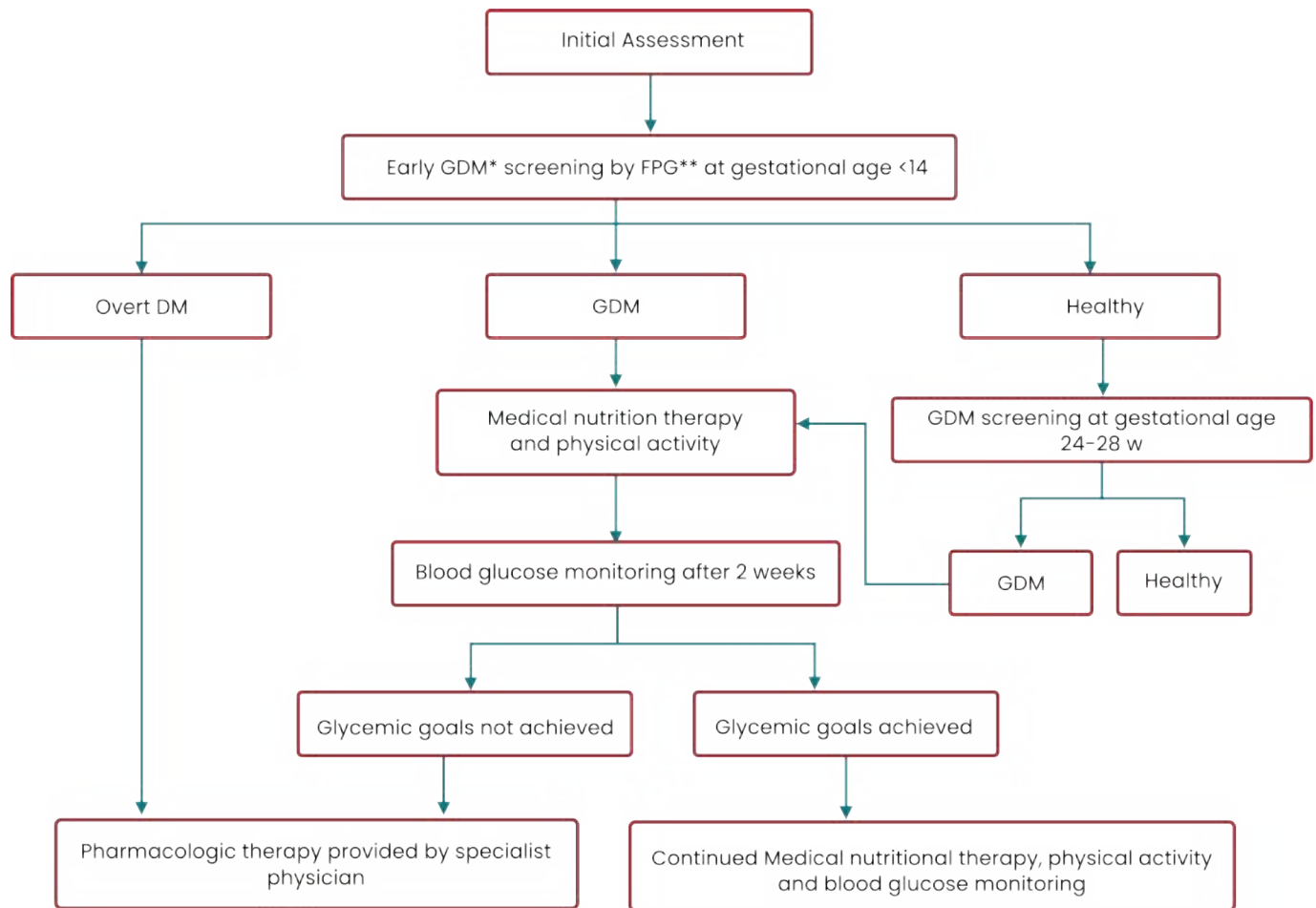


Figure 35: Flow chart of screening and management of Gestational Diabetes in Pregnancy

*GDM: gestational diabetes mellitus; **FPG: fasting plasma glucose

Notes:

- If the woman has more than one risk factor (Table 27) do an RBS/FBS/OGTT at first contact.
- Universal screening:
- Screening should be done at 24-28 weeks (or at first contact if patient presents late).
- Perform a 75-g OGTT - Administer 75 g of glucose orally after an 8-hr. overnight fast and do a blood glucose level after 1 hour and 2 hours (1 standard level tea spoon =5 g).
- Diagnosis: criteria in Table 26

Glucose targets in Pregnancy:

- FBS: 3.7- 5.3 mmol/l
- 1 hour post prandial: <7.8 mmol/l
- 2 hours post prandial <6.7 mmol/l

Management of diabetes in pregnancy

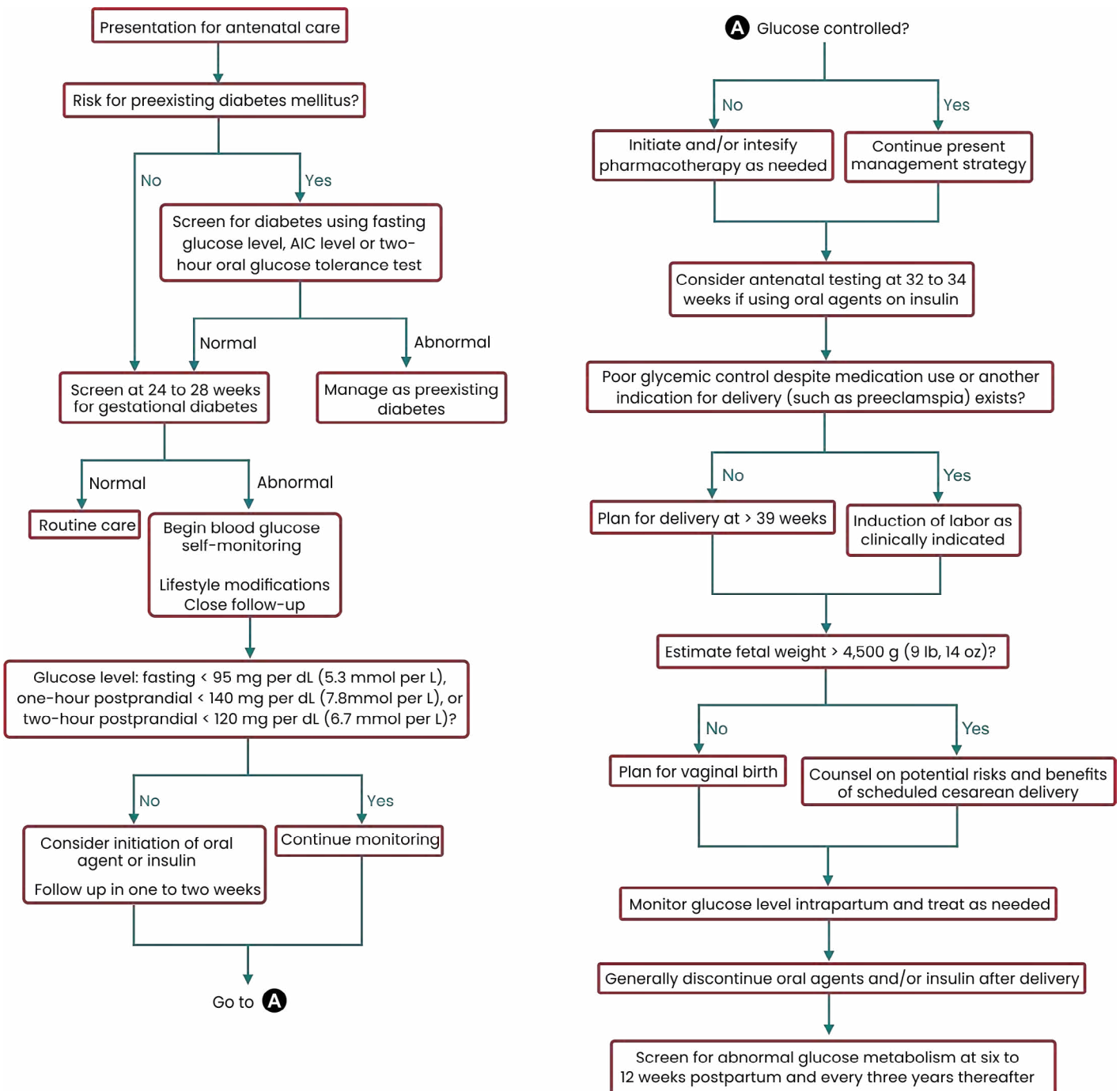


Figure 36: Management of diabetes in pregnancy

20.3: Pharmacologic Therapy in Gestational Diabetes

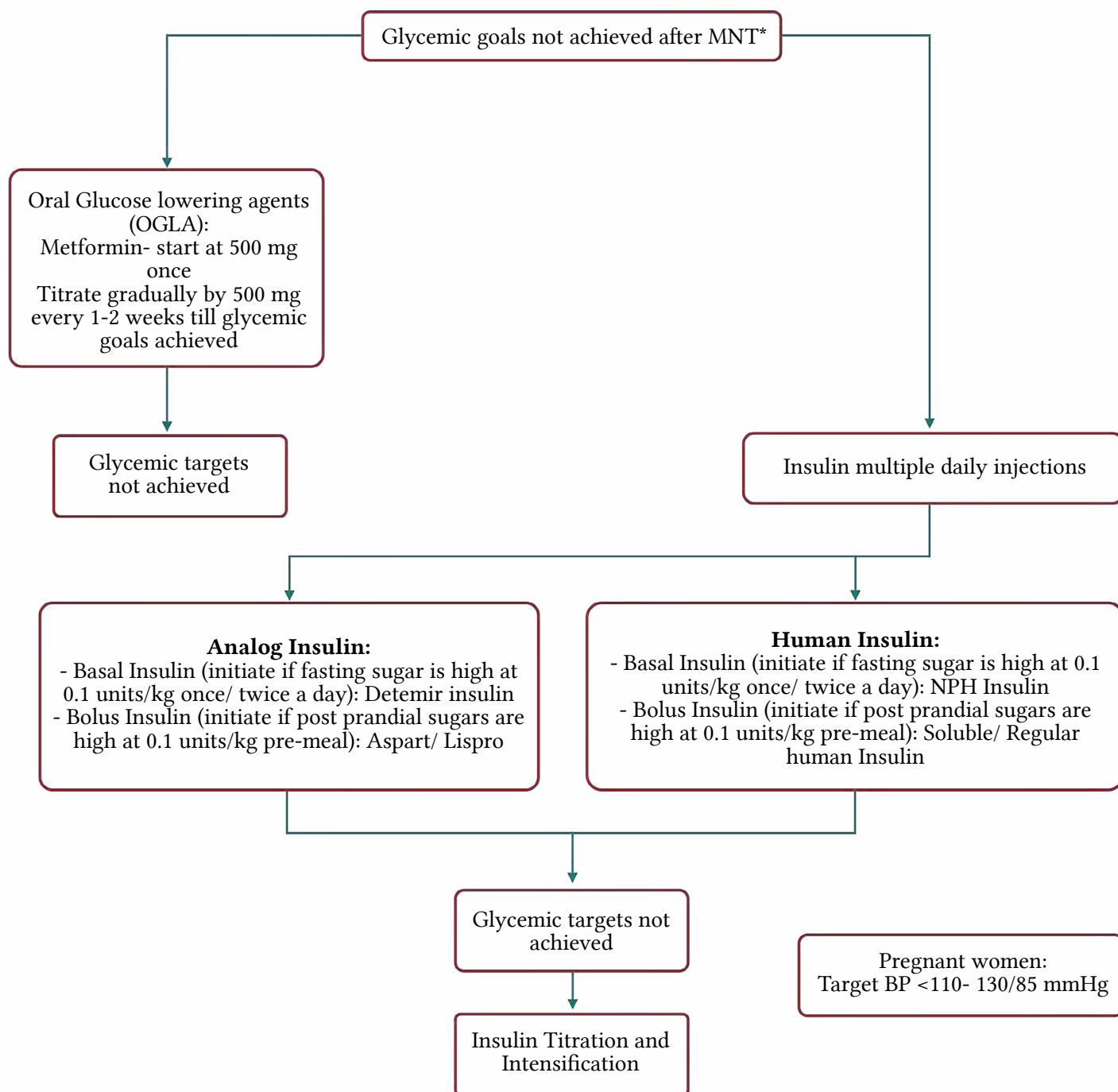


Figure 37: Treatment of GDM

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DIABETES AND RAMADAN FASTING

- Fasting in the month of Ramadan is strongly recommended for all adult Muslims. This month is based on the lunar calendar and occurs once a year, where Muslims across the globe abstain from all foods and drinks from dawn to dusk, correlating with the pre-dawn prayers and evening prayers.
- Important terminologies during this period include:
 - ***IFTAR- evening meal while breaking the fast**
 - ***SUHUR- pre-dawn meal before starting the fast**
- Patients living with diabetes are recommended to get risk stratification before Ramadan in order to evaluate the risk fasting could have on them and whether they can be recommended to fast or not, based on medical and religious consensus. This should involve a pre- Ramadan visit at least 8 weeks prior to Ramadan.
- Patients in moderate or high-risk categories who opt to fast during Ramadan should be supported through appropriate pre-Ramadan and during-Ramadan education on safe fasting.
- A post-Ramadan visit is necessary to assess the safety of fasting and outcomes related to fasting including hypoglycemic and hyperglycemic episodes, hospital admissions and diabetes complications. ‘

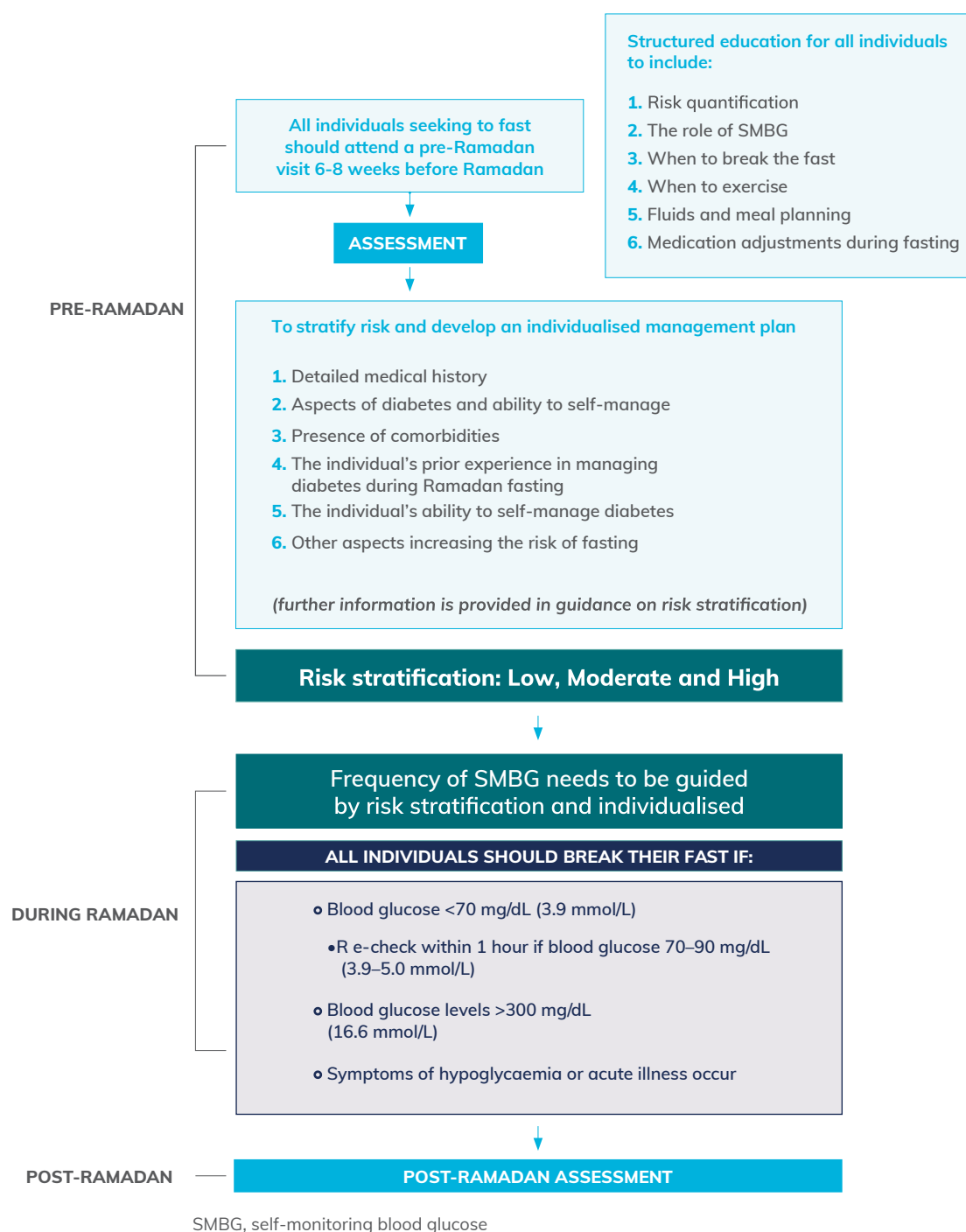


Figure 38: Assessment flowchart

- SMBG, self-monitoring blood glucose

*This applies for those with sudden rise in blood glucose level, individualization of care is advisable

ALL INDIVIDUALS SHOULD BREAK THEIR FAST IF:
Blood glucose <70 mg/dL (3.9 mmol/L) • Re-check within 1 hour if blood glucose is between 70–90 mg/dL (3.9–5.0 mmol/L) Blood glucose >300 mg/dL (16.6mmol/L)* Symptoms of hypoglycaemia, hyperglycaemia, dehydration or acute illness occur

HYPOGLYCAEMIA	HYPERGLYCAEMIA
Trembling Sweating/chills Palpitations Hunger Altered mental status Confusion Headache	Extreme thirst Hunger Frequent urination Fatigue Confusion Nausea/vomiting Abdominal pain

*Consider individualisation of care

Figure 39: When to break the fast

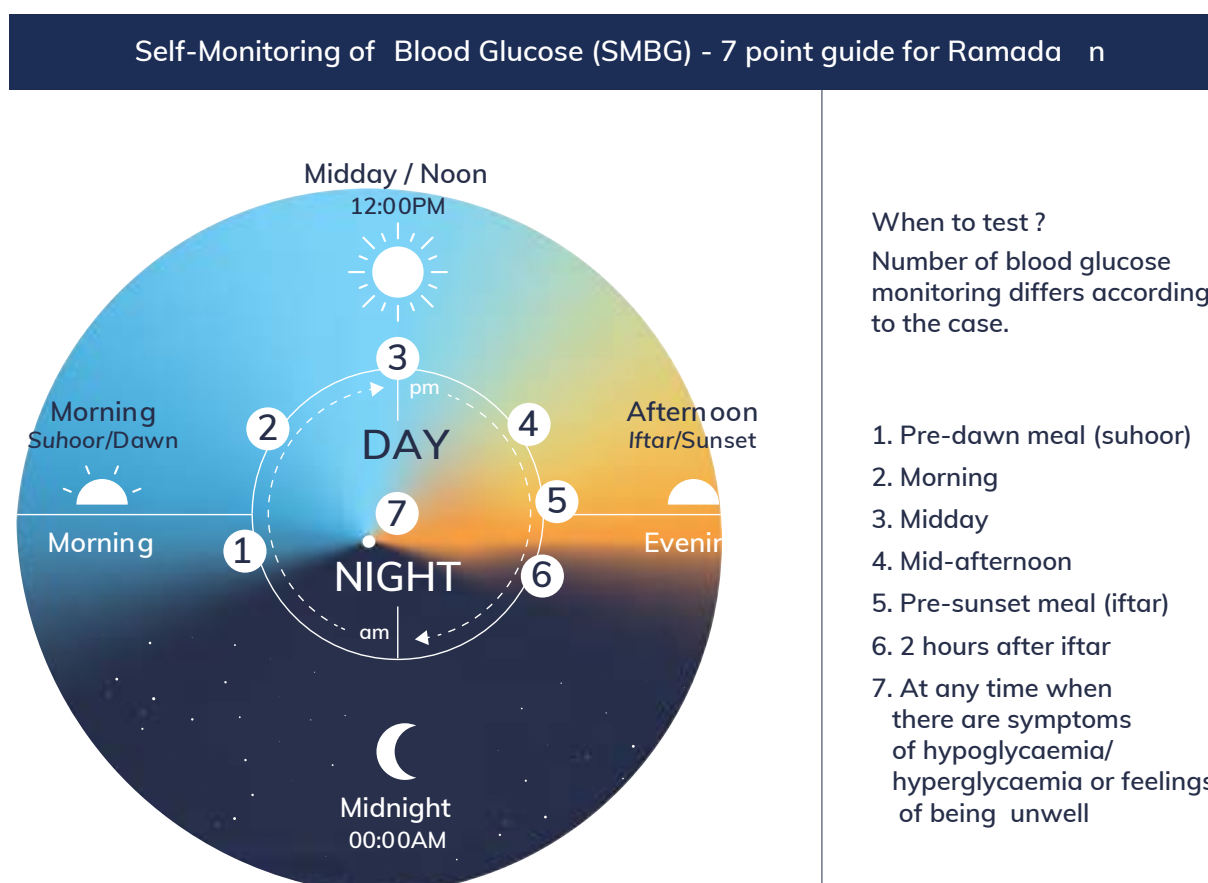


Figure 40: A seven point blood glucose monitoring guide for people with diabetes fasting during Ramadan

Table 28: Recognized Factors That May Influence The Development of Personalised Care For People With Diabetes That Fast During Ramadan

Ramadan related factors	Diabetes related factors	Factors concerning the individual
Length of fasting hours	Type of diabetes	Age (adolescents and elderly)
Season of fasting	Duration of diabetes	Gender
Weather	Diabetic complications	Occupation
Geographical location	Antidiabetic therapies	Pregnancy/Lactation
Social changes	Previous control	Meal pattern
Past experiences	Proneness to hypoglycaemia	Exercise nature/timing
	Hypoglycaemic unawareness	Motivation
	Access to care	Personal preferences

Risk Element	Risk Score
1. Diabetes type and duration	
Type 1 diabetes	1
Type 2 diabetes	0
A duration of ≥ 10	1
A duration of < 10	0
2. Presence of hypoglycaemia	
Hypoglycaemia unawareness	5
Recurrent/severe hypoglycaemia	4
Daily mild hypoglycaemia	3
Hypoglycaemia 1–6 times per week	2
Hypoglycaemia less than 1 time per week	1
No hypoglycaemia	0
3. Characteristics of glycaemic control	
HbA1c levels > 9% (11.7 mmol/L)	2
HbA1c levels 7.5–9% (9.4–11.7 mmol/L)	1
HbA1c levels < 7.5% (9.4 mmol/L)	0
4. Self-Monitoring of Blood Glucose (SMBG)	
Indicated but not conducted	2
Indicated but conducted suboptimally	1
Conducted as indicated	0
5. Acute complications	
DKA/ HONC in the last 3 months	3
DKA/ HONC in the last 6 months	2
DKA/ HONC in the last 12 months	1
No DKA or HONC	0
6. Chronic Complications/Comorbidities	
Unstable angina/Heart failure/eGFR < 30 mL/min	6
eGFR 30–45 mL/min	4
Stable CVD/eGFR 45–60 mL/min	2
No CVD and normal eGFR	0

Risk Element	Risk Score
7. Pregnancy	
Pregnant not within targets	4
Pregnant within targets	2
Not pregnant	0
8. Frailty and Cognitive function	
Impaired cognitive function	4
Frail	3
> 70 years old with no home support	1
No frailty or loss in cognitive function	0
9. Physical Labour	
Intense physical labour	1
No physical labour	0
10. Previous Ramadan Experience	
Overall negative experience	1
No negative or positive experience	0
11. Fasting hours (location)	
≥ 16 hours	1
< 16 hours	0
12. Diabetes treatment	
Multiple daily mixed insulin Injections	3
Basal Bolus/Insulin pump	2.5
Once daily Mixed insulin	2
Basal Insulin	1.5
Glibenclamide	1
Gliclazide/MR or Glimepride or Repaglanide	0.5
Other therapy not including SU or Insulin	0

DKA — Diabetic Ketoacidosis

HONC — Hyperglycaemic Hyperosmolar Nonketotic Coma

eGFR — Estimated glomerular filtration rate

CVD — Cardiovascular disease

*Pregnant and breastfeeding women have the right to not fast regardless of whether they have diabetes



Figure 41: Risk score and risk categories

21.1: Medication Adjustment During Ramadan

1. Type 1 Diabetes:

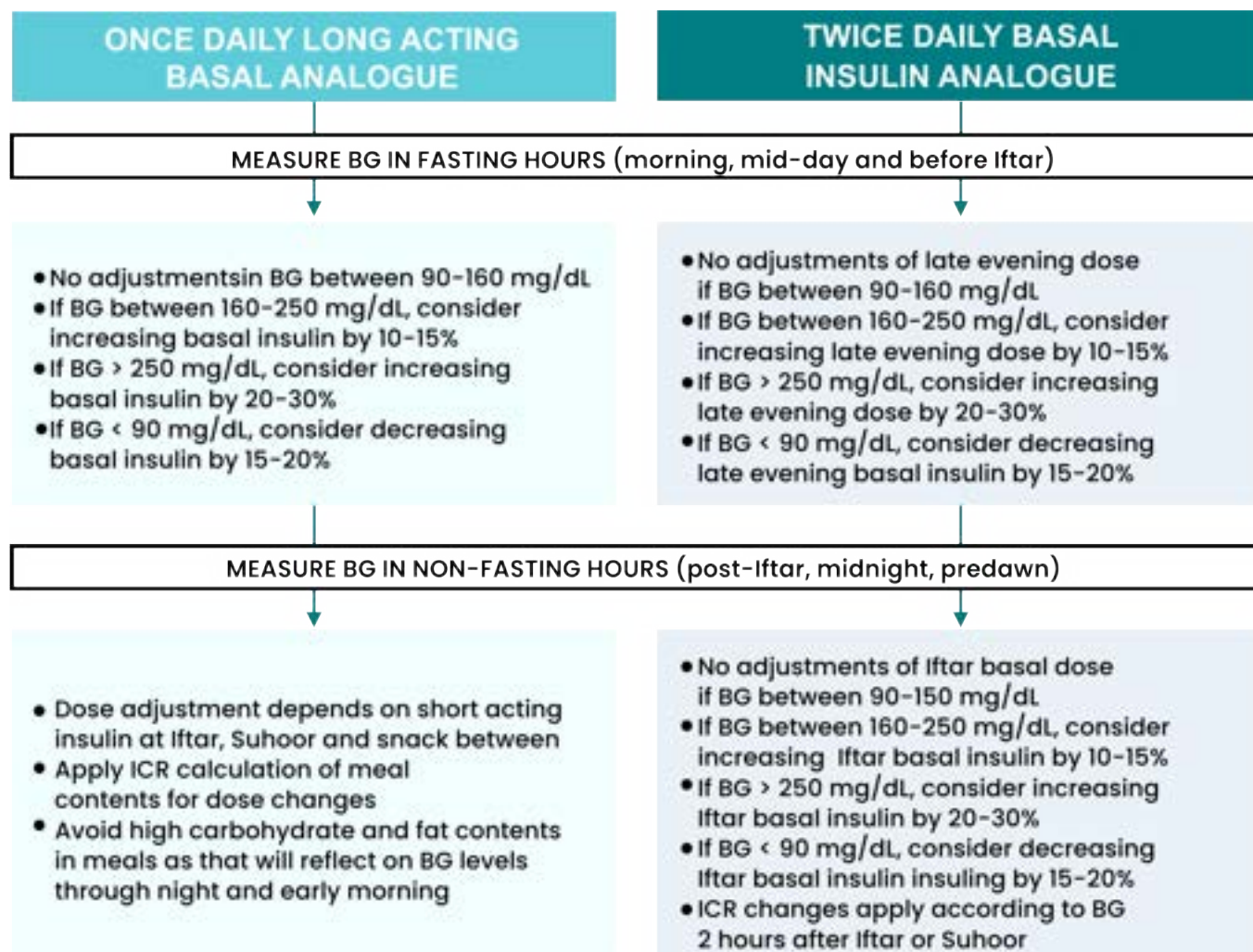


Figure 42: Schematic adjustments of insulin and/or food considerations during fasting and non-fasting hours

Note:

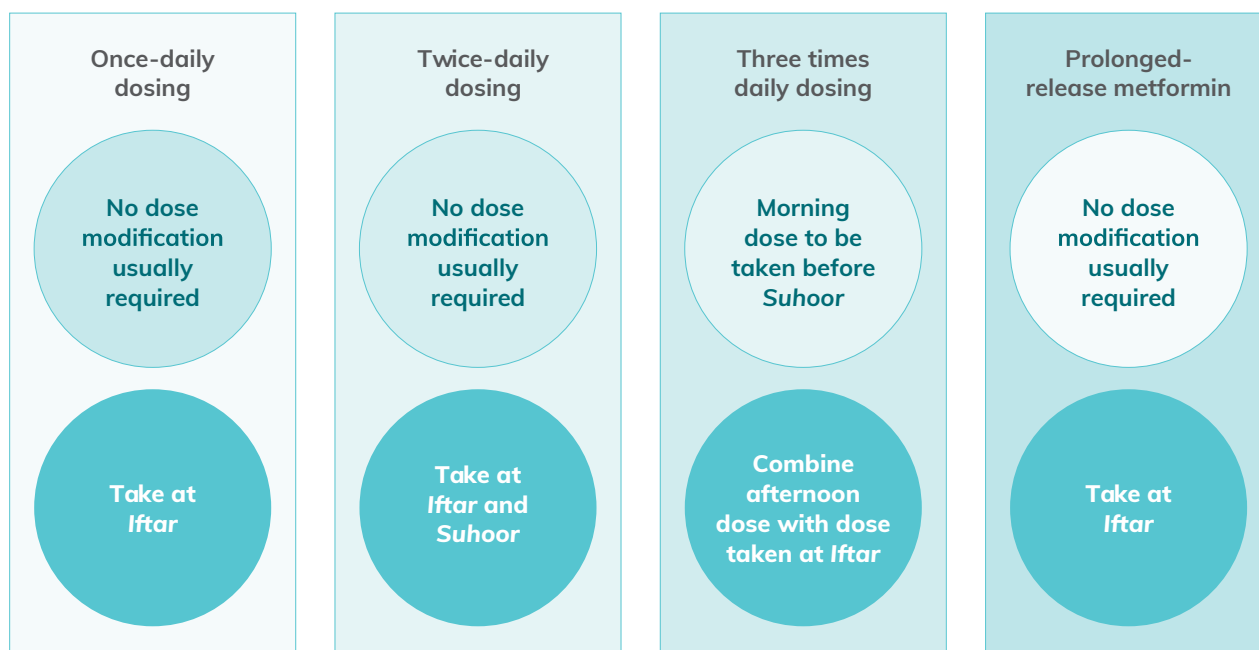
- Glucose in mg/dl can be converted to mmol/l by dividing by 18

Table 29: Recommendations For Insulin Dose Adjustments Based On Type of Regimen

Type of Insulin Regimen	Adjustment for fasting during Ramadan	Methods of monitoring during Ramadan
CSII / Insulin Pump	<u>Basal rate adjustment</u> -20-40% decrease from the last 3-4 hours of fast -10-30% increase for the first few hours after Iftar <u>Bolus doses</u> Same principle prior to Ramadan	CGM
MDI (basal bolus) with analogue insulin	<u>Basal insulin</u> 30-40% reduction in dose and to be taken at Iftar <u>Rapid Analogue insulin</u> -Dose at Suhoor to be reduced by 30-50% -Pre-lunch dose to be skipped -The dose around Iftar to be adjusted based on the 2-hour post Iftar glucose reading	7-point glucose monitoring
MDI (Basal bolus) with convention insulin	<u>NPH insulin</u> -The usual pre-Ramadan morning to be taken in the evening during Ramadan -50% of the pre-Ramadan dose to be taken at Suhoor <u>Regular insulin</u> -Dose at evening meal remains unchanged -Suhoor dose to be 50% of the pre-Ramadan evening dose -Afternoon dose to be skipped	7-point glucose monitoring or 2-3 staggered readings throughout the day
Premixed (analogue or conventional)	Shift the usual pre-Ramadan morning dose to Iftar 50% of the pre-Ramadan evening dose to Suhoor	At least 2-3 daily readings and whenever any hyperglycaemic symptoms develop

2. Type 2 Diabetes:

CHANGES TO METFORMIN DOSING DURING RAMADAN



In Ramadan, NO dose adjustments necessary for:

5. Acarbose 6. DPPIV inhibitors
7. GLP-1 receptor agonists 8. SGLT2 inhibitors

CHANGES TO SU DOSING DURING RAMADAN

Once daily dosing

Take at
Iftar

In individuals
with well-controlled
BG levels,
the dose may
be reduced

Twice-daily dosing

Iftar dose
remains
the same

In individuals
with well-controlled
BG levels,
the Suhoor
dose should
be reduced

Older drugs in SU class

Older drugs
(e.g. glibenclamide)
carry a higher risk
of hypoglycaemia
and should
be avoided

2nd generation
SUs such as
glicazide,
glicazide MR,
glimepiride should
be used instead

CHANGES TO INSULIN PUMP DOSES DURING RAMADAN

Basal Rate

Reduce dose by 20-40% in
the last 3-4 hours of fasting

Increase dose by 0-20%
early after Iftar

Bolus Rate

Normal carbohydrate
counting and insulin
sensitivity principles apply

CHANGES TO LONG AND SHORT-ACTING INSULIN DOSING DURING RAMADAN

Long/intermediate-acting (basal) insulin	Short acting insulin
NPH/detemir/glargine/giargine 300/degludec ONCE DAILY Reduce dose by 15-30% Take at Iftar	Normal dose at Iftar Omit lunch-time dose Reduce Suhoor dose by 25-50%
NPH/detemir/glargine TWICE-DAILY Take usual morning dose after Iftar Reduce evening dose by 50% and take at Suhoor	

Fasting/pre-iftar/pre-Suhoor blood glucose	pre-iftar	pre-iftar*/post-Suhoor**
	Basal insulin	Short-acting insulin
<70 mg/dL (3.9 mmol/L) or symptoms	Reduce by 4 units	Reduce by 4 units
<90 mg/dL (5.0 mmol/L)	Reduce by 2 units	Reduce by 2 units
90-126 mg/dL (5.0-7.0 mmol/L)	No change required	No change required
>126 mg/dL (7.0 mmol/L)	Increase by 4 units	Increase by 4 units
>200 mg/dL (16.7 mmol/L)	Increase by 2 units	Increase by 2 units

*Reduce the insulin dose taken before Suhoor, **Reduce the insulin dose taken before Iftar

CHANGES TO PREMIXED INSULIN DOSING DURING RAMADAN

Once daily dosing	Twice daily dosing	Three-times daily dosing
Take normal dose at Iftar	Take normal dose at Iftar Reduce Suhoor dose by 20-50%	Omit afternoon dose Adjust Iftar and Suhoor doses Carry out dose-titration every 3 days (see below)

Fasting/pre-Iftar/pre-Suhoor blood glucose	pre-Iftar insulin modification
<70 mg/dL (3.9 mmol/L) or symptoms	Reduce by 4 units
<90 mg/dL (5.0 mmol/L)	Reduce by 2 units
90-126 mg/dL (5.0-7.0 mmol/L)	No change required
>126 mg/dL (7.0 mmol/L)	Increase by 2 units
>200 mg/dL (16.7 mmol/L)	Increase by 4 units

Figure 43: Dose adjustments during ramadhan

22

TARGETS IN DIABETES- GLYCEMIC AND NON-GLYCEMIC

22.1: Glycemic Targets and Self-Monitoring of Blood Glucose in Diabetes

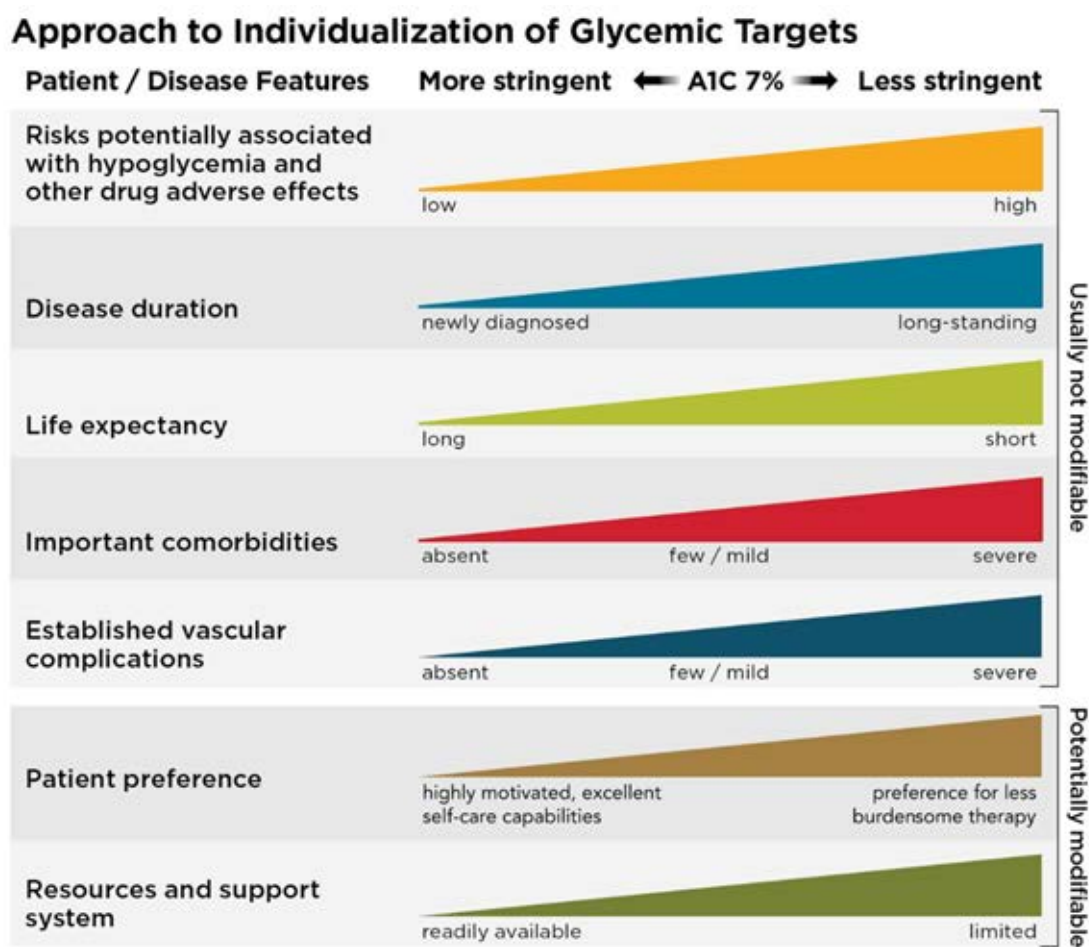


Figure 44: Glycaemic Targets

22.2: HBA1C targets including in special groups (1,2)

- HBA1C monitoring should be done every 3-6 months and should be done at labs that have been accredited by the International Federation of Clinical Chemistry standardization.
- For adults who are on lifestyle management or not on a drug associated with hypoglycaemia, a HBA1C target of 6.5% is recommended.
- For adults who have a drug that is associated with hypoglycaemia, the target is 7.0%
- Individualized target is recommended for patients with type 2 diabetes who are older and frail, or who have reduced life expectancy, have a high risk of hypoglycaemia or who have significant co-morbidities which make intensive management inappropriate. The target can be higher than 7.

Table 30: Treatment targets

Parameter	More stringent	Less stringent
HbA1c (%)	<7.0	<8.0
Fasting/pre-prandial glucose (mmol/L)	4.4-7.2	<8
Post-prandial glucose (mmol/L) (1-2 hours after a meal)	<9.0	

22.3: Self-monitoring of blood glucose

The ideal Self-Monitoring Blood Glucose (SMGB) regimen is shown in figure below.

Table 31: 7-point profile for self-monitoring of blood glucose

	Pre Breakfast	Post Breakfast	Pre Lunch	Post Lunch	Pre Supper	Post Supper	Bedtime
Monday							
Tuesday							
Wednesday	X	X	X	X	X	X	X
Thursday	X	X	X	X	X	X	X
Friday	X	X	X	X	X	X	X
Saturday							
Sunday							

In situations where the above is not feasible, a staggered self monitoring blood glucose can be utilised as depicted in the figure below

Table 32: Staggered self-monitoring of blood glucose

	Pre Breakfast	Post Breakfast	Pre Lunch	Post Lunch	Pre Supper	Post Supper	Bedtime
Monday	X	X					
Tuesday	X	X					
Wednesday			X	X			
Thursday			X	X			
Friday					X	X	
Saturday					X	X	
Sunday							

Notes:

- Post prandial readings are to be taken 2 hours from the start of the meal.
- Pre-meal means immediately before the respective meal
- Females with Diabetes/ hyperglycemia in pregnancy need to include 1 hour post prandial readings alongside FBS/ Premeal/ 2 hour post prandial readings (as recommended per regimen/ cost/ availability).

22.4: Non-glycaemic targets in diabetes

Table 33: Optimal targets for glycaemic, and lipid control in people with diabetes (3,4) (5)

NON GLYCEMIC PARAMETER	TARGET
Cigarette smoking	Cessation
Alcohol consumption	Avoid/cessation
BMI Kg/m ²	<25 Kg/m ²
Blood Pressure (mmHg)*	130/80
Lipids	
Total cholesterol	<4.5 mmol/L
LDL cholesterol	<2.6 mmol/l (<1.8 mmol/l for high risk patients)
HDL cholesterol	> 1.0 mmol/L (men) >1.2 mmol/L (women)
Triglycerides	<1.7mmol/l
Waist circumference	
Women	< 88 cm
Men	< 102 cm

Table 34: BMI Categories and Recommended Interventions

Classification	Values (kg / m ²)- non-Asian	Intervention
Underweight	<18.5	• Multidisciplinary evaluation for underlying factors and planning treatment
Normal weight	18.6-24.9	• Routine Nutrition support and counselling
Overweight	25-29.9	• Diet, physical activity, and behavioral therapy • Pharmacotherapy
Obesity (class 1)	30-34.9	• Diet, physical activity, and behavioral therapy • Pharmacotherapy • Metabolic surgery
Obesity (class 2)	35-39.9	• Diet, physical activity, and behavioral therapy • Pharmacotherapy • Metabolic surgery
Extreme obesity (class 3)	>40	• Diet, physical activity, and behavioral therapy • Pharmacotherapy • Metabolic surgery

Note:

- Management for overweight and obesity be sequential, from non-medical to medical.

23

DIABETES AND MENTAL HEALTH

23.1: Psychosocial Care in Diabetes

Table 35: Situations that warrant referral of a person with diabetes to a mental health provider for evaluation and treatment

Psychosocial care should be integrated with a collaborative, patient-centered approach and provided to all people with diabetes, with the goals of optimizing health outcomes and health-related quality of life
Psychosocial screening and follow-up may include, but are not limited to, attitudes about diabetes, expectations for medical management and outcomes, affect or mood, general and diabetes-related quality of life, available resources (financial, social, and emotional), and psychiatric history
Providers should consider assessment for symptoms of diabetes distress, depression, anxiety, disordered eating, and cognitive capacities using appropriate standardized and validated tools at the initial visit, at periodic intervals, and when there is a change in disease, treatment, or life circumstance. Including caregivers and family members in this assessment is recommended.
Consider screening older adults (aged ≥ 65 years) with diabetes for cognitive impairment and depression

Refer for psychological evaluation & follow up

If:

Self-care remains impaired in a person with diabetes distress after tailored diabetes education
A person has a positive screen on a validated screening tool for depressive symptoms
In the presence of symptoms or suspicions of disordered eating behavior, an eating disorder, or disrupted patterns of eating
Intentional omission of insulin or oral medication to cause weight loss is identified
A person has a positive screen for anxiety or fear of hypoglycemia
A serious mental illness is suspected
In youth and families with behavioral self-care difficulties, repeated hospitalizations for diabetic ketoacidosis, or significant distress
A person screens positive for cognitive impairment
Declining or impaired ability to perform diabetes self-care behaviors
Before undergoing bariatric or metabolic surgery and after surgery if assessment reveals an ongoing need for adjustment support

23.2: Assessment For Depression In Diabetes Done By Using Certain Questionnaires

1.	World Health Organization (WHO)-5 Well-Being Index
	5 items scoring of 0–5 based on the extent to which the respondent agrees with the statement. A score of <13 indicates likely clinical depression.
2.	Becks Depression Inventory (BDI)
	21 item self-report multiple choice questionnaire relating to cognitive and somatic symptoms of depression occurring in the previous 7 days. Each response is scored 0–3 with higher values for more intense symptoms, and then summed with total scores of ≥10 commonly used to indicate depression
3.	Center for Epidemiologic Studies Depression (CES-D) Scale
	20 item self-report scale rated on a 4-point scale indicating the frequency of occurrence of each item in the previous week (0 – rarely/none to 3 – most/all). Scores are summed with ≥16 indicating depression.
4.	Hospital Anxiety and Depression (HADS) Scale
	Measures symptoms of anxiety and depression in patients with somatic complaints. It comprises of 14 items, with half the items addressing depression and the other half, anxiety. Answers score 0–3 and are evaluated as two sum scores between 0 and 21. Scores ≥11 are considered clinically relevant.
5.	Patient Health Questionnaire (PHQ)-9
	9 item questionnaire with each item scoring 0–3 based on the frequency of symptoms. Severity of depression as follows: 5–9 (mild), 10–14 (moderate), 15–19 (moderately severe), and 20–27 (severe). PHQ-8 variant used in epidemiological studies omits a single question regarding suicidal ideation. PHQ-2 has also been studied with a score ≥3 out of a possible 6 identified as the optimal threshold for the diagnosis of major depression.

Assessment for depression in diabetes care can be done using the Patient Health Questionnaire-9 as indicated below.

PATIENT HEALTH QUESTIONNAIRE - 9 (PHQ-9)

Over the last two weeks, how often have you been bothered by any of the following problems?
(Use ✓ to indicate your answer)

	Not at all	Several Days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
5. Feeling bad about yourself - or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING _____ + _____ + _____ + _____

=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all

☐

Somewhat difficult

☐

Very difficult

☐

Extremely difficult

☐

Figure 45: PHQ-9 questionnaire

Score	Depression Severity	Action
0 – 4	None-minimal	Patient may not need depression treatment.
5 – 9	Mild	Use clinical judgment about treatment, based on patient's duration of symptoms and functional impairment.
10 – 14	Moderate	Use clinical judgment about treatment, based on patient's duration of symptoms and functional impairment.
15 – 19	Moderately severe	Treat using antidepressants, psychotherapy or a combination of treatment
20 – 27	Severe	Treat using antidepressants with or without psychotherapy

23.3: Management of Depression In Diabetes

A. NONPHARMACOLOGICAL THERAPY:

- Cognitive behavioural therapy.
- Problem solving.
- Interpersonal therapy.
- Motivational interviewing.
- Counselling.
- Psychodynamic therapy.

B. PHARMACOLOGICAL THERAPY:

- SSRI's are preferred mainly Mirtazapine, Venlafaxine and Bupropion due to less side effects and reduced drug interactions.

C. ELECTROCONVULSIVE THERAPY (ECT):

- Particularly for the elderly patients with Diabetes.

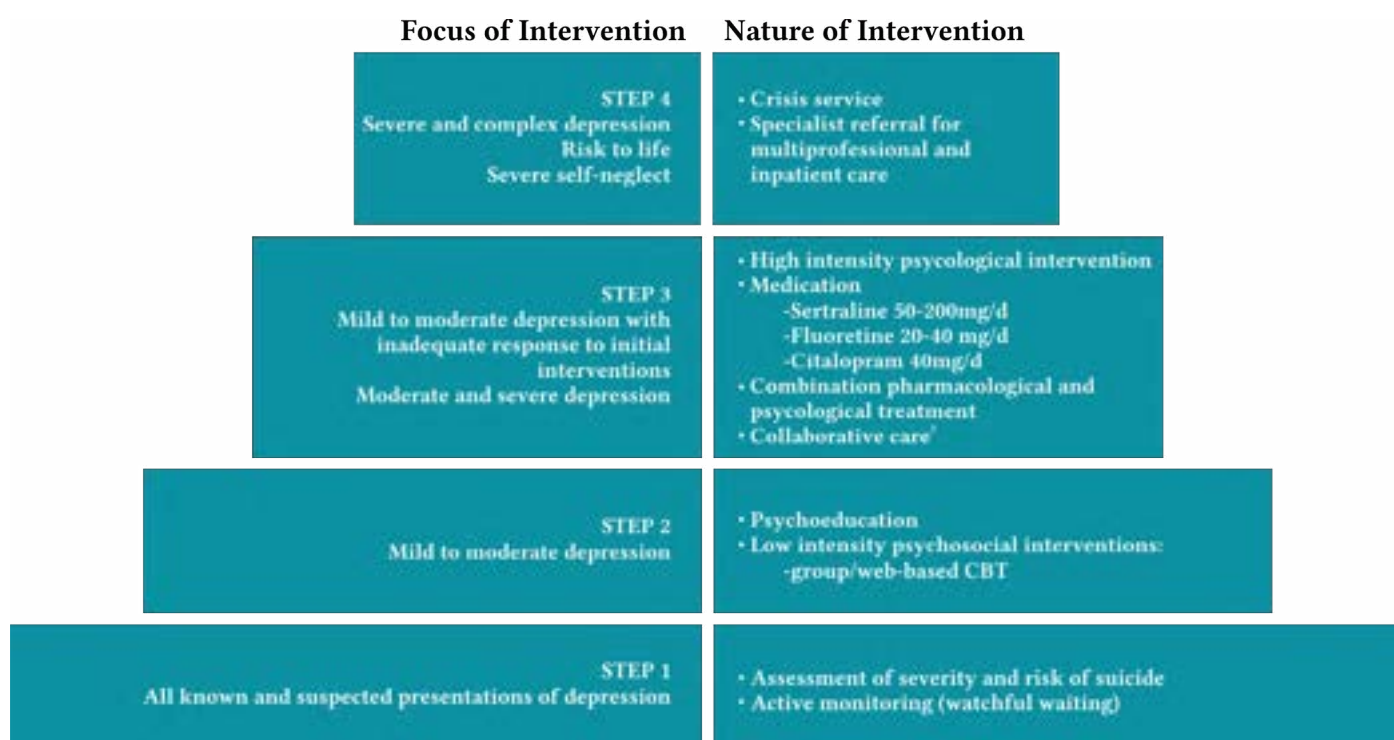


Figure 46: Diabetes and co-morbid depression stepped care model.

CHAPTER 3

Special Considerations for type 1 DM in Childhood and Adolescence

24

**INTRODUCTION TO TYPE 1
DIABETES IN CHILDHOOD AND
ADOLESCENCE**

24.0 Introduction

Diabetes often begins without any symptoms and early screening and detection will identify more patients. Once diagnosed, people living with diabetes need continuous care over the long-term, as well as education and support to manage this condition. In addition, patients may have comorbidities which share similar approaches for diagnosis, treatment and control, calling for provision of integrated services across the care continuum.

24.1 Criteria for the diagnosis of Type 1 diabetes mellitus

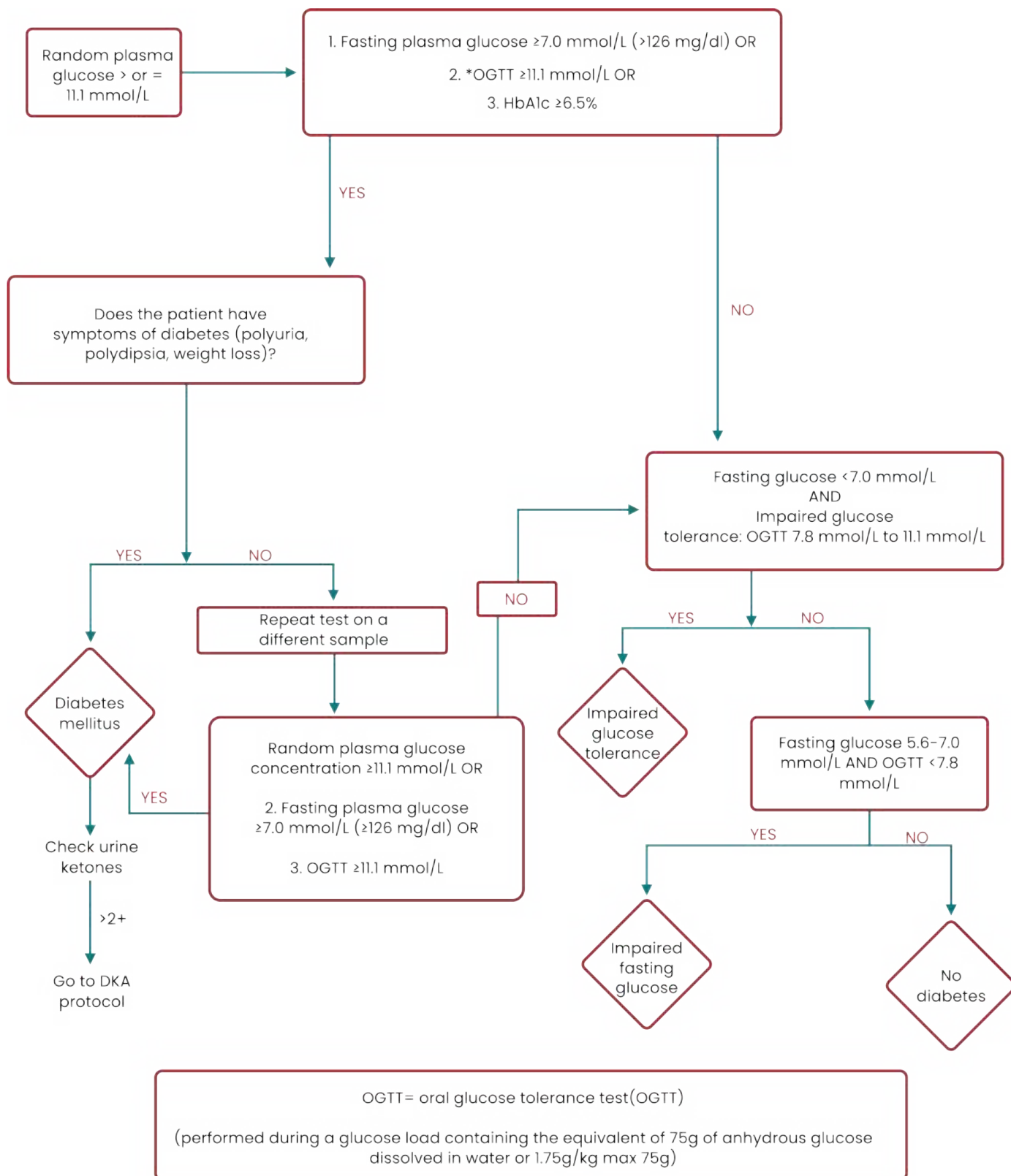


Figure 47: Criteria for the diagnosis of Type 1 Diabetes Mellitus

1. Where possible islet antibodies tested at diagnosis: GAD 65, IA2, IAA, ZnT8 are useful markers to demonstrate autoimmunity.

2. All children 0-6 months of age with a diagnosis of diabetes (regardless of antibody status), and those 6-12 months of age with negative antibodies should be referred to a paediatrician or where possible, a paediatric endocrinologist for investigation for monogenic diabetes.

24.2 Risk factors for type 1 Diabetes Mellitus

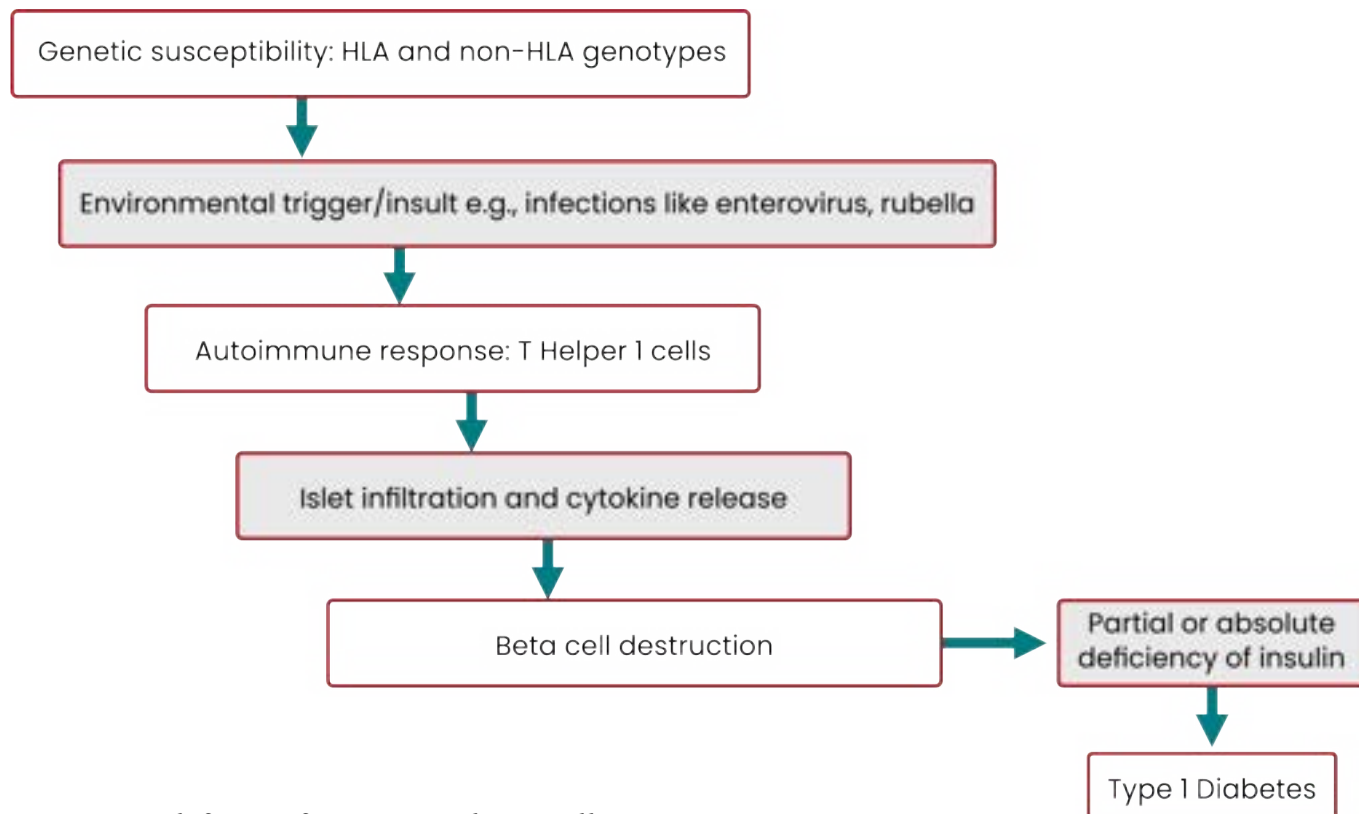


Figure 48: Risk factors for type 1 Diabetes Mellitus

24.3 Signs and symptoms of Type 1 diabetes

Table 36: Signs and Symptoms of Type 1 diabetes

SYMPTOMS	SIGNS
1. Polyuria	Dehydration
2. Polydipsia	Deep acidotic breathing
3. Weight loss	Reduced consciousness level
4. Fatigue	Acetone (fruity) smell
5. Recurrent infections (otitis media, pyogenic skin infections, monilial vaginitis, candida diaper rash)	Shock
6. Secondary enuresis	Coma
7. Nocturia	
8. DKA symptoms (vomiting, abdominal pain)	
9. Polyphagia (rare in type 1 diabetes)	

Notes:

Beware diabetes may present like pneumonia, acute abdomen, gastroenteritis, malaria, meningitis and malnutrition.

25

**DIABETIC KETOACIDOSIS (DKA) IN
CHILDREN AND ADOLESCENTS**

DKA is a common acute complication in type 1 diabetes and potentially fatal if there is a delay in management.

25.1 Biochemical criteria of diagnosis of DKA in children and adolescents

Table 37: Biochemical criteria if diagnosis of DKA in children and adolescents

Diabetes (hyperglycemia)	Blood Sugar/ glucose >11 mmol/L
Ketosis	Blood ketones: ≥ 3 mmol/L OR Moderate/large urine ketones (urine ketones $\geq 2+$)
Acidosis	Venous pH <7.3 and OR Bicarbonate <18 mmol/L

25.2 Severity of DKA in children and adolescents

Severity grading	Venous pH	Bicarbonate level (mmol/L)
Mild	7.2 to <7.3	10 to <18
Moderate	7.1 to <7.2	5 to <10
Severe	< 7.1	<5

25.3 Risk Factors for DKA

NEWLY DIAGNOSED PATIENTS	PATIENTS KNOWN TO HAVE DIABETES
• Younger patients <5 yr • Delayed diagnosis • Lower socioeconomic status • Countries with low prevalence of type 1 diabetes	• Insulin omission • Poor metabolic control • Previous DKA episodes • Acute gastroenteritis with persistent vomiting and inability to maintain hydration • Peripubertal and adolescent girls/ eating disorders • Limited access to health services • Insulin pump failures • Binge alcohol consumption

25.4 Management of DKA in children and adolescents

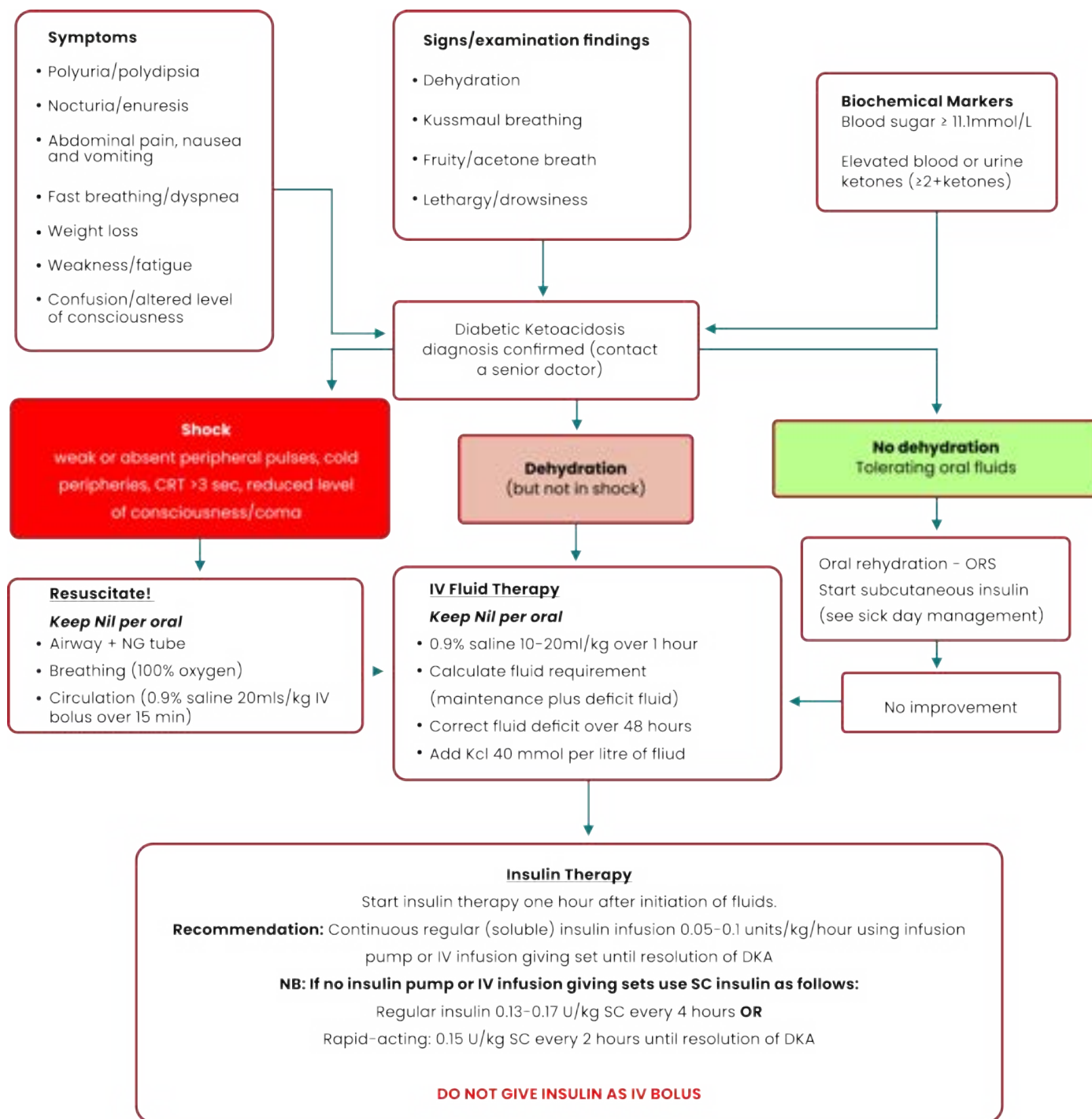


Figure 49: Management of DKA in children and adolescents

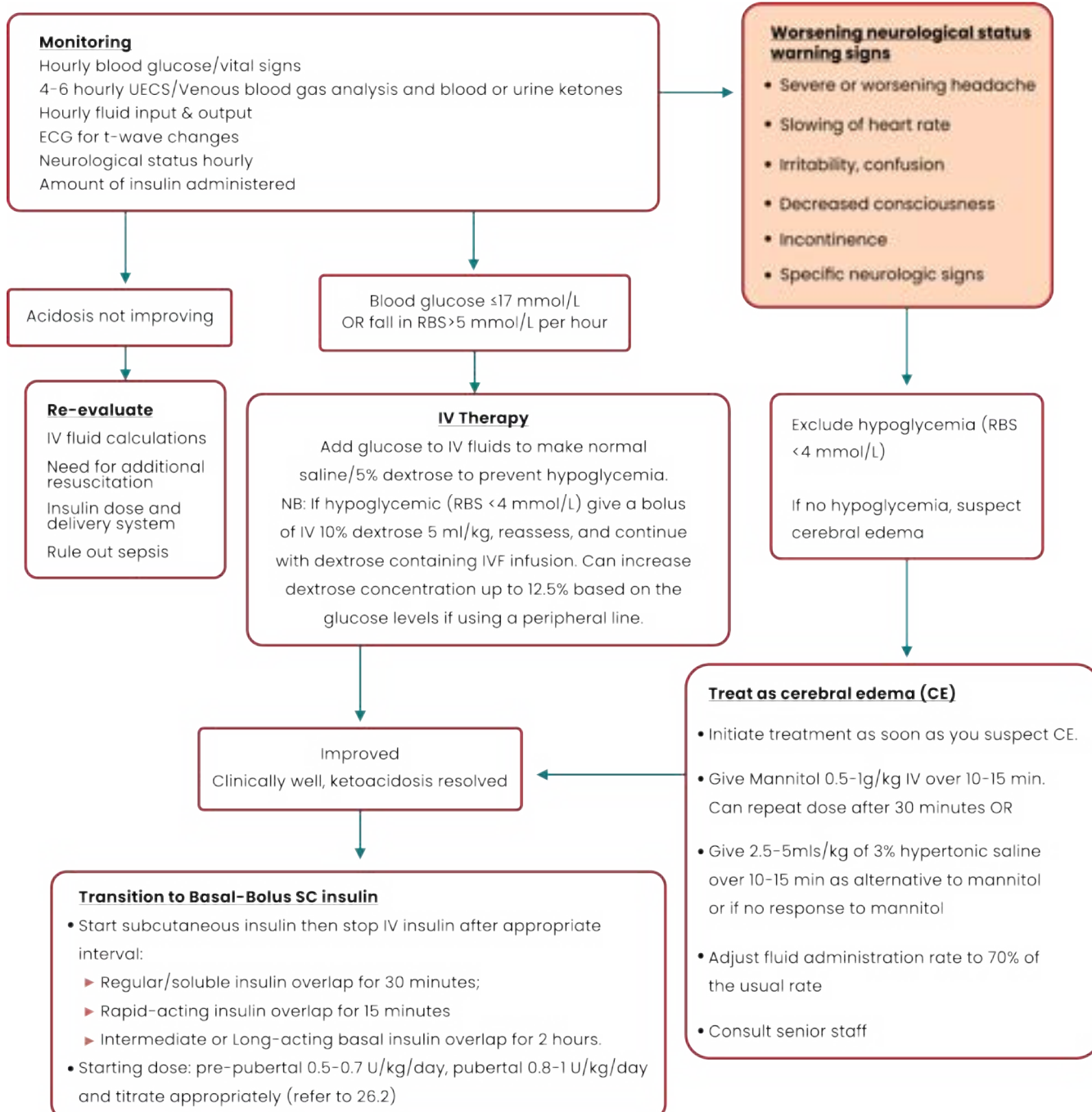


Figure 50: Management of DKA in children and adolescents

POTASSIUM

- In DKA the total body potassium is low.
- Hypokalemia: If potassium is <3.5 mmol/L, start replacement at the time of initial resuscitation/ volume expansion (during 1st one hour) and before starting insulin therapy (40 meq per litre of IV fluid).
- Normokalemia: If potassium is 3.5-5.5 mmol/L, start replacing after initial volume expansion (after 1st one hour) and concurrent with starting insulin therapy at a dose of 40 mmol of KCl per litre of fluid given (maximum 0.5 mmol/kg/hr).
- Hyperkalemia: If potassium >5.5 mmol/L, delay initiation of potassium until there is urine output. Start KCl infusion when potassium is <5.5 mmol/L.
- Monitor potassium every 2-4 hours.
- Once taking orally and still hypokalemic, replace with oral KCl (1-4 mmol/kg/day in 4 divided doses (max 100 mmol/24 hours)

Fluid therapy: Maintenance and Deficit

Choice of Fluid: Normal Saline. If unavailable use Ringer's Lactate.

Calculation of maintenance fluid for 24 hours

- 1st 10 kg: 100 ml/kg, 2nd 10 kg 50ml/kg, any weight above 20 kg, 20ml/kg; e.g., in a 20 kg child, maintenance fluid is 1500 ml.

Calculation of deficit fluid:

- Weight $\times 10 \times$ % dehydration
- Example: Shock/ severe DKA - Assume 10% dehydration: e.g., in a 20 kg child, deficit is $10 \times 10 \times 20 = 2000$ ml as deficit fluid.

Calculation of the total fluid required for 48 hours: Total maintenance fluid for 2 days + deficit – resuscitation fluid

NB – Subtract the initial resuscitation fluid from the total fluid calculated over 48 hours

Insulin Therapy

- To calculate the regular (soluble) insulin dose for IV infusion, dilute 50 units of regular (soluble) insulin in 50mls of 0.9% saline therefore 1 unit of insulin = 1 ml.
- Insulin infusion starting dose: children > 5 years 0.1 U/kg/hour, <5 years 0.05 U/kg/hour.
- Do not give insulin as IV bolus.
- Plasma glucose concentration should fall at a rate of 2-5 mmol/L/h.
- If the rate of fall is precipitous (>5 mmol/L/h) add 5% dextrose to the fluid. Can increase dextrose concentration up to 12.5% if using peripheral line.
- Once DKA resolves, transition to subcutaneous insulin (starting dose: pre-pubertal 0.5-0.7 U/kg/day, pubertal 0.8-1 U/kg/day). The best time to transition is just before meals. Transition to basal-bolus regimen (see chapter on introduction to insulin for dosing).
- **DO NOT GIVE BICARBONATE:** Consult Paediatrician/ Intensivist/ Paediatric endocrinologist if patient has severe acidosis (venous pH of <6.9 , life-threatening hyperkalemia or impaired cardiac contractility).

Table 38: Fluid maintenance and replacement volumes

Fluid Maintenance and replacement volumes based on body weight and assumption of 10% dehydration (* Replace after 48 hours)			
Body Weight (Kg)	Maintenance (mL/24hr)	DKA: Give Maintenance + 5% of body weight (50mL/kg/24hr)	
		mL/24hr	mL/hr
4	325	530	22
5	405	650	27
6	485	790	33
7	570	920	38
8	640	1040	43
9	710	1160	48
10	780	1280	53
11	840	1390	58
12	890	1490	62
13	940	1590	66
14	990	1690	70
15	1030	1780	74
16	1070	1870	78
17	1120	1970	82
18	1150	2050	85
19	1190	2140	89
20	1230	2230	93
22	1300	2400	100
24	1360	2560	107
26	1430	2730	114
28	1490	2890	120
30	1560	3060	128
32	1620	3220	134
34	1680	3360	140
36	1730	3460	144
38	1790	3580	149
40	1850	3700	154
45	1980	3960	165
50	2100	4200	175
55	2210	4420	184
60	2320	4640	193
65	2410	4820	201
70	2500	5000	208
75	2590	5180	216
80	2690	5380	224

DKA in special situations:

- ◆ Children with Severe Acute Malnutrition. These should be:
 - Managed like other children with DKA.
 - Consult a Paediatrician or a Paediatric endocrinologist.

26

INTRODUCTION TO INSULIN

26.1 Types of insulin and their onset and duration of action

Table 39: Types of insulin and their onset and duration of action

Insulin Type	Onset	Time to Peak	Duration
Rapid Acting			
Aspart	5-15 Min	30-90 Min	4-6 Hr
Glulisine	20 Min	100 Min	4-6 Hr
Lispro	5 -15 Min	30-90 Min	4-6 Hr
Short Acting			
Regular	30-60 Min	2-3 Hr	8-10 Hr
Intermediate Acting			
Neutral Protamine Hagedorn	2-4 Hr	4-10 Hr	12-18 Hr
Long Acting			
Detemir	2-4 Hr	Relatively Flat	Upto to 24 Hr
Glargine	2-4 Hr	No pronounced peak	Upto to 24 Hr

26.2 Insulin regimens

A. Basal Bolus Regimen

- This is the recommended insulin regimen for type 1 diabetes, as it is closer to physiological norm.
- It is a combination of a long- or intermediate-acting insulin given once or twice a day (basal) and boluses of a rapid- or short-acting insulin given with meals.
- The long- or intermediate-acting insulin constitutes 40-50% of the total daily insulin dose.
- Individual meal dose distribution of the 50-60% rapid- or short-acting insulin component is determined by the insulin: carbohydrate (I:C) ratio, which is not uniform for all the meals.
- Mastery of carbohydrate-counting is, therefore, crucial for this regimen to be effective.
- The I:C ratio is calculated using 450 or 500 rule, depending on whether short- or rapid-acting insulin is used.
- The number 450 or 500 is divided by the total daily dose of insulin, including basal: Use 450 if patient is on short -acting and 500 if rapid-acting Insulin.
- Since the ratio varies with time over a 24-hour period, meal dose adjustments are made tailored to an individual's pattern.
- The basal-bolus regimen requires close blood glucose monitoring to aid in making required individual adjustments.

Intermediate and short-acting insulin (NPH and Regular insulin)

- This combination is cost effective and provides a fair control of diabetes.
- The NPH provides a basal insulin cover, though with a peak at its onset of action, unlike the long-acting insulin.
- Meal boluses are provided using regular insulin.
- Total NPH dose should be 40-50% of the total insulin dose.
- NPH should be given as twice daily injection with morning dose as 2/3 and evening dose as 1/3 of the NPH component.

Is there room for twice daily pre-mixed insulin injections?

NO! NOT FOR TYPE 1 DIABETES

Twice daily injections of pre-mixed insulin is not a recommended insulin regimen for type 1 diabetes, because:

- It cannot provide good blood glucose control.
- It does not mimic the normal, physiological insulin-glucose interplay, so will be riddled with high and low blood glucose levels.
- It does not enable appropriate individualized insulin dose adjustments.

1. NPH: humulin N®, insulatard®
2. TDD: Total daily dose of insulin
3. Glargine: e.g. lantus®
4. Detemir: e.g. levemir®
5. Degludec: e.g. tresiba®
6. Short acting (regular/soluble) insulin: e.g. humulin R®, actrapid®
7. Rapid acting insulin: e.g. Lispro (humalog®); Aspart (novorapid®); Glulisine (apidra®)

B. Continuous subcutaneous insulin infusion (CSII) or insulin pump

- This is a convenient way of administering insulin involving continuous subcutaneous infusion of rapid-acting insulin with boluses of the same insulin with meals.
- In the conventional pump, settings are pre-programmed into the pump, with different basal rates set for different segments of a 24-hour period, tailored to patient's individual requirements.
- During meals, boluses of the same insulin are given, with doses determined by I.C. ratio and the amount of insulin still active in the system.
- A closed-loop system (or an artificial pancreas) uses algorithms to enable real-time feedback between blood glucose excursions and insulin delivery by the pump.

26.3 Insulin dosage and adjustment

Below is a guide on dosing when starting insulin:

- ◆ Prepubertal: 0.5-0.7 units/kg/day
- ◆ Pubertal: 0.8-1 units/kg/day
- Once insulin has been started as above the dose is adjusted over time, guided by the individual's requirement, since each individual has unique metabolism of food and insulin response.
- Adjustments of the dosage is 10-20% depending on the level of control, or lack thereof.
- The decision to adjust the basal insulin, or the premeal bolus insulin will depend on the time the measured blood sugar is high or low.
- Thus, blood glucose monitoring is vital in dose adjustments.

26.4 Structured blood glucose

Frequency of blood glucose measurement depends on the level of control, presence of acute illness, and availability of testing strips:

- 7-point testing: Blood sugar is tested pre-meal, post-meal, at bedtime, and at 3 a.m.
- 5 tests a day: Blood sugar is tested before meals, at bedtime and at 3 a.m.
- 3 tests a day: usually done pre-meal to allow for correction of pre-meal hyperglycemia.

Where availability of strips is a challenge, tests can be modified to collect as much information as possible. For example, seven-point testing for three days in a row in one week and over the weekend the following week.

26.5 Correction Factor

It is also called **Insulin Sensitivity Factor (ISF)**.

- To calculate the correction doses for mmol/L, use the “100 rule,” that is, divide 100 by total daily insulin dose to get the mmol/L that 1 unit of rapid-acting insulin will lower the blood glucose by.
 - For regular insulin, use the “83-rule” for results in mmol/L.

26.6 Expected interventions depending on various blood glucose readings

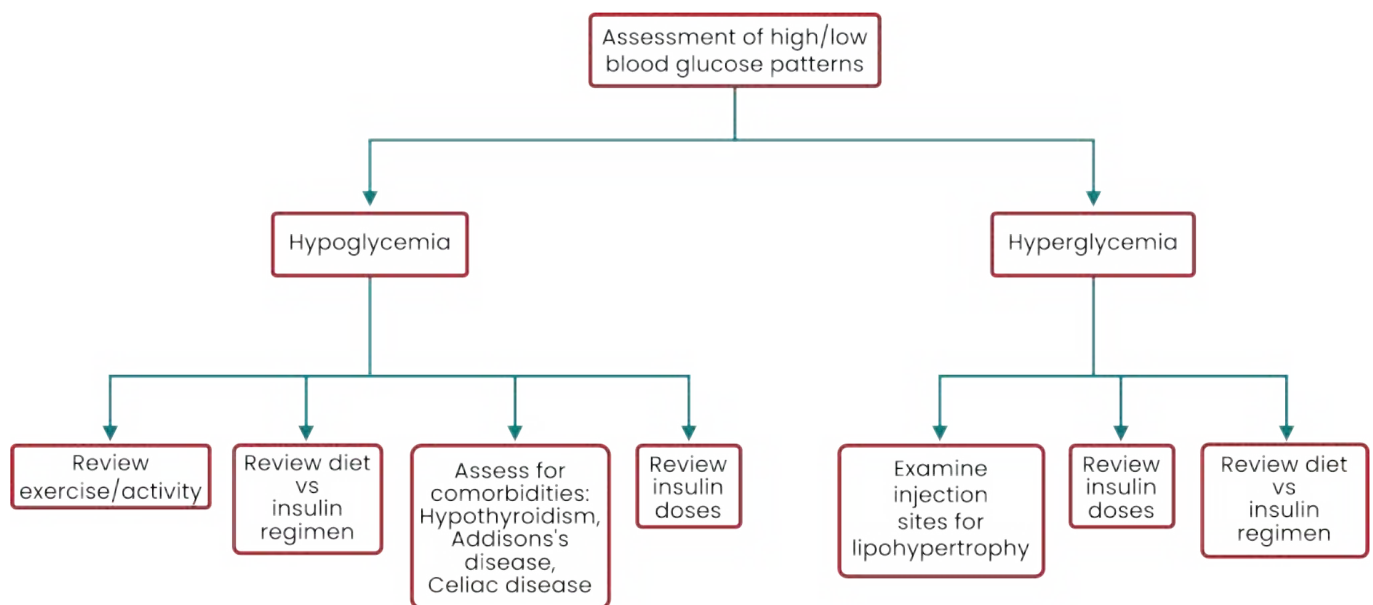


Figure 51: Expected interventions depending on various blood glucose readings

The table below shows blood glucose readings at different times and expected action/intervention depending on the reading.

When an increase or reduction of insulin dose is indicated it is done by 10-20% of the total daily insulin dose at a time.

Table 40: Expected interventions depending on various blood glucose readings

Time of low or high blood glucose reading	Insulin dose to adjust		Other intervention
	Hyperglycemia	Hypoglycemia	
Fasting	Increase evening intermediate or long-acting insulin	Decrease evening intermediate or long-acting insulin	
After breakfast	Increase pre-breakfast rapid- or short-acting insulin	Decrease pre-breakfast rapid- or short-acting insulin	Check breakfast insulin: carbohydrate ratio
Pre-lunch	Increase morning basal or pre-breakfast insulin	Decrease morning basal or pre-breakfast insulin	Mid-morning exercise management Check mid-morning snack
After-lunch	Increase pre-lunch rapid- or short-acting insulin	Decrease pre-lunch rapid- or short-acting insulin	Check lunch insulin: carbohydrate ratio
Pre-Supper	Increase morning basal or pre-lunch insulin	Reduce morning basal or pre-lunch insulin	Afternoon exercise management Check afternoon snack
After-supper	Increase pre-supper rapid- or short-acting insulin	Decrease pre-supper rapid- or short-acting insulin	Check supper insulin: carbohydrate ratio
All Levels	Affected by exercise, snacks, acute illnesses	Consider honeymoon period Check meal ratios	

26.7 Insulin administration

- Insulin should be given subcutaneously.
- Pinch up some skin and quickly insert the needle at a 90° angle.
- Keep the skin pinched to avoid having the insulin go into the muscle.
- Push the plunger down all the way.
- Hold the syringe and needle in place for 15 seconds.
- Let go of the pinched skin and remove the needle from the skin.
- If you see blood or clear fluid (insulin) where the needle went in, press on the area for 10 seconds.
- Do not rub.

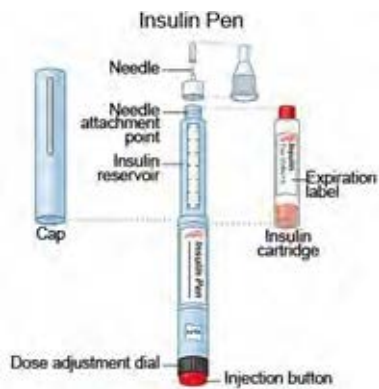


Figure 52A: Insulin administration

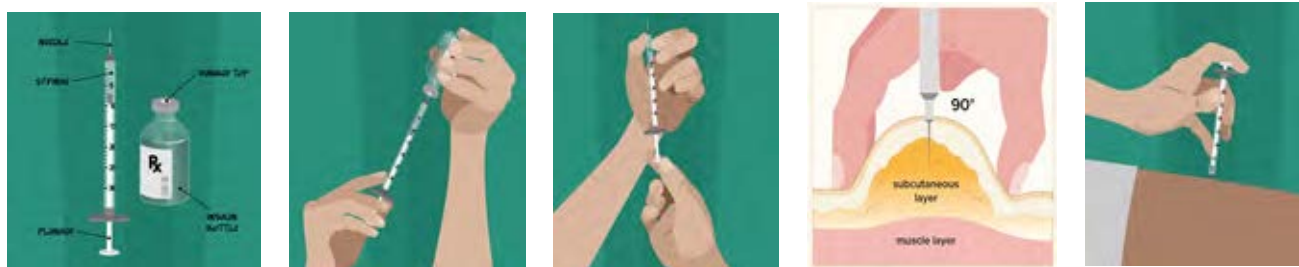
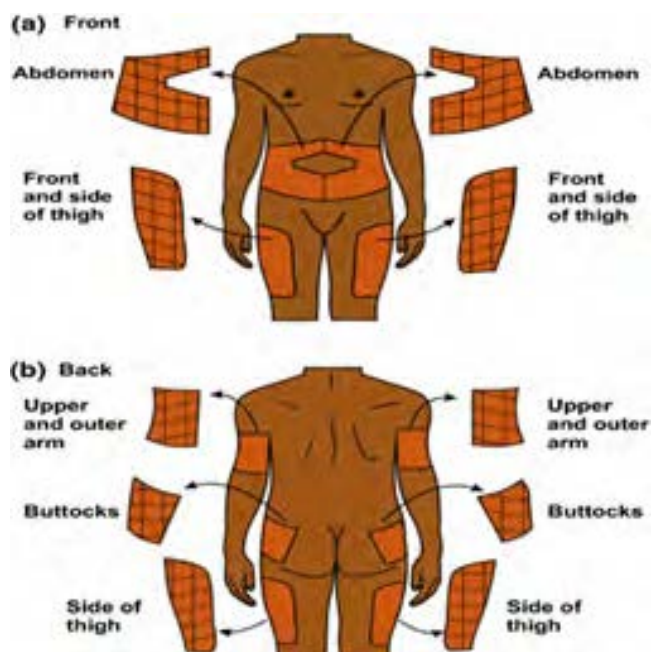
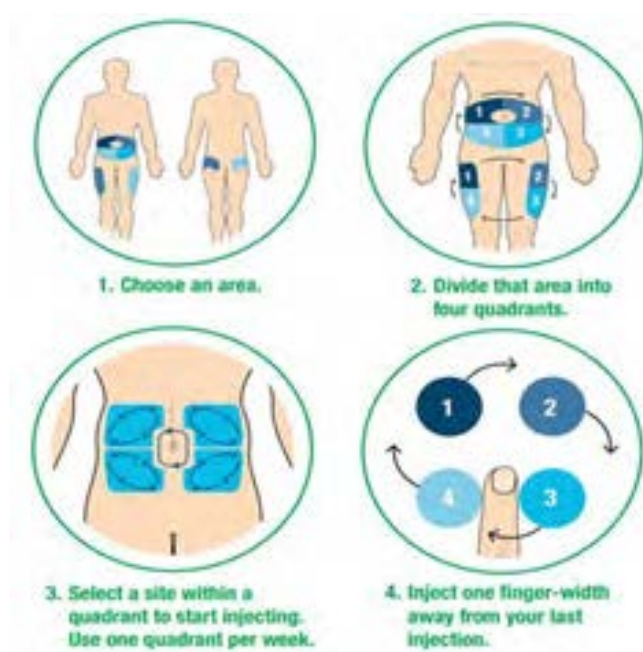


Figure 52B: Insulin administration

26.8 Sites of insulin injection and rotation



Where and how to inject.



How to give an insulin injection.

Figure 53: Sites of insulin injection and rotation

27

AMBULATORY CARE FOR CHILDREN WITH DIABETES

- The goals of care for a child with diabetes are to ensure a high quality of life, normal growth and development, appropriate psychosocial adaptation, early detection of comorbidities and avoidance of complications.
- Patients should be reviewed at least 3 monthly, except for those who are newly diagnosed, infants, adolescents, and those about to undergo circumcision who should be reviewed more frequently.

27.1 Person-Centered Paediatric Diabetes Care Model

- ✓ Children with diabetes require a multidisciplinary team for management.
- ✓ Each member of the team should have training in both paediatrics and diabetes.

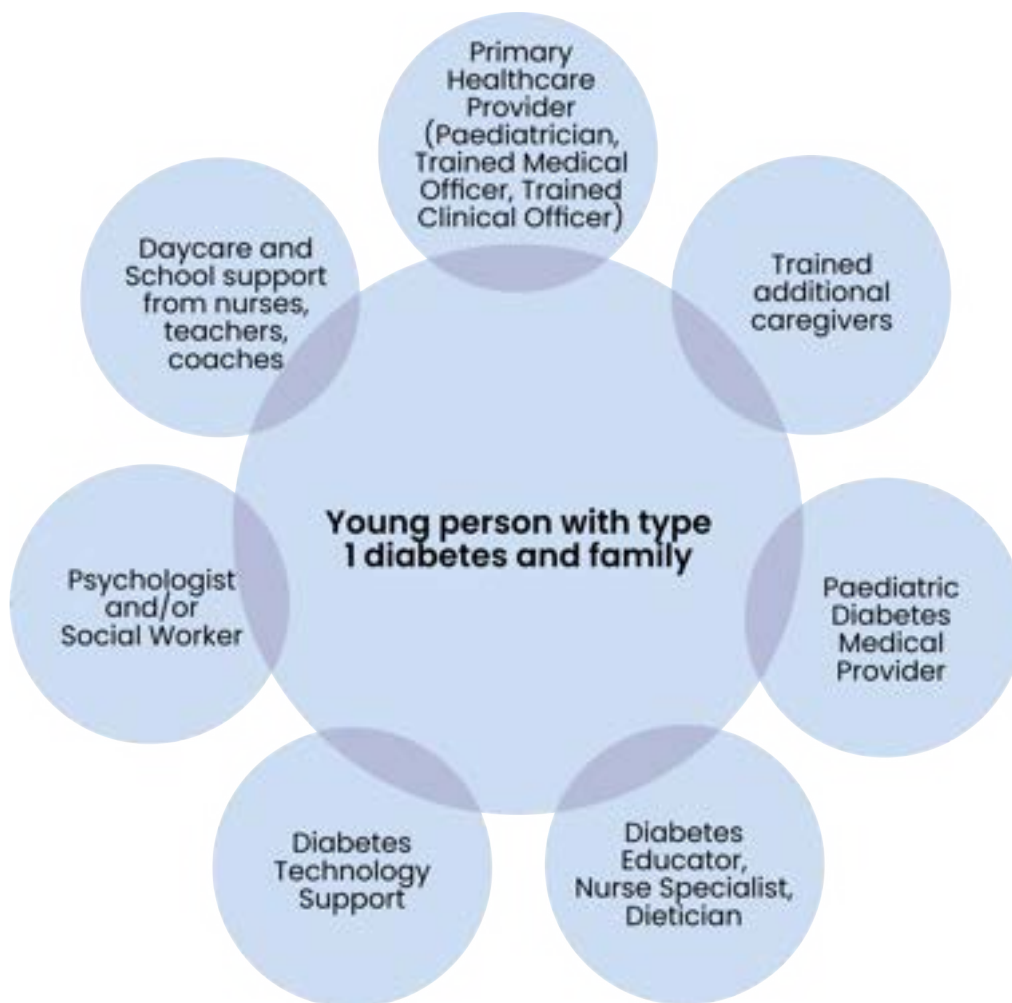


Figure 54: Person centered pediatric diabetes care model

27.2 Follow Up

Vital/Anthropometric measurements	• Height • Weight • Body mass index • Blood pressure
General health	• Intercurrent health problems • Review of all medications and supplements
Physical examination	• Pubertal status • Oral mucosa and dentition • Skin: lipodystrophy, acanthosis nigricans, hirsutism, acne • Abdomen (hepatomegaly for Mauriac syndrome) and Cardiac • Neurological function tests • Foot examination • Thyroid
Insulin review	• Dose • Injection techniques • Injection sites/ rotation • Storage
Glycaemic management	• Review blood glucose diary and meter/CGM records • HbA1c
Nutrition	• Review food patterns, activity vs insulin regimen • Assess for disordered eating behaviours • Every 3 months
Screening for comorbidities	• Thyroid • Adrenal • Celiac disease • Psychosocial
Screening for complications	• Cardiovascular risk factors • Microvascular complications: nephropathy, retinopathy, neuropathy
General well being	• Development, education, sports, leisure

Figure 55: Follow up

27.3 Screening and prevention guidelines for routine paediatric and adolescent visits for type 1 diabetes mellitus

Table 41: Screening and prevention guidelines for routine visits

	Evaluation	When to Screen
Glycemic Management	HbA1c	Quarterly
	Glucose values from meter, log, or CGM	At each visit and in between visits as needed for insulin dose adjustments
Cardiovascular risk factors	Blood pressure	Every visit
	Smoking status	Every visit
		Discourage smoking in youth who do not smoke and encourage smoking cessation in those who do
	Lipids	Begin ≥ 11 years; if normal results are obtained; repeat every 3 years
Microvascular complications	Kidney disease: urine albumin: creatinine ratio	Start at puberty or from age 11 years, whichever is earlier, after 2–5 years diabetes duration; repeat annually for kidney disease and neuropathy; every 2–3 years for retinopathy
	Retinopathy: dilated eye exam	
	Neuropathy: comprehensive foot exam	
Autoimmune screening	Thyroid function: TSH, total or free T4 (and thyroid autoantibodies if available)	At or near diagnosis; Every 2 years: TSH (sooner if with symptoms or positive thyroid autoantibodies at diagnosis)
	Celiac screening (TTG-IgA, if IgA normal)	At or near diagnosis; repeat at 2– 5 years intervals (sooner if symptomatic or first degree relative with celiac disease)
	Addison’s disease (primary adrenal insufficiency), autoimmune hepatitis, autoimmune gastritis, dermatomyositis, and myasthenia gravis	As clinically indicated
Psychosocial screening	Diabetes distress, depression, disordered eating	Begin shortly after diagnosis; routinely (at least annually)
Anticipatory guidance	Pre-conception counseling, risk-taking behaviors, transition to adult care	Pre-conception counseling for girls of childbearing potential. Discussion about risk-taking behaviors and preparation for transition to adult care can begin in early adolescence and be revisited at least annually

28

**TYPE 1 DIABETES GUIDELINES FOR
INFANTS, PRESCHOOLERS AND
ADOLESCENTS**

28.1 Infants and Preschoolers

This age group is unique because:

They are dependent on caregivers.

- A higher percentage of young children may present with DKA at disease onset.
- They decompensate fast if care is inadequate.
- Intensive management towards good glycemic control is vital to avoid impaired cognitive and brain development.
- They are at increased risk of microvascular and macrovascular complications due to long duration of diabetes.

28.1.1 - Insulin therapy in infants and preschoolers

Intensive insulin regimen is recommended.

- **Multiple daily insulin injection (MDI)**

- ◆ Pre-meal rapid-acting insulin before main meals (3 injections). When not sure how much the child is going to eat, give half the dose of premeal insulin before and the other half after completion of the food.

- ◆ Long-acting insulin once daily (one injection).

- **Where possible continuous subcutaneous insulin infusion via insulin pump and continuous glucose monitoring should be prioritized.**

- **Twice daily injection of premixed insulin is NOT recommended and should be avoided as much as possible.**

28.1.2 - Diet management highlights in infants and preschoolers

- Implement structured mealtimes.
- Discourage continuous eating habits.
- Offer small, balanced snacks.
- Limit mealtime duration (approx. 30 minutes).
- Avoid force feeding; reassure about mild hypoglycemic episodes.
- Balance insulin and food intake
- Help the child connect insulin, food, and well-being positively.

28.2 Adolescents

The glycemic control is poor during adolescence due to a combination of factors such as:

- Physiological insulin resistance
- Effect of gonadal steroids
- Increased insulin requirements
- Psychosocial and behavioral changes which lead to reduced adherence: impulsive decisions, questioning, and disruptive behaviour.
- Decline in physical activity.

28.2.1 The effect of adolescence on control of diabetes

Table 42: Adolescents

Change	Effect	Consequence
Growth	Increasing weight	Increasing doses
Puberty	Decreasing insulin sensitivity Psychosocial stresses	Increasing doses More education Alcohol and drug use Risk-taking behavior
Menses	Changes in insulin sensitivity	Fluctuating insulin needs with increased doses during menses
Lifestyle	Increasing activity	Increase food intake/ decreased doses
	Decreased activity	Encourage exercise Increased doses
Intellectual Maturation	Increased understanding Increased independence	More education Increased autonomy

28.2.2 Sexual health and pregnancy in adolescents with T1DM

- Advice and counselling on abstinence from sexual activity
- Unplanned pregnancies should be avoided
- Use of hormonal contraceptives may increase insulin resistance and thus poor control

Consider:

- Religious, cultural, and family perspectives,
- Nonjudgmental approach to sexual activity

29

DIABETES EDUCATION

- Diabetes education is a core component in management of T1DM.
- It is done in a structured way to ensure patients have the necessary knowledge, skills and confidence to successfully manage diabetes.
- It is mainly done by the qualified diabetes educator who is part of the diabetes team and walks with the patient from diagnosis all the way in their management.
- Education can be done either in an individual or a group setting.

Table 43: Diabetes Education

VISIT 1 is done at the initial contact at the ICU, ward or outpatient department. It is recommended that newly diagnosed patients even those with hyperglycaemia and not in DKA are admitted for starting of education. Education for visit 1 and 2 can be covered.	VISIT 1 • What is diabetes and specifically type 1 diabetes • Blood glucose testing: targets/ when to monitor/how to interpret readings/ testing techniques • DKA • A proper food/ insulin/ blood sugar diary. • Hyperglycaemia signs and symptoms and management including correction factor. • Hypoglycaemia signs and symptoms and correction • Insulin therapy: types/ mode of action/ storage/ injection techniques/ sites/ rotation/ safe use and disposal of both needles and injection pens • Nutrition
VISIT 2 • This is two weeks after initial contact • Growth assessment (weight, height, BMI) • Interpreting blood sugar readings • Return demonstration on blood glucose testing and insulin injection • Honeymoon phase • Insulin adjustment • Nutrition and carbohydrate counting • Diabetes in school including exercise/ sick day management. • Recap of TOPICS COVERED IN VISIT 1	VISIT 3 • Done 1 month after visit 1 or 6 weeks after diagnosis or initial contact • Recap of TOPICS IN VISIT 1 AND 2 • Sick day management (both hyper and hypoglycaemia) and ketones monitoring • Insulin: patient to state type, dose, time, route and peak times • Annual review: remind about assessment for microvascular complications, thyroid assessment
VISIT 4 • Recap and demonstrations of previous topics • Growth assessment • Diabetes and exercise • Nutrition and carbohydrate counting • Travelling, holidays and camps • Parties and festive seasons • Foot care, dental and eye follow up • Lifestyle issues: smoking, drugs and sexual health	HOME VISIT • Family teaching on diabetes management • Carbohydrate counting to insulin matching is done practically • Insulin storage is assessed • Ongoing community support

30

**DIET MANAGEMENT IN TYPE 1
DIABETES**

30.0 Introduction

Diet management is one of the cornerstones of diabetes care and education. Carbohydrate counting is important in diet management in type 1 diabetes. Healthy eating is encouraged to ensure healthy growth without adversely affecting blood glucose control. Healthy eating should be:

- ◆ Acceptable
- ◆ Feasible
- ◆ Affordable
- ◆ Sustainable
- ◆ Safe

Food groups include proteins, carbohydrates (starch), grains, oils and solid fats, fruits, vegetables and dairy.

Refer to the Healthy Eating Plate in chapter 1 of this guideline

Note:

There is no diet called Diabetic Diet for Children with Type 1 Diabetes

30.1 Dietary goals for people with type 1 diabetes

- Provide adequate calories and nutrients for achieving and maintaining a reasonable body weight, normal growth, and development.
- Improve overall health through healthy food choices.
- Maintain good glycaemic control (as near normal as possible).
- Ensure child gets satisfied with the meals they consume.

30.2 Algorithm of diet education

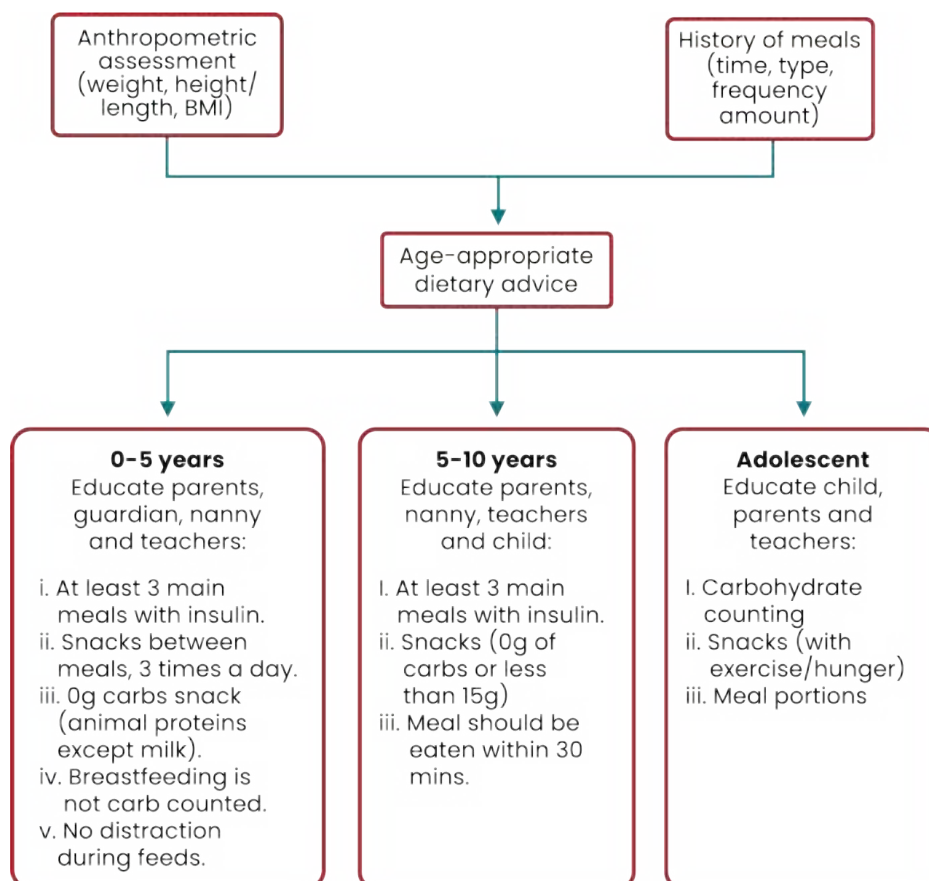


Figure 56: Algorithm of diet education

30.3 Carbohydrate counting

Definition:

Counting the amount of carbohydrates present in a meal and matching it to the dose of insulin.

It is necessary to match insulin to carbohydrates being consumed to reduce episodes of hypoglycemia and hyperglycemia.

Tools used in carbohydrate counting include:

- 1) Food models
- 2) Food charts showing serving sizes for 15 g of carbohydrates
- 3) Measuring cups, bowls, plates, spoons.
- 4) Kitchen weighing scale.

Note: The amount of insulin dosage is determined by the amount of carbohydrate consumed per meal.

Insulin to carbohydrate ratio:

500/total daily dose for rapid acting insulin.

450/total daily for regular insulin

Examples of Carbohydrate exchanges:

Example using rapid-acting insulin in a child on total daily dose (TDD) of 50 units of insulin:

$500/50 = 1:10$ (1 unit of insulin given for 10 g of carbs)

Regular insulin for a child using TDD of 50 units of insulin:

Example: $450/50 = 1:9$ (1 unit of insulin given for 9 g of carbs)

HOW TO USE INSULIN: CARBOHYDRATE RATIO

Example: insulin to carb ratio: 1:10

1 cup (250ml) of rice = 45 g

1 cup (250ml) of peas = 30 g

1 cup (250ml) cooked vegetables = 10 g

Total = 85 g

10 g = 1 unit of insulin

85 g = How much insulin? = $85/10 = 8.5$ units (round off to 9 units)

Table 44: Carbohydrate counting

1 cup cooked pasta or 1 cup cooked rice	45g Carbohydrate
Whole English Muffin	30g Carbohydrate
3 cups popped popcorn	15g Carbohydrate
Medium potato	30g Carbohydrate
1 cup corn or peas	30g Carbohydrate
1 ½ cup veggies (green beans, broccoli or carrots cooked)	15g Carbohydrate
Small fruit (apple, orange, nectarine)	15g Carbohydrate
17 grapes, 12 cherries, ½ cup apple sauce	15g Carbohydrate
1 cup milk	12g Carbohydrate
1 container (6oz) yoghurt, flavored, artificially sweetened	12g Carbohydrate
½ cup vanilla ice cream	15g Carbohydrate
½ cup sherbet	30g Carbohydrate
2 small cookies	15g Carbohydrate

Images of measuring tools



Figure 57: Measuring tools

31

**TYPE 1 DIABETES IN SPECIAL
CIRCUMSTANCES**

31.1 Children and adolescents with diabetes requiring surgery

- Surgery or surgical procedures requiring general anesthesia in children and adolescents with diabetes should be performed in centres with appropriate personnel and facilities to support pre-, intra-, and post-operative care at the highest standard.
- Crucial to ensuring the highest level of safety is a careful liaison between the surgical, anaesthesia and diabetes care teams before elective surgery and as soon as possible after admission for emergency surgery.
- Centers performing surgical procedures on young people with diabetes should have written protocols for postoperative management of diabetes in the wards where children are admitted.
- Literature shows that outcomes of patients with diabetes who have undergone surgery are affected by the state of patients before the procedure. Preoperative hyperglycemia has been found to be an independent predictor of infectious complications and length of hospital stay.

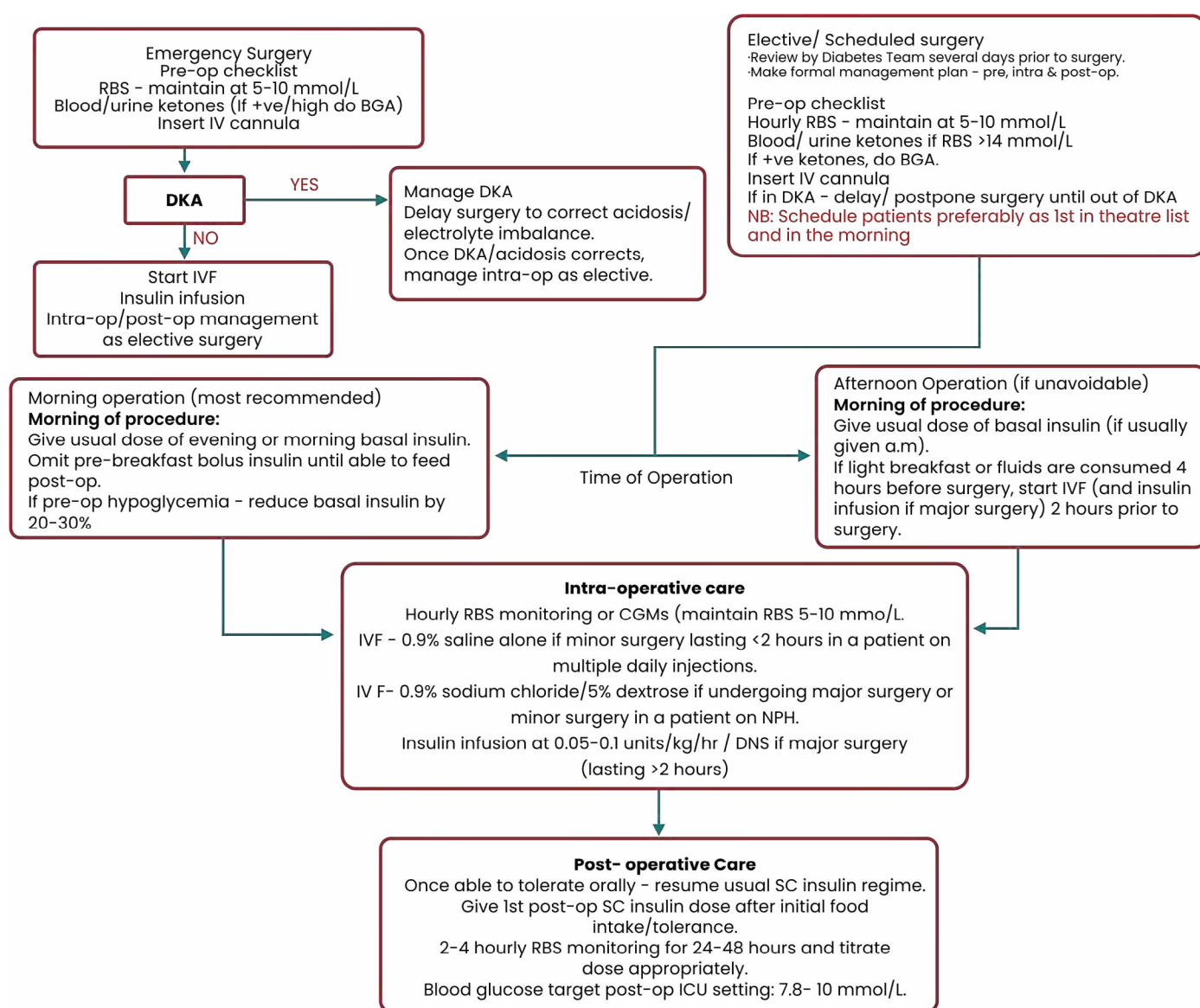


Figure 58: Algorithm of management of children and adolescents with diabetes requiring surgery

Childhood and Adolescent Management on sick day

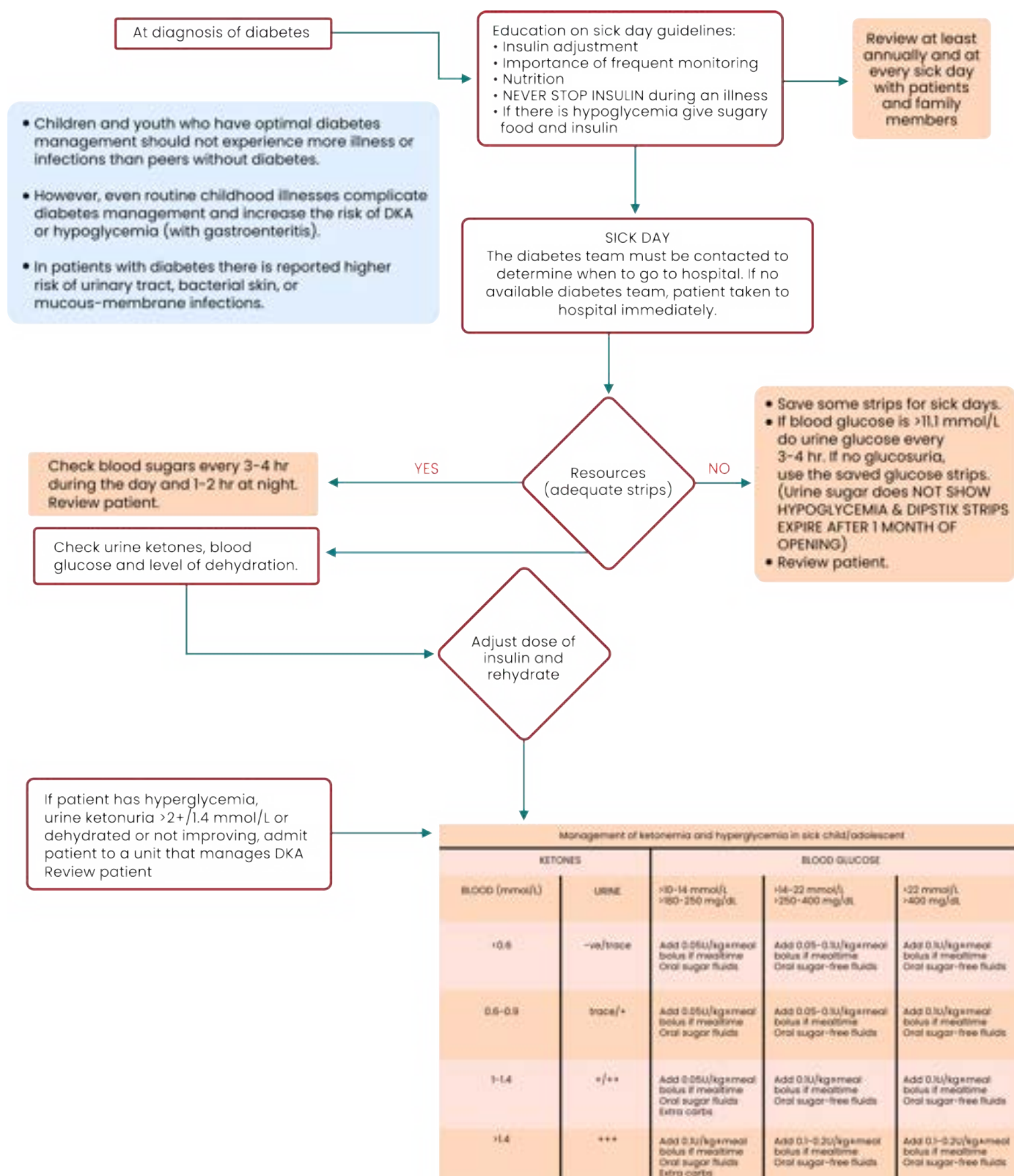


Figure 59: Childhood and adolescent management on sick day

32

EXERCISE MANAGEMENT IN TYPE 1 DIABETES

32.0 Introduction

- Exercise is very beneficial and should be encouraged. Diabetes should not be a barrier to participating in exercise.
- The recommendation for people with T1DM is to accumulate at least 150 min/week of moderate-intensity aerobic and resistance exercise and to have no more than two consecutive days without physical activity.
- Children and adolescents should have at least 60 min per day of moderate to vigorous-intensity, primarily aerobic, physical activity across the week.
- Vigorous intensity aerobic activities and activities that strengthen muscle and bone should be incorporated at least 3 days a week.

32.1 Different types of exercise and effect on blood sugar

- ♦ Aerobic exercise (low intensity) such as cycling or jogging will lower blood glucose, as the muscles use glucose to give energy.
- ♦ Anaerobic exercise (high intensity) such as resistance training, weightlifting or sprinting, are likely to initially cause an increase in blood glucose as the body releases stored glucose. However the blood glucose is likely to drop later.

32.2 The three basic guidelines for diabetes exercise management

- Monitoring glucose before, during, and after exercise
- Eating enough carbohydrates
- Adjusting insulin as necessary

32.3 Algorithm for exercise management in T1DM

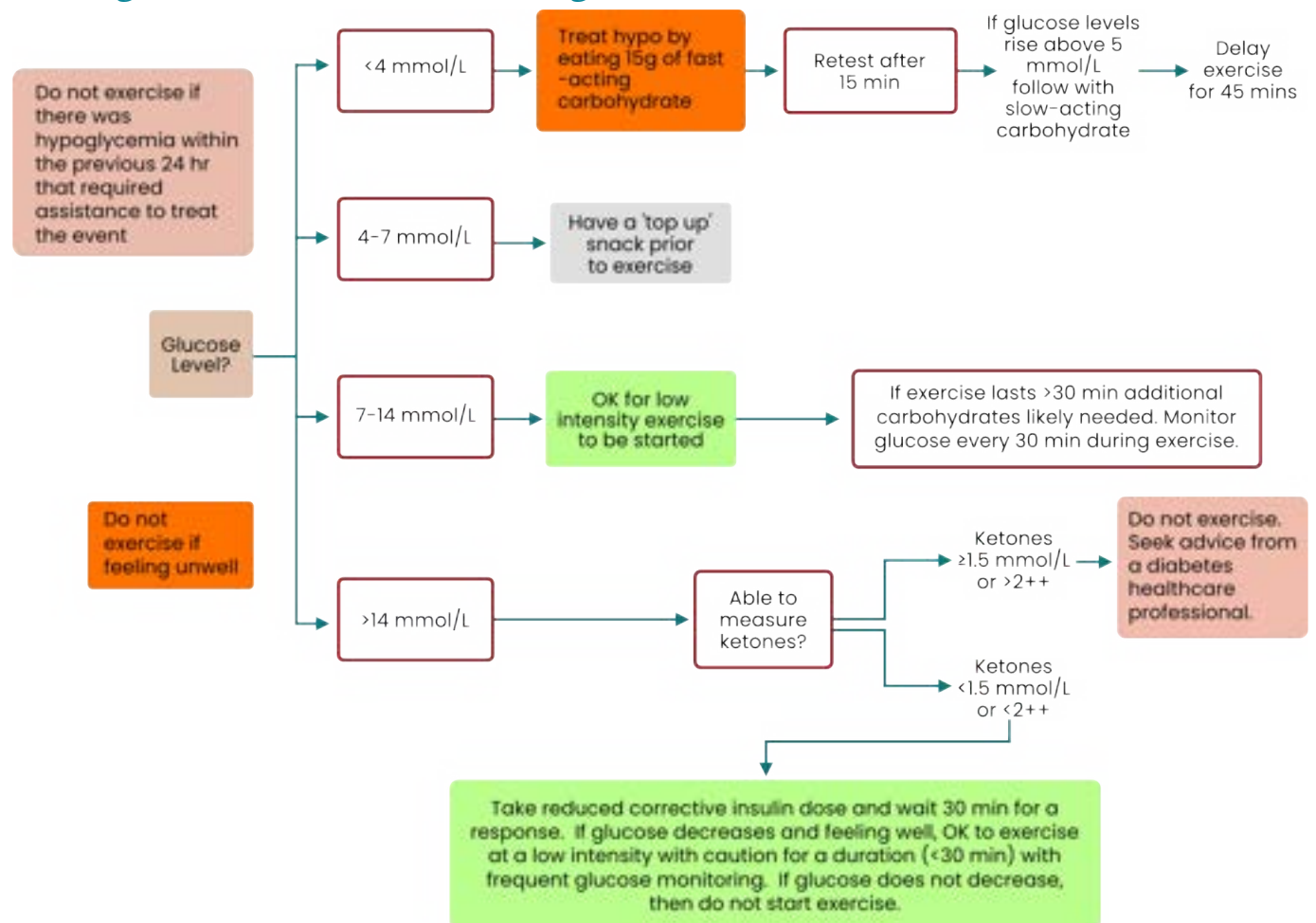


Figure 60: Algorithm for exercise management of T1DM

32.4 Guidelines for carbohydrate required for 30 minutes of exercise

Table 45: Guidelines for carbohydrate required for 30 min exercise

Carbohydrate required for 30 minutes of exercise			
Glucose level	Weight of person 10-30 kg	Weight of person 30-50 kg	Weight of person >50 kg
>15.0 mmol/L	If unwell, do not exercise		
10.1-15.0 mmol/L	0g	0g	0g
7.0-10.0 mmol/L	5g	10g	20g
4.0-6.9 mmol/L	10g	20g	30g
<4.0 mmol/L	Treat Hypoglycemia		

32.5 Guidelines for adjusting food (bolus) insulin doses, if activity is within 2 hours of bolus insulin injection

Table 46: Guideline for adjusting food (bolus) insulin doses

		Reduction in pre-meal insulin BEFORE activity			Reduction in pre-meal insulin AFTER activity		
Activity Level	Examples	15-30 Min	31-60 Min	More than 60 min	15-30 Min	31-60 Min	More than 60 min
Light	Slow walking Gardening Dancing	10%	25%	30%	None	10%	20%
Moderate	Brisk walking Hiking Cycling	20%	30%	50%	10%	20%	40%
Vigorous	Running Playing football Aerobics	30%	50%	65%	15%	30%	50%

32.6 Guidelines for adjusting basal insulin doses

- If a very active day is anticipated, more than the usual routine, reduce morning basal insulin dose by 20%.
- If one takes basal insulin twice daily, after an exercise session or an active day reduce the evening basal dose by 20%.
- 50% reduction of normal correction dose for 12 hrs.

NOTE: If one plans to exercise after injecting insulin, avoid the area that will exert the most energy. For example, if one plans on doing a lower body workout, avoid using thighs. Or if playing a game of tennis, avoid the arms.

Injecting into these active sites will increase the absorption rate and increase the risk of hypoglycemia.

33

**MANAGEMENT OF TYPE 1
DIABETES IN SCHOOL**

- In school and daycare, control of blood sugar is a challenge especially for preschoolers with many episodes of hyperglycemia and hypoglycemia.
- Type 1 diabetes should not be a barrier to learning when the glycemic control is good.
- Qualified diabetes educators and doctors should work with the school staff team to take care of the children (See Annex 6. Sample school plan).

Lack of knowledge has created fear in staff who work in school resulting in:

- Schools denying some of the children/ adolescents admission for learning.
- Schools giving children with diabetes special treatment causing lots of attention and isolation.
- Fear of participating in school activities or sports.
- Some parents staying in school during classes.
- Some students not being allowed to attend all learning hours

Students with diabetes who may require close supervision include:

1. Toddlers and preschoolers.
2. Special needs students e.g., children with autism spectrum disorder.
3. Non-compliant or rebellious students.
4. Sick students.

33.1 Algorithm for type 1 diabetes management in school

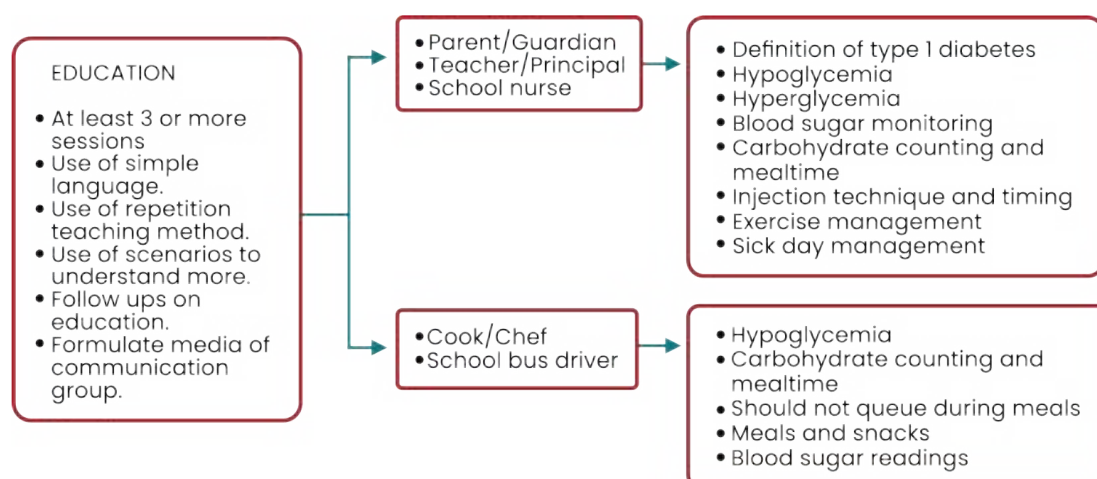


Figure 61: Algorithm for T1 diabetes management in school

NOTE:

- ◆ Students with diabetes should never queue for food in school.
- ◆ Ensure privacy when checking blood sugar and during administration of insulin.
- ◆ Give time to student to check blood sugars during classes when experiencing hypoglycemia symptoms.
- ◆ Allow for snacks/ bathroom breaks even during lessons.

34

HYPOGLYCEMIA IN TYPE 1 DIABETES

Hypoglycemia is a common occurrence in the management of T1DM. It is as a result of a mismatch between insulin administered and food consumed. It can be defined as:

1. Clinical Hypoglycemia alert: Blood glucose <3.9 mmol/L
2. Clinically important or serious hypoglycemia: Blood glucose <3.0 mmol/L
3. Serious Hypoglycemia: coma, convulsions and altered mental status

34.1 Signs and symptoms of Hypoglycemia



Figure 62: Signs and symptoms of Hypoglycemia

Additional symptoms include:

- ◆ Fast heart beat
- ◆ Convulsions
- ◆ Coma

34.2 Management of hypoglycemia

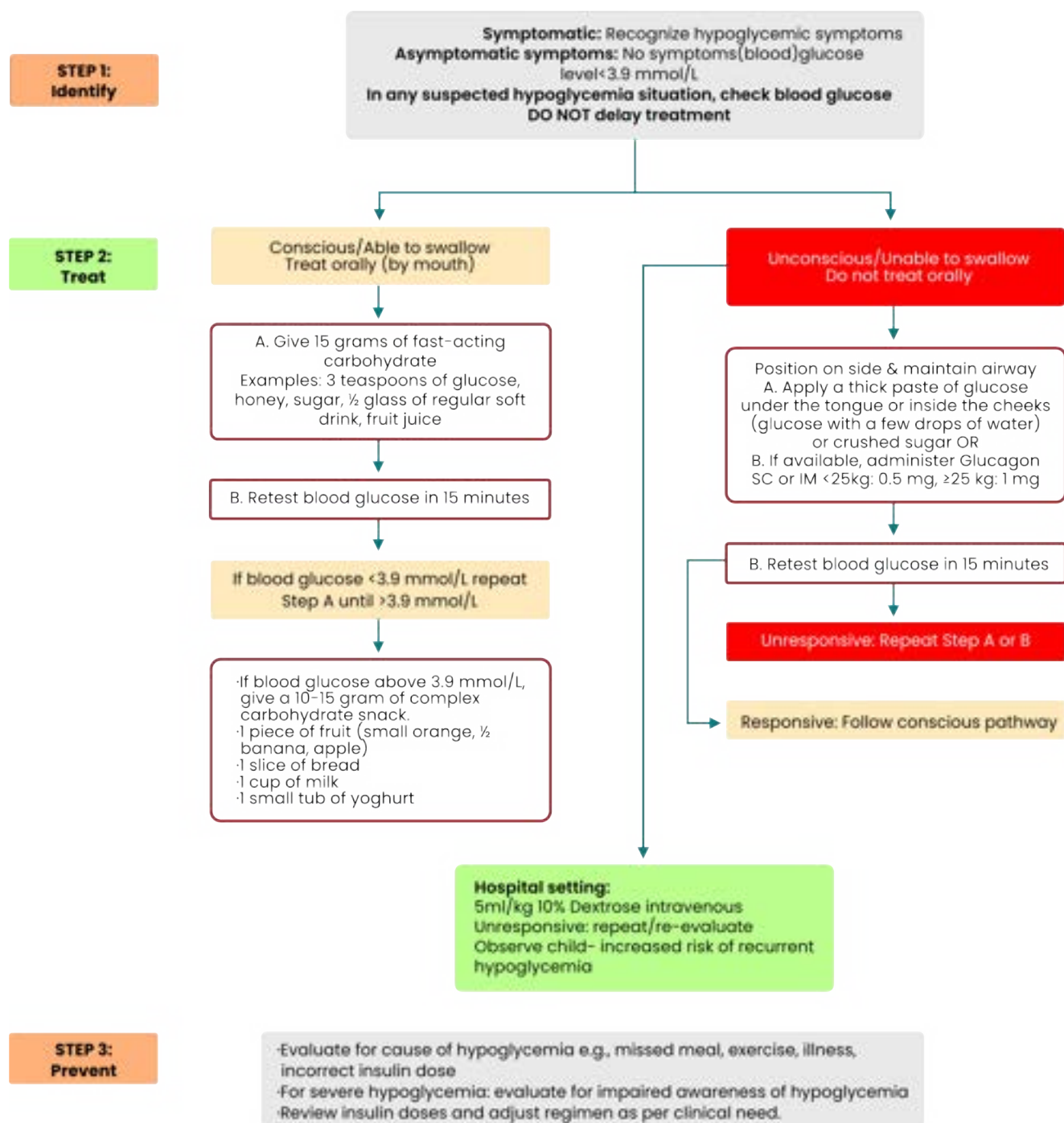


Figure 63: Management of hypoglycemia

35

**LONG-TERM COMPLICATIONS IN
CHILDREN AND ADOLESCENTS
WITH DIABETES**

Long-term vascular complications of diabetes

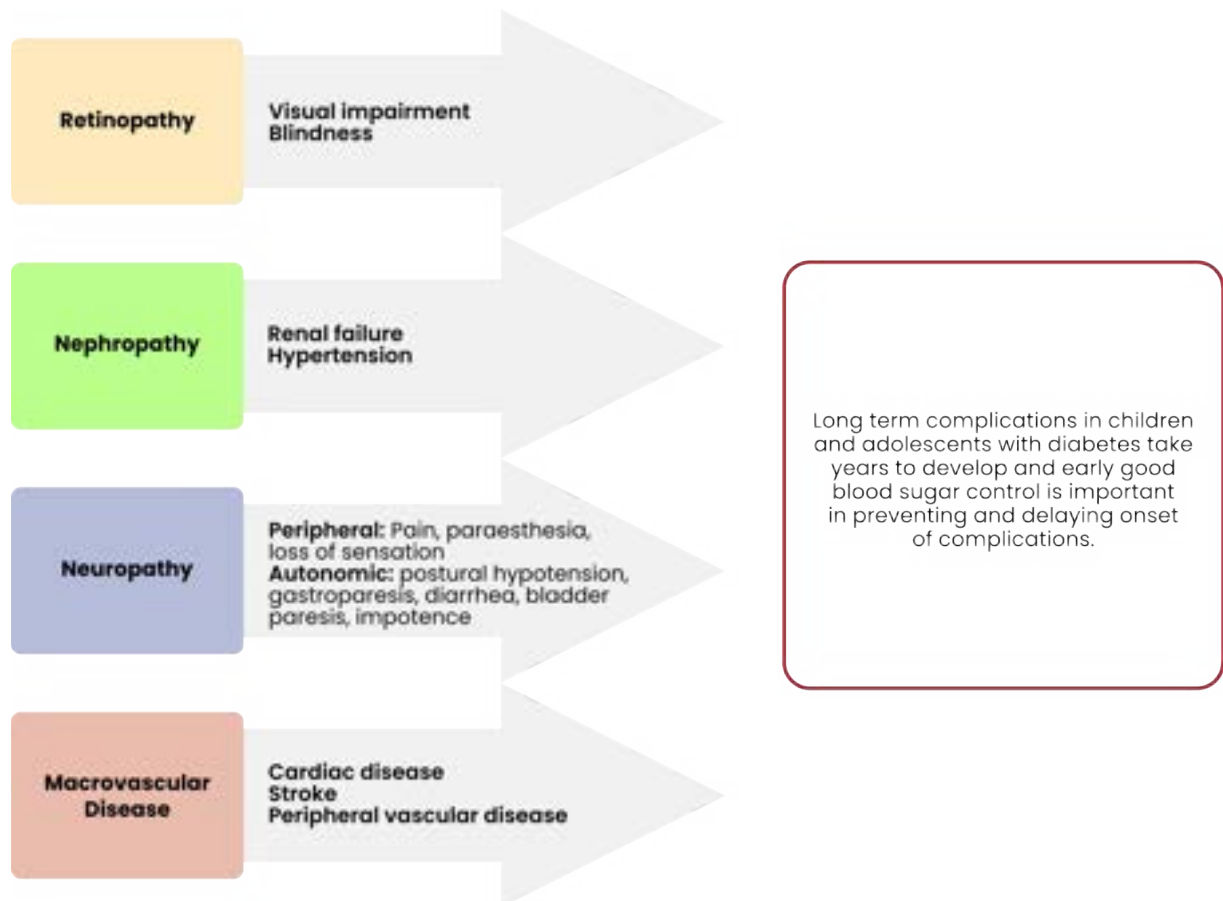


Figure 64: Long term vascular compliments of diabetes

35.1 Retinopathy

Diabetic Retinopathy (DR) is a progressive, potentially sight-threatening disease of the retinal neurovasculature. It is classified into:

- Non-proliferative retinopathy
- Proliferative retinopathy
- Diabetic macular edema (maculopathy)

Children and adolescents with diabetes require regular screening to identify those at risk for DR for intervention.

Screening for Retinopathy



Figure 65: Screening for retinopathy

35.2 Diabetic Kidney Disease (DKD)

DKD refers to **abnormalities of kidney structure or function that are present for more than 3 months (Chronic Kidney disease) which is attributed to diabetes.**

Screening for albuminuria which is the earliest clinical manifestation of DKD and a key risk factor for progression to overt proteinuria is important.

All children and adolescents with type 1 diabetes should have a baseline kidney function test.

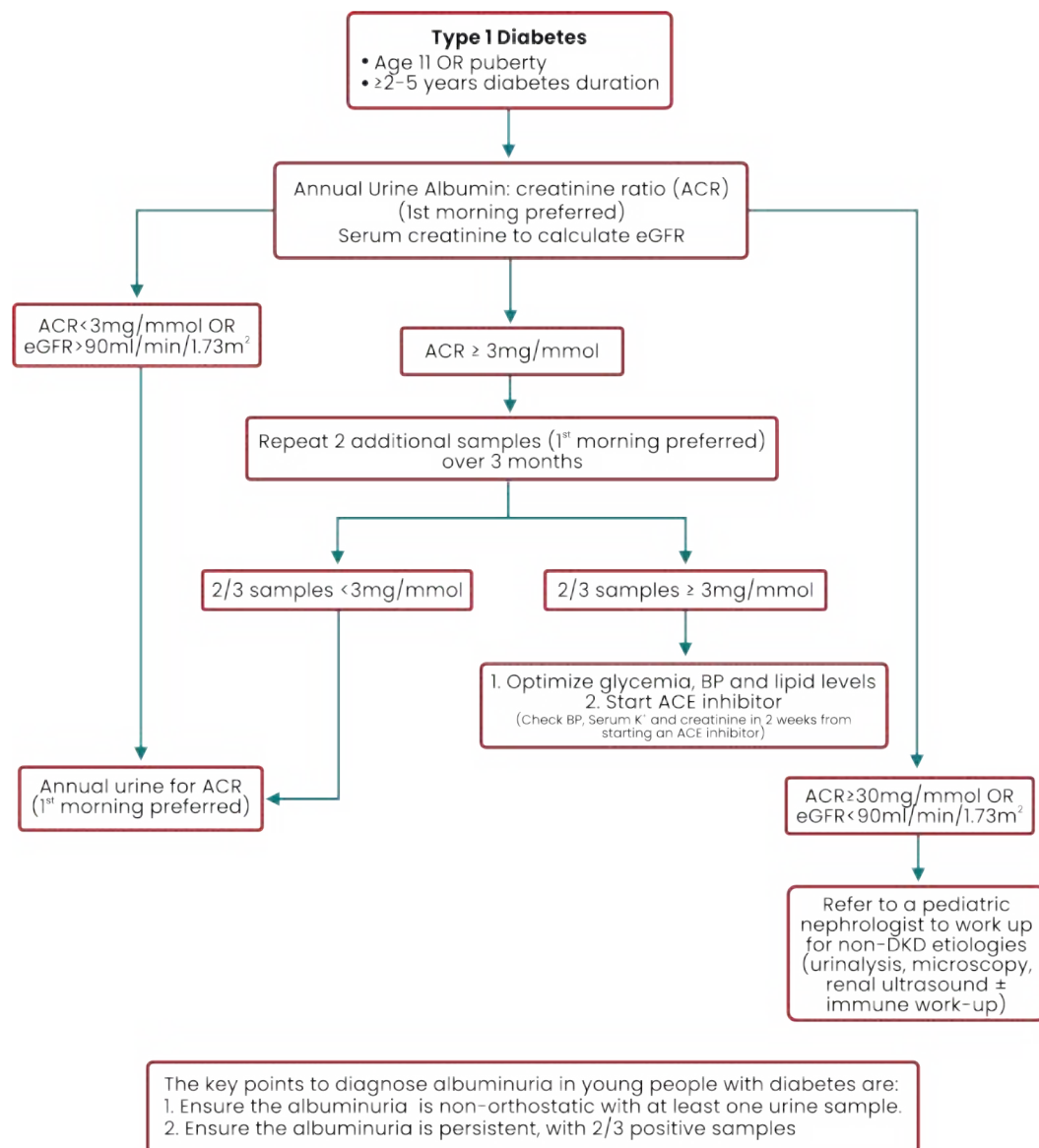


Figure 66: Diabetes Kidney Disease screening algorithm in young persons with type 1 diabetes

35.3 Neuropathy

Both the somatic and autonomic components of the peripheral nervous system are commonly affected. Small unmyelinated nerve fibers that carry pain and temperature perception are frequently affected first in diabetes. This is followed by injury to myelinated nerve fibers, which convey vibratory and position sense. This often presents as stocking-and-glove pattern diabetic neuropathy involving the distal parts of the limbs in a symmetrical manner.

Screening for Neuropathy

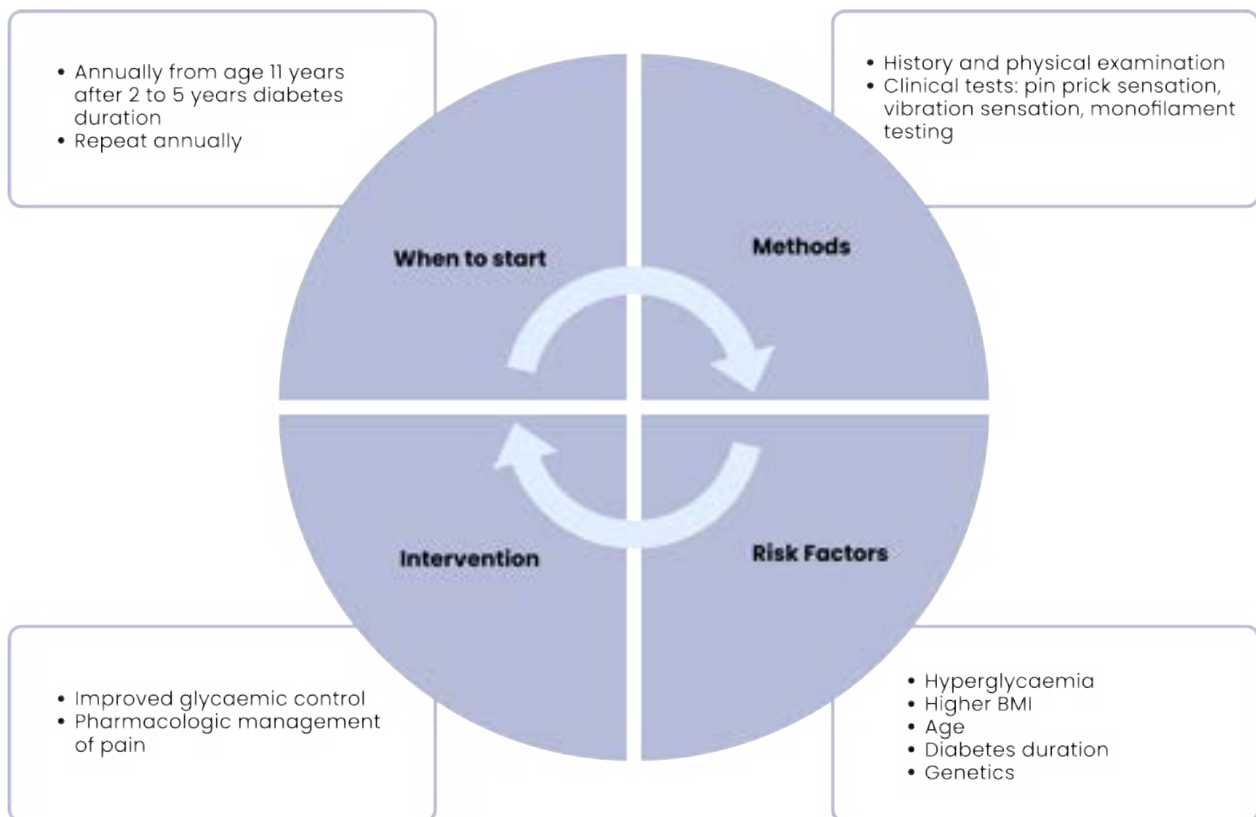


Figure 67: Screening for Neuropathy

35.4 Macrovascular Disease

- Individuals with T1DM experience an earlier onset of cardiovascular events and a higher mortality compared to their peers without.
- Studies show that young people diagnosed with T1DM before the age of 10 years have a 10 times higher risk of future acute myocardial infarction compared to those diagnosed between the ages of 26–30 years. They also have 30 times higher cardiovascular disease risk than the general population.

Screening for Macrovascular Disease

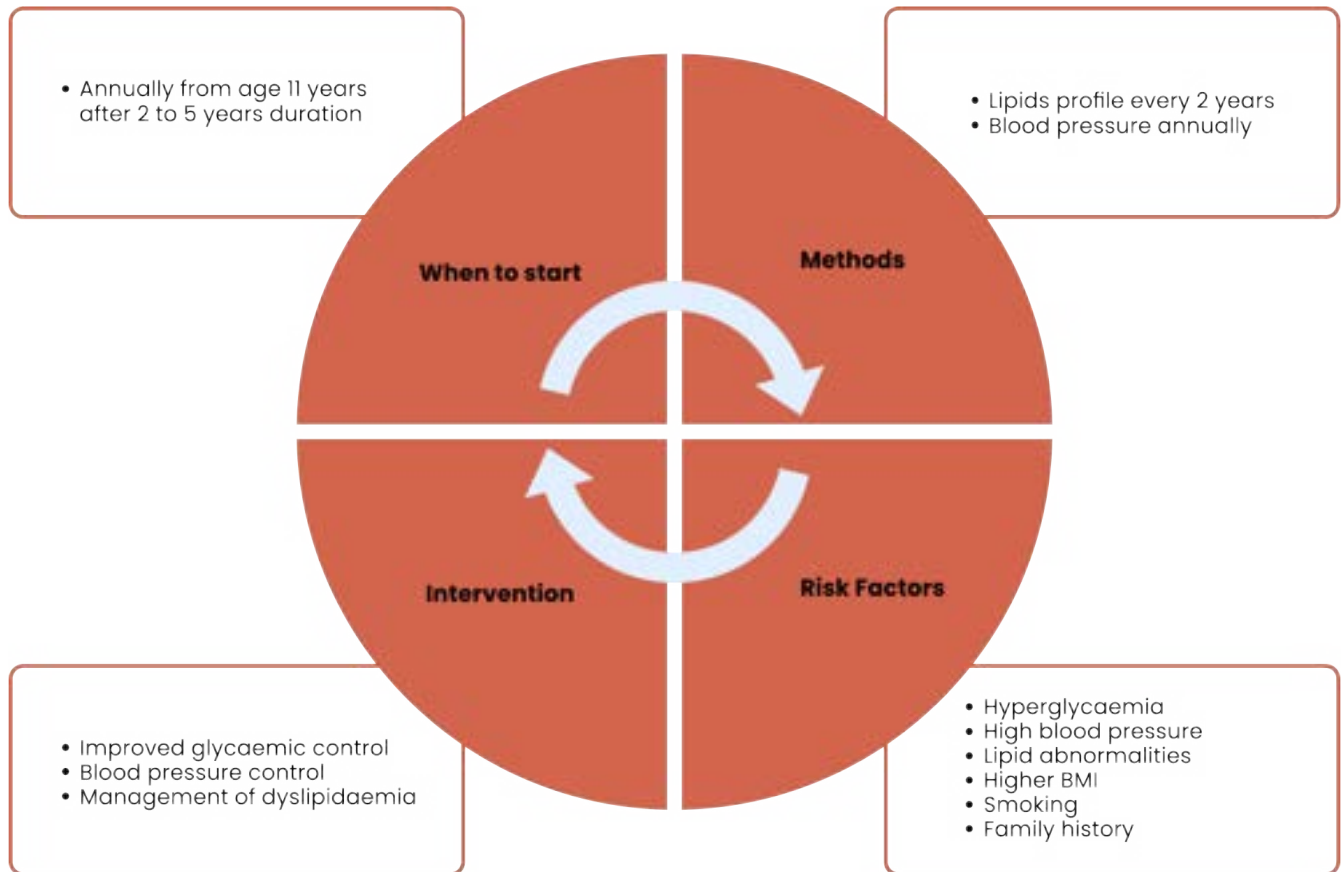


Figure 68: Screening for Macrovascular disease

36

NEONATAL HYPERGLYCEMIA

Neonatal hyperglycemia is defined as serum glucose greater than 150 mg/dl (8.33 mmol/L) or whole blood glucose greater than 125 mg/dl (6.9 mmol/L) irrespective of gestational or postmenstrual age. Usually, the safe target for a neonate's blood glucose level is 70 to 150 mg/dl (3.9 - 8.33 mmol/L). The cut off for safe target is based on the renal glucose threshold of preterm neonate.

Table 47: Neonatal Hyperglycemia

Causes	
• Latrogenic e.g. errors in glucose infusion rate • Drugs such as phenytoin, glucocorticoid, caffeine, maternal use of diazoxide • Prematurity and intrauterine growth restriction: inadequate insulin secretion, increased insulin resistance • Impaired glucose homeostasis in SGA babies.	• Sepsis and Stress • Transient neonatal hyperglycemia • Chromosomal anomalies and genetic syndromes • Lipid infusion • Diabetes mellitus in newborn
Laboratory Investigations	
• Serum glucose level • Detection of glucose in urine • Complete blood count	• Serum electrolytes • Serum insulin and C-peptide levels if the hyperglycemia persists after sepsis resolution
Complications	
• Severe intraventricular hemorrhage and increased mortality • Late-onset sepsis • Necrotizing enterocolitis • Retinopathy of prematurity	• Poor neurodevelopmental outcome • Prolonged hospitalization • Acute kidney injury

Flow chart on management of neonatal hyperglycemia

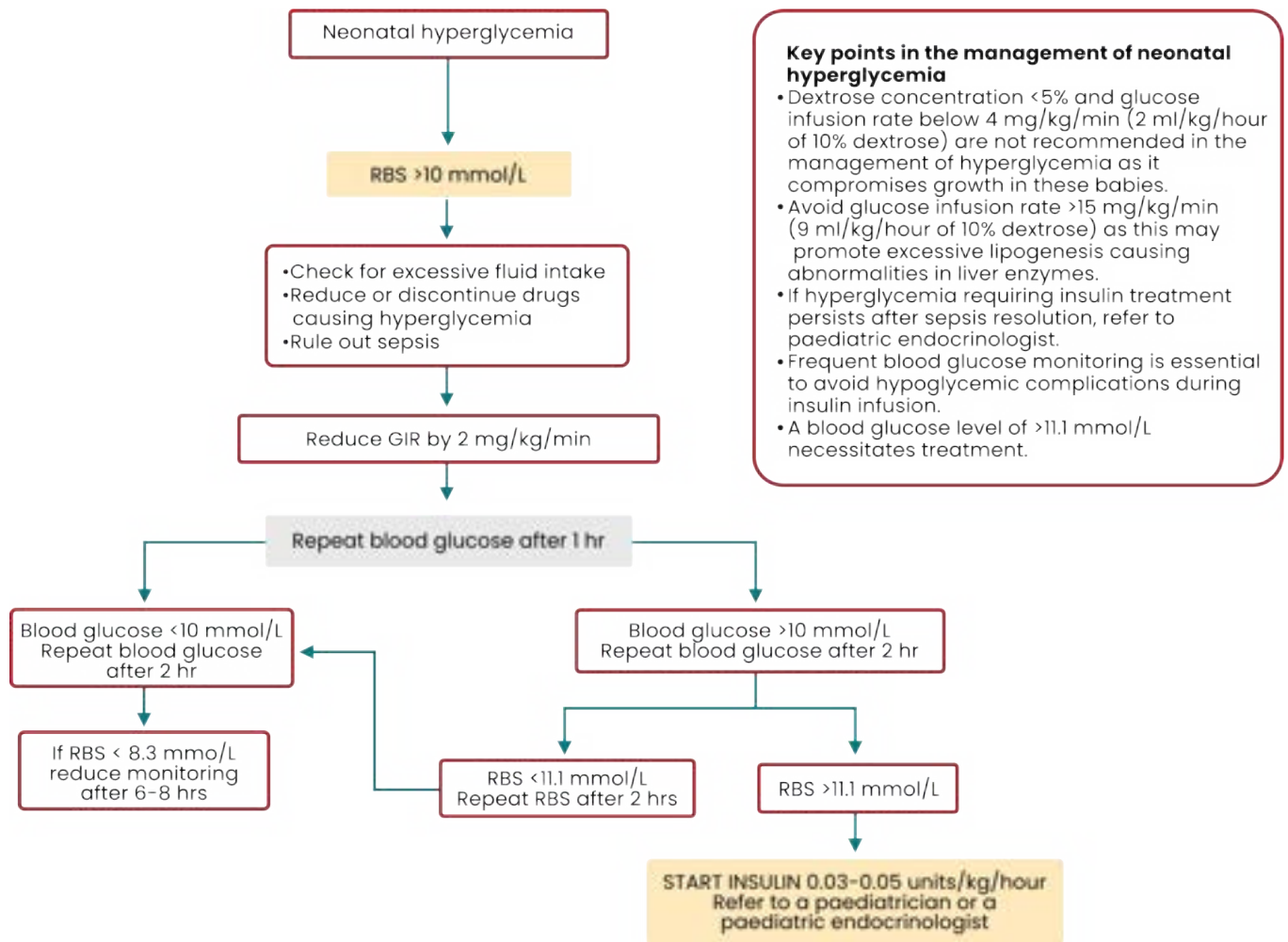


Figure 69: Flow chart on management of neonatal hyperglycemia

37

GROWTH MONITORING IN TYPE 1 DIABETES

- ◆ Growth can be affected by diabetes, i.e., insufficient insulin dosing can cause stunted growth even if blood glucose levels seem fine.
- ◆ Normal growth is an indicator of adequate diabetes care.
- ◆ Both pre-pubertal growth and the pubertal growth spurt are impaired.
- ◆ However, if there is pubertal delay with good glycemic control, assess for other causes including sex hormone or growth hormone deficiency.
- ◆ Watch out for Mauriac syndrome in patients with poorly controlled sugars (characterized by growth failure, hepatomegaly due to glycogen accumulation, delayed puberty, and Cushingoid features).
- ◆ Decreased growth in T1DM is correlated with microvascular complications including nephropathy and may share a common pathophysiology with diabetes-associated skeletal fragility.

Measurements

- Measure height, weight and BMI at each clinic visit (preferably every 1-3 months)
- Record in medical chart and plot on growth chart.
- Take both parents' heights, calculate the mid-parental height and chart child's target height.
- If the child has put on more than 1 kg in a month, a change of insulin dose may be necessary. Poorer than expected growth rates should prompt an inquiry into the cause, which could be hypothyroidism, celiac disease, adrenal insufficiency, poor glycemic control or poor calorie intake; and corrective action should be taken.
- Standing height should be taken without shoes. For young children under 2 years, total body length should be measured.
- Measure weight to nearest 0.1 kg with shoes off, wearing light clothes or underwear and having emptied the pockets.



CHAPTER 4

In-Patient Protocols

38.1: Hypoglycemia Management in Diabetes

Hypoglycaemia is when the blood glucose is $\leq 3.9\text{mmol/L}$ (70mg/dl)

Algorithm for the Treatment and Management of Hypoglycaemia in Adults with Diabetes Mellitus in Hospital

Hypoglycaemia is a serious condition and should be treated as an emergency regardless of level of consciousness. Hypoglycaemia is defined as blood glucose of less than 4.0mmol/L (if not less than 4.0mmol/L but symptomatic give a small carbohydrate snack for symptom relief).



*GLUCAGON MAY TAKE UP TO 15 MINUTES TO WORK AND MAY BE INEFFECTIVE IN UNDERNOURISHED PATIENTS, IN SEVERE LIVER DISEASE AND IN REPEATED HYPOLYCAEMIA. CAUTION IN ORAL HYPOLYCAEMIC AGENT- INDUCED HYPOLYCAEMIA.

**IN PATIENTS WITH RENAL/CARDIAC DISEASE, USE INTRAVENOUS FLUIDS WITH CAUTION. AVOID FRUIT JUICE IN RENAL FAILURE

Figure 70: Management of hypoglycemia

NOTES:

^15-20g oral carbohydrate:

- 5-7 Dextrosol tablets or 4-5 glucotabs
- 1 bottle (60ml) juice or soda
- 150-200 ml pure fruit juice e.g orange
- 3-4 heaped teaspoons sugar dissolved in water

*Small carbohydrate snack examples: 1 medium banana, a slice of bread or normal meal

38.2: Peripartum Management of Diabetes Mellitus

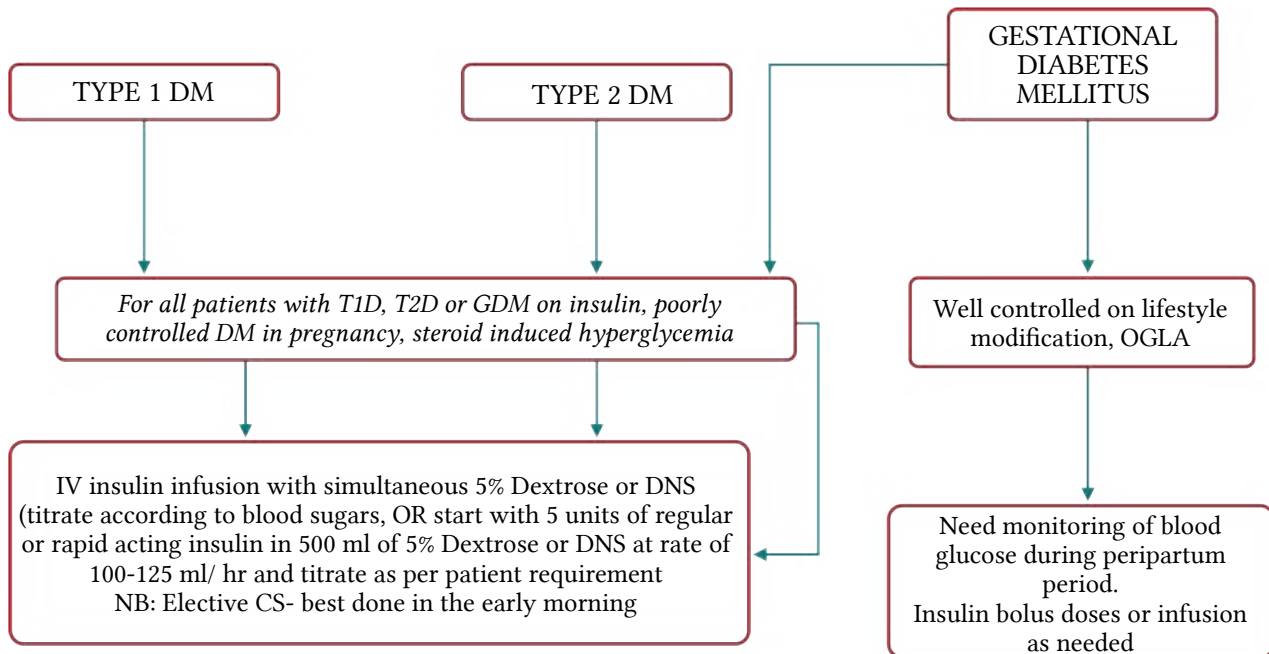


Figure 71: Peri-partum management of diabetes

Notes:

- Target blood glucose in peripartum period: 3.9- 6.1 mmol/l
- Usual dose of intermediate or long-acting insulin given at bedtime- prior to delivery
- Morning dose: withhold or reduce depending on time of induction/ delivery
- Monitor sugars every 2-4 h during the latent phase, every 1-2 h during the active phase and hourly in patients on glucose infusion
- GDM well controlled on Lifestyle alone- monitor glucose every 4-6 hours, if on infusion, monitor hourly.
- GDM- rarely require insulin during labour- monitor glucose to determine need, if sugars above target range, consider starting insulin infusion or s.c bolus short acting insulin doses (if infusion not available).
- If steroids administered for lung maturation, anticipate increased insulin requirement for upto 5 days, ensure close monitoring of blood glucose
- In patients with DM in pregnancy undergoing General Anesthesia, monitor sugars every 30 mins (NICE guidelines, 2015)
- In post-partum period- Reduce dose of insulin, hold oral agents/ insulin in GDM, close glucose monitoring.

38.3.1: Pre-Operative Management of Diabetes

NOTES:

- Sulfonylureas have an increased risk of hypoglycemia
- Metformin is contraindicated in conditions that may increase risk of renal hypoperfusion, increase risk of lactate accumulation and may precipitate AKI
- Thiazolidinediones may worsen fluid retention and precipitate congestive cardiac failure
- SGLT-2 inhibitors increase risk of hypovolemia and may precipitate AKI and euglycemic DKA
- DPP4 inhibitors may precipitate or worsen gastric dysmotility
- The risk for post-operative complications and increased mortality relates to both long term glycemic control and the severity of hyperglycemia on admission and during the hospital stay.
- Surgeries on the thorax and abdomen are associated with higher chances of hyperglycemia and insulin resistance. Laparoscopic procedures have less chance of these
- General anesthesia is associated with greater risk of hyperglycemia as volatile gases induce insulin resistance and increase hepatic gluconeogenesis
- Preoperative blood glucose levels should be maintained between 7-10mmol/L, intraoperatively at about 10mmol/L by use of rapid acting insulins subcutaneously
- Intravenous rapid insulins are recommended for those undergoing procedures with anticipated hemodynamic changes, significant fluid shifts, expected changes in temperature, use of inotropes or procedures lasting more than 4 hours

Preoperative management of patients with diabetes on oral glucose lowering agents (OGLAs)

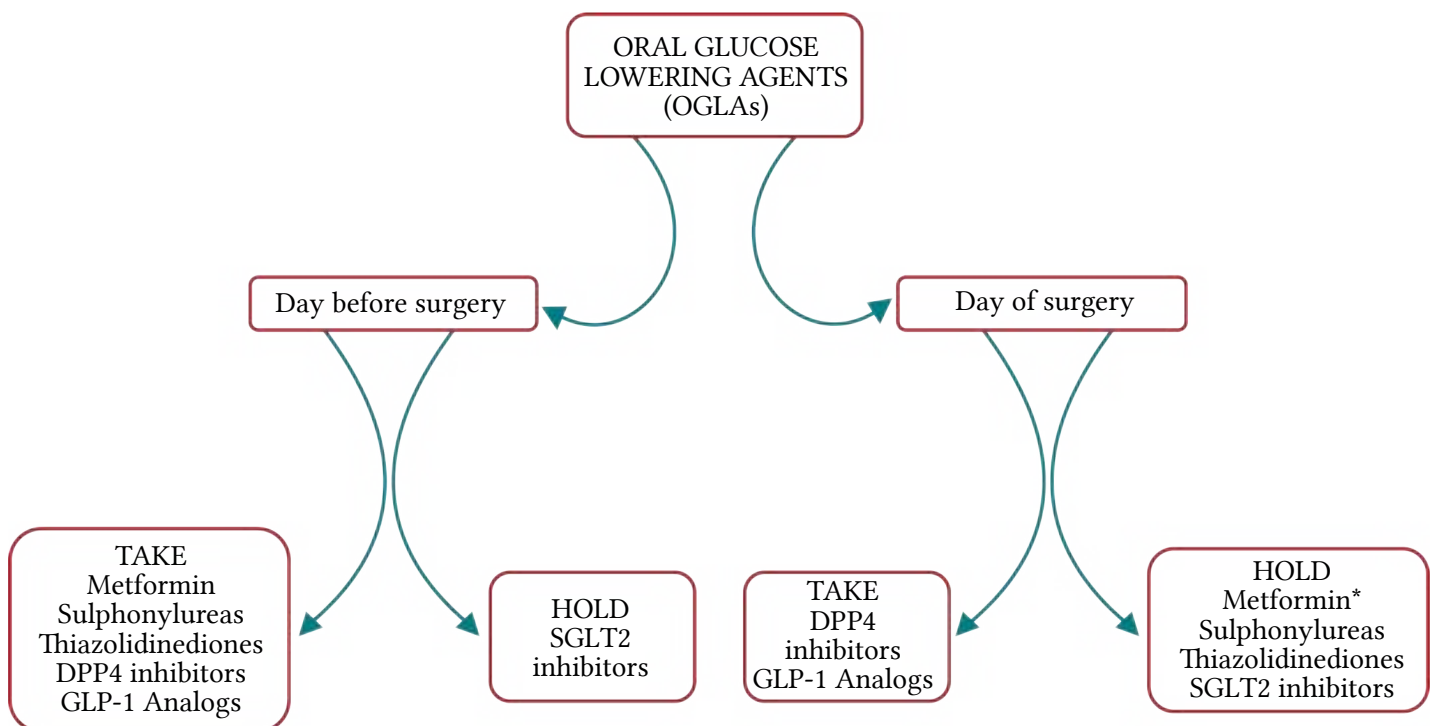


Figure 72: Pre-operative management of diabetes

*can be restarted once adequate oral intake has resumed

38.3.2: Preoperative management of patients with diabetes on insulin

Day before surgery

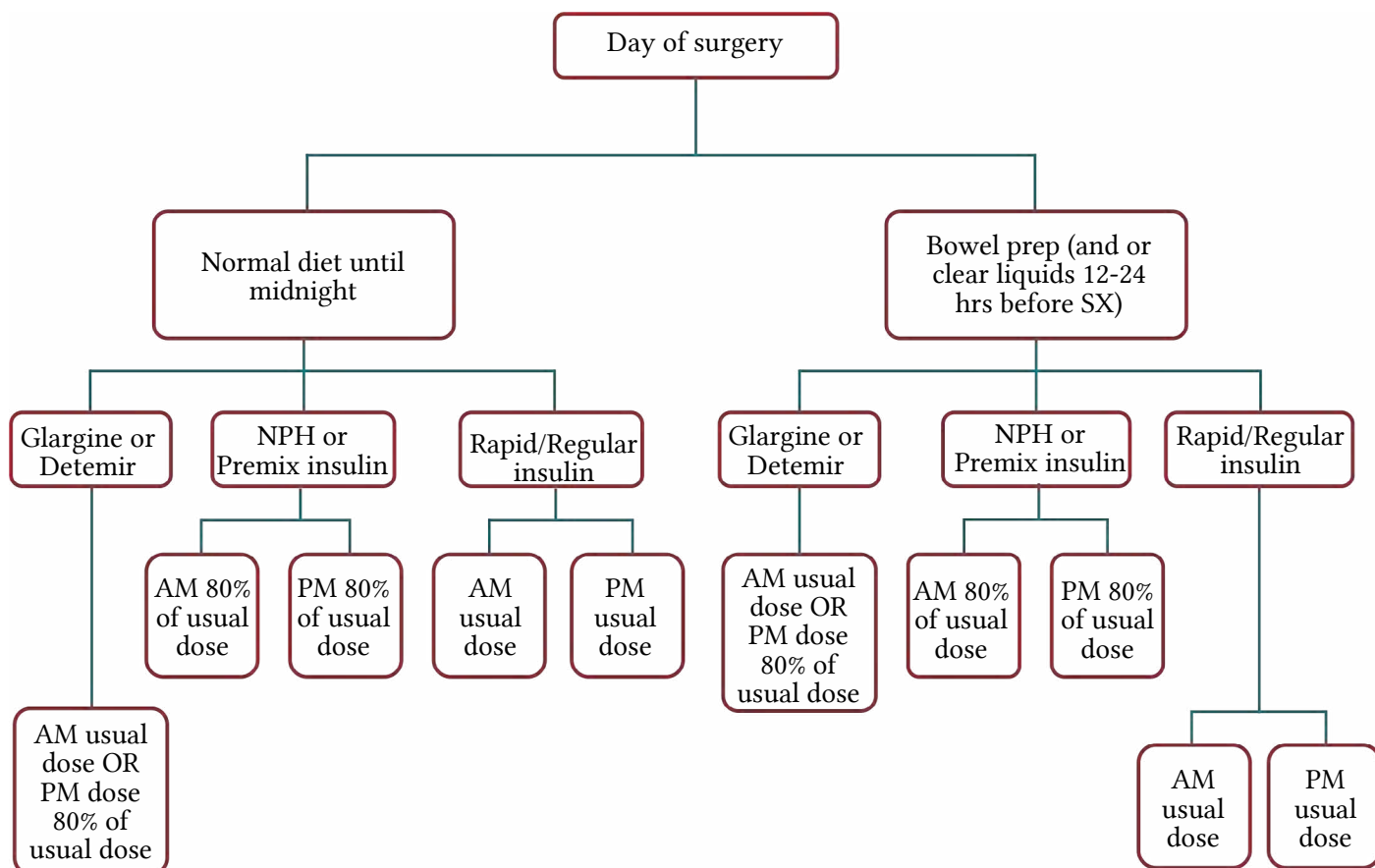


Figure 73: Pre-operative management of DM adult patients on insulin: day before surgery

Notes:

- Patients with type 1 diabetes undergoing surgical procedures require insulin during the perioperative period. They should receive 80% of basal insulin dose the evening before surgery and NOT on the morning of surgery in order to prevent hypoglycemia. Prandial insulin is stopped when the fasting state begins.

Day of surgery

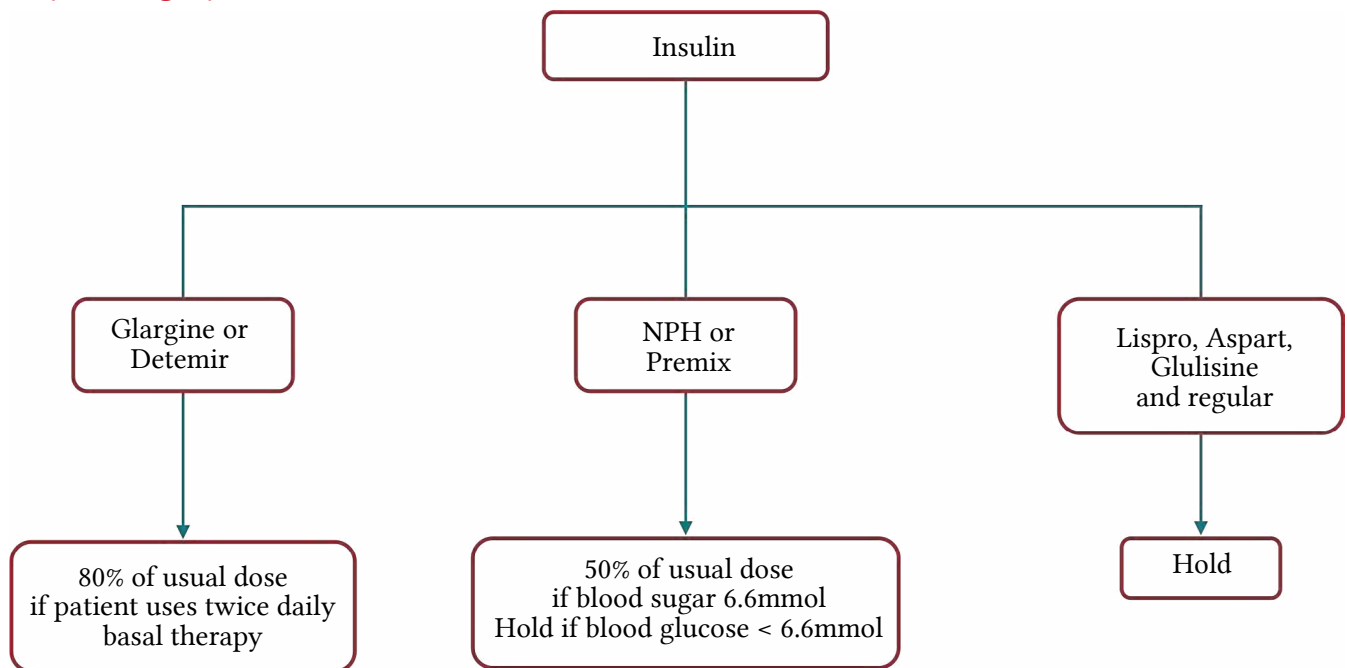


Figure 74: Pre-operative management of DM patients on insulin: day of surgery

38.5: Intraoperative Management of Diabetes Mellitus- Insulin Protocol

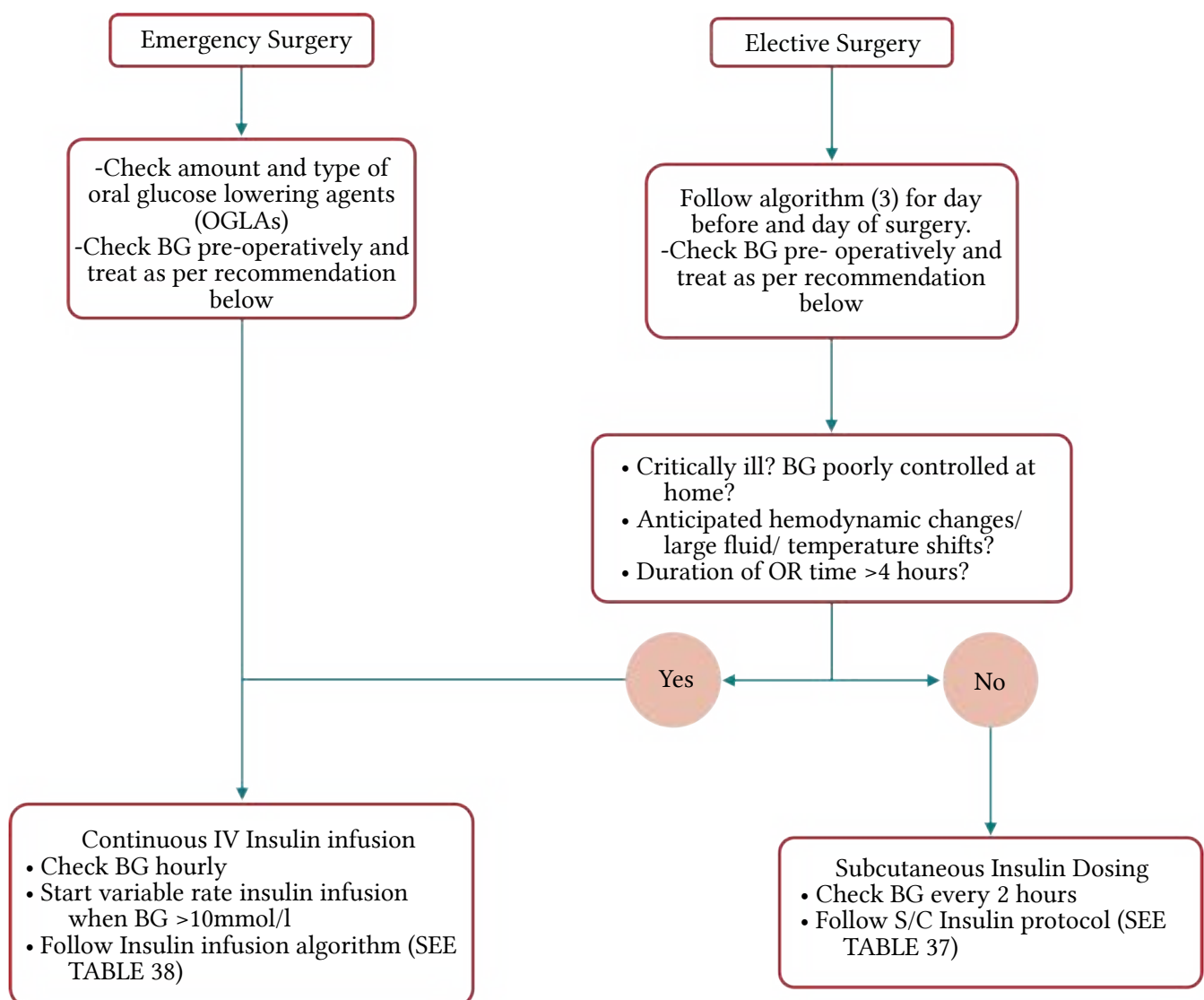


Figure 75: Intra-operative management of diabetes

- For BG <3.9 mmol/l- Stop insulin therapy. Treat with D50 bolus (25 ml) or start D10 infusion
 - For BG <2.8 mmol/l- Stop insulin therapy. Treat with D50 bolus (50 ml)
 - Recheck BG every 15 mins until BG >4 mmol/L
- (Abbreviations: BG- blood glucose, ISF- Insulin Sensitivity Factor, TDD- Total Daily Dose, OR- Operating Room)

Table 48: Correctional SC Insulin Scale Day of Surgery and Post-Operative Surgical Ward Care

Blood Glucose (mmol/L)	Insulin Sensitive* Age > 70, GFR < 45mL/min, No history of diabetes	Usual Insulin	Insulin Resistant* BMI > 35kg/m2, Home TDD Insulin > 80U, Steroids > 20mg prednisone daily
7.7-10	0	2	3
10-12.2	2	3	4
12.2-14.4	3	4	5
14.4-16.6	4	6	8
16.6-19.4	5	8	10
19.4-22.2	6	10	12
> 22.2	8	12	14

(GFR: glomerular filtration rate, mL: milliliter, min: minute, m: meters, U: units, kg: kilograms, BMI: body mass index, mg: milligrams, d: deciliter, mmol: millimoles, L: liter, TDD: total daily dose)

**If the patient falls into more than one insulin treatment group, choose the category with the lowest correctional dose to minimize the risk of hypoglycemia.*

- Check blood glucose 2 hourly with subcutaneous protocol

Table 49: Variable Rate Continuous Insulin Infusion

Blood Glucose (mmol/L)	If BG increased from previous measurement	BG decreased from prior measurement by less than 1.7 mmol/l	BG decreased from prior measurement by greater than 1.7 mmol/l
13.4	Increase rate by 3U/h	Increase rate by 3U/h	No change in rate
11.7-13.4	Increase rate by 2U/h	Increase rate by 2U/h	No change in rate
10-11.7	Increase rate by 1U/h	Increase rate by 1U/h	No change in rate
7.8-10	No change in rate	No change in rate	No change in rate
6.1-7.8	No change in rate	Decrease rate by ½ U/h	Hold insulin infusion
5.5-6.1	1. Hold insulin infusion 2. Re-check BG hourly 3. Restart infusion at ½ the prior infusion rate if BG > 10mmol/L		
3.9-5.5	1. Hold insulin infusion 2. Check BG every 30 minutes until BG > 5.5mmol/L 3. Resume BG checks every hour 4. Restart infusion at ½ the prior infusion rate if BG > 10mmol/L		
3.9 or lower	If BG 2.8-3.9mmol/L, 1. Give 25mL D50 2. Repeat BG checks every 30 minutes until BG > 5.5mmol/L If BG < 2.8mmol/L 1. Give 50mL D50 2. Repeat BG every 15 minutes until > 3.9mmol/L 3. When BG > 3.9mmol/L , BG checks every 30 minutes until > 5.5mmol/L. Repeat 50mL D50 dose if BG < 2.8 mmol/l, a second time and start D10 infusion. 4. After BG > 5.5mmol/L, resume hourly BG check Restart infusion at ½ the prior infusion rate if BG > 10 mmol/L)		

BG: Blood Glucose, mg: milligrams, dL: deciliter, mmol: millimoles, L: liter, U: Units, h: hour, D50: 50% dextrose solution, D10: 10% dextrose solution, mL: milliliters

1. If BG > 10mmol/L, start insulin infusion
2. Consider bolus dose [BG – 2.2 mmol/l]
3. Start rate at BG/5.5 = U/hr
4. Check BG hourly and correct per table

38.6: In- Patient Management of Hyperglycemia - Non-Critical Care

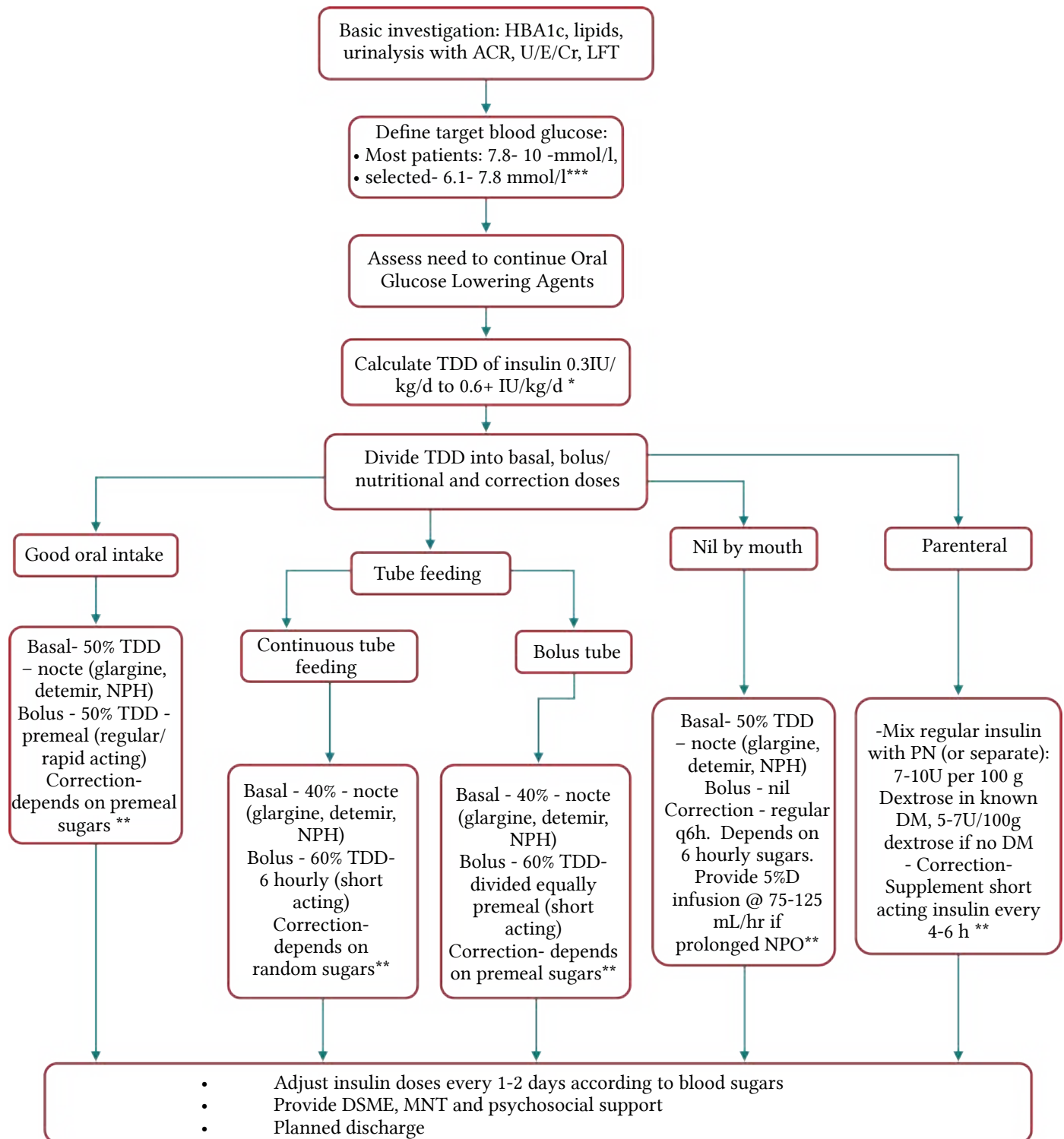


Figure 76: Non-critical care for patients with diabetes

*Weight-based estimation: TDD (in units) = the patient's weight (in kg) x N

N = Malnourished, elderly, CKD, (on dialysis), severe liver disease 0.3

Normal-weight patients, Type 1 diabetes. 0.4

Overweight 0.5

Obese, high dose steroids, or other markers of significant insulin resistance. 0.6 +

** calculate insulin sensitivity factor: 100/ TDD

Add 1 unit insulin for each ISF above target range.

E.g. if TDD is 30 units of insulin and premeal blood glucose is 15 mmol/l, Insulin Sensitivity Factor (ISF) = 100/30=3.3

Thus, for each 3.3 mmol/l blood glucose above upper limit of target glucose, add 1 unit of Insulin.

Therefore, correction dose in this example: $(15-8) / 3.3 = \sim 2$ units

- Continuous tube feeds or bolus feeds may vary in caloric content depending on type of feed used / volume used, which may affect the basal amount used, consult specialist for adjustments.
- Young type 2 diabetes, newly diagnosed DM

38.7: In- Patient Management of Hyperglycemia - Critical Care

ICU insulin orders – IV insulin infusion protocol

(Not intended for use in patients with DKA (SEE PROTOCOL) or hyperglycemic hyperosmolar states (SEE PROTOCOL))

DIAGNOSIS: ☐ Type 1 DM ☐ Type 2 DM ☐ Stress hyperglycemia

Start IV insulin infusion when blood glucose is:

☐ More than 10mmol/l ☐ More than 8.3 mmol/l ☐ Other: _____

1) **Start an IV Insulin Flow Sheet** and keep record at bedside

2) **Start IV fluids:**

_____ D5W at 100ml/h

_____ D5W½NS at _____ ml/h

_____ Other: _____

3) **Mix standard insulin drip:** 100 units Regular, aspart, lispro or glulisine insulin in 100 cc NS (1 unit insulin /cc) (Circle one)

4) **Give initial insulin bolus:**

- Bolus units of I.V. insulin = Glucose $\div$ 5.6 (e.g. if glucose = 13.3 mmol/l, give 2.5 units)

5) **Start insulin infusion (SEE SECTION 8):**

- Initial infusion rate of insulin units/h = Glucose $\div$ 5.6 (e.g. if glucose= 13.3 mmol/L, begin 2.5 units/h)

6) **Target range for glucose:**

- Low Target (circle one)

3.9 5.6 or _____ mmol/l

- High Target (circle one)

6.1 6.7 7.8 or _____ mmol/L

7) **Monitor capillary (finger stick) glucose** every hour until it is within target range for 4 hours, then decrease blood glucose checks to every 2 hours.

- Always resume hourly check if blood glucose exits goal range.
- If blood glucose is below 6.1 mmol/l or decreases more than 6 mmol/l in the previous hour, check blood glucose in 20-30 minutes.
- Hourly checking can be continued even at stable sugars in critically ill or those having medical/ surgical procedures.
- Obtain lab glucose if finger stick BG is 22.2 mmol/L , use arterial or venous blood glucose for patients in shock, vasopressor therapy, severe peripheral edema or on prolonged insulin infusion.

8) **Adjust insulin infusion rate** each hour after initial insulin bolus and infusion

- Start on Algorithm 1 (No patient begins on Algorithm 3 or 4 without endocrine service authorization)
- Start on Algorithm 2 (s/p CABG, transplant, glucocorticoids or >80 units/d insulin outpatient)
- Move up or down on the same algorithm each hour if glucose remains outside the target range
- Advance to the next algorithm (i.e. 1–2 etc.) if outside target range at highest infusion rate
- Treat for hypoglycemia if glucose 3.3mmol/L in 1 hour
- See insulin infusion algorithm decision tree for transition between algorithms.

Table 50: Algorithms for insulin infusion in critical care

Algorithm 1		Algorithm 2		Algorithm 3		Algorithm 4	
BG	Units/h	BG	Units/h	BG	Units/h	BG	Units/h
<3.3 mmol/l- hypoglycemia (see hypoglycemia protocol)							
<3.9	Off	<3.9	Off	<3.9	Off	<3.9	Off
3.9-6	0.2	3.9-6	0.5	3.9-6	1	3.9-6	1.5
6.1-6.6	0.5	6.1-6.6	1	6.1-6.6	2	6.1-6.6	3
6.7-8.2	1	6.7-8.2	1.5	6.7-8.2	3	6.7-8.2	5
8.3-9.9	1.5	8.3-9.9	2	8.3-9.9	4	8.3-9.9	7
10-11.6	2	10-11.6	3	10-11.6	5	10-11.6	9
11.7-13.2	2	11.7-13.2	4	11.7-13.2	6	11.7-13.2	12
13.3-14.9	3	13.3-14.9	5	13.3-14.9	8	13.3-14.9	16
15- 16.6	3	15- 16.6	6	15- 16.6	10	15- 16.6	20
16.7-18.3	4	16.7-18.3	7	16.7-18.3	12	16.7-18.3	24
18.4-19.9	4	18.4-19.9	8	18.4-19.9	14	18.4-19.9	28
>20	6	>20	12	>20	16	>20	32

9) Treat for hypoglycemia if glucose <3.3 mmol/l or _____ mmol/l

- Glucose 2.2- 3.3 mmol/l: Give ½ ampule (12.5 grams glucose) D50W by slow IV push over 30 seconds.
- Glucose <2.2 mmol/l: Give 1 ampule D50W (25 grams glucose) by slow IV push over 30 seconds
- Decrease insulin drip rate by moving down 1 algorithm (i.e. from Algo 3 to Algo 2, etc.)
- Recheck glucose in 15 minutes and repeat D50W, as above, if necessary

10) Call Endocrine Service if:

- Other physicians make changes to subcutaneous or IV insulin regimen
- TPN, steroids or feedings are started, stopped or changed
- Other physicians turn off the insulin drip for any reason
- Patient does not respond to above pathways for glycemic control

11) Transition from IV insulin to SC insulin:

- Give specified basal insulin dose SC – calculate the total daily dose (TDD) of IV insulin from the mean hourly dose for the prior 6 hrs (if carbohydrates have been steady in infusion), use half of this dose as basal insulin, given 2-4 hours before discontinuation of infusion. (Bolus/ nutrition doses are divided from the remaining half of the TDD, according to expected carbohydrate distribution of meals).
- Then discontinue insulin infusion in 2-4 hours.
- If need for immediate discontinuation, give alongside rapid acting insulin (10% of basal dose)

Physician: _____ Time: _____ Date: _____

38.8 Insulin infusion decision tree

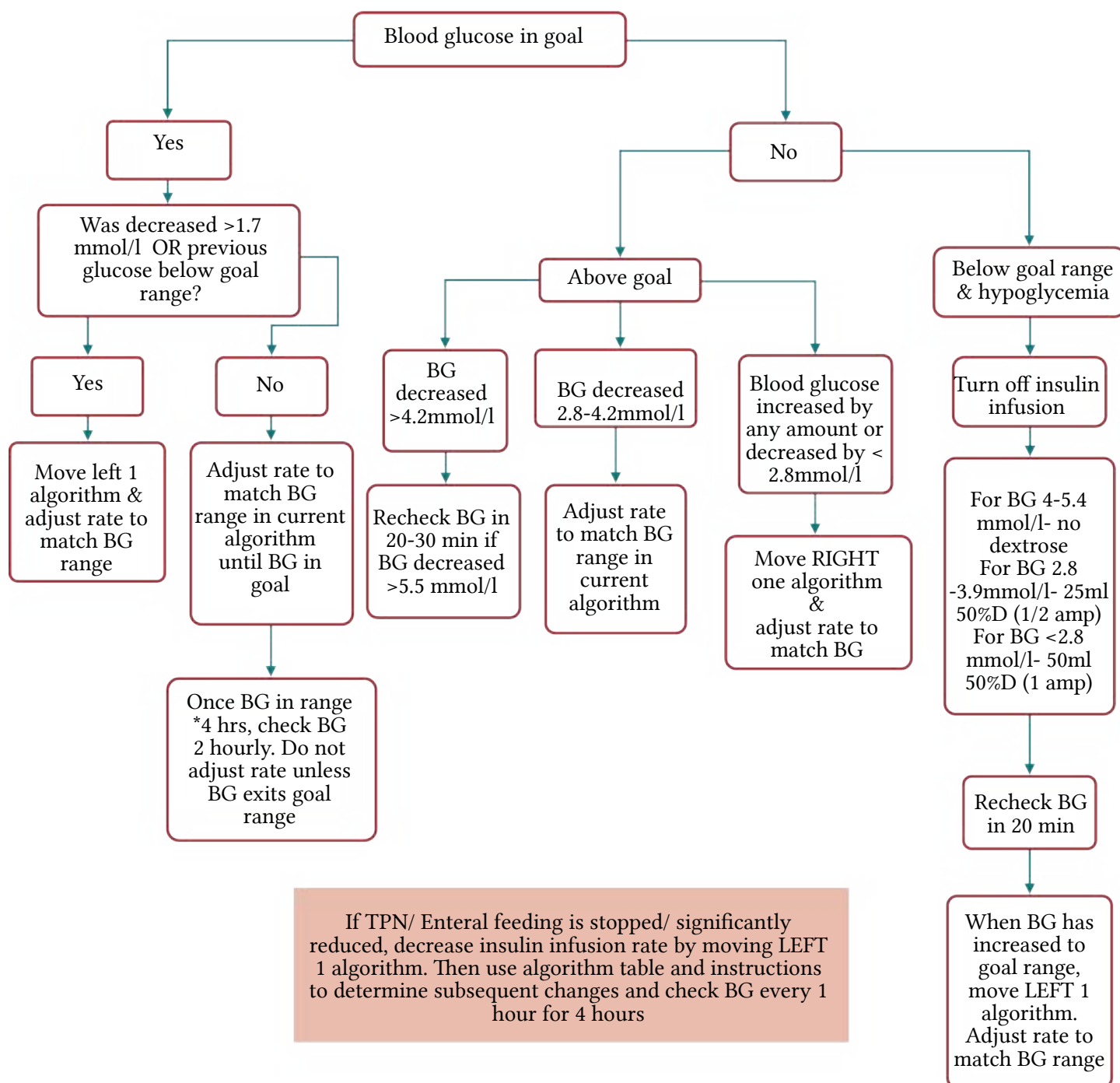


Figure 77: Insulin infusion decision tree

39

MANAGEMENT OF DIABETIC KETOACIDOSIS (DKA)

NOTES

- Diabetic ketoacidosis is defined by hyperglycemia over 13.9 mmol/L, a bicarbonate level less than 18 mEq/L, and a pH less than 7.30, with ketonemia and ketonuria.
- In HHS, blood glucose is >33 mmol/L but pH is greater than 7.3 and serum bicarbonate greater than 15 mEq/L
- If ketosis/ ketoacidosis noted with normal sugars, consider euglycemic DKA. Rule out SGLT2 use, infections, severe dehydration, starvation, pancreatitis, low carbohydrate diet- manage as DKA but use DNS in place of normal saline. Treat underlying cause (if on SGLT2 inhibitors, hold them).
- Basal insulin- glargine or detemir (0.2-0.3 units/kg) can be considered at diagnosis (within 2 hours) in patients with moderate to severe DKA, alongside IV insulin, particularly if delays are anticipated. Monitor for serum potassium since this has a risk of hypokalemia.
- Resolution of DKA should not be monitored with urine ketones alone since they may remain positive even after DKA resolution (measure acetoacetate rather than beta hydroxyl butyrate)

Diagnosis of DKA

All of these must be present to make the diagnosis

The 'D' – a blood glucose concentration of >11.0 mmol/L **or known to have diabetes mellitus**

The 'K' – a capillary or blood ketone concentration of 3.0 mmol/L or significant ketonuria (2+ or more on standard urine sticks)

The 'A' – a bicarbonate concentration of <15.0 mmol/L **and or** venous pH <7.3

Category of DKA	PH level	Serum bicarbonate mEq/L	Anion Gap
Mild	7.25-7.3	15-18	>10- 12
Moderate	7.0-7.24	10-15	>12
Severe	<7.0	<10	>12

39.1: Dka Management Pathway- Time Based Approach

ASSESSMENT OF SEVERITY:

The presence of one or more of the following may indicate severe DKA:

- Blood ketones > 6.0 mmol/L
- Bicarbonate level < 5.0 mmol/L
- Venous/arterial pH < 7.0
- Hypokalaemia on admission (under 3.5 mmol/L) • GCS < 12 or abnormal AVPU scale
- Oxygen saturation < 92% on air (assuming normal baseline respiratory function)
- Systolic BP < 90 mmHg
- Pulse > 100 or < 60 bpm
- Anion gap > 16 [Anion Gap = (Na⁺ + K⁺) – (Cl⁻ + HCO₃⁻)]

BOX 1: Immediate management: time 0 to 60 minutes

(T=0 at time intravenous fluids are commenced) If intravenous access cannot be obtained request critical care support immediately Action 1: - Commence NS (use a large bore cannula) via an infusion pump (See Box 2 for rate of fluid replacement) Action 2: - Commence a FRIII. (0.1unit/kg/hr based on estimate of weight) 50 units human soluble insulin made up to 50ml with NS solution. - If patient normally takes long acting insulin (glargine, detemir, degludec) continue at usual dose and time	Action 3: Assess patient - Respiratory rate; temperature; blood pressure; pulse; oxygen saturation - Glasgow Coma Scale - Full clinical examination Action 4: Further investigations - Capillary and laboratory glucose - Venous BG - U&E and FBC - Blood cultures - ECG - CXR - MSU	Action 5: Establish monitoring regimen - Hourly capillary blood glucose - Hourly capillary ketone measurement if available - Venous bicarbonate and potassium at 60 minutes, 2 hours. 2 hourly thereafter 4 hourly plasma electrolytes - Continuous cardiac monitoring/ SPO2 if required Action 6: Consider precipitating causes and treat appropriately
--	--	--

HDU/ higher level care/ insertion of central line in:

- Young people (18-25 years)
- Elderly
- Pregnant
- Heart or kidney failure
- Other serious co-morbidities
- Severe DKA (criteria in box above for assessment of severity)

BOX 2: Initial fluid replacement

Restoration of circulating volume is priority

SBP < 90mmHg: Likely due to low circulating volume, but consider other causes such as heart failure, sepsis, etc.

- Give 500mls NS over 10-15 minutes. .
- If SBP remains 90mmHg, give 1L NS over the next 60 minutes
- The addition of K is likely to be required in this 2nd litre of fluid

SBP 90 mmHg and over

- Give 1L 0.9% NS over the 1st 60 minutes

Potassium replacement (see box on K replacement)

Potassium replacement in DKA	
K level in first 24 hours (mmol/L)	K replacement in mmol/L of infusion solution
Over 5.5	Nil
3.5-5.5	40
Below 3.5	Senior review

BOX 3: Immediate management: time 0 to 60 minutes

Aims of treatment: - Rate of fall of ketones of at least 0.5 mmol/L/hr OR bicarbonate rise 3 mmol/L/hr and blood glucose fall 3 mmol/L/hr - Maintain serum potassium in normal range - Avoid hypoglycaemia Action 1: Re-assess patient, monitor vital signs - Hourly blood glucose (lab blood glucose if meter reading ‘HI’) - Hourly blood ketones - Venous blood at 60 minutes, 2 hours and 2 hourly thereafter - If K is outside normal range, re-assess K replacement and check hourly. If abnormal after further hour seek immediate senior medical advice	Action 2: Continue fluid replacement via infusion pump: <table><tr><th>FLUID</th><th>VOLUME</th></tr><tr><td>NS 1 L *</td><td>1000 ml over 1st hour</td></tr><tr><td>NS 1 L with KCL</td><td>1000 ml over next 2 hours</td></tr><tr><td>NS 1 L with KCL</td><td>1000 ml over next 2 hours</td></tr><tr><td>NS 1 L with KCL</td><td>1000 ml over next 4 hours</td></tr><tr><td>NS 1 L with KCL</td><td>1000 ml over next 4 hours</td></tr><tr><td>NS 1 L with KCL</td><td>1000 ml over next 6 hours</td></tr></table> <i>*KCL may be required if > 1 L of NS has been given to resuscitate those who are hypotensive.</i> - Add 10% glucose 125ml/hr if blood glucose falls below 14 mmol/L - Consider reducing the rate of intravenous insulin infusion to 0.05 units/ kg/hour when glucose falls below 14 mmol/L More cautious fluid replacement in young people aged 18-25 years, elderly, pregnant, heart or renal failure. (Consider HDU and/or central line)	FLUID	VOLUME	NS 1 L *	1000 ml over 1st hour	NS 1 L with KCL	1000 ml over next 2 hours	NS 1 L with KCL	1000 ml over next 2 hours	NS 1 L with KCL	1000 ml over next 4 hours	NS 1 L with KCL	1000 ml over next 4 hours	NS 1 L with KCL	1000 ml over next 6 hours	Action 3: Assess response to treatment Insulin infusion rate may need review if: - Capillary ketones not falling by at least 0.5 mmol/L/hr - Venous bicarbonate not rising by at least 3 mmol/L/hr - Plasma glucose not falling by at least 3 mmol/L/hr - Continue FRIII until ketones < 0.6 mmol/L, venous pH >7.3 and/or venous bicarbonate over 18 mmol/L If ketones and glucose are not falling as expected - check the insulin infusion pump is working, connected and correct insulin residual volume is present (to check for pump malfunction). If equipment working but response to treatment is inadequate, increase insulin infusion rate by 1 unit/hr increments hourly until targets achieved	Additional measures - Regular observations and Early Warning Score (NEWS2) - Accurate fluid balance chart, minimum urine output 0.5ml/kg/hr - Consider urinary catheterisation if incontinent or anuric (not passed urine) by 60 minutes - NGT with airway protection if patient obtunded or persistently vomiting - Measure ABG and repeat CXR if SPO2 < 92% - Thromboprophylaxis with LMWH - Consider ECG monitoring if K abnormal or concerns about cardiac status
FLUID	VOLUME																
NS 1 L *	1000 ml over 1st hour																
NS 1 L with KCL	1000 ml over next 2 hours																
NS 1 L with KCL	1000 ml over next 2 hours																
NS 1 L with KCL	1000 ml over next 4 hours																
NS 1 L with KCL	1000 ml over next 4 hours																
NS 1 L with KCL	1000 ml over next 6 hours																

BOX 4: 6 to 12 Hours

Aims: - Ensure clinical and biochemical parameters improving - Continue IV fluid replacement - Avoid hypoglycaemia - Assess for complications of treatment e.g. fluid overload, cerebral oedema - Treat precipitating factors as necessary	Action 1: Re-assess patient, monitor vital signs - If patient not improving by criteria in Box 3, seek senior advice - Continue IV fluid via infusion pump at reduced rate (See Box 3) - Consider reducing the rate of intravenous insulin infusion to 0.05 units/ kg/hour when glucose falls below 14 mmol/L - Reassess cardiovascular status at 12 hours; further fluid may be required - Check for fluid overload	Action 2 – Review biochemical and metabolic parameters - At 6 hours check venous pH, bicarbonate, potassium, capillary ketones and glucose - Resolution of DKA is defined at ketones 7.3 (do not use bicarbonate as a marker at this stage) - Ensure a referral has been made to the diabetes team - If DKA not resolved review insulin infusion (see BOX 3 Action 3) - If DKA resolved go to BOX 6
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BOX 5: 12 to 24 Hours

Expectation: By 24 hours the ketonaemia and acidosis should have resolved. Request senior review is not improving

Aim:

- Ensure that clinical and biochemical parameters are continuing to improve or are normal
- Continue IV fluid replacement if not eating and drinking
- If ketonaemia has cleared and the person is not eating or drinking, move to a variable rate intravenous insulin infusion (VRIII) as per local guidelines
- Reassess for complications of treatment, e.g. fluid overload, cerebral oedema
- Continue to treat precipitating factors
- Transfer to subcutaneous insulin if the person is eating and drinking normally and biochemistry is normal

Action 1 – Re-assess patient, monitor vital signs
Action 2 – Review biochemical and metabolic parameters

- At 12 hours check venous pH, bicarbonate, potassium, capillary ketones and glucose
- Resolution is defined as ketones 7.3
- If not resolved review fluid Box 4 Action 1 and insulin infusion Box 3

Action 3 If DKA resolved go to Box 6

BOX 6: Resolution of DKA

Expectation: Patient should be eating and drinking and back on normal insulin.

- If DKA not resolved identify and treat the reasons for failure to respond. This situation is unusual and requires senior and specialist input

Transfer to subcutaneous insulin Convert to subcutaneous regime when biochemically stable (capillary ketones less than 0.6 mmol/L AND pH over 7.3) and the patient is ready and able to eat.

- Do not discontinue intravenous insulin infusion until 30 minutes after subcutaneous short acting insulin has been given.
- Conversion to subcutaneous insulin should be managed by the Specialist Diabetes Team. If the team is not available use local guidelines
- If the patient is newly diagnosed it is essential they are seen by a member of the specialist team prior to discharge
- **Arrange follow up with specialist team**

- NS- 0.9 % Sodium Chloride- Normal Saline
- FRII- Fixed Rate Insulin Infusion; MSU- mid-stream urine
- K- potassium; KCL- Potassium Chloride
- NGT- Naso Gastric Tube
- SPO2- oxygen Saturation in %
- LMWH- Low Molecular Weight Heparin

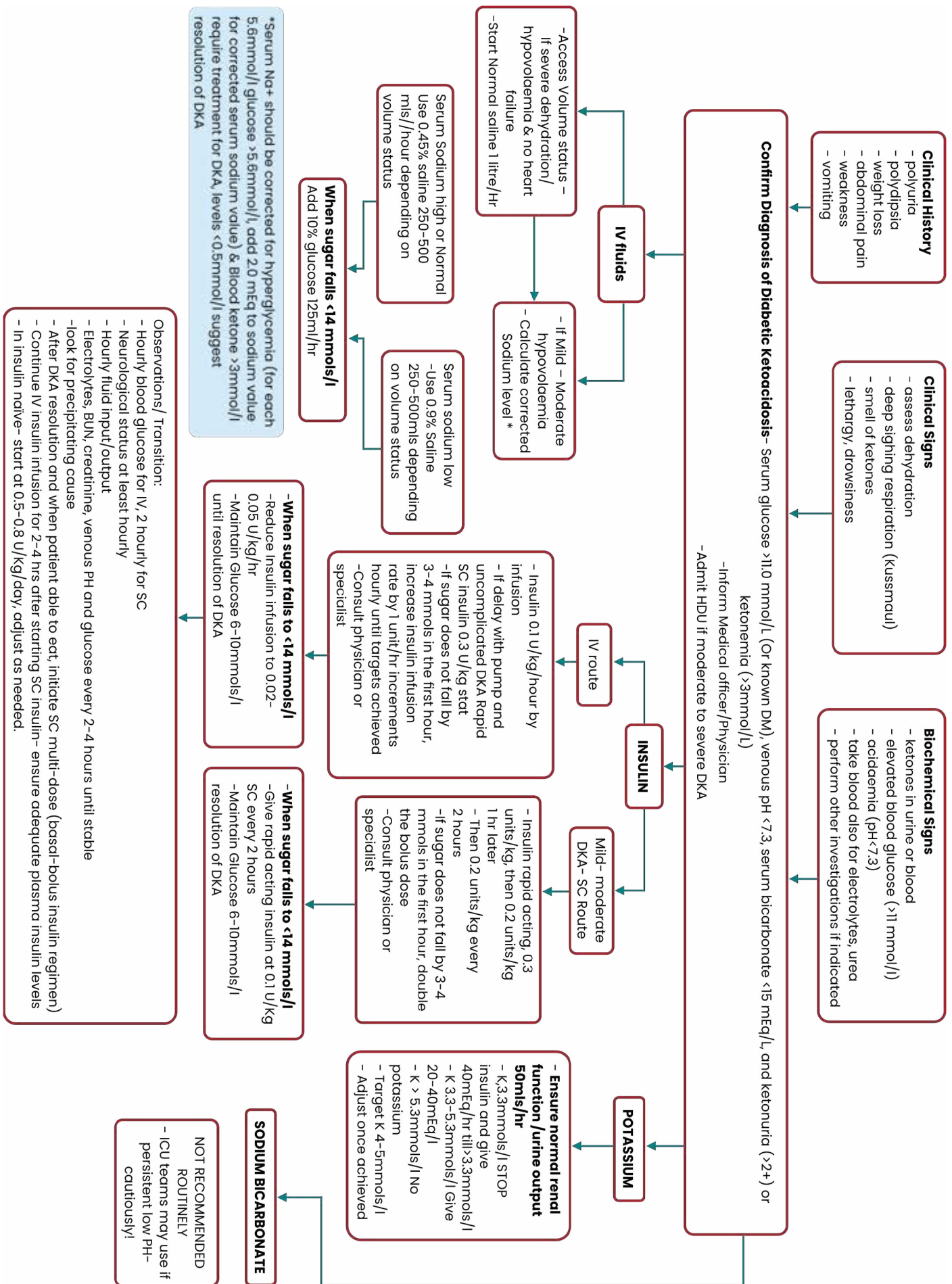


Figure 78: Adult DKA Pathway Algorithm

39.2: Management of Hyperosmolar Hyperglycemic State (Hhs)

	DKA	HHS
Plasma glucose level	DKA ≥ 13.9 mmol/L (250 mg/dL), occasionally lower	≥ 33.3 mmol/L (600 mg/dL) Urine ketones
Urine Ketones	Positive	Negative (or weakly positive)

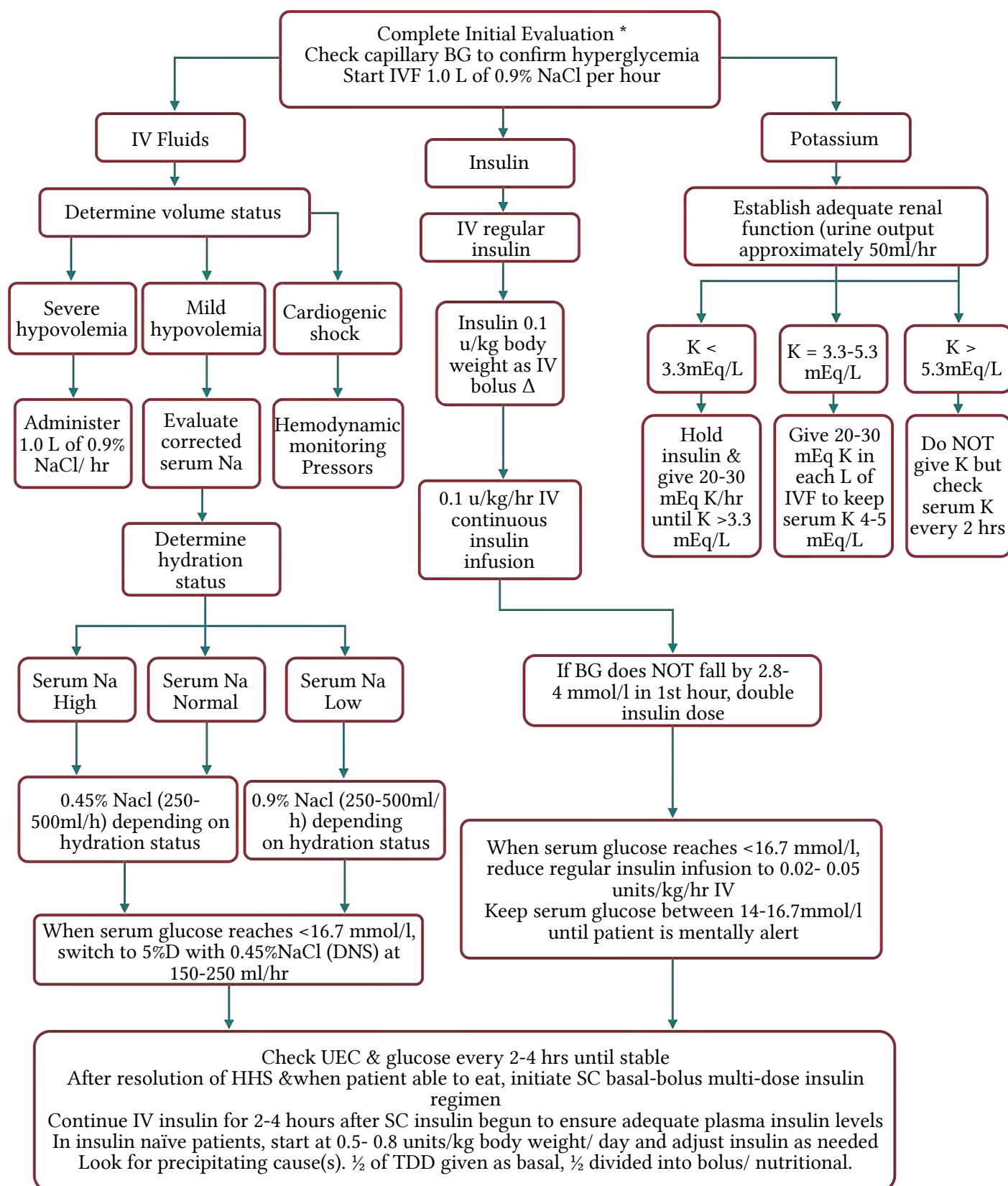


Figure 79: Management of hyperglycemic hyperosmolar state

Notes:

- HHS diagnostic criteria: Serum glucose >33.3 mmol/L, arterial pH >7.3, serum bicarbonate >15 mEq/L, and minimal ketonuria and ketonemia. Normal laboratory values vary; check local lab normal ranges for all electrolytes.

HHS: hyperosmolar hyperglycemic state; IV: intravenous; NaCl: sodium chloride; K: potassium; Na: sodium; BUN: blood urea nitrogen; SC: subcutaneous.

* After history and physical exam, obtain capillary glucose and serum or urine ketones (nitroprusside method). Begin 1 liter of 0.9% NaCl over one hour, and draw arterial blood gases, complete blood count with differential, urinalysis, serum glucose, BUN, electrolytes, chemistry profile, and creatinine levels STAT. Obtain electrocardiogram, chest radiograph, and specimens for bacterial cultures, as needed.

¶ Serum Na⁺ should be corrected for hyperglycemia (for each 5.5 mmol/l glucose >5.5 mmol/l, add 2.0 mEq to sodium value for corrected serum sodium value). Corrected Na = Na + 0.4 ([Glucose] - 5.5)

Δ An alternative IV insulin regimen is to give a continuous intravenous infusion of regular insulin at 0.14 units/kg per hour; at this dose, an initial intravenous bolus is not necessary.

Table 51: Typical laboratory characteristics of DKA and HHS*

	DKA			HHS
	MILD	MODERATE	SEVERE	
Plasma glucose (mmol/L)	>13.9	>13.9	>13.9	>33.3
Arterial pH	7.25 to 7.30	7.00 to 7.24	<7.00	>7.30
Serum bicarbonate (mEq/L)	15 to 18	10 to <15	<10	>18
Urine ketones¶	Positive	Positive	Positive	Small
Serum ketones - Nitroprus-side reaction	Positive	Positive	Positive	≤ Small
Serum ketones - Enzymatic assay of beta hydroxybutyrate (normal range <0.6 mmol/L)Δ	3 to 4 mmol/L	4 to 8 mmol/L	>8 mmol/L	<0.6 mmol/L
Effective serum osmolality (mOsm/kg)◇	Variable	Variable	Variable	>320
Anion gap[^]	>10	>10	>12	Variable
Alteration in sensoria or mental obtundation	Alert	Alert/drowsy	Stupor/coma	Stupor/coma
Serum bicarbonate (mEq/L)	15 to 18	10 to <15	<10	>18

DKA: diabetic ketoacidosis; HHS: hyperosmolar hyperglycemic state.

* There may be considerable diagnostic overlap between DKA and HHS.

¶ Nitroprusside reaction method.

Δ Many assays for beta hydroxybutyrate can only report markedly elevated values as >6.0 mmol/L.

◇ Calculation: 2[measured Na (mEq/L)] + glucose (mmol/l)

[^] Calculation: (Na⁺) - (Cl⁻ + HCO₃⁻) (mEq/L).

39.3: Management of DKA and HHS where insulin infusion pumps are not available

Although Variable rate insulin infusion through insulin pumps is the mode of choice for insulin delivery in DKA/ HHS, in settings where these are not available, alternative options could be used, particularly when referral to an ideal setting is expected to be delayed or not possible. Most of these are not validated, but have been used successfully in various settings (see references). These include:

1. Subcutaneous insulin- as included in algorithms for DKA and HHS
2. IM insulin followed by subcutaneous insulin- (see protocol below)
3. Intramuscular with IV Insulin (see protocol below)
4. Intravenous insulin in IV fluids- same rate as in IV insulin infusion pump, e.g 60 units of insulin 500 mls normal saline at a rate of 50 mls/ hour will deliver insulin at a rate of 6 units/ hour (for a 60 kg individual).

NB: Use of solusets can be considered to ease drop rate determination

Calculating drops/ min with IV insulin infusion in IVFs:

500 mls infusion bottle: each ml contains 20 drops. Therefore, in a 60 kg individual, to deliver insulin at 0.1 units/kg/ hr, or 6 units/ hr, 60 units of insulin can be added to 500 mls normal saline, thus to run over 10 hours at 50 mls/ hr. This would mean $20 \times 50 \text{ drops} / 60 \text{ mins} = 1000 \text{ drops} / 60 \text{ mins} = \text{approximately } 17 \text{ drops/ min}$.

Soluset: each ml contains 60 drops. Therefore, in a 60 kg individual, to deliver insulin at 0.1 units/kg/ hr, or 6 units/ hr, 60 units of insulin can be added to 500 mls normal saline, thus to run over 10 hours at 50 mls/ hr. This would mean $60 \times 50 \text{ drops} / 60 \text{ mins} = 3000 \text{ drops} / 60 \text{ mins} = 50 \text{ drops/ min}$.

How to prepare half saline (0.45% saline) in resource scarce settings

Empty half bottle (250 mls) of 500 mls 0.9% Normal saline, add 250 mls of water of injection.

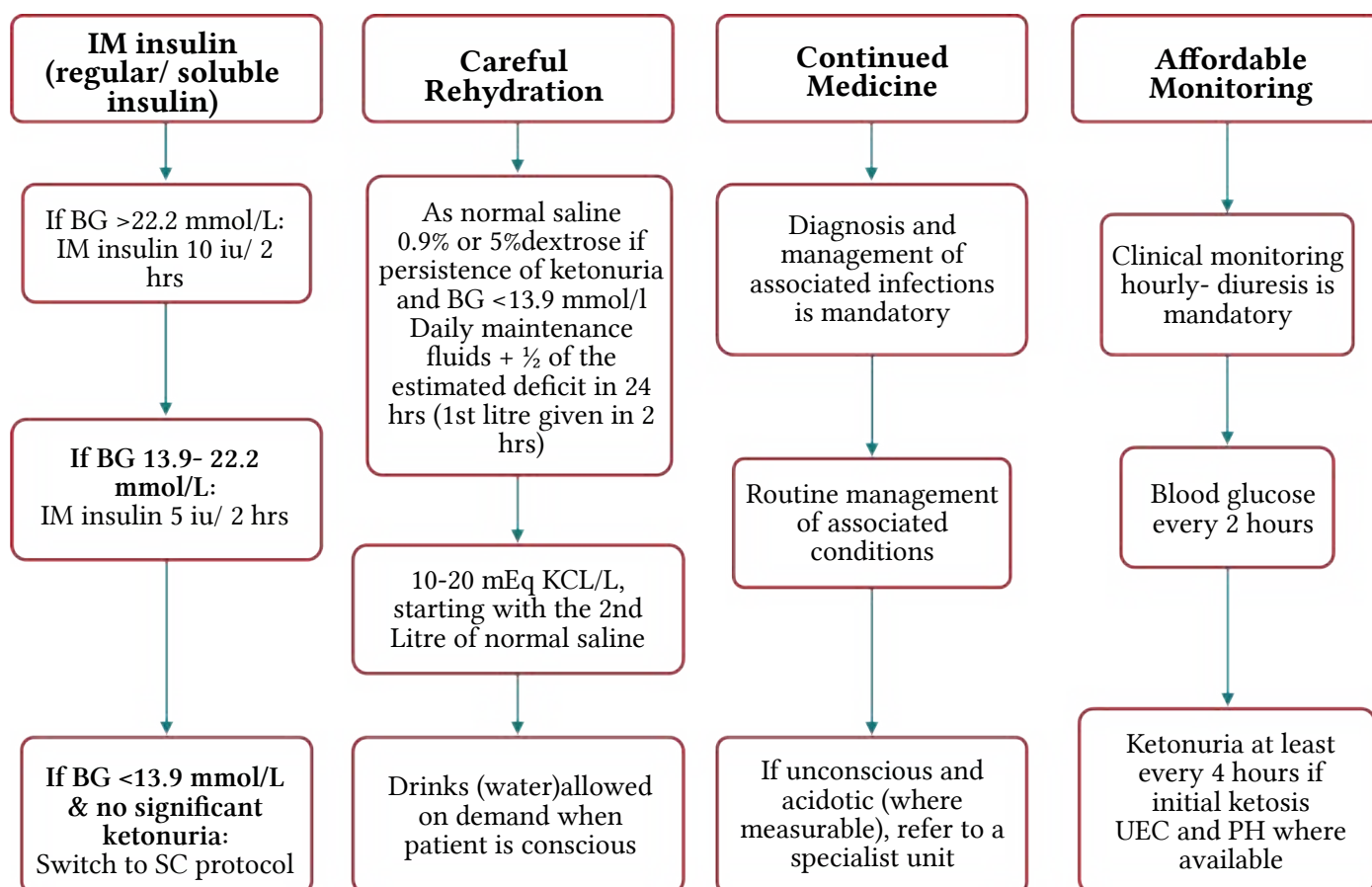


Figure 80: Intra-muscular insulin protocol

39.4: Intramuscular with IV Insulin (regular/soluble insulin)

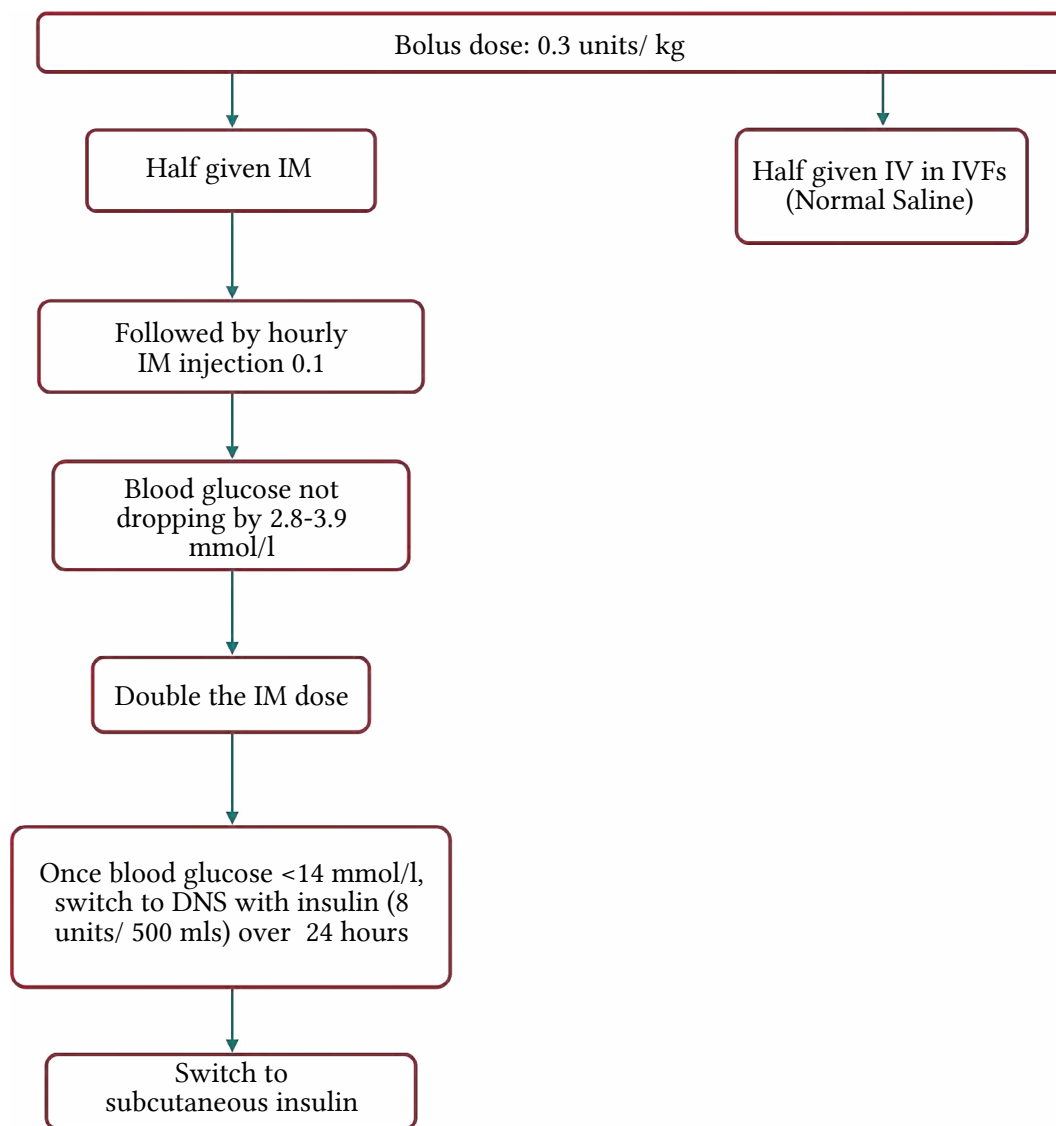


Figure 81: Intramuscular with IV insulin protocol

40

**MANAGEMENT OF
HYPERGLYCEMIA AND DKA IN
CRITICAL CARE IN COVID-19
PATIENTS**

40.1: Critical Care Subcutaneous Insulin Guideline For Hyperglycemia And/ or Mild-Moderate Dka

APPROPRIATE PATIENT

Critically ill patient with COVID-19 and 2 consecutive glucoses >11.1 mmol/l, 4 hours apart OR mild-moderate DKA

TARGET GLUCOSE RANGE

5.5-11.1 mmol/l 80% of the time in the last 24 hours (may be individualized)

PURPOSE

Use of aspart q 4h with basal insulin to allow

- 1) *High insulin doses when needed distributed across multiple adjustable doses per day,*
- 2) *Minimize frequency of glucose monitoring and*
- 3) *Minimize risk of hypoglycemia*

This protocol should **NOT** be used for the following patients:

- Patients who are not critically ill and/or eating meals
- Patients who are on > 1 vasopressor
- Severe Hyperglycemic Crisis = DKA with bicarbonate ≤ 10 mEq/L and/or HHS (calculated OSMeff ≥ 320)[^]

[^]Calculated effective osmolality (Osmeff)= $2[\text{Na}^+] + \text{BG}$ (note: for calculation use measured (not corrected) Na^+)

a. NON-DKA HYPERGLYCEMIA

INSULIN THERAPY:

STEP 1: Discontinue ALL prior insulin orders.

STEP 2: Order POC glucose check every 4 hours.

STEP 3: Choose Low, Medium or High dosing strategy.

- Select patient characteristic and order insulin per the corresponding row (glargine OR NPH plus Short acting insulin (SAI)). Start at Low dose for all patients EXCEPT start Medium dose if patient already received > 0.5 units/kg/day total daily dose of scheduled or IV insulin.

STEP 4: Plan for Hypoglycemia Prevention and Treatment:

- For ANY glucose 3.9-6.7 mmol/l: Hold Aspart. Reduce all future scheduled insulin doses by 20%.
- Start dextrose-containing fluids IF continuous nutrition has been held.
- For ANY glucose <3.9 mmol/l: Hold Aspart. Give IV Push 12.5g (25ml) 50% dextrose and Start dextrose containing fluid until glucose is >6.7 mmol/l for at least 4 hours. Continue dextrose containing fluids if continuous nutrition has been held. Reduce ALL future scheduled doses of ALL insulin by 30%.

STEP 5: Titrate insulin.

- If above range (defined above or individualized): Increase scheduled insulin doses by 20% per dose 1-2 times daily until target range achieved. After 3 or 4 titrations, if still above goal, move to next dosing level.

1. Low dose strategy: Starts at total daily insulin dose between 0.4 – 0.6 units/kg/day

Patient characteristic	Glargine (Lantus) *	NPH	SA1- fixed dose	SAI scale q 4h
Prior Diabetes	0.25 units/kg/dose q 12h	0.12 units/kg/dose q 12h		**Custom
No known Diabetes	0.2 units/kg/dose q 12h	0.1 units/kg/dose q 12h		**Custom
High dose steroids€ or continuous nutrition support	0.15 units/kg/dose q 12h	0.15 units/kg/dose q 12h	0.05 units/kg/dose scheduled q 4h	**Custom

SAI- short acting insulin: Aspart, Lispro, Glulisine, Regular insulin

2. Medium dose strategy: Starts at total daily insulin dose = 0.6 - 1.4 units/kg/day

Patient characteristic	Glargine (Lantus) *	NPH	SA1- fixed dose	SAI scale q 4h
Prior Diabetes	0.3 units/kg/dose q 12h	0.15 units/kg/dose q 12h	0.1 units/kg/dose scheduled q 4h	**Custom
No known Diabetes	0.25 units/kg/dose q 12h	0.1 units/kg/dose q 12h	0.05 units/kg/dose scheduled q 4h	**Custom
High dose steroids€ or continuous nutrition support	0.25 units/kg/dose q 12h	0.25 units/kg/dose q 12h	0.05 units/kg/dose scheduled q 4h	**Custom

SAI- short acting insulin: Aspart, Lispro, Glulisine, Regular insulin

3.1 High dose strategy A. Starts at total daily insulin dose = 1.5 to 1.95 units/kg/day. NOTE: Before moving to High Dose, INJECT INTO NEW subcutaneous injection site. Abdomen (anterior or side) and upper buttock are preferred for best subcutaneous absorption

Patient characteristic	Glargine (Lantus) *	NPH	SA1- fixed dose	SAI scale q 4h
Prior Diabetes	0.5 units/kg/dose q 12h	0.25 units/kg/dose q 12h	0.15 units/kg/dose scheduled q 4h	**Custom
No known Diabetes	0.3 units/kg/dose q 12h	0.15 units/kg/dose q 12h	0.1 units/kg/dose scheduled q 4h	**Custom
High dose steroids€ or continuous nutrition support	0.25 units/kg/dose q 12h	0.25 units/kg/dose q 8h	0.2 units/kg/dose scheduled q 4h	**Custom

SAI- short acting insulin: Aspart, Lispro, Glulisine, Regular insulin

3.2 High dose strategy B. Starts at total daily Insulin dose = 2.1-3 units/kg/day NOTE: This requires inpatient diabetes consultation. Please consult unit Endocrinologist or physician for starting IV hourly dose. If target glucose not achieved after 36 hours on step 2, consider continuous IV insulin protocol provider adjusted with modified targets and frequency of glucose monitoring.

Patient characteristic	Glargine (Lantus) *	NPH	SA1- fixed dose	SAI scale q 4h
Prior Diabetes	0.3 units/kg/dose q 12h	0.3 units/kg/dose q 12h	0.2 units/kg/dose scheduled q 4h	**Custom
No known Diabetes	0.3 units/kg/dose q 12h	0.3 units/kg/dose q 12h	0.2 units/kg/dose scheduled q 4h	**Custom
High dose steroids or continuous nutrition support	0.4 units/kg/dose q 12h	0.4 units/kg/dose q 8h	0.3 units/kg/dose scheduled q 4h	**Custom

*Glargine is preferred for patients at higher risk of hypoglycemia: GFR 75, advanced cirrhosis

*High dose steroids: equivalent of >40 mg prednisone, >100 mg hydrocortisone or >6 mg dexamethasone per day

**Custom scale:

Blood Glucose- mmol/L	Units of SAI
8.33-10	2
10.05-11.7	6
13.4- 15	8
15.1- 16.7	10
16.8- 18.3	12
>18.4	14 Units

SAI- short acting insulin: Aspart, Lispro, Glulisine, Regular insulin

b. MILD TO MODERATE DIABETIC KETOACIDOSIS

IMPORTANT: Patient must have ALL of the following criteria for mild to moderate DKA:

- Glucose >13.9 mmol/l,
- Ketosis as defined by elevated serum BHB or urine ketones
- WITH acidosis as defined by bicarbonate 10-18 mEq/L and/or acidemia by venous or arterial pH <7.1-7.3

THIS PROTOCOL SHOULD NOT BE USED FOR THE FOLLOWING:

- Severe DKA or HHS: bicarbonate <10 mEq/L AND/OR pH ≤7.1 AND/OR effective osmolality $OS_{Meff} \geq 320$
- Calculated Effective osmolality (OS_{Meff}) = $2[Na^+] + BG/18$ (note: for calculation use measured (not corrected) Na^+)
- Patients with the following medical conditions: pregnancy, acute CHF exacerbation, ESRD or CKD stages 4 and 5, acute hepatic failure or decompensated cirrhosis

1. FLUIDS AND ELECTROLYTES:

IMPORTANT: Hypoglycemia prevention: WITH FIRST BG < 13.9 mmol/l, change IVF to D51/2 NS at 150-250 cc/h

- Assess patients volume status frequently: severe hypovolemia, mild volume depletion, or volume overload with cardiopulmonary compromise
- Smaller fluid volumes may be required for ESRD/ anuric/ COVID patients with cardiopulmonary compromise
- Ringers Lactate is the preferred fluid for continuous resuscitation, unless hyperkalemic
- NS or RL can be given as bolus or continuous infusion

Sodium (corrected) = Sodium (measured) + glucose / 4

Hypernatremia (corrected Na⁺ >135): consider change to D51/2 NS at 150-250 cc/hr

Hypokalemia: see table below

Table 52: Managing volume in DKA- COVID-19

Volume status	Orders	Considerations
Severe hypovolemia	Serum K ⁺ ≤ 5.1 mmol/l- RL @500-1000 ml/hr Serum K ⁺ > 5.1 mmol/l- NS @500-1000 ml/hr Until clinically volume resuscitated	Anticipate ICU level of care if refractory to IVF
Mild hypovolemia (calculate corrected sodium)	Corrected sodium < 135 mmol/l Serum K⁺ ≤ 5.1 mmol/l RL @200-400 ml/hr Serum K⁺ > 5.1 mmol/l NS @200-400 ml/hr Corrected sodium ≥ 135 mmol/l 1. Change IVF to 0.45% saline infusion @200-400 ml/hr until resuscitation complete 2. For serum sodium > 140 mmol/l, calculate free water deficit and carefully replace free water along with IVF	
Volume overload with cardiopulmonary compromise	Discontinue IVF therapy	Consider ICU level of care

Hyperchloremia and Hypobicarbonemia: consider changing to ringer lactate

Hypophosphatemia: urgently replete serum phosphate to >1mg/dl (0.32 mmol/l) with IV phosphate therapy (potassium phosphate or sodium phosphate (if hyperkalemic))

Hypomagnesemia: urgently replete magnesium to < 1.2 mg/dl (0.5 mmol/l) with IV magnesium sulphate
Once minimum goals achieved, replete both phosphate and magnesium to normal levels with oral or IV as tolerated.

2. POTASSIUM REPLETION:

or initial KCL administration see table below. Monitor K⁺ q 4-6 h.

Serum K ⁺ (mEq/L)	Peripheral or Enteral	Central
>5 or/ urine output < 0.5 cc/kg/hr	None	None
4-5	10 mEq IV x 2 doses OR 20 mEq enterally	20 mEq IV
3-4	10 mEq IV x 2 doses OR 20 mEq enterally	20 mEq IV x 2 doses
<3	10 mEq IV x 6 doses OR 40 mEq enterally then 20 mEq 2hr after	20 mEq IV x 3 doses

3. INSULIN THERAPY:

Administer both long acting insulin (glargine) dosed every 24 hours and SAI, which should be dosed q4 hours

	Subcutaneous SAI q4 hours	Subcutaneous long acting insulin (glargine) q24 hours
Initial dose	0.3 units/kg/dose Maximum of 20 units	If eGFR >40: 0.25 units/kg/dose If eGFR <40: 0.15 units/kg/dose
Subsequent dose	0.2 units/kg every 4 h Maximum of 20 units	Re-dose glargine in 24 h based on response to initial dose
Blood glucose < 13.9 mmol/	0.05-0.1 units/kg every 4 h and start IV Dextrose containing fluid	Re-dose glargine q 24h based on response to subsequent dose

SAI- short acting insulin: Aspart, Lispro, Glulisine, Regular insulin

4. DKA MONITORING AND TRANSITION RECOMMENDATIONS

Patients will need q4-6h chemistry monitoring (BMP) and electrolyte repletion as above. When AG < 12 and bicarbonate > 18 mEq/L, transition to non-DKA subcutaneous regimen. Dextrose may be tapered to off.

- If patient feeding, staff/ patient should check POC glucose pre-meals and before bedtime and order prandial insulin
- When necessary patient can check their own BG and report out to nurse who will input into chart
- If patient is NPO or on TPN or Tube enteral nutrition, check POC BG every 4-6 hourly
- Ensure daily basal insulin dose is ordered to be administered within 24 hrs of now basal insulin dose
- Watch for decreasing insulin requirements as infectious precipitants and glucose toxicity improves.

41

**MANAGEMENT OF STEROID
INDUCED HYPERGLYCEMIA
(SIHG)/ DIABETES MELLITUS**

- **Steroid induced diabetes:** Individuals who develop diabetes in relation to steroid therapy without having a prior diagnosis of diabetes are said to have steroid induced diabetes.
- **Steroid induced hyperglycaemia (SIHG):** Increase in blood glucose levels due to steroid treatment, including persons with pre-existing diabetes who have a deterioration of glycaemic control
- The patient's clinical status, changes in trajectory of glucose measures and nutritional status should be noted and included in day-to-day decisions concerning insulin doses.

Glycaemic targets for steroid induced hyperglycaemia

Ward and home based care	<7.8 mmol/l fasting, <10mmol/l post prandial
ICU	7.8 – 10 mmol/l

- Hypoglycemia should be avoided.
- The dose of insulin should be based on the dose of glucocorticoid (GC). If the prednisone (or equivalent dose of GC) is 10, 20, 30, or 40 mg, then the dose of basal insulin should be 0.1, 0.2, 0.3, or 0.4 U/kg per day respectively.
- A weekly 5mg reduction of prednisolone from 20mg may require a 20-25% reduction in insulin dose, or a 40mg (30MR) reduction in gliclazide.

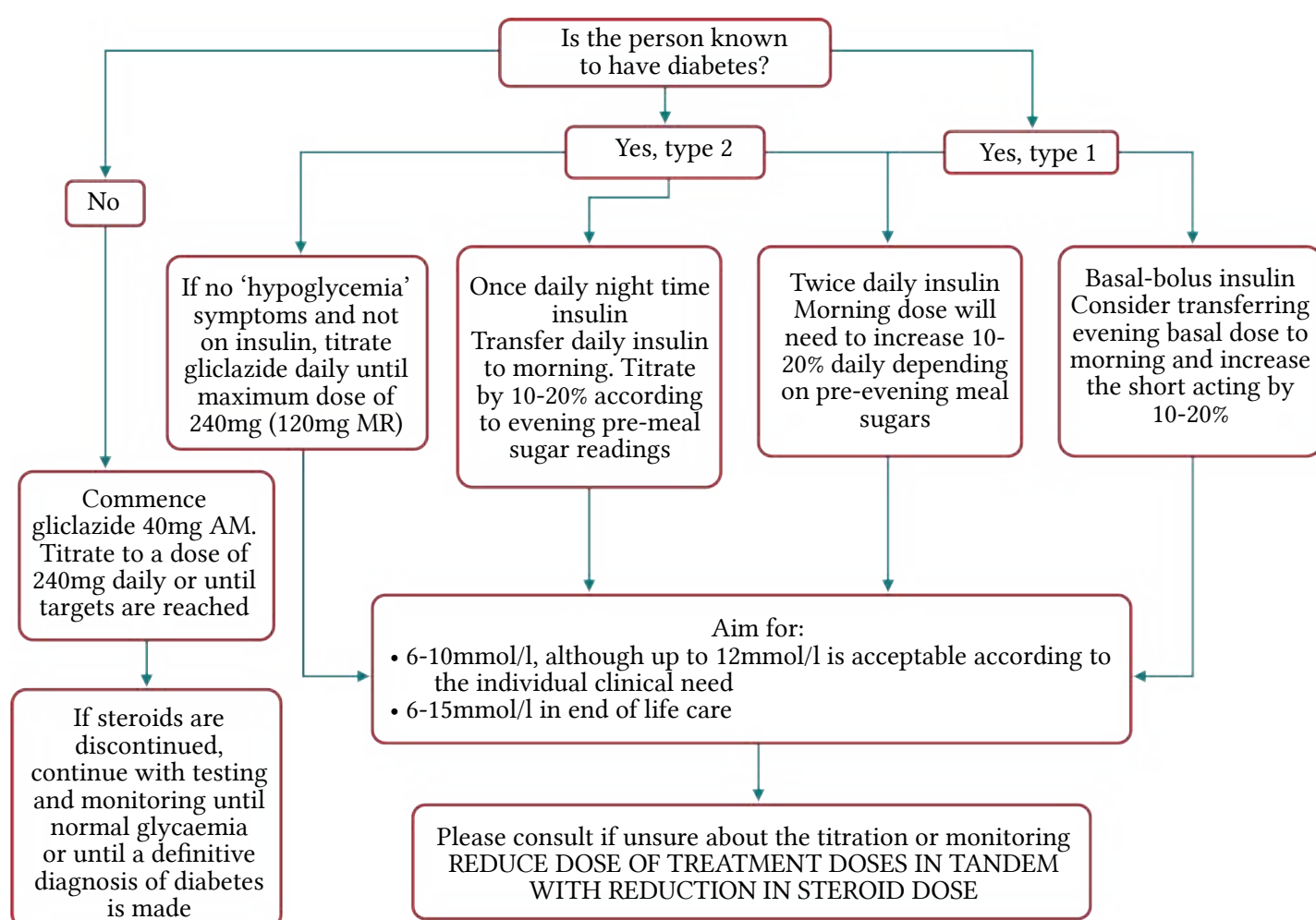


Figure 82: Initial assessment of hyperglycaemia in people taking steroids

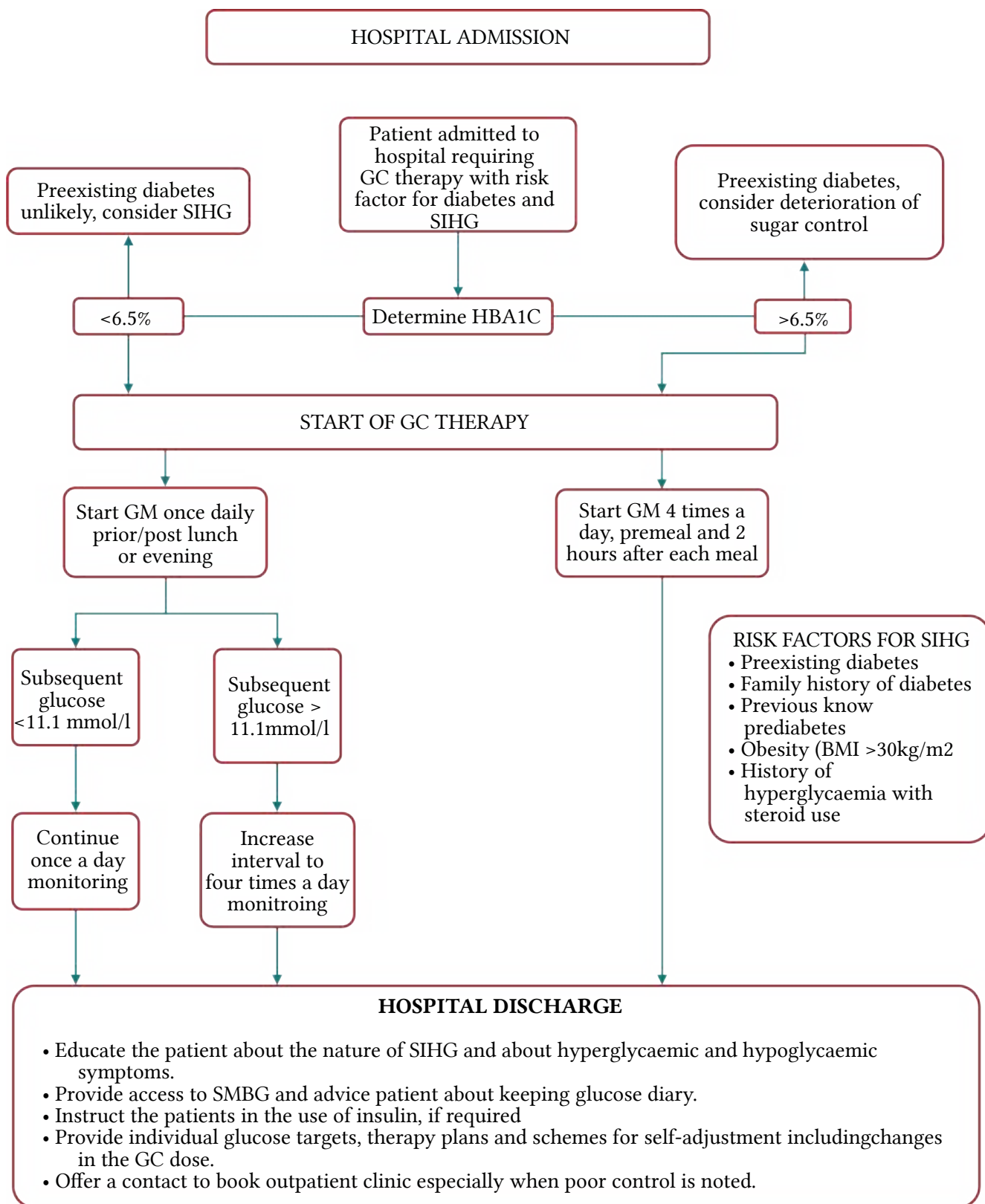


Figure 83: Glucose monitoring of patients who have been started on glucocorticoid therapy and at risk of steroid induced hyperglycaemia (SIHG)

Table 53: Summary of Glycemic Management in Patients Known to have Diabetes Mellitus who are on Glucocorticoid Therapy

Patient Clinical Status	Management
Patients with pre-existing DM who are stable with no metabolic or medical compromise	• Monitor regularly • Continue existing therapy • Increase insulin dose by 20% if was on insulin • Increase dose/add sulfonylurea for post prandial control • Metformin, pioglitazone, DPP-4 inhibitors and SGLT2 inhibitors can be continued as such unless there is clinical deterioration or patient is not eating well
Patients in Non-ICU/Ward	• Begin basal bolus with correction regimen • If not feasible, begin premix with an oral (metformin, +/- short acting sulfonylureas/DPP-4 inhibitors) at lunch
Patients in ICU	• Intravenous insulin infusion • If not feasible, basal-supported correction bolus dose

*HBA1C test should be done 3 months post steroid therapy is recommended to check the diabetes status

Note:

- 30 mg of Gliclazide Modified Release (MR) is equivalent to 80 mg of Gliclazide.
- Maximum dose of Gliclazide MR is 120 mg in a day, of Gliclazide is 320 mg in a day.
- If NPH insulin is not available, substitute with long acting insulin- glargine or detemir, monitor for hypoglycemia.

Individuals at risk for steroid induced hyperglycemia are:

- Pre-existing type 1 or type 2 diabetes
- People at increased risk of diabetes (e.g. obesity, family history of diabetes, previous gestational diabetes, ethnic minorities, polycystic ovarian syndrome)
- Pre-existing impaired fasting glucose or impaired glucose tolerance, HbA1c 6-6.4%
- People previously hyperglycaemic with glucocorticoid therapy

Hospital discharge of patients at risk of glucocorticoid-induced diabetes/hyperglycaemia

- Glucocorticoids commenced and patient discharged
- Standard education for patient and carer
- Blood glucose testing once daily (pre or post lunch or evening meal)
- If blood glucose readings greater than 12 mmol/l increase frequency of testing to four times daily
- If two consecutive blood glucose readings greater than 12 mmol/l in a 24 hour period follow algorithm for management of glucocorticoid-induced diabetes

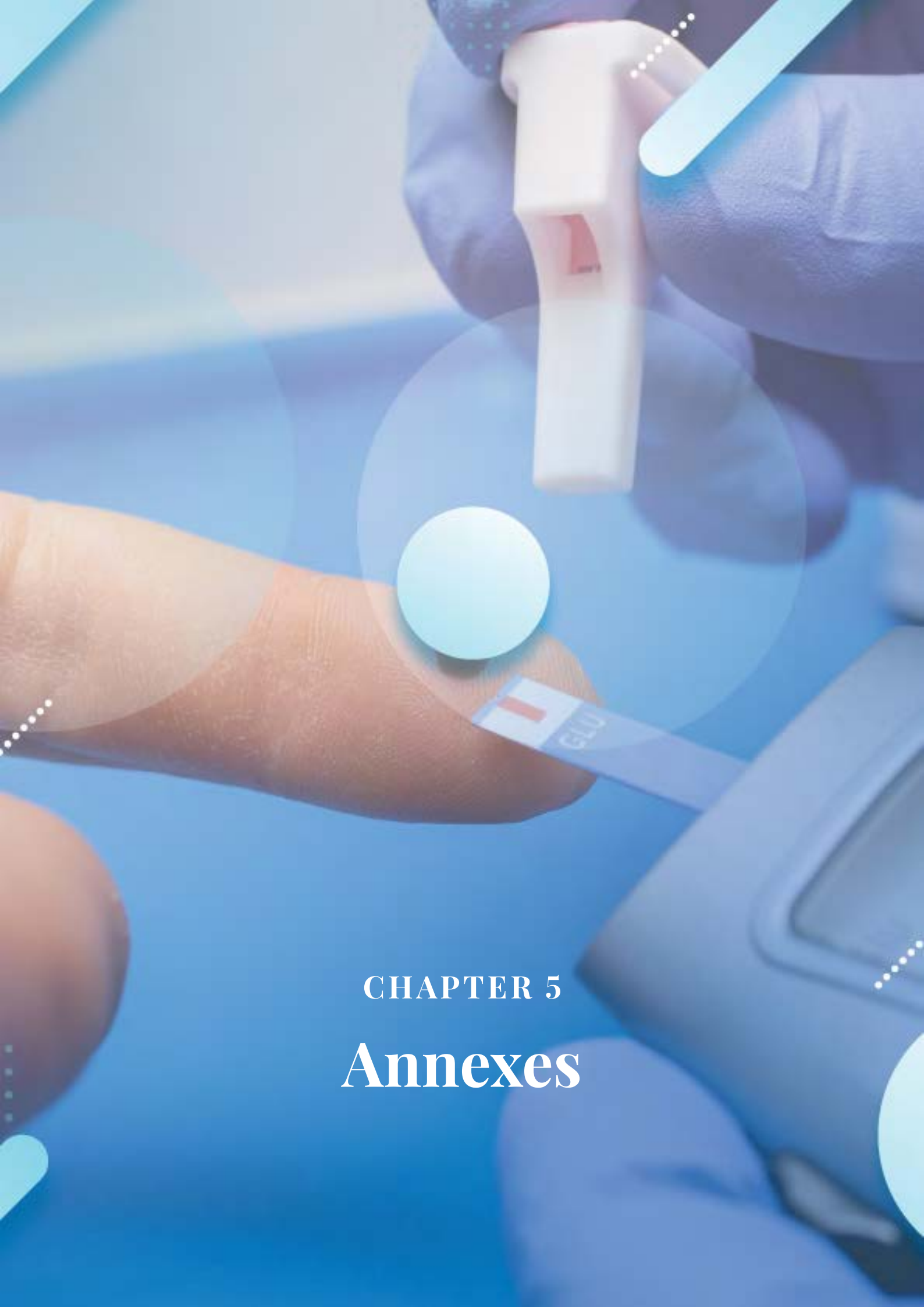
Patient discharged on decreasing dose of glucocorticoid above 5 mg od

- Standard education for patient and carer including advice on hypoglycaemia
- Continue CBG monitoring until blood glucose normalises (4–7 mmol/l)
- Review by agreed individual (e.g. GP, diabetologist, diabetes specialist nurse, etc) at an appropriate juncture to consider down-titration of antihyperglycaemic therapy if necessary

Patient discharged following glucocorticoid cessation

If hyperglycaemia persists:

- CBG testing until return to normoglycaemia (4–7 mmol/l) or until a definitive diagnosis of diabetes is undertaken
- If hyperglycaemia resolved, stop CBG testing and arrange definitive test for diabetes



CHAPTER 5

Annexes

42.1: Annex 1

Table 54: Examples of subcutaneous insulin regimens

Regimen	Timing and distribution	Adjusting doses
Insulin pump therapy (hybrid closed-loop, low-glucose suspend, CGM-augmented open-loop, BGM-augmented open-loop)	Basal delivery of URAA or RAA; generally 40–60% of TDD. Mealtime and correction: URAA or RAA by bolus based on ICR and/or ISF and target glucose, with pre-meal insulin ~15 min before eating.	Mealtime insulin: if carbohydrate counting is accurate, change ICR if glucose after meal consistently out of target. Correction insulin: adjust ISF and/or target glucose if correction does not consistently bring glucose into range. Basal rates: adjust based on overnight, fasting or daytime glucose outside of activity of URAA/RAA bolus.
MDI: LAA + flexible doses of URAA or RAA at meals	LAA once daily (insulin detemir or insulin glargine may require twice-daily dosing); generally 50% of TDD. Mealtime and correction: URAA or RAA based on ICR and/or ISF and target glucose.	Mealtime insulin: if carbohydrate counting is accurate, change ICR if glucose after meal consistently out of target. Correction insulin: adjust ISF and/or target glucose if correction does not consistently bring glucose into range. LAA: based on overnight or fasting glucose or daytime glucose outside of activity time course, or URAA or RAA injections.
Four injections daily with fixed doses of N and RAA	Pre-breakfast: RAA ~20% of TDD. Pre-lunch: RAA ~10% of TDD. Pre-dinner: RAA ~10% of TDD. Bedtime: N ~50% of TDD.	Pre-breakfast RAA: based on BGM after breakfast or before lunch. Pre-lunch RAA: based on BGM after lunch or before dinner. Pre-dinner RAA: based on BGM after dinner or at bedtime. Evening N: based on fasting or overnight BGM.
Four injections daily with fixed doses of N and R	Pre-breakfast: R ~20% of TDD. Pre-lunch: R ~10% of TDD. Pre-dinner: R ~10% of TDD. Bedtime: N ~50% of TDD.	Pre-breakfast R: based on BGM after breakfast or before lunch. Pre-lunch R: based on BGM after lunch or before dinner. Pre-dinner R: based on BGM after dinner or at bedtime. Evening N: based on fasting or overnight BGM.
Three injections daily: N+R or N+RAA	Pre-breakfast: ~40% N + ~15% R or RAA. Pre-dinner: ~15% R or RAA. Bedtime: 30% N.	Morning N: based on pre-dinner BGM. Morning R: based on pre-lunch BGM. Morning RAA: based on post-breakfast or pre-lunch BGM. Pre-dinner R: based on bedtime BGM. Pre-dinner RAA: based on post-dinner or bedtime BGM. Evening N: based on fasting BGM.
Twice-daily “split-mixed”: N+R or N+RAA	Pre-breakfast: ~40% N + ~15% R or RAA. Pre-dinner: ~30% N + ~15% R or RAA	Morning N: based on pre-dinner BGM. Morning R: based on pre-lunch BGM. Morning RAA: based on post-breakfast or pre-lunch BGM. Evening R: based on bedtime BGM. Evening RAA: based on post-dinner or bedtime BGM. Evening N: based on fasting BGM.

ICR, insulin:carbohydrate ratio; ISF, insulin sensitivity factor; LAA, long-acting analog; N, NPH insulin; R, short-acting (regular) insulin; RAA: rapid-acting analog; TDD, total daily insulin dose; URAA, ultra-rapid-acting analog.

42.2: Annex 2 - Monitoring And Evaluation

Policy statement: Information on diabetes cases diagnosed should be reported to the Kenya Health Information System to inform policy and planning. Reporting at health facility level reporting is supposed to be done through the necessary provided tools from facility to national both in public, private and faith-based health facilities.

Purpose: To guide effective documentation, reporting and evaluation of interventions in Kenya

Objective: To monitor and evaluate progress towards achievement of the policy implementation

Republic of Kenya - Ministry of Health



Diabetes and Hypertension Comprehensive Care
Permanent Register MOH 270

County:	
Sub -County:	
Health Facility:	
Type:	
Start date:	

Republic of Kenya - Ministry of Health



Diabetes and Hypertension Comprehensive Care
Daily Register MOH 222

County:	
Sub -County:	
Health Facility:	
Type:	
Start date:	

MINISTRY OF HEALTH

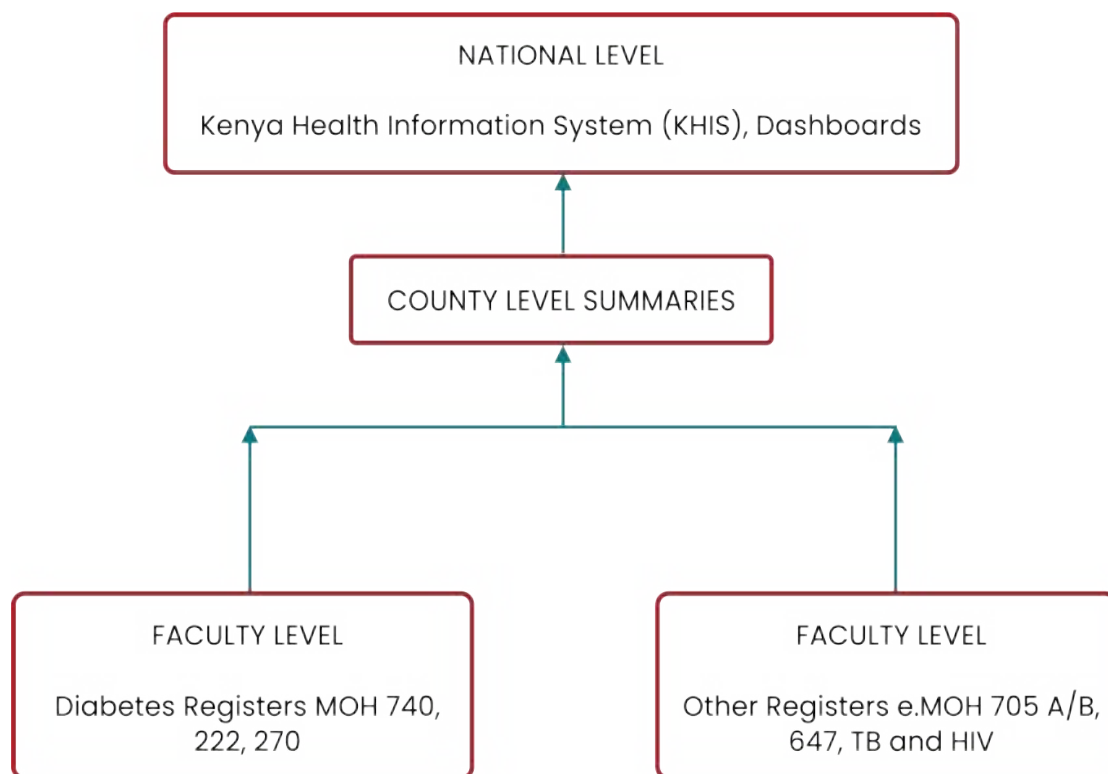


DIABETES AND HYPERTENSION
COMPREHENSIVE CARE
MONTHLY SUMMARY FORM - MOH 740

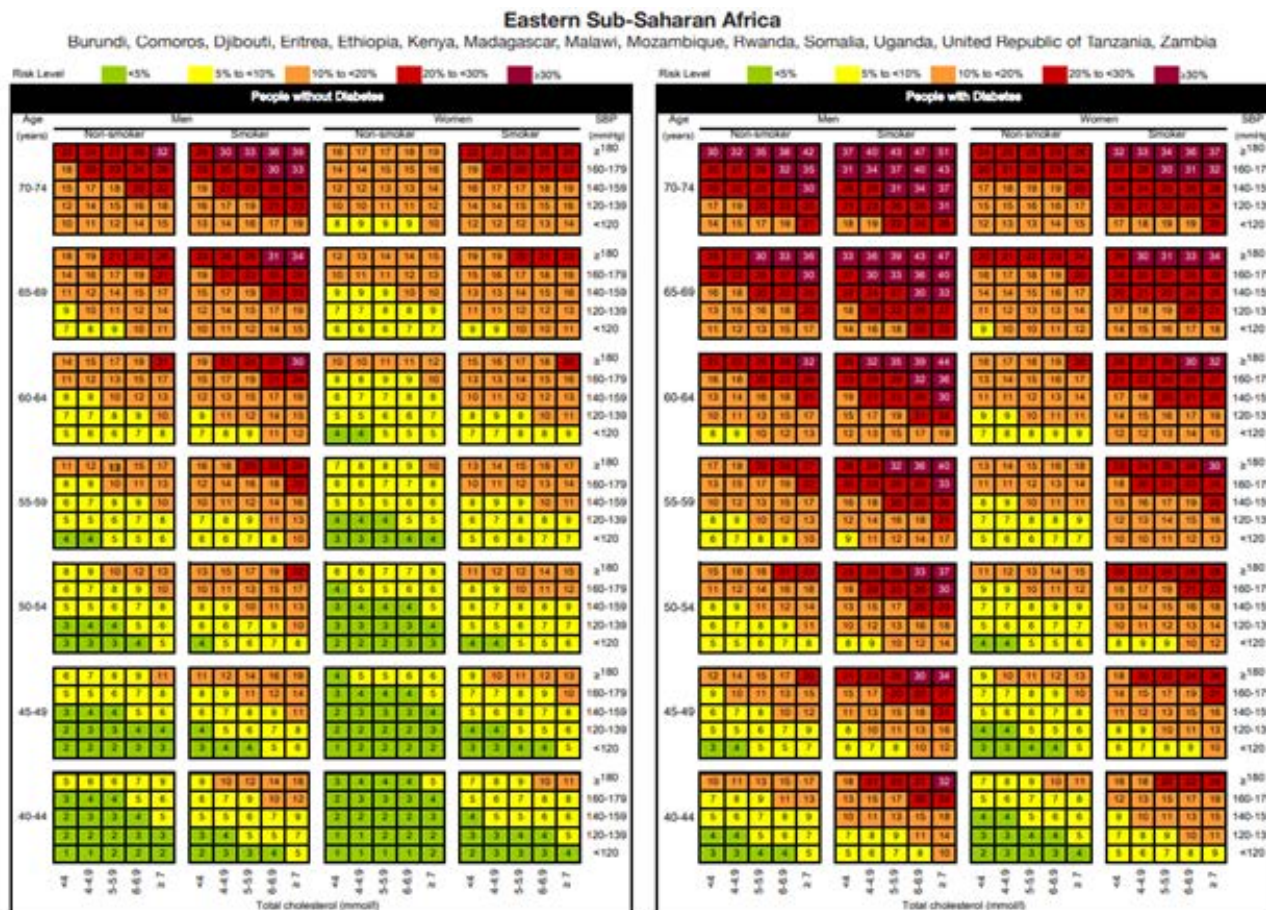
42.3: Annex 3 - Key indicators

Indicator description	Outcome indicators	Targets	Impact
Screened	Proportion of patient screened for diabetes mellitus	95%	Reduce premature death by a ½ by the year 2030
Diagnosed	Proportion of patient diagnosed for DM with • Type 1 • Type 2 • Gestation DM	95%	
Treatment	Proportion of patients treated for diabetes Proportion of patient treated for hypertensive	95%	
Retained in care	Proportion of diabetes patients in care Proportion of hypertensive patient in care	60%	
Achieving control	Proportion of patient achieving control among people treated for diabetes	40%	
Complications	Proportion of diabetes patient on treatment developing complication e.g • diabetic foot • nephropathy • retinopathy • neuropathy • cardiovascular diseases	50%	Reduced Cost
Commodities	Monthly consumption rate for glucose strips	100%	
	Monthly consumption rate for insulin	100%	
	Monthly consumption rate for HTN/DM drugs	100%	

42.4: Annex 4 - Data flow



42.5: Annex 5 - CVD risk calculator



42.6: Glucocorticoids in Clinical Use: Preparations and Equivalent Potency

	Type of Glucocorticoid	Duration of Action (Hours)	Equivalent Potency	Relative Glucocorticoid Activity	Relative Mineralocorticoid Activity	Peak of Action (h)
Short acting	Hydrocortisone	8–12	20 mg	1	1	1
	Cortisone	8–12	25 mg	0.8	0.8	-
Inter-mediate acting	Prednisone	12–36	5 mg	4	0.8	1–3
	Prednisolone	12–36	5 mg	4	0.8	-
	Methylprednisolone	12–36	4 mg	5	Minimal	-
	Triamcinolone	12–36	4 mg	5	0	-
	Deflazacort	12–24	6 mg	4		1.3
Long acting	Dexamethasone	36–72	0.75 mg	30	Minimal	1.6-2
	Betamethasone	36–72	0.6 mg	30	Negligible	-
	Fludrocortisone	12–36	Not used for glucocorticoid activity due to very high mineralocorticoid activity	10–15	125–150	-

42.7: Annex 6 - Sample school plan

Child's photo
(updated every year)

DIABETES MANAGEMENT PLAN FOR TYPE 1 DIABETES MELLITUS

Name of School: _____

Child's Name: _____

Age: _____ years

Class: _____

Parent/Emergency contact details

1. _____

2. _____

3. _____

Key points

- There should be no queuing during mealtimes.
- He/she should eat all snacks and meals provided.
- He/she should not exchange snacks or meals with another child.
- Physical activity lowers the blood glucose level and should be encouraged always.
- Blood glucose testing should take place where the child is comfortable.
- His/her **hypo/testing kit/water** should be always with him/her.
- He/she should not be left alone during a hypo.
- He/she may not be able to concentrate on schoolwork for several hours following a hypo.
- If a staff member performs the blood glucose level, they should wear disposable gloves and have proper disposal of needles.
- If he/she has an injection at school, school staff must be educated to supervise especially if the child is too young to inject themselves.
- Insulin should always be stored in a cool dry place away from light and if possible, in a fridge.

Blood Glucose Testing should be done:

- _____ minutes before breakfast and _____ minutes before lunch.
- Any time there are symptoms of hypo or hyper.

What is a hypo?

- A hypo is a blood glucose level below 4mmol/L.

Management of a hypo or low blood glucose level

- If child says he/she feels unwell or has signs of hypo (**sleepy, shaky, poor concentration, weakness, sweating, erratic behaviour**), he/she should not leave where they are.
He/she should have a blood glucose test done immediately.

- If in doubt or not able to test, assume it is a hypo and treat immediately.
- Do not be afraid of overtreating, it is better that than undertreating.

If able to swallow and take direction, treat with:

- Easily absorbed carbohydrate e.g., sugar, glucose, juice, sweet, soda.
- Do not use fat-containing foods like chocolate, milk, ice-cream, biscuit to correct a hypo as the absorption is slow.
- Retest the blood glucose level in 15 minutes, if still below 4mmol/L repeat the sweet part of the treatment.
- Once the blood glucose level is above 4mmol/L, follow with a snack or meal if due within 1 hour or give longer acting carbohydrate (1 slice of bread or half a banana or 200ml of milk or a medium apple) in hypo kit (should be always with child).

Management of a severe hypo (when child cannot swallow, is drowsy or unable to take direction)

- Coma position (lie on the side)
- Keep airway clear
- Smear glucose gel or a thick paste of glucose on the dependent (lower) cheek pad.
- Stay with child
- Call ambulance, consult diabetes team, take child to the hospital - “diabetes emergency”
- Call parent and let them know

High levels (hyperglycaemia/hyper)

When blood glucose level is above 10mmol/L he/she will be thirsty and want to pass urine more frequently.

- He/she needs to be allowed to drink water and go to the toilet as necessary.
- If he/she feels unwell, the school nurse should assess the child and refer to the hospital if necessary.
- If child is vomiting, ambulance should be called to take the child to the nearest hospital for further management.

Management of physical activity

- Child should test blood glucose level before exercise.
- If glucose is below 7mmol/L, he/she should have a “top up” snack prior to the activity (e.g., 1 slice of bread or half a banana or 200ml of milk or a medium apple).
- If it is 7-14mmol/L, he/she can proceed with the activity.
- If it is above 14mmol/L, he/she should take water and extra insulin, and wait for the blood glucose level to come down to 7-14mmol/L before beginning the exercise.
- If the exercise session lasts more than 30 minutes, he/she should take a snack every 30 minutes (e.g., 1 slice of bread or half a banana or 200ml of milk or a medium apple).
- Child’s parent/guardian can attend excursions and sporting events wherever possible.
- His/her hypo/testing kit/water should be with him/her during exercise.

In case of any queries or clarifications, please contact the Paediatric Emergency on (Tel) _____

ALL CHILDREN HAVE A RIGHT TO EDUCATION

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REFERENCES

Section 1.9

1. Wamai, R. G., Kengne, A. P., & Levitt, N. (2018). Non-communicable diseases surveillance: overview of magnitude and determinants in Kenya from STEPwise approach survey of 2015. *BMC Public Health*, 18, 1-8.
2. Devi, R., Kanitkar, K., Narendhar, R., Sehmi, K., & Subramaniam, K. (2020). A narrative review of the patient journey through the lens of non-communicable diseases in low-and middle-income countries. *Advances in Therapy*, 37(12), 4808-4830.

Section 2.3

1. Diagnosis and management of type 2 diabetes (HEARTS-D). Geneva]: World Health Organization; 2020 (WHO/UCN/NCD/20.1). Licence: CC BY-NC-SA 3.0 IGO.
2. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & American Diabetes Association. (2023). 4. Comprehensive medical evaluation and assessment of comorbidities: Standards of Care in Diabetes—2023. *Diabetes Care*, 46(Supplement_1), s49-s67.

Section 3.0

1. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & American Diabetes Association. (2023). 4. Comprehensive medical evaluation and assessment of comorbidities: Standards of Care in Diabetes—2023. *Diabetes Care*, 46(Supplement_1), s49-s67.

Section 4.2

1. SEMDSA Type 2 Diabetes Guidelines Expert Committee, 2017. SEMDSA 2017 guidelines for the management of type 2 diabetes mellitus. *J Endocr Metab Diabetes S Afr*, 22(1 Suppl 1), pp.S1-S196.
2. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 5. Facilitating positive health behaviors and well-being to improve health outcomes: standards of Care in Diabetes—2023. *Diabetes Care*, 46(Supplement_1), S68-S96.
3. Diagnosis and management of type 2 diabetes (HEARTS-D). Geneva]: World Health Organization; 2020 (WHO/UCN/NCD/20.1). Licence: CC BY-NC-SA 3.0 IGO.
4. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 9. Pharmacologic approaches to glycemic treatment: standards of care in diabetes—2023. *Diabetes Care*, 46(Supplement_1), S140-S157.

Section 5.2

1. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 9. Pharmacologic approaches to glycemic treatment: standards of care in diabetes—2023. *Diabetes Care*, 46(Supplement_1), S140-S157.
2. McGuire, H., Longson, D., Adler, A., Farmer, A., & Lewin, I. (2016). Management of type 2 diabetes in adults: summary of updated NICE guidance. *Bmj*, 353.
3. Garber, A. J. (2009). Insulin intensification strategies in type 2 diabetes: when one injection is no longer sufficient. *Diabetes, Obesity and Metabolism*, 11, 14-18.

Section 6.2

1. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 14. Children and adolescents: standards of care in diabetes—2023. *Diabetes Care*, 46(Supplement_1), S230-S253.
2. Lucaccioni, L., & Iughetti, L. (2016). Issues in diagnosis and treatment of type 1 diabetes mellitus in childhood. *Journal of Diabetes Mellitus*, 6(02), 175-183.
3. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 9. Pharmacologic approaches to glycemic treatment: standards of care in diabetes—2023. *Diabetes Care*, 46(Supplement_1), S140-S157.
4. Holt, R. I., DeVries, J. H., Hess-Fischl, A., Hirsch, I. B., Kirkman, M. S., Klupa, T., ... & Peters, A. L. (2021). The management of type 1 diabetes in adults. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes care*, 44(11), 2589-2625.

Section 7.4

1. Steps to draw up and use Insulin. [Online]. Available at: <https://patient.uwhealth.org/healthfacts/4315>

Section 9.4

1. Down, S. (2020). How to advise on sick day rules. *Diabetes Prim Care*, 22, 47-48.
2. Leicester Diabetes Centre (2020) Sick Day Rules: Type 1 Diabetes Resources Online. Available At: <https://www.t1resources.uk/resources/item/sick-day-rules-pdf/>
3. American Diabetes Association. (2019). 5. Lifestyle management: standards of medical care in diabetes—2019. *Diabetes care*, 42(Supplement_1), S46-S60.
4. Monnier, L., & Colette, C. (2009). Target for glycemic control: concentrating on glucose. *Diabetes care*, 32(Suppl 2), S199.
5. Owolabi, E. O., Ter Goon, D., Adeniyi, O. V., & Ajayi, A. I. (2018). Optimal waist circumference cut-off points for predicting metabolic syndrome among low-income black South African adults. *BMC research notes*, 11, 1-5.
6. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 8. Obesity and weight management for the prevention and treatment of type 2 diabetes: standards of care in diabetes—2023. *Diabetes care*, 46(Supplement_1), S128-S139.
7. Athyros, V. G., Doumas, M., Imprialos, K. P., Stavropoulos, K., Georgiou, E., Katsimardou, A., & Karagiannis, A. (2018). Diabetes and lipid metabolism. *Hormones*, 17, 61-67.

Section 10.3

1. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 10. Cardiovascular disease and risk management: standards of care in diabetes—2023. *Diabetes Care*, 46(Supplement_1), S158-S190.
2. ASCEND Study Collaborative Group. (2018). Effects of aspirin for primary prevention in persons with diabetes mellitus. *New England Journal of Medicine*, 379(16), 1529-1539.

Section 11.3

1. Tuttle, K. R., Mauer, M. G., & Narva, A. S. (2012). KDOQI Clinical Practice Guideline for Diabetes and CKD: 2012 Update.
2. Rossing, P. (2020). KDIGO 2020 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. *Kidney International Supplements*, 98(4), S1-S115.
3. American Diabetes Association. (2019). 5. Lifestyle management: standards of medical care in diabetes—2019. *Diabetes care*, 42(Supplement_1), S46-S60.
4. Monnier, L., & Colette, C. (2009). Target for glycemic control: concentrating on glucose. *Diabetes care*, 32(Suppl 2), S199.
5. Owolabi, E. O., Ter Goon, D., Adeniyi, O. V., & Ajayi, A. I. (2018). Optimal waist circumference cut-off points for predicting metabolic syndrome among low-income black South African adults. *BMC research notes*, 11, 1-5.
6. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 8. Obesity and weight management for the prevention and treatment of type 2 diabetes: standards of care in diabetes—2023. *Diabetes care*, 46(Supplement_1), S128-S139.
7. Athyros, V. G., Doumas, M., Imprialos, K. P., Stavropoulos, K., Georgiou, E., Katsimardou, A., & Karagiannis, A. (2018). Diabetes and lipid metabolism. *Hormones*, 17, 61-67.

Section 12.3

1. American Diabetes Association. (2019). 5. Lifestyle management: standards of medical care in diabetes—2019. *Diabetes care*, 42(Supplement_1), S46-S60.
2. Monnier, L., & Colette, C. (2009). Target for glycemic control: concentrating on glucose. *Diabetes care*, 32(Suppl 2), S199.
3. Owolabi, E. O., Ter Goon, D., Adeniyi, O. V., & Ajayi, A. I. (2018). Optimal waist circumference cut-off points for predicting metabolic syndrome among low-income black South African adults. *BMC research notes*, 11, 1-5.

4. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 8. Obesity and weight management for the prevention and treatment of type 2 diabetes: standards of care in diabetes—2023. *Diabetes care*, 46(Supplement_1), S128-S139.
5. Athyros, V. G., Doulas, M., Imprialos, K. P., Stavropoulos, K., Georgiou, E., Katsimardou, A., & Karagiannis, A. (2018). Diabetes and lipid metabolism. *Hormones*, 17, 61-67.

Section 13.3

1. Allen, M. L., Van der Does, A. M., & Gunst, C. (2016). Improving diabetic foot screening at a primary care clinic: A quality improvement project. *African journal of primary health care and family medicine*, 8(1), 1-9.
2. 3- minute-foot-exam. [Online]. Available at: <https://diabetesed.net/wp-content/uploads/2017/05/3-minute-foot-exam.pdf>
3. Gottrup, F., Holstein, P., Jørgensen, B., Lohmann, M., & Karlsmar, T. (2001). A new concept of a multidisciplinary wound healing center and a national expert function of wound healing. *Archives of Surgery*, 136(7), 765-772.

Section 14.2

1. Solomon, S. D., Chew, E., Duh, E. J., Sobrin, L., Sun, J. K., VanderBeek, B. L., ... & Gardner, T. W. (2017). Diabetic retinopathy: a position statement by the American Diabetes Association. *Diabetes care*, 40(3), 412.
2. Hooper, P., Boucher, M. C., Colleaux, K., Cruess, A., Greve, M., Lam, W. C., ... & Tourville, E. (2013). Contemporary management of diabetic retinopathy in Canada: from guidelines to algorithm guidance. *Ophthalmologica*, 231(1), 2-15.
3. Solomon, S. D., Chew, E., Duh, E. J., Sobrin, L., Sun, J. K., VanderBeek, B. L., ... & Gardner, T. W. (2017). Diabetic retinopathy: a position statement by the American Diabetes Association. *Diabetes care*, 40(3), 412.
4. Harris Nwanyanwu, K., Talwar, N., Gardner, T. W., Wrobel, J. S., Herman, W. H., & Stein, J. D. (2013). Predicting development of proliferative diabetic retinopathy. *Diabetes care*, 36(6), 1562-1568.
5. Estacio RO, McFarling E, Biggerstaff S, Jeffers BW, Johnson D, Schrier RW. 'Overt albuminuria predicts diabetic retinopathy in Hispanics with NIDDM.' *Am J Kidney Dis* 1998; 31: 947-953
6. Leske, M. C., Wu, S. Y., Hennis, A., Hyman, L., Nemesure, B., Yang, L., ... & Barbados Eye Study Group. (2005). Hyperglycemia, blood pressure, and the 9-year incidence of diabetic retinopathy: the Barbados Eye Studies. *Ophthalmology*, 112(5), 799-805.
7. Chew, E. Y., Davis, M. D., Danis, R. P., Lovato, J. F., Perdue, L. H., Greven, C., ... & Ambrosius, W. T. (2014). Action to Control Cardiovascular Risk in Diabetes Eye Study Research Group. The effects of medical management on the progression of diabetic retinopathy in persons with type 2 diabetes: the Action to Control Cardiovascular Risk in Diabetes (ACCORD) Eye Study. *Ophthalmology*, 121(12), 2443-2451.

Section 15.2

1. Cheng, A. Y., Feig, D. S., Ho, J., Siemens, R., Bajaj, H., Gilbert, J., ... & Diabetes Canada Clinical Practice Guidelines Expert Working Group. (2021). Blood glucose monitoring in adults and children with diabetes: update 2021. *Canadian Journal of Diabetes*, 45(7), 580-587.
2. Updated guidelines for diabetes patients on glucose monitoring. [Online]. Available at: <https://www.shropshiretelfordandwrekin.nhs.uk/updated-guidelines-for-diabetes-patients-on-glucose-monitoring/>

Section 16.2

1. Ahmad, R., & Haque, M. (2021). Oral health messengers: Diabetes mellitus relevance. *Diabetes, Metabolic Syndrome and Obesity*, 3001-3015.
2. IDF Clinical Guidelines Task Force. (2009). *IDF Guideline on Oral Health for People with Diabetes*.

Section 17.2

1. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 10. Cardiovascular disease and risk management: standards of care in diabetes—2023. *Diabetes*

Section 19.2

1. Viswanathan, V., Bajaj, S., Kalra, S., Aggarwal, S., Atreja, A., Chaudhry, D., ... & Wilson, N. (2017). RSSDI clinical practice recommendations for diagnosis, prevention, and control of the diabetes mellitus-tuberculosis double burden. *International Journal of Diabetes in Developing Countries*, 37, 379-399.

Section 20.5

1. Hod, M., Kapur, A., Sacks, D. A., Hadar, E., Agarwal, M., Di Renzo, G. C., ... & Divakar, H. (2015). The International Federation of Gynecology and Obstetrics (FIGO) Initiative on gestational diabetes mellitus: A pragmatic guide for diagnosis, management, and care. *International Journal of Gynecology and Obstetrics*, 131, S173-S211.
2. Ramezani Tehrani, F. (2019). Cost effectiveness of different screening strategies for gestational diabetes mellitus screening: study protocol of a randomized community non-inferiority trial. *Diabetology & Metabolic Syndrome*, 11(1), 1-13.
3. Garrison, A. (2015). Screening, diagnosis, and management of gestational diabetes mellitus. *American family physician*, 91(7), 460-467.

Section 21.3

1. DaR Practical Guidelines for Healthcare Professionals, 2021. <https://www.idf.org/our-activities/education/diabetes-and-ramadan/healthcare-professionals.html>
2. Hassanein, M., Al-Arouj, M., Hamdy, O., Bebakar, W. M. W., Jabbar, A., Al-Madani, A., ... & Ben-Nakhi, A. (2017). Diabetes and Ramadan: practical guidelines. *Diabetes research and clinical practice*, 126, 303-316

Section 23.4

1. Unützer, J., & Park, M. (2012). Strategies to improve the management of depression in primary care. *Primary Care: Clinics in Office Practice*, 39(2), 415-431.
2. Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*, 16(9), 606-613.
3. ElSayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., ... & Gabbay, R. A. (2023). 5. Facilitating positive health behaviors and well-being to improve health outcomes: standards of Care in Diabetes—2023. *Diabetes Care*, 46(Supplement_1), S68-S96.
4. Hermanns, N., Caputo, S., Dzida, G., Khunti, K., Meneghini, L. F., & Snoek, F. (2013). Screening, evaluation and management of depression in people with diabetes in primary care. *Primary care diabetes*, 7(1), 1-10.

Section 24

1. American Diabetes Association Professional Practice Committee; Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2022. *Diabetes Care* 1 January 2022; 45 (Supplement_1): S17-S38.
2. Beyerlein A, Bonifacio E, Vehik K, et al. Progression from islet autoimmunity to clinical type 1 diabetes is influenced by genetic factors: results from the prospective TEDDY study. *J. Med. Genet.* 2019; 56(9):602-605.
3. Penno M, Couper J, Craig M, et al. Environmental determinants of islet autoimmunity (ENDIA): a pregnancy to early life cohort study in children at-risk of type 1 diabetes. *BMC Pediatr.* 2013; 13:124.

Section 25

1. Dunger D, Sperling M, Acerini C, et al. ESPE / LWPES consensus statement on diabetic ketoacidosis in children and adolescents. *Arch Dis Child.* 2003;89:188-194.
2. Chase H, Garg S, Jelley D. Diabetic ketoacidosis in children and the role of outpatient management. *Pediatr Rev.* 1990;11:297-304.
3. von Oettingen J, Wolfsdorf J, Feldman HA, Rhodes ET. Use of serum bicarbonate to substitute for venous pH in new-onset diabetes. *Pediatrics.* 2015;136(2):e371-e377.
4. Glaser N, Fritsch M, Priyambada L, et al. ISPAD clinical practice consensus guidelines 2022: Diabetic

ketoacidosis and hyperglycemic hyperosmolar state. *Pediatric Diabetes*. 2022 Nov;23(7):835-856.

5. Foster D, McGarry J. The metabolic derangements and treatment of diabetic ketoacidosis. *N Engl J Med*. 1983;309:159-169.

Section 26

1. Home PD. The pharmacokinetics and pharmacodynamics of rapid-acting insulin analogues and their clinical consequences. *Diabetes Obes Metab*. 2012;14(9):780-788.
2. Lucidi P, Porcellati F, Marinelli A, et al. Pharmacokinetics and pharmacodynamics of NPH insulin in type 1 diabetes: the importance of appropriate resuspension before subcutaneous injection. *Diabetes Care*. 2015;38(12):2204-2210.
3. Lepore M, Pampanelli S, Fanelli C, et al. Pharmacokinetics and pharmacodynamics of subcutaneous injection of long-acting human insulin analog glargine, NPH insulin, and ultralente human insulin and continuous subcutaneous infusion of insulin lispro. *Diabetes*. 2000; 49(12):2142-2148.
4. Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. Diabetes Control and Complications Trial Research Group. Clinical trial multicenter study randomized controlled trial research support, non-U.S. Gov't research support, U.S. Gov't, P.H.S. *J Pediatr*. 1994;125(2):177-188.
5. Woodworth J, Howey D, Bowsher R. Establishment of time- action profiles for regular and NPH insulin using pharmacodynamic modeling. *Diabetes Care*. 1994;17(1):64-69.
6. Garg S, Gottlieb P, Hisatomi M, et al. Improved glycemic control without an increase in severe hypoglycemic episodes in intensively treated patients with type 1 diabetes receiving morning, evening, or split dose insulin glargine. *Diabetes Res Clin Pract*. 2004;66(1):49-56.
7. Robertson K, Schoenle E, Gucev Z, et al. Insulin detemir compared with NPH insulin in children and adolescents with type 1 diabetes. *Diabet Med*. 2007;24(1):27-34.
8. Renner R, Pfitzner A, Trautmann M, et al. Use of insulin lispro in continuous subcutaneous insulin infusion treatment. Results of a multicenter trial. German Humalog-CSII study group. *Diabetes Care*. 1999;22(5):784-788.
9. McClure Yauch L, Velazquez E, Piloya-Were T, et al. Continuous glucose monitoring assessment of metabolic control in East African children and young adults with type 1 diabetes: A pilot and feasibility study. *Endocrinol Diabetes Metab*. 2020 Jun 8;3(3):e00135.
10. Panagiota M, Nikolaos G, Athanasios C, et al. The efficacy of automated insulin delivery systems in children and adolescents with type 1 diabetes Mellitus: A systematic review and meta-analysis of randomized controlled trials. *Diabetes Research and Clinical Practice*. Volume 199, 2023.
11. Cengiz E, Danne T, Ahmad T, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Insulin treatment in children and adolescents with diabetes. *Pediatr Diabetes*. 2022;23(8):1277-1296.
12. Cobry E, McFann K, Messer L, et al. Timing of meal insulin boluses to achieve optimal postprandial glycemic management in patients with type 1 diabetes. *Diabetes Technol Ther*. 2010;12(3):173-177.
13. Luijck Y, van Bon A, Hoekstra J, et al. Premeal injection of rapid-acting insulin reduces postprandial glycemic excursions in type 1 diabetes. *Diabetes Care*. 2010;33(10):2152-2155.
14. Tan C, Wilson D, Buckingham B. Initiation of insulin glargine in children and adolescents with type 1 diabetes. *Pediatr Diabetes*. 2004;5(2):80-86.
15. Kinmonth A, Baum J. Timing of pre-breakfast insulin injection and postprandial metabolic control in diabetic children. *Br Med J*. 1980; 280(6214):604-606.
16. Hofman P, Lawton S, Peart J, et al. An angled insertion technique using 6-mm needles markedly reduces the risk of intramuscular injections in children and adolescents. *Diabet Med*. 2007;24(12): 1400-1405.
17. Hofman P, Derraik J, Pinto T, et al. Defining the ideal injection techniques when using 5-mm needles in children and adults. *Diabetes Care*. 2010;33(9):1940-1944.
18. Birkebaek N, Johansen A, Solvig J. Cutis/subcutis thickness at insulin injection sites and localization of simulated insulin boluses in children with type 1 diabetes mellitus: need for individualization of injection technique? *Diabet Med*. 1998;15(11):965-971.
19. Smith C, Sargent M, Wilson B, et al. Subcutaneous or intramuscular insulin injections. *Arch Dis Child*. 1991;66(7):879-882.
20. Ginsberg B, Parkes J, Sparacino C. The kinetics of insulin administration by insulin pens. *Horm Metab*

Section 27

1. Limbert C, Tinti D, Malik F, et al. ISPAD Clinical Practice Consensus Guidelines 2022: The delivery of ambulatory diabetes care to children and adolescents with diabetes. *Pediatr Diabetes*. 2022;23(8):1243-1269.

Section 28

1. Sundberg F, deBeaufort C, Krogvold L, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Managing diabetes in preschoolers. *Pediatr Diabetes*. 2022;23(8):1496-1511.
2. Gregory J, Cameron F, Joshi K, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes in adolescence. *Pediatr Diabetes*. 2022;23(7): 857-871.

Section 29

1. Lindholm O, DeAbreu M, Greene S, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetes education in children and adolescents. *Pediatr Diabetes*. 2022;23(8):1229-1242.

Section 30

1. Annan S, Higgins L, Jelleryd E, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Nutritional management in children and adolescents with diabetes. *Pediatr Diabetes*. 2022;1-25.
2. Enander R, Gundevall C, Strömgren A, et al. Carbohydrate counting with a bolus calculator improves post-prandial blood glucose levels in children and adolescents with type 1 diabetes using insulin pumps. *Pediatr Diabetes*. 2012;13(7):545-551.
3. Davidson P, Hebblewhite H, Steed R, et al. Analysis of guidelines for basal-bolus insulin dosing: basal insulin, correction factor, and carbohydrate-to-insulin ratio. *Endocr Pract*. 2008;14(9): 1095-1101.

Section 31

1. Kapellen T, Agwu JC, Martin L, et al. ISPAD clinical practice consensus guidelines 2022: Management of children and adolescents with diabetes requiring surgery. *Pediatr Diabetes*. 2022;23(8):1468-1477.
2. Phelan H, Hanas R, Hofer SE, et al. Sick day management in children and adolescents with diabetes. *Pediatr Diabetes*. 2022;23(7):912-925.

Section 32

1. Adolfsson P, Taplin C, Zaharieva D, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Exercise in children and adolescents with diabetes. *Pediatr Diabetes*. 2022;23(8):1341-1372.
2. World Health Organization Physical activity. <https://www.who.int/news-room/fact-sheets/detail/physical-activity>.
3. Riddell M, Gallen I, Smart C, et al. Exercise management in type 1 diabetes: a consensus statement. *Lancet Diabetes Endocrinol* 2017.

Section 33

1. Bratina N, Forsander G, Annan F, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Management and support of children and adolescents with type 1 diabetes in school. *Pediatr Diabetes*. 2018 Oct;19 Suppl 27:287-301.

Section 34

1. Abraham M, Karges B, Dovc K, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Assessment and management of hypoglycemia in children and adolescents with diabetes. *Pediatr Diabetes*. 2022;23(8): 1322-1340.

Section 35

1. Bjornstad P, Dart A, Donaghue KC, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Microvascular and macrovascular complications in children and adolescents with diabetes. *Pediatr Diabetes*. 2022;23(8):

Section 36

1. Şimşek D, Ecevit A, Hatipoğlu N, et al. Neonatal hyperglycemia, which threshold value, diagnostic approach and treatment?: Turkish Neonatal and Pediatric Endocrinology and Diabetes Societies consensus report. *Turk Pediatri Ars.* 2018;53(Suppl 1):S234-S238.
2. Parappil H, Gaffari M, Paramban R, et al. Management of hyperglycemia in the neonatal unit: A practical approach to diagnosis and management. *J Clin Neonatol* 2022;11:38-44.

Section 37

1. Mitchell D. Growth in patients with type 1 diabetes. *Curr Opin Endocrinol Diabetes Obes.* 2017 Feb;24(1):67-72.

Section 38

1. Barski, L., Brandstaetter, E., Sagy, I., & Jotkowitz, A. (2018). Basal insulin for the management of diabetic ketoacidosis. *European journal of internal medicine*, 47, 14-16. American Diabetes Association. (2020). 15. Diabetes care in the hospital: standards of medical care in diabetes—2020. *Diabetes Care*, 43(Supplement_1), S193-S202.
2. Joint British Diabetes Societies for In-patient Care (JBDS-IP). (2021). The Management of Diabetic Ketoacidosis in Adults- revised in 2021. (Online). Available at: https://abcd.care/sites/abcd.care/files/site_uploads/JBDS_02%20DKA_Guideline_amended_v2_June_2021.pdf
3. Heddy, N. (2021). Guideline for the management of children and young people under the age of 18 years with diabetic ketoacidosis (British Society for Paediatric Endocrinology and Diabetes). *Archives of Disease in Childhood-Education and Practice*, 106(4), 220-222.

Section 39

1. Shivani Agarwal, Jill Crandall, Yaron Tomer, (2020). Montefiore Subcutaneous Insulin DKA Protocol. https://professional.diabetes.org/sites/professional.diabetes.org/files/media/ada-montefiore_dka_protocol_version_3.0_5_22_20.pdf
2. Brigham and Women hospital: BWH COVID-19 Critical Care Subcutaneous Insulin Guideline for Hyperglycemia and/or Mild-Moderate DKA https://covidprotocols.herokuapp.com/pdf/Intensive_Subcutaneous_Insulin_Protocol_for_ICU.pdf
3. Hirsch, I. B., & Emmett, M. (2020). Diabetic ketoacidosis and hyperosmolar hyperglycemic state in adults: Treatment. UpToDate.
4. Kitabchi, A. E., Umpierrez, G. E., Miles, J. M., & Fisher, J. N. (2009). Hyperglycemic crises in adult patients with diabetes. *Diabetes care*, 32(7), 1335.
5. Sobngwi, E., Lekoubou, A. L., Dehayem, M. Y., Nouthe, B. E., Balti, E. V., Nwatssock, F., ... & Mbanya, J. C. (2009). Evaluation of a simple management protocol for hyperglycaemic crises using intramuscular insulin in a resource-limited setting. *Diabetes & metabolism*, 35(5), 404-409.
6. Basetty, S., Kumar, G. Y., Shalini, M., Angeline, R. P., David, K. V., & Abraham, S. (2017). Management of diabetic ketosis and ketoacidosis with intramuscular regular insulin in a low-resource family medicine setting. *Journal of Family Medicine and Primary Care*, 6(1), 25.
7. Hamdy, O., & Khardori, R. (2017). Diabetic ketoacidosis. *Medscape JM*.
8. The Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus ; 3rd edition (Revised February 2018). Joint British Diabetes Societies (JBDS) for Inpatient Care; revised 2023. Online. Available at: http://www.diabetologists-abcd.org.uk/jbds/jbds_hypoguideline_final_280218.pdf

Section 40, 41

1. Aberer, F., Hochfellner, D. A., Sourij, H., & Mader, J. K. (2021). A practical guide for the management of steroid induced hyperglycaemia in the hospital. *Journal of Clinical Medicine*, 10(10), 2154.
2. Shah, P., Kalra, S., Yadav, Y., Deka, N., Lathia, T., Jacob, J. J., ... & Das, S. (2022). Management of glucocorticoid-induced hyperglycemia. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, 1577-1588.

3. Roberts, A., James, J., Dhatariya, K., Joint British Diabetes Societies (JBDS) for Inpatient Care, Agarwal, N., Brake, J., ... & Winocour, P. (2018). Management of hyperglycaemia and steroid (glucocorticoid) therapy: a guideline from the Joint British Diabetes Societies (JBDS) for Inpatient Care group. *Diabetic Medicine*, 35(8), 1011-1017.
4. Management of Hyperglycaemia and Steroid (Glucocorticoid) Therapy; a guidance from the Joint British Diabetes Societies (JBDS) for Inpatient Care; revised 2023. Online. Available at: [https://abcd.care/sites/default/files/site_uploads/JBDS_Guidelines_Current/JBDS_08_Management_of_Hyperglycaemia_and_Steroid_\(Glucocorticoid\)_Therapy_with_QR_code_January_2023.pdf](https://abcd.care/sites/default/files/site_uploads/JBDS_Guidelines_Current/JBDS_08_Management_of_Hyperglycaemia_and_Steroid_(Glucocorticoid)_Therapy_with_QR_code_January_2023.pdf)

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